Critical Insight

An Intensive Care Society (ICS) introduction to UK adult critical care services

The Intensive Care Society

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Preface

Critical care is a vital hospital service and the Intensive Care Unit (ICU) is the area where the sickest patients in hospital are treated. These desperately unwell patients may come from the general wards, both medical and surgical, the Accident and Emergency Department, or the operating theatres. The staff of the critical care unit use modern high-technology organ support to save patients' lives. Over three-quarters of patients survive and are discharged to other wards to complete their recovery.

Because of the physiological stress of critical illness many patients have little recall of their experiences. Relatives are frequently too distraught to fully appreciate all that is being done. Because critical care accepts and returns patients to other hospital specialties its interface with primary care is limited. All of this means that the concept of critical care is poorly understood by those not working closely within this environment. The purpose of Critical Insight is to offer a view of critical care to those not familiar with this important specialty.

The Intensive Care Society (ICS) is the oldest critical care society in the world and represents all professionals working to deliver a top quality critical care service. Our aims are to improve patient care primarily through education and research and we hope you will find this document enlightening, informative and, most importantly for our patients, useful.

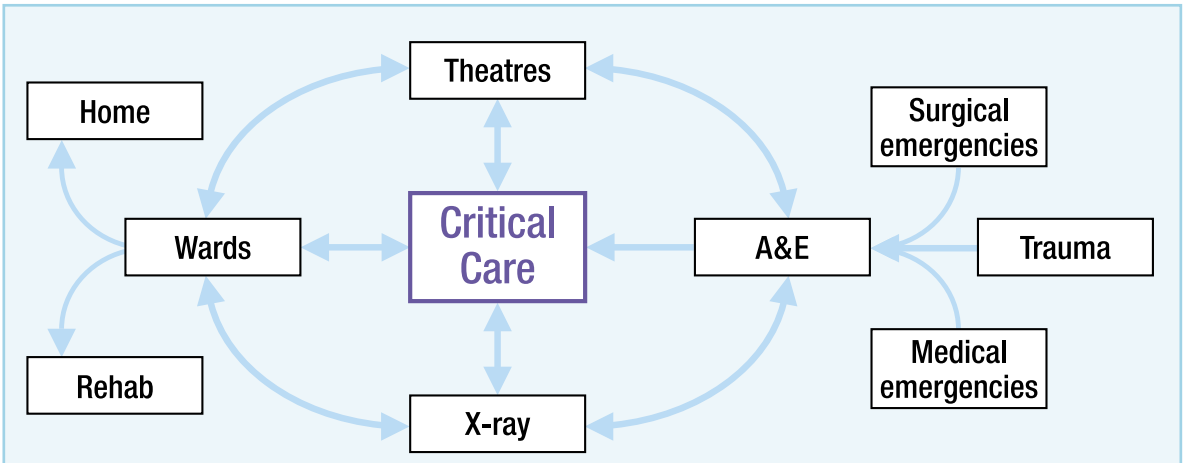


Figure 1: Critical interface - the central role of critical care

1 Critical care in the UK

1.1 What is critical care?

While many medical specialties deal with specific organs or systems of the body, patients who present to critical care units have a wide range of diseases. In most cases the illness has resulted in severe dysfunction or failure of one or more vital organs but these are often treatable and potentially reversible. In this setting, critical care medicine (or intensive care medicine) provides the technology to support the failing organs and the time and means to treat the underlying disease. It is high technology, life-saving care that interacts with all areas of a hospital.

Some patients need critical care because of a major medical illness or an accident, while others need support to overcome the problems associated with major surgery or surgical complications. Many patients admitted to critical care units are unable to breathe on their own and need artificial ventilation. Other organ systems such as the heart and circulation or the kidneys may also need support.

Critical care affects clinical outcomes across a spectrum of illnesses and age groups. It may be crucial in ensuring survival from meningitis in the teenager, optimise functional recovery in the young man admitted to hospital with a head injury after an accident, allow major curative cancer surgery to take place in the adult, or provide postoperative support following open heart surgery. Modern medicine is underpinned and made possible by intensive care.

1.2 Evolution of critical care

Generally speaking, critical care has developed in an ad hoc fashion, largely in response to gaps in service provision, and in response to new medical or surgical developments. This is best illustrated by the polio epidemic in Denmark half a century ago. Prior to 1952, patients suffering respiratory muscle paralysis due to polio were kept alive with negative pressure ventilators, colloquially known as ‘iron lungs’. However, these were far from ideal; 87% of patients eventually died. When Copenhagen was affected by a polio epidemic there were too few iron lungs available, so doctors transferred a technique in use in the operating theatre to support patients in respiratory failure. They found that mortality rates were reduced by 50% by combining manual positive pressure ventilation provided through a tracheostomy, and by caring for patients in a specific area of the hospital instead of across different wards (Figure 2).[1]

This innovation led to the creation of specially equipped areas in most hospitals to support critically ill patients, and critical care units subsequently provided expertise to support other forms of organ failure allowing major surgery to proceed. Intensive care medicine has now developed into a specialty providing the clinical expertise to successfully care for the sickest patients, many of whom suffer from multiple organ failure, and would undoubtedly die without such specialist care.

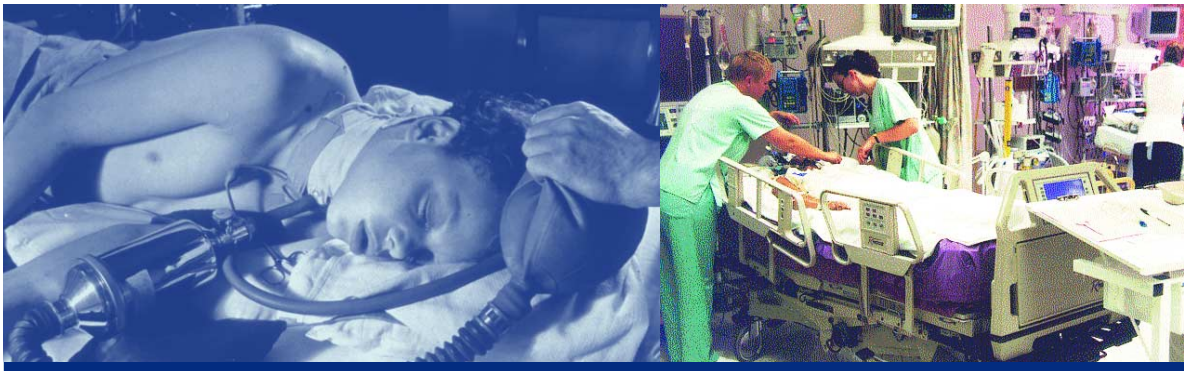


Figure 2. A child with tetanus receiving manual artificial ventilation through a tracheostomy (left) and the bed space of a modern intensive care unit (right).

1.3 Modern critical care

During the 1970s and 1980s the modern concept of critical illness developed, and research and clinical experience identified a number of common features. Alongside the traditional medical model of diagnosis, treatment and cure, a parallel model of patient care became established. This recognised that the physiological disturbances produced by critical illness required urgent identification and correction, usually *before* the causative disease was actually diagnosed. It also became apparent that a large proportion of this burden of abnormal physiology was part of the body's reaction to disease. This "host response" has evolved as a defence against invading microbes and is hence often termed the sepsis syndrome, even when the primary trigger is not infective. However, in many patients this host response, if excessive, may *cause* problems, and modulating its intensity may prevent or shorten the episode of critical illness.

1.4 The Intensivist: an established superspecialty

The arrangements for specialising in critical care medicine were initially poorly defined, but these have evolved along with the clinical specialty. The first formal intensive care training for doctors in the UK was established in 1986 via the Joint Advisory Committee for Intensive Therapy (JACIT), formed by the Royal College of Surgeons, the Faculty of Anaesthetists and the Royal College of Physicians. Since 2000, training has been administered by the Intercollegiate Board for Training in Intensive Care Medicine, which has adopted a competency-based framework and introduced a Diploma in Intensive Care Medicine. Intensivists, who come from a variety of clinical backgrounds such as anaesthesia, internal medicine, accident & emergency medicine or surgery, now have a well-defined training framework and there are clear criteria for defining adequacy of such training.

2 Critical to acute hospitals

2.1 The nucleus of a hospital

Critical care areas are a complex, diverse network of general and specialist services that interact with all areas of the hospital (Figure 3). On average, a quarter of patient admissions to critical care are planned, but the majority of patients are unexpected emergencies.

Typically, a critical care area has six intensive care beds and may be supported by a variable number of high dependency beds. The whole area is staffed by several consultants with responsibility for clinical care and an average of 30-50 nurses per unit so that the sickest patients have 24-hour, one-to-one nursing care. Physiotherapists, pharmacists, dieticians, microbiologists and medical physics technicians also play a role in critical care areas.

Much has changed over the last fifty years. Hospitals have become larger and more specialised, expectations of patients have increased and society has changed. Changing patterns of medical practice have resulted in patients increasingly being treated as day cases, and older patients and those with chronic diseases are increasingly being offered the option of elective surgery for relief of symptoms and improved

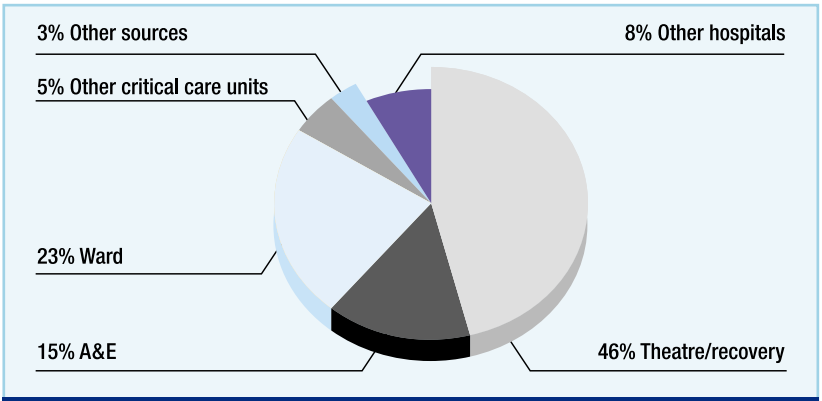


Figure 3: Source of patients admitted to critical care areas (Audit Commission, Critical to Success)[2]

quality of life. Consequently, inpatients in modern hospitals are, on average, far sicker than in the past, and the skills that have been developed in critical care units are finding application in acute settings throughout the hospital.

Critical care areas have, traditionally, been divided into ICUs (intensive care units), where the highest level of care is given to the sickest patients, and HDUs (high dependency units), where an intermediate level of care is provided for those who are not well enough to go back on general wards. However, the Department of Health has recommended[3] that the existing division into high dependency and intensive care beds be replaced by a classification (Table 1) that focuses on the level of care that individual patients need.

Table 1: Classification of comprehensive critical care[3]

Level 0	Patients whose needs can be met through normal ward care in acute hospital.
Level 1	Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team.
Level 2	Patients requiring more detailed observation or intervention, including support for a single failing organ system or post-operative care and those 'stepping down' from higher levels of care.
Level 3	Patients requiring advanced respiratory support alone or support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure.

It is hoped that such a system will help policymakers and commissioners better understand the provision of critical care in the NHS. Importantly, it also concentrates on the care that patients need, rather than the location in which it is delivered. This has lead to several new initiatives such as Critical Care Outreach, which aims to supplement the ward based care delivered to level 1 patients with expert input from critical care teams, thus allowing the early identification of patients who would benefit from ICU admission, while preventing the need for admission in other patients with early ward based interventions.

Another major organisational change has been the development of critical care networks. Such networks consist of several neighbouring intensive care units that raise standards by adopting common policies and protocols, and optimise resource usage by integrating their capacity. Other than for specialist referral, it is generally undesirable to transfer critically ill patients between hospitals, and coordination across critical care networks can help to ensure that such transfers are kept to a bare minimum.

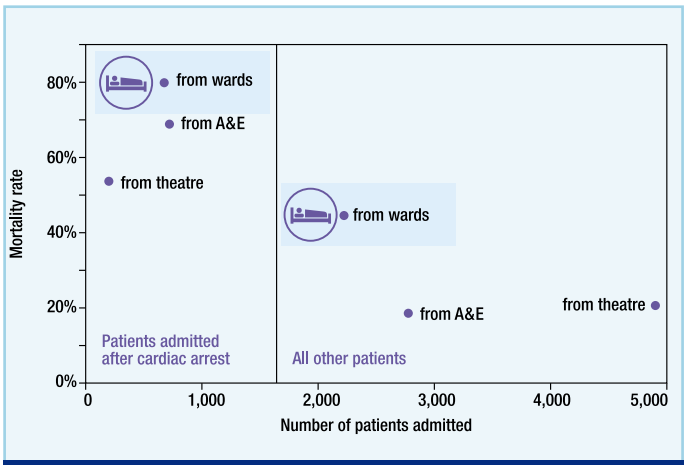


Figure 4: Mortality rates for patients admitted to ICUs from different sources[2]

Some patients in intensive care stay for several weeks and months, though most are discharged within a few days. In addition to treating the physical illness, clinical staff are relied upon to provide psychological and emotional support for relatives and patients. Overall mortality in intensive care is around 25%, but this varies between patients according to case mix and referral patterns (Figure 4).

2.2 Critical care under pressure

Critical care has had its fair share of publicity over the past few years, mainly due to the frequent and acute shortages of intensive care beds in the late 1990s that led to the Government's current drive to modernise critical care services.

To support the Government's modernisation programme for critical care, an additional £145m was allocated in 2000/01 by the Department of Health for adult critical care services, including £2.5m to support local service redesign. As a result, the NHS Plan target (set in 2000) of 30% more critical care beds by 2003 has been achieved. However, the main impact of these extra funds was to increase the number of level 2 critical care beds (Figure 5). Patients requiring level 2 support (high dependency) are less sick than those requiring level 3 (intensive care). There has been a slow, but progressive move to open high dependency beds to reduce the pressure on level 3 beds. However, changing patient demographics and expectation coupled with increasing staff shortages mean that future bed crises due to insufficient capacity are inevitable. The Society's members believe that such a crisis may well occur in the near future, especially during the winter months.

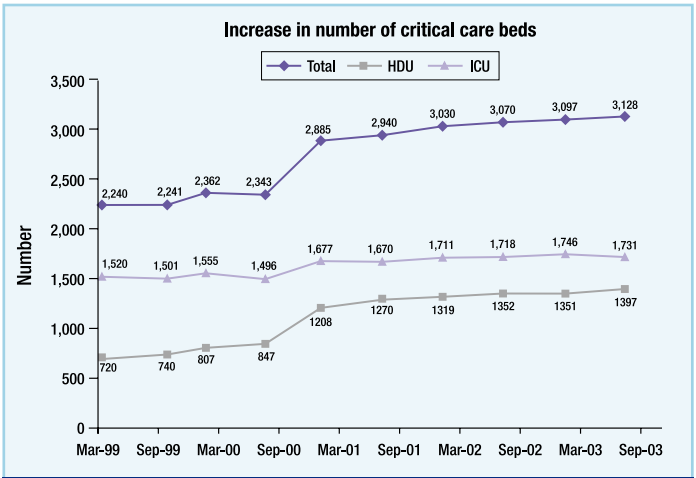


Figure 5: Number of critical care beds on census day[4]

Critical care areas can become the "backstop for a poorly performing hospital"[2] because there is a two-way interaction between these areas and the rest of a hospital. Rarely, critical care beds can be blocked with patients who should be on the general ward because they have been admitted unnecessarily. More commonly, critical care beds may be unnecessarily occupied because patients are unable to be discharged because of lack of ward beds. If critical care beds are full, elective major operations may need to be cancelled.

Due to pressure on critical care beds, it may be necessary to discharge patients at night, though research shows that patients discharged at night fare significantly worse than those discharged during the day.[5] Research has also shown that suboptimal care before admission to critical care areas is associated with increased morbidity, mortality and avoidable admissions.[6]

2.3 Funding for critical care

In 1962 The Department of Health proposed the "systematic grouping of patients according to their illness and dependence on the nurse, rather than by classification of disease or sex".[7] With this document came funding to establish critical care areas. The document also suggested that between 2% and 5% of a hospital's acute beds should be earmarked for care of patients who were severely ill or required specialist acute care. The most recent and extensive audit of critical care facilities in England and Wales was undertaken by the Audit Commission in 1998.[2] This found that the median size of an intensive care unit was 5.3 beds. However, there is wide variation between hospitals in the number of critical care beds (Figure 6).

The Audit Commission undertook its survey because services were viewed as "fragmented, expensive and under pressure". Also, due to the ad hoc way critical care services have developed over the decades, critical care resources have been poorly categorised. Consequently, the contracting process for NHS services has found it difficult to account for critical care.

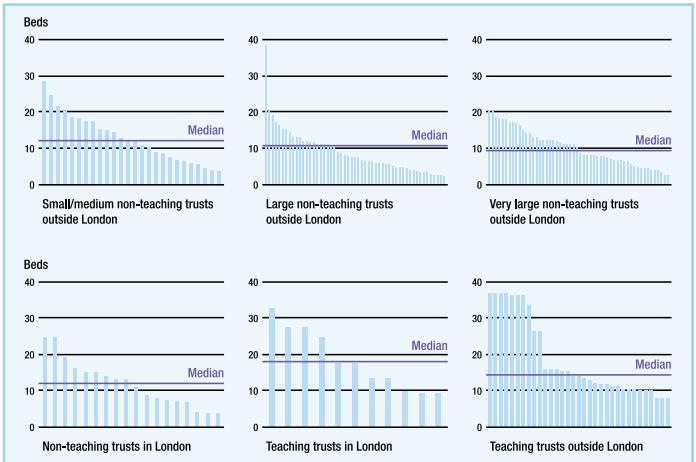


Figure 6: Variation in the number of critical care beds per 500 acute hospital beds based on 187 acute trusts[2]

The intensive care budget often falls within a directorate such as anaesthesia or theatres, although large units may have a separate budget. There has been no national plan for adult intensive care services and only limited regional planning of service configuration. A more formal structure for commissioning of critical care is needed, and indeed, work is underway at a national level to determine how resources used in critical care are identified and costed, a process that should lead to changes in the way critical care is commissioned and funded.

For example, critical care networks had been led to believe that £14 million would be "ring-fenced" by the Department of Health for critical care networks to bid against for service improvement projects in 2003. Networks put together bids that were sent centrally to be prioritised. However, in a letter to the networks early in 2003, Keith Young, Head of the Government's Emergency Care Strategy Team, wrote: "All of the £14 million central budget for critical care has been allocated to Primary Care Trusts as part of the general allocations made shortly before Christmas. This means that, as things stand at present, there will not be a separate central budget for critical care during the spending review period 2003-2006." It is not clear how much of this £14 million actually went towards enhancing critical care services.

2.4 Value for money?

Critical care is often seen to be expensive because there is an awareness of how much it costs to treat relatively few patients and that it requires high staff:patient ratios, intensive monitoring and therapeutic inputs. Edbrooke and colleagues[8] estimated the average cost per patient day in 11 ICUs was £1,000, suggesting that a critically ill patient costs six times more per day than a non-critically ill patient on the ward. Bennett and Bion[9] have estimated the cost per intensive care bed day at £1,000-£1,800, with salaries accounting for over 60%, pharmacy for 10%, and disposables for a further 10%.

However, according to Stockwell,[10] intensive care costs compare well with other treatments in the UK, when the longer term benefits of critical care are considered. His analysis suggests that the cost per additional life saved in critical care is £45,000, compared to a cost of £226,560 per additional survivor for treatment of hypercholesterolaemia with statins. Additionally, he compared intensive care costs with controlling hypertension with the ACE inhibitor, enalapril, arguing that the cost per life saved of £36,300 is not very different from that for intensive care.

2.5 Critical care across Europe

The UK spends less on healthcare than most other Western nations. Consequently, critical care has been neglected and under-resourced.[11] Within Europe, the UK has the smallest proportion of acute hospital beds allocated to critical care (Figure 7) and the intensive care units with the smallest number of beds. In a recent survey undertaken for the NHS Executive of 11 ICUs across Europe,[12] including two from the UK, the UK was confirmed to have the lowest levels of ICU beds per 100 acute hospital beds. This survey found, not surprisingly, that there was a greater problem with patient transfers between ICUs as a result of bed pressures than in most other countries.

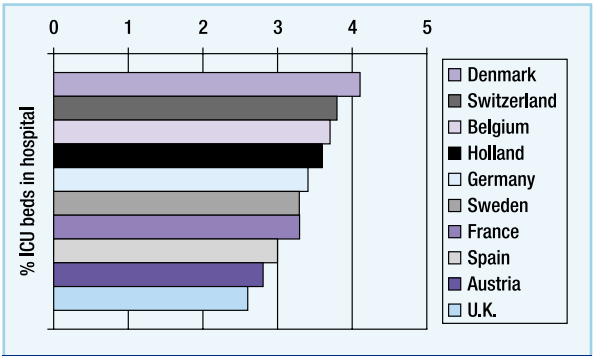


Figure 7: Allocation of resources for provision of critical care services[11]

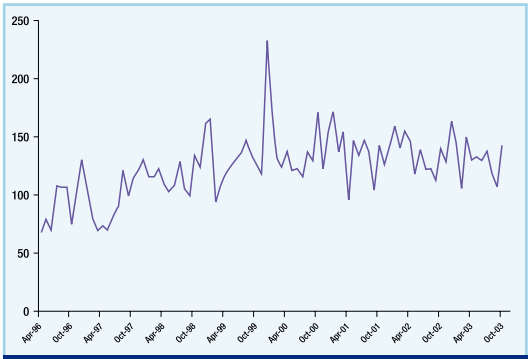


Figure 8. Monthly rate of interhospital transfers in the Northwest Region

The Eastern Region Transfer Project reported about one non-clinically indicated transfer per day in a population base of approximately three million in 2002, and recent data from the Modernisation Agency suggests that overall there are about 40 non-clinically indicated transfers of critically ill patients per week. Data from the Intensive Care Bed Information Service (IBIS) suggest that the frequency of transfers in the Northwest Region showed a steady increase between 1996 and 2001 (Figure 8). The availability of the additional funding provided in 2001 may have slowed or reversed this trend, but this is as yet uncertain. These transfers are usually due to critical care bed shortages within a hospital and critical care network, respectively, and suggest inadequate capacity.

3 Evidence-based critical care

One of the most important aspects of the evolution of intensive care in the UK has been a change in emphasis, from the intensive care unit as a location in which to gather critically ill patients, towards intensive care medicine as an evidence and knowledge base directed at providing for the critically ill throughout the hospital. Such evidence has changed critical care practice in several ways.

3.1 Optimising organ support

At the simplest level, we have optimised the way in which we conduct our traditional activity providing organ support. For example, research published three years ago showed that reducing the volume of breaths delivered by the ventilator (the tidal volume) resulted in a significant reduction in mortality in patients with acute lung injury and acute respiratory distress syndrome.[13]

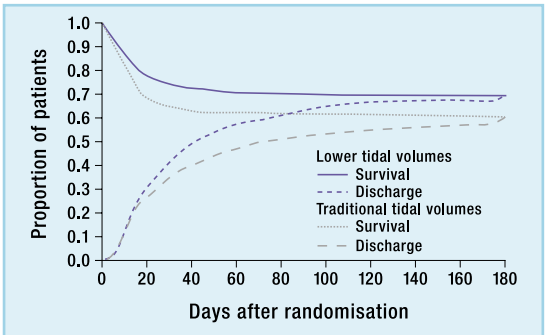


Figure 9. Probability of survival and of being discharged home and breathing without assistance during the first 180 days after randomisation in patients with acute lung injury and the acute respiratory distress syndrome.

3.2 Improving physiological homeostasis

More recent studies have confirmed the clinical impression that the tolerances for acceptable physiological control may be far more rigorous in critically ill patients than in healthy individuals or those with less severe illnesses. A recent controlled trial[14] showed that intensive insulin therapy to maintain normal blood glucose levels reduces mortality and morbidity among critically ill patients. Hyperglycaemia is common in critically ill patients, even in those who do not have diabetes, and it may directly or indirectly lead to complications such as severe infection and multiple-organ failure.

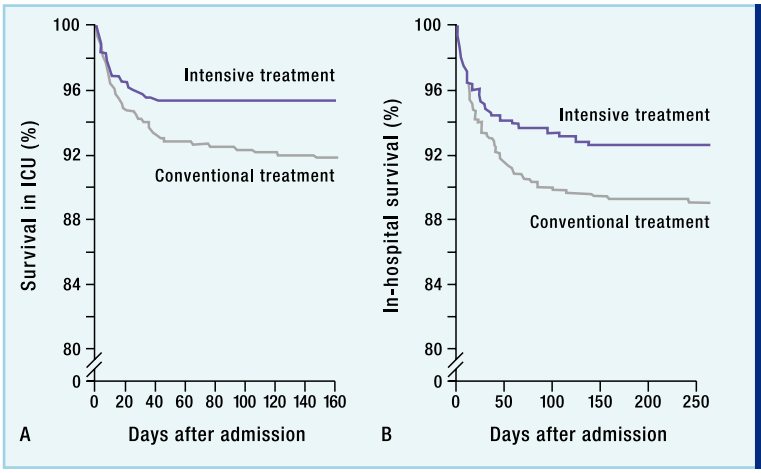


Figure 10. Kaplan-Meier curves showing cumulative survival of patients who received intensive insulin treatment or conventional treatment in the Intensive Care Unit (ICU).
Patients discharged alive from the ICU (Panel A) and from the hospital (Panel B) were considered to have survived. In both cases, the differences between the treatment groups were significant (survival in ICU, nominal P=0.005 and adjusted P<0.04; in-hospital survival, nominal P=0.01). P values were determined with the use of the Mantel-Cox log-rank test.

In other settings, however, physiological norms derived from healthy individuals may be inappropriate in the context of the physiological demands of critical illness. For some years, the role of haemodynamic optimisation in the care of the critically ill has been debated. The publication of a meta-analysis last year has confirmed that haemodynamic optimisation undertaken before organ failure occurs leads to a substantial and significant reduction in death.[15]

3.3 Targeting inappropriate host responses

Most recently, our fundamental understanding of the host response has lead to improvements in therapy of the sepsis syndrome, providing specific therapies directly aimed at the pathophysiology of critical illness, rather than the underlying disease.

Severe sepsis is said to exist when the body's systemic response to overwhelming infection results in acute dysfunction of at least one organ. It is triggered by a bacterial, viral, parasitic or fungal infection, and can result from trauma, surgery and burns, or illnesses such as cancer and pneumonia. The inappropriate host response that results in severe sepsis is costly, both in terms of patient outcome and treatment costs. The development of severe sepsis within 24 hours of ICU admission increases mortality by 15%, when compared to the average mortality rate for all adult general ICU patients.[16] The mean cost per case of severe sepsis in an ICU is £18,173 compared to a cost per case of non-sepsis of £3,828.[17]

Up until now, many potential therapies aimed at the host response in severe sepsis have failed to deliver positive results. However, the PROWESS trial,[18] published in 2001, showed that drotrecogin alfa (activated), a recombinant formulation of activated protein C with antithrombotic, profibrinolytic and anti-inflammatory properties, significantly reduced mortality in adults with severe sepsis. The trial demonstrated that drotrecogin alfa (activated) saved 6.1% more patients at 28 days than placebo (a relative risk of about 20%), and there was no significant difference in length of stay between drotrecogin alfa (activated) and placebo.

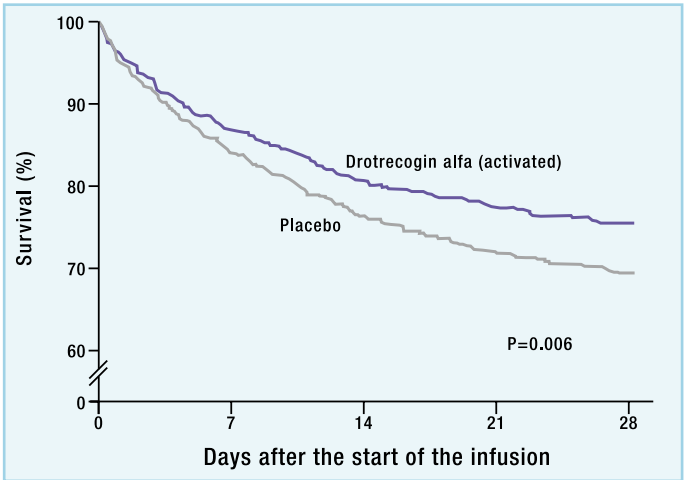
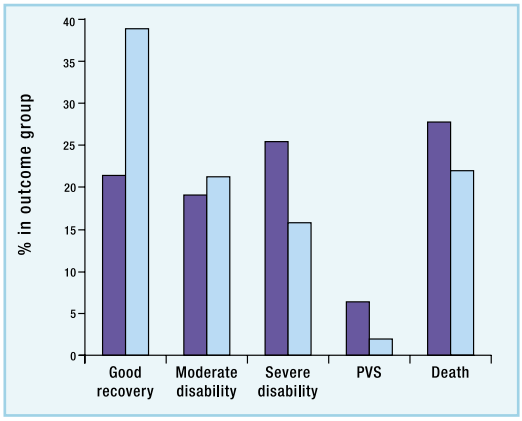


Figure 11. Kaplan-Meier estimates of survival among 850 patients with severe sepsis in the drotrecogin alfa (activated) group and 840 patients with severe sepsis in the placebo group. Treatment with drotrecogin alfa (activated) was associated with a significantly higher rate of survival (P=0.006 by the stratified log-rank test).

3.4 Organisational benefits from intensive care and intensivists



Finally, a clutch of papers have provided strong indications that intensivists, working in critical care units and delivering protocol driven therapy, can significantly improve clinical outcomes in a range of conditions as diverse as trauma, intracranial haemorrhage and general critical illness.[19, 20, 21]

Figure 12. Outcomes from severe head injury before (dark blue) and after (light blue) implementation of protocol guided critical care, coordinated by a specialist neurointensive care team.[21] The increases in good recovery rates, and the reductions in the incidence of severe disability and persistent vegatative state (PVS) are statistically significant (P< 0.05).

4 The Intensive Care Society

4.1 History and role of the ICS

The ICS was founded in 1970 to bring together clinicians whose main interest is caring for critically ill patients. Its membership today of around 2,500 is made up, in the main, of doctors, who obtain their initial specialist training in anaesthesia, medicine, or surgery. The Society also has a rapidly growing membership amongst nurses and allied health professionals and also NHS managers and other non-medical staff involved in critical care. The Society's primary role is education and research. It offers educational opportunities by organising two large scientific conferences a year, smaller focus meetings, and six local educational workshops held in hospitals around the UK. It facilitates educational activities and the maintenance of professional standards by liaising with the Royal Colleges of Anaesthetists, Surgeons and Physicians, and with the Intercollegiate Board for Training in Intensive Care Medicine.

4.2 ICS Council and structure

The ICS council is the organising and decision-making body and is composed of 10 elected members who are eligible for two terms of three years. It has representation from Scottish, Welsh and Irish Intensive Care Societies. The ICS also has a Trainees Division. Council members delegate the activities of the Society to one of several committees (Figure 13).

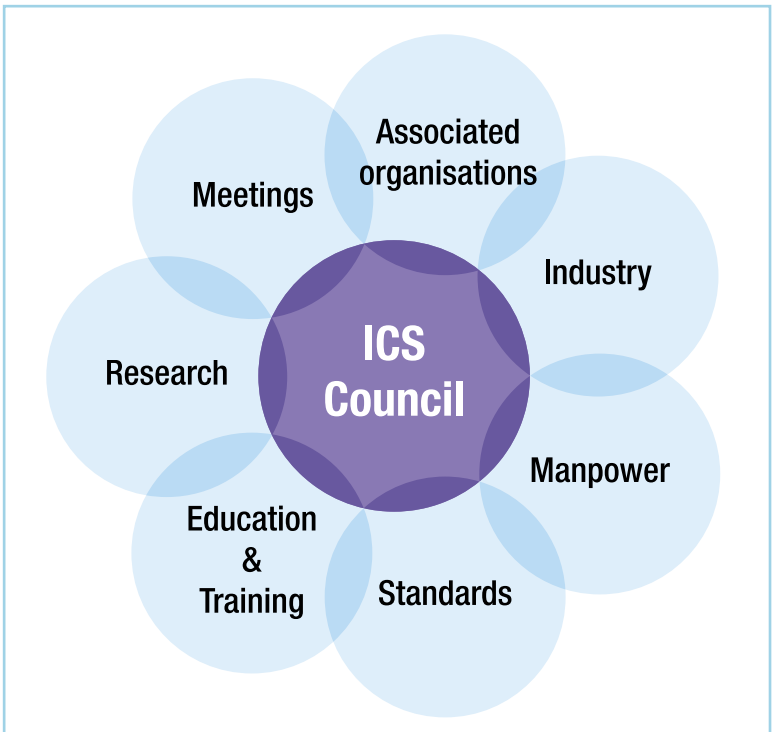


Figure 13. ICS Structure

Council of the Intensive Care Society (November 2003)

Saxon Ridley (Norfolk & Norwich University Hospital, Norwich)	President Chair Council Chair Executive Committee Chair Adverse Incidents Working Group
Peter Nightingale (Wythenshawe Hospital, Manchester)	Immediate Past President
Andrew Cohen (St James' University Hospital, Leeds)	Honorary Secretary
Carl Waldmann (Royal Berkshire Hospital, Reading)	Honorary Treasurer Chair Finance Committee Chair Meetings Committee Editor, JICS
Anna Batchelor (Royal Victoria Infirmary, Newcastle upon Tyne)	Chair, Education & Training Committee Chair, Local Education Workshops
Andrew Bodenham (Leeds General Infirmary)	Chair, Standards Committee
David Goldhill (Royal National Orthopaedic Hospital, London)	Chair, Patient Liaison Group
Richard Griffiths (Whiston Hospital, Merseyside)	Chair, Research Committee
Paul Hughes (Leeds General Infirmary)	Chair, Trainees' Division Committee
Roop Kishen (Hope Hospital, Manchester)	Chair, Manpower Committee
Peter Macnaughton (Derriford Hospital, Plymouth)	Council Member
David Menon (Addenbrooke's Hospital, Cambridge)	Council Member
Bruce Taylor (Queen Alexandra Hospital, Portsmouth)	Council Member
Robert Winter (Queen's Medical Centre, Nottingham)	Chair, Website Editorial Board

4.3 Achievements

Over its thirty-three year history the ICS has played an important role in establishing, maintaining and raising standards of treatment for critically ill patients (Figure 14). Its educational activities have contributed substantially to the training of the current generation of Consultants who run critical care units in the UK.

The Intensive Care National Audit and Research Centre (ICNARC) was originally set up by the Society to conduct a nationwide programme of clinical audit in intensive care. The Casemix Programme allows each participating unit to compare its performance over time and with other units. ICNARC has now matured into an internationally respected organisation, independent of the Society, with a strong research programme.

Figure 14. Examples of the material published by the ICS in recent years

The Society is the largest UK sponsor of critical care research, and supports research activities in several ways. This ranges from small awards, which encourage educational travel or act as pump priming grants for young clinicians, to a major research programme commissioned by the ICS and lead by the Society's Director of Research.

4.4 The future

We have achieved an enormous amount, but much remains to be done. The critical care community confronts enormous clinical and organisational challenges as we strive to deliver the best possible care that we can to all of our patients. In addition, we need to address the cost-benefit and ethical issues that are the consequence of advancing technology. We should aim to intervene not just because we can, but because doing so improves survival and quality of life for patients who survive critical illness.

However, we are also presented with great opportunities. Systematic clinical research will allow us to optimise current interventions in a rigorous manner, and develop and carefully evaluate novel therapies. Importantly, these may increasingly be aimed at the deranged host responses that contribute to organ failure in critical illness. Success in this area may allow us not just to treat the underlying disease, but also arrest the processes that make patients critically ill. Finally, the lessons learnt from genetic medicine provide the exciting prospect of carefully tailoring therapy for individual patients, thus maximising benefits and reducing risks. These are exciting prospects, but they require clinical science on a large scale, with multidisciplinary input and carefully organised research. Individual doctors or intensive care units working in isolation cannot conduct such science.

The framework that the Society provides represents an excellent context for developing better organisation and delivery of critical care, ensuring that we continue to train the high quality health care professionals that the critical care community needs, and conducting large scale clinical studies that have the statistical power to produce definitive advances in patient management.

The Society aims to maintain a key contribution in these areas. We will continue to promote a multi-disciplinary approach to critical care, to improve the profile of critical care with patients, other hospital services and within the NHS in general. The Society will offer professional support and advice for practicing clinicians, develop new services and better liaison for patients, and enhance the science and art of intensive care through its educational and research activities. These aspirations will, in part, be embodied in the establishment of an ICS Foundation, which will strive to provide a scientific evidence and research base for the specialty, and act as a centre for advice and guidance.

5 Further information

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http://www.ics.ac.uk

www.doh.gov.uk/compcritcare/index.htm	The Department of Health's report, *Comprehensive Critical Care*
www.scottishintensivecare.org.uk	The Scottish Intensive Care Society
www.icnarc.org	The Intensive Care National Audit and Research Centre
www.audit-commission.gov.uk	The Audit Commission's report, *Critical to Success*
www.criticalcareinfo.org	A resource for critical care nurses, provides information to print off for friends and relatives of patients in critical care

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