



Better Care for the Severely Injured



A Joint Report from
The Royal College of Surgeons of England
and the British Orthopaedic Association



July 2000

Review date 2003

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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.**

Executive Summary

- This report from The Royal College of Surgeons of England and the British Orthopaedic Association examines the care of life- and limb-threatening injuries in England, Wales and Northern Ireland. An agenda for the improvement of care, through the audit of achievable standards, is presented.
- A National Trauma Service, based upon geographical trauma systems for England, Wales and Northern Ireland, is recommended. The service must be seen in the context of overall emergency provision and the backbone of the service will remain the acute general hospital.
- A strategy for rehabilitation based on each trauma system would improve outcomes and make better use of acute hospital resources.
- A National Trauma Audit Committee should set standards and develop realistic trauma outcome indicators against which Trusts can audit severe injury management.
- A separate National Trauma Audit Research Network for the collection of data must sequentially examine the set standards of care for the severely injured.
- The achievement of audited standards of trauma care should determine a hospital's future reception of severe injuries rather than its size or apparent catchment population.
- Some concentration of trauma services and skills is required to meet the standards for high quality care. This will require co-operation between neighbouring Trusts.
- Planning should be centred on the management of severe and complex injuries as well as the multiply injured.
- There would be an advantage in a single ambulance service with a medical director for each trauma system. Ambulance services should implement *Pre-hospital Trauma Life Support* (PHTLS) training as a mandatory requirement for paramedics, who should be state registered.
- The National Trauma Service should be supported by sufficient intensive care facilities for injured adults and children in major acute hospitals.

Introduction

In England, Wales and Northern Ireland, severe injury remains a common cause of death and disability in all ages. Of particular concern is the high incidence of trauma leading to death and disability in people under 40 years of age. Some 450 children are known to die every year as a result of accidents and 10,000 are permanently disabled.¹

While prevention must remain the major strategy for improving this unacceptable situation, the arrangements for the care of the severely injured based on the existing district general hospitals (DGHs) require urgent change.

Despite the recommendations of The Royal College of Surgeons of England² and the British Orthopaedic Association,^{3,4,5} there is still no national strategy for the care of the severely injured. Data from the Trauma Audit Research Network (TARN) shows that mortality varies inexplicably between hospital Trusts and mortality from blunt trauma is higher than in the USA. TARN, in Manchester, is the only available major trauma database in England, Wales and Northern Ireland and presently analyses death and survival after severe injury. The current system does not assess the quality of life of those that survive and it is regrettable that only 50 percent of Trusts subscribe to TARN.

Uniquely this report presents standards of care for the severely injured. These standards should be achievable locally or in co-operation with other hospitals in the area, thus forming a trauma network or system. A major reorganisation of existing practice and service delivery is not proposed. The fundamental requirement is that injured patients should be taken to hospitals most suited to the nature of their injuries rather than to the nearest hospital. This report recommends that the standards in Chapter 13 should be audited at Trust level, in conjunction with other hospital Trusts in the system or network and co-ordinated by a National Trauma Audit Committee. The role of the committee would be to further develop standards based on realistic outcome indicators. With the development of a National Trauma Service and integrated trauma systems, opportunities will also arise to facilitate a co-ordinated approach to injury prevention.

*Our Healthier Nation*⁶ quotes £1.2 billion as the cost of all injuries to the NHS and social services, but the total cost to the economy would be considerably greater. Reducing the numbers of preventable deaths and improving the outcomes of survival by setting standards for audit would represent a wise investment.

The Royal College of Surgeons of England and the British Orthopaedic Association look forward to widespread debate on the proposals in this report.

1 The History of Trauma Organisation

- 1.1 Over the last 40 years many reports have highlighted an under-provision of facilities and inadequate staffing for the care of severely injured patients, with many small hospitals struggling to provide an effective service.
- 1.2 The Osmond-Clark report of 1961⁷ recommended a tripartite scheme of peripheral casualty units, DGH accident centres and a regional major injury unit serving a population of one to two million.
- 1.3 In 1985 Trunkey's seminal work⁸ described the effect of a regional trauma system in reducing trauma mortality in the USA.
- 1.4 The report from The Royal College of Surgeons of England published in 1988² further raised awareness, drew clear conclusions and made positive recommendations. The conclusions and recommendations were:
 - There were significant deficiencies in the management of seriously injured patients. On the basis of a retrospective study of 1,000 trauma deaths,⁹ they concluded that one third of all deaths occurring after major injury were preventable in the large DGHs.
 - The majority of patients should be managed in large DGHs with a wide range of facilities and appropriate senior staffing.
 - Life-threatening injuries should be transferred if their management was beyond the capabilities of the DGH.
 - Enhanced training for ambulance staff was required.
 - An improvement in communication between ambulance and hospital receiving staff was necessary.
 - More sophisticated methods of transport would save lives.
 - Support for a major trauma outcome study would be welcome.
 - There was a requirement for improved training for all staff dealing with major injuries.
 - Investment into trauma research was overdue.
- 1.5 The British Orthopaedic Association report of 1989³ also recommended that services should be concentrated. There were too many small units and too few consultants with a special interest in trauma care. Further, any rationalisation of trauma services could not occur without an expansion of consultant numbers. Importantly, the report proposed that any trauma system should provide a better service for the more numerous, serious,

complex but non-life-threatening injuries. The report recognised the considerable resource implications of ‘trauma centres’, based upon the American model.

- 1.6 The British Orthopaedic Association report of 1992⁴ reviewed trauma care in 283 hospitals in the UK, identifying many which were inadequately staffed and ill-equipped. The delivery of trauma services had not kept pace with technical advances, and many units were too small to sustain an adequate standard of care. The report expressed a view on trauma organisation and set standards for the facilities required in a DGH. Smaller hospitals would treat major injuries according to agreed protocols. The report described the regional trauma centre with its multi-disciplinary arrangements. It was recommended that orthopaedic surgeons in training should be encouraged to specialise in trauma.
- 1.7 The British Orthopaedic Association report of 1997⁵ reviewed the care of severely injured patients in the UK. The report concluded that patients in the UK were not receiving the quality of care available in many developed countries, including Germany, Switzerland and the USA. An integrated approach based upon a hub and spoke model was recommended. The American model of a ‘level 1 trauma centre’ was not recommended and the bulk of trauma would still be treated in DGHs. Standards of care should be defined. The report enthusiastically supported a national strategic plan for the management of severe trauma. In the Association’s view, the quality of care would only be achieved by:
- The rapid transfer of severely injured patients to hospitals most suited to their need.
 - Concentrating expertise in the management of severe injuries.
 - A multi-disciplinary team approach with the integration of hospitals into a system of care.
 - The direct involvement of senior clinicians.
- 1.8 There have been a number of reports exploring the delivery of acute general hospital services ^{10,11,12,13} and all have recommended systems or networks of care and collaboration between hospital Trusts. All recognised that an effective trauma service cannot evolve in isolation and will always be integrated with acute hospital service provision.

2 | The New Influences on Trauma Care

2.1 ADVANCING TECHNOLOGY AND THRESHOLDS FOR SURGICAL INTERVENTION

With advances in technology, the practice of trauma surgery has in general become more interventional. For example, fractures hitherto treated conservatively with reduction, splinting and prolonged rest are now treated by operative fixation. Children and adults with abdominal, neurological, vascular and many other types of injury require sophisticated

investigations before selecting appropriate treatment. These modern interventions are technically demanding, and require a level of training and expertise only acquired with considerable experience. When dealing with major trauma, best practice frequently requires the clinical input of more than one surgical discipline, expensive technology and investigative techniques.

2.2 JUNIOR DOCTORS' HOURS (THE NEW DEAL)

The New Deal on junior doctors' hours arose out of public and political concern over the excessive hours worked by all doctors in training up to the early 1990s. The target for full implementation was December 1996 and it is now the rule that no junior doctor should work more than an average of 56 hours per week. The *European Working Time Directive*, when implemented, will have a further impact on the service that trainees have hitherto provided. The appointment of non-consultant career grade doctors has dramatically increased in many specialties.¹⁴ Associate specialists and staff grade doctors are part of the surgical team but cannot practice independently in NHS hospitals, as they require direction and supervision by consultants.

2.3 CALMAN TRAINING ARRANGEMENTS

The revision of the arrangements for the training and education of higher surgical trainees has required adherence to curricula, an emphasis on direct supervision, and more hands-on consultant management of emergencies. The intensity of training takes considerable consultant time and is yet another argument for increasing the consultant workforce in all surgical disciplines. The consequence of these adjustments to the roles of both consultants and trainees has challenged the traditional firm structure, and introduced the opportunity for team-working between consultants themselves and all other staff, which will, in due course, foster common approaches to a single clinical condition in an individual unit. There is a strong case for agreed processes of management of the injured. The timely availability of consultants throughout the 24 hours is likely to improve service, outcomes of care, and training potential of all members of the surgical team. Presently, it is not expected that consultants should be resident in the hospital when on call, although this is a component of the Oxford Trauma Service. The main elements of the Oxford experiment were to have consultant surgeons dedicated to trauma resident in the hospital, to lead the service, provide 24-hour senior assessment and to teach on all trauma patients. This has only been possible because of a major change in the culture of both nursing and medical care. The measure of this 24-hour regional facility for patients with complex or multiple injuries has been the 200 patients referred annually from the surrounding hospitals in the region. An interim report after two years, presented to the British Orthopaedic Association, indicated supervision rates for surgery had improved from 15 percent to 70 percent and length of stay fell from eight to five days despite an increasingly complex case-mix. There is no published audit of the Oxford arrangements.

2.4 THE AGEING POPULATION

The trend of increasing numbers of elderly patients presenting as emergencies is a challenge for the NHS. The elderly are subject to multiple co-morbidities and demand multi-disciplinary management, requiring a high level of consultant activity, in a hospital close to the patient's home. For example, there is a five percent annual increase in the incidence of proximal femoral fractures in the elderly. Some 95 percent of these patients receive a surgical operation and 80 percent suffer from significant co-morbidity. More resources will be required to treat these patients in all acute hospitals. Supervised daytime trauma lists for such patients is the suggested policy and required by the Specialist Advisory Committee in Trauma and Orthopaedics of the surgical Royal Colleges. The 1999 report of the National Confidential Enquiry into Perioperative Deaths (NCEPOD) reinforces this.¹⁵

2.5 THE CONSULTANT WORKFORCE

The concept of skill mix and the extended roles of non-medically qualified professionals is to be supported, but this will not lessen consultant responsibilities in the care of the severely injured. The requirement for a consultant provided trauma service requires an expansion of consultant numbers in the surgical disciplines and in accident & emergency (A&E) medicine.

2.6 GOVERNMENT POLICY: NHS FRAMEWORKS

The government's quality programme set out in *A First Class Service*¹⁶ aims to ensure clear national standards for quality with responsibility for delivery being taken locally, backed by consistent monitoring arrangements. At local level, a clinical governance framework ensures clear lines of responsibility and accountability for the overall quality of clinical care through NHS Trust chief executives. In addition, the Commission for Health Improvement (CHI) has been established to provide independent scrutiny of local efforts to improve quality and to help address any serious problems.

While the provision of services for the severely injured is an obvious candidate for a national service framework, this programme only anticipates one major new topic each year. The present document sets out an immediate way forward with recommended standards of care and a national trauma audit network to monitor their achievement. A National Trauma Audit Committee should further develop standards and define outcome indicators for the survivors of severe injuries.

3 **The Incidence of Severe Injury**

- 3.1 Road trauma has remained a major cause of death and serious injury in the UK, but there has been a fall in both during the last decade. Government legislation on seat belts and alcohol limits has been a major factor in this reduction.

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- 3.2 In 1981-85 there were (on average) 5,800 traffic related fatalities per annum in the UK and in 1995 there were 45,253 serious injuries on our roads. In 1996 there were 3,740 deaths together with a fall of 39 percent in fatal and serious injuries. During the same period there has been a 34 percent fall in trauma mortality of 16-19 year olds.¹⁷
 - 3.3 The government White Paper on the future of transport commits it to reduce road accidents by at least 50 percent by 2010¹⁸. At the same time, the Department of Environment, Transport and the Regions (DETR) has submitted proposals to the European Union for making vehicles less lethal or dangerous to pedestrians, and enhancing safety in car design.
 - 3.4 There are concerns regarding the definitions of injuries used by the DETR, particularly those of 'serious' and 'severe' injury. Police statistics may underestimate the incidence of major trauma.¹⁹
 - 3.5 The incidence of severe trauma defined by an Injury Severity Score greater than 15 [ISS >15] is estimated to be four per million per week,²⁰ a lower prevalence than in the USA where penetrating trauma is more common.
 - 3.6 The average acute hospital is not likely to be called upon to treat more than one severely injured patient each week. Such low numbers suggest that some acute hospitals may have too little experience to give these patients their best chance of optimum outcome.
 - 3.7 Burdett-Smith estimated that there are between 10,000 and 10,600 patients suffering multiple injuries in the UK each year.²¹ This, on average, represents one per 1,000 emergency cases admitted. Adequate experience in the definitive management of such difficult problems is hard to acquire without centralisation to larger acute hospitals.

4 The Costs of Injury

- 4.1 The DETR have estimated the costs of road trauma, which accounts for over a third of the 9,000 deaths due to injury each year.²² Costs are calculated in terms of direct medical expenditure, loss of economic activity and the human aspects of grief, suffering and pain. In 1997 a fatal injury valued in this way, cost the nation £902,500, a major injury £102,880 and a minor injury £7,970. The medical costs are a relatively small part of the total costs – £4,470 for a fatality, £9,440 for a major injury and £780 for a minor injury.
- 4.2 The majority of the savings achieved by preventing road trauma and, presumably all other types of injury, would be made by agencies other than the Department of Health (DH). The total cost savings using the DETR formula would be greater than £20 billion per annum. These figures clearly justify the retention of 'injury' as a major theme for improving the state of public health.

- 4.3 Nevertheless, the economic consequences for the DH are considerable. Annual hospital costs for road trauma alone are about £500 million and ambulance costs a further £20 million. *Our Healthier Nation*⁶ quotes the cost of treating all injuries as £1.2 billion.
- 4.4 The central tenet of this report is that the treatment of those who are severely injured is often provided in a less than optimum environment which can lead directly to avoidable mortality and morbidity. Improving trauma care should lead to better outcomes which will have major social consequences, and create the opportunity to reduce the costs of avoidable death and unnecessary morbidity.

5 **The Outcome of Severe Injury**

- 5.1 Following Anderson's 1988 study of 1,000 deaths,⁹ which concluded that one-third of all the deaths occurring after major injury were preventable, there have been many other studies which continue to highlight serious deficiencies in the services for managing the severely injured.
- 5.2 Court Brown²³ concluded that many of the patients in his study should have survived when compared with international norms.
- 5.3 Staniforth²⁴ noted that in 12 percent of the patients that he reviewed, treatment was sub-optimal.
- 5.4 The major trauma outcomes study (MTOS) report of 1992²⁵ showed that the initial management of major trauma remained unsatisfactory. There were delays in providing experienced staff and timely operations. Mortality varied between hospitals and for blunt trauma was higher than in the USA, a trend which has continued.²⁶
- 5.5 In another study²⁷ of 1,088 injured patients, 430 died prior to arrival in hospital and a further 309 following treatment. Subsequent revaluation showed that 46 of these 309 deaths in hospital were possibly preventable. Extrapolating this figure to the whole country would produce a total of 770 preventable deaths per annum. Three further studies^{28,29,30} identified preventable deaths and errors of management.
- 5.6 While there is evidence of increased survival after severe injury^{26,31} during the last decade, there are no large cohort studies of the disabilities of the increased numbers of surviving patients nor knowledge of this burden of human suffering and cost. Both are likely to be considerable and require urgent investigation.

6 The Present Arrangements for the Care of Major Injuries

- 6.1 In the UK, there is no nationally co-ordinated policy for the care of the severely injured. In all but a few areas, major trauma is taken to the nearest hospital rather than to a designated hospital with appropriate resources and staff experienced in the care of these patients.
- 6.2 In hospitals treating comparatively few severely injured patients (ISS >15), there are often delays in definitive treatment due to inadequate numbers of experienced staff in the surgical disciplines, and the unavailability of investigative and theatre resources.²⁵
- 6.3 Presently, there are around 230 acute hospitals with A&E departments in England, Wales and Northern Ireland. Twenty-two of these acute hospitals have neurosurgery departments on site but **only five have the full range of surgical services.**
- 6.4 Well-established systems of referral exist for head, spinal and burn injuries, and to a lesser extent for pelvic and acetabular fractures. There is an increasing willingness to transfer patients.

7 The Evidence for Systems of Care for Major Injuries

- 7.1 There is evidence that overseas trauma systems which have rationalised their service offer significantly improved care and outcomes. Expertise is concentrated in hospitals designated to receive patients with severe injuries.^{32,33}
- 7.2 In England, Wales and Northern Ireland the only audited trauma systems are in the North West Midlands and Yorkshire.³⁴ The North West Midlands Trauma System has evolved over many years and its development was given impetus when, following the report of The Royal College of Surgeons of England on the management of major injuries,² it became the subject of the Department of Health's Trauma Centre Evaluation Study. The system was centred on the major acute hospital at Stoke-on-Trent, one of only a handful of such hospitals in the country with all major surgical services on site, including neurosurgery and cardiothoracic, plastic, maxillofacial, general and orthopaedic surgery. DH funding was used to enhance the facilities of the A&E department, provide dedicated trauma beds in the intensive care unit, improve operating theatre facilities and continue trauma audit.
- 7.3 A report from the Sheffield University Medical Care Research Unit, published in 1995,³⁵ concluded from its study of the West Midlands Trauma System from 1990-1993, that the system was not cost-effective. There were, however, many methodological problems with this study.³⁶ After the pilot study period, the trauma service continued to develop. The crude mortality rate in patients admitted to the North Staffordshire Hospital continued

to fall.³⁷ Seventy-five percent of deaths after major trauma were in patients with severe head injury or who were over the age of 70 years.³¹ A longitudinal prospective audit of patients with major injuries [ISS >15] at the North Staffordshire Hospital which started in 1992-1993, just as the Sheffield Study ended, has shown a significant decrease in mortality from 26.5 percent in 1992-3 to 13 percent in 1997-8.³⁸

- 7.4 The experience of the North West Midlands Trauma System and the widespread data collection of TARN in Manchester have clearly demonstrated that collaboration between hospitals and sequential audit can reduce the mortality of the severely injured.

8 | The Objectives of a National Trauma Service

The Royal College of Surgeons of England and the British Orthopaedic Association consider that a National Trauma Service would guarantee universal standards of provision of care while allowing acceptable access for patients and their relatives.

The following objectives of a National Trauma Service should apply equally to large cities, conurbations and more rural communities and may be summarised:

- Organise the expert assessment and co-ordinated care of patients with major injuries and those with severe complex injuries, from the time of injury through to rehabilitation.
- Respect the access needs of both patients and relatives.
- Ensure the maintenance of adequate clinical experience for all staff treating severe trauma.
- Strike the best balance between cost-effectiveness and clinical excellence.
- Allow the implementation of national standards of care.
- Facilitate knowledge of outcome through effective data collection.
- Test the standards through audit.
- Complete the audit loop to improve provision and patient care.

9 The Need for Audit

- 9.1 **It should be the achievement of acceptable standards and satisfactory outcomes of trauma care that determine a hospital's future reception of severe injuries rather than its size or estimated catchment population.**
- 9.2 There is increasing awareness of the importance of measuring the effectiveness of the 'process' of trauma care as an aid to developing optimal systems. Trauma scoring is now widely used, but much more work is required to define outcomes in survivors. All current systems of trauma audit use death or survival alone. **These systems do not assess the effect of treatment on the quality of life or functional outcome in survivors.** The target population is young and many severe disabilities are known to persist. Even temporary disability has important social and economic effects.
- 9.3 Refinements in audit methodology have demonstrated improvements in outcome after trauma in the UK over the past decade. A recent analysis from the Trauma Audit and Research Network (formerly MTOS), which receives data from over 50 percent of trauma-receiving hospitals in England and Wales, has shown a gradual decline in the severity of adjusted risk of death after trauma since 1989. (The odds ratio between 1989 and 1997 is 0.63 (95 percent confidence interval 0.49-0.82)).²⁶ The proportion of severely injured patients seen first by a senior house officer has fallen during this period by 41 percent with a corresponding increase in the contribution of specialist registrars and consultants. However, there remains significant variation in the case-mix adjusted numbers surviving between hospitals in England and Wales, first reported in the MTOS report of 1992.²⁵
- 9.4 The statistical analysis of trauma care is now sufficiently robust to identify the overall effectiveness of a hospital with regard to mortality. However, much remains to be done – the remaining 50 percent of hospitals must join TARN so that population studies can be conducted. More resources are required to ensure a high quality of data input and, importantly, urgent attention must be directed towards the identification of the most appropriate method of measuring disability.

10 | A National Trauma Audit Research Network (NTARN)

- 10.1 The audit of an acute hospital's ability to meet the recommended standards and outcomes of care is pivotal to the evolution of quality services for the injured and the further development of those standards. Where local procedure and service changes in response to audit are unsuccessful, collaboration within the proposed trauma system of hospitals, linked to the pre-hospital services, will facilitate the achievement of that standard of care by co-operative working, inter-hospital transfer and agreed bypass procedures.
- 10.2 The process of data handling must be undertaken by an independent professional group which should have expertise in quality assurance and analysis. A **National Trauma Audit Research Network (NTARN)** is proposed with functional units at the acute Trust, trauma system and national levels. The aim is to develop, monitor and improve standards of care for the severely injured patient. A secondary aim will be to expedite the necessary practice changes and service configurations by informing the public, clinicians, hospital managers and healthcare planners.
- 10.3 All acute receiving hospitals should be required to make trauma audit returns to NTARN. We propose that each acute hospital should have a **Trauma Audit Group** responsible for the receipt of and response to their unit's analysed audit data. This group should be multi-specialty and multi-disciplinary. It will make returns to its **Trauma System Audit Group** which will include clinical representatives from each hospital Trust, the Department of Public Health, nursing, the ambulance service, as well as a patient representative. This group will scrutinise the standards of trauma care within its system and develop individual strategies to address difficulties and improve access to treatment. This group would determine the level of trauma care for each component hospital in its system based on their audited performance. Transfer policies and bypass protocols will be agreed to meet the local requirements for standards.

11 | A National Trauma Audit Committee (NTAC)

- 11.1 A National Trauma Audit Committee (NTAC) overseen by The Royal College of Surgeons of England, the Faculty of Accident and Emergency Medicine and the surgical specialist associations should be created to set and further develop trauma care standards. Representation from patient groups is also recommended. The committee will establish subspecialty working parties with other Royal Colleges, faculties and professional organisations, to evaluate and develop agreed standards of care for index injuries and treatments within the expertise of that subspecialty. These standards will be based on published scientific evidence, good practice and contemporary wisdom. Joint working will frequently be required between subspecialty working parties where the standard

involves several disciplines. The role of the National Trauma Audit Committee will be to receive those recommended standards and agree priorities for standard setting.

- 11.2 The NTAC will develop measurable audit indicators to assess performance against recommended standards agreed with the National Trauma Audit Research Network, and national reporting will suggest directions for further research.

12 | The Need for Research

- 12.1 The burden of disease inflicted on all sections of the population by intentional and unintentional injury is enormous. Earlier sections of this report have identified deficiencies in the organisation and practice of trauma care. Methods exist to measure the extent of these inadequacies. These three facts have led to the inclusion of injury in the Department of Health's priority list for action in *Our Healthier Nation*.⁶ It is disappointing that there has not been a corresponding interest from the research community. In comparison to the research effort put into the other diseases in the priority list, injury remains a neglected epidemic.
- 12.2 This report emphasises that developments in trauma care must be evidence based and that performance against proposed standards must be measured by a robust system. It is proposed that a National Trauma Audit Committee will gather evidence of good practice and develop standards of care. The application of these standards will then be monitored by the National Trauma Audit Research Network, which will gather information on process and outcome. Initially this will be limited to reports on survival but will extend to quality of life issues and functional outcome when ongoing research provides robust systems to measure such disability.
- 12.3 This framework prompts two questions: how is the quality of evidence to be assessed and how is a research agenda to be identified and pursued? It is proposed that a national injury research initiative be established to co-ordinate work on these related issues. The national trauma database itself will provide opportunities to undertake general epidemiological studies and more focused research on specific injuries. However this work should be separated from the audit function of the National Trauma Audit Research Network. Other agencies must be encouraged to develop research portfolios on the injury theme and seek external funding from grant-awarding bodies.

13 | Recommended Standards of Care in Major Trauma

The following represents the first attempt to define standards of care for major injuries across the spectrum of trauma. They are standards against which to audit; they are not direct indicators of adequacy of care. They are intentionally set at a level of desired attainable care, and failure to achieve the standard requires investigation and further analysis of care. Many of the standards listed require complex pathways of care involving several disciplines and treating units.

13.1 THE ASSESSMENT AND RESUSCITATION OF THE SEVERELY INJURED

It is recommended that all hospitals that receive patients following major injury should establish a system of advance notification with the Ambulance Service. This arrangement should allow the ambulance paramedic at the scene to notify the A&E department directly ('talk-through') of the details of the injured patient(s). These details should include the numbers involved, age, gender, mechanism and types of injuries for each patient. Vital signs including pulse, blood pressure, Glasgow Coma Score (GCS) or AVPU (alert, responds to verbal commands, responds to pain, unresponsive), respiratory rate, arterial oxygen saturation and treatment applied, would be the minimum information that is required for each patient. Each hospital and the Ambulance Service should also agree criteria for activation of the trauma team. This should ideally occur in advance of the patient's arrival in the resuscitation room. The trauma team leader, a consultant from a relevant specialty, should have an identification badge or tabard. The composition of the trauma team is set out in Chapter 15.

The trauma team leader should allocate roles to each member of the team, according to their level of skill. The resuscitation should follow *Advanced Trauma Life Support (ATLS)*® guidance. The airway should be managed by the most experienced anaesthetist present. Two doctors should be allocated to cannulation (including blood sampling). The primary survey and initial resuscitation should be preferably performed by a doctor other than the team leader, for example the A&E medicine specialist registrar. The team leader should concentrate on ensuring that the resuscitation follows the correct sequence, identifying the most important injuries first.

The trauma team leader should remain with the patient until transfer to the care of one of the inpatient surgical teams or to another hospital. This transfer will usually only occur after most of the immediate investigations have been performed and a plan of management has been agreed and documented with the admitting team(s) or the secondary receiving hospital.

Recommended standards of care:

- Advance warning details from the ambulance service should include patient numbers, age, gender, mechanism and types of injuries for each patient. Vital signs including pulse, blood pressure, GCS (or AVPU), respiratory rate, arterial oxygen saturation and treatment given should be the minimum information that is required for each patient.
- Each hospital that receives major trauma should establish a trauma team that is available at all times.
- The hospital should agree criteria for the activation of the trauma team with the ambulance service(s), to ensure that the team is prepared for the arrival of the patient(s).
- The trauma team leader has responsibility for the continuing care of the patient until a management plan has been formulated for either admission or transfer.
- The resuscitation should follow *ATLS*® or equivalent guidelines. Airway control must be supervised by the most experienced anaesthetist available, supported by a suitably trained assistant. To ensure consistency of care, *ATLS*® training for all medical members of the trauma team is strongly recommended.
- The involved hospital specialist services should have pre-agreed which personnel should respond, and the communication process involved, with the trauma team leader.

13.2 MAJOR HEAD INJURIES

Major head injury is a frequent component of the multiply injured patient and often the major determinant of outcome. Worsening of the primary brain injury can be minimised by preventing hypotension and hypoxia. Recognising the potential for the neurosurgical and neuro-intensive care of secondary intracranial complications and haemorrhage must be a priority for those receiving such patients. The majority of hospitals will not have on-site neurosurgical support and an appreciation of the critical timing and indications for CT scanning in the immediate assessment of these patients is essential. Early consultation and image transfer to the neurosurgical unit is fundamental to the rapid and safe transfer of those patients requiring management by neurosurgeons. Continuing neurosurgical advice on treatment and further scan interpretation are components of the system of care for the brain-injured patient.

Recommended standards of care:

- The clinical management of patients with head injuries must be in accordance with the recommendations of The Royal College of Surgeons of England's *Report of the Working Party on the Management of Patients with Head Injuries*³⁹ and *Safe Neurosurgery 2000*.⁴⁰
- There should be pre-hospital and hospital spine protection.
- There must be a 24-hour capability to secure an airway and provide mechanical ventilation in every receiving hospital.
- All receiving hospitals must have direct access to 24-hour CT scanning with on-call radiologists.
- An effective image transfer facility must be available between the receiving hospital and the neurosurgical unit.
- Patients needing ventilation and/or intracranial pressure monitoring should be transferred to a neurosurgical intensive care unit or an intensive care unit with neurosurgeon and neuroanaesthetist support.
- The hazards of inter-hospital transfer of the seriously head-injured or multiply injured patient demand the direct involvement of consultant clinicians.
- Patients with severe head injuries or focal signs should be transferred to the care of neurosurgery units regardless of whether they need surgical intervention.
- The system of care should achieve surgical evacuation of a significant subdural haematoma within four hours.
- Neurosurgical units should be part of a major acute hospital so allowing joint clinical management with the other acute disciplines involved in trauma care.

13.3 CARDIOTHORACIC INJURIES

Twenty percent of severely injured patients admitted to hospital have chest injuries.⁴¹ The majority of chest injuries are not fatal and their management will frequently lie with a surgeon whose specialist interest does not regularly involve chest surgery. This clinical issue combined with the potential for occult or progressive cardiopulmonary problems poses a significant risk of under-diagnosis and avoidable compromise. Due note must be taken of the history of the injury and, in particular, in the case of blunt trauma, the

magnitude of energy dissipated should alert the clinician to the severity of the intra-thoracic damage. The inherent difficulties of chest assessment and sub-optimal resuscitation room radiographs should be recognised. Early diagnosis of lung contusion, pneumothorax and haemothorax is essential. An understanding of the potential for blunt or penetrating injury, tamponade, oesophageal rupture and aortic rupture comes from the mechanism of injury. Urgent specialist investigation and advice is mandatory. Penetrating chest trauma is infrequent in the UK, but 20 percent of such injuries require thoracotomy.

Recommended standards of care:

- Examination of the chest is a fundamental component of the cardiopulmonary assessment of the seriously injured and should be supervised by the most experienced clinician.
- Repeated clinical (and radiographic) assessments are essential to detect developing intra-thoracic conditions, before and after interventions (eg central venous lines, tracheal intubation, mechanical ventilation).
- Monitoring must include pulse oximetry and serial blood gas analysis to detect hypoventilation. A 12-lead ECG is essential.
- Surgical airway, chest tube decompression and pericardiocentesis skills must be available in every trauma team.
- Urgent referral to a specialist thoracic or cardiothoracic surgeon is required for major chest injury, massive or continuing intra-thoracic haemorrhage, major or persistent air leaks, suspected aortic tears and oesophageal ruptures.
- Inter-hospital transfer will be frequently required for angiography, thoracic surgery and for access to cardiopulmonary facilities.
- A consultant surgeon capable of immediate thoracotomy must be available in all hospitals receiving major trauma patients and may need to proceed under remote specialist guidance where a patient's condition is too critical to allow transfer.

13.4 ABDOMINAL INJURIES

Severe blunt injury to the abdomen is relatively rare. In the UK, while general surgeons may be involved in the assessment of 25 percent of severely injured patients, fewer than 10 percent require surgical intervention in the abdomen.^{41,42} The infrequency of these injuries, coupled with the difficulties in assessment, present a potential pitfall for the unwary or inexperienced. The presence of altered consciousness, distracting pain from skeletal injuries, spinal cord injury and the minimal peritonism caused by free abdominal blood, limits the reliability of clinical examination. The detection of abdominal visceral injury is vital if mortality is to be minimised and other trauma salvage and reconstructive surgery undertaken safely. Emergency laparotomy for trauma is surgically demanding, with the nature and extent of injury often unknown. The involvement of an experienced, fully trained surgeon is essential.

Recommended standards of care:

- In a hospital receiving severe trauma, the input of a general surgeon into the resuscitative trauma team is essential.
- An immediate response from a senior general surgeon of sufficient experience to perform life-saving emergency laparotomy is essential. Where the infrequency of emergency calls does not allow the on-call general surgeon to be free from all other duties, practices must be agreed to adequately investigate the 'at risk' abdomen.
- The indications for immediate laparotomy include penetrating trauma with haemodynamic instability, ballistic injury, free air, diaphragmatic rupture, intraperitoneal bladder rupture and haemodynamic shock unexplained by other injury sites.
- All patients who are considered to be at risk of abdominal injury who cannot be continuously assessed, must be investigated after the resuscitation phase and before definitive non-emergency treatment. They must be investigated by the receiving unit's preferred method. The preference for CT, ultrasound screening, diagnostic peritoneal lavage and laparoscopy will depend on the stability of the patient and on the local 24-hour availability of expertise and facilities.
- Where visceral injury requires operative management, the start of the operation must be possible within 60 minutes of admission in all cases.
- Associated major chest or pelvic injuries need a combined surgical approach with cardiothoracic, orthopaedic and urological surgeons. Cardiopulmonary bypass facilities will be required for some major liver injuries.

- Where inter-hospital transfer of patients is required, the potential for deterioration should be appreciated and appropriate investigation and transfer provision should be made, including anaesthetic and transfusion facilities.
- In the conscious patient, re-evaluation is the key to detection of occult injuries; in the compromised patient detailed and repeated investigations are essential.

13.5 SOFT TISSUE AND SKELETAL INJURIES

□ **Open Fractures**

The early management of severe open fractures, especially of the tibia, requires combined plastic and orthopaedic assessment.⁴³ The severity of open fractures is frequently under-estimated. The significance of fracture fragmentation, closed or multi-layer degloving and the degree of contamination are the pitfalls for the inexperienced surgeon. The fear of creating unmanageable wounds, inadequate wound excision, inappropriately sited, extensions, insufficient skeletal immobilisation and delayed transfer have tested and undermined the efforts of the reconstructing plastic and orthopaedic surgeons for many years. The opportunity for salvage and optimal soft tissue cover by very early microvascular tissue transfer, local flap or acute shortening and bone transport is frequently missed, despite published evidence. Amputated parts must be retained for possible donor use.⁴⁴

Recommended standards of care:

- The clinical management of open fractures should be in accordance with the recommendations of the Combined Working Party of the British Orthopaedic Association and the British Association of Plastic Surgeons.⁴³
- There should be a combined assessment by an orthopaedic and a plastic surgeon to decide a shared surgical tactic of skeletal stabilisation and soft tissue reconstruction. This should be agreed at or before the first surgical procedure. Where plastic surgery is not available in the receiving unit, a telephone discussion between senior surgeons should achieve that objective.
- A full wound excision and irrigation should be performed by the consultant surgeon within six hours of injury. Reduction and stabilisation of the fracture with internal or external fixation (as appropriate) should be achieved at that primary procedure.

- A combined plastic/orthopaedic surgical approach is required when a significant tissue defect is present or anticipated. Optimal management requires definitive restoration of the soft tissue envelope within five days of injury. Early or immediate transfer will often be required.

□ **Pelvic and Acetabular Fractures**

The initial assessment and management of these high-energy complex fractures may be extremely difficult. Prompt and appropriate surgical reconstruction in the majority of cases will substantially improve outcome. The most demanding, but fortunately rare, injury is the haemodynamically and mechanically unstable pelvic disruption. This injury combination requires rapid and decisive action by senior members of the orthopaedic, general surgery and urology teams, trained in the critical approach to abdominal assessment and imaging, pelvic external fixation and selective laparotomy. These injuries often exceed a hospital's expertise and available facilities. Many patients with pelvic (and acetabular) fractures have other and more pressing injuries, but the window to perform pelvic reconstruction is limited. Delay in transfer compounds the difficulty of surgery, increases the complication rate and worsens the outcome. Protracted intensive care unit (ICU) stays in district general hospitals are a common failing. Currently, the number of units dealing with adequate numbers of cases is limited and scheduling of these lengthy procedures is difficult.

Recommended standards of care:

- The immediate application of a pelvic external fixator is indicated for the combination of haemodynamic and mechanical instability relating to pelvic fracture/dislocation. This may be required in the resuscitation room. Advice should be sought from a pelvic surgeon on the appropriateness of a pelvic external fixator, as the necessary wounds may violate common reconstruction approaches to the viscera.
- Early contact with a hospital specialising in pelvic and acetabular fractures, should follow resuscitation of the patient and within 24 hours of presentation.
- Major hip or sacro-iliac joint dislocations should be reduced and placed on skeletal traction as an emergency. Trochanteric traction must be avoided.
- Pelvic fracture management demands an awareness of the urological components of these injuries. Early advice from a consultant urologist should be sought.

- For open pelvic fractures with wounds in the perineum, buttock, vagina or rectum, a defunctioning colostomy and washout is mandatory as an emergency. The colostomy should be sited in an upper abdominal quadrant away from pelvic surgical approaches.
- Imaging is required to determine the role of surgery and need for transfer. This is usually AP and Judet oblique plain radiographs of the whole pelvis for acetabular fractures. CT is optional. An AP pelvis radiograph and CT scan [10mm cuts] are required for pelvic disruptions.
- Contact with or transfer to the pelvic trauma unit should not be delayed. Investigations will be promptly available in the receiving unit. Digital image, telephonic or courier service transfer of images allows the pelvic surgeon to prioritise the transfer.
- Pelvic and acetabular reconstruction surgery should be performed within ten days of injury.

□ **Unstable Spinal Injuries**

Spinal injury patients are managed at acute general hospitals, specialist orthopaedic or neurosurgical units and spinal injuries units. The latter are dedicated to the total management and rehabilitation of patients with spinal cord injury. Patterns of referral are well-established, but often not supported by agreed standards or protocols. The infrequency of these injuries and the inexperience of the initial receiving staff are the weakest links in the process. Injuries at more than one spinal level are not uncommon. For the best outcome, very early consultant involvement and discussion with specialists in spinal injury is required.

Recommended standards of care:

- A full spinal protection, handling and nursing protocol must be in place for all at-risk patients. This is maintained throughout the care and investigation of a patient identified to be at risk of a spinal injury. A hospital policy for full spinal protection must be agreed for all unconscious trauma patients, including those in the ICU.
- A complete and documented neurological examination must be performed at presentation and at regular intervals.

- Immediate referral must be made to the appropriate spinal injury service if there is evidence of partial or complete spinal cord or cauda equina lesion.
- Referral within 12 hours must be achieved for all patients with unstable injuries. Immediate care, transfer advice, and prioritisation of patients are the advantages of this early contact.
- Deterioration in lung function should be anticipated and there must be a regular re-assessment of the need for mechanical ventilation.
- Patients must have their spine fully immobilised for emergency transfers. Local nursing protocols must ensure that patients are promptly moved off spinal boards and definitive spinal nursing practice commenced.
- Appropriate measures must be taken for urinary and bowel function.
- Imaging studies [plain radiographs and CT scans] must be completed as an emergency in patients with neurological deficit, and urgently [within 12 hours] in other unstable injuries. CT scans must include the first normal vertebra above and below the fracture to allow surgical planning. Patient transfers should not be delayed by the unavailability of CT scan facilities. These will be readily accessible in the receiving unit.
- The receiving spinal units must have 24-hour access to an MRI scanner with facilities for general anaesthesia.

□ **Fractures with Associated Vascular Injuries**

Severe limb trauma associated with a vascular injury demands an urgent response from the orthopaedic surgeon. The receiving hospital specialist carries the absolute responsibility for rapid assessment and delivery of the patient to a vascular specialist, so that reperfusion can be achieved within six hours of warm ischaemia time. Where a vascular service is not available on site, transfer arrangements must be in place and must not be left to chance.

Vascular surgeons may be available locally, but the limited number of consultants in this specialty will often lead to inter-hospital transfer. Frequently, major soft tissue damage accompanies such injuries. Transfers and vascular repair surgery take considerable time. A high index of suspicion, careful examination and senior staff involvement are essential to prevent irreversible ischaemic damage. For remote hospitals with long transfer times, local policies for treating these injuries by continuing skills training, including the use of shunt techniques, will be required. These policies must not further delay transfer. Injured patients are frequently young and rapidly

develop ischaemic necrosis. Compartment syndrome should be anticipated and appropriate observations and the technique of fasciotomy taught.

Recommended standards of care:

- Vascular assessment must be included and documented in all patients with limb injuries, notation should be dated, timed and signed.
- Severe limb injuries should be recognised to be at high risk and require frequent reassessments of pulses and perfusion. Joint dislocations and fractures adjacent to joints are at the highest risk. Dislocations of the knee carry such risk as to require urgent angiography, even in the absence of reduced distal perfusion.
- Variation in pulse volume or altered perfusion in an injured limb, requires the involvement of a vascular surgeon.
- Doppler pressure measurement should be recorded whenever possible.
- The warm ischaemic time and fracture/dislocation pattern will determine the place of immediate surgery or angiography.
- The objective of treatment is to obtain reperfusion of the limb, either in the receiving hospital or after transfer within six hours of injury.
- Delays in getting access to angiography must not impede transfer or operation.
- The risk of compartment syndrome associated with reperfusion after vascular repair demands full prophylactic fasciotomies.
- The severity of the injury to a limb by vascular damage, ischaemia or soft tissue and/or bone damage may be so great that primary amputation is considered appropriate treatment. In that circumstance, two fully trained surgeons from the specialties of trauma and orthopaedics and/or plastic surgery and /or vascular surgery should assess the patient and jointly agree their decision.

□ **Complex Hand and Brachial Plexus Injuries**

Complex hand injuries, including extensive skin loss and replantations, are best treated by specialists in hand injuries from the fields of orthopaedic and plastic surgery. The severity of these injuries is usually self-evident and direct transfer to the hand surgeon

should be possible from the A&E department. There is evidence that most patients endure delays of greater than six hours before surgical management.⁴⁵

Brachial plexus injuries may require exploration and grafting in the first week. Early discussion with a specialist in brachial plexus surgery is recommended.

Recommended standards of care:

- All severe hand injuries including flexor tendon injuries, open bone and joint injuries, peripheral nerve injuries, those with extensive skin loss and digital amputation must be discussed immediately with a specialist in hand injuries. Criteria for transfer must be agreed.
- Immediate treatment includes wound irrigation and dressing, temporary splintage, elevation, appropriate intravenous antibiotics and tetanus cover.
- Receiving hospitals must refer complex hand injuries and patients requiring replantation to an appropriate hand service and transfer protocols should be agreed. Patients should be in the operating theatre within six hours.
- Brachial plexus injuries must be discussed with a specialist in brachial plexus surgery within 24 hours of injury, even if the patient is not immediately fit for transfer.

13.6 VASCULAR INJURIES

Severe vascular injuries are a rare component of major blunt injuries. Penetrating injuries carry a much higher risk but are presently uncommon in the UK. Blunt or penetrating vascular injuries may frequently present a threat to life or limb; prompt recognition and rapid access to vascular surgical expertise is required for a favourable outcome. Vascular trauma emergencies may be complex and test the skills of a specialist vascular unit. The Vascular Surgical Society of Great Britain and Ireland recommended that existing resources be merged and a 24-hour rota should be in place for all vascular emergencies including trauma. There should be a full vascular radiology service.⁴⁶ The balance between accessing surgical proficiency and a potential ischaemic interval must be explicit and addressed in the emergency service planning for all receiving hospitals. Delays can be avoided by the vigilance of senior clinicians and agreed transfer arrangements with a vascular surgical unit and ambulance services. Such patients should be accorded the same priority as neurosurgical transfers.

Recommended standards of care:

- For vascular injuries associated with skeletal limb injuries, refer to pages 29–30.
- All patients with significant blunt injuries and those with penetrating wounds require full documentation of the distal neurological and vascular status. Particular reference should be made to pulse volume and symmetry, skin capillary perfusion, temperature and sensation. Doppler pressure measurement should be recorded whenever possible.
- Reassessments at intervals are mandatory and must be recorded, timed and signed.
- For patients with vascular injuries associated with acute limb ischaemia or altered perfusion the clinical diagnosis, referral and transfer to a vascular surgeon should occur within two hours of injury. Reperfusion must be achieved within six hours of injury.
- Delays in accessing angiography in receiving hospitals must not impede transfer or time to surgery. This investigation will be promptly available in the vascular surgery unit.
- In the more remote acute hospitals without vascular surgeons, surgical skills aimed at achieving the reperfusion objective should be maintained.

13.7 HEAD AND NECK INJURIES

It is estimated that at least half a million patients suffer facial injuries each year in the UK. There is a very strong correlation with alcohol consumption.⁴⁷ Whilst the majority of injured patients requiring surgery can be placed on the next available operating list, some head and neck operations will be performed out of hours, most frequently when the trauma patient is undergoing other emergency procedures. The practice of head and neck surgery is encompassed within the specialties of otorhinolaryngology, oral and maxillofacial surgery and plastic surgery. Trauma to the facial skeleton is mainly treated by oral and maxillofacial surgeons; nasal injuries, trauma to the temporal bone, the larynx and the upper airway by otorhinolaryngologists. Plastic, vascular, thoracic and general surgery expertise may also be required. Major and complex injuries may, in addition, require support from neurosurgery.

Recommended standards of care:

- Hospitals providing a head and neck surgical service must have 24-hour consultant cover.
- 24-hour CT scanning and experienced theatre and ward teams must be available.
- Defined routes of referral and procedures must be in place to urgently involve head & neck surgeons and anaesthetists in the assessment of severe face- and head-injured patients. Advice for upper airway, management of oral and laryngo-tracheal injuries, tracheostomy, haemorrhage control and interpretation of CT scans of the facial skeleton is essential.
- Early head and neck surgical expertise is required for auditory/vestibular damage, persistent CSF leaks and facial nerve injuries.
- Head and neck surgical services, including otorhinolaryngology, maxillofacial and plastic surgery must be available in major acute hospitals and children's tertiary referral units. Established communication pathways must be in place for head and neck injuries in each trauma system.

13.8 UROLOGICAL INJURIES

Urological trauma is relatively uncommon. Most injuries to the urinary tract result from blunt trauma. Early recognition is essential to secure better outcomes.

Recommended standards of care:

- In all cases of urological trauma, the advice and involvement of a consultant urologist should be sought.
- Renal injury is usually not severe, but may be the major cause of hypovolaemic shock. Specialist imaging facilities are required to fully assess the degree of renal damage.
- In pelvic fractures, the lower urinary tract may be disrupted and require full radiological investigation including urethrography and retrograde cystography.
- If an intraperitoneal bladder rupture is suspected, a cystogram will be necessary to establish the diagnosis.

13.9 EYE INJURIES

Blunt (non-penetrating) ocular injuries are common and when not associated with cranio-facial trauma are most appropriately dealt within the emergency hospital eye service by the on-call training grade ophthalmologist. Visual acuity in each eye must always be recorded. All acute hospitals receiving trauma must have access to an on-call ophthalmologist with appropriate senior cover.

Serious ocular injuries not associated with life-threatening clinical signs, eg suspected perforation of the globe, may require tertiary (out of area) referral following telephone consultation.

Severe ocular injury of one or particularly both eyes in association with cranio-facial or other multi-system trauma must be managed within a team according to a priority-led approach, incorporating an appropriately experienced ophthalmic surgeon.

Recommended standards of care:

- A training grade ophthalmologist (SHO/SpR) should be included in the assessment and management of ocular injuries at the earliest opportunity.
- Visual acuity in each eye must be recorded in all conscious patients.
- Full neurological observations and documentation of pupil signs must be recorded and made available to the ophthalmologist in all semi-conscious or unconscious patients.
- An appropriately experienced ophthalmologist must be advised of ocular manifestations of the injury if it is proposed to take the patient to theatre – thereby allowing an opportunity for detailed examination under anaesthesia.
- Out-of-area transfer for intra-ocular microsurgery must be considered when vital signs are stable and the benefit of transfer is considered greater than the risk.
- When both eyes are injured and critical list status is maintained, expertise from outside the area should be sought by contacting the regional centre.

13.10 ANAESTHESIA FOR THE SEVERELY INJURED

Many studies highlight the preventable mortality and morbidity that occur following major trauma.^{2,8,9} Airway problems and hypovolaemia are very often the causes, and the anaesthetist is uniquely trained to provide prompt and appropriate management when they are identified. The *ATLS*® system of trauma care stresses the importance of recognition of airway and ventilation problems. The value of early senior anaesthetic

involvement cannot be over-stated. The anaesthetist should be part of the resuscitative trauma team, rather than being called only when serious problems have already developed. Early consultant involvement is important, since the trauma patient presents many problems to the inexperienced; failed intubation is more common in the trauma patient⁴⁸ than the ordinary surgical population, and pre-existing hypoxia, the possibility of neck instability and urgency can make intubation and ventilation difficult. The anaesthetist in the resuscitative trauma team should be assisted by an anaesthetic nurse or operating department practitioner (ODP), who is regularly involved in anaesthetic practice. The hospital anaesthetic department should have input into the range and presentation of anaesthetic equipment that is available in the trauma resuscitation room. This should include equipment for adult and paediatric intubation, as well as devices to assist with difficult or failed intubation, including facilities for high-pressure jet ventilation. There should also be facilities for rapid infusion of warmed fluids, and the use of a fluid warming cabinet is preferable. It is recommended that high-flow fluid warmers, suitable for rapid infusion should be combined with the insertion of large-bore cannulae (eg 8.5 FG introducer sheaths). A forced air-warming unit should be immediately available for use on the injured patient. There must be facilities for invasive continuous monitoring of arterial blood pressure and central venous pressure. There should be a blood gas analyser next to the resuscitation room. In addition, an anaesthetic machine and a fibre-optic bronchoscope must be available for the management of the difficult airway.

The injured patient is likely to require transfer to the radiology department, operating theatre, the ICU, or to another hospital. Facilities for portable monitoring and ventilation should be available in the resuscitation room, and their function regularly checked by experienced personnel. The guidelines of the Association of Anaesthetists of Great Britain and Ireland (AAGBI) for standards of transfer⁴⁹ and the guidance of the Intensive Care Society⁵⁰ must be followed.

Advanced airway care must only be provided by doctors trained and experienced in the technique of rapid sequence intubation (RSI) in association with manual in-line neck stabilisation (MILNS). These doctors must be experienced and trained to deal with the consequences of these interventions, including the management of failed intubation: this would include the use of the laryngeal mask airway (LMA), and the insertion of a device for trans-cricothyroid jet ventilation.

Recommended standards of care:

- An anaesthetist of SpR grade or above should be part of the initial team response to major injury.
- The anaesthetist must be assisted by an appropriately trained ODP or anaesthetic trained nurse.
- Given the potential difficulties, the initial decision to secure the airway by tracheal intubation requires careful consideration. However, airway

compromise from head injury, direct airway injury or hypoxia unrelieved by simple measures necessitates urgent tracheal intubation, and help from a senior anaesthetist must be sought as early as possible.

- The intubation sequence of choice is:
 - a) pre-oxygenation for as long as is practical;
 - b) manual in-line neck stabilisation (MILNS), followed by removal of all cervical spine stabilisation except the posterior portion of the hard collar;
 - c) rapid sequence induction using an appropriate induction agent and a rapid onset muscle relaxant;
 - d) oro-tracheal intubation; and
 - e) confirmation of tracheal tube placement should be by auscultation, and capnography, supplemented by continuous pulse oximetry.

- Facilities and skilled personnel must be available to perform cricothyroidotomy or tracheostomy in the event of failure to maintain oxygenation after failed intubation.

- Cannulation of two large veins with short large-bore cannulae is essential in severe hypovolaemic shock. Fluid should be administered using a high performance fluid infusor.

- Transfer to other areas of the hospital, or to other hospitals, must be undertaken only by experienced anaesthetic personnel. The patient remains the responsibility of the referring hospital until arrival at the receiving hospital, unless a trained retrieval team is used.

13.11 INTENSIVE CARE FOR THE SEVERELY INJURED

The severely injured require intensive care. The level of care recommended can only be achieved by a substantial increase in intensive care resources for the severely injured.

High dependency units (HDUs) are not a substitute for intensive care, but the provision of HDU beds will reduce the required number of ICU beds by allowing trauma patients who fulfil the criteria for HDUs or who merely need regular assessment to avoid ICUs altogether. HDUs can be used as a step down unit before patients return to an adequately resourced ward.

Trauma patients require co-ordination between specialties. Consultants in intensive care are crucial for proper co-ordination between other specialties. This can only be achieved if the consultants have adequate contracted sessions solely for the management of critically ill patients.

Recommended Standards of Care:

- An SpR or consultant in intensive care must attend each major trauma patient as soon as possible after they arrive in the hospital.
- Seriously ill patients who do not require immediate surgery should be transferred to intensive care as soon as they have been assessed and stabilised. Intensive care units should have the necessary space and facilities for ongoing resuscitation.
- Multi-system trauma patients in intensive care units should be under the overall care of an intensive care consultant who should co-ordinate decisions concerning treatment. This demands regular joint ward rounds with other specialties and close working relationships between consultants.
- Trauma patients require the same standard of ICU support as other critically ill patients including haemodialysis, ultrafiltration, forced air warming, pressurised fluid infusors and air loss beds.
- Intrahospital transfer involves risk to the patient and adequate senior staff and equipment must be available. The recommendations for intrahospital transfer⁴⁹ must apply to these transfers. ICUs should be co-located with HDUs, theatres, A&E departments, helipads and ambulance bays so as to reduce the time at risk.
- Inter-hospital transfer must be adequately funded. Staff and equipment must be additional to that needed in the intensive care unit. All ICUs within a trauma system must meet regularly to agree the indications and methods of transfer. Helicopter transfer should be considered for transfers of over 60 miles. Protocols and funding must be in place to ensure that immediate transfer can occur when clinically required.
- Trauma patients with major head injuries, burns and spinal injuries frequently have other serious injuries. Each trauma network must have ICUs in neurosurgical, spinal and burn units which have the necessary training and expertise to provide for these other injuries.
- There must be adequate facilities for relatives who may not live locally and need accommodation. Relatives must be kept regularly informed of the patient's progress.
- The transfer of trauma patients out of ICU should only occur when their condition is suitable. Each patient should then be under the overall care of a suitable named consultant. Consultants in intensive care must continue

to visit these patients ensure they receive seamless care, and that they do not need to return to intensive care, and to advise on intensive care aspects such as respiratory support and pain relief.

- Adult ICUs must not be used for the long term (greater than 24 hours) treatment of paediatric trauma.

13.12 BURNS

The initial clinical management of patients with complex burns and related problems should be in accordance with the recommendations of the British Burn Association encompassed in the *Emergency Management of Severe Burns* (EMSB) course. The identification of the extent and depth of skin injury, including the presence of any inhalation injury and associated non-burn injuries, is of primary importance. It is estimated that there are 16,000 NHS admissions per year with burns. Only a small proportion are immediately life-threatening, but complex burns are amongst the most challenging forms of trauma.

Referral for definitive care should be in accordance with the criteria being set by *The National Burn Care Review* (NBCR), which will be published shortly.

Patients with complex burn injuries require the simultaneous availability of the skills of burn nurses, burn surgeons, anaesthetists with burn care experience, and a consultant in intensive care with burn experience. Burn management requires a high degree of team working, with 24-hour access to investigation facilities and a dedicated operating theatre.

Burn services should be situated in hospitals with full laboratory and investigative facilities and the core medical and surgical specialties of a major acute hospital as detailed elsewhere in this document. The specific requirements will be presented in the report and recommendations of the NBCR.

Recommended standards of care:

- The clinical management of patients with burn injuries should be in accordance with the British Burn Association recommendations within the *National Burn Care Review* report.
- Initial assessment and care should be along EMSB guidelines.
- All injuries requiring admission to hospital must be to a service with experienced staff trained in the provision of burn care.

- All complex injuries require the skills of the whole burn team, available on one site with suitable accommodation and equipment. Patient transfer to that team should be within six hours of injury.
- Treatment must achieve rapid stabilisation of the patient, to allow early excision of the burn wound and the earliest possible full skin healing. Rehabilitation should begin on the day of admission.

13.13 THE SEVERELY INJURED CHILD

The majority of injuries from infancy to puberty are simple isolated limb injuries and should be treated in the local hospital. Assessment and care of the severely injured child can place a much greater demand on receiving clinicians. The child presents a different spectrum of potential injuries, a result of its smaller size to absorb impact and its flexible skeleton. Multi-system injury should be assumed despite the dearth of external signs. This, accompanied by the different physiological response to injury and frequent rapid deterioration, is a pitfall for the unwary. The severely injured child is fortunately rare but this, compounded by most doctors' inexperience with small children, often results in indecision and late intervention. There is a much higher frequency of serious head, chest and abdominal injury than in the adult. There is also the greatest opportunity for salvage. Detection of skeletal injury may be difficult, but is also urgent. Fracture intervention after the first few days, particularly with epiphyseal injuries and in the head-injured child with accelerated fracture healing, may be unsuccessful and result in the greatest long-term disability. By necessity, access to paediatric intensive care or specialist paediatric surgical services will require inter-hospital transfer for most children.

Recommended standards of care:

- Any hospital receiving and caring for the severely injured child must have on-site support from paediatricians, paediatric anaesthetists, and a full range of appropriate resuscitation equipment.
- There should be a separate resuscitation area for children in A&E departments.
- A separate on-call response team ensuring the most senior paediatrician involvement must be in place for severely injured children. Although the resuscitation and surgical priorities remain the same, the skills are specific.
- Each receiving A&E department should have a children's nurse available at all times recognising the particular need for holistic care.

- Early advice from a paediatric intensive care unit (PICU) should be sought.* Inter-hospital transfer of the critically injured child requires multi-disciplinary consultant involvement and should be managed according to locally agreed protocols. A retrieval team from the PICU should be available for urgent transfer. It is recognised that a local team may effect more rapid transfer.
- Receiving PICUs should have on-site supporting allied trauma specialities available and agree joint reception of the severely injured child.

*The location and standards of care for PICU have been defined by the National Coordinating Group on Paediatric Intensive Care.⁵¹ Currently designated PICUs co-exist with the major acute hospitals in only 50 percent of cases.

13.14 THE MULTIPLY INJURED PATIENT

The complexity of these injuries requires that they must only be managed in a major acute hospital with the full complement of supporting specialities.

Agreed transfer policies must be defined by the hospitals within each trauma network. Communication to warn involved services of an accepted patient, and securing, in advance, access to investigation, the operating theatre and intensive care, is essential. Defined routes of referral should be agreed and the referral arrangements made between the consultants. Such high-risk transfers of critically injured patients deserve senior involvement.

13.15 THE REHABILITATION OF THE SEVERELY INJURED

It makes sense that if great efforts are made to save life and reduce the impact of the injury, there should be an effective rehabilitation programme to minimise disability and prevent complications. Rehabilitation begins at admission and must be integrated with acute care. A properly resourced rehabilitation service is seen as an integral part of a National Trauma System. There is an urgent need for investment in rehabilitation services both locally and centrally for the most severely disabled patients, particularly those who have suffered head injuries. The poorly resourced rehabilitation service results in patients spending longer in acute hospital beds and therefore denying access for patients requiring elective treatment.

The aims of rehabilitation are to prevent complications, eg the physical effects of neurological injury and immobility. The aim must be to optimise the physical and social functioning of patients so as to allow their planned return to the community and to recognise cognitive and emotional complications of traumatic brain injury, even in the absence of physical sequelae.

The rehabilitation environment should have the appropriate skill-mix, including a concentration of therapy services. A major role of the rehabilitation component of each system would be to audit the outcome of patients that have suffered severe trauma.

Recommended standards of care:

- Specialist rehabilitation services should be integrated with each trauma system and should be under the clinical leadership of a consultant in rehabilitation medicine.
- Patients must have equal access to all appropriate rehabilitation services.
- Each rehabilitation unit should have written admission criteria.
- Each rehabilitation unit should utilise appropriate outcome measures.
- Written goals should be identified for each patient's rehabilitation.
- The rehabilitation programme should be carried out by a co-ordinated multi-disciplinary team with all the relevant clinical disciplines, including doctors and nurses trained in rehabilitation, the professions allied to medicine, psychologists, social workers, etc.
- Staff numbers, qualification and experience must be adequate to meet the caseload.

14 | A National Trauma Service

A **National Trauma Service should develop from defined trauma systems** using a ‘hub and spoke’ or ‘network’ arrangement between adjacent hospitals with different levels of provision for the severely injured. Each geographical system would integrate pre-hospital care, initial transfer from the scene, inter-hospital transfer where necessary, definitive hospital care and rehabilitation. NHS administrative boundaries should not constrain organised systems of care and cross-boundary co-operation will often be required. The hospitals in each system are defined by the resources and specialist skills available. The single **major acute hospital** (level 1) in each system will have all of the specialist departments on site. The **acute general hospital** (levels 2 and 3) will be supported by the major acute hospital, to achieve the standards set in Chapter 13. The National Trauma Service will ensure uniform provision of trauma care in England, Wales and Northern Ireland with identified acceptable standards and taking accessibility for patients into account. This should be an inclusive trauma service incorporating all of the hospitals within each system. **Audit of the process of care and the outcome of severe injuries would be the ethos of each system.**

14.1 TRAUMA SYSTEMS

- In order to improve the care of the severely injured there should be a network of geographical trauma systems covering England, Wales and Northern Ireland.
- Each system would serve a population of up to three million.
- There would be an advantage in a single emergency ambulance service with a medical director for each system.
- The backbone of the National Trauma Service will remain the acute general hospital. In line with the Audit Commission report,⁵² there should be a reduction in the number of hospitals that receive major trauma.
- In support of the National Trauma Service, there should be sufficient intensive care facilities for severely injured children sited in major acute hospitals providing specialist paediatric services. Severely injured children may be transferred to specialist children’s hospitals which meet the requirements of a major acute hospital.
- Rehabilitation arrangements for the severely injured must be identified for each system.
- Each trauma system should have an agreed major incident policy

14.2 THE MAJOR ACUTE HOSPITAL – LEVEL 1

- This will be a designated large acute hospital.
- There should be only one major acute hospital in each system.

- The major acute hospital will receive all trauma from its immediate catchment population.
- The major acute hospital will receive patients directly from any part of the trauma system, even though this may mean bypassing other hospitals when appropriate.
- The major acute hospital will receive secondary transfers from other hospitals in the system.
- The major acute hospital will provide pre-hospital advice to ambulance personnel.
- The major acute hospital will receive trauma patients from other hospitals in the system when the standards of care set out in Chapter 13 cannot be met by an acute general hospital.

The Required Facilities at the Major Acute Hospitals (Level 1)

- A 24-hour resuscitative trauma team, led by a consultant with current *ATLS*® certification or equivalent, must be in place.
- A 24-hour, fully staffed A&E department, supported by on-call A&E consultants, supported by specialist registrars.
- ICU beds and trauma beds on the same site as the A&E department.
- On-site 24-hour X-ray and CT scanning with appropriate staffing and immediate reporting facilities.
- The equivalent of four to eight whole-time consultants exclusively dealing with orthopaedic trauma.
- A dedicated trauma theatre and daily consultant orthopaedic trauma lists.
- A helicopter pad close to the A&E department is mandatory. There should be no additional secondary journey by road. The helicopter landing site should allow landing throughout the 24 hours.
- There must be on-site departments of:
 - Orthopaedic trauma
 - Neurosurgery
 - General and vascular surgery
 - Plastic surgery
 - Cardiothoracic or thoracic surgery
 - Head & neck surgery
 - Urology
 - Anaesthesia with intensive care
 - Interventional radiology

Paediatric surgery
Intensive care beds for children

- A named consultant director of trauma.

14.3 THE ACUTE GENERAL HOSPITALS – LEVEL 2

- These hospitals will inevitably vary in size and will not have all of the major surgical disciplines on site.
- They will often be at some distance from the major acute hospital.
- They will act in partnership with the major acute hospital.
- They must be able to resuscitate the severely injured.
- Audit will scrutinise whether hospitals receiving few severely injured patients would be able to retain sufficient expertise to deal with them.

The Required Resources for the Acute General Hospital (Level 2)

- A 24-hour resuscitative trauma team, led by a consultant with current *ATLS*® certification or equivalent, must be in place.
- A 24-hour fully staffed A&E department supported by A&E consultants with specialist registrars.
- ICU beds and trauma beds on the same site as the A&E department.
- On-site 24-hour X-ray and CT scanning with appropriate staffing and immediate reporting facilities. CT scanning linked to the neurosurgery centre allows optimum management of head injuries and transfer where necessary.
- At least six consultants in orthopaedics with a special interest in trauma taking part in an emergency rota.
- A dedicated trauma theatre and daily consultant orthopaedic trauma lists.
- A helicopter landing pad close to the A&E department is mandatory. There should be no additional secondary journey by road. The helicopter landing site should allow for helicopter landing throughout the 24 hours.
- A named consultant director of trauma.

14.4 THE ACUTE GENERAL HOSPITAL – LEVEL 3

- It should be emphasised that the role of some acute general hospitals, whether in thinly populated rural areas or in conurbations, will change little but these hospitals are less likely to meet the standards required in Chapter 13.

- Some acute general hospitals do not receive sufficient numbers of major trauma patients to retain the skills of the staff and to justify the expensive resources required for the reception and resuscitation of major injuries.
- Patients with severe injuries or multiple injuries should bypass these level 3 hospitals and be taken directly to the major acute hospital [level 1] or an acute general hospital [level 2], even if they are further from the scene of the incident than the level 3 hospital.

The Typical Resources for Trauma in the Acute General Hospital (Level 3)

- A 24-hour staffed A&E department with dedicated resident medical staff.
- 24-hour X-ray facilities including CT scanning.
- At least six consultant orthopaedic surgeons dealing with trauma taking part in an emergency rota.
- Daily consultant orthopaedic trauma lists.
- Orthopaedic surgery, general surgery and general medicine on site.
- Pre-agreed arrangements for immediate (blue light) inter-hospital transfer to a level 1 or 2 facility.
- A named consultant should direct the trauma service.

14.5 MINOR INJURIES UNITS [MIUs]

- MIUs have no role in the management of severely injured patients and explicit bypass policies must be implemented such that these units never receive blue light ambulances.
- An MIU is defined as a unit offering open access and self-referral for minor injuries and ailments in ambulatory patients. These units may also see patients referred by family doctors and pre-agreed patients with minor injuries arriving by ambulance.
- Consultants in A&E medicine should be closely involved in these MIUs. The staff of such units, in order to retain skills, should rotate through large A&E departments.
- It is recognised that the contribution GPs make to minor injuries units is considerable.

15 | How the System Works

15.1 ON-SCENE CARE

- Emergency ambulances and paramedic response units invariably have a trained paramedic on board, although not all are currently trained to the *PHTLS* standard. This training should be mandatory for ambulance paramedics. All 999 calls indicating major trauma must result in the dispatch of a front-line ambulance with a trained paramedic on board.
- The paramedic, after a rapid primary survey of airway, breathing, circulation and the level of consciousness, applies specific resuscitation interventions to rectify identified life-threatening problems. Some preventable deaths that occur before arrival at hospital probably relate to a failure in basic patient assessment skills at the scene. Prolonged on-scene interventions by the paramedic in major injury patients will result in unnecessary delay in the arrival of patients at the receiving hospital, and there must be a target of not more than ten minutes at the scene, except where there is entrapment.
- These ten minutes must incorporate on-scene primary patient assessment, initial life saving resuscitation and transfer to the ambulance. Other interventions may be completed en route to hospital.
- The paramedic will select the most appropriate receiving hospital, using pre-agreed protocols, or seek medical advice by radio from the A&E department of the major acute or acute general hospitals.
- There must be effective radio/telephone links between the ambulance and its paramedic and the receiving A&E departments in the system. A suitably detailed pre-alert message must be transmitted to the receiving hospital so that the resuscitative trauma team can be assembled and prepared for the patient's arrival.
- There must be a formal handover between the paramedic and the resuscitative trauma team leader. The paramedic must provide a copy of the ambulance form.

15.2 AN INTEGRATED AMBULANCE SERVICE

- Presently there are 32 ambulance services operating as independent NHS Trusts and many hospitals are served by several ambulance services.
- There would be a clear advantage in further operational integration of the ambulance services with A&E departments. Further appointments of medical directors of ambulance Trusts would result in improved training for paramedics and the opportunity to develop protocols jointly between receiving A&E departments and ambulance services.
- There would be an advantage in a single emergency ambulance service serving each trauma system, so allowing agreed transfer protocols to be implemented.

- Hospital consultants committed to and involved in pre-hospital trauma care should be more extensively involved with ambulance service medical directors and managers in developing clinical and operational strategy.

15.3 TRANSFER FROM THE SCENE

- Patients with life-threatening trauma should go either to a major acute hospital [level 1] or an acute general hospital [level 2]. It may however be appropriate to take the patient directly to the major acute [level 1] hospital even where it is at a greater distance from the acute general hospital.
- Suitable bypass procedures to be followed by paramedics should be established and agreed by the ambulance service and all component hospitals of the system to allow direct patient admission to the most appropriate hospital. The effectiveness of bypass procedures must be scrutinised by audit.
- Patients with life-threatening trauma or multiple injuries should never be taken to the acute general hospital [level 3].
- Patients with injuries that are non-life-threatening should be taken to the nearest acute hospital.
- Suitably responsive and safe inter-hospital transfer procedures should be established and agreed by the ambulance service and the component hospitals of the trauma system. These procedures must be scrutinised through audit.
- It is recognised that primary helicopter retrieval from the scene of injury may be beneficial in some locations, especially where distances from the major acute hospitals [level 1] are great. The 'HEMS' model in London is unique in this context where a full aeromedical system is staffed by an experienced doctor and a paramedic. Expert assessment and critical intervention enables the earliest possible transfer to the most appropriate hospital. The pre-hospital phase is used for active treatment. This model of primary transfer may only be appropriate in London.

15.4 ACTIVATING THE RESUSCITATIVE TRAUMA TEAM

- Each hospital receiving major trauma should have a protocol for activating the resuscitative trauma team.
- The resuscitative trauma team must be activated prior to the arrival of the injured patient. The paramedic on scene should alert the receiving centre and suggest the level of response required.

15.5 CRITERIA FOR ACTIVATING THE TRAUMA TEAM

Patients with any of the following:

- Airway compromise
- Signs of Pneumothorax
- Sp O₂ < 90 percent
- Pulse > 120/min. or systolic blood pressure < 90mm Hg. in adults
- Unconsciousness > five mins
- An incident with five or more casualties
- An incident involving fatality
- High-speed motor vehicle crash
- Where the patient has been ejected from a vehicle
- Knife wound above the waist
- Any gunshot wound
- Fall from >25 feet (eight metres)
- A child with altered consciousness, capillary refill >three seconds. Pulse >130
- A child pedestrian or cyclist hit by a vehicle

15.6 THE RESUSCITATIVE TRAUMA TEAM LEADER

The trauma team leader must be a consultant. Trauma management is by its very nature a multi-disciplinary field and the specialty of trauma team leaders is less important than their commitment. The team leader must have an *ATLS*® certificate or equivalent. The British Trauma Society⁵³ has defined the role of the trauma team leader. Consideration should be given to formal training for trauma team leaders beyond *ATLS*® provider level.

15.7 RESUSCITATIVE TRAUMA TEAM MEMBERS

Each medical member of the trauma team should be trained to *ATLS*® or to equivalent standard. Similarly each nurse member should hold the *ATNC* [Advanced Trauma Nursing Certificate] or have observed on an *ATLS*® course or be of equivalent standard. The team structure may vary in different hospitals. In addition to the team leader, the trauma team should comprise representatives at SpR or consultant grade in A&E and anaesthesia and training grade representatives of the surgical disciplines. Two A&E nurses and a radiographer are essential parts of the team. The components of the trauma team should always reflect the importance of training in trauma. The team leader decides the level of response and the involvement of other specialties.

15.8 SECONDARY TRANSFER

- The literature highlights the dangers of inadequately organised or supervised inter-hospital transfer.⁵⁴ The advice contained in the document *The Recommendations for the Transfer of Patients with Acute Head Injuries to Neurosurgical Units*⁴⁹ must be followed.

- Protocols for secondary transfers from the acute general hospital to the major acute hospital must be in place and targets for transfer time should be agreed by the admitting hospital and the ambulance service.
- The majority of short distance transfers can be by land ambulance, but secondary helicopter transfers may be beneficial over longer distances.
- If helicopter operations are to be safe and effective, helicopter landing pads should be placed adjacent to the A&E departments of level 1 and level 2 hospitals. The speed of helicopter transfer can be lost and patients put at risk if further transfer by land ambulance is necessary due to the landing site being remote from the receiving hospital.
- Where air ambulances operate, with suitable landing facilities adjacent to major acute and acute general hospitals, larger geographical areas for the retrieval of patients with major injuries may be appropriate.

16 | The Consultant Workforce for Trauma

The development of a National Trauma Service is conditional upon an adequate consultant workforce in all disciplines that manage severe trauma. Additional consultants will be required. Evidence from the Calman-Hine Framework⁵⁵ for cancer services indicates how consultant workforce numbers can constrain the development of such service arrangements.

16.1 TRAUMA AND ORTHOPAEDIC SURGERY

The bulk of definitive trauma care is carried out by orthopaedic surgeons and is a major component of their hospital practice. Some 90 percent of consultant orthopaedic surgeons take part in a trauma rota and 80 percent are responsible for at least one trauma operating list each week. Despite this major commitment, 36 percent of consultants list trauma as a special interest. Eight percent describe trauma as a major sub-specialty interest.⁵⁶ There are only 22 orthopaedic traumatologists in the UK whose specialty is entirely devoted to acute trauma and trauma reconstruction. Many of them specialise in specific complex injuries and provide a secondary referral service for colleagues, and for other hospitals. Over the past five years the orthopaedic consultant workforce has increased on average 4.7 percent each year. It is evident that each trauma system would require a continued expansion in the number of orthopaedic surgeons with a principal interest in treating the severely injured. Each major acute hospital would require on average six WTE orthopaedic traumatologists and six practising largely elective orthopaedics and some trauma. The acute general hospitals would need eight WTE surgeons providing a service for both trauma and elective orthopaedics. The consultant workforce would need an expansion of just over four percent per annum over the next ten years in order to make a trauma framework feasible.

16.2 GENERAL SURGERY

A National Trauma Service would be an additional reason for expanding the general surgical workforce in both the major acute and acute general hospitals. It is recommended that general surgeons should be free of all other commitments during their emergency duty period.¹³ General surgery requires an increase in consultant numbers greater than the present three percent per annum in England and Wales.⁵⁷

16.3 HAND SURGERY

There has been an increase in demand for hand injury services. There is a shortage of consultant surgeons trained in the management of hand injuries as evidenced by the fact that more than 80 percent of emergency hand surgery is performed by surgeons-in-training.⁴⁵ It can be calculated that if all operations were to be supervised there would be a need for an additional 60 whole-time hand surgeons in England and Wales. There is no place for non-medically qualified practitioners to perform hand surgery which would sacrifice quality.

16.4 VASCULAR SURGERY

A minimum of four specialist vascular surgeons would be required in a major acute hospital. In the acute general hospital, consultant vascular practice may be combined with other general surgical interests. Vascular surgery requires an increase in consultant numbers.⁴⁶

16.5 NEUROSURGERY

The Royal College of Surgeons of England drew attention to the underprovision of resources for managing head injuries in 1999.³⁹ Neurosurgeons in the UK manage more than 4,000 patients with head and spinal trauma each year. The 37 neurosurgical units in the UK have been reduced in number since 1993. Only half of these units have reached the minimum consultant staffing level recommended in 1993. One in five has the minimum number of ward beds, and one in seven the recommended number of dedicated intensive care beds. It is hoped that there will be an additional 92 neurosurgeons and four additional ICU beds per million population by 2005.⁴⁰

16.6 CARDIOTHORACIC SURGERY

The National Service Framework published in March 2000 by the DH will assure adequate senior involvement in the management of severe cardiothoracic injuries.⁵⁸

16.7 ORAL & MAXILLOFACIAL SURGERY

There is a requirement for oral and maxillofacial trauma services to provide 24-hour cover. Despite a move to conduct trauma surgery in daylight hours, the majority of patients are operated on by trainees, often unsupervised. This is due to the parallel commitments of consultants to elective out-patients and in-patient lists, often to meet contractual targets. There is a requirement for one consultant per 150,000 population to achieve a consultant-provided service. An additional 90 consultants are required to meet this target. Trauma services should be based at sub-regional centres, recognising that a population base of 500,000 generates approximately 250 fractures of the facial skeleton requiring treatment each year.

16.8 PAEDIATRIC SURGERY

Paediatric surgeons have an increasing role in the organisation and delivery of trauma services for children. While severely injured children are treated in a major acute hospital or a specialist paediatric hospital, most children with a stable injury are treated in acute general hospitals. Increasingly, as a result of the recommendations of the NCEPOD report on the surgical care of children,¹⁵ and the lack of general surgeons with training in paediatric surgery, these patients are being transferred to specialist paediatric surgical centres. The growing pressures on specialist paediatric surgeons, including trauma care, will require an increase of 72 percent above the current quota of 92 whole-time equivalents⁵⁹ in the next five to ten years.

16.9 ACCIDENT & EMERGENCY MEDICINE

A National Trauma Service would require enhancement of the A&E consultant workforce in those hospitals receiving major trauma, particularly major acute hospitals. It is self-evident that experienced staff must be immediately available in all hospitals receiving major trauma. There is thought to be a shortfall of about 400 A&E consultants in the UK, based upon normal daytime working hours with an on-call commitment. A greater consultant presence at the 'front door' of hospitals can only be achieved with an increase in the consultant workforce. There are additional pressures from head injury management, investigative protocols and assessment units.

16.10 ANAESTHESIA

The anaesthetic consultant workforce requirements are presently under review. The commitment to a consultant-provided trauma service can only emphasise the shortfall in existing numbers of consultant anaesthetists.

16.11 PLASTIC SURGERY INCLUDING BURNS

The volume of soft tissue and burns together with the complexity and time-consuming nature of modern reconstructive surgery including microvascular repair, highlights the need for an early increase in consultants to provide the service.

16.12 REHABILITATION MEDICINE

Each trauma system requires integrated rehabilitation services led by consultants in rehabilitation. The present consultant workforce will need expansion to match the expected caseload.

17 Training in Trauma Care

17.1 ADVANCED TRAUMA LIFE SUPPORT IN THE UK

- It is 12 years since The Royal College of Surgeons of England reported that as many as one in three of deaths occurring in hospital as a result of injury were potentially preventable.² The College responded by introducing the *ATLS*® programme from the United States.⁴⁵ This system of managing the severely injured has now become part of best practice.
- The programme has expanded over the years. Most A&E departments use the *ATLS*® protocols and the number of courses has increased throughout the last decade. There are more than 220 *ATLS*® courses every year producing more than 3,000 providers. Despite this, the waiting time to get onto a course remains at 18 months. There is still concern that the majority of senior house officers in A&E departments are not *ATLS*®-trained. The *ATLS*® Steering Group has addressed this issue over the years by the provision of more courses with more participants. The UK has trained nearly 16,000

students and 936 instructors and has the largest *ATLS*® programme in the world outside the USA. The Royal College of Surgeons of England holds nine instructors' courses each year. A regional quality assurance mechanism is in place through regular inspection of courses. During the last decade the ultimate aim of providing *ATLS*® courses for all doctors that treat the injured has not quite been realised.

- Similar courses for pre-hospital care (*PHTLS*), military casualties (*BATLS*), emergency general practitioners (*PHEC*) and nursing trauma care (*ATNC*) have developed alongside *ATLS*®. *ATLS*® offers clear protocols for managing major trauma and is now part of a common international language of care of the injured.⁶⁰

17.2 THE TRAINING OF PARAMEDICS

- The training of paramedics has been based on the acquisition of interventional skills rather than on critical patient assessment. There is an urgent need to remedy this by further education and exposure to patient assessment training.
- A new paramedic course has been launched (*IHCD* 1999), with particular emphasis on trauma and paediatric care.
- Formal training and the subsequent maintenance of certification in *PHTLS* should be mandatory for all ambulance paramedics.
- There is a need for a career progression pathway within the clinical area for NHS ambulance paramedics. Ambulance Trusts should link with suitable universities to provide access for paramedics to certificate, diploma and degree courses. This should link with the proposals for the new practitioner in emergency care, a degree-level advanced paramedic practitioner.⁶¹
- Identification of future training and education needs for paramedics must be undertaken in line with their evolving role in trauma and emergency care.
- State registration of paramedics is imminent and will impact on many aspects of their role including professional standards.

17.3 PRE-HOSPITAL IMMEDIATE CARE

Doctors working unsupervised in the field should have undertaken appropriate training and passed the Diploma in Immediate Care or achieved a fellowship in a specialty that encompasses the necessary cardio-respiratory skills (eg FRCA or FFAEM). In addition, they must have received supervised experience in the field before undertaking duties on their own.

17.4 TRAUMA TEAM LEADER TRAINING

The role of the team leader does not belong to any particular specialty. It is a multi-disciplinary role and needs an understanding of a wide range of injuries and their management. The spectrum of trauma in the UK makes it important for the team leader

to be confident in the initial management of head, spine, trunk and limb trauma. This, in turn, requires training and experience beyond that usually gained in a single specialty and beyond that acquired in completing an *ATLS*® course. The team leader should be a consultant in an acute specialty involved in trauma care. There should be a multi-disciplinary selection process within the hospital to confirm that the prospective team leader has an appropriate background training and experience. Team management requires more than just technical knowledge and practical skills⁶² and a team leader should be apprenticed under supervision before undertaking this duty alone. Team leader reports on individual patients managed (outlining presentation, listing injuries identified, procedures undertaken, management decisions made and reporting the patient's progress) should form the basis of continuing local audit and appraisal.

17.5 INTER-HOSPITAL TRANSFER TRAINING

Training requirements have been specified by the Association of Anaesthetists and the Neuroanaesthesia Society.^{49, 54} For transferring head-injured patients, formal training in the theoretical and practical aspects of the subject should be undertaken. The training should include:

- The principles of managing a patient with an acute head injury.
- The principles and practice of *ATLS*®.
- The adverse physiological changes associated with patient transfers.
- Practical aspects of working in an ambulance or helicopter.
- Knowledge of the equipment and drugs used in transfer.
- The legal and safety aspects of transfer.
- Communications.

The head-injured patient should be accompanied by a doctor with at least two years' experience in an appropriate specialty (usually anaesthesia). The transferring doctor should have received supervised training in undertaking transfers.

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A&E	Accident and Emergency
<i>ATLS</i> ®	Advanced Trauma Life Support course
<i>ATNC</i>	Advanced Trauma Nursing Certificate
AVPU	Alert, responds to Verbal commands, responds to Pain, Unresponsive
<i>BATLS</i>	Battle Advanced Trauma Life Support
CHI	Commission for Health Improvement
CT scan	Computerised tomography scan
DETR	Department of Environment, Transport and the Regions
DGH	District general hospital
DH	Department of Health
ECG	Electrocardiogram
EMSB	Emergency management of severe burns
FG	French gauge
FFAEM	Fellow of the Faculty of Accident & Emergency Medicine (of the RCS)
FRCA	Fellow of the Royal College of Anaesthetists
GCS	Glasgow coma score
HDU	High dependency unit
ICU	Intensive care unit
IHCD	Institute of Health Care and Development (IHCD 99 is a course for paramedics)
ISS	Injury severity score (a more comprehensive method of measuring injury severity. An ISS > 15 implies a significant risk of death)
MILNS	Manual in-line neck stabilisation
MIU	Minor injuries unit
MRI	Magnetic resonance imaging
MTOS	Major Trauma Outcomes Study (now TARN)
NBCR	National Burn Care Review
NCEPOD	National Confidential Enquiry into Perioperative Deaths
NICE	National Institute for Clinical Excellence
NTAC	National Trauma Audit Committee
NTARN	National Trauma Audit Research Network
ODP	Operating department practitioner
<i>PHEC</i>	Pre-hospital Emergency Care (award)
<i>PHTLS</i>	Pre-hospital Trauma Life Support course
PICU	Paediatric intensive care unit
RCS	The Royal College of Surgeons of England
TARN	Trauma Audit and Research Network
WTE	Whole-time equivalent

Major Acute Hospital (level 1): A hospital trust with all specialist surgical departments and support services on site.

Acute General Hospital (levels 2 & 3): Hospitals without the full complement of specialist surgical departments and support services on site.

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