Evaluation of the Modernisation of Adult Critical Care Services in England

Research Report

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prepared by

Andrew Hutchings

- Health Services Research Unit, London School of Hygiene & Tropical Medicine

Mary Alison Durand

- Health Services Research Unit, London School of Hygiene & Tropical Medicine

Richard Grieve

- Health Services Research Unit, London School of Hygiene & Tropical Medicine

David Harrison

- Intensive Care National Audit & Research Centre (ICNARC)

Judith Green
- Health Services Research Unit, London School of Hygiene & Tropical Medicine

John Cairns
- Health Services Research Unit, London School of Hygiene & Tropical Medicine

Kathy Rowan
- Intensive Care National Audit & Research Centre (ICNARC)

Nick Black
- Health Services Research Unit, London School of Hygiene & Tropical Medicine

Address for correspondence

Andrew Hutchings

Health Services Research Unit

London School of Hygiene & Tropical Medicine

Keppel Street

London

WC1E 7HT

E-mail: andrew.hutchings@lshtm.ac.uk

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Acknowledgements

Glossary

Care bundle	A group of guidelines that, when implemented and monitored together as a group, produce better outcomes than would be the case with individual implementation
Comprehensive Critical Care	The review of adult critical care services published by the Department of Health in England in May 2000. The report outlined a modernisation programme focusing on the organisation and delivery of critical care.
High dependency care	Comprehensive Critical Care defines level 2 care as the level of care for "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." The Department of Health calculates available high dependency bed numbers as those capable of providing level 2 care.
Intensive care	Comprehensive Critical Care defines level 3 care as the level of care for "patients requiring advanced respiratory support alone or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure." The Department of Health calculates available intensive care bed numbers as those capable of providing level 3 care.
Modernisation Agency	The organisation created in April 2001 by the Department of Health with the remit of co-ordinating modernisation at a national level by providing help in redesigning services, support the spread of best practice, and stimulate change at a local level. The Modernisation Agency was reconfigured in July 2005 as the NHS Institute for Innovation and Improvement.
Network, Critical Care	Geographically-based networks involving several trusts working to common protocols and standards. Each network would have responsibilities for needs assessment and

planning critical care services, encouraging the development of services, and agreeing critical care standards and protocols and how they should be audited.

Outreach, Critical Care | The provision of support outside the critical care unit with the aims of (i) averting admissions by identifying patients at risk of deterioration and either preventing admission or ensuring timely admission; (ii) enabling discharges by providing support to patients discharged from critical care areas to enable their continuing recovery on wards and after discharge from hospital; and (iii) sharing critical care skills.

Track and trigger | Physiological track and trigger warning systems aim to ensure timely recognition of patients with potential or established critical illness and timely attendance by appropriate staff. The track component involves observation of a patient's selected vital signs, which subject to pre-specified criteria, would trigger a call for assistance from more experienced staff.

Ventilator bundle | A care bundle for preventing ventilator-acquired pneumonia in critical care comprising four components: elevation of the head of the bed to 30-45 degrees; management of sedation through daily sedation vacations and daily assessment of readiness to extubate; peptic ulcer prophylaxis; and deep vein thrombosis prophylaxis.

Acronyms

CCDG	Critical Care Delivery Group
CEA	Cost-Effectiveness Analyisis
CMP	Case Mix Programme
CMPD	Case Mix Programme Database
DGH	District General Hospital
HDU	High Dependency Unit
HRQoL	Health-Related Quality of Life
ICNARC	Intensive Care National Audit and Research Centre
ICU	Intensive Care Unit
INMB	Incremental Net Monetary Benefit
LOS	Length of Stay
NMB	Net Monetary Benefit
PDSA	Plan Do Study Act
QALY	Quality Adjusted Life-Year
VAP	Ventilator Associated Pneumonia

The Report

1 Introduction

In May 2000 the Department of Health in England published *Comprehensive Critical Care: A review of adult critical care services* which advocated the need to 'modernise' services. Two months later, the Department published its long-term vision and commitments for health care in general, *The NHS Plan*, which included a 30 percent increase in the number of adult critical care beds. To achieve this, an additional £145m a year commenced in 2000/01 with a further £154m in 2001-02 and 2002-03, resulting in an overall increase of £299m a year.

Responsibility for transforming services was given to the newly created NHS Modernisation Agency's Critical Care Programme. This ran for four years (from 2000 to 2004) and a key element was the establishment of 29 geographically-based critical care networks made up of the hospitals providing critical care.

Towards the end of the Critical Care Programme, in 2004, the Department of Health's Policy Research Programme approached the Intensive Care National Audit & Research Centre (ICNARC) to explore the feasibility of evaluating the impact of changes in adult critical care. ICNARC co-ordinates a national clinical audit (the Case Mix Programme) of outcomes for patients admitted to adult critical care units in England, Wales and N Ireland since 1995. The existence of high quality data, in the Case Mix Programme Database, on admissions both before and during the period of critical care modernisation, provided a unique opportunity to undertake a rigorous quantitative evaluation of the impact of the changes that have taken place since 2000. There were no other areas of health care in which such an investigation could have been undertaken.

In addition, it was important to conduct a qualitative study that could inform the design of the quantitative study, help interpret the findings and, most importantly, reveal the impact of modernisation on the organisation of services, on staff and on organisational culture.

In summary, the aim of this study was to evaluate the impact of modernisation and increases in capacity on the provision, use and outcomes (including cost effectiveness) of critical care, and to explore the impact of modernisation on the organisation, delivery and culture of critical care.

2 Background and context

2.1 Modernisation and the NHS in England

In 1997 the newly elected government published its White Paper *The new NHS: modern, dependable* setting out their long term strategy for the NHS which aimed to 'provide new and better services to the public' (Department of Health, 1997). The White Paper stated:

> "This is an ambitious programme which cannot happen overnight. It will be achieved over ten years with demonstrable improvements each year. We have already made a start. The process of modernisation began on May 2nd, the day after the election."

There was an emphasis on 'driving change in the NHS' centred around four themes: raising quality standards, increasing efficiency, driving performance, and new roles and responsibilities (Department of Health, 1997).

These aims were reinvigorated three years later when the Department published *The NHS Plan* (Department of Health, 2000a) which set out the government's plans for investing in and reforming the delivery of services. It cited a lack of national standards and performance incentives, over-centralisation, barriers between services, outdated demarcations between staff groups, and disempowered patients as contributing to the need for reform (Department of Health, 2000a). It also acknowledged that the spread of best practice was often slow and that NHS organisations received little external support in redesigning services. It emphasised the need to "redesign care around the patient" in order to deliver high quality services.

To help overcome these perceived problems, the Department of Health created a new organisation, the Modernisation Agency, to provide help in redesigning services, support the spread of best practice, and stimulate change at a local level. A key element was to be the re-design of service organisation and delivery in order to prioritise patients' and carers' needs and ensure that services functioned better for staff (Gollop *et al*, 2004). Planned investments included an increase of 2100 beds in general and acute wards over the following three years. The introduction of new national service standards was described, as were new contracts for medical staff, the expansion of nursing and other staff roles, the establishment of primary care trusts to commission both health and social care, the introduction of the patient choice agenda, and a reduction in health inequalities. More specifically, objectives included reducing waiting list times, and improvements in services for the elderly and those suffering from cancer, heart disease and mental health problems.

Organisational changes and developments, designed to facilitate implementation, were described the following year in *Shifting the balance of power within the NHS: Securing delivery* (Department of Health, 2001a). New roles for primary care trusts, NHS trusts, strategic health authorities and the Department of Health itself were outlined. The delivery strategy was to be programmatic and transformational (Bate *et al*, 2004). National Service Frameworks were drawn up which provided service standards for managing and treating people with coronary heart disease, mental health problems, cancer, older people's services and paediatric critical care. The National Institute for Clinical Excellence (NICE), now the National Institute for Health and Clinical Excellence, which had been established in 1999, was to provide evidence-based recommendations about new treatments and procedures, and the Commission for Health Improvement (now the Healthcare Commission) was set up to provide external inspection and regulation.

Turning specifically to adult critical care, in 1999 the Department of Health had set up a review with the aim of developing a national framework for the organisation and delivery of services and setting standards for staffing, transfer levels and levels of provision. This built on recently completed work by the Audit Commission which had outlined the role of critical care within the acute NHS hospital and had made recommendations for improvements (Audit Commission, 1999). The Department's views, contained in *Comprehensive Critical Care: a review of adult critical care services* (Department of Health, 2000b) published in May 2000, appear to have influenced The NHS Plan, which appeared two months later. The latter pledged the government to increase the provision of adult critical care beds by 30 percent and to the establishment of the Modernisation Agency.

2.2 Comprehensive Critical Care

Comprehensive Critical Care: a review of adult critical care services (Department of Health, 2000b) outlined a modernisation programme focusing on the organisation and delivery of critical care, and in particular (i) the integration of critical care with a range of other acute services in the hospital; (ii) the establishment of integrated networks involving several trusts working to common protocols and standards; (iii) a planned approach to workforce development; and (iv) the promotion of a data collecting culture designed to build a firm evidence base for the work of critical care services.

Comprehensive critical care was to be seen not simply as a new name for intensive care, but as a new specialty based on severity of illness ("the complete process of care for the critically ill which focuses on the level of care that individual patients need rather than on beds and buildings") and which would impact not only on intensive care and high dependency care as they then existed but also on the delivery of acute care as a whole, leading to the concept of 'critical care without walls' (Hillman, 2002). A new classificatory system was introduced to identify the needs of patients. These were:

level 0 - patients whose needs can be met through normal ward care in an 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 basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure.

(Department of Health, 2000b)

Supplementary classifications would be used to identify patients requiring specialist investigation and treatment such as neurosurgical or cardiac surgical care. Other proposals were grouped under four headings: (i) organisation within NHS trusts; (ii) organisation between NHS trusts; (iii) human resources; and (iv) standards and guidelines.

2.2.1 Organisation within NHS trusts

Recommendations concerning the organisation of critical care services within trusts included the establishment of a trust-wide Critical Care Delivery Group with a designated Executive Director taking lead responsibility for critical care services. Other recommendations related to the content of the service with respect to outreach, facilities, hospital bed management, and long-term follow-up of critical care patients. The report highlighted the role of outreach services as being integral to comprehensive critical care and identified three essential objectives.

- Outreach services that aim to avert admissions to critical care by identifying patients at risk of deterioration and either preventing admission or ensuring timely admission. The approaches used to identify such patients outside critical care areas are commonly referred to as physiological track and trigger warning systems (Gao *et al*, 2007a). The track component involved observation of a patient's selected vital signs, which subject to pre-specified criteria, would trigger a call for assistance from more experienced staff.

- Outreach services to enable discharges (by providing support to patients discharged from critical care areas to enable their continuing recovery on wards and after discharge from hospital.)

- Sharing of critical care skills with other staff on wards and in the community.

The report stated that outreach services should be provided by a multidisciplinary team with both clinical critical care skills and the ability to

share their skills with other staff in an effective way. However, the report did not identify any specific model for how outreach should be provided.

Comprehensive Critical Care recommended that beds should be staffed flexibly and that there should be a shift from the traditional use of rigid nurse staffing ratios for patients requiring level 2 and 3 care. It also recommended that all critical care bed provision should be in adjacent locations and that all level 2 and 3 beds should be equipped with appropriate monitoring and other life support equipment. With respect to bed management the report recommended that the hospital/trust bed manager should have responsibility for critical care within the context of the hospital to ensure timely critical care discharges to appropriate locations, consideration of the impact of hospital admission pressure on critical care, communication between the hospital and the lead clinician for critical care, and implementation of policies from the Trust-wide Critical Care Delivery Group. Finally, trusts should review their policies for following-up patients after hospital discharge.

2.2.2 Organisation between trusts

The report made two recommendations regarding organisation between trusts. First, regional offices in the NHS should work with trusts to develop networks that would bring providers and commissioners together to develop critical care in their geographical area. The networks should operate at a lower level than the existing NHS regions and boundaries should be appropriate to the provision of critical care rather than necessarily following administrative boundaries. Each network would have responsibilities for needs assessment and planning critical care services, encouraging the development of services, and agreeing critical care standards and protocols and how they should be audited.

The second recommendation aimed to reduce the number of long distance transfers of critical care patients that were taking place for non-clinical reasons. Non-clinical transfers should only take pace within networks following discussion and agreement between consultants.

2.2.3 Human resources

Recommendations concerning human resources focused on nursing, medical, therapy and resource staff. The findings from the related *Review of Adult Critical Care Nursing* (Department of Health, 2000c) were incorporated and included the recommendations that patient dependency rather than bed numbers should form the basis for staffing in critical care and that an integrated strategy for the recruitment and retention of critical care nurses should be produced by each local health economy. In addition, a modular framework of courses should be developed based on the continuum of critical care provision. In terms of medical staff, it was recommended that an assessment be made of medical workforce needs in the context of comprehensive critical care rather than just intensive care medicine. Furthermore, and in the longer term, all consultants in intensive care medicine should have undertaken specialist training and possess the

specific competencies recommended by the relevant Royal Colleges, and every critical care service should ensure that every weekday session is covered by a consultant.

2.2.4 Standards and guidelines

The report recommended that all trusts should develop policies, guidelines and protocols that are appropriate in the following areas: admissions and discharges; the transfer and transportation of critically ill patients; information for patients, their relatives and friends; and the organisation of organ donation. Policies should be based on standard guidance provided by the Department of Health and other organisations such as the Intensive Care Society, the Association of Anaesthetists of Great Britain and Ireland, and the Royal College of Nursing.

2.3 The NHS Modernisation Agency

The NHS Modernisation Agency was created in April 2001 with the remit of co-ordinating modernisation at a national level. (The Modernisation Agency was reconfigured in July 2005 as the NHS Institute for Innovation and Improvement). The focus of the Agency's work was service modernisation and improvement both within individual organisations and across health care economies. The Modernisation Agency defined modernisation as "making improvements that patients can sense, touch and feel" and as involving the three core strands of 'renewal', 'redesign' and 'respect' (Matrix MHA, 2004). Modernisation (and the tools and skills for undertaking service improvement) was to be delivered to local areas through knowledge management, national improvement programmes, and the provision of tailored support to organisations.

- Knowledge management involved the identification, development and dissemination of effective practice through national programmes, publications (e.g. Improvement Leader Guides) and developing individual capacity.

- National improvement programmes included 'collaboratives' (e.g. the Cancer Services Collaborative Improvement Partnership) which focused on service-wide issues and/or particular illnesses or types of patients, as well as leadership programmes and programmes designed to develop partnership working.

- Tailored support to organisations that received a 'zero star' performance rating, failed to meet their priorities and planning framework targets or had an adverse review by the Commission for Health Improvement (Matrix MHA, 2004).

Modernisation was conceptualised as consisting of a series of stages: recognition that change is required; desire to change; diagnosis; preparing and planning to implement change; implementation; and ongoing review (Matrix MHA, 2003). Three phases in modernisation were identified: (i) nationally driven with a programme focus; (ii) locally driven with a

programme and project focus; and (iii) locally driven with a mainstream focus (Matrix MHA, 2003). Modernisation initiatives were expected to impact first on organisational capacity, secondly, on clinical and non-clinical outputs, and thirdly, on clinical and non-clinical outcomes (Matrix MHA, 2004). The 'improvement themes' which fell within the Agency's remit were grouped as: cross-cutting (including access, 10 High Impact Changes, clinical systems improvement etc); service (e.g. acute services, ambulance services, primary care, mental health etc); clinical (e.g. critical care, dermatology, neurology, heart disease, dentistry etc); workforce (using staff skills effectively, attracting staff and retaining and developing staff); and tools and techniques such as methods of continuous quality improvement.

NHS improvement "relied mainly upon a nationally initiated, programme-by-programme approach to service change and development" (Bate *et al*, 2004). Fundamental to the modernisation and service improvement agenda were the establishment of new, or the use of existing, geographically based service networks and the application of the Plan-Do-Study-Act (PDSA) service improvement methodology (Ketley & Bevan, 2007) at a local level. The first component of the PDSA technique involves setting aims, defining how achievement of the aims can be measured, and what can be changed to make an improvement. The second component comprises Planning and Doing the change, Studying or measuring the impact of the change, and Acting on planning the next change cycle or implementing the change.

In 2004 the Modernisation Agency published *10 High Impact Changes for Service Improvement and Delivery* (NHS Modernisation Agency, 2004). This report highlighted service improvements that had resulted from the Modernisation Agency's work with clinical teams. Examples included treating day surgery as the norm for elective surgery for specific procedures and the use of process templates to optimise patient flows through services.

2.4 The Modernisation Agency's Critical Care Programme

The Critical Care Programme was originally established in September 2000 (as part of the National Patient Access Team) to implement the proposed modernisation outlined in Comprehensive Critical Care, with the emphasis on the establishment of integrated service provision through critical care outreach within hospitals and the development of local critical care networks, as well as on workforce planning and the collection of reliable management information and data. The ultimate goal of the programme, as stated on the Modernisation Agency's website, was "to improve access, experience and outcomes for patients with potential or actual need for critical care". Specific aims were:

- prediction of demand and forward planning across the service

- hospital-wide identification and assessment of critically ill patients

- effective, humane and equitable care to those in need

- appropriate care in the right place at the right time and given by the right people

- continuous review of systems to pursue improvements for patients

- support for teams working in the service's critical care specialties.

It was anticipated that by the end of the two-year programme every hospital with critical care facilities would have undertaken an improvement project, co-ordinated by the project lead in their local network, and following the PDSA cycle. A total of 29 critical care networks were established to support modernisation and all NHS trusts in England that provided critical care belonged to a network. By the end of 2004 the Modernisation Agency website included details of 721 local service improvement projects, ranging from 6 to 78 per network.

While the Programme initially had a completion date of September 2002, its duration was extended to September 2004. In addition, of the initial £145m extra resources for adult critical care, £2.5m was intended to support local service redesign with the remaining £142.5m distributed to NHS regions to support the modernisation of services and increase level 2 and level 3 critical care capacity for winter 2000/01.

A number of key stakeholders (including the Department of Health) subsequently produced more detailed strategies and action plans for the implementation of the various initiatives and activities recommended. In relation to the development of outreach services the Intensive Care Society published *Guidelines for the Introduction of Outreach Services* (2002). This was followed in 2003 by the Modernisation Agency's (2003) report *Critical Care Outreach 2003: Progress in Developing Services*. This aimed to highlight good practice and offer practical guidance given that it had found wide variation in how outreach was being delivered across England.

One particular approach taken by the Critical Care Programme was the use of care bundles. The original concept of care bundles emerged from the United States as part of the Idealized Design project for intensive care (Resar *et al*, 2005). This approach had been promoted by the Institute for Healthcare Improvement in the United States. A care bundle is a group of guidelines that, when implemented and monitored together as a group, produce better outcomes than would be the case with individual implementation (NHS Modernisation Agency, 2004). For example, the ventilator care bundle for preventing ventilator-acquired pneumonia in critical care comprises four components: elevation of the head of the bed to 30-45 degrees; management of sedation through daily sedation vacations and daily assessment of readiness to extubate; peptic ulcer prophylaxis; and deep vein thrombosis prophylaxis (Resar *et al*, 2005). Other care bundles include the central venous line bundle to prevent infection (Robson, 2006) and the sepsis resuscitation and management bundles (Gao *et al*, 2005).

The Modernisation Agency set out five steps for implementing a care bundle: agreement by clinical and non-clinical professionals to measure processes of care; selecting a small group of elements to measure;

developing local guidance including indications and exceptions; regular monitoring with timely feedback; and discussion on potential further improvements to processes (NHS Modernisation Agency, 2004). The Agency provided general support to critical care networks and trusts implementing bundles, with a particular focus on the ventilator bundle. It was the ventilator bundle that featured as one of the 10 high impact changes in 2004 (NHS Modernisation Agency, 2004). The ventilator bundle also featured prominently in the Institute for Healthcare Improvement's 100,000 Lives campaign in the United States (Berwick *et al*, 2006; McCannon *et al*, 2006).

Critical care staffing, and in particular nurse staffing, has received a considerable amount of attention since the Audit Commission's (1999) report, which noted that "Developments in critical care – especially in ICUs – are changing the nursing role by involving nurses more in decisions to alter treatment levels to maintain or attain desired goals. Changing the scope of nursing practice can limit demands on trainees, which is important as their hours reduce".

Recommendations made in the Review of Adult Critical Care Nursing (Department of Health, 2000c) were incorporated into Comprehensive Critical Care (Department of Health, 2000b). In 2001, the Department of Health published a strategic action programme for the nursing contribution to the provision of adult critical care services covering (i) service delivery and organisation; (ii) clinical effectiveness and research and development; (iii) education, training and workforce development; (iv) career pathways, recruitment and retention; and (v) leadership development (Department of Health, 2001b).

Additional guidance for nursing staff in critical care has also been provided by the Royal College of Nursing (2003). The Royal College argues that "The best people to decide on nursing staffing levels are senior critical care nurses themselves, who have the skills and experience in assessing patient need. As well as measuring individual patient dependency, other aspects of nursing care must be taken into account in determining nursing requirements – for example, the skill mix of nurses and other staff, the needs of patients' relatives and friends, the number of patient transfers taking nurses away from the ward, risk management and patient safety."

The College recommended that managers should work closely with those providing pre- and post-registration education to ensure that the workforce is educated to meet the needs of critical care services and that new staff in critical care are provided with network-wide induction packages incorporating core competencies. It also notes that health care assistants, while making an important contribution to critical care services, should only provide direct patient care under the supervision of a registered nurse, and should not "be used to reduce the level of skilled care available to save costs." Furthermore, Glen (2004), in a paper reviewing the policies that have driven health care reforms in general, argues that new ways of working in acute and critical care should not simply involve delegating doctors' responsibilities to nurses. She suggests that "a clear definition of

competence and national standards of knowledge required to practice" are needed for nurses working in critical care and that for the Government's modernisation agenda to be realised there needs to be a culture change in higher education institutions, professional organisations and workforce development confederations:

> "Fitness for purpose for the next generation of health professionals is being conceptualised in policy documents in terms of shared core knowledge and competencies, team working, flexibility, and potential skills transferability"

A review of the literature from 1990 to 2003 on workforce planning for critical care was conducted to inform the work of the Critical Care Workforce Sub-Group (Williams *et al*, 2003) The findings suggested that there was a need to develop 'interdisciplinary approaches to new ways of working' in critical care services. In 2002 *The Role of Healthcare Professionals within Critical Care Services* was published (NHS Modernisation Agency, 2002) followed two years later by *The Recruitment and Retention of Staff in Critical Care* (Department of Health, 2004a) which describes local and national practices and initiatives on education and training, role re-design, and service improvement that have been implemented to address some of the recruitment and retention issues facing staff providing critical care services.

There have been many other policy changes in the NHS that are likely to have had some effect on the provision of critical care services in England:

- In 2000 the first nurse consultant posts were established in critical care and other areas and the role of the modern matron role was introduced.

- The first four hospital at night pilots started in 2003 and by 2005 over two dozen hospitals had implemented the concept of hospital at night for out of hours cover (Department of Health, 2005a). The original aim of hospital at night was to reduce reliance on training grade doctors providing night cover and ensure compliance with the European Working Time Directive on working hours through multidisciplinary teams providing clinical care outside normal hours.

- Critical care staff pay, terms and conditions would have been affected by the new consultant contract in 2003 and Agenda for Change in 2004 (Department of Health, 2004b).

- In 2004 delayed discharge fines were introduced which allowed NHS trusts to be reimbursed for costs of patients who could not be discharged from hospital due to failures by social services.

However, the introduction of payment by results in 2005 did not directly affect critical care.

The final year of the Critical Care Programme saw the establishment of the Adult Critical Care Stakeholder Forum in April 2004. The Forum has a membership of around 30 drawn from the Department of Health, Intensive Care Society and several Royal Colleges. In 2005 the Forum's report *Quality*

Critical Care: Beyond 'Comprehensive Critical Care' (Department of Health, 2005b) highlighted the importance of critical care, provided examples of good practice, and described quality indicators that should underpin service delivery. The report stated that the Critical Care Programme had been "successful in delivering significant service improvements" but also noted that early improvements in reducing inappropriate critical care transfers had not continued and had improved little since 2002. Specific recommendations included:

- providers of critical care services should adopt appropriate care bundles and other standards of care;

- critical care networks should be retained and developed in accordance with local requirements;

- hospitals should develop a standard approach to detecting and treating critically ill patients on general wards including the development of outreach to a 24 hours a day, seven days a week service;

- roles should be redesigned and new roles developed to improve patient care.

Thus it can be seen that the modernisation agenda supported by the Critical Care Programme did not end with its closure in 2004. Indeed, one of the key features of the Modernisation Agency's approach was to avoid 'improvement evaporation' by ensuring the sustainability of organizational change (Buchanan & Fitzgerald, 2007).

2.5 Overview of the research literature on critical care organisation and modernisation

To date much of the research on the organisation of critical care has focused on patient outcomes and has been quantitative in nature. Several reviews have drawn together findings from these studies. Carmel and Rowan (2001) reviewed 54 empirical studies on the relationship between organizational factors and variation in intensive care unit outcomes. The majority of studies were observational (only 3 randomised trials) and reported findings from the studies suggested some effects of organisational factors on case-mix adjusted outcomes. There was a tendency for improved outcomes associated with greater medical staffing intensity and intensivist-led critical care provision. By contrast the eight studies looking at nursing autonomy and intensity reported little evidence for improved outcomes. A systematic review of staffing patterns and outcomes in critically ill patients (Provonost *et al*, 2002) identified 26 observational studies meeting their inclusion criteria. The authors compared high-intensity staffing (an intensivist-led critical care service or mandatory intensivist consultation) compared with low-intensity staffing (no intensivist or voluntary intensivist consultation). The meta-analysis found lower hospital mortality (risk ratio 0.71, 95% confidence interval 0.62-0.82) associated with high-intensity staffing. However, one recent study of over 100,000 patients in 123

intensive care units in the United States showed higher case mix adjusted mortality in patients treated by intensivists (Levy e*t al*, 2008).

The National Institute for Health and Clinical Excellence (2007) carried out a review of the timing of critical care transfers and discharges that formed part of the guideline *Acutely Ill Patients in Hospital: Recognition of and Response to Acute Illness in Adults in Hospital*. The review found that transfer or discharge of patients from critical care areas at night was associated with increased hospital mortality and a higher rate of readmission to intensive care.

A rapid review of the workforce literature undertaken by Williams *et al* (2003) in order to inform the work of the Critical Care Workforce Sub-Group set out to appraise the safety, effectiveness and costs of different models of organising critical care and describe the 'policy contexts and secular trends surrounding substantive shifts in approaches to organising critical care services internationally'. The findings from 55 studies identified suggested that in assessing the safety, effectiveness and costs of different models of organising critical care there is a need to go beyond measures of mortality and survival and to be concerned about longer term outcomes for patients and their carers. A review of studies of the impact of critical care pharmacy services (Papadopoulos *et al*, 2002) suggests that the presence of a critical care pharmacist service has measurable benefits including reduced adverse drug events and errors, lower overall costs, and decreased mortality and morbidity.

There is comparatively little research that reports on the impact of critical care 'modernisation' activities per se. One exception is the introduction of critical care outreach services in England which has been evaluated in a SDO-funded study led by the ICNARC. A survey of hospitals conducted as part of the study found wide variation in how outreach services were provided (McDonnell *et al*, 2007). Responses were received from 191 (80%) out of 239 hospitals surveyed and indicated that 72 percent of hospitals had an outreach service that provided direct bedside clinical support from critical care staff on adult wards, 78 percent of hospitals had an outreach service that followed up patients discharged from level 2 or 3 facilities to adult wards, and 85 percent of hospitals used an early warning track and trigger system to identify patients on wards at risk of deterioration.

The study included a systematic review of track and trigger warning systems that identified a wide variety of track and trigger systems in use (Gao *et al*, 2007a). The 36 reviewed studies all had some methodological limitations and evaluation of 15 datasets that did meet pre-defined quality criteria indicated that track and trigger had low sensitivity (median 43.3%) and low positive predictive value (36.7%) for identifying patients in need of critical care.

Another systematic review from the same study examined the impact of critical care outreach services and found limited evidence for reductions in mortality and unplanned admissions and mixed evidence for impact on length of stay with the introduction of outreach (Esmonde *et al*, 2006). Only two of the 23 studies were randomised trials: a single hospital study from

England reported a significant reduction in mortality (odds ratio 0.52) and a multi-centre study from Australia reporting no reduction in unexpected deaths (odds ratio 1.04).

A further component of the study examined the impact of introducing critical care outreach services (Gao *et al*, 2007b) using data on 108 units (79 of which had introduced critical care outreach support) from ICNARC's Case Mix Programme. The results showed that the provision of outreach was associated with a significant reduction in the proportion of patients receiving cardiopulmonary resuscitation before admission to a critical care unit (odds ratio 0.84, 95% confidence interval 0.73-0.96), admission outside normal working hours (odds ratio 0.91, 95% confidence interval 0.84-0.97) and lower physiology scores following admission. However there was no significant difference found for unit mortality or mortality in patients discharged alive from units.

There is less evidence on the impact of implementing the ventilator care bundle (as opposed to the individual components that make up the bundle) in critical care and the studies that have been published have major methodological limitations. A study of 61 hospitals in the United States and Canada found that in the 21 hospitals that had at least 95 percent compliance with the bundle following implementation the rate of ventilator associated pneumonia (VAP) fell from 6.6 to 2.7 per 1000 ventilator days (p<0.001) (Resar *et al*, 2005). Similar reductions in VAP were observed in a two-hospital (Youngquist *et al*, 2007) and a single hospital study (Jain *et al*, 2006) from the United States. Another study in a single hospital in the United States reported that rates of VAP did not decline with implementation of the bundle components alone but did decline with daily auditing and weekly feedback (Cocanour *et al*, 2006). In England a study in one hospital reported a shorter length of stay and duration of ventilation following implementation of the bundle but no evidence for a difference in crude unit mortality (Crunden *et al*, 2005). Finally, a single centre study of 288 patients from the United States reported a reduction in the average number of ventilator days and length of stay (Hampton *et al*, 2005). This study also reported a greater than 50 percent reduction in mortality but provided no further information on how this reduction was estimated.

The changing roles of critical care staff have also been the focus of a number of recent studies. The potential role of the health care assistant in critical care, for example, has received some attention (e.g. Hind *et al,* 2000; Hogan and Playle, 2000; Wainwright, 2002; Sutton *et al*, 2004), as have those of the pharmacist and dietician (e.g. Windle, 2007; Papadopoulos *et al*, 2002). The role of the nurse consultant has also been studied (e.g. Fairley, 2003; Dawson and McEwen, 2005; Dawson and McEwen, 2006; Fairley and Closs, 2006; Dawson and Coombs, 2008). The findings of a national postal survey (Dawson and McEwen, 2005) of the 72 critical care nurse consultants in post in England by August 2003 revealed that those who responded (52; 72%) were clinically experienced and highly educated. While leading the development of care for the critically ill outside the traditional boundaries of the ICU, they had less direct involvement with patient care on the ICU. The findings suggested that the respondents were

highly involved with "practice and service development roles, but with progressively less involvement in expert practice, education, training and development and leadership and consultancy functions." They also had low involvement with strategic organisations such as the Department of Health, strategic health authorities and primary care trusts, which Dawson and McEwen suggested might limit the development of their role. Dawson and McEwen (2006) also reported that a subset of the above sample had a significantly greater involvement with outreach services than others, and suggested that the benefits and drawbacks of their involvement should be assessed, given the lack of evidence for outreach. A follow-up survey by Dawson and Coombs (2008) revealed that there has not been a substantial increase in the number of critical care nurse consultants in post between 2003 and 2006. The study found that in terms of their core roles, nurse consultants are highly involved in practice and service development, including the evaluation of practice, and have an increasing involvement in a leadership capacity with the audit and clinical nursing research agendas. There has also been a shift towards more engagement with strategic input at a trust or organisational level, and with education and development on the ICU itself. However, there has been a decrease in their involvement in expert practice roles.

A 10-site study by Ball and McElligott (2003) focusing on the issues associated with care delivery by nurses in critical care, and involving 231 nurse interviews and 51 relative interviews during 33 'observation participation' periods, found that the context of the critical care unit (e.g. layout, activity, patient case mix and staff skill mix) had a major impact on nurses' ability to aid the recovery of critical care patients. The meaning of 'caring' to ICU nurses has also been studied (e.g. Wilkin and Slevin, 2004), as have the ethical issues facing nurses working in critical care (e.g. Bunch, 2001; Melia, 2001). A longitudinal qualitative study of nurses new to working on the ICU (Farnell and Dawson, 2006) identified four key themes in their experiences, which the researchers described as support, knowledge and skills, socialisation, and moving on, while a small qualitative study by Cox *et al* (2006) highlighted the complexities for trained nurses in managing critically ill patients on wards; these included issues to do with the clinical environment, patient assessment, professional relationships, and the individual nurse's educational and development needs. In light of the Modernisation Agency's recommendation that speech and language therapists have a role to play in the assessment and management of critical care patients with communication difficulties, barriers to and strategies for improving communication on the critical care unit were identified in a small multi-centre pilot study investigating staff and patient perceptions and experiences of communication on the unit (Magnus and Turkington, 2006). The study recommendations included the early identification of patients with communication difficulties and exploring possibilities for training communication link nurses.

A survey of staff perceptions of the impact of critical care outreach services on patient care in one critical care network (1303 questionnaire distributed to staff on duty on one particular day, with a 52 percent response rate)

revealed that the majority of respondents believed that outreach enhanced patient care (Plowright *et al*, 2006). Respondents felt that outreach helped to facilitate referrals to critical care, with 93 percent reporting that the involvement of the outreach team speeded up patients' transfers to critical care, while 98 percent of the respondents felt that patients benefited from the follow-up support. A study by Baker-McClearn and Carmel (in press), involving 100 semi-structured interviews with acute hospital staff who were either members of, or came into contact with, the outreach services in eight English hospitals found that outreach was perceived to have had two main impacts on the delivery and organisation of hospital care. Firstly, it was seen to impact on the organisation of care and to result, for example, in more timely provision of critical care and fewer referrals, including averting inappropriate admissions to the ICU, as well as in improved communication between nurses working on the wards and medical teams. Secondly, it was perceived to have a positive impact on the confidence and skills of ward nurses and junior doctors, empowering them through education and training and providing reassurance and support to them in their caring for seriously ill patients. However, it was also suggested that the presence of outreach teams may be deskilling junior doctors, and concerns existed about the sustainability of improvements in clinical skills among ward staff. Baker-McClearn and Carmel conclude that while they have had a beneficial impact on the organisation and delivery of care in the acute setting, outreach services face a tension between delivering a service and providing education.

Carmel's (2003) ethnographic study of the organisation of work in intensive care identified a number of strengths of the organisational culture of critical care. Features that he identified included the following: strong clinical leadership; identification with, and loyalty to, the unit by medical and nursing staff; and positive, functional interactions between the different professionals (the working partnership/relationship between senior nurses and junior doctors being particularly strong). He suggests that the manner in which work in critical care is organised (and the 'craft' of critical care is practiced) is a function of strong boundaries around the unit, an overlap in the ideologies of the medical and nursing staff, and the focus of the technological aspect of care. He notes that there are four ways in which the work in ICUs is unlike that in other 'locations' of medical practice, in that "patients are, more than in any other are of clinical practice, physical bodies rather than social patients" (p 152); "the materiality of the environment is evident" (p 152); "patients come with a range of 'diagnoses'" (p 152); and "the 'evidence base' is regarded by practitioners as particularly poor" (p 153).

Carmel (2006a) posits that 'convergence' and 'incorporation', rather than 'competition', characterise the relationship between the medical and nursing professions in intensive care and that this is exemplified by a joint allegiance to the unit rather than to professional colleagues working in other locations. He argues that "an occupational division of labour is rhetorically and practically obscured, while an organisational division is rhetorically and practically reinforced" (p 155). Carmel (2006b) also elaborates on the

'caring role' of the nurse in ICU (care being focused not only on the individual's social self but also his/her social contexts – e.g. family and friends) and the overlapping roles and philosophies of the medical and nursing care professions in ICU. However, Carmel's study was undertaken prior to the implementation of the modernisation programme, and there is currently a knowledge gap concerning how health care professionals and other key stakeholders view the impact of the recent changes on the organisation, delivery and culture of adult critical care.

2.6 Evaluating the modernisation of adult critical care services

In 2004 the Department of Health Policy Research Programme approached ICNARC to conduct a small study to look at the feasibility of evaluating the modernisation of adult critical care services. The study's objectives included: clarification of the aims of an evaluation; identification of data requirements and sources; a review of relevant documents (some of which have been referred to); meetings with stakeholders; and the identification of the activities that had occurred during modernisation and what the impact of these activities had been.

The latter two objectives were achieved through consultation with stakeholders. First, a facilitated group discussion was held with 10 members from the Modernisation Agency's critical care team. Second, 23 members of the Adult Critical Care Stakeholders' Forum responded to open questions about their awareness of activities to modernise critical care and the impact of modernisation. They included representation from the Department of Health, Royal Colleges, the Patients' Association, the Intensive Care Society, the British Association of Critical Care Nurses and others involved in modernisation activities (e.g. service improvement leads, nurses leads, medical leads, allied health professionals, independent health care representatives).

Some activities were identified by several participants (Table 1), although there was some debate about whether increasing capacity was part of 'modernisation'. There was more variation in what participants reported in terms of impact. Many of the reported impacts could be grouped under changes in ways of working (e.g. critical care without walls). Process measures, such as fewer transfers, reduced length of stay, improved efficiency and better access, were more frequently reported than outcomes. There was uncertainty as to whether there had been any impact on health outcome (in terms of mortality). Several participants mentioned improvements in the quality of care generally without referring to specific aspects of quality.

At the Stakeholders' Forum another issue that emerged was that the development of outreach services and 'critical care without walls' had resulted in a lack of clarity in the boundary between critical care and other acute care, and uncertainty as to the role of critical care staff (e.g. as a training/support provision or taking greater responsibility for care outside

the unit). As one participant put it, there was a feeling that critical care was now 'shoring up' the rest of acute services.

Table 1. NHS and critical care modernisation policies

Modernisation Activities	Impact
Increase in capacity	Change in culture/ways of working
Outreach	Improvement in quality of care
Networks	Fewer transfers
Care bundles (clinical practice guidelines)	Reduction in length of stay
	More patients treated
Changes in roles and responsibilities/ways of working	Improved access
	Better collaborative working
plus many local service improvement projects	Improved efficiency
	Boundary between critical and acute care outside the critical care unit unclear

We also sought from Modernisation Agency staff their views as to concurrent policy changes that may have had an impact on critical care. The major factors identified were the introduction of targets (such as Accident and Emergency waiting times), clinical governance, the European Union Working Time Directive, the new consultant contract, staff shortages and increases in overseas recruitment.

In identifying the activities that constitute 'modernisation', the exercise highlighted the difficulty in defining which changes since 2000 were part of 'modernisation'. For example, the increase in capacity (critical care beds and staff) was included by many participants as a 'modernisation' activity although it was not a feature of *Comprehensive Critical Care* (which focused on the organisation and delivery of care) nor part of the remit of work of the Modernisation Agency. A second issue was the extent to which 'modernisation' activities and their impact could be attributed to the work of the Modernisation Agency.

2.7 Aim and objectives

Given the uncertainties and debate among stakeholders as to what constituted 'modernisation', it was felt that any evaluation should not restrict itself to any a priori definition of the term. Instead, the research should focus on the period from 1998 to 2006 during which several key changes occurred, most notably a significant increase in funding and provision and the establishment and work of the Modernisation Agency's Critical Care Programme (Figure 1). The principal elements of the latter were the establishment of critical care networks, the introduction of care bundles, and the implementation of outreach services in hospitals.

While many other activities took place locally, it was clear from the feasibility study that they were so diverse and heterogeneous it would be impossible to measure them and include them in a quantitative analysis.

Given there was no explicit 'modernisation' activity in Wales and N Ireland, and no significant increase in funding in 2000-03 in those jurisdictions, a sample of hospitals was identified with which to compare the English experience.

Figure 1. Peak periods of implementation of modernisation activities and capacity expansion
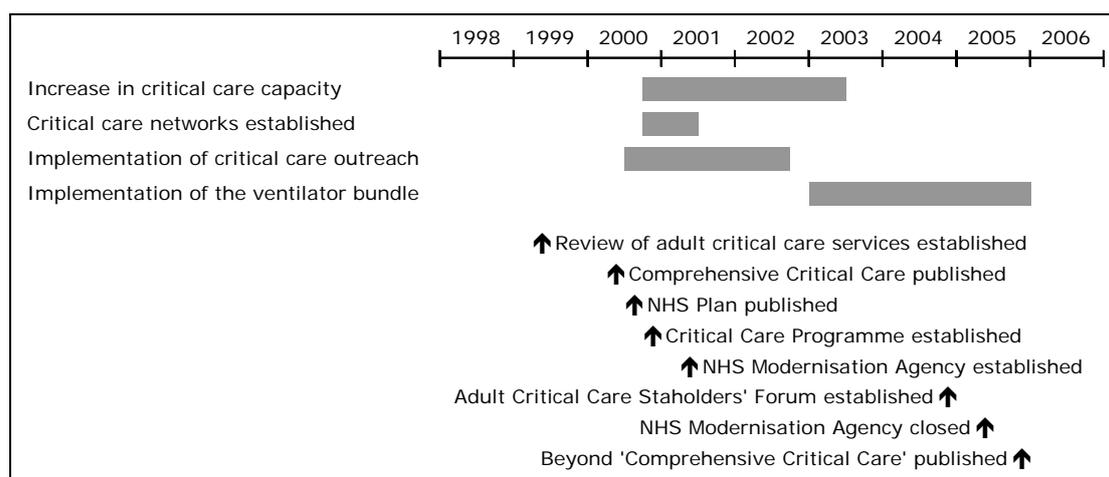
The aim of the research was therefore to determine the impact that the three major features of modernisation and the increase in funding had on adult critical care.

The objectives of the research were:

(i) to describe the trends from 1998-2006 in inputs, organisation, processes and outcomes of critical care in a representative sample of hospitals;

(ii) to explore associations of such trends with the three major features of modernisation and the increase in funding;

(iii) to undertake an economic evaluation of the costs and impact of the key modernisation activities and increase in capacity;

(iv) to compare changes and associations observed in England with experiences in a sample of hospitals in Wales and N Ireland;

(v) to explore the impact of modernisation on the organisation, delivery and culture of critical care.

3 Quantitative study of the impact of critical care modernisation

3.1 Introduction

This section of the report addresses objectives (i) to (iv) of the research. The overall study design was to relate changes in the inputs (structure) and organisation of adult critical care in England between 1998 and 2006 to changes in the processes and outcomes of care. Inputs included the numbers of beds and costs; organisational factors considered were critical care networks, use of the ventilator care bundle, outreach services and local improvement projects. The processes (activities) included changes in case-mix, rates of reported transfers, and discharge practices. And the outcomes included critical care unit and ultimate hospital mortality, and some proxy outcomes including length of stay and readmissions.

3.2 Methods

3.2.1 Data sources

Several sources were used, each of which is described below. However, one particular source provided much of the data on inputs, processes and outcomes - the ICNARC Case Mix Programme Database (CMPD). The Case Mix Programme (CMP) is a national comparative audit of outcomes of adult critical care admissions (Harrison *et al*, 2004) with participation by most units in England, Wales, and Northern Ireland. According to an independent review using the Directory of Clinical Databases criteria for clinical databases (Black and Payne, 2003), the CMPD is nationally representative, high quality clinical database with a mean rating of 3.4 (on a 1-4 scale in which 4 is the maximum score for each of 10 criteria measuring coverage, reliability, and validity).

Inputs (structure)

Critical care beds

In England, the Department of Health has been collecting trust-level data since 1999 using KH03a returns. These identify the number of available intensive care and high dependency beds by location in the trust (general units, specialist units, and those located outside units) on two census days each year. The timing of data collection changed in 2000 from March and September to January and July. In addition, data on high dependency beds located in specialist units started to be included.

The second source of data on available bed numbers (for participating units) is ICNARC. In addition, estimates of the number of occupied beds in

participating units at any point in time were derived from the CMPD. A third source of data is the NHS reference costs (Department of Health, 2008) which provided the number of critical care bed-days at trust level.

Costs

Unit costs for critical care were taken from the NHS reference cost database (1998/99 to 2005/06).

Organisational factors

Performance of Critical Care Networks

Data on ratings of the performance of the 29 critical care networks were obtained from the Modernisation Agency. Ratings were based initially on each network's self-assessment and by visits to the network by Modernisation Agency staff. Ratings were performed five times, from the final quarter of 2002 and throughout all quarters in 2003. Network implementation was rated for each of ten items on a five point scale (1 not met; 2 action needed; 3 action occurring; 4 fully met; 5 surpassed) producing a total score of 10-50. The ten items were:

- total engagement with the acute trust, primary care trust and strategic health authority boards

- projects are seen and demonstrated to be mainstream

- a Critical Care Delivery Group is in place

- network management arrangements are in place

- the network has a strategic an operational and a quality plan in place

- there is a balanced team

- links are demonstrated to other programmes

- the network has the ability to function independently

- local sharing events are organised

- information collected within the network is timely, informative, and constructive, and reported nationally

The criteria used to assess each item are listed in Appendix 1. Networks were categorised by the Modernisation Agency according to their total score: excellent (score in range 41-50), ready to receive (33-40), developing (24-32), at risk (16-23), or significant risk (10-15).

Implementation of the ventilator care bundle

Data on the implementation of the ventilator care bundle were obtained from a mailed survey of all general critical care units in England, Wales and N Ireland participating in the CMP at November 2007 (Appendix 2). The questionnaire sought information on whether a unit had implemented the entire bundle and, if so, the date of implementation. Implementing the bundle requires regular audit of compliance with the individual components and units were also asked to report their compliance for each year, with

compliance categorised as >90%, 75-90% or <75%. The survey also sought to identify units that had partially implemented the bundle or used an alternative protocol for the prevention of ventilator-associated pneumonia.

Critical care outreach services

Data on the provision of outreach services were collected from a questionnaire distributed to hospitals in England in February 2005 as part of an evaluation of critical care outreach services (project SDO/74/2004). Completed questionnaires were received from 191/239 (80%) of hospitals and results have been reported (McDonnell *et al*, 2007). For this study, data on three key outreach services were used: (i) the provision of direct bedside clinical support on adult wards from critical care staff; (ii) follow-up of patients receiving level 1 care on adult wards after discharge from critical care; and (iii) the use of an early warning or track and trigger system to identify patients outside critical care who were at risk of deteriorating.

Local service improvement projects

An original aim of the study was to use data on local service improvement projects collected by the Modernisation Agency. Their database included details of 721 projects. However, lack of completeness of project details, concerns regarding non-reporting, and difficulties in attributing projects to individual units and trusts were a concern and it was decided not to make further use of these data.

Processes

Case-mix

Data on the case-mix of patients admitted to critical care units were obtained from the CMPD. This included data collected on the first 24-hours of a patient's admission on their age, sex, diagnosis, history of comorbidity, source of admission, acute physiology, organ failure, and predicted risk of death.

The reason for admission to a CMP unit is recorded using the ICNARC Coding Method (Harrison *et al*, 2004). The standard five level hierarchical method classifies admissions by the type of condition (if the condition requires surgery), the body system, the anatomical site, the pathological/physical process, and the condition.

Discharge practice

Discharges at night were identified using the time of discharge in the CMPD for all patients discharged alive from a unit and were defined in two ways: discharged between 22:00 and 06:59; and discharged between 00:00 and 04:59 (Goldfrad and Rowan, 2000). For comparison a daytime discharge was defined as between 07:00 and 21:59.

Data on reported early discharges and delayed discharges due to a shortage of ward beds were extracted from the 'reason for discharge from the unit' field in the CMPD.

Discharges home or to normal residence were identified from the 'destination following discharge from your unit' field in the CMPD.

Outcomes (and intermediate outcomes)

Length of stay

The CMP derives the unit length of stay for each admission from the date and time of admission and discharge. Unit length of stay is defined as the total length of stay in the CMP unit including any readmission during the same hospital stay. The hospital length of stay for each admission is derived from the dates of admission and discharge from the CMP hospital.

Readmissions during the same hospital stay

All admissions within the CMP are identified as either an initial admission or as a readmission during the same hospital stay. Readmissions within 24 and within 48 hours of discharge were identified using a unique patient identifier.

Unit and hospital mortality

The CMPD provides data on both unit and ultimate hospital mortality. Unit mortality is defined as survival status before discharge from the CMP unit. Ultimate hospital mortality is defined as survival status before ultimate discharge from hospital (including any transfers from the CMP hospital to another acute hospital).

3.2.2 Analysis

There were five components to the analyses: description of trends in inputs (structure); description of organisational changes; description of trends in processes (activities) and analysis of association with inputs and organisational changes; description of trends in outcomes (and proxy outcomes) and analysis of association with inputs and organisational changes; and cost-effectiveness of the impact of any associations detected. In addition, the impact of one specific intervention, the ventilator care bundle, was considered in greater detail.

In each component, two principal approaches were taken: the period before the start of 'modernisation' in England in 2000 was compared with the period after; and comparisons were made with non-English units (in Wales and N Ireland). The latter was inevitably limited as data were available for only 11 critical care units in those jurisdictions.

Datasets

The overall approach to the analysis draws on the timing of key events during the modernisation of adult critical care services in England. The year 2000 can be regarded as the key point with the publication of Comprehensive Critical Care, the announcement of a substantial investment to increase critical care capacity for winter 2000/01, and the establishment of the Modernisation Agency's critical care programme. Analysis therefore

focuses on two time periods: from the start of 1998 to the final quarter of 2000, that represents the pre-modernisation period, and from the final quarter of 2000 to the end of 2006, that represents the era of 'modernisation'.

The number of units participating in the CMP increased over the years so not all units include data on admissions for the pre-modernisation period. Also, a few units stopped participating. By the end of 2007, 179 general critical care units in England, Wales and Northern Ireland had contributed data on 509,451 admissions to critical care. In order to maximise the use of available data, two datasets were identified based on the periods for which data were available:

1998-2006

Units with data for both periods (i.e. started participating in the CMP before the end of 1998 and still participating at the end of 2004). Patients in eligible units were included in analyses if they were admitted between 1998-2006. CMP units outside England were excluded because only four met the criteria.

2000-2006

Units with no data for the pre-modernisation period (i.e. started participating in the CMP before the end of 2000 and still participating at the end of 2004). Patients in eligible units were included in analyses if they were admitted between 2000-2006. CMP units outside England were included to allow comparison between units in and outside England.

Two critical care networks had no member units in the CMP so only 27 networks were represented. Figure 2 summarises the CMP data used in the analyses. For 1998-2006, data were available on 349,817 admissions in 96 units in 25 networks. For 2000-2006, there were data on 309,686 admissions in 115 units, including 104 units in England from 27 networks.

Figure 2.   Summary of data used in main analyses

	England	Non-England
Networks	27	n/a
Units	160	19
Admissions	461,984	47,467

1998-2006

	England	Non-England
Networks	25	-
Units	96	-
Admissions	349,817	-

2000-2006

	England	Non-England
Networks	27	n/a
Units	104	11
Admissions	278,890	30,796

Operationalisation of organisational changes

One approach to classifying organisations is based on how early they are to adopt an innovation (Berwick, 2003). Organisations follow a normal distribution over time whereby 'innovators' represent the first 2.5% of organisations to adopt an innovation, followed by 'early adopters' (the next 13.5%), the 'early majority' (34%), the 'late majority' (34%) and the 'laggards' (the last 16%).

With data on only 27 networks it was not possible to use so many categories. However, it is possible to draw on this approach to classify networks as either 'earlier adopters' or 'later adopters'. For networks the 'earlier adopters' were those networks that achieved 'ready to receive' status or better at the Modernisation Agency's first assessment. 'Later adopter' networks were those that did not achieve 'ready to receive' status until later assessments by the Modernisation Agency.

Critical care units were classified as either 'earlier adopter' or 'later adopter' as an indicator of 'modernisation' based on if and when they implemented critical care outreach and the ventilator bundle. 'Later adopter' units were defined as units that had not implemented a critical care outreach service (either provision of direct bedside clinical support on wards or follow-up of patients on wards after discharge) by the end of 2003 and/or had not implemented the ventilator bundle by the end of 2005. Units that had implemented both outreach and the ventilator bundle by these dates were classified as 'earlier adopters'. Units that completed only one or other of the outreach and bundle surveys were classified using their response to the survey they did complete.

Units were also categorised by the extent of their increase in capacity in the period 2000 to 2004. The categories were increases of: <20%, 20-50%, and >50%.

Case-mix adjustment

In 2007 a new risk prediction model (the ICNARC model) was developed and tested, and shown to outperform existing models in UK critical care admissions (Harrison *et al*, 2007). The components of the ICNARC model comprise physiological score, age, diagnostic categories, interactions between diagnostic categories and physiology scores, cardiopulmonary resuscitation prior to admission, and source of admission which are used to derive predicted mortality.

Impact of changes on processes and outcomes

Chi-square tests and correlation coefficients are used to examine the impact of changes in inputs and organisational factors on processes and outcomes. Firstly, crude trends in processes are plotted graphically for units in England for the period 1998-2006 and for units outside England for the period 2000-2006.

Secondly, the trends for process measures pre-modernisation are compared with those during the modernisation period using regression analysis.

Logistic regression is used for dichotomous dependent variables to estimate odds ratios and their 95% confidence intervals for the average annual change in each time period. Linear regression is used for continuous dependent variables to estimate mean change per year and its 95% confidence intervals for each time period. The two time periods are fitted as an interaction to test if the trends differ between the two periods. The time periods are based on quarterly data adjusted for quarterly seasonality. Case-mix is adjusted for using predicted mortality from the ICNARC model and units are included as random effects to allow for clustering of admissions within units.

Similar regression analyses are used to test whether trends during the modernisation period differed between units in England and units outside England. For these analyses an England/non-England:time interaction is included instead of a pre-modernisation period: modernisation period interaction.

This same regression analysis approach is also used to evaluate the impact of three features of modernisation: whether units were earlier or later adopters; whether units were located in earlier adopter or later adopter networks; and the unit's increase in bed numbers between 2000 and 2004. Limited to units with data from 1998-2006, interactions were fitted between each time period and each modernisation variable in order to test whether trends in outcome were associated specifically with any particular modernisation variable.

Cost-effectiveness analyses

The aim of the economic evaluation was to describe costs and outcomes for patients admitted to critical care units in the period 1998-2006. The relative cost-effectiveness of the period of 'modernisation' in England after 2000 compared with the period before was estimated using trends in costs and outcomes up to and after 2000. The evaluation followed current methodological guidance (National Institute of Clinical Excellence, 2004) by using quality adjusted life-years (QALYs) projected over a patient's lifetime as the outcome measure. The evaluation took a hospital perspective and included all hospitalisation costs incurred after admission to critical care including days on general wards and any transfers to other hospitals or readmissions to critical care. Unit cost data are only available for English NHS Trusts so the economic evaluation was undertaken using data from English critical care units.

As the critical care units participating in the CMP were either standalone ICUs or combined ICUs/HDUs, the most appropriate reference cost category was the cost per ICU bed-day. For the financial years 1998-2003, a single unit cost for ICU bed-days was available for each trust, whereas for 2004 and 2005, ICU unit costs were subdivided according to the level of care (1, 2 or 3). For the latter two financial years the unit costs for each trust were taken as the mean across these categories weighted by the relative number

of bed-days in each category.[1] The unit cost for general wards was taken as the weighted average for all Healthcare Resource Groups (HRGs) for non-elective bed-days from NHS reference costs. All unit costs were inflated to 2006-7 prices using the HCHS price index (NHS Executive, 2007).

The costs for each individual patient were calculated by multiplying their length of stay in critical care (including readmissions during the same hospital stay) by the trust-specific unit cost. The costs in general wards were calculated by multiplying the patient's LOS by the average cost per bed-day from reference costs. The costs incurred in critical care and on general wards were summed to give each patient's episode costs. Following current recommendations costs were discounted at a rate of 3.5% (National Institute of Clinical Excellence, 2004).

To calculate lifetime QALYs requires information on the long-term survival and health-related quality of life (HRQoL) for ICU survivors. Those patients who died in hospital were assigned a QALY of zero. For ICU survivors it was necessary to extrapolate their life expectancy. The evidence base for whether long-term survival is worse for ICU survivors than the general population is fairly weak and inconclusive (Wright *et al*, 2003; Keenan *et al*, 2002; Williams *et al*, 2008). The base case analysis, made the conservative assumption that the life expectancy for ICU survivors is 80% that of the age and gender matched general population (Office for National Statistics, 2004). Similarly, there is some evidence to suggest that HRQoL is lower for ICU survivors (Cuthbertson *et al*, 2005), and so general population values for HRQoL (Kind *et al*, 1999) were down-weighted by 20%. The lifetime QALYs combining life expectancy and HRQoL were reported for each patient. As above, QALYs were discounted at a rate of 3.5% (National Institute for Clinical Excellence, 2004).

The incremental cost-effectiveness of modernisation is reported as the Incremental Net Monetary Benefit (NMB) (Hoch *et al*, 2002). NMBs were calculated for each patient by valuing any QALYs gained at £20,000 per QALY which is the willingness to pay below which NICE describes interventions as 'relatively cost-effective' (National Institute for Clinical Excellence, 2004). The individual's costs were then subtracted from this overall measure of gain to give their NMB (Hoch *et al*, 2002).

The economic evaluation used regression models to describe LOS, costs and QALYs over time. The models included separate components of the ICNARC risk prediction model as independent variables to allow for changes in case-mix over time and dummy variables to allow for seasonal effects. The models were specified with random effects to allow the estimated effects and the standard errors to recognise the clustering of data within critical care units. The models reported the annual change in mean LOS, costs,

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[1] In 2006/7 NHS reference costs made a more fundamental change to the classification system and unit costs were reported according to different numbers of organ failures for each ICU bed-day. To minimise methodological inconsistencies, 2005-6 unit costs were applied to 2006 resource use data.

QALYs and NMB for the pre-modernisation (1998-2000q4) and modernisation (2000q4-2006) periods.

The regression analysis estimated the incremental effects of modernisation on LOS, costs, QALYs as the mean annual change following the introduction of modernisation. These effects were estimated by including a dummy variable defining a 'modernisation by time period' interaction term. The cost-effectiveness analysis then used the same model with NMB as the dependent variable to report the Incremental NMB associated with modernisation.

Evaluating implementing the ventilator care bundle

The impact of implementing the bundle on hospital mortality was assessed using a logistic regression model. Units both in and outside England (and their admissions from 2000q4 to 2006q4) were included in the analysis. The model was adjusted for components of the ICNARC model and seasonality. Time was fitted on a quarterly basis and unit:time interactions were included without main effects for units to allow each unit a different trend in mortality. Units were included as random effects after centring the time variable to allow for the clustering effect of admissions within units. A three month interruption post-implementation was applied by excluding admissions in the three months following any implementation of the bundle. A binary bundle variable (0=not implemented, 1=implemented) was included for each admission depending on whether a unit had implemented the bundle at the time of each patient's admission. A separate variable was included for each patient's ventilation status (whether or not they were ventilated within the first 24 hours of admission). A bundle:ventilation interaction was included in order to estimate the impact of implementing the bundle for (i) patients ventilated within 24 hours; and (ii) patients not ventilated in the first 24 hours.

The economic evaluation assessed the cost-effectiveness of implementing the bundle. This cost-effectiveness analysis (CEA) used the same general approach as the economic evaluation of modernisation described above. Briefly, costs were measured from a hospital perspective by applying reference costs to resource use data from the CMP database. Survival data on admissions to CMP units in England were extrapolated to give lifetime QALYs. The cost-effectiveness analysis used the binary bundle variable described above for admissions to CMP units in England from 2000q4 to 2006q4 to compare resource use, costs and outcomes before and after units fully implemented the bundle after allowing for a three-month interruption post-implementation.

Incremental costs and effects were estimated as the difference in the mean costs and QALYs before and after bundle implementation. Net Monetary Benefits were calculated as above. The CEA then reported the incremental cost-effectiveness of introducing ventilator care bundles as the Incremental NMB (Hoch *et al*, 2002).

Linear regression models fitted by maximum likelihood were used to estimate QALYs, costs, and NMB after adjusting for components of case mix

and seasonality. Quarterly trends from unit:time interaction terms were included as fixed effects and units were included as random effects. The basic models included an interaction between bundle implementation and ventilation status.

The sensitivity of the hospital mortality, cost, QALY, and NMB results were examined for:

- variations in the units included in the analyses (by excluding units that had not implemented the bundle by 2006);

- excluding patients who were not ventilated in the first 24 hours following admission to the unit;

- case mix adjustment (using predicted mortality instead of individual components of the ICNARC Model);

- adjusting for the potential confounding effects of the implementation of outreach services and growth in capacity;

- estimating costs to reflect the proportion of high dependency beds in general units providing intensive care;[2]

- assuming QALYs for critical care survivors at 100% of the general population level (instead of 80%);

- assuming a willingness to pay threshold of £30,000 per QALY (instead of £20,000);

- fitting units as fixed effects instead of random effects in the regression analysis.

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[2] The base case analysis used the Trust specific reference costs for ICU bed-days. The KH03a data on critical care beds suggest that the proportion of HDU bed-days increased from 2000 to 2006 (see Section 3.3.1). The sensitivity analysis estimated unit costs (UC) as UC=HDfactor*mean HDU cost + ICfactor*mean ICU cost using ICU and HDU reference costs. The HDfactor was estimated as the percentage of HD beds (and the IC factor the percentage of IC beds) in general units providing intensive care each year using KH03a data. The HDU factor varied from 13.5% in 2000 to 23% in 2006.

3.3 Results

3.3.1 Trends in inputs (structure)

Trends in numbers of beds

The total number of staffed critical care beds in England increased from 2,240 in March 1999 to 3,359 in January 2007, a rise of 50% (Figure 3). Most of the increase has been in the number of high dependency beds (a rise of 106% from 720 to 1,485 beds) with a smaller increase observed for intensive care beds (a rise of 23% from 1,520 to 1,874 beds).

The main increase occurred during winter 2000/01 following the publication of Comprehensive Critical Care and the additional expenditure announced in May 2000. By January 2001 the number of high dependency beds had increased by 49.6% compared with January 2000, an extra 401 beds. There was a smaller increase of 7.8% in the same period in the number intensive care beds, an extra 122 beds. After January 2001 bed numbers continued to rise by an average of 3.5% per year for high dependency beds and 1.9% per year for intensive care beds.

Figure 3.   Number of critical care beds in England 1999-2007
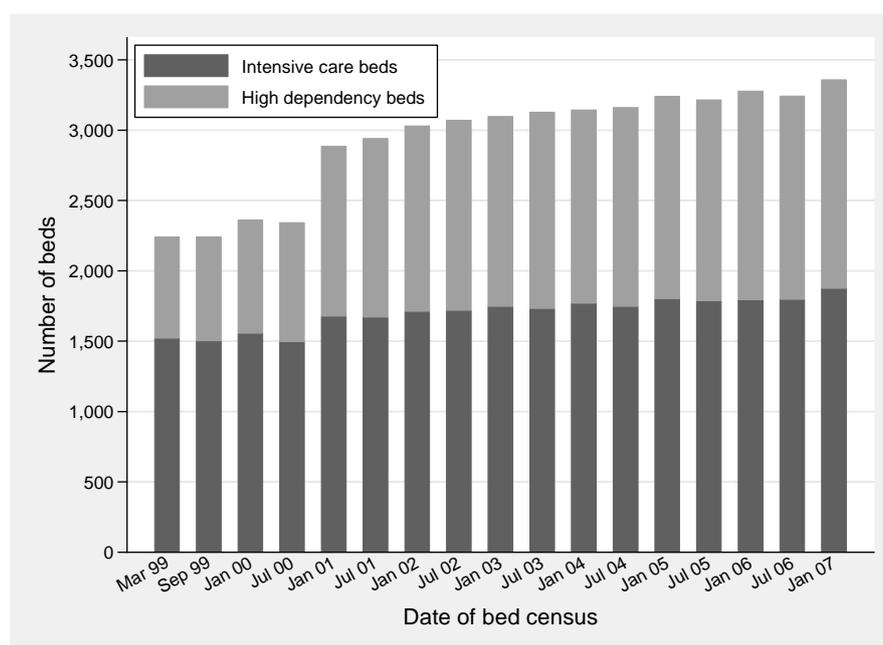
Source: Department of Health KH03a reports

These numbers include critical care beds in general units (standalone ICU or HDU, combined ICU/HDU, and combined ICU/HDU/coronary care units), specialist units (such as cardiothoracic or neurological units), and outside of units. Between 2000 and 2007, the proportion in general units fell slightly:

from 80% to 77% of intensive care beds and from 68% to 63% of high dependency beds.

As the CMP is restricted to general units providing intensive care (standalone ICUs, combined ICU/HDU, and combined ICU/HDU/coronary care unit), we analysed the Department of Health KH03a data for similar units (so excluding beds in specialist units and standalone HDUs). This showed a similar pattern of change in high dependency and intensive care beds: between January 2000 and January 2001 there were increases of 57.5% and 7.2% in high dependency and intensive care beds respectively, or 13.3% overall; after January 2001 bed numbers continued to increase at an average rate of 9.0% per year for high dependency beds and 1.4% per year for intensive care beds, or 2.9% for all critical care beds.

The rate of increase for high dependency beds (9.0%) located in units providing intensive care is greater than the rate of increase for high dependency beds overall (3.5%). There has also been a trend towards less provision of intensive care in standalone units (i.e. units not providing high dependency care): in 2001 around 67% of intensive care beds in general units were located in standalone ICUs whereas by 2007 it had fallen to 47% (Figure 4).

Figure 4.   Number of critical care beds in England located in general units providing intensive care 1999-2007
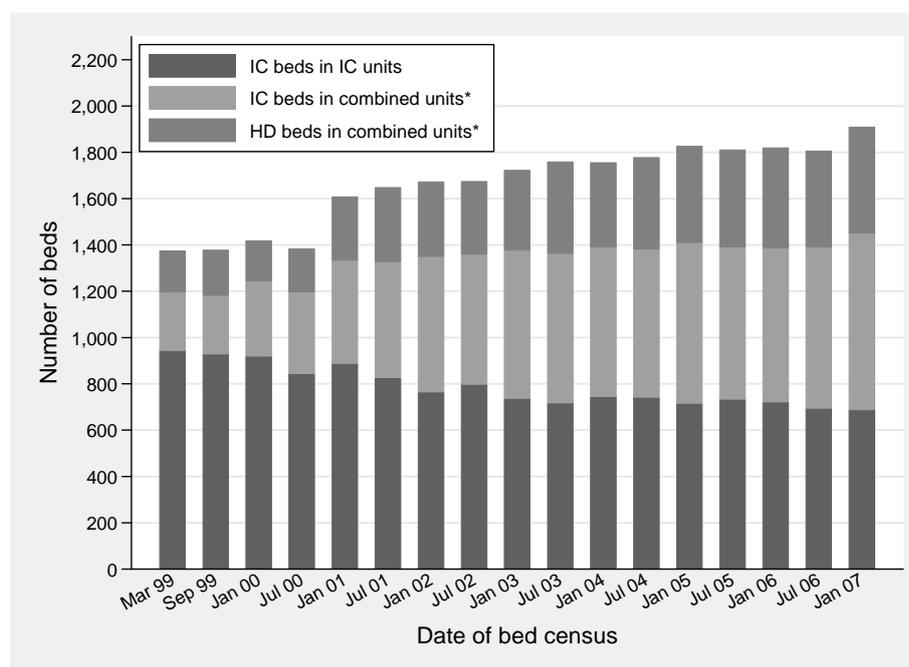
combined ICU/HDU or ICU/HDU/coronary care unit; Source: Department of Health KH03a reports

Department of Health KH03a data refer to trusts rather than individual critical care units. Information on the latter can be obtained from the CMPD. For the 104 units in England included in the database for 2000-6, the mean number of beds reported was 6.6 (range 2 to 22, median 6) in the first

quarter of 2000 and 7.2 (range 3 to 22, median 6) in the first quarter of 2001 (Figure 5), an increase of 8.5% compared with the 13.3% increase estimated using national Department of Health data.

By the first quarter of 2006 the mean size of CMP units in England was 8.9 beds (range 3 to 22, median 8), representing an average annual increase in capacity of 4.4% per year compared with the 2.9% average annual increase estimated using the Department of Health returns.

For the 11 CMP units outside England for which we had data, the mean unit size in the first quarter of 2000 was 6.6 beds (range 4 to 14, median 6) which had increased by 17.6% to 7.8 beds (range 5 to 14, median 6) by the first quarter of 2001. By the first quarter of 2006 mean reported unit size was 9.3 beds (range 5 to 17, median 8) representing an average annual increase of 3.5%.

Figure 5.   Mean reported number of beds in a unit in CMP units (2000-6)
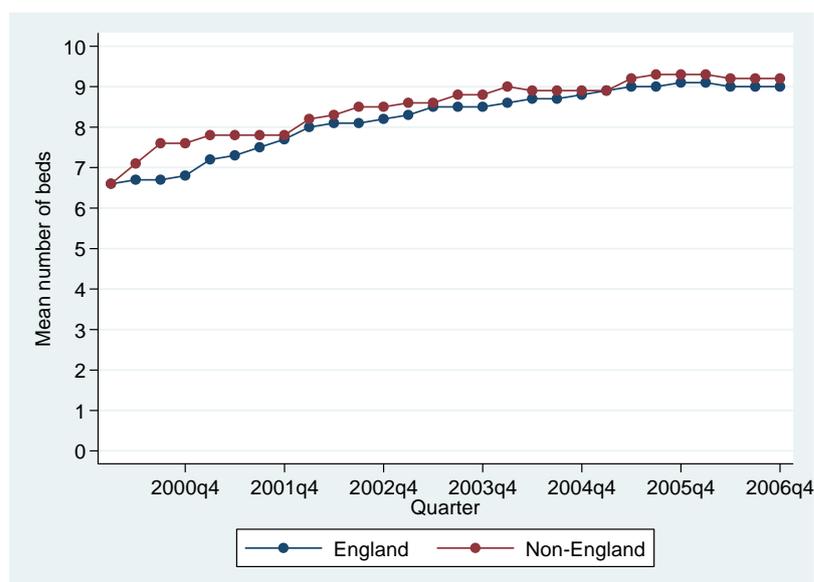
It is possible that the smaller increase in 2000-01 reported by CMP units is due to delays in notification of increases in capacity. To avoid this problem an alternative approach was used based on the number of occupied beds (Figure 6). Between the first quarters of 2000 and 2001 the mean number of occupied beds in England increased by 9.4% (17.6% for units outside England) and after 2001 the mean number increased at an average annual rate of 5.1% in England (3.0% outside England). These rates of increase in England are similar to those based on reported beds so delayed notification does not appear to be an important reason for the difference between national Department of Health data and CMPD data

That difference (Department of Health data suggesting a higher increase in 2000-01 but a lower annual rise subsequently) may reflect a true difference between those units participating in the CMP and units nationally. However, other factors may also contribute to the observed differences. Firstly, there

will be unoccupied but staffed beds that cannot be measured using the CMPD. Secondly, capacity estimates using CMPD data are based on quarterly averages whereas national KH03a returns are estimated on one day every six months so may be less reliable. For these reasons, further analyses were based on CMPD estimates of capacity based on occupied beds at the individual unit level.

Figure 6.   Mean unit size (occupied beds) between 2000 and 2006 in CMPD units
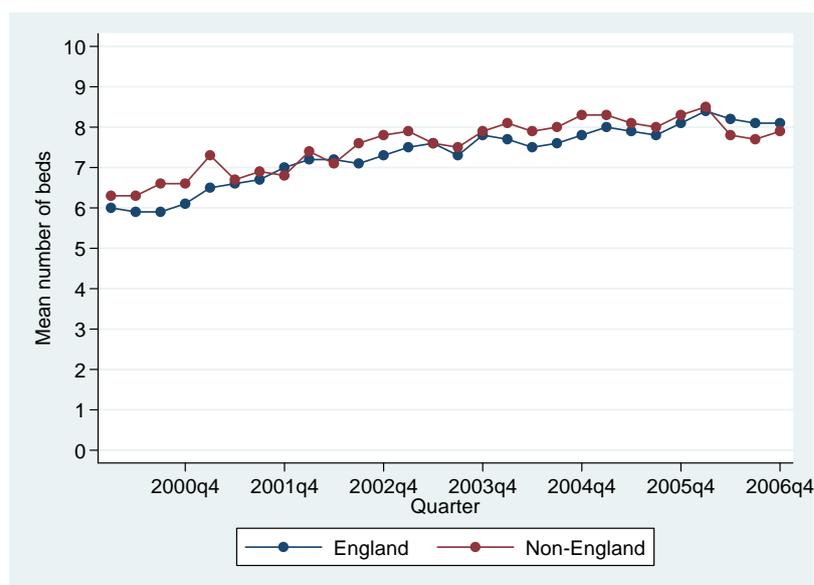
Growth in capacity was not uniform across all units. This can be seen by looking at the distribution of capacity changes between 2000 and 2004. For units in England the mean increase in capacity was 38.6% (36.7% in units outside England). The distribution of increases varied, with over one third of units increasing in size by at least 50% (Table 2).

Table 2. Increase in capacity between 2000 and 2004 in CMP units

	Increase in capacity		
	<20%	20-50%	>50%
Number (%) English units	38 (40)	23 (24)	33 (35)
Number (%) Non-English units	2 (20)	7 (70)	1 (10)

not calculated in 9 units (8 England, 1 non-England) that joined the CMP after 2000q2

Another way of examining changes in critical care capacity is to use NHS reference costs. As expected, this shows that the total annual occupied bed-days (general ICU+HDU) increased between 1999 and 2005 (Figure 7) with a particularly large increase in the HDU occupied bed-days per year during 2000-2001. ICU bed capacity also increased but more modestly.

Subsequently, from 2001/02 to 2005/06 the number of ICU bed-days remained fairly constant in keeping with the capacity in general ICUs which remained fairly stable over this period. In contrast, the number of bed-days reported in HDUs continued to increase until 2005. This reflected the long-term trend towards increasing capacity in HDUs often as part of combined ICU/HDUs and a corresponding decrease in the capacity of standalone ICUs (Figure 4).

Figure 7.   Annual number of bed-days for general ICUs and HDUs reported for all English NHS trusts by financial year (1998/99-2005/06)
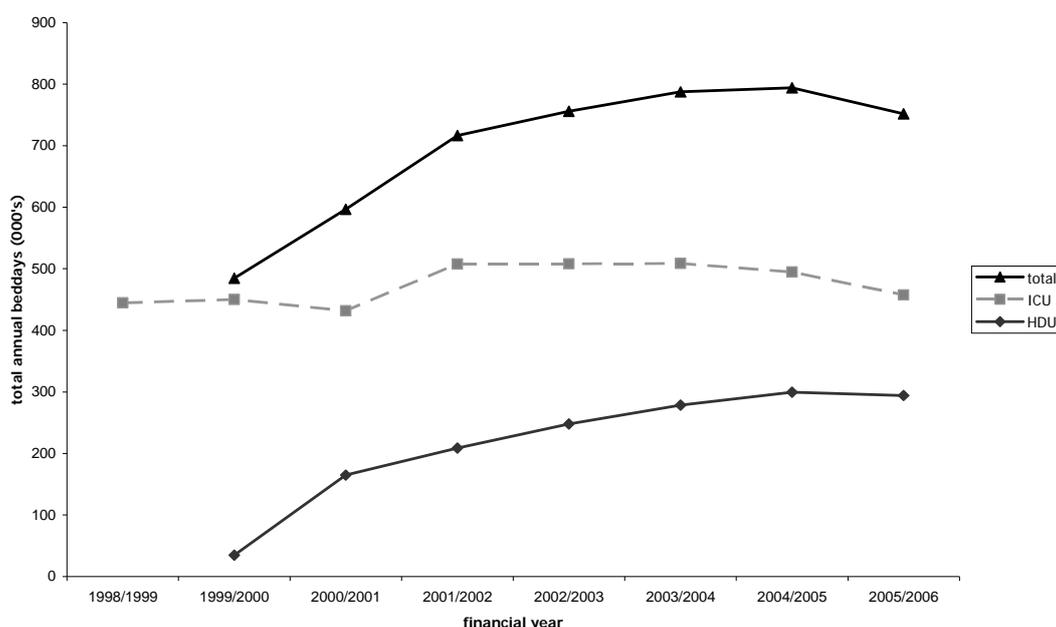
Source: NHS reference costs. Note: Total includes bed-days reported for general ICU and HDU and excludes specialist units

Trends in costs

After using the Hospital and Community Health Services (HCHS) conversion factor to allow for NHS price increases, slight increases in costs per occupied ICU and HDU bed-day were observed over the period (Figure 8). These differences could reflect: factors potentially associated with improved quality of care, for example new pharmaceuticals, increases in staff to bed ratios or new capital equipment; and external factors such as case-mix or price changes specific to critical care, or reduced efficiency.

Figure 8.   Annual trends in average unit costs (£ per bed-day) for general ICUs and HDUs reported across all English NHS trusts for each financial year
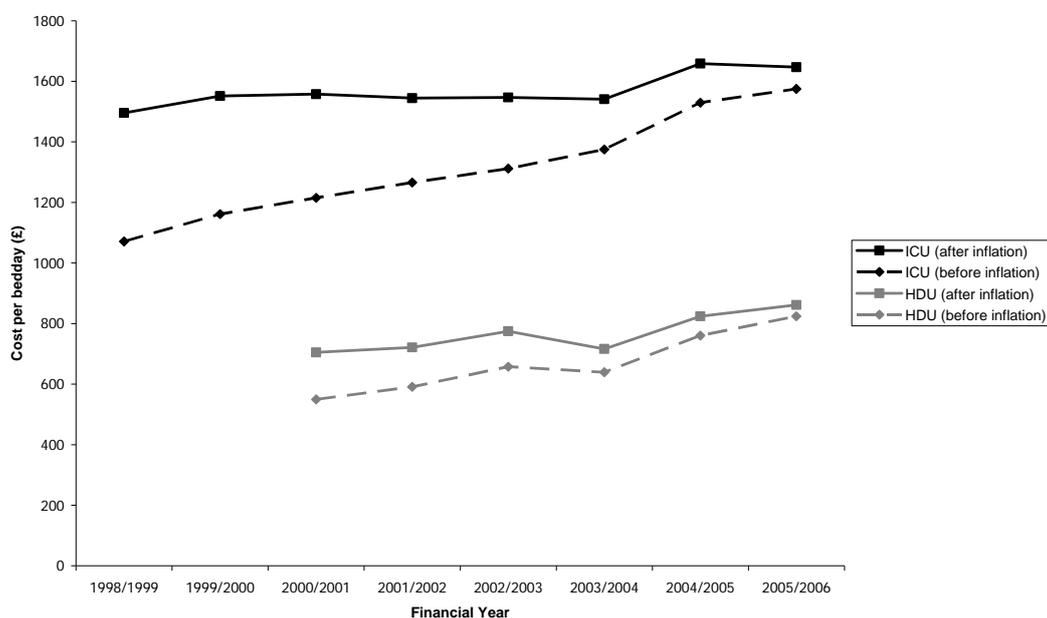
Source: NHS reference costs. Inflation adjustment used the HCHS inflation factor to report all unit costs at 2006-7 prices (NHS Executive, 2007)

The net effect of the changes in activity and unit cost was that total annual expenditures increased between 1999-2006 (Figure 9). While there was a general trend towards higher HDU expenditure over the entire period, there was a particularly marked increase in ICU and total expenditure (19%) in 2001-2002, the period immediately following the start of modernisation.

Figure 10 places the changes observed in annual expenditure in critical care over the period 1999-2006 in the context of total expenditure by NHS Trusts. The large increases in annual expenditure for critical care, particularly between 2000/01 and 2001/02, were not observed in general expenditure by Trusts and were mainly the result of increases in the number of bed-days. However, the relative increase observed between 2003/04 and 2004/05 was mainly due to the increase in average unit costs in the same period as shown in Figure 8.

Figure 9. Annual trends in total expenditure (£) for general ICUs and HDUs reported across all English NHS trusts by financial year
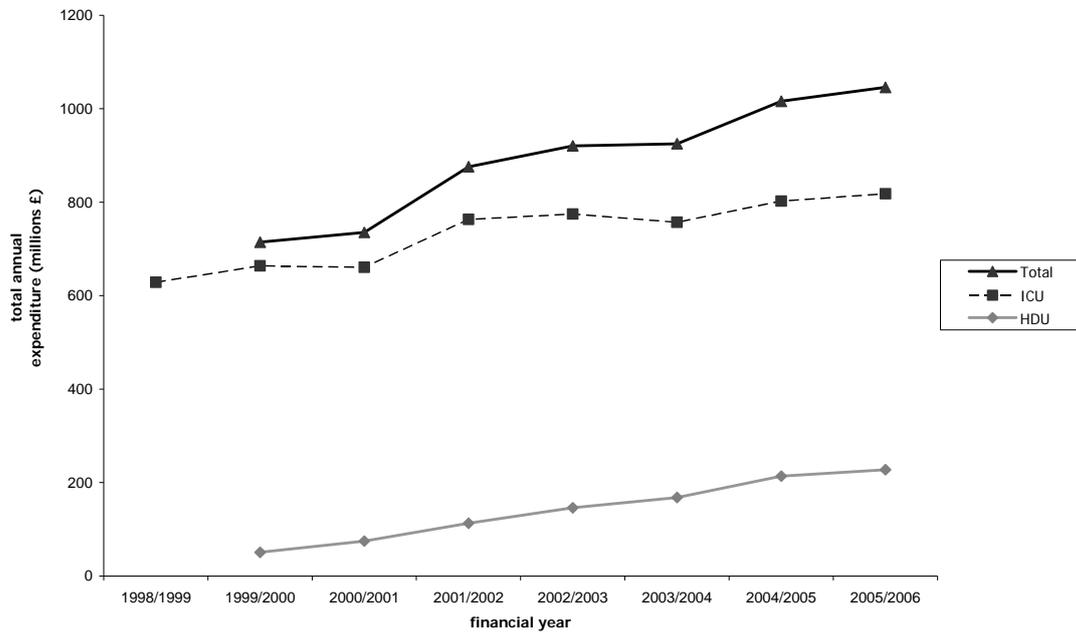
Source: NHS reference costs. Note: Total includes expenditure for those units that return general ICU and HDU bed-days and excludes expenditure for specialist units.

Figure 10. Change in annual expenditure (% change from previous year) in general ICUs and HDUs and in total annual expenditure in NHS trusts
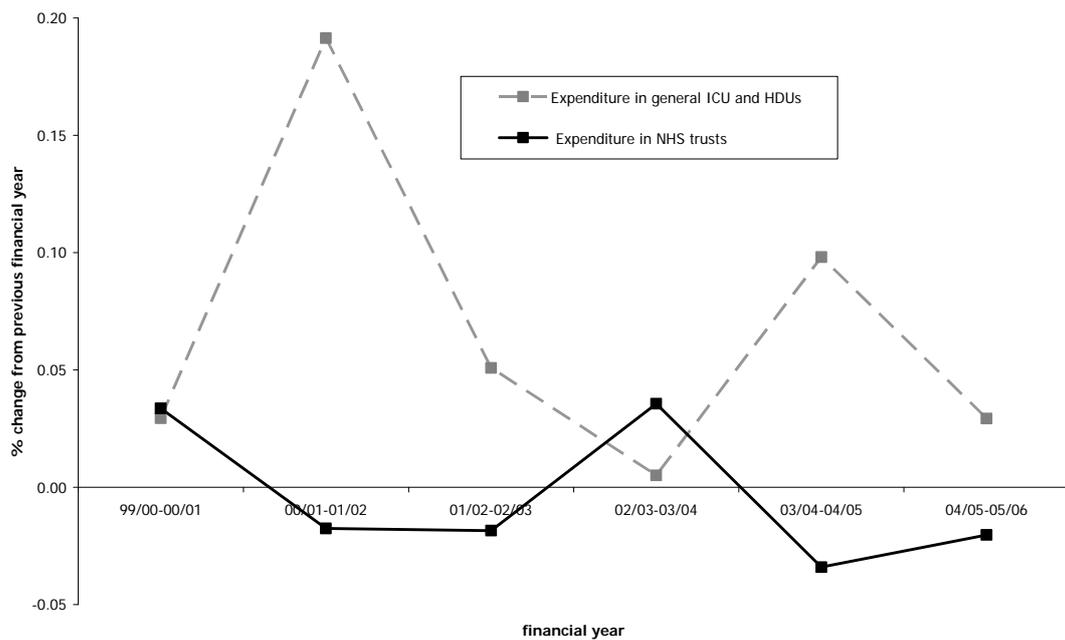
Summary (trends in inputs)

Between 2000 and 2006 the number of critical care beds in England increased by over 40%. Much of this growth occurred in the winter of 2000-01 and was followed by steady annual increases. Additional beds were largely high dependency (level 2) beds rather than intensive care (level 3) beds. The increase in capacity has resulted in an increase in the total number of bed-days. Total expenditure on critical care also increased between 2000 and 2006, largely reflecting the increased capacity but also a small increase in the cost per bed day, and was growing faster than expenditure on other hospital services.

3.3.2 Organisational changes

Critical care networks

The Modernisation Agency rated the 29 networks over five quarters in 2002 and 2003. At the end of 2002 (first quarterly assessment) there was some minor variation by question with, on average, local sharing events and information collection (questions 9 and 10) scoring highest, and network plans and links to other programmes scoring lowest (Table 3). The networks' overall scores for the ten items ranged from 11 to 46. The scale demonstrated good internal consistency (Cronbach's alpha 0.923), indicating that the items are measuring the same underlying construct.

Table 3. Mean rating by question of the 29 networks

	2002 q4	2003 q1	2003 q2	2003 q3	2003 q4
Engagement (q1)	2.9	3.2	3.4	3.5	3.7
Projects mainstream (q2)	2.8	3.4	3.6	3.7	4.0
CC Delivery Group (q3)	2.6	2.8	3.0	3.2	3.3
Network management arrangements (q4)	2.6	3.3	3.5	3.8	3.9
Network plans (q5)	2.0	2.8	3.2	3.3	3.4
Balanced team (q6)	2.8	3.4	3.6	3.8	3.9
Links to other programmes (q7)	2.2	2.9	3.6	3.7	3.8
Function independently (q8)	2.9	3.4	3.9	3.9	3.9
Local sharing events (q9)	3.2	3.7	3.9	4.0	4.2
Information collection (q10)	3.1	3.2	3.5	3.7	3.9

1 not met; 2 action needed; 3 action occurring; 4 fully met; 5 surpassed

Over the five quarters all questions showed a trend towards higher scores and improvements in mean scores of between 0.8 and 1.6 between the first and last assessment. The networks' overall scores at the end of 2003 ranged from 17 to 48 and the scale again demonstrated good internal consistency (Cronbach's alpha 0.944). Given the level of internal

consistency it was decided not to undertake any further analysis at the individual question level.

Using the Modernisation Agency's categories of network performance (see Appendix 1), seven (24%) of the 29 networks had met the threshold for being classified as 'ready to receive' at the first assessment. At that time nine (31%) other networks were categorised as being at risk or at significant risk. By the final assessment 23 (79%) networks were categorised as at least 'ready to receive', including the seven networks that had achieved this level at the first assessment, though two (7%) networks were still categorised as 'at risk'.

Table 4. Ratings of 29 networks as assessed by the Modernisation Agency

	2002 q4 n (%)	2003 q1 n (%)	2003 q2 n (%)	2003 q3 n (%)	2003 q4 n (%)
Excellent	1 (3%)	6 (21%)	8 (28%)	9 (31%)	14 (48%)
Ready to receive	6 (21%)	9 (31%)	14 (48%)	15 (52%)	9 (31%)
Developing	13 (45%)	10 (35%)	5 (17%)	4 (14%)	4 (14%)
At risk	7 (24%)	4 (14%)	2 (7%)	1 (3%)	2 (7%)
Significant risk	2 (7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Based on their transition throughout the assessment period, the networks were classified into three groups depending on when they achieved the 'ready to receive' threshold. Networks classified as earlier adopters were those that had achieved the 'ready to receive' level at the first assessment. Those networks that only reached the level of 'ready to receive' at subsequent assessments were classified as later adopters.

Networks that had not achieved the 'ready to receive' threshold by the final assessment were classified as other. It was hypothesised that this might represent a heterogeneous group of networks including not only those that were genuine under-performers but also networks that chose not to comply with the Modernisation Agency approach because they felt they were already performing effectively. Given such uncertainty, although we analysed and present data for the 'other' category, we make no attempt at interpretation.

Using this classification over half of networks were categorised as later adopters with seven earlier adopter networks and six other (Table 5). Restricting analysis to the 96 units in England which had participated in the CMP since at least 1998 (Figure 2) resulted in four networks without any CMP participating units. When the 104 units that had participated in the CMP since 2000 were considered only two of the 29 networks were not represented.

Table 5. Classification of networks and participating CMP units

Classification of network	Number of networks and units (%)		
	Earlier adopter	Later adopter	Other
All networks	7 (24%)	16 (55%)	6 (21%)
Represented in CMP since 1998:			
Networks	6 (24%)	15 (60%)	4 (16%)
Units	27 (28%)	57 (59%)	12 (13%)

Represented in CMP since 2000:			
Networks	6 (22%)	15 (56%)	6 (22%)
Units	28 (27%)	61 (59%)	15 (14%)

Ventilator care bundle

The implementation of the ventilator care bundle was identified by a survey of all units participating in the CMP at November 2007. Responses were received from 144 (83.7%) units (81.6% for units in England and 100% for units outside England).

The first implementation of the ventilator care bundle occurred in 2002 and by 2004 half of the units in England reported they had implemented the bundle. At the time of the survey, 14 (11%) CMP units in England (and one outside England) claimed not to have implemented the bundle. Implementation outside England was slower, with only one unit implementing the bundle prior to 2006. The large uptake in 2006 was mainly due to a national campaign in Wales.

Table 6. Cumulative implementation of the ventilator care bundle in CMP units

	England units (n=125)		Non-England units (n=19)	
	Number (%)	Cumulative %	Number (%)	Cumulative %
2001	0 (0%)	0%	0 (0%)	0%
2002	5 (4%)	4%	0 (0%)	0%
2003	24 (19%)	23%	0 (0%)	0%
2004	35 (28%)	51%	1 (5%)	5%
2005	27 (22%)	73%	0 (0%)	5%
2006	9 (7%)	80%	12 (63%)	68%
2007	11 (9%)	89%	5 (26%)	95%
not implemented	14 (11%)	-	1 (5%)	-

Out of the 15 units that had not implemented the bundle, 13 reported that they had implemented components (mostly the sedation component was not implemented), one unit reported using an alternative protocol, and one unit did not comment.

One feature of bundle implementation is auditing compliance with the bundle components. The survey revealed that three-quarters of units in England that had implemented the bundle reported compliance levels above 90% and only 7 (6%) units reported compliance levels below 75% (Table 7). Compliance rates were higher in units outside England.

Table 7. Compliance levels with the ventilator care bundle

			Number (%)					
		England units				Non-England units		
	n	>90%	75-90%	<75%	n	>90%	75-90%	<75%
2002	5	3 (60%)	1 (20%)	1 (20%)	0	-	-	-
2003	29	9 (31%)	9 (31%)	11 (38%)	0	-	-	-
2004	62*	27 (42%)	24 (38%)	13 (20%)	1	1 (100%)	0	0
2005	89*	48	30	11	1	1	0	0

		(54%)	(34%)	(12%)		(100%)		
2006	99*	69	23	7	13	12	1	0
		(70%)	(23%)	(7%)		(92%)	(8%)	(0%)
2007	110*	83	20	7	18	16	1	1
		(75%)	(18%)	(6%)		(89%)	(6%)	(6%)

*compliance levels missing for two units in 2004 & 2005 and one unit in 2006 & 2007

Outreach services

Data on the implementation of critical care outreach services had been collected from critical care units in England in 2004 as part of a previous study (McDonnell *et al*, 2007). A survey resulted in responses from 191 of 239 units (79.9%). Of these, 134 units participated in the CMP. (Data were not available on outreach implementation in units outside England or on implementation of outreach services since 2004).

Data on the implementation of three outreach services (direct bedside clinical support on wards; follow-up of patients post-critical care; use of a physiological track and trigger warning system on general wards) are shown in Table 8. Initial implementation of outreach services occurred most often in 2000 and 2001. By the end of 2001 implementation of all three types of outreach service had occurred in over 50% of units.

Table 8. Implementation of critical care outreach by year in CMP units

	Discharge (n=131)		Support (n=130)		Track & trigger (n=129)	
	n	cumulative* n (%)	n	cumulative* n (%)	n	cumulative* n (%)
1996 & earlier	5	5 (4%)	2	2 (2%)	1	1 (1%)
1997	0	5 (4%)	0	2 (2%)	0	1 (1%)
1998	0	5 (4%)	0	2 (2%)	0	1 (1%)
1999	2	7 (5%)	2	4 (3%)	2	3 (2%)
2000	26	33 (25%)	30	34 (26%)	27	30 (23%)
2001	45	78 (60%)	38	72 (55%)	38	68 (53%)
2002	15	92 (70%)	17	88 (68%)	24	92 (71%)
2003	8	97 (74%)	4	89 (68%)	16	106 (82%)
2004	9	106 (81%)	8	97 (75%)	14	120 (93%)
not implemented	21	-	29	-	7	-

*cumulative figures adjusted for units that stopped providing specific outreach services by 2004 (4 discharge, 4 support & 2 track & trigger)

Implementation of one type of outreach service was strongly correlated with implementing one of the other types. Correlation coefficients were 0.63 between bedside clinical support and follow-up of discharged patients; 0.65 between bedside clinical support and track and trigger; and 0.45 between follow-up of discharged patients and track and trigger (all $p<0.001$).

There was no evidence for an association between implementation of outreach services and a unit's history of participation in a critical care network or adoption of the ventilator care bundle (Table 9). The only significant positive association found was between the implementation of

outreach for discharge follow-up and the extent of increase in bed numbers. There was also no significant associations between the adoption of the three other organisational interventions: ventilator care bundle, critical care networks and capacity increase (Table 10).

Table 9. Association between the implementation of outreach activities and other changes in critical care in 104 units in England

	Discharge		Support		Track & trigger	
	yes	no	yes	no	yes	no
Network category						
earlier adopter	20	3	19	3	23	0
later adopter	39	10	33	17	45	4
other	8	1	8	1	9	0
	p=0.65		p=0.11		p=0.25	
Change in capacity 2000-2004						
<20%	28	1	26	3	26	2
20-50%	13	5	11	6	18	0
>50%	19	7	19	8	26	1
	p=0.02*		p=0.09*		p=0.52*	
Ventilator bundle						
implemented	51	11	47	16	60	2
not implemented	7	2	6	3	8	1
	p=0.75		p=0.61		p=0.27	

* p value for trend

Table 10. Association between ventilator care bundle, network category and change in capacity in English units

	Ventilator care bundle		Network category	
	yes	no	earlier adopter	later adopter
Network category				
earlier adopter	21	3		
later adopter	43	7		
other	14	0		
p-value	p=0.34			
Change in capacity 2000-2004				
<20%	26	5	9	24
20-50%	19	0	12	10
>50%	26	4	7	21
p-value for trend	p=0.72		p=0.93	

It was possible to classify 97 units represented in the CMP since 2000 (89 since 1998) as 'earlier adopter' or 'later adopter' units based on their implementation of outreach services and the ventilator bundle.[3] There were 58 (65%) units represented in the CMP since 1998 that were classified as earlier adopters (Table 11). There was no strong association between earlier adopter units and earlier adopter networks - in earlier adopter networks 73% of CMP units were classified as earlier adopters whereas in later adopter networks 59% of CMP units were classified as earlier adopters (p=0.12). There was also no strong association between a unit's classification and its change in capacity between 2000 and 2004.

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[3] based on 72 (74%) units completing both surveys, 15 (15%) units completing the ventilator bundle survey only, and 10 (10%) units completing the outreach survey only

Table 11. Classification of CMP units as earlier and later adopters

	Represented in CMP since 1998		Represented in CMP since 2000	
	earlier adopter	later adopter	earlier adopter	later adopter
Network category				
earlier adopter	19 (73%)	7 (27%)	20 (74%)	7 (26%)
later adopter	30 (59%)	21 (41%)	31 (56%)	24 (44%)
other	9 (75%)	3 (25%)	11 (73%)	4 (27%)
p-value*	p=0.34		p=0.21	
Change in capacity 2000-2004				
<20%	28 (80%)	7 (20%)	28 (80%)	7 (80%)
20-50%	10 (53%)	9 (47%)	10 (50%)	10 (50%)
>50%	19 (61%)	12 (39%)	20 (62%)	12 (38%)
p-value for trend	p=0.11		p=0.13	
Total	58 (65%)	31 (35%)	62 (64%)	35 (36%)

*if the other category is excluded the p-values are 0.12 (in CMP since 1998) and 0.22 (in CMP since 2000)

Summary (organisational changes)

Changes in the organisation and delivery of critical care (often referred to as 'modernisation') varied in timing and adoption. Around a quarter of networks were fully developed at the end of 2002 and by the end of 2003 this proportion had increased to four-fifths. Outreach services were adopted by the majority of units, largely between 2000-02. The ventilator care bundle was also adopted by the majority of units over a more extended period from 2002 to 2005. There were no strong associations between the timing of adoption of outreach, the ventilator care bundle, and networks.

3.3.3 Trends in critical care processes

Case-mix of admissions

Several aspects of case-mix were investigated: source of admission, body system, primary diagnosis, socio-demographic characteristics, comorbidity, and severity.

Source of admission

There have been only slight changes in the source of admissions to CMP units in England (Table 12). The percentage of admissions following elective surgery has fallen slightly (26.7% to 23.2%), with most of this decline occurring before 2000; admissions from the ward have increased (23.4% to 26.3%), with most of this increase occurring post-2000; and admissions from other critical care units (either intensive care of high dependency care) increased from 6.5% in 1998 to 8.4% in 2001 before declining to 6.7% in 2006.

CMP units outside England showed more dramatic changes but such comparisons should be treated with some caution given the small numbers involved. Admissions from accident & emergency or other hospitals increased from 21.7% in 2000 to 27.2% in 2006 whereas elective surgical admissions fell (32.5% to 20.7%) in the same period.

Table 12. Admissions to CMP units in England by source of admission

	% of admissions								
	1998	1999	2000	2001	2002	2003	2004	2005	2006
A&E/other hospital	*23.6*	*23.4*	*23.9*	*25.4*	*24.5*	*24.3*	*24.1*	*24.0*	*23.7*
Clinic or home	*0.7*	*0.4*	*0.3*	*0.3*	*0.3*	*0.2*	*0.2*	*0.1*	*0.1*
Critical care transfer	*6.5*	*7.2*	*7.7*	*8.4*	*7.8*	*7.2*	*6.9*	*6.7*	*6.7*
Elective surgery	*26.7*	*26.3*	*24.2*	*22.5*	*22.8*	*23.7*	*24.4*	*24.0*	*23.2*
Emergency surgery	*19.2*	*19.7*	*20.2*	*19.8*	*20.1*	*20.0*	*19.5*	*19.4*	*20.0*
Ward	*23.4*	*23.1*	*23.7*	*23.7*	*24.5*	*24.6*	*24.9*	*25.6*	*26.3*

Body system

In 1998 cardiovascular admissions comprised the largest percentage of admissions (29.2%) but by 2006 these represented only 19.5% (Table 13). Admissions for neurological reasons also fell (13.5% to 10.9%). Meanwhile the proportion of admissions for gastrointestinal (21.3% to 26.8%), genitourinary (4.9% to 8.3%) and musculoskeletal (3.0% to 4.4%) reasons increased. There are no clear changes associated with changes in capacity after 2000.

Changes in the proportions of admissions are similar to those in CMP units outside England. However, some caution is required in making comparisons because these results are based on fewer than 5,000 admissions a year.

Table 13. Admissions to CMP units in England by body system

	% of admissions								
	1998	1999	2000	2001	2002	2003	2004	2005	2006
Cardiovascular	*29.2*	*25.6*	*24.2*	*22.7*	*20.5*	*19.8*	*20.1*	*19.9*	*19.5*
Gastrointestinal	*21.3*	*22.6*	*23.2*	*24.0*	*25.5*	*26.0*	*26.3*	*26.2*	*26.8*
Renal	*20.2*	*21.0*	*20.9*	*20.8*	*20.7*	*20.9*	*20.5*	*21.2*	*20.6*
Neurological	*13.5*	*14.1*	*14.6*	*14.6*	*14.2*	*13.3*	*12.3*	*11.2*	*10.9*

Endocrine	*6.0*	*6.2*	*6.1*	*6.5*	*6.3*	*6.4*	*6.5*	*6.6*	*6.6*
Genitourinary	*4.9*	*5.3*	*5.6*	*5.7*	*6.7*	*7.2*	*7.8*	*7.8*	*8.3*
Musculoskeletal	*3.0*	*3.0*	*3.0*	*3.4*	*3.9*	*4.0*	*4.0*	*4.4*	*4.4*
Other	*1.8*	*2.2*	*2.4*	*2.4*	*2.3*	*2.5*	*2.6*	*2.7*	*2.8*

body system defined using the ICNARC Coding Method (missing in 3.6% of admissions)

Primary diagnosis

Categorising admissions by body system provides only a general view of reason for admission. The 20 most common primary reasons for admission for the years 1998 to 2000 are shown in Table 14, and the equivalent analysis for the period 2004 to 2006 is shown in Table 15. In both periods the 20 most common primary reasons make up over 40 percent of all admissions.

In both periods the three most common reasons for admission were pneumonia, aortic or iliac dissection or aneurysm, and large bowel tumour. Pneumonia made up 7.0% of admissions in 1998-2000 and increased to 8.6% in 2004-2006; surgical admissions with aortic or iliac dissection or aneurysm declined from 6.1% in 1998-2000 to 4.5% in 2004-06, contributing to the overall decline in cardiovascular admissions, and surgical large bowel tumour admissions increased from 2.7% in 1998-2000 to 4.3% in 2004-2006.

Table 14. Commonest primary diagnoses 1998 to 2000 (n=85,670)

Rank (2004-06 rank)	Diagnosis	Surgical or non-surgical admission*	percent
1 (1)	Pneumonia	non-surgical	7.0%
2 (2)	Aortic or iliac dissection or aneurysm	surgical	6.1%
3 (3)	Large bowel tumour	surgical	2.7%
4 (23)	Epidural injection or infusion	surgical	2.4%
5 (5)	Acute myocardial infarction	non-surgical	2.1%
6 (12)	Primary (diffuse) brain injury	non-surgical	1.8%
7 (7)	Chronic obstructive pulmonary disease with acute lower respiratory infection	non-surgical	1.7%
8 (11)	Malignant neoplasm of oesophagus	surgical	1.6%
9 (16)	Self poisoning with tri- and tetracyclic antidepressants	non-surgical	1.6%
10 (18)	Asthma attack in new or known asthmatic	non-surgical	1.5%
11 (4)	Acute renal failure	non-surgical	1.5%
12 (13)	Non-traumatic subarachnoid haemorrhage	non-surgical	1.4%
13 (6)	Status epilepticus or uncontrolled seizures	non-surgical	1.4%
14 (9)	Non-traumatic large bowel perforation or rupture	surgical	1.3%
15 (20)	Ventricular tachycardia or fibrillation	non-surgical	1.3%
16 (21)	Left ventricular failure	non-surgical	1.3%
17 (15)	Chronic obstructive pulmonary disease (COPD/COAD)	non-surgical	1.3%

18 (18)	Intracerebral haemorrhage	non-surgical	1.2%
19 (10)	Acute pancreatitis	non-surgical	1.1%
20 (24)	Cardiogenic shock	non-surgical	1.1%

*based on admission from theatre

Generally, the 20 most common diagnoses in 1998-2000 were the same in 2004-2006. Seventeen reasons were common to both periods and the other three that featured in 1998-2000 were still within the 30 most common reasons in 2004-2006. One notable change is the decline in admissions for epidural injection or infusions which declined from 4th (2.4% of admissions) to 23rd (0.9% of admissions). These admissions were concentrated in a few units and the decline largely reflects changes in admission policies in specific units. Smaller declines in the percentage of admissions were observed for ventricular tachycardia or fibrillation (1.3% to 0.9%), and left ventricular failure (1.3% to 0.9%), as part of a general decline in cardiovascular admissions.

The three diagnoses in 2004-2006 that did not feature in the 20 most common reasons in 1998-2000 were rheumatoid or osteoarthritis surgical admissions (0.5% to 1.2%), acute renal failure for other reasons (0.5% to 1.1%), diabetic ketoacidosis (0.6% to 1.0%), and intra-oral or pharyngeal tumour (no change at 1.0%).

Table 15. Commonest primary diagnoses 2004 to 2006 (n=107,905)

Rank (1998-00 rank)	Diagnosis	Surgical or non-surgical admission*	percent
1 (1)	Pneumonia	non-surgical	8.6%
2 (2)	Aortic or iliac dissection or aneurysm	surgical	4.5%
3 (3)	Large bowel tumour	surgical	4.3%
4 (11)	Acute renal failure	non-surgical	2.9%
5 (5)	Acute myocardial infarction	non-surgical	1.9%
6 (13)	Status epilepticus or uncontrolled seizures	non-surgical	1.8%
7 (7)	Chronic obstructive pulmonary disease with acute lower respiratory infection	non-surgical	1.6%
8 (10)	Asthma attack in new or known asthmatic	non-surgical	1.5%
9 (14)	Non-traumatic large bowel perforation or rupture	surgical	1.4%
10 (19)	Acute pancreatitis	non-surgical	1.4%
11 (8)	Malignant neoplasm of oesophagus	surgical	1.4%
12 (6)	Primary (diffuse) brain injury	non-surgical	1.3%
13 (46)	Rheumatoid or osteoarthritis	surgical	1.2%
14 (12)	Non-traumatic subarachnoid haemorrhage	non-surgical	1.2%
15 (17)	Chronic obstructive pulmonary disease (COPD/COAD)	non-surgical	1.2%
16 (9)	Self poisoning with tri- and tetracyclic antidepressants	non-surgical	1.1%
17 (41)	Diabetic ketoacidosis	non-surgical	1.1%
18 (18)	Intracerebral haemorrhage	non-surgical	1.0%
19 (21)	Intra-oral or pharyngeal tumour	surgical	1.0%

| 20 (15) | Ventricular tachycardia or fibrillation | non-surgical | 0.9% |

*based on admission from theatre

Sociodemographic characteristics

The mean age of admissions in England increased from 59.6 to 60.5 years between 1998 and 2006 and the increase since 2000 is similar to that observed for units outside England (Table 16). The percentage of female admissions also increased in units in and outside England (Table 17).

Table 16. Case-mix of admissions to CMP units in England

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Age: mean (years)	59.6	59.8	60.0	60.0	60.3	60.2	60.6	60.6	60.5
Sex: female (%)	41.3	41.7	41.5	42.2	43.0	42.6	43.0	43.4	43.8
Past medical history: at least one chronic condition (%)	13.4	13.6	13.4	13.5	13.6	13.4	13.4	13.5	13.8
ICNARC Model physiology score (mean)	18.0	18.1	18.6	18.5	18.3	18.1	18.1	18.1	18.0
ICNARC Model physiology score (median)	16	16	17	17	17	16	16	16	16
ICNARC Model predicted mortality (mean %)	30.5	30.7	32.1	32.5	32.0	31.3	31.3	31.5	31.4
ICNARC Model predicted mortality (median %)	19.5	20.1	22.0	22.5	21.9	21.1	21.2	21.7	21.7

Table 17. Case mix measures of admissions to CMP units outside England

	2000	2001	2002	2003	2004	2005	2006
Age: mean (years)	60.4	60.0	60.0	60.5	60.5	60.2	60.7
Sex: female (%)	41.5	41.8	43.2	43.3	42.5	42.6	42.4
Past medical history: at least one chronic condition (%)	11.0	11.1	9.1	11.9	9.5	9.8	12.7
ICNARC Model physiology score (mean)	17.7	18.2	18.4	18.7	18.7	18.7	18.9
ICNARC Model physiology score (median)	16	16	17	17	17	17	17
ICNARC Model predicted mortality (mean %)	30.0	31.5	31.6	32.3	32.4	32.5	33.3
ICNARC Model predicted mortality (median %)	18.5	20.6	21.0	22.2	23.0	22.9	24.4

Past medical history/comorbidity

Admissions in units in England are more likely to have a past medical history (at least one chronic condition) than admissions to units outside England though this percentage has remained fairly constant at around 13.5%.

Severity

In England there was an increase in the severity of admissions before 2000, as measured by their mean physiology score and the predicted risk of mortality, followed by a decline between 2001 and 2006 (Table 16), a possible consequence of the relative increase in high dependency bed numbers. This contrasts with a trend towards increasing severity after 2000 in units outside England (Table 17).

Increasing critical care capacity might have been expected to lead to a widening in the distribution of severity of admissions as patients who were previously considered to be of borderline appropriateness (the very severely ill with little chance of survival or the least severely ill who would probably survive without critical care) were admitted. Figure 11, which shows the nine deciles of predicted risk of mortality for admissions to units in England, suggests that this has not happened. The ninth (highest) decile has remained at around 80% risk of mortality, apart from a slight increase in 2000/2001 reflecting a slight increase in mean predicted mortality at this time. The first (lowest) decile also shows a slight increase around that time whereas a decrease would be expected if thresholds of admission were reducing for the least severely ill.

Figure 11. Change in deciles of predicted risk of mortality for patients admitted to CMP units in England 1998-2006
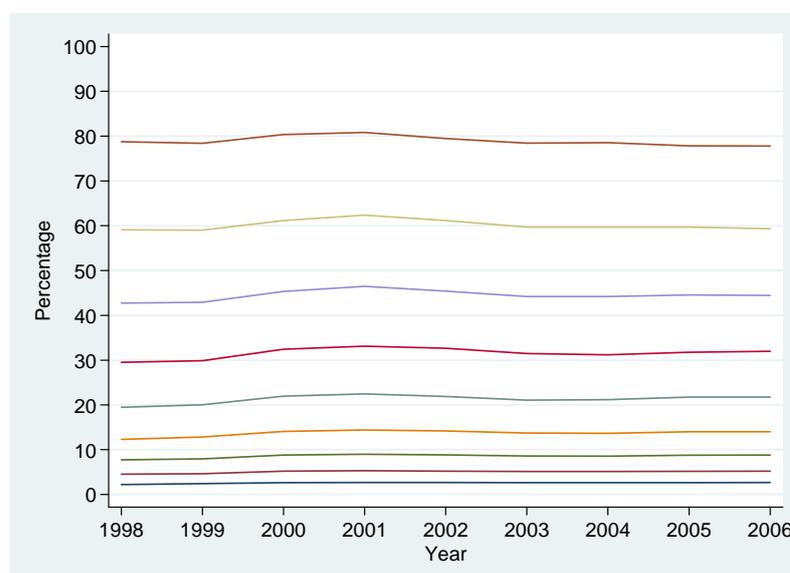
Figure 12 shows the deciles of predicted risk of mortality for units outside England and follows the pattern of a general increasing trend for percent predicted mortality in the period 2000-2006 across deciles.

Figure 12. Change in deciles of predicted risk of mortality for CMP units outside England 2000-2006
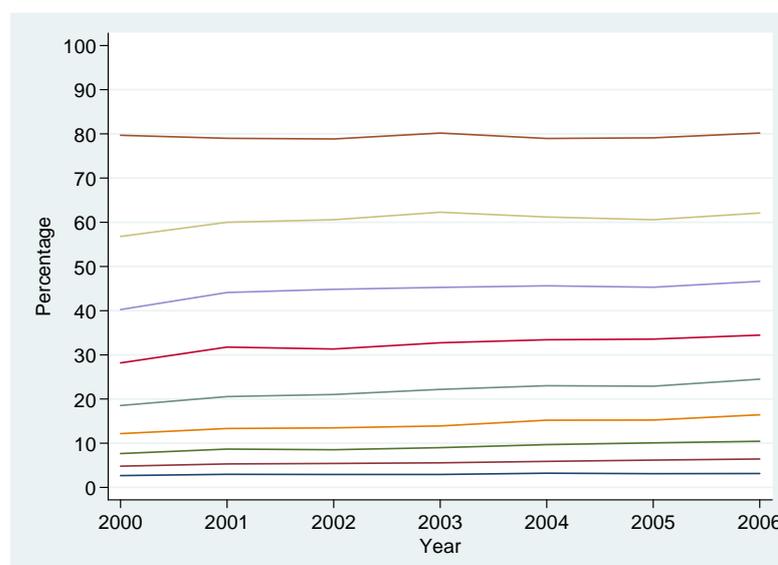
Results of the regression analysis of the changes in mean predicted mortality by time period and country are shown in Table 18. Using the 96 units which had CMPD data for 1998-2006, there was, on average, an increase in predicted mortality of 0.745 (95% CI 0.582 to 0.909) percentage points per year between 1998 and the fourth quarter of 2000. For the time period from the 2000q4 to the end of 2006, the mean predicted mortality was, on average, falling by -0.112 (95% CI -0.173 to -0.050) percentage points per year. In other words, there was strong evidence ($p<0.001$) that trends in mean predicted mortality before and after 2000 differed.

A comparison of the trends in the 104 units in England and 11 units outside England in the period from 2000q4 to 2006 showed that mean predicted mortality was falling in units in England by -0.108 (95% CI -0.172 to -0.045) percentage points while increasing in units outside England by 0.438 (95% CI 0.270 to 0.605). The difference between the trends was statistically significant ($p<0.001$).

Table 18. Regression coefficients for average annual change in mean ICNARC Model predicted mortality by country and time period

	n	mean annual change (%)	95% confidence interval	p-value for difference in trends
England 2000-2006	104	-0.108	-0.172, -0.045	<0.001
Non-England 2000-2006	11	0.438	0.270, 0.605	
England 1998-2000	96	0.745	0.582, 0.909	<0.001
England 2000-2006		-0.112	-0.173, -0.050	

Influence of organisational changes on severity of admissions

The results of further regression analyses of the 96 units in England for the periods up to and after the end of 2000 are shown in Table 19. Firstly,

trends in predicted mortality were examined according to whether units were located within earlier adopter or later adopter networks. For the period 1998-2000 there was some evidence (p<0.003) that the mean predicted mortality was increasing at a faster rate in units located in earlier adopter networks when compared with units located in later adopter networks. However, there was no evidence to suggest that the decline in predicted mortality after 2000 differed according to the type of network that units were located in.

Table 19. Regression coefficients (95% confidence intervals) for average annual change in mean ICNARC Model predicted mortality in 96 units in England

	units (n)	1998-2000 q4	p-value for difference	2000 q4-2006	p-value for difference
Network					
earlier adopter	27	1.085 (0.772, 1.398)	reference	-0.097 (-0.215, 0.021)	reference
later adopter	57	0.501 (0.283, 0.718)	0.003	-0.130 (-0.212, -0.048)	0.655
other	12	1.058 (0.651, 1.465)	0.917	-0.062 (-0.213, 0.088)	0.721
Units					
earlier adopter	59	1.014 (0.814, 1.214)	reference	-0.109 (-0.185, -0.032)	reference
later adopter	36	-0.171 (-0.494, 0.152	<0.001	-0.116 (-0.232, 0.000)	0.915
Increase in capacity 2000-2004					
<20%	40	1.131 (0.881, 1.381)	reference	0.318 (0.218, 0.417)	reference
20-50%	26	0.895 (0.499, 1.290)	0.322	-0.204 (-0.342, -0.067)	<0.001
>50%	33	0.287 (0.019, 0.556)	<0.001	-0.432 (-0.529, -0.335)	<0.001

Trends in predicted mortality in 1998-2000 did differ (p<0.001) depending on whether a unit was classified as an earlier or later adopter. The earlier adopter units experienced increasing predicted mortality of 1.014 (95% CI 0.814 to 1.214) percentage points per year in this period but no increase was observed for the later adopter units (-0.171, 95% CI -0.494 to 0.152). After 2000 there was no evidence to suggest any difference by type of unit (p=0.915) and earlier and later adopter units experienced similar declines in predicted mortality.

A comparison of units according to their growth in capacity showed that after 2000 the units that experienced little growth experienced increases in mean predicted mortality whereas units that increased in size by 20-50% or over 50% experienced a decline in predicted mortality, with a trend towards a larger decline associated with the larger increase in capacity. This finding could be a result of comparatively more high dependency care provision in the units experiencing the largest growth and the associated effect of lower predicted mortality in admissions for high dependency care. However, prior

to 2000 there was a similar pattern, with predicted mortality increasing at a faster rate in the units that would go on to experience little growth between 2000-2004, such that the differences observed in 2000-2006 by growth in capacity may reflect pre-existing trends to some extent.

Critical care transfers

Figure 13 shows changes in the percentage of discharged patients who were reported as transferred to another critical care unit to receive the same level of care. For units in England, the rate has declined since 2000. Reported transfers from units outside England have increased slightly over the same period.

Figure 13. Percentage of reported transfers to another unit 1998-2006
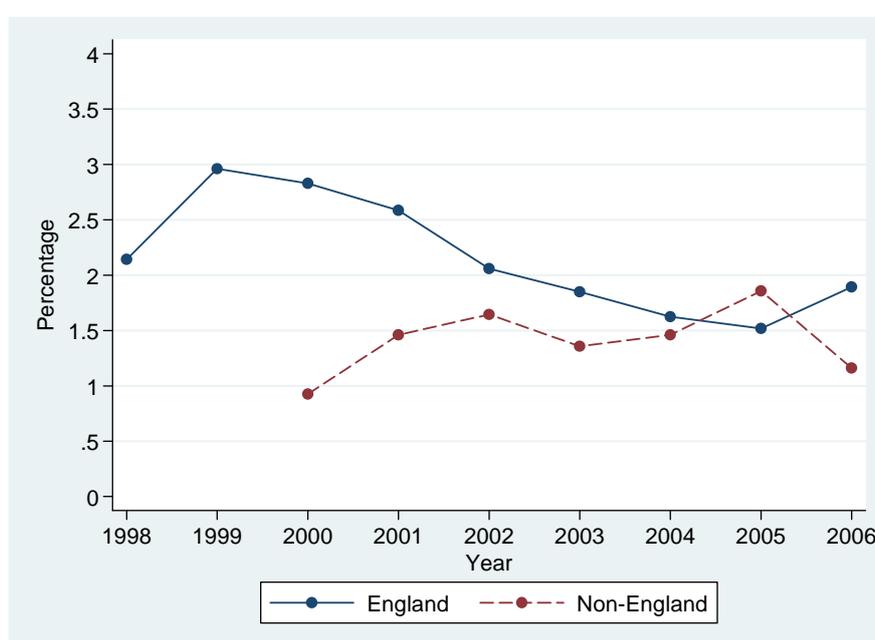
A significant decline in England since 2000 is apparent even after adjusting for case-mix (OR 0.884, 95% CI 0.869 to 0.900) equivalent to an annual average decline in risk of reported transfer of 11.6% per year (Table 20). There is also strong evidence for a difference in trends before and after 2000 (p<0.001). In contrast, for the period 2000-2006, there was no decline in reported transfers from units outside England (OR 1.010, 95% CI 0.956 to 1.066) and strong evidence (p<0.001) that the decline of reported transfers in England was greater.

Table 20. Odds ratios for average annual change in reported critical care transfers out of CMP units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.897	0.881-0.913	<0.001
Non-England 2000-2006	11	1.010	0.956-1.066	
England 1998-2000	96	1.026	0.984-1.071	<0.001
England 2000-2006		0.884	0.869-0.900	

Influence of organisational changes on reported transfers to other units

Before 2000 there was no evidence for a difference in the trend in reported transfers between units located in earlier or later adopter networks (Table 21) whereas after 2000 units located in later adopter networks showed a faster decline in the odds of reported transfer (14.0% versus 4.6% per year, p<0.001).

There was no evidence that earlier adopter and later adopter units differed up to 2000 (p=0.411) but after 2000 the odds of reported transfers out of early adopter units declined at a faster rate than for the later adopter units (13.6% versus 10% per year, p=0.040).

Units that experienced the largest growth in capacity also experienced the greatest reduction in reported transfers out since 2000 (on average by 18.5% per year compared with 8.9% for units with <20% increased capacity and 5.0% for units with 20-50% increased capacity) and there were no difference in trends before 2000.

Table 21.Odds ratios (95% confidence intervals) for annual trends in reported critical care transfers out of units

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	1.119 (1.030-1.217)	reference	0.954 (0.925-0.983)	reference
later adopter	57	1.043 (0.987-1.102)	0.167	0.860 (0.841-0.880)	<0.001
other	12	0.856 (0.768-0.953)	<0.001	0.830 (0.788-0.874)	<0.001
Units					
earlier adopter	59	1.067 (1.014-1.124)	reference	0.864 (0.846-0.883)	reference
later adopter	36	1.023 (0.938-1.116)	0.411	0.900 (0.871-0.930)	0.040
Increase in capacity 2000-2004					
<20%	40	1.043 (0.978-1.113)	reference	0.911 (0.887-0.936)	reference
20-50%	26	0.953 (0.866-1.049)	0.118	0.950 (0.917-0.985)	0.062
>50%	33	1.052 (0.980-1.128)	0.886	0.815 (0.791-0.839)	<0.001

An alternative approach to evaluating the impact of organisational changes on reported transfers is to examine the percentage of admissions who were unplanned transfers into CMP units from other ICUs. Figure 14 shows how reported transfers into CMP units in England followed a similar pattern to reported transfers out: increasing in 1999 and steadily decreasing after

2000. For units outside England the percentage of reported transfers was lower in 2000 but similar by 2005.

Figure 14. Percentage of reported transfers from another ICU 1998-2006
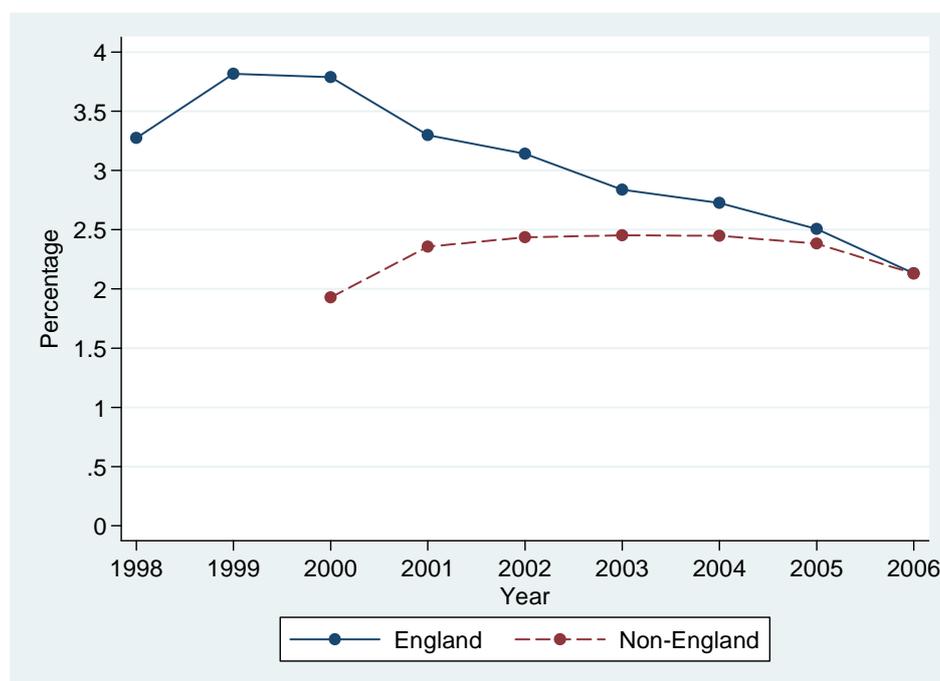
Table 22 shows odds ratios for trends in reported transfers into CMP units after adjusting for case-mix. The effects are similar to those reported for reported transfers out of CMP units (Table 20) with a slight increase (OR 1.040, 95% CI 1.007 to 1.074) of 4.0% per year before 2000 for units in England followed by a strong decline of 9.2% per year on average (p<0.001 for difference in trends). After 2000 the decline in units in England was also much greater than the (lack of) decline in units outside England (p<0.001).

Table 22. Odds ratios for average annual change in reported critical care transfers into units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.912	0.899-0.924	<0.001
Non-England 2000-2006	11	0.992	0.954-1.031	
England 1998-2000	96	1.040	1.007-1.074	<0.001
England 2000-2006		0.908	0.896-0.920	

Influence of organisational changes on reported transfers

In the period 1998-2000 there was no evidence that trends in reported transfers into CMP units in England was associated with whether units were in earlier or later adopter networks or with the extent of changes in their capacity (Table 23). After 2000 there was evidence that reported transfers

reduced at a faster rate in units located in later adopter networks compared with units in earlier adopter networks (p=0.003) and that units that experienced the greatest growth also reduced reported transfers at a faster rate (p<0.001). These findings are consistent with the analysis of reported transfers out of units reported above.

There was evidence that later adopter units experienced comparatively greater declines in reported transfers into the unit both before (p=0.034) and after (p=0.007) 2000 when compared with their earlier adopter counterparts. For reported transfers out of the unit (Table 21) there was no significant difference in trends before 2000 although the effect was smaller but in the same direction. After 2000 the analysis of reported transfers out of CMP units shows a significant effect in the opposite direction (a faster decline in earlier adopters). This would support the hypothesis that if earlier adopter units are better at managing capacity and reduce the number of patients they need to transfer out to another unit, then other units experience fewer patients transferred in. A less well managed unit may need to transfer out more patients which will be transferred in to other units, with better managed units potentially more likely to be able to receive these transfers. What is unclear is why a similar relationship was not observed for increase in capacity.

Table 23. Odds ratios (95% confidence intervals) for annual trends in reported critical care transfers into units

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	1.069 (1.009-1.133)	reference	0.934 (0.912-0.956)	reference
later adopter	57	1.021 (0.979-1.065)	0.211	0.894 (0.878-0.910)	0.003
other	12	1.068 (0.969-1.178)	0.988	0.914 (0.878-0.951)	0.358
Units					
earlier adopter	59	1.059 (1.019-1.101)	reference	0.913 (0.899-0.928)	reference
later adopter	36	0.975 (0.912-1.042)	0.034	0.875 (0.853-0.899)	0.007
Increase in capacity 2000-2004					
<20%	40	1.060 (1.010-1.112)	reference	0.938 (0.919-0.957)	reference
20-50%	26	1.052 (0.976-1.134)	0.871	0.935 (0.908-0.963)	0.872
>50%	33	1.002 (0.949-1.058)	0.127	0.856 (0.837-0.876)	<0.001

Early discharges due to a shortage of unit beds

The reduction in the reported number of patients discharged early due to a shortage of beds in a unit is illustrated in Figure 15. In England the percentage of reported early discharges declined from 7.1% in 1998 to 3.3% in 2006. Units outside England started with higher rates of reported early discharge (16.1%) which declined to 5.3% by 2006.

Figure 15. Percentage of patients reported as discharged early due to a shortage of unit beds
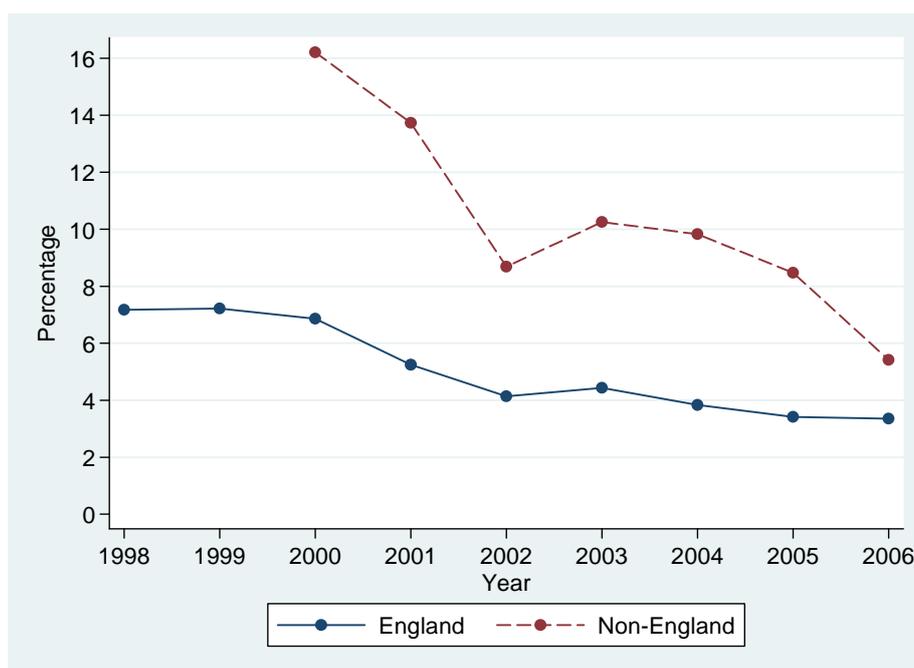
Logistic regression analysis adjusted for case-mix shows that in England there was a decline in the odds of reported early discharge of 9.1% per year up to the end of 2000 and 11.5% per year afterwards (Table 24). The difference in these trends was not statistically significant (p=0.109). The decline observed in units outside England was significantly greater than the decline in England in the period 2000-2006 (p<0.001).

Table 24. Odds ratios (95% confidence intervals) for annual change in reported early discharges by country and time-period

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.894	0.883-0.906	<0.001
Non-England 2000-2006	11	0.843	0.824-0.862	
England 1998-2000	96	0.909	0.884-0.935	0.107
England 2000-2006		0.885	0.875-0.896	

Influence of organisational changes on reported early discharges

Before 2000 there was no evidence that trends in reported early discharges differed depending on the type of network (Table 25). Significant differences were found in the decline after 2000 with units in later adopter networks experiencing faster declines (both p<0.001).

The extent to which the units themselves were earlier or later adopters was associated with different trends both prior to 2000 (when later adopters reported a faster decline in patients discharged early) and after 2000 (when the earlier adopters reported a faster decline).

Units that had the greatest growth in capacity between 2000 and 2004 also reported the biggest decline in the odds of early discharge both before and after 2000 (at an average decline of 17.9% and 18.8% respectively). Rates of decline in units that increased capacity by <20% and 20%-50% were similar after 2000 (p=0.989) but declined comparatively faster before 2000 in the units that grew by 20%-50%.

Table 25. Odds ratios (95% confidence intervals) for annual trends in reported early discharges

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	0.919 (0.867-0.974)	reference	0.952 (0.929-0.975)	reference
later adopter	57	0.892 (0.861-0.924)	0.393	0.863 (0.850-0.877)	<0.001
other	12	0.975 (0.906-1.049)	0.214	0.878 (0.850-0.906)	<0.001
Units					
earlier adopter	59	0.928 (0.897-0.960)	reference	0.874 (0.860-0.887)	reference
later adopter	36	0.835 (0.792-0.880)	0.001	0.916 (0.896-0.936)	0.001
Increase in capacity 2000-2004					
<20%	40	1.025 (0.981-1.071)	reference	0.928 (0.912-0.946)	reference
20-50%	26	0.918 (0.859-0.982)	0.007	0.928 (0.904-0.953)	0.989
>50%	33	0.821 (0.786-0.859)	<0.001	0.812 (0.795-0.830)	<0.001

Night discharges

Figure 16 shows the increase in the percentage of patients who are discharged between the hours of 00:00 and 04:59. For units in England rates steadily increased from 2.7% in 1998 to 3.9% in 2006. Rates for units

outside England followed a similar pattern until 2006 when there was a drop to 2.7%.

Figure 16. Night discharges (between 00:00 and 04:59) as a percentage of all discharges
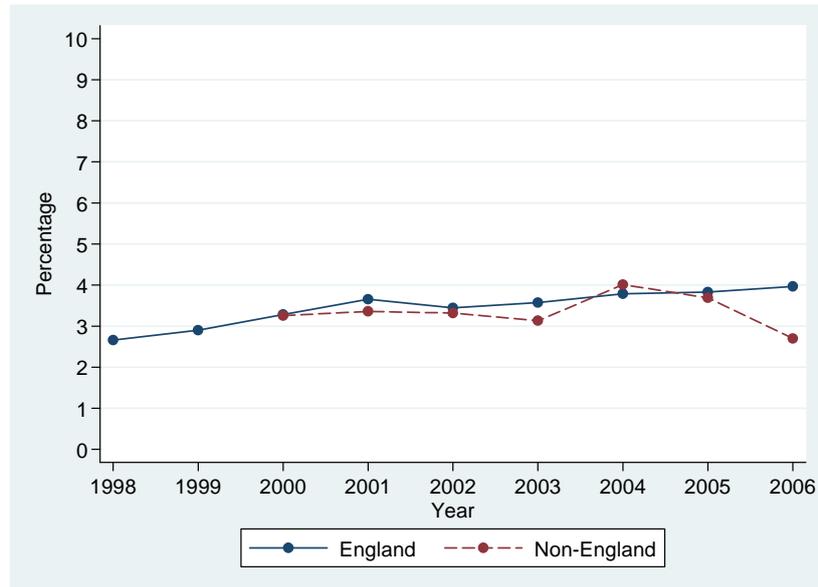
When the definition of a night discharge is broadened (22:00-06:69) there is still an increasing trend over time, rising from 6.4% in 1998 to 10.0% in 2006 (Figure 17). The percentage of night discharges in units outside England has shown more fluctuation but is based on smaller numbers.

**Figure 17. Night discharges (between 22:00 and 06:59) as a percentage of all discharges**
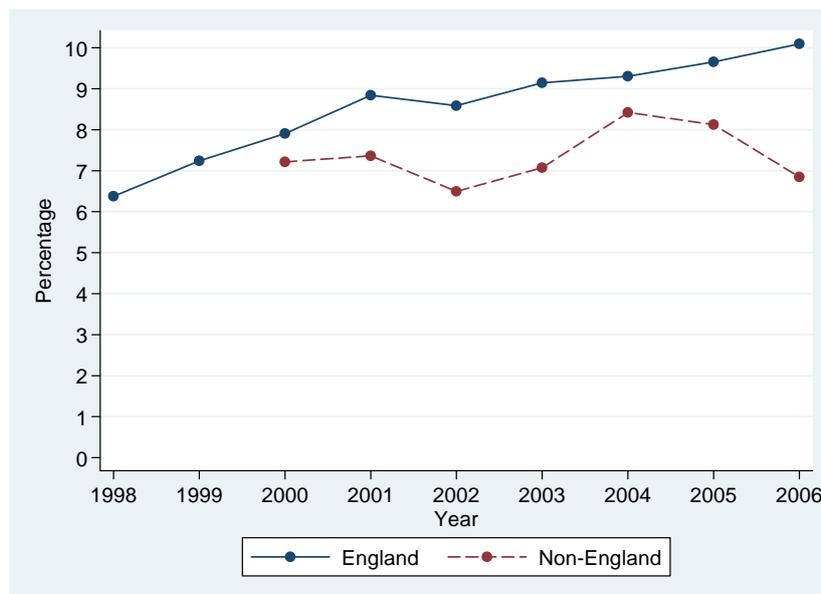
Patients are discharged to a variety of places and for different reasons. For the period 1998-2000 the percentage of night discharges between 00:00-

04:59 reported as early discharges due to a shortage of unit beds was 46.2% (36.0% for discharges between 22:00-06:59) compared with 4.2% reported for day discharges. By 2004-2006 the percentage of reported early discharges had declined to 25.1% (18.2% for discharges between 22:00-06:59) but was still much higher than the 1.7% reported for day discharges.

The reduction in reported early discharges at night was offset by an increase in the percentage of discharges reported as ready for discharge. For night discharges between 00:00-04:59 this increased from 38.6% in the period 1998-2000 to 64.1% in 2004-2006.

Further analysis of night discharges focused on the subgroup of patients who were discharged to wards and were ready for discharge (including reported delayed discharges due to a shortage of ward beds). Patients transferred to other units or discharged for palliative care or where treatment was withdrawn were excluded.

Table 26 shows that in England the rate of increase in night discharges has slowed (p=0.008 for 00:00-04:59 discharges) since 2000 but still demonstrates an upward trend (odds increasing on average by 9.5% per year for 00:00-04:59 discharges). Since 2000 night discharges outside England increased at similar rates.

Table 26. Odds ratios for annual change in the number of appropriate discharges to wards who were discharged at night

	n	Odds ratio	95% confidence interval	p-value for difference in trends
Discharged 00:00-04:59				
England 2000-2006	104	1.101	1.077-1.125	0.913
Non-England 2000-2006	11	1.095	0.996-1.203	
Discharged 22:00-06:59				
England 2000-2006	104	1.087	1.073-1.101	0.267
Non-England 2000-2006	11	1.120	1.063-1.180	
Discharged 00:00-04:59				
England 1998-2000	96	1.231	1.146-1.323	0.008
England 2000-2006		1.094	1.071-1.118	
Discharged 22:00-06:59				
England 1998-2000	96	1.192	1.145-1.242	<0.001
England 2000-2006		1.086	1.072-1.100	

Table 27 shows that before 2000, discharges at night were increasing at a faster rate in units located in later than in earlier adopter networks. After 2000, night discharges in units in earlier adopter networks were increasing at the fastest rate.

For earlier adopter units there were no differences in trends prior to 2000 compared with the later adopter units, though after 2000 discharges between 22:00-06:59 were increasing at a faster rate (p=0.005). However, for discharges between 00:00-04:59, where there remains a mortality differential compared with day discharges, the rate of increase was not higher compared with later adopters.

Before 2000 the units that subsequently increased in size by 20-50% had the lowest rate of increase in night discharges although post-2000 there were no differences in trends for 00:00-04:59 night discharges with respect to growth in capacity.

Table 27. Odds ratios for annual change in the number of appropriate discharges to wards who were discharged at night

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Networks					
Discharged 00:00-04:59					
earlier adopter	27	1.018 (0.891-1.163)	reference	1.168 (1.117-1.222)	reference
later adopter	57	1.317 (1.195-1.451)	0.020	1.074 (1.044-1.104)	0.011
other	12	1.331 (1.109-1.598)	0.002	1.068 (1.014-1.125)	0.002
Discharged 22:00-06:59					
earlier adopter	27	1.040 (0.961-1.125)	reference	1.162 (1.132-1.193)	reference
later adopter	57	1.231 (1.167-1.299)	0.001	1.060 (1.042-1.078)	<0.001
other	12	1.322 (1.190-1.469)	<0.001	1.075 (1.044-1.108)	<0.001
Units					
Discharged 00:00-04:59					
earlier adopter	59	1.258 (1.152-1.375)	reference	1.092 (1.062-1.122)	reference
later adopter	36	1.216 (1.046-1.414)	0.701	1.138 (1.093-1.185)	0.095
Discharged 22:00-06:59					
earlier adopter	59	1.222 (1.162-1.285)	reference	1.082 (1.065-1.100)	reference
later adopter	36	1.165 (1.073-1.266)	0.337	0.993 (0.950-1.038)	0.005
Increase in capacity 2000-2004					
Discharged 00:00-04:59					
<20%	40	1.206 (1.068-1.361)	reference	1.094 (1.050-1.140)	reference
20-50%	26	0.961 (0.812-1.137)	0.032	1.113 (1.057-1.173)	0.600
>50%	33	1.359 (1.218-1.515)	0.151	1.088 (1.057-1.121)	0.850
Discharged 22:00-06:59					
<20%	40	1.157 (1.084-1.235)	reference	1.064 (1.039-1.089)	reference
20-50%	26	1.016 (0.921-1.121)	0.030	1.117 (1.085-1.151)	0.011
>50%	33	1.332 (1.249-1.422)	0.003	1.086 (1.067-1.106)	0.172

Delayed discharges due to a shortage of ward beds

Figure 18 illustrates the increasing number of patients in England whose discharges are reported as delayed due to a shortage of ward beds. In 1998 just 2.7% of discharges were reported as delayed but this rate had risen to 14.2% by 2006. Units outside England also showed indications of an increasing trend from 2000 though this has reversed since 2003. However, some caution is needed in interpreting data on reported delayed discharges because observed differences may include changes (for example, greater reliability) in reporting as well as changes in actual delayed discharges.

Figure 18. Percentage of patients with reported delayed discharge
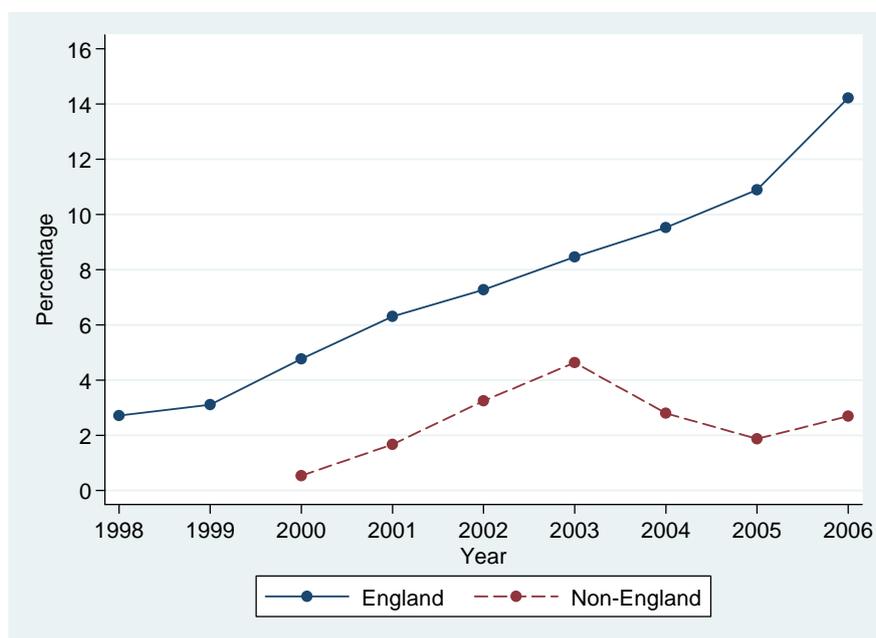
Regression analysis adjusted for case-mix shows that in England the odds of discharges being reported delayed increased by an average of 40.7% per year in the period 1998-2000 and by 20.0% per year after 2000 (Table 28). The rate of increase in England was significantly lower after 2000 (p<0.001) but still significantly greater than that outside England (4.5% per year) (p<0.001).

Table 28. Odds ratios for annual change in reported delayed discharges between England and non-England units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-6	104	1.198	1.187-1.210	<0.001
Non-England 2000-6	11	1.048	1.003-1.094	
England 1998-2000	96	1.407	1.356-1.459	<0.001
England 2000-6		1.200	1.189-1.211	

Influence of organisational changes on reported delayed discharges

The increase in reported delayed discharges was greatest in units located in earlier adopter networks during the periods before and after 2000 (Table 29). After 2000 the odds of reported delayed discharge increased on average by 33% per year, twice the rate for units in the later adopter networks (14.4%).

Before 2000 there was no evidence to suggest any difference between earlier and later adopter units but after 2000 the earlier adopter units reported delayed discharges were increasing faster than in the later adopter units (p<0.001). Units that experienced the greatest growth in capacity between 2000 and 2004 had the largest increase in reported delayed discharges before 2000 and the smallest increase afterwards.

Table 29. Odds ratios for annual change in reported delayed discharges

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	1.750 (1.603-1.910)	reference	1.330 (1.307-1.354)	reference
later adopter	57	1.440 (1.374-1.509)	<0.001	1.144 (1.130-1.159)	<0.001
other	12	1.145 (1.056-1.241)	<0.001	1.161 (1.132-1.191)	<0.001
Units					
earlier adopter	59	1.414 (1.354-1.476)	reference	1.231 (1.217-1.245)	reference
later adopter	36	1.387 (1.288-1.493)	0.659	1.094 (1.073-1.116)	<0.001
Increase in capacity 2000-2004					
<20%	40	1.273 (1.206-1.343)	reference	1.214 (1.195-1.233)	reference
20-50%	26	1.078 (0.984-1.181)	0.002	1.202 (1.172-1.233)	0.532
>50%	33	1.738 (1.635-1.849)	<0.001	1.185 (1.169-1.202)	0.027

Unit discharges directly home or to normal place of residence

Figure 19 shows an upward trend in the percentage of admissions who are discharged directly home or to their normal place of residence for units in England but no such trend for units outside England. By 2006 2.1% of discharges from units in England were to the a patient's normal residence.

Figure 19. Percentage of patients discharged directly home or to normal place of residence by country and year
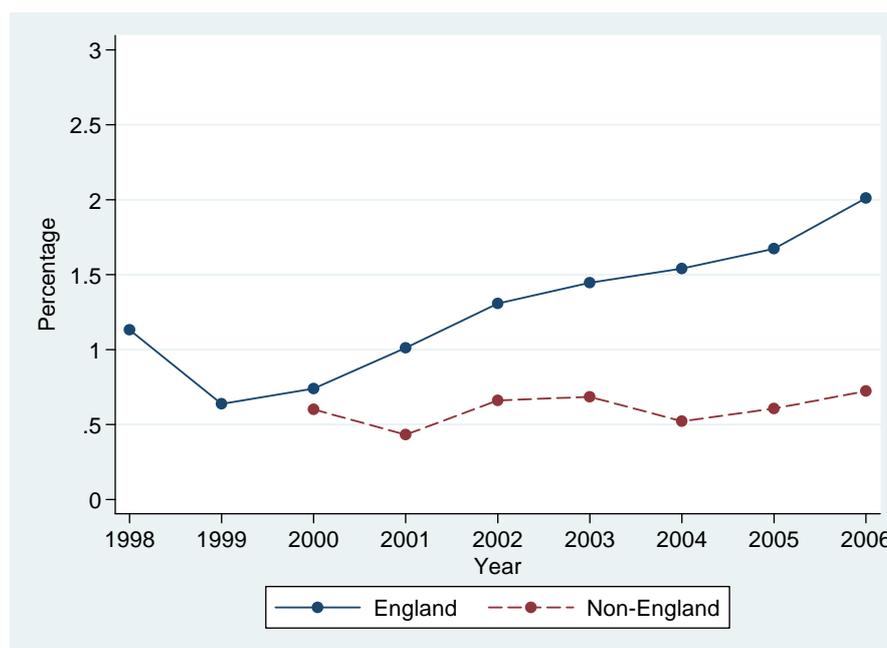
Regression analysis, adjusted for case-mix, showed that for units in England the trend was not significantly greater after 2000 than before, though it was for units outside England (p=0.029).

Table 30. Odds ratios for annual change in discharge directly home or to normal place of residence between England and non-England units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	1.155	1.129-1.181	0.029
Non-England 2000-2006	11	1.047	0.961-1.141	
England 1998-2000	96	1.129	1.052-1.211	0.376
England 2000-2006		1.173	1.147-1.199	

Influence of organisational changes on discharges directly home

There was some suggestion that units in later adopter networks experienced a faster increase after 2000 (p=0.045) (Table 31). No significant differences were found in trends for discharges home with respect to growth in capacity or whether units were earlier or later adopters.

Table 31. Odds ratios for annual change in discharge directly home or to normal place of residence

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	1.259 (1.069-1.482)	reference	1.141 (1.089-1.195)	reference
later adopter	57	1.140 (1.040-1.250)	0.301	1.206 (1.172-1.241)	0.045
other	12	0.993 (0.858-1.151)	0.035	1.101 (1.045-1.159)	0.318
Units					
earlier adopter	59	1.104 (1.014-1.201)	reference	1.180 (1.148-1.213)	reference
later adopter	36	1.073 (0.932-1.235)	0.739	1.211 (1.163-1.262)	0.291
Increase in capacity 2000-2004					
<20%	40	1.066 (0.963-1.180)	reference	1.154 (1.112-1.198)	reference
20-50%	26	1.185 (0.990-1.418)	0.317	1.130 (1.076-1.187)	0.504
>50%	33	1.251 (1.101-1.422)	0.054	1.203 (1.163-1.244)	0.106

Summary (trends in process measures)

There have been minor changes in the case mix of admissions to critical care units in England. The source of admissions, primary diagnosis and percentage of admissions with comorbidities have remained fairly stable and there have been small increases in the mean age of admissions and the percentage of female admissions. There has also been a reduction in the percentage of cardiovascular admissions. Between 2000 and 2006 the mean predicted hospital mortality of admissions has fallen slightly (more so for units with the largest increases in capacity) whereas units outside England have witnessed a slight increase in predicted mortality.

There has been a substantial decline in the frequency of transfers to and from other critical care units since 2000 which was associated with increased capacity and later network adoption. The frequency of early discharges of patients due to a shortage of unit beds declined substantially between 1998-2000 and since 2000. The decline since 2000 was also associated with increased capacity and later network adoption.

The frequency of discharges at night (00:00-04:59) has continued to increase post-2000 but at a slower rate than before. However, a higher

proportion of night discharges are reported by clinical staff as ready for discharge rather than due to pressure to vacate unit beds.

The frequency of patients whose discharge was reported as delayed due to a shortage of ward beds increased substantially from 1998-2006. Since 2000 this trend was stronger in units that were earlier adopters of outreach and the ventilator care bundle, whereas increased capacity and later network adoption were associated with a smaller increase. There has also been an upward trend in the frequency of patients discharged directly home from the unit to their normal place of residence though this trend shows little association with modernisation or increased capacity.

3.3.4 Trends in outcomes

Critical care unit mortality

Changes in the crude mortality before discharge from a critical care unit is shown in Figure 20. For units in England mortality increased between 1998 and 2000 to 22% and then declined steadily, reaching 19% in 2006. Crude unit mortality also declined in the period 2000-2006 for units outside England. It should be noted that these rates do not take into account any changes in case mix.

Figure 20. Unit mortality in admissions to CMP units 1998-2006
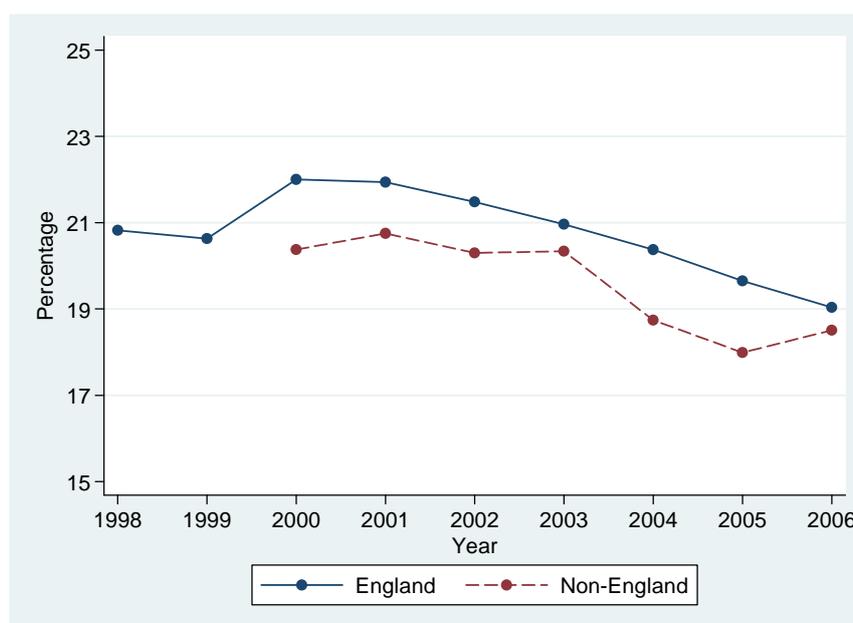
Adjustment for case-mix using regression analysis (ICNARC model) are shown in Table 32. The odds ratios represent the average annual change in unit mortality for the time periods 1998-2000 and 2000-2006. Between

1998-2000 there was no change in the case-mix adjusted odds ratio (1.000, 95% CI 0.983 to 1.018) for units in England, which suggests that the increase in Figure 20 is due to changes in case-mix. After 2000 case-mix adjusted unit mortality fell by an average of 3.9% a year (OR 0.961, 95% CI 0.955 to 0.967). The difference in trends in England before and after 2000 was statistically significant (p<0.001). However, the annual decline in unit mortality outside England after 2000 was 7.0%, significantly greater than in England (p=0.001).

Table 32. Odds ratios for annual change in critical care unit mortality between England and non-England units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.961	(0.954-0.967)	0.001
Non-England 2000-2006	11	0.930	(0.913-0.947)	
England 1998-2000	96	1.000	(0.983-1.018)	<0.001
England 2000-2006		0.961	(0.955-0.967)	

Influence of organisational changes on unit mortality

Trends in the odds of case-mix adjusted unit mortality differed according to whether a unit was located in an earlier or later adopter network (Table 33). For the period 1998-2000 the 27 units in earlier adopter networks experienced a greater decline in mortality (5.0%) than those in later adopter networks (3.2%) (OR 0.950, 95% CI 0.919 to 0.982) (p<0.001 for difference in trends). However, after 2000 the situation reversed. On average units in each type of network experienced declines in unit mortality but the decline was greater for the units located in the later adopter networks (reduction 4.7% versus 2.8% per year, p=0.012).

Earlier adopter units experienced a comparatively greater reduction in unit mortality than later adopter units up to 2000 (p=0.042) but there was no significant difference after 2000 (p=0.109). Units that experienced little growth (<20%) in capacity between 2000-2004 experienced a greater reduction in unit mortality both before (p=0.007) and after 2000 (p=0.029) when compared against units that grew by more than 50%.

Table 33. Odds ratios (95% confidence intervals) for average annual change in critical care unit mortality in 96 units in England

	Units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	0.950 (0.919-0.982)	reference	0.972 (0.960-0.984)	reference
later adopter	57	1.032 (1.009-1.056)	<0.001	0.953 (0.945-0.961	0.012
non-moderniser	12	0.978 (0.936-1.022)	0.287	0.972 (0.957-0.987)	0.982
Units					
earlier adopter	59	0.989 (0.968-1.011)	reference	0.960 (0.952-0.968)	reference
later adopter	36	1.031 (0.997-1.067)	0.042	0.971 (0.960-0.983)	0.109
Increase in capacity 2000-2004					
<20%	40	0.985 (0.959-1.011)	reference	0.949 (0.940-0.959)	reference
20-50%	26	0.957 (0.919-0.998)	0.263	0.976 (0.962-0.990)	0.002
>50%	33	1.040 (1.010-1.070)	0.007	0.965 (0.955-0.975)	0.029

Ultimate hospital mortality

Crude rates of ultimate hospital mortality in England increased in the period up to 2000 to 33.1% of admissions followed by a decline from 2001 onwards to 28.6% in 2006 (Figure 21). The trend was less clear for units outside England but appeared to show a decline in mortality.

Figure 21. Crude hospital mortality
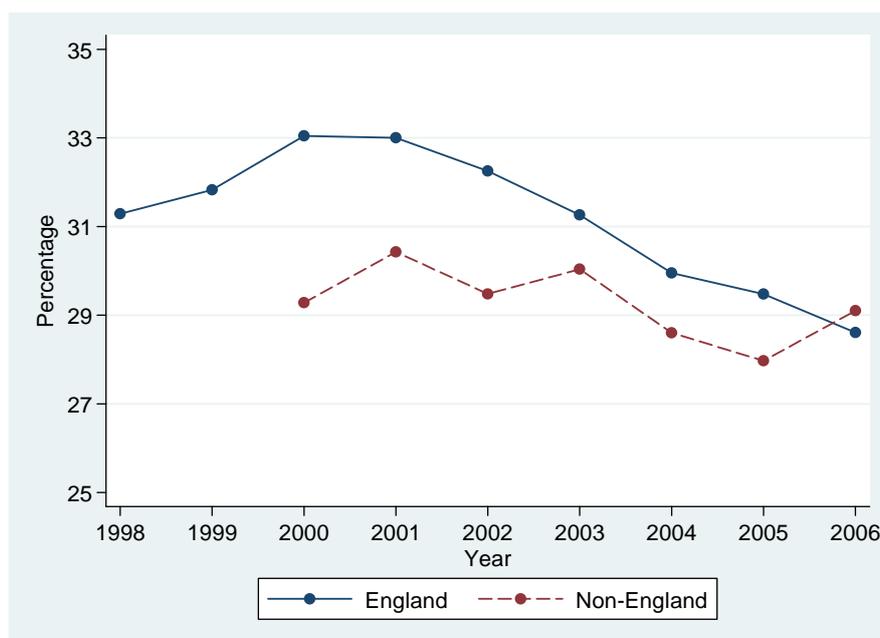
After adjusting for case-mix there was no longer an increase in hospital mortality in units in England before 2000 although there was still a significant decline after 2000 of 5.5% per year in the odds of mortality (OR 0.945, 95% CI 0.939 to 0.950). The difference in trends between the two time periods was statistically significant (p<0.001). However, a similar decline was seen among units outside England after 2000 similar to that in England (p=0.666).

Table 34. Odds ratios for annual change in case-mix adjusted hospital mortality between England and non-England units and by time period

	n	Odds ratio	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.944	0.938-0.950	0.666
Non-England 2000-2006	11	0.948	0.933-0.963	
England 1998-2000	96	1.003	0.987-1.019	<0.001
England 2000-2006		0.945	0.939-0.950	

Influence of organisational changes on hospital mortality

Before 2000 case-mix adjusted mortality in units located in earlier adopter networks were declining by 4.5% per year whereas it was increasing by 4.0% per year among units in later adopter networks (Table 35). After 2000

this relationship reversed and units located in the later adopter networks declined faster (6.6% versus 4.6% reduction per year (p=0.002).

Findings for the earlier adopter units were similar, with these units showing a slight but not statistically significant decline before 2000 while mortality increased in the later adopter units (p=0.002 for difference in trends). After 2000 the later adopter units reported a faster decline (6.5% versus 5.0% per year, p=0.015).

After 2000 there were no differences in the decline in mortality with respect to changes in capacity although the units that increased in size by >50% reported an increasing trend in mortality prior to 2000.

Table 35. Odds ratios for annual change in ultimate hospital mortality between England and non-England units and by time period

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Network					
earlier adopter	27	0.955 (0.927-0.984)	reference	0.954 (0.943-0.964)	reference
later adopter	57	1.040 (1.019-1.062)	<0.001	0.934 (0.926-0.941)	0.002
other	12	0.960 (0.924-0.999)	0.819	0.968 (0.955-0.982)	0.099
Units					
earlier adopter	59	0.990 (0.971-1.009)	reference	0.950 (0.943-0.957)	reference
later adopter	36	1.047 (1.016-1.080)	0.002	0.935 (0.924-0.945)	0.015
Increase in capacity 2000-2004					
<20%	40	0.982 (0.959-1.006)	reference	0.943 (0.934-0.952)	reference
20-50%	26	0.996 (0.959-1.034)	0.540	0.952 (0.939-0.964)	0.290
>50%	33	1.031 (1.005-1.058)	0.006	0.944 (0.935-0.953)	0.934

Length of stay

The mean length of stay in critical units in England rose from about 4.6 days in 1998 to about 5.5 days in 2001 since when there has been little change (Figure 22). The length of stay in units outside England has remained longer at 5.5-6.0 days throughout this period.

Figure 22. Mean unit length of stay for England and non-England units
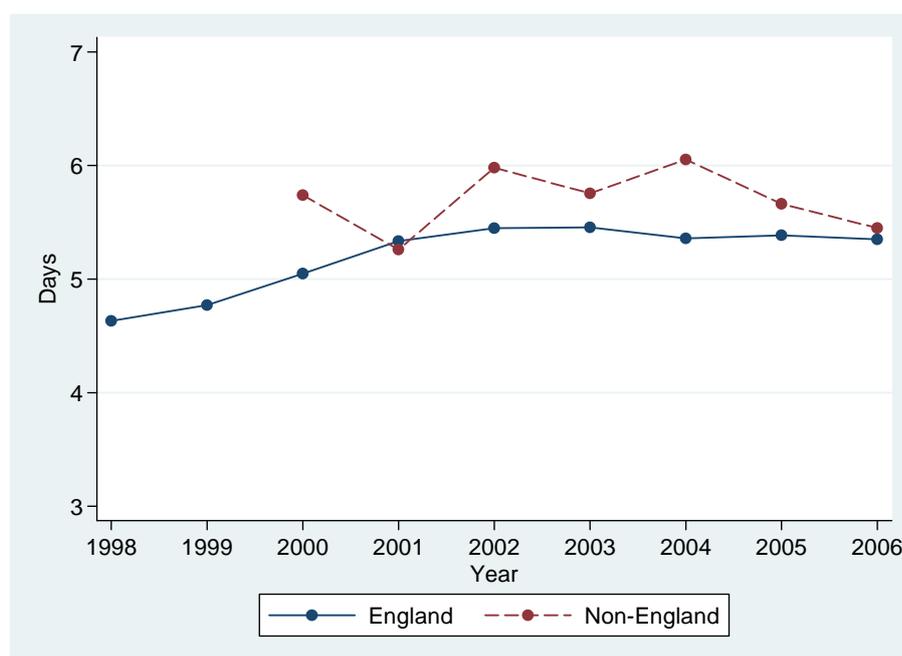
After adjusting for case-mix differences, a significant difference in trends was apparent before and after 2000 (Table 36). Whereas the mean length of stay was increasing in England before 2000 by 0.243 days a year, the increase was only 0.036 days a year afterwards (p<0.001). Since 2000, the mean length of stay in non-English units declined by 0.065 days a year, significantly different from the English experience (p=0.004)

Table 36. Regression coefficients for annual change in mean length of stay between countries and by time period

	n	Average annual change (days)	95% confidence interval	p-value for difference in trends
England 2000-2006	104	0.025	0.003, 0.047	0.004
Non-England 2000-2006	11	-0.065	-0.122, -0.007	
England 1998-2000	96	0.243	0.188, 0.298	<0.001
England 2000-2006		0.036	0.015, 0.056	

Influence of organisational changes on length of stay

Before 2000 there was no significant difference in annual change in mean length of stay (case-mix adjusted) between earlier and later adopter network (Table 37). After 2000, the mean length of stay in units in later adopter networks (0.015 days a year) did not increase as much as those in earlier adopter networks (0.089 days a year) (p=0.003).

Similarly, there was no significant difference between earlier and later adopter units before 2000 but there was after 2000. The mean length of

stay in later adopter units fell by 0.024 days a year whereas in earlier adopter units it continued to increase (0.072 days a year) (p<0.001).

There were no differences in changes in mean length of stay before or after 2000 according to changes in capacity in units.

Table 37. Odds ratios for annual change in length of stay between England and non-England units and by time period

	units (n)	Average annual change (days) 1998-2000q4	p-value for difference	Average annual change (days) 2000 q4-2006	p-value for difference
Network					
earlier adopter	27	0.177 (0.072, 0.282)	reference	0.089 (0.049, 0.128)	reference
later adopter	57	0.280 (0.206, 0.353)	0.116	0.015 (-0.013, 0.042)	0.003
other	12	0.236 (0.099, 0.373)	0.504	0.021 (-0.030, 0.072)	0.040
Units					
earlier adopter	59	0.235 (0.168, 0.301)	reference	0.072 (0.046, 0.097)	reference
later adopter	36	0.195 (0.087, 0.302)	0.534	-0.024 (-0.063, 0.014)	<0.001
Increase in capacity 2000-2004					
<20%	40	0.282 (0.200, 0.364)	reference	0.043 (0.010, 0.075)	reference
20-50%	26	0.237 (0.108, 0.367)	0.569	-0.005 (-0.050, 0.040)	0.092
>50%	33	0.200 (0.112, 0.288)	0.184	0.051 (0.019, 0.083)	0.727

Readmissions to the unit within 24 or 48 hours of discharge

The percent of patients in England who were readmitted within 24 hours of discharge showed a slight a decline from about 1.2% in 1998 to just under 1.0% by 2006 (Figure 23). The decline is more striking for readmissions within 48 hours but this only started after 2001 having previously been increasing. By contrast, readmissions to units outside England tended to rise.

Figure 23. Percentage of patients re-admitted within 24 or 48 hours of unit discharge by country and year
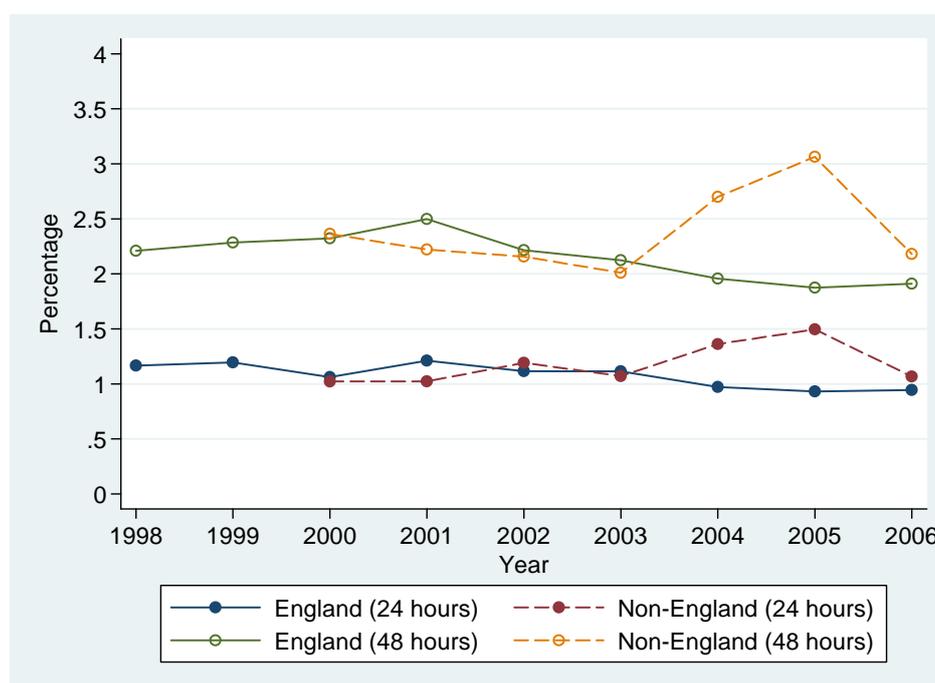
England - solid line, non-England - dashed line; Within 48 hours - hollow markers, within 24 hours - solid markers

After adjusting for case-mix any difference in trends in readmissions within 24 hours before and after 2000 was not significant (p=0.451) though it was for readmissions within 48 hours, with a greater decline after 2000 (p=0.007). The decline in English units was greater than units outside England both for readmissions within 24 (p=0.21) and 48 (p=0.002) hours.

Table 38. Odds ratios for annual change in readmission within 24 and 48 hours of unit discharge in England and non-England units

	n	Odds ratio	95% confidence interval	p-value for difference in trends
Readmitted within 24 hours				
England 2000-2006	104	0.951	0.929-0.974	0.021
Non-England 2000-2006	11	1.024	0.965-1.086	
Readmitted within 48 hours				
England 2000-2006	104	0.952	0.936-0.968	0.002
Non-England 2000-2006	11	1.020	0.978-1.064	
Readmitted within 24 hours				
England 1998-2000	96	0.989	0.932-1.048	0.451
England 2000-2006		0.958	0.937-0.981	
Readmitted within 48 hours				
England 1998-2000	96	1.027	0.984-1.072	0.007
England 2000-2006		0.953	0.937-0.969	

Influence of organisational changes on readmissions

There was no strong evidence that trends in readmissions within 24 and 48 hours of discharge differed according to the adopter status of the network or unit or the increase in unit capacity (Table 39).

Table 39. Odds ratios for annual change in readmission within 24 and 48 hours of unit discharge

	units (n)	Average annual change 1998-2000q4	p-value for difference	Average annual change 2000q4-2006	p-value for difference
Networks					
Readmitted within 24 hours					
earlier adopter	27	0.986 (0.881-1.104)	reference	0.972 (0.930-1.016)	reference
later adopter	57	0.986 (0.912-1.066)	0.999	0.947 (0.918-0.977)	0.957
other	12	1.005 (0.868-1.164)	0.839	0.974 (0.922-1.028)	0.354
Readmitted within 48 hours					
earlier adopter	27	1.041 (0.959-1.130)	reference	0.968 (0.939-0.999)	reference
later adopter	57	1.031 (0.974-1.091)	0.847	0.936 (0.915-0.957)	0.077
other	12	1.000 (0.898-1.113)	0.560	0.985 (0.947-1.025)	0.500
Units					
Readmitted within 24 hours					
earlier adopter	59	1.008 (0.939-1.081)	reference	0.943 (0.916-0.970)	reference
later adopter	36	0.938 (0.832-1.058)	0.313	0.993 (0.950-1.038)	0.052
Readmitted within 48 hours					
earlier adopter	59	1.017 (0.967-1.069)	reference	0.945 (0.926-0.964)	reference
later adopter	36	1.070 (0.977-1.172)	0.335	0.963 (0.933-0.995)	0.319
Increase in capacity 2000-2004					
Readmitted within 24 hours					
<20%	40	0.957 (0.876-1.045)	reference	0.982 (0.947-1.019)	reference
20-50%	26	0.989 (0.858-1.139)	0.698	0.963 (0.914-1.015)	0.550
>50%	33	1.023 (0.928-1.127)	0.317	0.939 (0.905-0.974)	0.087
Readmitted within 48 hours					
<20%	40	0.994 (0.933-1.059)	reference	0.963 (0.938-0.988)	reference
20-50%	26	1.000 (0.901-1.108)	0.926	0.972 (0.937-1.009)	0.671
>50%	33	1.083 (1.008-1.163)	0.079	0.935 (0.911-0.960)	0.119

Cost-effectiveness of changes in critical care

From 1998 to 2006, after case-mix adjustment, there were small increases in the mean length of stay in England in critical care units, general wards, and in the two combined.

Figure 24. Mean length of stay: raw data and predictions from the regression models*
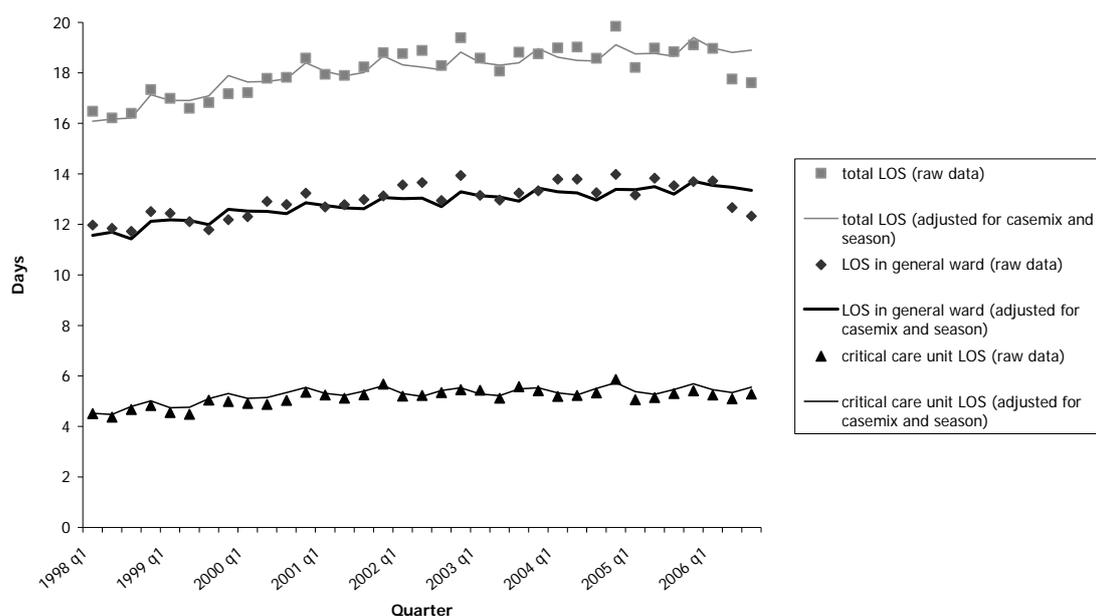
*adjusting for case-mix and season. Source: ICNARC CMP dataset

However, the mean annual increases in LOS (Table 40) were smaller after 2000 than before. It was estimated that the incremental effect of changes implemented from 2000 onwards was therefore to reduce LOS by 0.18 days in the critical care unit (p<0.001); 0.35 days on general wards (p<0.001), and 0.53 days for the overall episode (p<0.001).

Table 40. Annual differences in mean predicted LOS before and after 2000

	Mean annual change (before 2000)	Mean annual change (after 2000)	Increment (95% confidence interval)	P value[+]
Mean unit LOS	0.224	0.040	-0.18 (-0.256 to -0.108)	<0.001
Mean ward LOS	0.460	0.116	-0.348 (-0.52 to -0.16)	<0.001
Mean total LOS	0.684	0.156	-0.528 (-0.736 to -0.324)	<0.001

*adjusting for case-mix and season, + p value refers to the difference in the pre-modernisation and modernisation annual trends

When these LOS data were combined with increasing unit costs in critical care over time, the net effect was that mean costs per patient, both in critical care and for the entire episode, increased over time (Figure 25).

Figure 25. Mean costs per quarter from the raw data and mean predictions from the regression models*
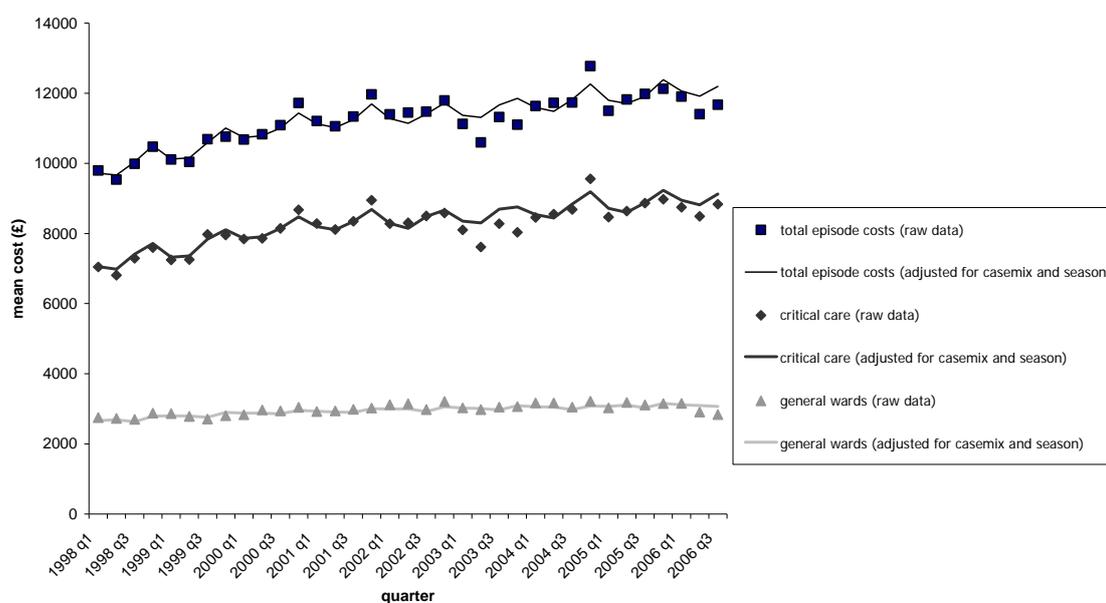
*adjusting for case-mix and season, Source: ICNARC CMP dataset

However, the mean annual cost increases since 2000 were smaller than before. The key factor was the lower annual increases in LOS which dominated any relative increases in unit costs. Hence the overall incremental cost associated with changes since 2000 was negative (-£195; p<0.001).

Table 41. Annual differences in mean predicted* costs before and after 2000

	Mean annual change (before 2000)	Mean annual change (after 2000)	Increment (95% confidence interval)	p value[+]
Mean critical care costs	285	170	-116 (-236 to 5)	0.10
Mean ward costs	106	26	-80 (-120 to -39)	<0.001
Mean episode costs	391	196	-195 (-330 to -59)	<0.001

*adjusting for case-mix and season; + p value refers to the difference in the pre-modernisation and modernisation annual trends

The mean QALYs (Figure 26) mirrored the survival differences reported
After adjusting for case-mix differences, mean QALYs improved slightly over
time.

**Figure 26. Mean QALYs over time. Means for each quarter
taken from the raw data and predicted from the regression
model***
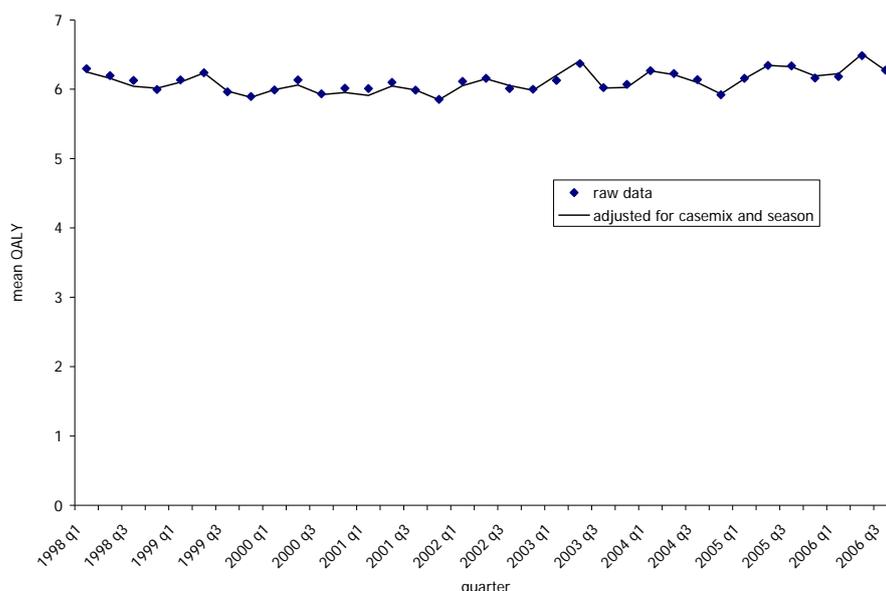
*adjusting for case-mix and season

The annual improvements in the mean adjusted lifetime QALYs were slightly
greater after 2000 and the incremental QALY was positive (0.025) but not
statistically significant (p=0.06). The gain in lifetime QALYs was smaller
than that reported for survival. Firstly, the lifetime QALY gives a lower
payoff to older patients, and the case-mix adjustment did not fully
recognise the increase in the mean age of survivors after 2000. Secondly,
both life expectancy and HRQOL were down-weighted by 20% for these ICU
survivors. Thirdly, future QALYs gained were discounted at 3.5% per
annum.

The NMB combined the effects of modernisation on both QALYs and costs.
The positive incremental QALY (0.025) valued at £20,000 per QALY, coupled
with the negative incremental costs (-£195) gave a positive incremental
NMB (£695, p=0.008). The base case results therefore indicated that, if the
differences in costs and QALYs can be attributed to 'modernisation', then it
can be regarded as a relatively cost-effective intervention.

Table 42. Incremental cost-effectiveness (mean predicted costs, QALYs, and NMB) for 2000-2006 compared with 1998-2000

	Mean annual change (before 2000)	Mean annual change (after 2000)	Increment (95% confidence interval)	p value
Mean QALY	0.040	0.064	0.025 (-0.001 to 0.050)	0.057
Mean cost (£)	391	196	-195 (-330 to -59)	<0.001
Net monetary benefit	402	1,096	692 (176 to 1,208)	0.008

Means adjusted for case-mix, season and admission quarter. P value refers to whether difference in incremental change (before-after 2000) differs from zero

Sensitivity analysis

The sensitivity analysis tested the impact of changing some of the key assumptions made in the base case analysis. The results showed that the main findings (that the modernisation period was associated with improved QALYs, negative incremental costs and positive incremental NMBs) were unchanged.

The base case analysis used trust-specific unit costs which limited the range of unit costs to those trusts with units participating in the CMP. The sensitivity analysis assessed the effect of taking mean ICU unit costs from all English NHS trusts. Using these average unit costs led to a relative decrease in costs post 2000, lower incremental costs and higher incremental NMB (Table 43).

The base case analysis costed critical care using ICU costs. However, units within the CMP include some high dependency care so the sensitivity analysis re-weighted average unit costs to include a high dependency component. The KH03a data suggested that in 2002 (the midpoint year) 20% of beds in general units providing intensive care were high dependency beds.[4] The sensitivity analysis estimated unit costs by initially applying the same weight (20%*HDU unit cost + 80%*ICU Unit cost) to unit costs across the entire period (1998-2006). Using this approach led to a relative reduction in mean costs after 2000 and a lower incremental cost.

The KH03a data indicated that the percentage of high dependency beds in general units providing intensive care increased from 13% in 1998 to 23% in 2006. The next sensitivity analysis recognised this by re-weighting the unit costs using a year-specific weight to reflect the increasing proportion of high dependency beds. The results showed almost identical results compared with the base case.

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[4] The relevant definition of critical care applied to the CMP is general ICU beds in standalone units, or ICU or HDU beds in general combined ICUs/HDUs.

In the base case analysis the case-mix adjustment used separate components of the ICNARC model, baseline probability of death. The sensitivity analysis explored an alternative, used in the main outcome analysis, of using the summary baseline probability of death. The results showed that using this measure led to greater QALY gains, smaller incremental costs and larger incremental NMB associated with modernisation.

The evidence on the long-term survival and HRQoL for ICU survivors is limited. While the base case analysis made the conservative assumption that HRQoL and survival for ICU patients was 80 percent that of the general population, the sensitivity analysis ran a scenario that followed previous cost-effectiveness analysis (Stevens *et al*, 2005) and assumed the same survival and HRQoL as for the general population. This gave greater weight to the survival gain since 2000 and hence yielded a higher incremental NMB compared to the base case. The base case analysis included those units that participated in the CMP for reasonable periods before and after 2000. Extending the analysis to all units (n=159) and cases (n=422 434) led to a higher incremental NMB. Finally, using the same data and assumptions but valuing the QALY gain at £30 000 per QALY (the upper threshold above which NICE tends to regard interventions as unlikely to be cost-effective), increases the INB from £692 to £940.

Table 43. Sensitivity analysis of incremental cost, incremental QALY and incremental net monetary benefit (£)

	Incremental QALY	Incremental Cost	Incremental NMB(£)
Base case	0.025 (0.057)	-195 (<0.001)	692 (0.008)
Unit costs: All trusts	0.025 (0.057)	-278 (<0.001)	773 (0.003)
Unit costs: 20% HDU	0.025 (0.057)	-510 (<0.001)	1,004 (<0.001)
Unit costs: 13-23% HDU	0.025 (0.057)	-226 (<0.001)	720 (0.006)
Summary case-mix adj	0.04 (0.027)	-307 (<0.001)	1,112 (0.002)
No ICU decrement for QALY	0.038 (0.037)	-195 (<0.001)	955 (0.009)
All cases	0.091 (<0.001)	-256 (<0.001)	2,072 (<0.001)
WTP= £30,000 per QALY	0.025 (0.057)	-195 (<0.001)	940 (0.016)

Influence of organisational changes on cost-effectiveness

The mean annual change in costs was significantly lower after 2000 in the later (£95) than in earlier adopter units (£270) (p<0.001) (Table 44). The mean gain in QALYs was similar after 2000 in both groups of units.

However, before 2000 the later adopter units reported lower annual QALY gain (-0.017) compared with the earlier adopter units (0.054) (p=0.003). Hence the net effect was that while NMB increased in the earlier adopter units following modernisation the incremental NMB was small (£964-£743=£221) and not statistically significant (p=0.57). However, in the later adopter units the incremental NMB was large (£2,184) and highly statistically significant (P<0.001).

Table 44. Annual differences (95% confidence intervals) in mean predicted costs, QALYs and NMB, before and after 2000 for earlier and later adopter units

	Mean annual change (before 2000)	p value	Mean annual change (after 2000)	p value
Mean cost (£)				
Earlier adopters	338 (204 to 472)		270 (223 to 317)	
Later adopters	482 (269 to 695)	0.26	95 (24 to 166)	<0.001
Mean QALY				
Earlier adopters	0.054 (0.288 to 0.079)		0.062 (0.053 to 0.07)	
Later adopters	-0.017 (-0.057 to 0.02)	0.003	0.072 (0.059 to 0.086)	0.19
NMB				
Earlier adopters	743 (234 to 1252)		964 (788 to 1143)	
Later adopters	-828 (-1636 to -16)	0.001	1356 (1088 to 1628)	0.002

Note 8 units were unable to be categorised as earlier or later adopters (20,672 cases) and were not included in these analyses; means adjusted for case-mix and seasonality; p value refers to difference in trend earlier versus later adopters

Summary (trends in outcomes and cost-effectiveness)

Major downward trends in case mix adjusted unit mortality and ultimate hospital mortality have occurred since 2000. The odds of unit mortality remained stable up to 2000 but subsequently declined by around 4% per year. However, an even greater decline since 2000 was observed for units outside England. Ultimate hospital mortality followed a similar pattern, remaining stable up to 2000 and then declining by around 5.5% per year (a similar decline of 5.2% was observed in units outside England). Networks that developed earlier and units that adopted modernisation earlier saw a reduction in ultimate hospital mortality up to 2000 whereas networks and units that developed later experienced a stronger downward trend after 2000.

The proportion of patients readmitted to a critical care unit within 24 and 48 hours of discharge declined between 2000-06 by, on average, 4.2% and 4.7% per year respectively. No decline was observed for the period 1998-2000 or between 2000-2006 in units outside England. The trend in England between 2000-2006 did not appear to be associated with increased capacity or adoption of modernisation by networks and units.

Average unit length of stay (including any readmission during the same hospital stay) showed a small upward trend after 2000 compared with a strong upward trend between 1998-2000. However, units outside England saw a fall in average length of stay between 2000-2006. The upward trend

in England after 2000 was stronger in units and networks that adopted modernisation earlier.

Results from the economic evaluation showed a strong trend for increasing costs up to 2000 and a slowing of the trend after 2000, reflecting changes in unit and hospital length of stay. The upward trend in QALYs after 2000 was slightly stronger than the trend between 1998-2000. The incremental effects of costs and QALYs after 2000 produced a significant incremental net monetary benefit for the modernisation period compared with 1998-2000, a finding which was robust to sensitivity analysis. The period 1998-2000 saw an upward trend in NMB for units that adopted modernisation earlier and a downward trend in those that adopted later. However, after 2000 the units that were later in adopting modernisation saw the greater upward trend.

3.3.5 Impact of ventilator care bundle

Analysis of the impact of implementing the ventilator care bundle used data from the 88 units in England and the 11 units outside England in the CMP since 2000 that responded to the care bundle survey. For the units in England over half had implemented the bundle by 2004 though 10 units had not implemented the bundle by 2007.

Table 45. Implementation of the ventilator care bundle by year and country in units in the CMP since 2000

	England		Non-England	
Year	Units implementing bundle (n)	Cumulative percentage	Units implementing bundle (n)	Cumulative percentage
2002	5	6	0	0
2003	19	27	0	0
2004	22	52	1	9
2005	17	72	0	9
2006	7	80	7	73
2007	8	89	2	91
not implemented	10		1	
total	88		11	

There were therefore 245,262 admissions between 2000 and 2006 of whom 145,459 (59%) were mechanically ventilated within the first 24 hours of admission. Ventilated admissions were younger (mean age 59.5 versus 62.0, p<0.001), less likely to be female (41.9% versus 44.3%, p<0.001), had a higher mean ICNARC Model physiology score (22.3 versus 12.7, p<0.001), and had a higher mean predicted mortality (41.3% versus 18.6%, p<0.001).

In the base model (adjusted for case mix components) there was a reduction in hospital mortality (odds ratio 0.935, p=0.014) in patients ventilated within 24 hours of admission (Table 46). There was no significant

reduction in hospital mortality in patients who were not ventilated within the first 24 hours (odds ratio 0.966, p=0.268). The interaction between the two effects was not significant (p=0.329).

Restricting the analyses to the 88 units in England (that are used in the economic evaluation) gives a slightly larger beneficial effect of implementing the bundle (odds ratio 0.924, p=0.005) in ventilated admissions and smaller effect in non-ventilated admissions (0.973, p=0.407), with a p-value of p=0.059 for the interaction between these two effects.

Table 46. Impact of the ventilator bundle on case mix adjusted hospital mortality

	Ventilated in first 24 hours	Not ventilated in first 24 hours	interaction p-value
99 units in CMP since 2000 Hospital mortality: odds ratio (95% confidence interval)	n=141,139 0.935 (0.887 to 0.986) p=0.014	n=99,803 0.966 (0.909 to 1.026) p=0.268	0.329
88 units in CMP since 2000 in England Hospital mortality: odds ratio (95% confidence interval)	n=128,941 0.924 (0.874 to 0.976) p=0.005	n=85,221 0.973 (0.913 to 1.037) p=0.407	0.059

bundle:ventilated interaction model adjusted for case mix components; n=141,139 ventilated admissions due to three-month interruption post-implementation

The sensitivity of the results to variations in the regression models is shown in Table 47. None of the variations had any substantial impact on the odds ratios reported in Table 46. Increasing the interruption period around the time of bundle implementation resulted in p-values closer to 0.05 (p=0.048 with an interruption of 3 months before and 6 months after implementation. However, this was partly due to fewer observations because there was little change in the reported odds ratio.

Table 47. Impact of model specification on estimated effect of the implementation of the ventilator care bundle on hospital mortality

Model	Units (n)	Admissions (n)	Odds ratio (95% confidence interval)	p-value
Adjusted for ICNARC model predicted mortality* Admissions excluded from analysis:	99	141,139	0.934 (0.880 to 0.992)	0.026
within 6 months post-implementation	99	136,238	0.930 (0.870 to 0.994)	0.031
within 6 months post-implementation and 3 months pre-implementation	99	134,715	0.934 (0.878 to 1.000)	0.048
no exclusions	99	145,459	0.927 (0.878 to 0.979)	0.007
Adjustment for changes in unit capacity	90	131,791	0.919 (0.869 to 0.973)	0.004
Adjusting for implementation	70	103,571	0.918	0.011

of outreach services			(0.860 to 0.981)	
Limited to units in England that implemented the bundle by 2006	70	101,347	0.931 (0.875 to 0.991)	0.024
Limited to units in England in the CMP since 2002 that implemented the bundle by 2006	92	121,916	0.934 (0.889 to 0.981)	0.007

* instead of individual components

Adjusting for the potential confounding factors of the introduction of outreach services and growth in capacity resulted in a marginally bigger effect of the ventilator bundle although these analyses excluded some units. Limiting the analysis to units in England that had implemented the bundle by 2006 (70 units) produced similar results, and extending this analysis to include units in the CMP since 2002 (rather than 2000) again made little difference.

The results of repeating the analysis but including level of compliance with the bundle in place of implementation of the bundle are shown in Table 48. As expected mortality was higher where the bundle had not been implemented. No significant differences were found between different levels of compliance but the direction of effect is consistent with lower mortality being associated with higher compliance.

Table 48. Impact of level of compliance on case-mix adjusted hospital mortality (n=141,139)

Compliance	Odds ratio (95% confidence interval)	p-value
>90%	reference	
75-90%	1.01 (0.95, 1.08)	0.74
<75%	1.03 (0.93, 1.15)	0.64
not implemented	1.09 (1.02, 1.16)	0.009

The CEA found that over all admissions, introducing the ventilator care bundle was associated with a significant gain in QALYs of 0.081 (p=0.009) (Table 49). The introduction of the bundle was associated with reduced mean LOS in critical care (p=0.046), but with a non-statistically significant increase in LOS on general wards (p=0.12). Unit costs in critical care were higher in the period following bundle implementation, which coupled with the small increase in total LOS, led to positive (£310) incremental costs (p=0.07). The overall cost-effectiveness results showed that with the QALY gain valued at £20,000 per QALY, the incremental NMB was positive (£1,317) and statistically significant (p=0.048).

Table 49. Mean (standard error) incremental effects of implementing ventilator care bundles in 88 CMP units in England

	overall n=210,656	ventilated n=125,061	not ventilated n=85,595
Unit LOS (days)	-0.187 (0.09)*	-0.176 (0.100)	-0.215 (0.107)

General ward LOS (days)	0.35 (0.223)	0.629 (0.24)*	-0.037 (0.258)
Total LOS (days)	0.163 (0.261)	0.453 (0.282)	-0.252 (0.30)
ICU cost (£)	231 (154)	407 (165)*	-38 (176)
General Ward cost (£)	81 (51)	145 (56)*	-8.5 (59)
Total Hospitalisation cost (£)	310 (173)	551 (186)*	-48 (198)
QALY	0.081 (0.03)*	0.130 (0.033)*	0.012 (0.036)
Net Monetary Benefit (£20,000 per QALY)	1,317 (632)*	2,078 (685)*	292 (730)

Adjusted for case-mix, season and time trend; *$p<0.05$

The incremental QALYs gained following bundle implementation were higher (0.13 versus 0.08) for the ventilated versus non-ventilated admissions (p value for interaction term <0.001). For ventilated patients the incremental costs associated with bundle implementation were relatively high (£551 versus -£48, p value for the interaction <0.001). The higher QALY gain for the ventilated group led to a relatively high incremental NMB (£2,078 vs £292, p value for the interaction <0.001).

The sensitivity analysis tested whether the results were robust to certain assumptions made in the base case analysis (Table 50). While the sensitivity analysis was applied to the overall group and for the non-ventilated patients, the presentation of the results focuses on the main group of interest, those patients who were ventilated within 24 hours of admission. The cost-effectiveness of implementing the ventilator bundle was generally robust to the different assumptions made in the sensitivity analysis. Treating units as fixed effects rather than random effects produced almost identical results.

Table 50. Sensitivity analysis on incremental cost (£), incremental QALY and Incremental NMB (£20,000 per QALY) of bundle implementation for ventilated patients.

	N Units / admissions	Incremental QALY	Incremental Cost	Incremental NMB(£)
Base case	88/210,656	0.130(0.033)*	551(186)*	2,078(1,626)*
Fixed effects	88/210,656	0.131(0.045)*	574(406)	2,062(939)*
Model ventilated only	88/125,061	0.100(0.045)*	372(264)	1,664(913)
Summary case-mix adj	88/210,656	0.089(0.047)	487(188)*	1,290(959)
Fully impl. pre 07	70/166,102	0.124(0.034)*	586(180)*	1918(696)*
Adjusting for outreach	70/168,803	0.123(0.038)*	717(211)*	1,796(773)*
13-23% HDU unit costs	88/210,656	0.130(0.033)*	133(164)	2,485(670)*
Gen. population QALY	88/210,656	0.183(0.047)*	551(186)*	3,127(945)*
WTP=£30,000 per QALY	88/210,656	0.130(0.033)*	551(186)*	3,384(1012)*

*p<0.05

If the analysis was restricted to ventilated patients only the smaller sample size led to a smaller estimate for the QALY gain with a larger standard error. The net effect was that while the incremental NMB was positive it was no longer statistically significant (p=0.069). The base case analysis found that adjusting for separate components of the ICNARC risk prediction model fitted the data better than using predicted mortality to adjust for case mix. However, the sensitivity analysis tested whether the results were robust to the method of case-mix adjustment by rerunning the CEA using predicted mortality in place of the individual components. The results suggested that once the summary method of case-mix adjustment was used, the QALY gain and the incremental NMB were no longer statistically significant (p=0.06 and p=0.18 respectively).

The base case analysis included all units in England in CMP since 2000 who responded to the ventilator bundle survey. The units that did not implement the ventilator bundle or implemented the bundle after 2006 acted as a control group (in addition to the historical controls within units that implemented the bundle). Sensitivity analysis excluding units that had not implemented the bundle by 2006 did not make a substantive difference to the results.

In order to reflect the trend towards increasing numbers of high dependency beds in general units providing intensive care the sensitivity analysis estimated unit costs by applying HDU (rather than ICU) reference costs to a proportion of bed-days each year. This proportion was based on the percentage of high dependency beds in general units from the KH03a data and varied from 13.5% in 2000 to 23% in 2006. The results showed that using these alternative unit costs made little difference to the estimates of incremental costs and incremental NMB.

It is possible that the effects observed for implementing the bundle were confounded by other modernisation activities. The sensitivity analysis adjusted for the introduction of outreach services (support, discharge, and track and trigger) as separate independent effects. The results were not sensitive to the inclusion of these variables.

The sensitivity analysis tested whether the results were sensitive to the assumption that long-term mortality and HRQoL for ICU survivors is 80% that of the general population, by running a scenario assuming the same life expectancy and HRQOL as for the general population. This led to higher QALY gain (0.18 versus 0.13) and larger incremental NMB (£3,127 versus £2,018). Finally, when an additional QALY was valued at £30,000 the incremental NMB increased to £3,384.

Summary (impact of ventilator care bundles)

The specific analysis of the adoption of the ventilator care bundle indicated that after adjusting for case mix there was a reduction in ultimate hospital mortality (odds ratio 0.935, 95% CI 0.887-0.986) and a significant QALY gain of 0.13 in patients who were ventilated within the first 24 hours of admission. Following implementation unit length of stay declined but hospital length of stay increased, resulting in higher total costs. Overall, adoption was associated with a significant incremental net monetary benefit, a finding that was generally robust to sensitivity analysis.

Some caution is required in inferring causality given the observational nature of the data and p-values for effectiveness that were just below the conventional level of 0.05 for statistical significance. However, the finding that lower levels of compliance were associated with smaller effects provides additional support for evidence of effectiveness.

3.4 Discussion

3.4.1 Main findings

From late 2000, the capacity of adult critical care in England increased and this was associated with a reduction in the severity of admissions, fewer transfers and discharges for non-clinical reasons, and better risk-adjusted outcomes. Although the cost of care increased, major improvements in outcome meant the cost-effectiveness of critical care improved. Comparison of critical care units revealed: those that increased in capacity the most experienced greater changes in case-mix and processes of care but no concomitant improvement in outcome; adoption of the ventilator care bundle was associated with improvement in outcome; and involvement in clinical networks and outreach services was associated with somewhat inconsistent changes in processes or outcomes of care.

Inputs

The increase in capacity from 2000 was largely in high dependency (level 2) beds rather than intensive care (level 3) beds. Much of the expansion took place in 2000-01 though this was followed by steady annual increases. Not surprisingly, the total expenditure on critical care rose reflecting not only the increased capacity but also a modest increase in the cost per bed day. While overall hospital expenditure was rising during this period, expenditure on critical care rose faster than that for other hospital services.

Organisation of care

While capacity was being increased, parallel changes took place in the organisation and delivery of critical care (often referred to as 'modernisation'). These were more sporadic, with the adoption of the three key interventions (networks; outreach; care bundles) occurring at different times in different units: implementation of outreach services largely took place between 2000 and 2002 and adoption of the ventilator care bundle over a more extended period from 2002 to 2005.

Case-mix

The changes in the case-mix of admissions observed was to be expected. Additional capacity allowed the threshold for admission to drop resulting in a slight diminution in the average severity of patients. The implementation of outreach services may have contributed if staff were identifying patients on the wards at an earlier stage in their decline. An increase in the mean age of patients suggests that the previous unmet need for critical care was predominantly among older patients (i.e. younger patients needs were being met fully). The rising proportion of women is simply a consequence of the increase in the age profile of patients (women predominate in older age groups in the general population). The fall in the proportion of admissions

with cardiovascular disease reflects wider changes in the incidence and prevalence of atherosclerosis and coronary heart disease.

Processes of care

The decline in the frequency of transfers to and from other critical care units since 2000 appears to have been associated with increased capacity of most units and the implementation of networks. Increased capacity was also associated with a fall in the number of patients who had to be discharged early (to provide beds for more pressing cases), though this decline was already underway before 2000 so was not entirely due to increased capacity.

At first sight the increase in discharges at night, between midnight and 5.00am, is unexpected given the other trends observed. However, according to clinical staff, an increasing proportion of these discharges were planned and not the result of urgent measures to vacate beds.

Not only were patients less likely to be discharged prematurely, there was evidence that discharges were more likely to be delayed, particularly in units that had not increased in capacity. This appears to have resulted from a change in the ratio of critical beds (level 2 & 3) to ward beds (level 0 & 1). While the number of critical care beds increased from 2000, the number of ward beds either remained the same or decreased. This imbalance may have also explained the increasing proportion of patients discharged home, rather than via a ward bed.

Outcomes

The decline in risk-adjusted unit mortality of about 4 percent a year and in hospitality mortality of 5.5 percent a year from 2000 is striking. The reasons for this dramatic improvement in outcomes are not clear. It certainly coincides with the start of increased expenditure and the implementation of modernisation activities. But at unit level there was no significant association between the decline in mortality and changes in capacity or adoption of modernisation activities.

Improved health outcomes were reflected in the two 'intermediate' outcomes considered: length of stay and readmissions. The mean length of stay, which had been increasing, largely stabilised after 2000 and the readmission rate declined. These may reflect the same improvements in care that contributed to lower mortality.

Cost-effectiveness

The economic evaluation used patient-level data to describe and evaluate the impact of changes from 2000 to 2006 on costs, QALYs and Net Monetary Benefits (NMB). The results showed that the period was associated with a statistically significant reduction in the trend of increasing costs and a QALY gain of marginal statistical significance, leading to a positive and statistically significant incremental NMB. The process of care results indicated that a higher proportion of cases were discharged directly

home from critical care units and the mean length of stay on the wards was reduced. While the mean length of stay in critical care units increased throughout the period, the annual change was lower after 2000.

Our results suggest that there may be scope for further reducing the unit length of stay without worsening outcomes. Data on the processes of care indicated that after 2000 a significant proportion of cases discharged to the ward were described as 'delayed'. Reducing these delayed discharges, for example by improving capacity outside the critical care units, could further reduce costs without compromising outcomes.

If all the observed differences in costs and QALYs are attributed to modernisation, then it would appear a relatively cost-effective collection of interventions. This raises the issue as to which components are most worthwhile. The specific analysis of the ventilator care bundle (see below) provided some indication.

Impact of critical care networks

Assessment of the impact of clinical networks was restricted to a comparison of critical care in units which were part of networks that had been established and were functioning well by 2002 (earlier adopters) and those that were not fully functioning until 2003 (later adopters). There was little consistent difference between these groups of units (Table 51).

Table 51. Summary of results for earlier and later adopter networks

| | Overall trend and any difference between earlier adopter and later adopter networks | |
Processes	**1998-2000**	**2000-2006**
Case mix (predicted mortality from the ICNARC Model)	overall: increasing networks: increasing faster in earlier adopters	overall: decreasing networks: no difference
Critical care transfers	overall: no change networks: no difference	overall: decreasing networks: decreasing faster in later adopters
Early discharges due to a shortage of unit beds	overall: decreasing networks: no difference	overall: decreasing networks: decreasing faster in later adopters
Delayed discharges due to a shortage of ward beds	overall: increasing networks: increasing faster in earlier adopters	overall: increasing networks: increasing faster in earlier adopters
Discharges at night	overall: increasing networks: increasing faster in later adopters	overall: increasing networks: increasing faster in earlier adopters
Outcomes		
Hospital mortality (adjusted for case mix)	overall: no change networks: decreasing in earlier adopters, increasing in later adopters	overall: decreasing networks: decreasing faster in later adopters
Length of stay in critical care unit	overall: increasing networks: no difference	overall: increasing networks: increasing faster in earlier adopters
Readmissions to the	overall: no change	overall: decreasing

| unit | networks: no difference | networks: no difference |

The lack of any clear pattern may reflect the rather crude method for measuring the performance of networks which depended on a set of criteria, the validity of which is unknown. In addition, creating a simple dichotomy based on assessments undertaken during one fairly limited time period (late 2002-2003) may have masked some benefits of networks. However, given the historic data that were available, this was all that was possible.

Impact of outreach & care bundles

As with networks, there was no consistent effect of the adoption of outreach services and care bundles (Table 52). Again, this may reflect the insensitivity of the method: uncertainty about the validity and reliability of the measures of adoption of the two interventions; adoption of each intervention did not necessarily coincide; and assignment of units to early and late adopter categories was imposed on a continuous variable, the time of adoption. A more sensitive approach to evaluating the impact of the ventilator care bundle was therefore undertaken (see below).

Table 52. Summary of results for earlier and later adopter units

Processes	Overall trend and any difference between earlier adopter and later adopter units	
	1998-2000	**2000-2006**
Case mix (predicted mortality from the ICNARC Model)	overall: increasing units: increasing faster in earlier adopters	overall: decreasing units: no difference
Critical care transfers	overall: no change units: no difference	overall: decreasing units: transfers out decreasing faster in earlier adopters, transfers in decreasing faster in later adopters
Early discharges due to a shortage of unit beds	overall: decreasing units: decreasing faster in later adopters	overall: decreasing units: decreasing faster in earlier adopters
Delayed discharges due to a shortage of ward beds	overall: increasing units: no difference	overall: increasing units: increasing faster in earlier adopters
Discharges at night	overall: increasing units: no difference	overall: increasing units: no difference for discharges 00:00-04:59
Outcomes		
Hospital mortality (adjusted for case mix)	overall: no change units: increasing in later adopters	overall: decreasing units: decreasing faster in later adopters
Length of stay in critical care unit	overall: increasing units: no difference	overall: increasing units: increasing faster in earlier adopters
Readmissions to the unit	overall: no change units: no difference	overall: decreasing units: no difference
Cost-effectiveness (net monetary benefit)	overall: positive units: positive in earlier adopters, negative in later	overall: positive units: greater in later adopters

adopters

Impact of capacity changes

Units with larger increases in capacity enjoyed several benefits as regards the processes of care: larger reductions in patient severity after 2000, a faster decline in transfers in and early discharges, and a slower increase in delayed discharges (Table 53). However, this did not translate into better outcomes. Given that increased capacity was not accompanied by increased resources per patient day, this finding is to be expected.

Table 53. Summary of results by the extent of a unit's change in critical care capacity

| Processes | Overall trend and any difference by change in capacity between 2000 and 2004 (<20%, 20-50%, >50%) | |
	1998-2000	2000-2006
Case mix (predicted mortality from the ICNARC Model)	overall: increasing capacity: increasing slower in >50%	overall: decreasing capacity: increasing in <20%, decreasing in 20-50% and >50%
Critical care transfers	overall: no change capacity: no difference	overall: decreasing capacity: decreasing faster in >50%
Early discharges due to a shortage of unit beds	overall: decreasing capacity: decreasing faster in 20-50% and >50%	overall: decreasing capacity: decreasing faster in >50%
Delayed discharges due to a shortage of ward beds	overall: increasing capacity: increasing faster in >50% & <20%	overall: increasing capacity: increasing slower in >50%
Discharges at night	overall: increasing capacity: no change in 20-50%, increasing faster in >50%	overall: increasing capacity: no difference for 00:00-04:59 discharges; increasing faster in 20-50% for 22:00-06:59 discharges
Outcomes		
Hospital mortality (adjusted for case mix)	overall: no change capacity: increasing in >50%	overall: decreasing capacity: no difference
Length of stay in critical care unit	overall: increasing capacity: no difference	overall: increasing capacity: no difference
Readmissions to the unit	overall: no change capacity: no difference	overall: decreasing capacity: no difference

Impact of the ventilator care bundle

A more sensitive and specific analysis of the impact of adopting the ventilator care bundle revealed it to be a cost-effective intervention. Despite its widespread adoption in many countries, this is the first demonstration of its value. Following implementation, mortality fell. Although the length of stay in the critical care unit decreased, this was more than compensated for

by longer stays in the ward resulting in higher incremental costs. However, the positive QALY gain meant that the incremental net monetary benefit (£2 078) confirmed the value of introducing the care bundle.

Comparison with non-English units

In an attempt to gain some further insight into the impact of changes in England from 2000 onwards, data on 11 units in Wales and N Ireland were used for comparison (Table 54). Broadly speaking there were no differences in outcomes - the non-English units also experienced a decline in unit and hospital mortality. Indeed, for unit mortality the rate of decline was higher in non-English units (7% v 4% a year). Length of stay and readmission rates showed little or no difference.

In contrast, English units performed better as regards several aspects of the process of care. Whereas before 2000 the mean severity of patients admitted to English units was higher than non-English units, by 2006 this had reversed. This probably reflects the additional capacity acquired during the intervening years. Consistent with the extra capacity in England, the rate of transfers to other units declined (to reach a similar level to non-English units) and early discharges for non-clinical reasons decreased faster (to remain lower than outside England).

Table 54. Summary of results comparing units in and outside England

Processes	Differences in 2000	Trends 2000-2006	Differences in 2006
Case mix (predicted mortality from the ICNARC Model)	Slightly higher in England	Decreasing in England Increasing outside England	Slightly lower in England
Critical care transfers	Higher in England	Decreasing in England No change outside England	No difference
Early discharges due to a shortage of unit beds	Lower in England	Decreasing in both Faster decrease outside England	Lower in England
Delayed discharges due to a shortage of ward beds	Higher in England	Increasing at a faster rate in England	Higher in England
Discharges at night (00:00-04:59)	No difference	Increasing at a similar rate in both	No difference
Outcomes			
Ultimate hospital mortality (adjusted for case mix)	No difference	Decreasing at a similar rate in both	No difference
Length of stay in critical care unit	Slightly lower in England	Slight increase in England, slight decrease outside England	No difference
Readmissions to the unit	No difference	Decreasing in England	Slightly lower in England

No change outside England

3.4.2 Methodological issues

Strengths

This study was more ambitious than any previous attempt to determine the impact of a complex, multi-dimensional set of diffuse interventions. Despite several methodological limitations which were recognised at the outset, these were balanced by several strengths which justified undertaking such an ambitious analysis. The key one was the availability of high quality longitudinal data on case-mix and outcomes from a large number of units, representative of England. This enabled rigorous risk-adjusted outcomes to be calculated both for the period prior to modernisation and capacity expansion and for several years following. An additional benefit was the opportunity to carry out a limited comparison with critical care units in other parts of the UK.

Given the impossibility of performing now or, in all likelihood, ever in the future a randomised trial of such policies as modernisation or capacity expansion, a non-randomised study which takes advantage of variations in implementation is all that will ever be possible. So, while there is inevitably some uncertainty about the results, the data presented provides some insight into what is otherwise an evidence-free area.

Limitations

Defining and measuring modernisation

The difficulty of defining what constituted modernisation has been made clear from the start of this report. Restricting the definition to the activities of the Modernisation Agency was rejected at the outset as being too limited and unrealistic, given the wide range of activities outwith the Agency's responsibility.

For any quantitative study, it is essential that any variables have to be measurable. This inevitably restricts the factors that can feasibly be considered and risks the omission or neglect of some key variables. And even for those factors that are included, the validity and reliability of the measurements may be uncertain. This was true for the measures of organisational change such as clinical networks, care bundles and outreach services. For example, decisions had to be made regarding those units that did not implement the whole of the ventilator care bundle. Also, some units that reported not using the bundle (as defined internationally) claimed that this was because they used their own clinical guidelines on caring for patients on a ventilator.

A further measurement problem was recall bias. Data on the timing of adopting care bundles and outreach services depended on respondents in units recalling accurately.

Measuring inputs

It was not possible to quantify the extent to which units' bed complements comprised intensive care (level 3) or high dependency (level 2) beds. In combined units, the definition depended on the needs of the patient in any given bed. In other words the definition depended on the patient rather than the bed. A patient could, and often did, shift between levels during their stay in a unit. The study therefore had to ignore the distinction and simply consider the overall bed capacity, regardless of level of care.

All the cost analyses used data from NHS reference costs. Taking such an aggregated approach to unit costing may be criticized (Wordsworth et al). However, another cost-effectiveness analysis in critical care that compared a micro-costing approach to using reference costs found very similar results. In this study, one concern was whether differences in costing method over time could confound the results. For example, a different method was used to report unit costs from 2004 onwards. However, the main drivers of the positive NMB reported were the relative reduction in length of stay and the gain in QALYs. Both these parameters were measured using consistent methods over time.

Analysis

The analysis was limited by the duration of data available for before 2000. Although the CMPD has data going back before 1998, the sample of units gets progressively smaller and, therefore, less representative. The starting point was a compromise but one that was felt to provide sufficient indication of existing trends prior to 2000.

While the final quarter of 2000 represented the optimum time point to mark as the start of modernisation and capacity expansion, it is clear that many units were already undertaking some of the 'new' initiatives prior to that date. As with evaluating any diffuse innovation, the analysis must inevitably decide upon the best time point which will maximise the chances of detecting an effect.

Despite having an accurate outcome measure, mortality, there is some uncertainty as to the quality of life of the 70 percent of patients who survive critical care. Assumptions had to be made in the economic evaluation as regards outcomes in terms of QALYs. In particular, as there is no clear evidence on long-term survival and quality of life of survivors, the base case analysis made the relatively conservative assumption that both were 20 percent lower than for the general population. Recent research suggests that this may overstate the relative decrement (Williams *et al*, 2008), and indeed other analyses have assumed the same survival and quality of life as the general population (Stevens *et al*, 2005). However, the sensitivity analysis showed, that making this alternative assumption would simply reinforce the conclusion that modernisation in critical care appeared relatively cost-effective.

The hierarchical nature of the data (patients in critical care units, critical care units in trusts[5], trusts in networks) made it inappropriate to analyse the data ignoring this hierarchy (Calhoun *et al*, 2008). The main analyses treated the critical care unit as the 'unit of analysis' by fitting critical care units as random effects. Networks were not treated as a separate level in the analyses due to potential biases in networks with lower participation in ICNARC's Case Mix Programme (participating critical care units may differ from those that do not participate). Some caution is therefore required in interpreting the findings for network adoption.

Attribution of changes

One of the challenges that a time series analysis of the type undertaken faces is determining whether any revealed associations are causal and, if so, the direction of causality. Its possible that units that embraced modernisation activities enthusiastically also happened to be the best performing units with the best patient outcomes. Its also possible that units with the best outcomes are more likely to adopt national recommendations rather than the reverse.

Another difficulty is the existence of concurrent interventions - other (unmeasured) national and local changes that contribute to the observed effects. For example, the publication of a National Service Framework.

Two types of comparison were performed. The principal one was over time (or before and after) which is subject to the issue of concurrent interventions. The other comparison was between places (England versus non-England). While this overcomes the problem of concurrent interventions that were common to all jurisdictions, there remains the concern about 'contamination'. It is possible that modernisation activities in England influenced or were even adopted in Wales and N Ireland, thus reducing the difference and the sensitivity of the analysis. Another limitation of these comparisons was the small number of non-England units.

The finding that modernisation was associated with improved outcomes and lower costs raises the question of which aspects of this complex intervention were important. The more specific evaluation of ventilator care bundles suggested that this particular intervention was associated with positive QALY gains at small incremental costs and was relatively cost-effective, and provides some evidence that part of the overall improvement in outcomes can be attributed to implementation of the bundle.

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[5] each critical care unit in the analysis was in a unique hospital; two hospitals in one trust belonged to different networks.

4 'What's changed?' A study of NHS critical care staff views of the modernisation of adult critical care services in England

4.1 Introduction and background

This section of the report addresses objective (v) of the research: to explore the impact of modernisation on the organisation, delivery and culture of critical care. More specifically the qualitative study aimed to identify how modernisation initiatives and activities have shifted accounts of the organisation, delivery and culture of adult critical care, by exploring how staff account for changing practices since the implementation of the modernisation programme; how they characterise the contemporary culture of critical care; and the impact of modernisation on professional relationships within the critical care team, as well as between the critical care team and the rest of the hospital. Understanding organisational culture is important in that it can shape staff satisfaction with work, safety cultures, inter-professional interaction and trust between departments. Such information is crucial to future policy formulation, service development and workforce planning, and ultimately to patient care and outcome.

4.2 Methods

A multiple case study design was employed. Seven NHS hospitals providing general adult critical care services and located in three critical care networks in England were invited to participate in the study. Networks were chosen to be geographically spread across England, while individual hospital sites were chosen to reflect both large teaching hospitals and district general hospitals, and a range of adult critical care units varying in terms of their bed numbers.

At each unit, a purposive and critical case sampling strategy was employed in order to recruit a range of professionals working in or attached to the critical care team. The objective was to include allied health professionals with critical care roles, and members of critical care outreach teams, as well as consultants and nurses based in the ICU itself, so that the perspectives of the full range of professionals involved in providing critical care services might be obtained. Only staff who had worked in or been attached to the critical care service in their hospital for a number of years were invited to participate, so that those interviewed would have some awareness of the local and national modernisation changes that had taken place in critical care, and the impact of such changes on their own services and roles.

Individual in-depth interviews were conducted by one researcher on a face-to-face basis with participants, apart from two telephone interviews

conducted for the convenience of the interviewees. All of the interviews were audio-taped, after written consent had been obtained. A topic guide which covered the following issues was employed: the interviewee themselves (i.e., work history, job title, and current responsibilities in the critical care team); perceived key changes in the organisation and delivery of critical care services in recent years; communication and boundaries; critical care outreach; working practices and patient care; the multi-professional team; and challenges and achievements. It also covered involvement with Modernisation Agency programme initiatives (e.g. the local critical care network; critical care delivery groups; rapid-change studies and projects). As data analysis progressed in parallel with the interviews, the focus of later interviews was guided by issues and themes emerging in the earlier ones.

Ethical approval for the study was obtained from MREC (Riverside Research Ethics Committee) and NHS Trust R&D approval obtained from each of the participating hospitals. A study reference group comprised of key stakeholders (clinicians, nurses, an individual who had experienced critical care as a patient, policy makers etc) met twice during the course of the study, while the study team met regularly to discuss the themes emerging in the data.

Each interview was transcribed in full. Approximately 25 percent of the interviews were checked for accuracy of transcription. A thematic analysis was undertaken. Themes were generated using both the general framework of the topic guide, and open coding of sections of transcripts from the first site. Theme files were created as Word documents. A constant comparative method was employed, whereby individual transcripts were compared with one another to assess agreement and divergence between cases. In addition, similarities and differences between study sites were studied.

4.3 Results

4.3.1 Sample

Forty-five interviews were conducted with professionals including consultants (both critical care intensivists and consultant anaesthetists with sessions in critical care), nurses (including those with specialist roles, such as matron or unit manager, nurse consultant, nurse educator, service improvement lead, outreach nurses etc), physiotherapists, pharmacists, dieticians, a microbiologist, and administrative staff (Table 55). The number of staff interviewed at the sites varied from 2 to 11. The average age of the interviewees was 43 years (range 22 to 63 years). Twenty-eight were female. Interviewees reported being in their 'current job' for an average of 8 years (range 1.5 to 27 years).

Table 55. Types and numbers of professionals interviewed

Professional	Number interviewed
Consultants	11
Nurses	20
Physiotherapists	5
Pharmacists	4
Dieticians	2
Microbiologists	1
Administrative staff	2
Total	**45**

Three of the participant sites were situated in large teaching hospitals and the others in district general hospitals (DGHs). Units sizes ranged from 8 to 27 beds, including HDU beds. Staff at the majority of the units reported that their beds were used flexibly, according to demand, even where there were designated HDU beds. New units had been opened at two of the sites in recent years.

Four stakeholder interviews were conducted initially to inform the interview topic guide but are not included in the study findings.

4.3.2 Overview of findings from the qualitative interviews

Although they did not generally use the term itself, 'modernisation' was a salient concept for the interviewees. A positive sense of 'service improvement,' innovative developments in technology and drugs, new approaches to patient care and clinical practice, new and expanded roles for professionals, and/or the sense of a raised profile and identity for adult critical care itself were described by interviewees.

…..we're always improving, so if there's something better then we will give it a go…….I think as a unit, we're very forward looking, from a nursing and medical point of view, so, we're always trying to improve, which is great for the patients. (sister, teaching hospital)

I think the general feel is that we have progressed over those years. I think we've – all Critical Cares, we've looked at ourselves and said, you know, in comparison to Medicine, in comparison to Surgery, why have we not got the things in place that they have? Why have we not got the organisation? Why have we not got the benchmarks?, and certainly it feels more like a service in its own right, than it ever used to, I think, before………….. And, you know, whereas before we'd take the lead of we'd do that because the Respiratory people do that, now we do that because that's what we do in Critical Care….. (senior sister, DGH)

The perceived raised profile of critical care, both within the hospital setting and on a national levels was attributed to a number of factors, and although the official modernisation programme had ceased a number of years previously, its impact and that of the policy document and additional capacity funding were acknowledged.

> *Initially it made a huge change, not only that we expanded, we opened an extra bed or two. It seemed, at that time, there seemed to be a lot of money about for Critical Care, for new ventilators, new beds, redevelopment, new staff, you know, and the Outreach Nurses, etc. And at the time there was a big injection of cash into Critical Care. It was at the time when there was lots of stories in the press about people being shunted two or 300 miles across England for an ICU bed, and it did make a big difference. Now the impact of that is somewhat watered down because that was five, six years ago now, but the impact is still there. It's still seen as an enlargement of Critical Care Services, but I think at the present time, no matter how much we enlarge it, it will never be quite large enough to cater for everyone who could perhaps use the facilities.* (senior charge nurse, DGH)

> *I suppose one thing that I've not said, and I suppose is, sort of, implicit in all of that I've said has been the elevation of the profile of Critical Care within the hospital. And part of that is as a result of all of the changes from Comprehensive Critical Care and Critical Care without walls and so on and so forth, Outreach. It's been aided by other things such as the development of the Intercollegiate Board in Critical Care training,…….all of that stuff has just raised the profile, I think, of Acute Care and Critical Care to it – I feel no longer being just a place to send sick patients, but actually as a specialty and a service that's got value, and I think that's, yeah, I think that's very true in the last five or six years.* (consultant, DGH)

> *…over the years, it's just grown and I think, you know, in terms of evolution of medical provision, both nationally and I suppose around the world, Intensive Care has become more of a, sort of, prominent part of hospital care and I suppose it's, you know, newer technology, newer drugs, patients surviving longer with more complicated problems mean that there's a greater demand over time for Intensive Care.* (consultant, DGH)

Evidence of modernisation, as well as its perceived impact on the organisation, delivery and culture of critical care emerged in three overarching, but inter-related, themes in the interviews:

• The drive towards the standardisation of clinical practice and service delivery, as evidenced by reported increased involvement in the development and/or implementation of guidelines and protocols (e.g. the prime example being the use of the care bundle approach), and associated with a growing culture of audit, research and the use of evidence based practice in adult critical care.

- The re-framing of boundaries around the intensive care unit and new ways of communicating with the rest of the hospital (e.g. through outreach, training provided directly to the wards by critical care staff, and trust-based critical care delivery groups), and with critical care services and professionals based at other hospitals through networking on the formal, informal and professional levels.

- New and expanded roles and ways of working for members of the multi-professional critical care team.

A number of challenges and barriers to service improvement and development (e.g. perceived difficulties in recruiting staff, inadequate training for junior staff, concerns about capacity etc) were reported. Interviewees at some of the study sites reported that they thought their case mix had changed in a number of ways in recent years (e.g. seeing older patients, more/less critically ill patients) and that this brought with it the potential for both new problems and successes for adult critical care services.

Perhaps surprisingly, overall there was a general lack of nostalgia in the interviews. On the occasions when nostalgia did emerge, it tended to be related to, for example, inadequacies in training which were believed not to have existed in the past. When asked about successes and achievements in critical care, at both local and national levels, few interviewees hesitated to outline the advances they felt had been made, for example, through the introduction of outreach services, and the perceived emergence of critical care as a service with a heightened profile both within their own hospitals and nationally. However, interviewees' accounts suggested that changes in the organisation or delivery of critical care services could not be seen in isolation from changes occurring in the rest of the acute hospital, and that, for example, government targets for emergency care, trust priorities, staffing problems on the wards, and bed occupancy rates throughout the hospital at any given point in time also had implications for how critical care services and the intensive care unit itself can function. The modernisation of adult critical care was therefore viewed as a complex process, influenced by a wide variety of factors, some of which are not necessarily critical care specific.

Although the concept of 'modernisation' was salient and variously constructed by interviewees, there was evidence of less familiarity among a number of the interviewees with the Modernisation Agency's Critical Care Modernisation Programme and the improvement initiatives and activities it promoted at a local level. However, the introduction and development of outreach services was widely cited as a key modernisation initiative. While increased capacity in terms of bed numbers was noted as a development of recent years, some interviewees are still concerned about what they consider to be existing shortfalls in capacity. The instigation of the network approach to collaborative working was also mentioned in some interviews as an achievement of modernisation.

Each of the three themes outlined above will be described in detail below, followed by a brief section on the perceived achievements and successes in adult critical care and challenges to critical care modernisation in recent years, and a section reporting interviewees' views of the impact of the MA and its adult critical care modernisation programme.

4.3.3 The standardisation and protocolisation of care

The strategic aims of *Comprehensive Critical Care* (Department of Health, 2000b) included improving patient care through the development and implementation of standards, guidelines and protocols specific to adult critical care, along with the development of a data collecting culture designed to provide an evidence base by which to assess critical care outcomes. One of the objectives underpinning the development of local critical care networks was that services in a geographical area would start to work to common guidelines and protocols. On a national level, the care bundle approach was introduced in 2002, while the Intensive Care Society, and other relevant organisations have produced various guidelines and policies concerning the delivery of critical care services.

Standards of care

The drive to improve standards of care, or to maintain what were perceived to be existing high standards, was a theme which emerged in a range of guises. Central to participants' descriptions of their roles in adult critical care, whether working on the ICU or on the wards as outreach staff, was a concern with providing optimum care to patients. The belief expressed was that standards should, and are being raised. A nurse at a DGH argued that critically ill patients should receive the same service regardless of which English hospital they find themselves in. The quality and standards of care were described either explicitly or implicitly as being raised in part through the development and implementation of policies and guidelines, increased protocolisation of care, standardisation of clinical practices among professionals, and through engagement with the philosophy of evidence based practice and the activities of research and audit.

> *We've got a couple of senior nursing staff that are really, really pushing for maintaining high standards as well, so that's good, so working together to the same common guise. This is where our pride lies, let's not compromise, you know, "This is infection control, these are the procedures, these are the standards, let's set the example to everyone else, let's not compromise", or this is, you know, "This is pressure area care and prevention and what do we do and how do we approach this? Let's set the standard for the rest of the hospital."* (senior nurse, DGH)

> *In general I think that the game has been raised on standards, with Infection Control, you know, Saving Lives, and it's meeting and in some ways trying to beat those standards, to push patient care to a higher level…* (senior charge nurse, DGH)

And a lot of changes, and, you know, like protocols, policies, it is – although we have our challenges, it's all contributed to a lot of changes, the Best Practice, ……….. and monitoring, auditing, and a lot of research to improve the quality of care, to take Critical Care forward into the 21st Century, and I think we don't want to be left behind, and if patient care is our focus, we cannot go wrong (senior nurse, DGH)

I do think we really try to up the game with patient care and drugs and the care – I mean, I'm being biased 'cause this is like my Unit, but the standard of care on here is impeccable. It really is, even when we're short staffed and really, really trying to keep our heads above water. There isn't one nurse on here that would drop her standard. The standards of care are very good on here….. you know, there is standardisations and modernisation that's come in, that has brought these standards up. There's clinical competencies now, you know………….We've got teaching packages. We've got packages for everything you can think about on here, IV drugs, you know, mistakes happen. We're not robots but, you know, the standard on here is very high, as far as what we make them do, and we make sure that all our nurses on here are clinically competent before we do anything. (nurse, teaching hospital)

Guidelines and protocols; incentives and benefits

As a theme, the standardisation of care and the use of guidelines and protocols presented itself in discourses on a variety of topics, including key changes in clinical practices and care delivery, the introduction of care bundles, participation in the local network, multi-professional team working, and the clinical governance and risk management agendas. The sentiment expressed by some of those interviewed was that although practice had always been protocolised to an extent in adult critical care, there had been a noticeable increase in the use of guidelines and protocols in recent years.

We're much more protocolised and conformist, I think, in terms of practice than we used to be. We've developed a lot of standards, policies and protocols ourselves, but we've also been aware of and made use of things like Bundles of Care, and I think a lot of people have done that. (nurse consultant, teaching hospital)

Definitely now there is much, it's much more Protocol led. There we were – it was very bitty and there'd be bits of paper in various files. I think technology has helped us now because we have an intranet and we have quite a formal system for putting the Protocols onto the system which is good and it goes through various checking committees within the Trust, and then it goes onto the intranet. So that means that Protocols that are just on scrap of paper era is going and all the information is becoming much more available by the intranet, which is good. (pharmacist, DGH)

The standardising of clinical practice and care delivery was described as operating at a number of levels: at that of the individual critical care team;

across a local network; or on a national level, for example through the implementation of care bundles. It was described as being achieved in a number of ways, including the development, and/or adoption and implementation of practice guidelines and protocols; the introduction of new rota systems; and the completion by staff of competency-based training courses. Furthermore the emergence in recent years of new professional roles (e.g. that of the nurse consultant in critical care) or responsibilities, (e.g. service improvement) was thought to encourage or enhance opportunities for standardising practice and ensuring the implementation of guidelines and polices. Standardisation was also linked with data collection, audit and research, and evidence based practice.

Interviewees described a range of drivers or incentives to increased standardisation of practice. Firstly, a number spoke about what might be seen as a cultural shift away from an unquestioning belief in the acceptability of individualistic clinical practice in critical care.

> *'We should all be doing the same thing.'* (dietician, teaching hospital)

> *'We were looking at evidence based practice, and it became unacceptable just to say "Well, this is how we do it, because we do it like that."* (senior nurse, teaching hospital)

Individualistic practice was ascribed in particular to critical care consultants, and was said to have resulted in inconsistencies in care planning or clinical practices. A number of nurses and therapists expressed frustration with the amount of 'chopping and changing' that had happened between one consultant shift and the next.

> *What would happen is that we'd have one Consultant in the morning and we would have another one in the afternoon, so what the morning Consultant agreed to was completely deleted and something completely new set up in the afternoon, and then you'd come in on the Tuesday another third Consultant. So we had those five, six Consultants doing those little rounds and the change, they wouldn't listen to each other. They'd change the instructions and it was so frustrating for nurses, you know, or the Therapists.* (dietician, DGH)

> *It's much easier to follow a protocol which has been devised from the evidence base, or a research base, rather than consultant led decisions, because if you're working in an area where you have, you know, seven different Consultants, and if the Consultants change on a weekly basis, it's very frustrating. When you're delivering the day-to-day bedside care, that that all changes because the Consultants change, but if you're following a protocol, then you stick to the protocol and so you can see the continuity of care for that patient. Whereas before, you sometimes felt frustrated that we'd be following one particular plan, and it would all change, you know, for want of a better word, because the Consultant would, you know, the Consultants have all got their own different reading material, and different, you know, evidence and beliefs in that evidence and*

> *whatever. So I think we're moving more towards protocolised care, which is good.* (senior nurse/matron, teaching hospital)

The introduction of protocols, guidelines and new handover procedures, combined with changes in consultant rota patterns at some of the study sites, which resulted in consultants being physically present on the ICU for longer was said to have led to improved continuity of care for patients, and to a perceived decrease in the prevalence of idiosyncratic practices. It also provided non-medical professionals, such as nurses and allied health professionals, with greater clarity regarding the specific interventions and care packages to be provided to individual patients, thereby making it easier for them to carry out their own roles and responsibilities. A teaching hospital consultant also reported that s/he was now less likely to have to make decisions about patient care on his/her own than in the past, and viewed this as a positive development. A DGH consultant reported that while there might appear to be less protocolisation on his/her ICU than other units, in practice the team of consultants worked closely with one another to ensure consistency in the care of individual patients. In essence, it would appear that there has been an increasing recognition and acknowledgement by consultants and their critical care colleagues that idiosyncratic clinical practices need to be abandoned in favour of a team working, standardised approach to care delivery. Whether the emergence of the critical care intensivist role may have contributed in part to perceived changes in both care delivery and the working culture among consultants is hard to say, although reference was made to the possible link between 'intensivism' and a raised profile for critical care. Changes in shift patterns for nurses did not feature largely in the interviews – however, one consultant did note that changes resulting in a more frequent changeover in bedside nurses had the potential to delay interventions such as weaning off ventilators, and thereby impact on patient care.

Secondly, the clinical governance agenda and the increasing risk awareness/ management culture within the NHS was reported to have given impetus to the development and implementation of protocols and guidelines in adult critical care. Risk was perceived as being related not only to potential incidents involving patients but also to accountability for the actions of junior staff, agency staff and staff who have trained outside the UK. Risk avoidance was associated with not only with checking that staff were adhering to guidelines and protocols but also with ensuring that educational competencies were attained, specific courses attended and critical care related qualifications obtained.

> *I think we've all probably, really….., we've all become much more aware of adverse incidents, risk, the systems review, all of those kind of things and a recognition within that, that it's no longer acceptable just to develop your own particular peculiar style of delivery of care, but that everyone should be working towards best practice; hopefully, evidenced based, best practice, but where there's no evidence at least with a consensual of best practice.* (nurse consultant, teaching hospital)

> *There's an increase in them [policies] and some of it can come down to just, you know, if you had a high risk incident, or incident reporting. Like, we're very active with the incident reporting here, like, for example, I got one this morning…………… so we just followed up and then that way, sometimes policies come out of that.* (senior nurse/matron, DGH)

> *……. I'm a very protocol person, especially with junior staff…… because we've got a lot of junior staff coming in, and it's easy for them to follow protocols.* (senior nurse, DGH)

A third incentive to increased use of guidelines and protocols was the belief that critical care professionals should be delivering evidence-based care both on the ICU itself, and on the wards, through outreach (see also the sections on care bundles and audit/research below). It was argued that appraising and disseminating available research evidence within the team could lead to the development of more robust guidelines. Responsibility for appraising, sharing and communicating evidence to the multi-professional team members was not viewed as the remit of any one particular professional group. Organisational frameworks and processes for reviewing and disseminating both empirical research and new national policies and guidelines were described by interviewees.

> *I think it's been led in some ways by the, sort of, the best evidence, sort of, way of looking at things. [Sighs]. What was I going to say? I think overall it's a good thing, when you – a group of people who have looked at the evidence, which, sort of, spans more than your area and decided that – on a course of treatment, or a course of action. And I think you have to have a jolly good reason for deviating from the protocol. And it's your safety net, it's your guide, isn't it?* (senior charge nurse, DGH)

Other perceived drivers to care protocolisation included observed clinical needs and procedural problems that arose in individual services, the drive for consistency across a local critical care network (e.g. regarding transfers, data collection, implementation of care bundles), and competencies-based educational frameworks. The development of new drugs, technologies and treatments was also said to have increased the need for guideline and protocol development and implementation.

At sites where the local network had been/is active, interviewees described the production of joint protocols and operational guidelines for network-wide use and the types of benefits accrued by individual services as a result. The development of transfer protocols in particular was mentioned, and was said to have led to improvements in sourcing beds locally and facilitating the transfer of patients from one ICU to another.

The standardisation of practice and protocolisation of care was generally framed in positive terms, and a number of tangible benefits and outcomes attributed to it, such as the aforementioned increase in continuity of care for patients. At one site, long-term patients in particular were said to benefit from recent changes in practice. The use of standards, protocols

and/or guidelines was also said to lead to reductions in critical incidents; to legitimise specific treatment interventions and practices; lend a rationale to day to day activities and roles, and empower different professional groups; as well as facilitating opportunities for collaborative working and clearer communication between the different professional groups working in or attached to critical care.

> *I mean, we just – I think the whole thing just makes us much more aware of our practice, and we're all aiming to – instead of just doing things willy nilly, there's always a reason for why we're doing things and it just makes us much more aware of why we're doing it.* (sister, teaching hospital)

> *I think, particularly with transfers, enormous [benefits] – better standards of care, fewer critical incidents have occurred for patients. Our nurses are far more confident on transfer because we've been able to highlight things that have happened and again, on the back of that, we've put competencies into place, so all the nurses are working to the same standard. The Network were also quite keen as well to develop training, which we've done across the Network…...* (senior sister, DGH)

Issues concerning the processes, effort and resources involved in developing guidelines, protocols or competencies were raised by interviewees at a number of the study sites. While the view may be that the production of service-specific guidelines is the shared responsibility of the critical care team, in reality it is often seen to be led by a specific professional group or one individual, such as a nurse consultant or Service Improvement Lead, who has explicit responsibilities in this area. A number of interviewees named individuals or committees whose responsibility it was to lead on guideline and protocol development, even if they did not actually write the guidelines themselves. The development of profession-specific critical care guidelines was mentioned: for example, 'nursing' or 'physiotherapy' guidelines. While devised by a specific professional group such as nurses or physiotherapists, however, guidelines and protocols (e.g. feeding guidelines) were sometimes described as being designed to be used by, or support the work of other professions on the team, and to facilitate team working. Furthermore, guideline development was not necessarily seen as the responsibility of senior staff alone: at one site an interviewee spoke of junior staff being actively encouraged to get involved. On the other hand, a small number of interviewees expressed frustration at their own or their profession's perceived lack of involvement in guideline and protocol development. In general, though, nurses and allied health professionals who mentioned the issue were satisfied with their level of input. Specific organisational procedures for writing, amending, ratifying and circulating new guidance were said to exist within services.

The volume of work that goes into producing a guideline or protocol, or even keeping abreast of national guidelines and emerging empirical evidence, was said to be substantial for already busy and understaffed teams who are often lacking the appropriate resources. For this reason, the

belief that guidelines and protocols should be adopted from existing ones (e.g. national guidelines) or developed through the network, if possible, was expressed by some interviewees. The latter was said to provide opportunities for networking, sharing idea and obtaining peer support.

> *And again, things like Protocols and Guidelines, there's no point every Trust inventing its own Guideline when, you know, the whole Network could come up with one that is the same for everybody. Maybe even nationally it should be done, you know, so you just have one National thing that everybody uses…* (consultant, DGH)

> *Producing a robust clinical guideline takes resources, somebody's got to sit down, somebody's got to get the literature out, somebody's got to go through it systematically and then come up, if you're producing a local – well, I shy from the words 'protocol,' but if you're producing the local guidelines then that takes resources, and if you don't have those resources by adopting them from the network, you now improve the quality of care without having to put in that extra resource to develop the guideline in the first place.* (consultant, DGH)

> *….. we do borrow each others so, [laughs] certainly when I was doing mine I had a look at what other people were doing and I sent what I did, sometimes you ask for information and they'll give you some, in return you'll say, "Well, look, this is our final one", so we do share it.* (pharmacist, DGH)

Some interviewees argued that implementing guidelines and protocols (and bringing about changes in practice generally) is not necessarily straightforward, and raises issues of accountability, particularly for senior staff. Involving all grades of staff in writing guidelines or policies was seen as one way so ensuring their interest and motivation to change.

> *I think it's important to get the nurses to write the policies because you can't – to implement change is very, very difficult and I think one way you get around implementing change is to actually involve people in change from the very lowest level upwards, and I think if you do they feel that they've been part of that and it brings the change process in quicker……* (nurse, teaching hospital)

> *The easiest thing is to write a protocol, the most difficult thing is actually implementing it.* (consultant, teaching hospital)

> *And that you spend hours doing a guideline and then they say "Well, I didn't know there was a guideline."* (consultant, teaching hospital)

Strategies for increasing adherence to guidelines and protocols included circulating them on the critical care intranet, making them available at the bedside for staff to check, using the team communication book to notify staff of new documents, and providing both formal and informal training to junior staff in the use of guidelines and protocols. At one site, a senior nurse reported that s/he obtained staff signatures to prove that they were aware of/ had read specific policies and procedures.

It's just constant repetitive, shoving it in your face all the time until people have got it, until they realise, "Hey, this is important, and this is what I have to do." And it takes a while, doesn't it, familiarity with something. Especially if it's a change in your practice, it takes a lot to change someone's approach to something, so. (senior nurse, DGH)

So, you do have to be careful with them in the sense that people tend to want to write essays and essays of stuff in them, but if you do that, people will not read them. And I find, as a Manager, as well, you need to get a signature to prove that yes, this person has read it, because if an incident happens and you ask the person, they can easily say "Oh, I never seen it and I never read it", but if you say "This policy is here, it's your responsibility to read it", but then actually get their signature to say they've read it, and we've done that with a few policies that are quite relevant to here. (senior nurse/matron, DGH)

Whether or not specific guidelines and protocols (e.g. the sepsis care bundle) could be adopted and implemented by an individual critical service was seen as not entirely within the control of the critical care team itself, but depends to an extent on management priorities at a Trust level and/or on the cost implications of the specific guideline or protocol. Furthermore, where a local network was/had been functional it too potentially had a role to play in deciding which policies, guidelines and protocols would be prioritised and implemented in local services.

While the general sentiment was that increasing standardisation was beneficial to patients and staff alike, a small number of interviewees expressed concern about what they saw as the apparent over-proliferation of guidelines and protocols. They argued that the increasing protocolisation of critical care may result in the loss of the 'art' of medicine and nursing and lead to dependence on guidelines and protocols among junior staff.

…to the point where maybe you don't think out the box so much, and you're very tunnel vision, that you don't have the questioning skills. I think with us, our job is, you know, one of the most important things that we do is you think laterally. You look at everything before you come to your conclusion.......but then I also think the rigid protocols that you have protect the staff to make sure that we're all doing the right thing. (outreach nurse, DGH)

Furthermore, it was argued that critical care patients do not always fulfil protocol criteria and that in such cases there is no substitute for clinical judgement and experience. Indeed a number of interviewees made a distinction between guidelines and protocols (as one notes, they 'shy away' from the term 'protocol') and signalled their preference for the former for the reason that they provide leeway for the application of professional experience and skills and are less prescriptive in nature. The concern was that the pendulum might swing too far resulting in the loss of the benefits of individual expertise.

Yes, guidelines are – everyone in Critical Care is aware that patients are very much on the physiological edge and they don't follow the

rules and so guidelines are fine for the majority of people, but don't always work and again, you know, that's why we call them guidelines not protocols. (consultant, teaching hospital)

Care Bundles

Perhaps the most explicit example of the protocolisation of practice in adult critical care in recent years has been the introduction on a national level of the care bundle approach. The majority of the study sites had introduced a number of care bundles (the ventilator and sepsis bundles being the two most frequently mentioned), and interviewees reported that compliance was being audited. There was a general awareness of, and familiarity with, the concept of care bundles among interviewees, although some, when asked, mentioned protocols and guidelines, whose 'bundle' status they were uncertain about. While one interviewee explicitly attributed the introduction of care bundles directly to the Modernisation Agency, others placed the implementation of care bundles by their services in the same category as the adoption and implementation of other national guidelines. A consultant at one site noted that although bundles were being implemented on his/her unit, it was unlikely that junior nursing staff would recognise the bundle approach per se, as it would simply appear to them to be routine ICU practice.

I think basically because it was – it came out from the Modernisation Agency that, you know, I mean you've got to do that and also because of good practice really, you know, reviewing about consistency and the way people do things and also for, you know, it just – we haven't really, sort of – it's – I think [staff member] is doing an audit on it, on how well it's doing and things like that, but we haven't really had a chance to see the benefits of it and things like that, but this, the driving force was basically for consistency and also because that was the way forward really. (consultant, DGH)

A number of interviewees reported that care bundles were not implemented in their entirety and/or in their original form, but were adapted for use, in their ICUs, partly because elements of the care bundles already constituted long-standing and routine practice in their services, or formed part of an existing protocol.

Well, you see, all the elements of the Ventilator Bundle are already part of our protocol, so, to say we use – we haven't changed anything with the Ventilator Bundle, but Stress Prophylaxis, DVT Prophylaxis, keeping the patient head up, sedation breaks, were all part of the existing protocols, and the existing management, so I'm not sure that we've introduced a Ventilator Bundle, so we don't have a thing that says a Ventilator Bundle. We have audited – we've used that to undertake audits, to see if we're compliant. (consultant, teaching hospital)

I just feel that what we do as nurses is the same. We follow instructions, and I just feel that all these changes have come in and it's just a big stressor for people. "Oh my god, you know, Sepsis

Bundle, Ventilator Bundle," and it's like, "But we're doing it already, calm down," you know… (staff nurse, teaching hospital)

While arguing that they could see the potential merits of the care bundle methodology and its value in terms of providing a framework for auditing practice, some consultants and senior nurses in particular were sceptical about whether a package of changes, a 'bundle', was any more effective than making individual changes in clinical practice. This was associated with uncertainty about whether the individual elements of a bundle work synergistically or antagonistically, and also with concerns about the adequacy of the evidence base underlying care bundles, and emerging research findings which appear to challenge the efficacy of aspects of existing bundles.

The principle is good………..the principle I applaud. I mean, if you had something that's known to work, that's an effective piece of evidence, great, but that's a separate component. And then you've got to see that that component works with that component that works with that, and that some of the parts, that they are synergistic rather than antagonistic. And there's a lot of very tenuous evidence being put together within bundles. There's never been any validation, proof that they work; some of them actually generate a lot of work, and it's very interesting that a lot of the bundles that are being now pushed are now being undermined by new evidence coming out and saying "Well, actually that bit doesn't work; that bit doesn't work; that bit doesn't work, so again, a bit like Outreach, right idea but badly implemented. And it's a shame, because I think the principle's right, you know, we should all be raising standards……… (consultant, teaching hospital)

…… if I went and got you our Daily Review charts, they have plenty of Care Bundles on there with tick boxes. That's fine, and I think they work quite well for that, and it's a good way of auditing compliance with a process. My worry about Care Bundles is that the outcome is the process. The Sepsis Care Bundles I have quite a lot of issues with, a) around the quality of the evidence and, b) around the fact of combining a number of pharmacological interventions with the same end point where you don't know whether they're synergistic, antagonistic or what, and the one that screams out at me is the whole idea of giving steroids and insulin. You know, I don't know what happens when you do that, is it better, is it worse, is it the same? No idea. So I don't have a problem with them as a methodology. (consultant, teaching hospital)

I mean, they've supposedly produced all these evidence based Guidelines, but I think now, nearly all of their main recommendations, there is new evidence to show that most of their recommendations aren't actually that effective. So, yeah, we do try to adopt, you know, evidence based best practice where things come out nationally. So, for example, another thing I think is Activated Protein C where there was a NICE Guideline, so we do have that available and we use it, but

again, I think some of the newer studies are showing that maybe it's not as good as it was first thought anyway. (consultant, DGH)

The evidence base underlying the sepsis bundle in particular was a source of concern to a number of interviewees.

….you know, the evidence with surviving Sepsis is [sighs] back of a cigarette packet, and I mean, that's had a huge change to us in that we now have to start everyone on all this treatment, and I think there are certain things that are, you know, fine, but, you know, they've just changed, as you're probably aware, they've just changed the Surviving Sepsis Guidelines, so global changes, if you like, coming out without necessarily fantastic evidence. And the difficulty, of course, is what we do is often not based with fantastic evidence, but this concept of [sighs] packets of change being better than individual change, so – I don't know. It's a nice idea, isn't it, that if you make a whole series of changes that's going to be better than one thing. (consultant, teaching hospital)

…. and certainly when you read through the main paper that supports the Surviving Sepsis, some of the elements there are only or two pieces of work that's been done that does make you think, well, is that really classed as extensive evidence and should we really be going forward with this on the basis of only one or two pieces of work? So certainly, you know, good that our Consultants have sat back and thought about it and haven't just taken that at face value, because I think there was this whole oh, you know, Surviving Sepsis out there and we've got to get onboard and we've got to do it, and I think perhaps a good thing that they've actually sat back and thought about what we do want to pursue and what we don't really. (senior sister, DGH)

Individual concerns about the widespread adoption of care bundles included the belief that once a bundle had been adopted, it might be viewed as 'set in stone', and result in a failure to review and take into account new and emerging evidence, or that the implementation of care bundles might result in some units being dragged down to the average *'because you're changing their good practice into something that isn't particularly evidence based* (consultant, teaching hospital)'.

However, in spite of concerns, a couple of interviewees described occasions when the sepsis bundle had been used very effectively with patients who might not have been expected to survive. Similarly there was anecdotal evidence to support the efficacy of the ventilator bundle. As with protocols and guidelines in general, the types of perceived benefits of using care bundles included improved patient care, the standardisation of practice among consultants, a raised awareness of the importance of an empirical evidence base, and the generation of data which could be employed not only to audit practice or measure outcome, but also used strategically to make the case for new equipment, an increased drug budget, or some other perceived service-related need.

With the Ventilator Care Bundle as well, I think we have demonstrated that we are able to make a difference to patients on ventilators, if we're compliant with the bundle, and a tentative answer will be that yes, we can reduce the number of ventilator days by putting the Ventilator Care Bundle into practice. (senior sister, DGH)

I think they're beneficial definitely, that one would, for Sepsis, and you used to find a lot of patients died, but now, like, you don't have patients dying. …….. Just, sort of, they've made it easier to, sort of, fight your case to get things done for your patient. So I think people are clearer as well, so they know what they should be doing for this patient, whereas before you had them, you may have, you know, one Consultant doing one thing for a few days and then another Consultant trying another thing, whereas when you have them, you actually have all your Consultants following the same thing. (senior nurse/matron, DGH)

While concerned about the evidence base underlying care bundles, there appeared to be an implicit belief among a small number of interviewees that opting out of the care bundle approach was not really viable, given the approach's perceived links with national campaigns such as the Surviving Sepsis' campaign and a concern that there might be potential future financial consequences to not implementing national initiatives (e.g. when Payment by Results is introduced).

Yeah, we do all that stuff, but we've tended to just, I mean, again, we don't really adopt it as a Care Bundle. I mean, I think we just saw the Department of Health stuff and said, "Okay, well, yeah, we're doing most of the stuff anyway", but I think probably we will have to demonstrate that we are doing this bundle approach because I think probably it's part of the – I'm not sure about the Payment by Results, but I know some of these targets now are all based on whether or not you're complying with these national things. (consultant, DGH)

Culture of data collection, audit and research

A growing awareness of the importance of employing empirical research findings and the existing critical care evidence base, as well as conducting local audit and data collection in order to firmly underpin clinical practice, was cited as one of the perceived drivers to the standardisation and protocolisation of care. However, the association between the two was not unidirectional. Protocolisation (e.g. the use of care bundles) was also viewed as leading to an increasing amount of data collection and audit.

To some interviewees, the advent of the evidence-orientated culture is helping to facilitate the development of critical care as a specialty. It was also suggested, though, that there are still many gaps in the critical care evidence base; that some of the existing evidence is of poor quality; and that undertaking research and audit in critical care is not without a number of unique difficulties. For example, one of the reasons posited for why critical care has lagged behind other areas of clinical practice in terms of research is that the diverse nature of the case mix has impeded the conduct

of large studies producing generalisable findings. A view also expressed by a couple of interviewees is that, unlike other areas of medical and clinical practice, the evidence base in critical care has been built to an extent on establishing 'what not to do' in providing care, and effects of reducing rather than increasing interventions. In addition, the view was expressed that critical care professionals need to keep up-to-date with, and be able to interpret, emerging research findings, and that research is important to the future development of critical care. The expressed concern with the quality of the evidence base underlying care bundles, as described above, suggests that this is happening, at least to some extent, at the study sites.

> *I think one of the problems with ITU is it's quite a difficult group to look at. They're small numbers. It's difficult to double blind it since, you know, you can't have the patient that you're not feeding and one you are [laughs] and it's difficult to get the numbers sufficiently enough to convince people.* (pharmacist, DGH)

> *…..actually when you look at evidence based medicine, the really strong evidence within this field is really what not to do……not what you should do. We know what kills people, but actually we don't know what really helps people. And so, the real confident evidence based actions are what not to do.* (pharmacist, teaching hospital)

> *I think we were quite lucky 'cause we were in a Unit that was quite proactive in auditing and practising, where you try to identify what was good practice. I think the other things that have improved or changed is, you know, where everything used to always have to be research based, and now, of course, it's evidence based as well. So, sometimes it's quite difficult to have empirical new knowledge about something, and it would be difficult to suddenly devise a research question to provide that evidence for something that you have been doing for x amount of years. So, I think the move to evidence based, or accepting evidence as well as, purely, you know, purely empirical research, is a good move.* (senior nurse/matron, teaching hospital)

As elsewhere in the NHS, adult critical care was said to have witnessed a growth in the 'audit culture' in recent years. Perceived drivers to audit included the clinical governance and other government driven agendas (e.g. infection control), performance measurement, benchmarking, and service-related as well as continuing professional development needs. Notably, the perceived increase in audit was only rarely attributed to critical care modernisation per se. The imminent introduction of the 'Payment by Results' system, mentioned spontaneously by interviewees at several sites as a future 'concern' for adult critical care services, was seen as an powerful incentive to ensure that data are being collected in an accurate and appropriate fashion. However, the intrinsic value of audit as a useful tool in allowing individual services to measure their adherence to guidelines and protocols and their performance against standards over time, as well as to gauge improvements inpatient care and outcomes, and to feed back into best practice, was also reported.

It's become more prevalent as the years have gone on certainly, yeah. I would say there's certainly more emphasis on that data collection now 'cause like most Intensive Cares we also contribute to the ICNARC database, etc, etc, so there's more emphasis on data collection and on the quality of the data we collect as well. (senior charge nurse, DGH)

…….audit has, you know, increased a hundredfold, I'd say. Pretty much everything that we do is audited….., The G Grades are all involved in, and they have their own individual benchmark to audit. And these are all fed back as best practice and what our action plans are to the staff. (sister, teaching hospital)

While audit was described by some as currently being taken more seriously or conducted more professionally than in the past, other interviewees suggested that this was not the case, as critical care staff are simply too busy to pay anything other than lip service to it; their priority being patient care rather than form-filling. At a couple of DGH sites, perceived limitations in IT systems were mentioned as an impediment to audit and data collection in general. While expressing a general appreciation of the requirement to audit practice, several interviewees were of the opinion that too much audit is been undertaken and/or were concerned that they were not being made aware of what uses audit data are being put to.

It's like you can't blow your nose now without it being audited how many times you've done it…….. But then how do you find out if things are working if they're not audited? (nurse, teaching hospital)

And it's just – sometimes, sometimes, you just feel that you're doing an audit after audit to provide evidence that you are achieving those standards. And that's grand, and that is needed, and I did try to do it, but I didn't become a nurse to do that. (senior nurse/matron, teaching hospital)

One interviewee, however, felt that the amount of research and audit being undertaken had not lived up its promise vis-à-vis modernisation.

And I think there was a bit of a – a bit of excitement and everyone was quite keen to look at that, sort of, five years ago, but it seems – I don't know………. I can't help wondering whether that's slipped by the wayside. I don't think the amount of audit and research that they wanted has gone on. (physiotherapist, DGH)

Audit and data collection in general was described by a number of interviewees as a useful 'political' tool which might be employed strategically to make a case to, or obtain required resources from, Trust management or commissioners. Equally it could be employed strategically by networks.

And we had a really strong one, a Discharge recently because of the bed situations, you know, and we'd have patients who were discharged and then we'd been sitting on them ……………… you know, and then it would be reflecting on our finances and our situation and

then they would be questioning us why we didn't have a bed to admit so and so at three o'clock in the morning, so we had to initiate, sort of, a very clandestine audit to try to explain the fact that it's not our fault, this is a, you know, and things like that always happen in little approaches, and someone says "Well, the only way we're going to prove this is if we audit it."…to effect change and highlight stuff.
(senior nurse, DGH)

When asked about their own or their service's involvement in empirical research, interviewees were generally able to describe either national studies in which their ICU or critical care service had participated, and smaller ICU- or Trust-specific studies which they or their colleagues had conducted. Indeed interviewees at a couple of the study sites viewed their services as extremely research active and at the cutting edge of critical care research. At another site, the introduction of stringent and time-consuming R&D governance procedures were said to have impeded the amount of research the adult critical care service could initiate or engage in and audit was seen as a substitute of sorts. ICNARC was referred to by a number of interviewees when highlighting the merits of data collection in adult critical care.

Audit is the new research. (consultant, teaching hospital)

While there was a certainty in interviewees' descriptions of, or anecdotal references to, their own service's involvement (or lack of thereof) in undertaking research, some interviewees were more vague about whether local network-wide projects had been undertaken using rapid change methodologies. Indeed the term 'Plan Do Study Act project' was unfamiliar to some. Not surprisingly perhaps, there was a tendency for this to be the case at study sites where the local network was perceived by interviewees to be ineffective or non-functioning. Interviewees who described their network as functional and who had had some association with it were better able to describe policy- and research- or audit-related projects that had been conducted (e.g. regarding transfers), even if not personally involved in them.

There were some projects that went on, and I can't really recall. There definitely were some things that went on, but I can't remember now, to be honest. (dietician, teaching hospital)

There was a certain amount of scepticism about the value of 'rapid change' projects, particularly among consultants. It was suggested by some that the funding employed might have been put to better use, and that larger, 'pushing the boundaries' studies should have been prioritised over small PDSA projects which did not necessarily address the most pertinent issues or problems for critical care services, or have the potential to increase the knowledge base significantly in a sustainable fashion. In addition, local services were said to have always undertaken local projects in any case.

I think most of us ridiculed it a little bit as a method. (consultant, teaching hospital)

I'm sceptical on the Modernisation Programme and the Network, as you can hear. You know, when you read some of the things about the Small Step Change, I just – I would like to look at each of the things they're saying and then answer you as to what I think about them, but I have not been left with a great, cuddly sense of goodness coming out of it, at all. I think a lot of money went into and I'm not sure that it was money well spent. I'm not sure that I would have spent money better. I don't say that – sadly, I don't say I've got a better idea, but I don't know that they've got it right… (consultant, teaching hospital)

Everything was PDSA'd to within an inch of its life, but I'm not certain how many sustainable projects came out of that…We did quite a few PDSA projects, but they were mostly around things that we knew the answers to anyway. It just gave us tools to drive the change, in order to drive…..I'm not sure we needed to do it using a PDSA. I mean, the PDSA became the tool that fit every screw, wasn't it? (consultant, teaching hospital)

Summary

Modernisation, therefore, is at least in part viewed by interviewees as involving a drive to standardise practices locally and nationally and develop and implement care guidelines and protocols. Benefits are said to be evident, for example, in improvements in patient care and service delivery in recent years. While the use of care bundles, and an increased emphasis on developing policies and protocols, and collecting data were initiatives encouraged by both *Comprehensive Critical Care* (Department of Health, 2000b) and the MA, it would appear that broader issues and developments in the evolution of critical care (e.g. an accumulating evidence base), and in health care policy and organisation in general (e.g. new consultant contract) have also had a role to play in this aspect of perceived service development and improvement.

4.3.4 Boundaries, communication and the delivery of 'critical care without walls'

Previous research (e.g. Carmel, 2003, 2006a) had suggested that the boundaries around the ICU itself have traditionally been pronounced, both functionally and organisationally, with the ICU having its own *modus operandi* and existing very much as a 'closed' environment in the acute hospital setting. However, one of the key tenets of *Comprehensive Critical Care* (Department of Health, 2000b) was that critical care was to become a hospital-wide service, rather than simply a unit based one, and that it would focus on patients' needs for critical care regardless of their location within the hospital. In order to facilitate this cultural and organisational shift, and

to realise the concept of 'critical care without walls,' the links between the ICU and other acute services in the hospital were to be strengthened through, for example, the introduction of outreach services and Trust wide Critical Care Delivery Groups. However, the move towards dismantling 'walls' was not confined to within the perimeters of individual trusts. Trusts providing adult critical care within a given geographical area were to work together through a local critical care network to develop common standards of care and common operational procedures (e.g. for transferring critically ill patients from one ICU to another). In order to achieve this the MA provided an element of network funding (e.g. to fund the clinical lead's time).

The acute hospital setting

The concept of boundaries and the term 'critical care without walls' emerged spontaneously in interviewees' accounts of changes in critical care in recent years, for example when they were describing the impact of having an outreach service, or discussing new roles for critical care staff. Where these issues were not alluded to, and in order to explore potential cultural, organisational and social shifts in the way the ICU and critical care services are perceived to operate within the acute hospital setting, interviewees were asked to describe how critical care 'communicates' with the rest of the hospital and /or about the boundaries around the ICU and the adult critical care service.

The notion of 'walls' or boundaries around the ICU was a salient one, variously conceptualised as physical (e.g. the geographical location of the ICU in the hospital building and the 'locked door'), professional (e.g. team membership), and organisational (e.g. membership of specific directorates) in nature. However, regardless of how they were interpreted, boundaries appear to be less fixed and rigid than previously, or to have been re-framed on a number of levels. Interviewees reported improved communication and interaction between the ICU/critical care and rest of the hospital. Crucially, critical care is seen as no longer being delivered exclusively on the ICU at most of the study sites.

> ….traditionally, Critical Care Units have been known to be, sort of, ivory towers, and people never to come out and they all think they know best, and, I mean, obviously Comprehensive Critical Care was about breaking all that down. (nurse consultant, teaching hospital)

> So I mean there's a huge amount of Critical Care being managed outside ITU and even HDU, that yes, I mean it's been huge in the last ten years, that has taken off in that way. (physiotherapist, DGH)

The term 'critical care without walls' was also familiar and salient to many (but not all) of the interviewees, regardless of professional background. Like 'boundaries', it too was interpreted in a number of ways. It was defined, for example, in terms of the introduction of the levels of care classificatory system, of having facilities and staff to treat critically ill patients on wards, or as the presence of a critical care outreach team in the hospital. It also appears to involve an increased recognition and acknowledgement that critically ill patients are found not only on the ICU.

Well, I think it's made us much more aware that it's not just Intensive Care where patients are sick, and so this grading of patients, where we're all aware, like if someone says, "They made be needing Level 1 or 2 care" then we need to be aware that they are out on the ward. (sister, teaching hospital)

Well, I think that's very much a strategic change where we no longer talk about Critical Care occurring in HDU or ICU beds, but critically ill patients can be presenting anywhere and throughout the hospital, depending on what level of Critical Care they require. So we've had to very much take our services outside of the traditional walls of Critical Care and apply an element of Critical Care in, let's say just general ward environments as opposed to clinical specialty areas. (senior nurse/matron, teaching hospital)

Although it was suggested that the 'walls' are coming down to an extent and/or that boundaries have been re-framed, there was a lack of agreement about the degree to which critical care is becoming, or can ever feasibly become, a truly hospital-wide service. Achieving a seamless, hospital-wide service was described by one interviewee as 'the challenge' of modernisation. A number of metaphors were used to describe the coming down of 'walls.'

No, I don't think we're quite in Jericho yet [laughs]. But I think the walls have – are see through now, rather than opaque, and I think there are many more doors than there used to be… (nurse consultant, teaching hospital)

We've got Critical Care with a door slightly ajar….[laughs]. (consultant, DGH)

The dismantling of boundaries around the ICU and the critical care team is said to have been in part due to the development of critical care outreach teams, who serve not only to facilitate the delivery of critical care throughout the hospital but whose visible presence on the wards is said to have raised the profile of critical care in general. However, the ongoing development of new or extended professional roles, such as that of the nurse consultant in critical care, whose remit generally extends beyond the ICU, is also viewed as having helped open up the critical care service to the rest of the hospital and vice versa. So too is a perceived increased culture of multi-professional working, with greater integration into the critical care team of allied health professionals who, while crossing the 'walls' or boundaries in their critical care roles, also work with other teams and units throughout the hospital. Other opportunities for contact between ICU-based and ward staff have taken the form of new educational initiatives, such the provision for ward staff of critical care study days, training programmes and informal teaching sessions, by critical care professionals based on the ICU. Furthermore, efforts have been made to address perceptions of critical care staff as elitist and the ICU as a frightening environment, by welcoming non-ICU staff onto the unit. These inter-related issues will be discussed in more detail below, before the factors said to be impeding progress toward the establishment of critical care as a hospital-wide service are considered.

The role of outreach in fostering 'critical care without walls'

> 'The Outreach is what brings us together, I think.' (senior sister, DGH)

The advent of the critical care outreach service was repeatedly cited by interviewees as one of the most important organisational changes and /or most beneficial achievements of recent years in the way critical care is delivered in the acute setting. Six of the study sites had formal, staffed outreach services. Various levels and models of outreach provision were described, and the functions, activities, and objectively measured and/or anecdotal outcomes ascribed to the outreach team varied to an extent at the different study sites. Commonly cited outcomes, however, included earlier or avoided admissions, improved procedures for admitting patients to the ICU, more extensive follow-up for patients discharged back to the wards, and fewer re-admissions. Perceptions of how outreach is 'located' organisationally, operationally and culturally also varied; for example, some interviewees perceived the staff working on the outreach team to be integral to the ICU team, partly because their ICU nursing colleagues rotated through outreach; others saw the outreach team as an entity independent of both the ICU and the wards; and still others saw it as a ward based service. Regardless of its 'location' outreach was perceived to have played a key role in blurring boundaries, fostering relationships between critical care and the rest of the hospital, and creating a profile for the adult critical care service as more than simply the ICU and its staff.

The various practical roles and responsibilities undertaken by outreach staff on the wards – provision of advice, and clinical and practical support, education and training, and the organisation and facilitation of patient transfers between wards and ICU and vice versa - were seen as crucial to providing optimum care for ward based patients. However, the outreach team, positioned, as it is, as an initial point of contact with critical care services for ward staff when a patient triggers, and supporting, as it does, patients discharged from ICU to the wards, was also seen as having an important role in fostering communication and creating new relationships between ICU and ward staff. As well as the necessary clinical skills, a range of social skills such as diplomacy, and an ability to support without undermining or overwhelming, were said to be essential to those working in outreach.

> I mean it's [outreach] been, without a doubt, one of the two biggest changes since 2000. I think it's been an extremely difficult task, and we've been very fortunate in developing a team of people who are clinically very able, which is a prerequisite, but also have the maturity and [sighs] I don't quite know what the word is really, I think maturity's the best word really, to be able to develop relationships outside Intensive Care, and they have done that in spades. At times, it's been extremely difficult and there are still pockets – some big areas, to be fair, of the hospital, who are less accepting of Outreach than others, but the difference that it's made in us having knowledge

about ill patients out in the hospital has been fantastic and I wonder how we would ever have managed before. (consultant, DGH)

The outreach team was viewed as having an 'informational' function, serving as a conduit for the flow of information between the ICU and the wards and vice versa. ICU staff are kept informed not only about the status of individual patients (pre-admission and post-discharge), but also about the preparedness and ability of wards to accept or manage individual patients who are ready to be discharged to them. Information about issues such as the skill mix of ward staff is also relayed to the ICU. Equally, outreach staff serve as messengers from the wards, passing on information to ICU about any concerns which ward staff have about patients discharged into their care.

Well, they're the eyes and ears on the wards…….. For sending patients out, we refer them to the [outreach] Team and they will assess the patient for the suitability of the ward they're going to, 'cause they know the wards better than we do, and it's all very well me saying "Oh, send them to such and such floor. I don't know the staffing; I don't know the capabilities of the staff up there. It might be completely inappropriate for that patient to go there, so it's quite good to have them to liaise and say "Well, they won't cope with this patient", 'cause they know what's going on in there, it's not outside this floor and they know what's happening, we don't. (sister, teaching hospital)

The presence of an outreach teams also impacts on the social-organisational culture in the hospital in a number of other ways. It was reported, for example, as helping to increase understanding among staff on the ICU about the difficulties faced by ward staff on a day-to-day basis, resulting in an increased empathy and admiration for staff working on the wards among at least some of those working on the ICU. At one site, rotation of ICU nurses and staff onto the outreach team was reported to be particularly helpful in this respect, as they return to the ICU with a greater appreciation of life on the wards.

You know, they feedback to us what's happening on the wards, 'cause I hear some complete horror stories on the wards and I think, well, you know, they've got one trained staff and three health care assistants. Well, that's not enough if there's 50 beds, and things like that, so, I can sympathise with the wards, because I know from them what's going on, whereas without them, I don't know what's going on up there. You know, they could be all sitting up there having cups of tea 12 hours a day, you know, who knows. So yes, most definitely, you know, they are the important link between us and the outside. (sister, teaching hospital)

……sometimes we'll get a patient in and you'll hear quite inexperienced nurses criticising the care the patient's had on the ward, but, you know, my answer is, "You've got absolutely no idea what it's like out there. You don't realise how busy it is or what pressure these staff are under", so I think we've helped raise the profile of what the wards are

actually doing for these patients…… (nurse consultant, teaching hospital)

…..but I think if you've only ever worked here you're very blinkered to what nurses have to do on the ward and nurses on the ward are extremely, extremely busy…..and they are extremely pushed, and I think it's very, very easy for us to quickly criticise a ward nurse and say "Oh God, look at the state of that," you know, because they have a very difficult job and I wouldn't want to work on a ward for a million pound a week anymore, you know, I know which side my bread's buttered. (nurse, teaching hospital)

At the same time the outreach team was presented as helping to dispel 'myths' and negative views about ICU professionals among staff on the wards. The physical presence of critical care outreach nurses on the wards, for example, is said to have challenged the supposed view of critical care staff as both 'elite' and elitist, replacing it with one of them as simply nurses working in a different specialty and with a different set of skills (although there was some question about whether this new image is one which is happily owned by all critical care nurses).

I think we need to get away from thinking that Intensive Care's something special. And trying to promote out in the hospital that, you know, yes, we're nurses that deal with technology, but at the end of the day, it's still the patient that we deal with, you know, and we haven't got any more skills than the ones that they already have or could learn, 'cause I think, certainly in this hospital, sometimes you are still seen as the ICU Nurses and, you know, very special and – but we're not [laughs]. (senior sister, DGH)

In addition, the outreach team's role in encouraging ward staff to accompany patients when they are being admitted to ICU, for example, is thought to have helped quash images of the ICU itself as a 'scary' or 'frightening' environment. Outreach teams could be said therefore to have assumed, perhaps inadvertently, a public relations as well as a care delivery role, as they are seen to 'represent' critical care to the rest of the hospital, and, equally, ward staff to the ICU.

But the introduction of the Outreach Team has made Critical Care more accessible, and it was seen as quite an unfriendly place, before, I think. And I think that, to a certain extent, has alleviated that – it was a problem really and people were frightened to come onto the Intensive Care Unit……….Well, it has the reputation of Critical Care nurses having this, you know, I don't know if the word is [laughs] God-like, or they're special, which is not true at all, definitely not true. So I, you know, ward nurses, obviously our Intensive Care nurses are rotating through the different wards, so they're getting to realise that actually, you know, it's just another speciality. (sister, teaching hospital)

Definitely, sort of, with the Critical Care Outreach Team, there's definitely better communication between the wards and the unit,

because I remember when I was on the wards, you would actually be petrified to go down and speak to the ITU Sister [laughs]. I don't know why; they always made you feel that way, but then you are responsible for your own feelings, but you actually, sort of, got in a panic if you knew an ITU patient was coming to you, and that this Sister would be handing over to you, or somebody from ITU………So I think because Outreach have been out on wards, that barrier has been broke[n] down, and it was like there was a wall between ITU and the wards, and I don't feel that's there, definitely here in this Trust, it's not. (senior nurse/matron, DGH)

As such it was reported that they also fostered direct contact between the wards and ICU, of the sort that perhaps might not have happened in the past.

Our Outreach is run by a specific group of girls though, who don't work in the unit now; they work solely out on the wards, but you would consider that they're the, sort of, link between the two. What we do find is that when Critical Care girls aren't available, we do get the wards ringing us for advice, a lot more than they used to, so, you know, they must have given us a positive image out there because we do get more phone calls and perhaps the wards are a little bit more receptive than they may have previously been and do see us as a point of, you know, a point of reference if they come across something that they were unsure about and they will ring us, so. (senior sister, DGH)

What emerges from the data then is a sense that outreach is helping to facilitate the development of 'critical care without walls' not only by delivering and facilitating patient care in the ward, and support and education to ward staff, but also by playing a role in changing social-organisational beliefs said to be held by both ICU and ward staff about one another, and in re-framing historical boundaries.

New roles, ways of working, and opportunities for increased contact between staff on the ICU and the rest of the hospital

Opportunities for optimising patient care throughout the acute hospital setting, building stronger relationships between critical care and the rest of the hospital, increasing the profile of critical care, and breaking down perceived professional boundaries were not confined to the outreach team and its operations. They also involved an increased amount of direct contact between ICU-based staff and the wards.

The introduction and ongoing evolution of the role of the nurse consultant in critical care, for example, was viewed as beneficial not only to the development of critical care practices within the ICU and to the enhancement of the nursing role in developing nurse-led initiatives in critical care, but also to the development of links between the ICU and the rest of the hospital. While based in the ICU, nurse consultants were described, or described themselves, as having key roles and responsibilities outside the unit. They might, for example, have managerial responsibilities in relation to

the outreach team, service development roles in the directorate, or responsibilities for ensuring that critical care education was provided to the wards. (Indeed, a nurse consultant at one site described her role as having become so trust-wide in focus that she felt her skills were being lost to the ICU.) This was also the case for nurses with other specialist critical care roles.

> …there's a Professional Development Nurse that, again, comes under the umbrella of Critical Care, but doesn't work in Critical Care, she's out on the wards and does a lot of the training. (senior nurse/matron, DGH)

Some of the interviewees, particularly senior nurses and consultants, referred to the introduction in recent years of competency frameworks, and to changes in the medical training scheme, as well as to the development of new training courses and educational initiatives specific to critical care. Some of the more general changes introduced in relation to nursing and medical training were perceived as detrimental to adult critical care delivery. For example, junior nurses and doctors are described as being less well equipped nowadays both by their training and their hospital experience to deal with critical care patients when they first come onto the ICU. However, other training and professional development initiatives, such as the introduction of training packages across networks, were welcomed as opportunities to raise the standards of practice among critical care professionals and to ensure the standardisation of care delivery. Furthermore, a number of interviewees suggested that critical care now has a more pronounced educational role in the acute hospital: critical care skills and knowledge are being shared to a greater extent and no longer confined to staff on the ICU. Some interviewees described one of the key functions of their outreach team as educating ward staff, either formally, by running courses, or informally, at the bedside. However, education and training, although perhaps led by outreach, was not provided solely by members of the outreach team. Interviewees described critical care study days, courses and other training initiatives (e.g. training ward nurses to care for level 1 patients) which have been developed in recent years and are delivered directly from the ICU itself. Such training initiatives were seen as a part of critical care's remit to provide a hospital-wide service.

> The other thing is that there's much more involvement in education for Critical Care. Before sharing of our skills, I think it's true to say we were very mean with our Critical Care skills [laughs]. And so the change has been – and I think this has been Outreach led, is that we are involved in every level of education both pre-reg and post-reg and in terms of acute recognition and response skills mainly. (nurse consultant, teaching hospital)

> All of the education and training programmes that they offer ward staff is, you know, a really good step. So they do – they run Outreach Study Days for the ward nurses and they run Critical Care Skills Courses for ward nurses, and so it's people that they work with, and they see in a ward environment, so it can mean that they can target

areas that they maybe need to, and they can focus on areas that need improvement. And then they can work with the support, and give praise where it's needed as well. But I think, as with any kind of like educational thing, it's really important to make something that's been taught in a classroom meaningful at the bedside and the Outreach Team are really well placed for that. (senior nurse/matron, teaching hospital)

We now have it that all the House Officers come to us for a day before they actually start in the wards, which is great, so we have a day of indoctrinating them into our way of thinking. Then we also have virtually all the nurses in the hospital and also all the Physiotherapists come to our [name] course, and that's quite good in that we get Physios coming, because quite often the Physios getting called for respiratory deterioration, so we find that we get a lot of referrals from Physiotherapists, and I think the important thing about the [course name], it's not really the knowledge that it imparts because a lot of the time the knowledge is actually there, it's putting it all together, and so introducing them to the Outreach Team. (consultant, DGH)

A concern expressed by a small number of interviewees, however, was that the increased presence of critical care staff on the wards, instead of skilling-up ward staff, may in fact be having the opposite effect. While the initial remit of the outreach team might have been to educate staff on the wards, some interviewees reported that over time outreach staff have had to become increasingly involved in the actual management of patients on the wards. A number of interviewees were of the opinion that, for whatever reason (understaffing, poorer training etc), ward staff do not appear to be as well equipped to care for sicker patients as they once were. A number of interviewees noted that some wards and areas of their hospital are more willing to embrace the support given by outreach and critical care teams than others; an indication perhaps of some resistance to the concept of 'critical care without walls' on some wards, although this may simply reflect traditional territorial boundaries or personality clashes in individual hospitals.

But now, I think the Ward Teams are progressively getting deskilled because Outreach intervene more, you know, or take on the management of the patient themselves and the patient then gets taken away from the ward and brought to Intensive Care. So, I think the nurses and the doctors on the ward are now less familiar with and less able to deal with some of the sick patients on the ward, and quite often they'll just pick up the phone and say, "Oh, we've got a sick patient, can you come and sort them out?", and they end up not actually doing very much themselves. (consultant, DGH)

I just feel that where the Intensive Care Nurse role is expanding hugely, like we've got to know so much, you know, and you have to be competent at everything and still obviously you still have to be deemed competent, but then it seems that we're spreading our wings

> *and then the ward nurses are being sort of being clipped, if you know*
> *what I mean?* (staff nurse, teaching hospital)

At one study site a nurse expressed a belief that ICU staff were perhaps almost overstretching themselves in terms of trying to provide education and training to the rest of the hospital; the sentiment being that where a small pool of ICU staff takes on a trust-wide teaching role, the ICU itself can lose out.

A perceived increased emphasis on multi-professional team working in critical care (which will be explored in greater detail in a later section of this report), with the greater integration of a range of allied health professionals, such as dieticians, pharmacists and physiotherapists, into the critical care team is also seen as having helped to break down professional and territorial boundaries between medical and nursing staff based on the ICU and their professional colleagues drawn from other teams in the hospital. Like the outreach staff, allied health professionals are staff who 'cross walls', working a variety of settings and developing allegiances to a number of teams or wards. The physical presence of allied health professionals on the unit as well as their involvement in multi-professional ward rounds, protocol writing and care planning, and their contribution to outreach is said to have fostered mutual support and to have benefited patient care both on the unit and the wards. At the study site where there was no formal outreach team physiotherapists viewed themselves as acting as an informal outreach service for the ICU, feeding back information on patients who had been discharged to the wards.

Critical Care Delivery Groups

One of the recommendations of *Comprehensive Critical Care* (Department of Health, 2000b) was that Critical Care Delivery Groups (CCGDs) should be established in individual trusts so that all of the stakeholders (providers and users) would be involved in the development and delivery of 'integrated and flexible services (p.12).' It was also recommended that a designated Executive Director would take lead responsibility, on behalf of the NHS Trust Board, for critical care services. In spite of this, CCDGs were only occasionally spontaneously mentioned by interviewees. However, some interviewees spoke about the potential value and /or outcomes of having a trust-wide committee with a critical care focus. Perceived benefits included fostering communication, raising awareness of needs, agreeing strategies and policies between ICUs and critical care services based in the different hospitals in a Trust, or involvement in service planning at a hospital-wide level. At one site, a consultant spoke about the dangers of 'creeping development' which can take place in hospitals where services are designed without the involvement of critical care managers, even though their introduction may have enormous implications for the delivery of critical care within the trust.

> *They've improved and, sort of, made aware different Intensive Care's*
> *needs and what they're doing and these close relationships with them,*
> *what we'll do in Emergency, in major incidents, or flu pandemics, and*

we've developed a good strategy between the three of us [3 ICUs in a trust] for that. (sister, teaching hospital)

Interviewees at several sites spoke about their CCDG as being ineffective or as having petered out over time. Reasons for this included a perceived lack of interest by trust management, relevant stakeholders not attending meetings, poor leadership and a lack of financial incentives to participating in the CCDG.

> *But certainly, since it's also become clear that, for instance, money doesn't follow any of this, there's been a gradual withdrawal from the Critical Care Delivery Groups, in terms of both senior medical staff and service users. So, it has become a Critical Care Delivery Group, for Critical Care deliverers, as it were, and not much else, and I think that's a shame.* (nurse consultant, teaching hospital)

> *Well, when I first started there was one Critical Care Delivery Group meeting, and again, if it fell by the wayside. I think essentially the powers that be in the hospital weren't really very interested in that.* (consultant, DGH)

Efforts were said to be underway at a couple of the study sites to re-instate or address the problems of the CCDG, given the identified need for one and the policy recommendation that Trusts should have a CCDG.

> *Now what we're going to start doing here, is having an inside Critical Care Network Group as well, because we feel that, you know, the hospital should have one and it does come from National Guidelines that you should have one, and we can involve then people like Imaging, you know, Theatres, people we work a lot with, other Consultants that use our service here, and then at the meeting they can bring up stuff for us…* (senior nurse/matron, DGH)

> *I mean, various places I suppose have – I mean, this has, [Trust name] hasn't been as successful as some other places, has developed much better Critical Care Delivery Groups, or Critical Care. I mean, various titles have been used, but again, you know, Comprehensive Critical Care suggested that it was important to organise your Critical Care resources on a Trust wide basis with proper co-ordination and appropriate, you know, user, deliverer interfaces. So, certainly I've seen that function better elsewhere. I've seen that it is functioning well in some of the other hospitals in the network more so than at this particular Trust, at this moment in time. Although, you know, we're trying to address that as well.* (consultant, DGH)

Although a policy recommendation, and acknowledged as important by staff, CCDGs do not therefore necessarily appear to have been prioritised as a modernising initiative at some of the sites included in the present study.

Maintaining boundaries: factors impeding the realisation of 'critical care without walls'

While boundaries and 'walls' around the ICU may have become less pronounced on a number of levels in recent years, and the care of critically ill patients is no longer seen as confined to the ICU, a considerable amount of doubt was expressed by interviewees as to whether the concept of 'critical care without walls' is being, or can ever be, truly realised in the acute hospital setting. A number of practical, professional, organisational and cultural limitations were seen to apply.

Firstly, interviewees described issues such as those to do with infection control and the availability of equipment (e.g. ventilators) and specialist staff as reasons for confining the practice of critical care to defined geographical areas of the hospital.

> Well, you're always going to have the physical limitation. If a patient needs ventilating they need to be on the ITUs, so you are always going to have some kind of wall. Unless we start ventilating patients on the unit, on the ward, which they don't want us to do.
> (microbiologist, teaching hospital)

> ……you know, you can't really manage a big group of patients who are scattered all round the hospital. It just doesn't make sense. ………..So, again, I think the whole thing's in a way, it's got to be re-engineered so that all the sick patients are in one area and you have a designated team looking after them. But the idea that all these patients are just scattered all around the hospital is completely silly, I think.
> (consultant, DGH)

Secondly, it was suggested that ward staff do not have the capacity, manpower, or requisite skills to manage critically ill patients on the wards, and that the capacity of outreach to support the wards is itself limited, particularly where it is not a 24-hour, 7 days a week service. Associated with this was a concern expressed by a few interviewees about dilution or loss of skills on the ICU itself as some of the most experienced staff leave to take outreach jobs, because of the more sociable hours and opportunity for promotion they provide. This they saw as a potential problem for ICUs, particularly where there is difficulty in recruiting middle grade or experienced nursing staff. Thirdly, while outreach, as outlined above, has helped to dispel negative perceptions among ward staff about ICU-based staff, there are still perceived to be some remnants of a 'them and us' culture on the part of ICU staff, either because they are simply not exposed to ward staff or because, as a few interviewees argued, they wish to maintain what they see as their elite position in the hospital.

> There was something else, sort of, important that I was going to say about Critical Care without walls. I've tried very hard, there's – what is interesting is the [ICU] folk who do work outside the unit understand the need for developing relationships. The staff who don't go outside the unit don't, and therefore find it as easy to be [sighs] not difficult, but standoffish and to maintain that, sort of, barrier

that's always existed. And I think the more staff you get involved with doing stuff outside the unit, the more those walls break down…. (consultant, DGH)

I think there is always going to be a perception that Critical Care Nurses are somehow scary. And to be honest, I think Critical Care Nurses quite like it. Yeah. They like the fact – I know a lot of them like the fact that trainee medical staff from outside the Unit are scared of them. I mean, they may deny it, but they love it. I mean, [name] who's on today, you know, she loves the fact that trainee medical staff are terrified of her. I mean, we have nurses called 'Scary Mary,' I mean, you know, and that's a cultural thing to do with Critical Care. (consultant, teaching hospital)

Finally, there was also said to be some resistance from ward staff towards greater integration, partly perhaps for territorial reasons, partly because they may not welcome critical care staff telling them what to do, and partly because they are still said to fear the technological environment of the ICU. At one site, several interviewees described the existence of outreach 'friendly' and 'non-friendly' wards.

I think there are boundaries around medical staff, 'cause, "It's my patient, don't come and touch..." you know, I think that is a real – rather than thinking of the patient as a whole, and that it belongs to me when it's here, it doesn't. And I think they're traditional. I think that the boundaries around Critical Care have come down, and people are more open and happy to receive and to be involved. But you see, we could almost say that, by doing all the stuff that we're doing out there, some of the time people think, who the bloody hell do they think they are, coming in and doing that? You know, they're giving me this. We try very hard not to, but from the perspective, I mean, you look at the Outreach Report, and look at the quality aspects of it, and there's loads of people are saying, "Yes, it's great, we know we have some support." We've got people come up and sometimes they come in and, you know, it's like we're left to one side. We try very hard not to do that, but whether we always succeed, I don't know. I don't know. (nurse consultant, DGH)

I remember when we introduced Outreach, there was the initial resistance by some of the "dyed in the wool" Consultants, you know, that they felt, well a perceived threat that the Critical Nurses would come in and interfere, you know, and "how dare they", but now I think it's so well entrenched and accepted because I think they realise that without that resource, I think a large amount of the ward would collapse…. (consultant, teaching hospital)

Some of the critical care consultants described their roles as having always involved regular contact with ward staff. A number of consultants noted that they had sometimes experienced / still experience territoriality from their medical colleagues on the wards, but viewed the development of formal outreach roles for critical care consultants and/or the fact that consultants

on the wards are now having to become more accustomed to team working themselves as having helped to reduce the culture of territoriality.

Summary

There appears to be some agreement among the study participants that the boundaries around critical care are not as pronounced as they used to be. This is in part attributed to *Comprehensive Critical Care* (Department of Health, 2000b) and the modernisation agenda having pushed the introduction of initiatives like outreach. As a consequence of outreach, new educational and training provision and increased multi-professional working, the care of the critically ill patient is no longer confined to the ICU. While this is generally seen as a positive development, particularly for patients, there is disagreement about the extent to which critical care ever become a completely hospital-wide service. Reasons posited for why it may not be achievable or even desirable are partly grounded in practicalities, but it might also be suggested that there is still some ambivalence on the part of some ICU staff. While they have witnessed critical care emerge as a specialty in its own right in recent years, they have also experienced what might be described as a 'dilution' of skills on the ICU as staff have left to join outreach teams or have taken on hospital- or trust-wide roles.

4.3.5 Communicating with other critical care services: networks and networking

As reported earlier, one of the core recommendations of *Comprehensive Critical Care* (Department of Health, 2000b) was that geographically based, clinically focused, adult critical care networks should be set up across England to foster communication between trusts, and encourage the development of common standards, protocols, policies and guidelines. In addition, it was envisaged that Trusts within networks would undertake shared projects, using a rapid change methodology (Ketley and Bevan, 2007). By 2002 29 such networks were established, each comprised of approximately six providing adult critical care services, but at the time that the current study was conducted some of the networks were no longer functioning or had merged to form larger networks.

Although many of the interviewees were aware of their local network, a number, even when asked about the Modernisation Agency Programme and local modernisation initiatives, had to be prompted about their local network. In addition, networking was not conceptualised simply in terms of the geographically based Modernisation Agency-backed, formal network, but also as professional networking (e.g. through regional and national organisations), and networking on an informal basis with colleagues at other hospitals. The idea that critical care professionals needed to be told

how to network, or should be forced to network through a formal structure, was anathema to one interviewee.

I'm not sure what the Network really is [laughs]. (physiotherapist, DGH)

And I think – I think it's slightly precious of Networks to think that they have some role of friendship that we wouldn't have as professionals, and we're very close knit in our particular neck of the woods. We have our Regional Society, which is very popular. We all mix socially and professionally very well........ So, I think several of us laughed a little bit that the Networks' role was to make us talk to other people in our own specialty; we found that a bit condescending. We've been networking, with a small n, for longer than the Modernisation Agency has existed. (consultant, teaching hospital)

Views about the perceived success or otherwise of the local network and about the factors which contribute to that success were not confined to those with direct involvement in their local network, suggesting that a specific 'image' of the network is created and disseminated, to an extent at least, among staff within local services. Interestingly, where the local network was perceived to be active and successful a number of interviewees, when asked about perceived key changes in critical care service organisation and delivery in their organisation, framed the changes they reported in terms of the local network and its impact on their service. Where local networks were perceived to be less functional, interviewees tended to describe only those changes which were quite specific to their own services (e.g. growth in capacity or the introduction of an outreach team).

Interviewees described a range of service- and professional-related benefits which resulted from being part of a local critical care network. The network, for example, provided potential opportunities for communication, making contact, and building professional relationships with one's colleagues at other local units, which in turn made it easier to seek advice and peer support. The existence of the network legitimised or formalised contact which might not previously have taken place between units. Network meetings provided a focus for sharing information and learning from one another, as well as an opportunity for 'putting faces to names.' They allowed different professional groups and tiers of staff to get to know their 'opposite number' at other sites, and also facilitated multi-professional interaction between different units.

I think it's opened up a lot of channels of communication that probably weren't there before. (senior charge nurse, DGH)

Yeah, the communication issues. If I've got something that, you know, that I've done, in terms – or somebody else has done, like,[hospital name] have done something, and they say to me, "We've done this," and they present it at the Network, the sharing has been fantastic, and the actual ability to say, "Do you think I could use that?" And yeah, and this lack of, "That is mine," and there is no.……..

And that has helped an awful lot. That's helped an awful lot, because I wouldn't have been able to tell you who my opposite number was in [hospital] or [hospital], or [hospital] and we've all worked quite well together. And I think even if the Network was not there, we've still got those contacts and those links, now…. (nurse consultant, DGH)

I think some of it might be, I think for a long time when I came to Intensive Care, Clinicians made decisions on their own, and I think there may have been a degree of uncertainty, "We do that here, I wonder if they do that down the road?" And again, I think it just gives them that security of other ICU Clinicians do that, I think whereas Medics have always had big forums and Surgeons have always had it and I don't think that really existed for Intensive Care, and although there is the Intensive Care Society, that's different to having somebody local down the road that you could ring to say "We're faced with this situation, what, you know, have you come across it and how would you deal with it?" (senior sister, DGH)

It was suggested that nursing staff in particular benefited from their service being part of a local functioning network, as it opened up opportunities for meeting and working on joint projects, guidelines and professional issues that might not have been available to them in the past. In addition, those senior nurses who had taken on new roles within their own services such as that of service improvement or educational lead were able to provide support to one another through the network. Allied health professionals also described new opportunities for them resulting from the network; again including the chance to work on joint guidelines and projects and to engage in educational activities specific to their profession at a local level.

Yeah, it's about forming relationships and getting other people to form relationships, and the nurses [clears throat] had much less opportunity before to interact with nurses from the other Units, but once they've seen they've all got, you know, if somebody's now updating a policy rather than update the policy, they just email around the network to see what everybody else was doing. (consultant, teaching hospital)

It was just really sharing the information, but it was quite nice meeting up with them and, you know, if you were struggling here with something you could discuss it with another Matron over here, and add another unit and see if they had, sort of, experience of it, so it was good in that, you know, those meetings you often found you were having, sort of, informal chats at the end of the meeting about different stuff. (senior nurse/matron, DGH)

But the work from our point of view, from the Nursing and Physiotherapy and Speech and Language and the kind of Allied Health Professionals, was always about trying to work together to produce either a common policy on things or to share standards and protocols that we already had in place and we did quite a lot of that, you know, kind of swapping things, developing things. (nurse consultant, teaching hospital)

A second perceived benefit to network membership was the opportunity it afforded services to bring their practices into line with other local critical care services, by developing joint protocols (e.g. regarding transfers), implementing care bundles, undertaking network-wide projects and audits, and sharing existing guidelines, standards and practices. This in part was facilitated by new opportunities for benchmarking against other local units. Various tangible outcomes were described, including projects, guidelines and protocols. New approaches to, and agreed procedures for facilitating transfers were hailed as one of the most beneficial outcomes of having a local network. In addition, individual critical care services were said to benefit from standardised approaches to training courses introduced across the local network; an added bonus being that staff could adapt quickly if they changed job within the network. Network 'conferences' and training days were valued as learning opportunities.

> *We have annual conferences and obviously we get guest speakers from other Networks, from University Hospitals that come and speak. It gives you a chance to obviously go and listen to what's going on in Critical Care and it also gives you a chance to get in touch with other nurses and doctors within the Network, you know, and build those bridges and find out what's going on out there. So I think, as a community, as a Critical Care Community, it's pulled all of the units together really and it gives you that support, as a Critical Care, whereas I think before the Networks, it was all just isolated Critical Cares not communicating, you know, not using the resources that were available.* (senior sister, DGH)

> *I think the Network has been fabulous for – I think particularly for the smaller units actually. There's practical stuff that it's made a difference to, so transfers are undoubtedly no longer the hideous angst that they used to be, ringing up, asking your Network colleagues if they've got a bed no longer has the huge amount of stress that it used to. It still is, 'cause most of the time they haven't, but there's an acceptance that we will operate the Network's beds as a group of beds, so that's one area where practically it's made a big difference.* (consultant, DGH)

Joint initiatives were seen as a sensible use of resources, allowing smaller units to reap the benefits of lessons learned in larger teaching hospitals, equalising provision and driving up standards across the network. Individual units did not have to constantly re-invent the wheel, and were said to be able to adopt initiatives like the care bundle approach more rapidly than if simply working alone. However, as one consultant noted, for this type of intra-network sharing to be successful, larger units have to be willing to support smaller ones. Smaller units also have to be willing to be supported and to 'toe the line' to an extent. A number of interviewees working in district general hospitals argued that the benefits of networking are not uni-directional: smaller services also have a contribution to make to collective learning and standard-raising across a local network (e.g. through sharing the results of audits). The idea implicitly expressed by a number of interviewees was that of the 'sum being greater than the whole of its parts':

more can be accomplished by services working together through the network rather than on their own as individual units or hospitals.

> *I think it's been – having other people to refer to, as in, you know, you can go off at a limb on your own really and it's interesting to know that we're inline with other areas really. We're a District General Hospital, but I think although we're – I think we're a very on the ball District General Hospital, but I think a lot of that comes from the fact that we link in with the big teaching hospitals and from the network side of it.* (senior nurse/matron, DGH)

> *Our network has organised a very, very efficient transfer system within the network, standardised teaching, standardised equipment. You wouldn't achieve that with individual hospitals.* (consultant, DGH)

An appreciation of the potential value of the network model and the collaborative working approach it promoted was not confined to those who reported that their service had benefited directly from network membership. A number of interviewees whose networks were described by them as no longer functional or as having been unsuccessful from the start, still expressed the belief that the network concept has much to offer, and regret that more had not been achieved locally.

> *….it seemed like the others, they were just doing some amazing pieces of work at the time, I remember. So it was disappointing for us, 'cause I kept thinking, ooh, is it going to happen? and it just never did.* (dietician, teaching hospital)

> *But to be perfectly honest, the nursing [element of the network] has, you know, fallen right away and there's nothing from a nursing point of view, which is a shame because I think there are some key issues at the moment that we're all getting to grips with.* (senior nurse/matron, teaching hospital)

On the other hand, even where interviewees were very positive about the network approach, there were some perceived drawbacks: for example, it was suggested by individual interviewees that networks can become very insular, and that previously established links and 'alliances' with services which are now outside one's network may suffer. Although one of the perceived objectives of networking is to learn from, and develop common standards with, one's neighbouring hospitals, a consultant at one hospital suggested that there was potentially more to be learned from the large London teaching hospitals than the hospitals which are geographically one's neighbours. Having decisions taken at a network level that will then impact on one's own unit could also be potentially problematic. Even when decision making processes were described as democratic, a sense emerged of smaller units recognising that they might occasionally be forced to 'toe the line.' Where networks were spread over a considerable geographical area, it was also suggested that some of the hospitals involved might feel that they were somewhat peripheral to central activities, particularly where attending meetings involved a considerable amount of travel and use of resources.

It did make – it made you feel like you were maybe on the peripheries of things and maybe that they viewed as a, sort of, oh, little old [hospital name], it just gets on with it, and, you know, we'll decide what progresses and what's fantastic and [hospital name] are just the people that will just follow suit, type thing. So it did make you feel a little bit like that to start off with…………I think it was resolved by representation at the Groups and us being vocal and saying, you know, "Well, we don't think that's suitable for our area, that's not what we'd do in our unit", and, sort of, sticking to your guns a little bit and actually saying "Well, you know, we actually have this to offer to the Network" and then seeing that taken up. So I think by having the representation at the Groups really, and I think that was quite difficult 'cause it would have been quite easy to be disheartened and say "Oh well, [hospital name] are just going to tell us what to do, so we'll just pull out", but I think perseverance with, keep going and keep representing yourself and having that equal standing within the Network I think was important to do. (senior sister, DGH)

……nowhere does it say that you have to be, comply with every network guideline. Now if that came along, if it said you have to be part of a network and you have to comply with the network guidelines, probably, in reality, places like [hospital name] would have to bite the bullet and just do it, 'cause the alternative is to say "We're a small Intensive Care Unit that is choosing to do its own thing." And it's more likely that the larger Units might just turn around and say "Well, thank you very much, but we don't really need to be a part of the network. We are of a sufficient size that we develop all our own policies, all our own guidelines, and we're going to continue to do that." (consultant, DGH)

I wouldn't say 110 percent that that was successful, as you know, from a geographical point of view, we're, sort of, very spread out, right … and it was quite difficult to get all the clinicians and the senior nurses to attend… (nurse consultant, teaching hospital)

For all of those who felt that their network had been productive and useful, or that the network approach was a positive one in theory, there were others who felt that very little had been achieved by their own local network. Initial interest had either not been sustained, or the network was said not to have 'taken off' in the first place. Furthermore, there was a certain amount of concern expressed that the money spent on networks and their associated activities might have been better spent.

Well, as I said, they met every couple of months, and basically nothing seemed to be achieved. There were no, certainly in our Network, nothing was done in terms of common protocols, common transfer arrangement, nothing, but I'm, you know, I can't think of one benefit that I'm aware of. Perhaps things happen that I'm not aware of, I'm not aware of one single thing that came out of our Network…………. Unless you prompt me, I cannot think – it's sad that I… (consultant, teaching hospital)

But apart from having a few meetings and discussing a few things, nothing really ever got going on that. I mean, we did have a few ideas about trying to do things more collaboratively, particularly around bed capacity and transfers, 'cause that seemed to be a perennial problem around the whole patch, that, you know, almost every day one of the hospitals would be full and having to transfer a patient out and only one of the other hospitals would have a bed empty and so we tried to work out ways of having some, sort of, local liaison about transfers and overflow. And that gradually, I think, never really got off the ground. (consultant, DGH)

But I think essentially I would say this is money that hasn't been properly used probably, yes, because it all depends about the people who were involved who were leading on, you know, and about the amount of work that they were prepared to do and how the work was supposed to be done, you know, because if I – when I look on the website some of the Networks have produced very good protocols, bundles and all the rest, but ours didn't. (consultant, DGH)

A number of factors emerged as contributing to perceptions of why some networks have succeeded/ function well while others have not. Leadership, for example, was perceived to be fundamental to the success or failure of a network. The attributes of successful network leaders (clinical or administrative) were said to include having a vision and strategy for the network, being perceived as an influential advocate for it, and possessing an ability to engage and enthuse key stakeholders (consultants in particular), as well as knowledge of the workings of, and priorities for adult critical care services. In addition to personal characteristics, funding (and the power to use funding to benefit services on a network-wide scale), resources and the presence of support staff were described as essential to those trying to run a network successfully.

I think the Network Leader, [name], has worked extremely hard to engage all of the Networks to give them support. I know that, certainly from a Service Improvement point of view, s/he comes to each unit to see how things are going and s/he's always available for support, is contactable. And I think probably the Clinicians because the Clinicians have been onboard with it, and because we've got some strong Clinicians who got onboard with it quite quickly and have supported the Network, I think that's why it has kept going really. I think it's only because the staff have been onboard with everything and enthusiasm has been generated and the Network's been promoted as something that's positive, that it can support your unit, that it can give something back to your staff and the patients, and that it's been shown to work, I think that's probably the only reason why it's continued to work as well as it has. (senior sister, DGH)

I think it's mid Trent is the obvious, kind of, example one, but I mean they were very successful, but they had started off from a fairly well funded background, as I understand it, and success then tends to breed success, so that once they'd achieved some things, they also,

for instance, started influencing commissioning. They, I think, had salaries, monies, and they were in control of their own budget, etc, which certainly in most Networks, I think, was not the case. And I think that was a clear, you know, marker of success and they did an awful lot. I mean, there's no doubt they had excellent Leaders as well, you know, the whole things was a combination of that………... I think East Surrey was seen as a successful Network, but again, maybe with some personal – good leadership as well as – I don't know how much money they – I think they did have the ability to influence the Commission. But maybe I'm just being cynical, but the bottom line did seem to be that if you could actually start to draw the money flow, the funding flow through the Network then you were more likely to survive. (nurse consultant)

Where networks did not succeed this was attributed in part to poor leadership and an absence of funding.

You see, I feel that it's probably the person who are leading, the Lead Nurse the Lead Clinician…….yes, yes, yeah, leadership. Yes, yeah, I think so, because the leader is supposed to have a vision of what you're supposed to do, an agenda and all the rest, you know. Things were discussed, but they were never really strong things to be discussed, you know, and it's not been taken up really because I think the amount of work, and whether the time wasn't enough, whether the money wasn't enough, whether because I think they were given very little time to do it as well, and whether they were very busy people who were not really, sort of, you know, very interested to do it. I mean, very – they didn't think that, you know, you had to be extremely well organised to be doing it. (consultant, DGH)

Buy-in from stakeholders, especially medical consultants, and a will to make the network function, was also seen as fundamental to the success or failure of a network. One interviewee suggested that the personalities of the consultants at the different hospitals were important in this respect, as they needed to be capable of taking a network-wide view on things rather than being protectionist about their own services. However, 'buy-in' was also associated with funding in the minds of some interviewees. Where funding was not perceived to be forthcoming, or was withdrawn, medical interest was seen to wane (according to nurses especially). Nurses were sometimes viewed or viewed themselves as having 'bought into' the concept of networks more so than their medical consultant colleagues. Examples were given of where nurse led meetings or projects have continued after medics have withdrawn their support for the networks.

Because people have wanted it to work, and people are seeing the benefits, and if you can see the benefits of it. I think it worked for a lot more medical staff when there was money attached to it…..Well, when there was money attached to doing things, I think you had a lot more engagement of medical staff, whereas the nursing presence has seemed to be – remained constant throughout, and we still wanted to, you know, different ways of working, rather than actually, "Can we

have this for this?" But I think that's a historic, clinician, you know, role, "If I haven't, you know, I want to do this, give me some money." (nurse consultant, DGH)

……but then I think that funding dried up about two years ago, and I think the idea was, was that the funding would then be carried forward by the Specialist Commissioners within the [geographical area], but money was never allocated to it, so it lost its core management strand, for want of a better word. And so then it just became much more of an informal practice development group………. *so then it's lacked more rigour and the meetings haven't been as frequent, but we still try and meet every quarter.* (senior nurse/matron, teaching hospital)

It was also argued that for networks to be successful, there had to be a perceived need for one in terms of a specific focus for neighbouring hospitals to work on (e.g. transfer difficulties). Simply imposing a network on a geographical area (where, for example, there may have been prior professional networking and sharing between ICUs before the advent of the MA or where services see themselves as having little in common with one another) was not seen as a recipe for success. In some cases, for example, the geographical carve-up was said to have ignored existing working relationships between hospitals prior to the introduction of networks. A number of interviewees suggested that some networks may not have worked for reasons of territoriality; for example, DGHs being perceived to be worried that they would be taken over or swamped by the local teaching hospitals.

I have to say, before, it was mainly a talking shop, and I don't think we'd a big driver here that needs to be sorted out. My impression of when Networks have had a major impact, is when there's been a major problem with transfers, and they've sorted that out, and the management of transfers. Well, it's not been an issue in [network name]. (consultant, teaching hospital)

Well, I think firstly, it wasn't really terribly effective because most of the time none of the Units, you know, none of us had spare beds, and so we were having to transfer patients further away. And then I think there was also some general, I suppose squabbling over what went on....... so people started to get more, sort of, protective about their beds and – but I think it was at least a useful, sort of, lever to try and demonstrate that, you know, the whole area had no – had inadequate capacity and I think maybe out of that, there were some audits looking at overflow transfers and occupancy rates and maybe that had some influence on, you know, expanding capacity. And then I think we also, there were a few other topics that were discussed, but nothing really ever came of the whole Network thing, and I think the people in [DGHs], they always seemed to be quite suspicious of the, like [teaching hospitals], because they thought it was some, sort of, a takeover bid, that they were suddenly going to be swallowed up by

the big Units, so I think they were always a bit reluctant to get involved at all. (consultant, DGH)

Finally, network success was said by one consultant to be dependent on success. Services and individuals need to feel that they are reaping some tangible benefits and gains from network membership. The role of network leads and representatives from the constituent services in promoting the network, the benefits of membership, and the network's achievements was said to be a crucial one. It was also suggested that giving people ownership and responsibilities within the network fosters success.

And, of course, there is always the possibility that one Acute Trust could just take its bat and go home. The network is only a success because it's a success, and as soon as we fail something, then, you know, there is always the opportunity for people to go home, with their ball and their bat. (consultant, teaching hospital)

I think because we're able to come back and feed back to the staff and I think it's important that that happens, that they don't just [see] the Network as, you know a Big Brother type thing that just dictates what we do and watches what we do. I think the only way you can promote that is by coming back to the local area and saying "Look, this is the benefits we get from being in the Network." And then the staff, you know, we make sure that the staff go – have time out to go to the conferences and the meetings if they want to. And then we do usually get quite a good uptake of staff going to that, so. (senior sister, DGH)

In addition to the formal MA network, interviewees spoke about networking through their professional organisations (e.g. nursing, pharmacy, physiotherapy) and regional and national critical care-related organisations or bodies. Furthermore, and not surprisingly, even where networks were not viewed as functional, interviewees reported having contact with critical care professionals working in local critical care services. Informal contact had been built up over years of working in neighbouring hospital and meeting at professional forums.

Summary

While boundaries between ICUs and other services/wards within the acute hospital setting appear to have been reframed and reduced in recent years, so too to an extent do the boundaries between adult critical care services in some neighbouring hospitals or trusts. Critical care networks are reported to have produced a number of tangible benefits within geographical areas. However, the success of networks may be dependent on a number of factors, including leadership, funding, a perceived clinical need for the network, and a willingness to work collaboratively. Where these factors have not been in place, the network model has been perceived as less successful. Furthermore, definitions and descriptions of networking in critical care are not limited to those associated with the formal critical care network, but also include the types of professional and informal networking that is said to have always taken place before the advent of the MA and its critical care programme.

4.3.6 Multi-professional team working and extended roles in critical care

A planned approach to workforce development was another recommendation of *Comprehensive Critical Care* (Department of Health, 2000b). It was suggested that 'competencies are more important than professional boundaries in the delivery of a safe, efficient and cost-effective service (p19).' Several other policy documents published around the same time and in subsequent years also focused on the role and staffing levels of various professional groups in critical care (Royal College of Nursing, 2003; NHS Modernisation Agency, 2002; Department of Health, 2004a). In terms of empirical research, Carmel's (2003) ethnographic study identified a number of strengths to the organisational culture of critical care, including strong leadership on the ICU, identification with, and loyalty to, the unit by medical and nursing staff, and positive functional interactions between the different professionals. He suggested that the manner in which critical care is organised and practised is a function of strong boundaries around the ICU, an overlap in the ideologies of the medical and nursing staff, and a focus on the technological aspects of care. He suggests that the ICU also differs from other areas of clinical practice in that the focus of care is more on the patients as a physical body rather than a social individual; that patients are admitted with a wide range of diagnoses; that there is a 'materiality' to the ICU setting; and the evidence base in critical care has been regarded as poor by those working in the field. In addition, Carmel (2006a) posits that what he terms 'convergence and incorporation', rather than 'competition', characterise the relationship between the medical and nursing professions in critical care and that this is exemplified by a joint allegiance to the ICU rather than to professional colleagues working elsewhere in the hospital.

The question is therefore whether modernisation, new roles and responsibilities for critical care staff and new functional and organisational relationships with the rest of the hospital (e.g. through outreach and educational initiatives), the perceived reframing of boundaries around the ICU, an increasing evidence base, and the perceived drive towards the standardisation of care delivery, have shifted staff accounts of working practices and relationships in the critical care team. This section focuses on how membership of the critical care team is defined and on working relationships between medical, nursing and allied health professionals. New and extended roles and responsibilities for nurses and other professionals, and opportunities for collaborative working are also considered and workforce and training-related issues highlighted.

Multi-professional team working: team membership and 'crossing the walls'

The concept of the 'core critical care team' or the 'unit team' was a salient one to interviewees. The general view appears to be that while critical care has historically been inclusive in terms of the range of professionals involved in providing care on the ICU, it has become even more so in recent years. It would appear that a greater range of professionals, including dieticians and microbiologists, now 'cross the walls' to work on the unit on a regular basis, while still retaining their membership of other teams and working in other areas of the acute hospital. Conversely, new roles such as that of the nurse consultant mean that ICU based staff are also leaving the unit to a greater extent to carry out roles and responsibilities in other parts of the hospital or trust. In addition, outreach teams constitute a new 'species' of team member whose specific role is to bridge the 'walls' between the ICU and the wards in respect of the care of critically ill patients.

Descriptions of which professionals constitute the 'core' team varied to an extent from site to site and interviewee to interviewee. While physiotherapists, pharmacists and microbiologists (professionals who pay daily visits to the unit) were widely viewed as core team members, dieticians and speech therapists tended to be less frequently described in such terms. In general, however, allied health professionals were reported, and reported themselves, to be more fully integrated into the critical care team recent years.

> We used to just think of the team as just the nurses, and now we don't think that, the team is everyone: Physios, doctors, everyone who's involved with the patient's care is the team…. (senior nurse, teaching hospital)

> I think one thing we have done, is we've tried to get more support specialty people involved as part of a wider, sort of, multidisciplinary team. So we have got an ITU Speech Therapist; we've also got an ITU Pharmacist. We have a daily Microbiology ward round, to discuss all the patients, you know, discuss infections and antibiotics and all that, and Physiotherapy, again, we've got quite good links – well, we've got

an Outreach Physio, so Physiotherapy is well, sort of, provided and we've got an ITU Dietician who deals with all the, sort of, nutritional support for Intensive Care. So we've managed to try and maintain all those specialists, in terms of, you know, that multidisciplinary support…... (consultant, DGH)

But from our perspective, I think it's the fact that, well, the Unit here seems to have embraced a multidisciplinary way of managing patients. They're much more inclusive than they used to be. And I think communication has improved 100 percent. It's got a long way to go, but I think it's probably been more inclusive of people who weren't classically seen as Critical Care Clinicians. I think that's probably been the biggest impact on us. (physiotherapist, teaching hospital)

For some interviewees, the core ICU team extends beyond health professionals to encompass porters, technicians, housekeepers and administrative staff, all of whom are said to play important roles in helping to keep the ICU functioning effectively. Descriptions of the core team on the ICU as consisting only of doctors and nurses were rare.

Increased participation by allied health professionals appears to be driven in part by a growing awareness and acknowledgement of the value of their skills and expertise in the care of the critically ill patient, the emerging needs of particular types of patients, including those who have been on the unit for a prolonged period, and other non-ICU specific issues such as infection control. Throughout the course of the interviews, allied health professionals described themselves, and were described by doctors and nurses, as contributing to the critical care team in a variety of ways: employing their expertise in caring for specific patient groups; writing guidelines and care plans to support not only their work but also that of the ICU nurses and doctors; contributing to multi-professional ward rounds and other meetings on the unit ; working collaboratively with nurses, for example, on aspects of patient care or specific projects; contributing to teaching and training ICU nurses and doctors; facilitating communication with other parts of the hospital, for example, through supporting outreach; and contributing to the cost-effectiveness of critical care (e.g. in the case of the pharmacist, for example, by reducing the drugs bill).

When asked about what signifies a particular professional group's membership of the ICU/ critical care team as 'core', or why they view themselves or their colleagues as integral to the team, interviewees described what might be labelled 'criteria' of membership. These criteria were, not surprisingly, related to their reported contributions to patient care and team or service functioning, as outlined above. Having a perceived expertise, an objective and measurable input, or crucial role to play in some aspect of patient care, was seen as a marker of team membership.

The way we work has changed dramatically and the way we operate on the Unit, and for other people in the team too, I think. ………Well, you're considered – if you're the Dietician or the Pharmacist, you're considered the expert, and they go to you for that, and they want that expertise, and they expect it, and they expect a high standard of

delivery, and that's how it should be really. So that, and that seems to – so every member of the team has something to contribute, but the expectation is that you need to be up-to-date with your own area, and you need to be able to produce the goods, and produce them yesterday. (dietician, teaching hospital)

Being a regular and visible presence on the unit, having good working relationships with the ICU doctors and nurses, being involved in decision-making regarding patient care, attending unit meetings and/or ward rounds or being a member of ICU-relevant committees were also indicative of membership of the core team. Furthermore, team membership was associated with subjective feelings of 'belonging' and of being 'highly thought of' or respected by colleagues.

I think in the past there's been quite a turnover of Physios, so it's just been me for the last two years and it took a while to get the confidence and then once the confidence is there, as I said, they've just got that one constant face, so I think helps with communication as well. (physiotherapist, DGH)

…..we don't forget him [the pharmacist] because he's very important and he's provides reports on drug usage, expenditure, picks up when the funny anomalies are occurring, shows us ways of saving money relating to procurement and formulations and things. He's also fantastic, and if we have a patient with possible drug reaction, he goes away and looks things up, drug compatibilities, and I would have said that these days any Unit above a certain size should actually have a named Pharmacist who is there on a frequent basis, and other Trusts, if they're not doing that are stupid, because it saves you money and avoids complications enormously and along the line somewhere it'll save a life, although it always sounds a bit dramatic when you say that it saves lives, but it would do because eventually he'll point out an interaction. (consultant, teaching hospital)

Some of the allied health professionals interviewed reported that their acceptance as part of the ICU team had not been automatic, but had involved a considerable amount of work on their part to raise the profile of their profession or have the potential value of their input to the care of the critically ill patient recognised.

I've worked incredibly hard to increase the profile of Therapies, because I really do strongly feel that we've got a role, and I also felt that, probably, the role that we had ten years ago was perhaps not that evidence based, and we were really just seen as people who got in the way, I think. So, I mean, certainly, I've worked incredibly hard, and my Team have worked incredibly hard to increase the profile of Therapies up there. (physiotherapist, teaching hospital)

But I think they're more approachable, and they're more open now than they used to be. When I started, it was cracking a very large nut to get in. You know, they were really, really a law unto themselves. (dietician, teaching hospital)

> *Yeah. As I said, I mean, from our point of view the biggest success has been that, you know, we're going in there and we have been accepted, and this is purely from the Dieticians' point of view, and they're actually working with us and, you know, they – I mean, my Dietician who – the one who's going in permanently now was so pleased that, you know, even the Registrars are now approaching him……..* (dietician, DGH)

A number of ICU consultants and nurses, for their part, acknowledged that they would not be able to work as effectively on the ICU without the presence and input of professionals including pharmacists, microbiologists and physiotherapists. It is not just allied health professionals however, but also clinicians and nursing staff from other teams and wards, who are being actively encouraged to have a greater involvement with the ICU team. Indeed it was a source of some frustration to a few interviewees that ward teams sometimes show little interest in their patients once they have been admitted to ICU, although this is in part attributed to their workload on the wards. However, others spoke about the regular presence of 'visitors' from other teams (e.g. surgeons, the diabetes team etc) on the ICU.

> *Well, in fact everyone's integral........I think that one of the very good things about Intensive Care is, everyone is very nice and, sort of, the fact that it has to run as a team, you know, if it's – yes, alright, the Consultant and the Head Nurse generally drive the Unit, but by the same token, I think we all recognise that if any of the separate components aren't working, there's going to be a major problem. And so you need everyone; you need your Pharmacist; you need your Dietician; you need your Microbiologist, you know, the sum of the parts, it's certainly greater than the individual.* (consultant, teaching hospital)

Barriers to increased multi-professional working were described by a couple of interviewees as including cost considerations as well as allied health professionals' time commitments to other teams and wards.

> *I mean, I think one of the things that I've probably said before is the fact that there is a lack of other professions' involvement, just probably because of other areas not having the funding to allow them or the staffing levels to allow them to work within Critical Care, and I think that's a shame.* (physiotherapist, DGH)

The general perception of the relationships between staff on the ICU and outreach teams was of a close functional one, in some cases involving nursing staff rotating between teams and/or ICU consultants working outreach shifts. However, the relationship between the ICU and outreach teams is also potentially complex in that while outreach helps to prevent admissions to the ICU and fosters relationships between ICU and ward staff, it can also create more work for the ICU by what one interviewee described as 'trawling the wards' for patients, or by gate keeping discharge onto the wards.

Professional relationships: team climate and cohesiveness

Although there were individual 'niggles' about their colleagues from some of those interviewed, as in Carmel's (2003) study, the general sentiment expressed was that staff working on the ICU form a close team and have positive working relationships. The importance of personality to team functioning was alluded to, as was that of having strong leadership on ICU/ critical care teams. It was suggested that this is fundamental to fostering relationships and communication among team members, motivating the team, encouraging service development and improvement and pushing through necessary changes. Strong leadership is also seen as necessary for promoting critical care in the rest of the hospital and for communicating strategically with trust management.

While, as noted by a number of interviewees, the ultimate responsibility for clinical decision making lies with the consultant, and the 'old school' or hierarchical approach to managing both the unit and patient care was described by a small number of interviewees as operating on their units, what emerges from the data is the sense that work on the ICU is more likely to be organised in a collaborative rather than a hierarchical fashion, at least among senior staff. This would appear to be associated with the emergence of new roles and responsibilities for nursing staff, new training opportunities, and multi-professional team working. The arrival of new, younger consultants was also described as resulting in changes in working practices and relationships on the ICU.

> *I think one thing which is good is, like, the way the relationship has changed between nurses and doctors, and that nurses are more vocal and more - I think that one of the problems with UK training has always been that it's always been very separate, and I think that now, you know, nurses coming to the junior doctor's teaching and vice versa.* (consultant, DGH)

> *I think, over the – whether it's as a result of changes, or whether it's just a time change, I think the relationships between the Consultants and the, kind of, and the nursing and Physiotherapy staff, we've had a few changes of Consultants, and that seems to me a better relationship than was previously in the fact that the Consultants are more approachable now, and would have been more readily susceptible to people asking questions, and for communication between the two groups. I think that has changed. And I don't know what that's directly attributable to, but that is – I think working relationships are better than they were.* (physiotherapist, DGH)

Not surprisingly, there is also evidence to suggest that less senior staff are still likely to experience hierarchies and 'pecking orders,' which is on occasion reinforced by senior staff. As in Carmel's (2003) study, however, senior nurses described their roles in mentoring, monitoring and working closely with junior doctors. Interestingly, two allied health professionals mentioned that although working as part of the critical care team, they remain autonomous in terms of their practice.

I teach my juniors when they start, so we have SHOs and SpRs, and when I start, I'll explain to them that if I'm contacting in at night and I want to get an overview of the Unit, the person that I'll get the best overview from is the Nurse in Charge, not the SpR. And then if I want to know what's going on by the bed, the person I get the best overview from is the nurse by the bed, not the SHOs. The hierarchy is the SHO, the nurse by the bed, the SpR, the Nurse in Charge. That can change as the SHOs and SpRs have been in place for a while and relative to the experience of the Nurse in Charge, but if they come in with that concept, they're better suited to working on that Unit than if they think it's the other way round. (consultant, teaching hospital)

…. I was told before I came here that it was a very hierarchical Unit and that, you know, the junior staff weren't really given a lot of work. It was more down to the Sisters, and I feel that in a way because that's been the culture here that they're finding it really difficult to give us ownership because that would take away the hierarchical system, but for a nurse like me who's been there it's very – it has been very frustrating and I know that working with junior staff, once they've got more experience, they want that, they want ownership of something. ……….. I think the more senior nurses you speak to will feel that they've got a more nurse led role…. I don't know, some of the more junior Sisters might not feel that they have that role. (staff nurse, teaching hospital)

New and expanded roles

All of the interviewees were asked to describe their roles and responsibilities on a day-to-day basis. A significant proportion reported a wide range of clinical, managerial, educational, or service improvement-related roles and responsibilities, some of which they reported having taken on in recent years. New roles and interests were reported not only by nursing staff, but also by allied health professionals, and were associated with emerging opportunities for collaborative working; workforce and training/ education initiatives; the increased culture of governance, risk management, audit and research; and general NHS changes and other initiatives (e.g. the creation of nurse consultant posts, and policies such as the European Working Time Directive, Agenda for Change etc).

As in Carmel's study, nurses at some of the study sites described themselves, and were described by other members of the team, as having taken on a greater leadership role in recent years, and as working on an equal par (in some areas) with doctors. In the current study, however, there was greater focus on the emergence of nursing interests, including the management of long term patients on the ICU, managing and running outreach services, working in new ways with allied health professionals and greater involvement in teaching and training, as well as in research and audit. Some of those interviewed also described new network-related roles (e.g. representing their service as the nursing lead for various network initiatives). Nurse consultants were seen as championing the role of critical care nurses, introducing more nurse-led initiatives on the ICU, and fostering

the promotion of critical care skills on the wards through their roles outside the unit (e.g. managing outreach, and involvement in educational initiatives).

Well, the nurses are becoming more and more like mini SHOs really, you know, particularly, you're talk – you know, they're very highly experienced, and they, they're not like mini – they're more advanced than that really, in many respects, because there's a lot of autonomy in the way people practice…. (dietician, teaching hospital)

I would say appointing a Nurse Consultant and appointing the Modern Matron have been fantastic for the patient, and fantastic for the nurses, and for the unit. I think, you know, a Nurse Consultant has put nursing very much at the forefront of this unit, and the medical and nursing input is equally as important. And I think that's a fantastic success, and these two key nurses are people that you go to if there's problems and they take things forward, so, you know, that's definitely in the interest of the patient, and obviously the success of the Outreach Team has been excellent. (sister, teaching hospital)

Evidence of their perceived increasing autonomy was described by nurses and other interviewees in terms of their working relationships with doctors, and their undertaking of tasks which were traditionally the preserve of doctors. One nurse also described how she and her colleagues have taken on some of the work previously done by technicians and how they also make decisions about which patients should be seen by the physiotherapists.

Nowadays I've said to the doctor "Oh, you wouldn't just want to give me a hand to do this x-ray, would you?", and they'd help me sit the patient forward. That was a nurse's job and they didn't do that. It was clear defined. (senior nurse, teaching hospital)

…….like I know my Critical Care Outreach Team, they're developed to the point where they interpret x-rays, order x-rays, take arterial blood gases, you know, like at the minute, it's just me and the Team that prescribes, but we're going to get them all through prescribing, nurse prescribing. So, there's big changes in that sense, and it's – like I'm all for that change, but I think they haven't actually put on any extra nurses, to, sort of, support them taking on extra work, and if anything, they have decreased the doctors so there is more need for nurses to do this. (senior nurse/matron, DGH)

….. if you look at some of the more senior nurses who have really good experience, they'll instigate a lot of the treatment and the changes in care, before speaking to the Consultants, but there's only a few of those. (physiotherapist, DGH)

I think certainly in this area we have a lot of nurse led treatments. We've always been a unit where nurses are able to make changes to ventilation without a doctor's authorisation and the nurses, you know, act on blood gases or what they feel is suitable. So I think, from that respect, we've always been, sort of, a very nurse led unit and the

team is quite cohesive. We have very good communication with the Consultants and doctors and they're happy for us to the initiate care, as we see appropriate. (senior sister, DGH)

However, there was not universal agreement (even within sites) about the apparent rise in nurse-led initiative and perceived greater autonomy for senior nurses. Some of those interviewed felt that the traditional roles of doctors and nurses remain the status quo, and a couple of interviewees pointed out that new and extended roles can only be taken on when there is enough staff to fill the gaps left by those who are taking on new responsibilities.

There's very few things that is nurse led. It's, everything is very Consultant and doctors led. And in terms of teamwork the Nurse in Charge is mainly, co-ordinates the, you know, the management of the Unit as a whole and individual nurses at a bedside mainly is just doing what is required to do so. If it's basic nursing care, yes, they will do their – they will carry out their cares, but when it comes to medical things like when to start weaning the patient, when should we decanulate the tracheostomy or when do we deflate and train the person, you know, to drink a bit of water and things like that? It's not really nurse led; it's normally Consultants who give the order to do these and to do that, yeah. (nurse, DGH)

A number of interviewees described perceived changes in the role of the consultant, including more team working, no longer being 'consulted' to the same extent, taking a greater 'hands on' role on the unit, and playing a role in outreach provision. Such changes may in part be due to changes in the training of junior doctors which have resulted in greater consultant involvement in teaching and training junior staff. At least one consultant remarked on nurses taking on elements their traditional roles.

……and certainly the weekends were really quite a lonely time in that you made a lot of decisions on your own. Not just resource decisions, but treatment decisions and I think now that has changed dramatically in that it will be extraordinarily unusual for us, for example, to withdraw on a patient without consulting at least a couple, three, four of our colleagues and often we have, you know, more than that and again, it would be extraordinary unusual for us not to discuss all of our patients some time during our on call with one of our colleagues, so I think there's a much more – a much closer relationships between the colleagues….. (consultant, teaching hospital)

We used to do a traditional whole week at a time, but as the trainees have become less experienced and they are around for less time, and the workload has become less Consultants supervising them, more Consultant delivered, then our way of working has become much more shop floor. We're not Consultants anymore in the sense of being consulted. You know, we are staff specialists, we work on the Unit on the shop floor, doing tasks. ……….I don't mind it, and in fact it's made our lives better….. (consultant, teaching hospital)

Allied health professional, including physiotherapists, pharmacists, and dieticians, in addition to reporting perceived greater inclusiveness in the multi-professional team, also reported having (and were reported by other interviewees to have) expanded their roles in terms of involvement in the care of critically ill patients and in working collaboratively with critical care nurses and doctors. Physiotherapists, for example, described working with nursing staff to lead on the rehabilitative care of the long-term ICU patient, working as part of outreach teams or providing informal outreach services in the absence of an outreach team, and training nurses and junior doctors. While the concept of the pharmacist with a 'designated' critical care role is described as a relatively new development, it is said to be becoming increasingly common. Pharmacists described, and were described as, being involved in setting up systems and guidelines to support the work of nursing and medical colleagues, conducting research, and working on drug costing and unit budgeting issues, as well providing advice and training. The dieticians interviewed also described developing guidelines and protocols to support the work of other professionals and/or working collaboratively with nurses on feeding-related issues. Interviewees from these professional groups also reported attending ward rounds and/or other ICU or critical care service meetings, as well as involvement in multi-disciplinary care planning.

> *My role's changed quite a lot over the last few years. I mean, it was, kind of, originally it was very much around your classical, kind of, respiratory management of patients………. But the whole slant of Physiotherapy in Critical Care's changed considerably from purely just managing respiratory problems to managing a lot of the stuff to do with the long-term patients, the long-term weaning of patients, getting involved in weaning. So my role's changed quite dramatically over the last, probably over the last three years, to taking the need for co-ordinating some of the care for the long-term patients. Not officially, but it's just a role that's evolved.* (physiotherapist, teaching hospital)

> *… and also our role in Intensive Care, it's not just, I suppose with the patients and communicating, but we've done a lot with regards to education, with the nursing staff. We've done loads of in services… ………And I think also with those education sessions it's given them an avenue to ask questions, and a reference point, and I suppose, elevated our standing, ………A confidence builder, I suppose, that the Consultants ask us to teach their junior doctors about NIV and what have you, so it gives those junior doctors an idea that, okay, these guys have a degree of knowledge and professionalism and people that we should, you know, build a relationship with, perhaps, you know, breaking down the barrier of doctor, nurse, you know, therapist somewhere over there.* (physiotherapist, DGH)

> *And I'm into research, and with this information system there's a huge amount of research that can be done, and I've got quite a lot of new juniors to do research for me, which I'm enjoying. I'm getting doctors to do research for me, collaborating with the doctors, so it's actually quite fruitful.* (pharmacist, teaching hospital)

While there may be an increasing emphasis on critical care 'competencies' and expanding the range of one's professional practice, a physiotherapist argued that this has mainly been in relation to medical and nursing staff and that the fact that allied health professionals are also extending their roles is sometimes overlooked.

> *But, I mean, a lot of changes and a lot of developments in the NHS are very much doctor and nurse led and therapists do get [whispers] pushed to the wayside a little bit. So I think that's definitely a bit of a challenge, and I think also there's been a big – the other thing is, there's been a big enthusiastic rush. I think everyone's all of a sudden thought fantastic, you know, let's do all these new jobs, let's have extended roles, let's start doing something different, let's enjoy the diversity of our job and move on up and all the rest of it, but I think sometimes, and this is from a Physio point of view obviously, that I feel that Physios perhaps are little bit sidelined, which I think is sad. And I think that they have to remember that when they're doing all this change of practice that actually Allied Health Professionals and Dieticians and Speech and Language Therapists are also extending their boundaries…* (physiotherapist, DGH)

Finally, advances in medical and surgical procedures, changes in the case mix of patients seen on the ICU and by the critical care team, as well as changes in working patterns dictated by initiatives such as the European Working Times Directive and the new consultant contract are said to be influencing the type of professional input needed and the ways in which different professionals work together to provide patient care on the ICU.

> *…..in fact, I felt that these patients, patients who were in Intensive Care for, you know, sort of, 21 days or more, need much more of nursing leadership usually than necessarily medical input. And so we set up a Multidisciplinary Team with a Superintendent Physio, myself, the Nutritional, the Dietician and Speech and Language, and we address all aspects of rehabilitation and weaning for these patients; and that's been quite a big part in my role as well.* (nurse consultant, teaching hospital)

Workforce and training issues

For some of those interviewed one of the key issues in adult critical care in recent years has been about the recruitment and retention of an appropriately trained workforce on the ICU and in critical care services generally. Difficulties in recruiting nursing staff at a number of sites, for example, are said to have led to greater reliance on agency and part-time staff and to the recruitment of overseas-trained ICU staff and junior staff with limited or no experience of critical care and the ICU environment.

> *We have challenges in terms of recruitment and retention of staff because the Unit is so busy that people get just hacked off with having to give up, you know, all their extra shifts to staff it and they say "Well, I'll go and work in a quieter Unit, thanks very much."* (consultant, teaching hospital)

Staff, shortage of staff, definitely with our – no problem getting our, sort of, Sister, top Sister, no problem getting our junior staff, but the ones in between are not there. Some of it is that because the job isn't paid as well as it should be, they move on into others, there's more attraction to go into something that's non-nursing, you know, and maybe move into, sort of, a Rep in a Pharmaceutical company or stuff like that. (senior nurse/matron, DGH)

While emphasising the wide-ranging skills, competence and experience of the senior nursing staff on their ICUs, a number of interviewees suggested that that both junior nursing and medical staff currently starting work on the ICU are perhaps not as well equipped to do the tasks required of them as junior staff might have been in the past. This is in part attributed to changes in training schemes. Recruitment difficulties and the perceived skill deficits among junior staff are said to have implications both for the service that can be delivered by adult critical care staff and the ways in which senior staff work. For example, there is pressure on senior staff to ensure that they monitor and mentor juniors very closely.

I think especially with the way training is changing, both nurses and doctors, the Junior doctors are less experienced also in the Unit and so they need more mothering, than perhaps they needed a few years ago. (consultant, teaching hospital)

I think we've all recognised that the level of junior medical staff that we have, have a much lower exposure and level of knowledge than they used to, and I think that, that has only impacted on our senior nursing staff and our Consultants in the Unit. The Consultants have to be much more careful about ensuring an understanding. They have – we've actually, I suppose, also increased the numbers of staff because of it's a bigger Unit, but the Consultants are much more careful and the SpRs that we have on have to be much higher along the, sort of, level of SpR that they used to be. And so we've had to put in extra training, I think, because of that. (nurse consultant, teaching hospital)

Well, over the years, sort of, the last few years, all of the network have had issues with recruitment, and one of the big issues is recruiting skilled Critical Care Nurses. They – we went through, a couple of years ago, a real issue, we had a real – we had quite a high turnover of staff in here and it was very difficult to recruit experienced staff. (senior nurse/matron, DGH)

Strategies for coping with the perceived skills deficit have included the introduction of standard, formalised training packages (e.g. induction programmes) on the ICU, and the development of new roles and teams (e.g. practice development teams) to support critical care training and education, both on the ICU and additionally, as mentioned above, on the wards. Another perceived driver to providing formal training is the need to provide evidence of competencies attained in order to gain promotion.

……everybody who comes into Intensive Care has a fantastic package for development that, you know, everybody does get access to the

Critical Care course, so the workforce is much more of a trained establishment really, and they really do try and push that forward on this unit, and I think that it does make a difference…… the courses that the staff do hopefully will give them the good knowledge and clinical practice, and not just getting on the course, but also getting the clinical support that's needed. You know, we have the Practice Development Team, which we never had before….. (sister, teaching hospital)

….we had quite a large number of vacancies that we needed to fill on the unit and whereas before we've never had newly qualified nurses, we were in a position where really they were the only staff we could recruit into the posts. Because of that, we recognised that there was quite a big deficit in their knowledge and they would have huge learning needs to come to an area such as Critical Care, and because we've took on – we had a lot of overseas nurses at the time as well, who also had learning needs to try and adapt to the ways we work, so the way we tackled that was we do have a Nurse Educator, so I work quite closely with her and we came up with a Competency Package…… (senior sister, DGH)

Professional integration through training also emerged as a theme in the data. As noted above, allied health professionals described formal or informal roles in training and educating nurses and junior doctors, while senior nurses reported monitoring, mentoring and training junior doctors in aspects of critically ill patient care and the associated technology.

Summary

It would appear that as the boundaries around the ICU are changing organisationally and functionally, so too is the way in which the ICU/critical care team is defined in terms of its membership. As the amount of professional 'traffic' crossing the ICU walls in both directions increases, the term 'ICU / critical care team' is expanding, umbrella-like, to take on a service-wide rather than a unit-based perspective. Workforce, policy and patient-related drivers, as well as a recognition and acknowledgement of the expertise and input of other professionals, opportunities for collaborative working and training have all impacted on the concept of team working in the care of the critically ill patient.

4.3.7 Key achievements in adult critical care

Descriptions of the perceived key achievements and successes of adult critical care services in recent years emerged during the course of interviews and many have already been described above. However, in general, interviewees were also asked specifically about achievements and

successes towards the end of their interviews. Successes were described as occurring on a number of levels: within their own service or profession, locally in terms of the network, and on a national level. However, those reported were generally both inter-related and cross-cutting in nature (e.g. improvement in patient care, the introduction of outreach, increased capacity).

Interviewees at a number of sites reported that both the quality of patient care and clinical outcomes have improved in recent years. This is seen as being in part due to the development of new drugs, technologies and interventions, but was also said to be associated with new ways of working, new services (e.g. outreach) and increased capacity (e.g. HDU beds). Improving patient care was reported by some interviewees to provide them a sense of achievement and accomplishment.

> *….I think one of the most satisfying things is to see more patients surviving Critical Care.* (senior sister, DGH)

> *…….I can tell you about specific patients really, like you're thinking oh, my God, you know, they've been on the ward for about three months and then, like, there's a gentleman at the moment and, like, now he's up, and he's alive and you're thinking "wow"…….* (pharmacist, DGH)

> *I remember when I first started ten, what, nearly 15 years ago, some of the patients I see as being admitted now and recovering would never have got through the doors. They'd have been marked 'not for admission', or 'hopeless case' or whatever. Whatever euphemism was used at that time, you know, because many Units weren't offering a renal replacement therapy or a very limited one. Those patients frequently didn't do very well, now almost every Critical Care Unit offers a renal replacement therapy. We've had particular success with Xygris, people who were horribly septic and we felt sure were going to die have been, shall we say, turned round miraculously by the Xygris drug. And I think some of the technologies and the drugs, etc, have made a miraculous impact, and people who you thought were sure to die, 'cause in your own mind when someone's admitted, I think you look at people and think "God, I don't think you'll survive," and they have done, which is a really, really nice thing, and it gives one a sense of achievement.* (senior charge nurse, DGH)

> *In terms of patients, I think the achievement, we set up the HDU, the HDU's up and running, it's a very busy, successful unit. Patients come in, are looked after, pain controlled well with epidurals, they get – they maybe having a better quality of care in those first few days post-op, just from the fact that the staff ratio to patient, you know, that they haven't got on the wards really and that's an achievement, in that that was set up and running…...* (senior nurse/matron, DGH)

However, a couple of interviewees expressed concerns about the perceived lack of aftercare and follow-up beyond hospital discharge for long-term critical care patients, and the impact on, as well as costs to them, their families and society of the long-term consequences of their having spent a

considerable period of time on the ICU. One nurse, for example, expressed concern that recent advances in surgical procedures as well as in critical care have perhaps overshadowed the down-sides to being admitted to a critical care unit as an older patient following the type of major surgery that would not have been undertaken even a few years ago.

> *….as the patient, kind of, group changes, and the older and more complex patients I think that will continue to be a challenge in that they have ongoing – as soon as they've left Critical Care areas there are still a lot of problems with these patients when they go in the ward, and when they go home, and I think that's, again, another area that is, kind of, forgotten. Kind of, post ITU follow-up really, doesn't really occur to any formal degree here, and that's an area that patients may be fit enough to go home, but we don't really know what kind of state they're in once they have gone home. There's no real, proper, follow-up of the patients. So that's another issue as well.* (physiotherapist, DGH)

The development of outreach services was described, either directly or indirectly, by many interviewees a key achievement of recent years. Although, as noted above, there is doubt about whether the concept of 'critical care without walls' is realisable in practical terms, outreach and the new patient classificatory system associated with it are reported to have resulted not only benefits in terms of patient care but in a raised profile for critical care in the hospital setting, re-framed boundaries, and new opportunities for staff.

> *…..what it's meant is that probably we identify more sick patients and end up pulling more people into Intensive Care, whereas previously they were left and died on the ward without being picked up. But I think it has had the advantage that we can target patients who are sick, pick them up earlier and get them in more quickly, so hopefully they respond better and survive with a shorter length of stay in Intensive Care. And some patients we avoid having to bring them here in the first place because they – we intervened before they deteriorate. So I think Outreach has worked.* (consultant, DGH)

The network approach to collaborative working between critical care services in different trusts was also described by some as a positive development in critical care. Other reported achievements included the opportunities afforded by the development of new and extended roles for critical care staff and by perceived increased inclusiveness in terms of multi-professional team working. The standardisation of practices/protocolisation of care, new critical care educational packages, a growing evidence base for critical care and a raised profile for critical care as a specialism in its own right were also described in terms of successes or positive developments.

4.3.8 Challenges facing adult critical care services

As with achievements and successes, interviewees described perceived challenges facing their own critical care services and adult critical care

services in general in the course of their interviews, but were invited to comment on 'any challenges faced by critical adult care services in recent years' towards the end of the interview. In reporting challenges, it is important to bear in mind that interviewees possibly found it easier to describe recent challenges or potential future challenges facing their services rather than those from some years ago which may no longer exist. While some of the challenges reported are undoubtedly not unique to critical care, they highlight the fact that the capacity of critical care to modernise and develop is influenced by what is happening generally in individual trusts and by the impact on services, for example, of the introduction of government targets and changes in general training schemes.

A number of key organisational and capacity-related challenges emerged. Firstly, although bed capacity on ICUs was acknowledged to have increased since 2000, even where larger, new units have been opened, there were still some concerns about the capacity of ICUs to meet the demands currently being placed on them.

> *I think, I mean, the biggest challenge has been to develop – to meet the demand, shall we say, fundamentally. And from a, speaking from a medical perspective, but I suspect this certainly applies to the nursing workforce as well, the single biggest stressor for me, and if you like, a challenge for me, is when I have another patient requiring Intensive Care and I now don't have the facility to treat them. And I think most ICU – there are some papers out there, but most ICU Consultants agree that the most stressful thing about being on call for an ICU is the sure knowledge or, sorry, if you are on call for an ICU, which is full, and the sure knowledge that at some point somebody's going to ring you up asking for a bed, that is stressful. So that's been a big challenge and it remains that way.* (consultant, DGH)

> *Capacity, it's always been capacity, and the fact that new services have been developed in this hospital without the involvement of Critical Care.* (consultant, teaching hospital)

> *I think the big challenge is shortage of beds. We haven't got enough beds for all the patients that are sick.* (senior nurse/matron, DGH)

While outreach is perceived as one of the key successes of recent years, one of the perhaps unforeseen consequences is that the introduction of outreach teams has to an extent compounded capacity problems on the ICU itself by identifying patients on the wards who might not have been admitted to the ICU in the past.

> *I think the Outreach Service has had a good impact. I think their experience on the wards has prevented people from deteriorating into extremis, but the other side of that, of course, it's also flagged up a whole new group of patients in there no-one knew existed [laughs]. And so that, you know, and especially on medical wards where, you know, I think in the past, sort of, ICU's tried to focus really on Surgery and Surgical problems, apart from, you know, the patients in extremis they admit for A&E with respiratory disorders, but there's a whole*

group of patients within Medicine who will perhaps benefit from adequate pain relief through resuscitation, close monitoring for 24, 48 hours, whatever……do much better for it. And these patients are being flagged up, but I don't think any HDU in the country, at the minute, is able to cope with that demand. (senior charge nurse, DGH)

The issue of capacity also arose in relation to the impact on the ICU of trusts having to meet government targets, such as those related to A&E breach times.

…..and I think the present time there's lots of emphasis amongst elective care on breach dates and breach times, and that's really forced the hand of Critical Care Units to really squeeze people in……. Everyone is affected, by one way or another, by Government timescales, Government schedules, regional schedules, you know, A&E has its time for breaching on trolleys, and it's very much the agenda of the day, fit to timescales. (senior charge nurse, DGH)

Well, I mean, I think, the thing that's again quite irritating over time is the way that, you know, that all these sudden Government initiatives or Government targets and it's like, "Oh, yeah, we want all Units to comply", or, you know, "The hospital has to do this particular target", like say, I mean, if you think of something like four hour waiting times for A&E. I mean the biggest problem that that caused for us was that we could no longer easily discharge patients out to the ward when we had a patient who needed to go out, or was ready to leave, so the patient would be ready to leave in the morning and we'd make the decision to discharge the patient and the patient would still be sitting in the bed at midnight, and then a sick patient would then come into A&E at midnight and suddenly there'd be this big fuss like, "Oh my God, they've got to leave A&E within four hours to meet the targets" and they need to come to Intensive Care and we say, "Well, they can't come straightaway because we haven't had a bed to discharge the patient from the Unit in the daytime." So a lot, I think, what happens, the Ward Admissions from A&E were getting priority on all the ward beds and so a patient in the ITU was just being left and we still get patients who, you know, 48, 72 hours later, they're still waiting for a ward bed. And then miraculously, once a patient has to be admitted to ICU from the A&E, then a ward bed's immediately created so that we can get the patient out of A&E within the four hour target. So I think things like that are very artificial and they distort clinical priorities really and that I think is bad. (consultant, DGH)

Concern was expressed by a consultant at one site that his/ her ICU was in danger becoming a catch-all service/ resource, filling gaps emerging in other parts of the Trust's services, while another, as noted above, was concerned about the development of new clinical services within the trust without the involvement of critical care even though the new services would have implications for the ICU's capacity to deliver care.

Secondly, discharging patients from ICU was reported to be a problem at a number of sites. Delayed discharges were said to be due in part to a lack of

available beds on the wards. A small number of interviewees described situations where only the possibility of a breach of the A&E 4-hour target meant that a bed was made available. As illustrated earlier, one interviewee reported using an audit of delayed discharges to highlight the significance of the problem to trust managers. There were also a number of reports of having to discharge people directly home from the ICU because of the lack of availability of ward beds; this was described as having happened very rarely, if ever, in the past.

> *There's just nowhere to put them. It's incredibly frustrating. I mean, we've started discharging patients home from Critical Care. That's something I never – we need another Occupational Therapist up there now. It's – I mean, we discharged two – I might know – we'll have discharged – by Friday, we'll have discharged two patients home from ICU this week.* (physiotherapist, teaching hospital)

> *…and we've discharged, over the last couple of years, we've discharged a number of patients directly home, from ITU because, you know, after five or six days, because they hadn't – on day one when they'd been discharged, there hasn't been a bed for them…..I think that's certainly a newer development and it's happening a little bit more frequently because there's nowhere for them to go and they're stuck on the Unit.* (senior nurse, DGH)

> *And then I think another challenge, and I don't know how we're going to get over this because it's, sort of, almost outside our control, is the delayed discharge of patients back to the ward, from Critical Care…….. and one of our key targets is the four hour wait in A&E, which we breach regularly because we're such a busy, busy hospital, and obviously those patients get preferential treatment if there's a bed on the ward, they get the bed, and so it's very common now for our patients to be Level 0 or Level 1 within the Intensive Care Unit, wide awake, with no natural light, and some patients last week we discharged from Intensive Care to home. I mean, that's incredible. That's a massive challenge, how we can get the patients out the right place.* (nurse consultant, teaching hospital)

One interviewee spoke about what might be termed a 'conveyer belt' mentality emerging, with the emphasis being placed on getting patients in and out of ICU as quickly as possible: on the other hand, another reported that increased capacity at his/her unit had led to a reduction in 'early' discharges.

Thirdly, as noted above, staffing and workforce related issues have also posed challenges to the development of critical care, in a number of respects. For example, as a result of changes to medical and nurse training, junior staff are perceived as being less well prepared for working in the ICU environment than they might previously have been, and are therefore in greater need of training and mentoring on the ICU. Interviewees reported problems recruiting and retaining nursing staff, and maintaining competency in the workforce, as well as concerns about how to use staff most effectively. There was also concern among a number of interviewees

about the potential loss of experienced ICU staff to outreach and that the amount of time that certain types of ICU staff such as nurse consultants, or those with practice or educational responsibilities, could devote to the ICU itself was being reduced as their remits and responsibilities outside the ICU grew and they became increasingly viewed as hospital-wide 'resource'. In addition, and as noted earlier, doubts were expressed about the ability of ward staff to cope (for a variety of reasons) with critically ill patients located on wards.

> *The main challenges have been staffing, and getting the right staff really, because we had the issues of recruitment and that was a very big challenge, was to, sort of, recruit into Critical Care, how would you do that? Do you have newly qualified and, you know, how do you keep that staff? How do you make sure they're competent and how do you make sure they're safe?, and that, over the last couple of years, has been a very big challenge to us.* (senior nurse/matron, DGH)

Finally, funding and the costs of critical care services were thought to pose challenges at the organisational level. A number of interviewees described cut-backs that had been made in recent years either on their ICU or across the hospital that had an impact on the delivery of care.

> *Money. Because we're so expensive [laughs]. I think money. I mean an example is [therapy name]. [therapy name]. I mean that was free, sort of, 18 months, two years ago. And now, of course, we're having to pay for it, what we use. And we use it less and less because we have to pay for it. So if a patient does need it, we will use it, but it's a real case of, well, is there anything else, you know. And, sort of, the drug packets again, we're always looking at cheaper and better ways, cheaper and better drugs, well, if they're better, and it's all around costs.* (sister, teaching hospital)

> *And a lot of it does actually come down to funding, 'cause like they have activated Protein C, and it's very expensive and you have to go through so much to get to it, so that's the challenges, like, making sure the forms are filled in, make sure the "t"s are crossed, the "i"s are dotted, and it's not just, you can't just say, "Oh, it works, it's effective", you have to say how it's going to be cost effective, and then you've got to back to the PCT and then you've got to go to the Financial and then – that's been a major challenge.* (pharmacist, DGH)

Infection control was cited as a challenge which, although not unique to critical care, was argued to present more of a problem to patient care on the ICU than elsewhere in the hospital because, for example, of the limited availability of isolation facilities on ICUs.

> *The organisms we're seeing are changing. I mean we regularly have MRSA bacteraemias, and we didn't see any before the mid 90s at all. There are multiple resistant ground negative infections, so the level of bacterial resistance has increased. There's no doubt about that……Everything is focused in Critical Care, so you've got a lot of sick patients, very close together, all of them on antibiotics, so you get a*

lot of the resistance develops first in the Intensive Care Unit and then spreads out to the rest of the hospital. (microbiologist, teaching hospital)

Well, obviously, high instances of MRSA and CDiff within Critical Care, well, within hospitals full stop. But we've set the challenges like, The Saving Lives and The Clean Your Hands campaign and, sort of, they're generic things that are throughout the Trust, but are quite a challenge within Critical Care, when you've got no isolation facilities to reduce your instance of infection and that has been quite a challenge. I mean it's not – it is a challenge set by the Government, but it is a challenge we would set ourselves anyway, would be to reduce our infection control rates really. But it is with the instance of CDiff particularly; MRSA our rates are lowering, but CDiff is, sort of, getting quite prolific really and, you know, we're getting patients from outside coming in with CDiff and then it's quite a challenge really from that side of it. We end up barrier nursing all our patients really. But that is quite, I think, a challenge that as I say, it is a generic thing throughout Trusts, but not just Critical Care, but it is a challenge to us. (senior nurse/matron, DGH)

Another challenge mentioned by some interviewees is that of dealing with what they described as the ever increasing expectations of patients and relatives concerning both the hospital experience and critical care outcomes. At some of the sites, interviewees reported that their case mix had changed in recent years and that they were now treating older patients and patients with more complex problems (although there was not universal agreement on this and other interviewees were of the opinion that they are now seeing more level two, and by implication, less severely ill patients) and that while outcome may have improved, ICU staff cannot perform the 'miracles' sometimes expected of them.

I think society's changed hugely as well, lots, and I don't think that we can ignore that, and one of the things about society is, you know, the whole expectation kind of culture. They expect things. They expect more, and so you have to deliver more. And so, you know, the whole – how people perceive nursing or the hospital experience, you know, their expectations are just so different now, and it's set much, much higher. (senior nurse/matron, teaching hospital)

We get on with early trachies, very aggressive treatment for their COPD, but these patients long term outlook is pretty dreadful, but people know that ITU is there, it's discussed with them, and a lot of people do opt to want to come to ITU. I think this is going to become an increasing problem, because things like – it's always been, in the past, you had like a middle class patient who was very medically aware. They knew about what was going on in, like, their chronic disease and what was possible for them, from a chronic disease point of view. But we're moving into a situation now with the internet that a lot of people are aware of what is out there, and people are becoming very much more, "This is what I want for myself." (consultant, DGH)

I think that the expectation of the rest of the hospital on the provision of Intensive Care has gone up exponentially over the last ten years that I've been practicing…….Well, I think, I mean, it's driven from a number of different levels, but I think the public's expectations that they will receive, if you like, Intensive Care. The doctors who are treating patients with acute and, in the background, chronic illnesses, expectations that they will continue to be treated and have more and more aggressive therapies, I think has gone up. (consultant, DGH)

Perceived societal and relatives' expectations were associated with ethical and cost or resource implication concerns about the appropriateness of treatment in critical care, giving rise to questions about how much treatment is enough and at what point treatment should not be pursued any longer.

But no, sometimes I, sort of, think particularly, sort of, with the long term patients is, sort of, when is enough, enough, sort of thing. I mean, it's just, sort of, around what else can we do for these patients or is there anything else that can be done for these patients or are we just, sort of, going around and around in circles? Sort of, particularly the ones where you, sort of, improve their ventilation to a degree, then they get a recurrent sepsis and they're back fully ventilated again and, sort of, going around and it's always a hard question to ask as to when is enough, enough sort of thing. (physiotherapist, DGH)

The very concept of 'change' itself was also said to pose a challenge to critical care professionals, be it in terms of conceptualising critical care as a service 'without walls' or in terms of day to day practices such as encouraging staff to use and adhere to guidelines or complete data collection as appropriate.

Well, the Unit still faces the challenge of trying to disseminate information. I think information – and we've tried, I mean, we've put computers, easy access to staff. We've given them all access, you know, codes so they can logon. We've got communication bills [laughs], and we've got everything, but it's still a challenge to get information to staff. I think with every change, the management of change is always a challenge, and when you're managing change within a small group, it's still a challenge, but when you have to manage a change that encompasses, like on the ICU side, [number] members of staff, to get them all practising in the same way is a challenge, and as I say, over the years, there has been so many changes. (senior nurse, teaching hospital)

Finally, concerns about the future of critical care services generally included capacity, the viability of smaller units in the long-term, the impact of Payment by Results, and concerns about the availability of an appropriately trained workforce.

4.3.9 The Modernisation Agency

Interviewees were asked about their involvement in the MA's critical care modernisation programme's national and local initiatives. As reported earlier, some interviewees were less aware than others of local MA initiatives such as the network and local projects. However, where attributions were made by interviewees in the course of the interviews about changes which have occurred in recent years, increased capacity, outreach, the networks, the new classificatory system for critically ill patients, and the concept of 'critical care without walls' were generally attributed to the original strategy document, *Comprehensive Critical Care* (Department of Health, 2000b) and/or the modernisation programme. New ways of working and new opportunities for critical care staff were also attributed to the strategy by individual interviewees.

> *I think for, I suppose anyone who was in Critical Care before Comprehensive Critical Care will acknowledge that it's the most important significant document that's influenced Critical Care, so the investment and recommendations for that document were huge.* (senior nurse/matron, teaching hospital)

However, there was some confusion about where the money for specific initiatives came from.

> *Yeah, I mean, I can't remember now exactly how it, kind of, started up but I think initially, maybe there was a Government, kind of, approach to all hospitals individually and I think they said, "Oh, this Modernisation thing is going to – we're going to do certain things that involve Intensive Care", and then I think shortly after that, the Network, the Intensive Care Network idea came out. I think by then we were probably already – we were already doing stuff to do with Outreach and I think there was specific money allocated for Outreach services that came through the Modernisation Agency.* (consultant, DGH)

> *I think the expansion of this has been good. If that falls within the remit of Modernisation, well done, but I don't think it did. If it did, that's the one good thing that's happened.* (consultant, teaching hospital)

Other impacts and initiatives attributed by individual interviewees to the MA included fostering a culture of service improvement, data collection and information dissemination. However, a couple of interviewees reported that they felt that Modernisation Agency's programme had had little impact on their work, and there was also some concern voiced about the amount of money that had been spent on aspects the programme.

> *I just saw a large number of people being paid a large amount of money putting on the most ludicrously expensive, pointless conferences, some of which I went to and didn't understand a single word, and I'm not a stupid person, and I tend to feel that if I've not understood anything at all……then it probably wasn't worth understanding. And being impressed only by the fanfares and the*

fireworks and everything else that was going on, and I couldn't understand how that was benefiting us, and it was swallowing a vast amount of money. (consultant, DGH)

One interviewee expressed concern that much of what has come out of the modernisation of critical care has been advisory rather than mandatory in nature.

……and I think there is a big problem with some of the work that comes out around Critical Care; it is advisory, not mandatory. There's no, sort of – there's no real measures around what you do or you haven't got to report anybody, for example, you know, we've done [an initiative] but that's very unique to us and there's no, sort of, standard for how Comprehensive Critical Care or the Modernisation Agency stuff was interpreted, I think. (nurse consultant, teaching hospital)

4.4 Discussion

The concept of 'modernisation' is implicit in interviewees' reports of recent changes that have occurred in the ways in which adult critical care services in England are organised and delivered. A range of positively framed developments and initiatives were reported. Interviewees outlined the benefits accrued by patients and staff as a result, for example, of the introduction of outreach services and the network promoted collaborative approach to working with other local critical care services. They also described new opportunities for multi-professional team working and the expansion of their professional roles and responsibilities in the delivery of care to critically ill patients. It could be argued that, in essence, study participants were describing adult critical care as a specialism 'coming of age' in the sense of developing a larger and more robust evidence base, and a methodology for applying that evidence base (e.g. through the standardisation and protocolisation of care); the utilisation of the expertise of a wider range of practitioners in its application; and greater investment in a culture of evaluation through data collection, audit and research.

Concern was expressed about specific challenges facing individual services, and problems such recruiting appropriately qualified staff or discharging patients from the ICU were common to a number of study sites, while evidence emerged of scepticism about some elements of the critical care modernisation programme. In general, however, the study participants appeared to view as opportunities rather than threats the changes which they have encountered (or helped to initiate) in their own services and in adult critical care generally, suggesting a desire on their part to engage with the prevailing culture of improvement and modernisation. The injection of additional capacity funding and the perceived expansion of professional roles and responsibilities may potentially have contributed to this general positivity, as may the fact that initiatives such as outreach have now had a chance to 'bed-in', giving study participants time to adapt to them and to experience both patient and health professional-related benefits.

Furthermore, as at least one of the interviewees in the current study argued, critical care has always had the reputation of attracting staff who wish to engage with advances in technology and practice. It has been reported elsewhere (Gollop *et al*, 2004) that reasons for converting from scepticism to support for NHS modernisation programmes include observing evidence of benefits, and the attractiveness of the funding and other opportunities presented.

As reported earlier, studies of critical care modernisation and related initiatives have tended to based on a particular trust or network (e.g. Butler, 2005), or to focus specifically on only one aspect of modernisation, such as outreach (e.g. Plowright *et al*, 2006). The current study, however, involved seven study sites across three networks in geographically disparate areas of England, and focused not only on the critical care modernisation programme itself, but also on the wider changes that are perceived to have occurred both in interviewees' own services and in adult critical care nationally. As such, the findings are informative about both the processes and impacts of change on the organisation, delivery and culture of adult critical care. A number of key findings emerged.

Firstly, the study findings highlight not only the perceived positive impacts of the introduction of outreach services on patient care (e.g. faster and /or avoided admissions to the ICU, better follow-up for patients discharged from the ICU and fewer re-admissions), and the clinical and educational support provided to ward staff, but also suggest that outreach is playing a crucial role in re-framing the historical boundaries around the ICU by 'representing' the wards to the ICU and vice versa, and facilitating information flow between the two, thereby improving communication, and impacting positively on social-organisational processes and cultures in the hospital. While there is some scepticism about whether adult critical care can ever become a truly hospital-wide rather than a unit based service, in general the concerns expressed do not appear to represent an ideological opposition to the notion of critical care as a hospital-wide service but rather a belief that the capacity and personnel simply do not exist currently to allow for the realisation of the concept. Perceptions of the ICU as a scary, technological environment, of critical care staff, and in particular nurses, as 'elitist', and of 'them and us' demarcations between the unit and the wards, are believed to still persist to varying degrees. However, critical care professionals consider themselves to be making concerted efforts to address these perceptions and to open the 'doors' of critical care in a variety of practical, organisational and socio-cultural ways to other areas of the hospital. The study suggests a re-framing of the pronounced boundaries around the ICU noted by Carmel (2003) and that the 'walls' of critical care are being crossed in both directions to a greater extent than previously, as allied health professionals, and to an extent ward staff, visit the ICU on a regular basis and ICU-based staff and outreach teams diversify their clinical and educational activities onto the ward setting.

Secondly, although their local critical care network might not have been viewed as successful or particularly productive by some of those interviewed, the study findings highlight the range of potential benefits

which can be achieved through formal, collaborative networks, from the production of joint operational policies and engagement in across-service projects and audits to improved communication between organisations, opportunities for peer support, and the development of new working relationships between staff employed by critical care services in geographically neighbouring trusts. Furthermore, the findings point to the factors which are believed to make formal networks successful: these include visibly strong leadership, a strategic vision for the network, and appropriate funding and resources to support the network's operations and functions, as well as buy-in from medical and other health professionals, and a willingness on the part of individual services to commit to, support and share with other local services. The findings also suggest that collaborative networks may be most successful where there is a perceived need for one, where the functional and organisational boundaries of networks follow historical and/or existing patterns of communication and collaboration between services, and where a range of professionals experience observable benefits in terms of developing their professional practice or improving service delivery.

Thirdly, collaboration and teamwork have been described as '*key to success in the intensive care unit*' (Surgenor *et al*, 2003). As in Carmel's (2003) study, close working relationships were described in the main by our interviewees. The findings underscore the reported and perceived enthusiasm of allied health professionals for working with the critical care team, and the satisfaction they derive from bringing their expertise to bear in the care of critically ill patients, regardless of whether they are located on the ICU or the wards. In addition, they illustrate the value placed by critical care medical and nursing staff on the expertise and input of other professional groups, and the emergence of opportunities for collaborative working. In line with policy, strategic and workforce recommendations (e.g. Royal College of Nursing, 2003; NHS Modernisation Agency, 2002), the findings highlight a perceived range of new opportunities for role expansion and development available not only to nursing staff but also to professionals such as pharmacists and physiotherapists who wish to undertake designated critical care roles (e.g. on outreach, in the rehabilitative care of the long-term patient, or through conducting critical care focused research). The omission of the dietician as a perceived key member of the multi-professional team by some of those interviewed is perhaps not surprising: Windle's (2007) survey of dieticians in northern England revealed large deficiencies in dietetic support to critical care services. On the other hand, the leadership, training and development roles both described by and ascribed to senior nurses, including nurse consultants, echo closely those described by the nurse consultants surveyed by Dawson and Coombs (2008).

While initiatives such as critical care outreach and the networks are clearly attributable to the Department of Health's modernisation strategy, as outlined in *Comprehensive Critical Care* (Department of Health, 2000b), and the critical care modernisation programme, it is a challenge in both a practical and methodological sense in a study such as the present one to

separate out the impact of modernisation in general or the Modernisation Agency, in particular, from broader policy, workforce and funding changes on other recently introduced initiatives and developments in the organisation and delivery of adult critical care services. It is difficult to ascertain, for example, whether some of the changes perceived to have taken/ be currently taking place, such as the reported increased standardisation of care delivery and a more inclusive culture of multi-professional working, are unique to critical care or simply reflect similar changes taking place elsewhere in the NHS acute setting. Undoubtedly, the impact of changes in nursing and medical training programmes and the effects of the new consultant contract on shift patterns are also being felt by other areas of clinical practice in the acute hospital. Also, as noted or alluded to by some of the study participants, critical care services do not operate in isolation but are affected on a daily basis by government targets and hospital bed status. By their nature, health technologies and therapies, clinical practices and professional roles, and health services themselves are constantly evolving and changing. Whether or not critical care professionals identify the impetus to developments and innovations as a specific modernisation programme is probably less important than that they view those developments as beneficial to patient care and to their day-to-day working and professional development.

A potential shortcoming of the current study is that although it included interviews with allied health professionals and staff involved in outreach, it is impossible to tell how doctors, nurses and other ward based staff perceive the 'modernised' critical care service that has moved out of the confines of the ICU in recent years. The accounts given by some of the interviewees suggest that the reaction of ward staff has included a recognition, for example, of the value of outreach services but that this has been tempered in some areas by concerns that critical care professionals are encroaching on the traditional territory and activities of ward staff, and may be inadvertently deskilling such staff. A study of the impact of outreach teams on the delivery and organisation of hospital care (Baker-McClearn and Carmel, in press) suggests that while outreach empowers and reassures ward staff, it also stands accused of deskilling junior doctors.

As with any study of its type, where similar views and perceptions are voiced by a number of interviewees at a single site, one has to consider that they may represent a rhetoric, team 'line' or the influence of key members of staff. However, the fact that similar views emerged across the sites on a variety of issues, and further that there were divergent views within sites suggests that this is not the case.

In conclusion, modernisation, development and improvement are concepts are used either explicitly or implicitly by critical care professionals when talking about changes in organisational culture and the ways in which they deliver their service, as well as when describing their professional roles, identities and practices as members of the multi-professional critical care team. Although the formal critical care modernisation programme ended some years ago, the impacts of the initiatives set out in *Comprehensive Critical Care* (Department of Health, 2000b) continue to be felt by staff

working at the coal-face of critical care in England. Perhaps the greatest challenge to critical care professionals, and to the future of critical care services, is that in having emerged from within the four walls of the ICU and expanded their roles and remits, they can maintain the momentum to develop and modernise both inside and outside the walls.

5 Concluding remarks

Findings from the quantitative study show that 'modernisation' activities were, with some variation, taken up by units and networks and that there have been overall improvements in the effectiveness and cost-effectiveness of adult critical care services since 2000, for example, fewer transfers and discharges for non-clinical reasons, and better risk-adjusted outcomes. However, there was no consistent pattern in how involvement in modernisation activities related to changes in processes or outcomes of care. The qualitative research found that the concept of 'modernisation' is implicit in reports of the changes that have occurred. Although the formal critical care modernisation programme ended some years ago, the impacts of the initiatives continue to be felt by staff.

5.1.1 The value of parallel qualitative and quantitative studies in health services research

The value of combining quantitative and qualitative studies to address questions in health services research is well recognised (Murphy *et al*, 1998) although it has also been noted that there are often limits to how well data and analysis from different designs are integrated in reports (O'Caithain *et al*, 2008). In this study, although the findings from the qualitative and quantitative studies have been reported separately to reflect the different research questions addressed, there were a number of significant benefits in conducting the two studies in parallel, and in holding regular meetings to discuss emerging findings. These advantages related to both improved study design and to aiding the analysis and interpretation of results.

Qualitative data provide a picture of what changes mean in practice for those delivering services, and here provide a more nuanced picture than the inevitably rather global one provided by the analysis of CMPD and Modernisation Agency data. In this study, the accounts of professionals provide the contextual backdrop of a largely optimistic, forward-looking specialty, with evidence of a general perspective of having 'modernised' over the last five years. The qualitative data on how changes in critical care have been experienced uncover the detail of how networks have operated across a range of settings, and how key changes such as the emergence of 'critical care without walls' have shifted the organisation and delivery of critical care services. They also describe an essential context of how the Modernisation Agency's work was experienced on the ground, given the simultaneous introduction of other initiatives and policies. This is vital for understanding how to answer the broad question of how to evaluate the impact of modernisation. As well as unpacking the detail of the quantitative results, and ensuring that general findings are plausible in terms of the perspectives of those with direct experience of change, the qualitative data

were also drawn on in various ways in the conduct and analysis of the quantitative study. We summarise here these benefits in four areas:

- the definition, development and validation of study measures and concepts

- triangulation of empirical data

- strengthening the credibility of causal inferences

- ensuring the research met stakeholder needs

5.2 Definition, development and validation of study measures and concepts

Early qualitative data were essential to inform decisions about how to operationalise key measures in the quantitative study such that they were related to clinical and managerial service delivery concerns. The perspectives of professionals were useful, for instance, for defining pragmatic indicators such as level of network engagement and timing of discharge. They were also essential in aiding the design of the questionnaire to gather data on ventilator bundle adoption, to ensure it could be reliably and easily completed from data available within the unit.

At a more fundamental level, the accounts of participants who had been involved in these processes were crucial to a fuller understanding of the core concept of interest here: 'modernisation'. It was clear, from the lack of certainty and consensus among interviewees about the role of the Modernisation Agency specifically, and the various ways in which both the concept of 'modernising' and activities described as resulting from 'modernisation' were discussed, that the concept could not be reduced in any simplistic way to the activities defined by the Modernisation Agency. Assessing the impact of modernisation simply from the perspective of the Modernisation Agency and those professionals closely involved in it would not have reflected the ways in which activities were, in practice, implemented simultaneously with, and often understood as connected with, other policies and initiatives.

5.3 Triangulation of empirical data

On broad findings such as increased capacity, range of network forms and engagement, changing case mix, length of stay and changing rates of transfers in and out, it was important that professionals' descriptions of changes over time reflected those that we identified in the quantitative data. Consistency of broad findings aids the credibility of results, and ensures a basic validity check on the quantitative data used in the analysis. Professionals' perspectives are useful for 'checking out' assumptions from the quantitative analysis, such that increases in delayed discharges might result from the lack of increase in ward beds compared with critical care beds.

Second, triangulation can help explain findings, such the lack of association between process and outcome measures between units in early and late adopter networks. The qualitative finding that networks, for many, were not a significant issue in their day to day professional lives, and the detailed descriptions of how networks affected (or not) unit provision, help make sense of why network involvement might have little impact at the level of unit outcomes. Local clinical networks were simply not of major salience to many as an influence on unit level delivery of care.

5.4 Strengthening the credibility of causal inferences

Limited ability to attribute causality in observational studies remains a major challenge in developing the evidence base in health services research. The incorporation of qualitative data has been suggested as one method for strengthening the credibility of causal analysis in contexts where randomised designs are generally not feasible, such as the evaluation of policy interventions (Mercer *et al*, 2007; Waitzkin *et al*, 2008). The evaluation of the impact of modernisation on critical care is one such example.

The qualitative data in this study aided our understanding of the likely impact of 'modernisation' activities by providing detailed data on the processes by which modernisation influenced practice, which both aided the identification of plausible mechanisms for causal relationships, and provided confirming evidence for suggested relationships. One example is the broad finding that increased expenditure and capacity was associated with better case mix adjusted outcomes, but that no relationship was found at the level of the unit. This is puzzling if we assume a direct link between expenditure, capacity and clinical care. However, the accounts of professions in critical care make it clear that increased expenditure had effects above and beyond those of increasing capacity that are likely to have improved standards of care. These relate to the impact on morale, public profile and self-confidence in the service, which are likely to have had an effect across all units, irrespective of the particular level of increase in capacity within it. What we have identified as a feeling of 'coming of age' was associated with a greater acceptance of a research and evidence based culture, which is likely to have had a global impact on standards across the specialty. Thus increased expenditure may be causally related to better outcomes, but through the mechanism of improved morale, rather than only, or necessarily, through the direct provision of additional capacity.

Another suggested mechanism is the role of networks in fostering nursing professionalism in critical care. The quantitative data revealed few associations between organisation and outcome at the level of network, but the qualitative data suggested that it may well be professional networks, rather than the local networks of units, that have had the greatest impact on the observed changes within the specialty, leading to the growing perception (among some sites and professionals) that there was greater

nursing autonomy within critical care, which some associated with the move to a more evidence-based approach.

5.5 Ensuring the research meets stakeholder needs

Health services research is ultimately directed at improving health services, and it is important to ensure that the research is conducted and reported as far as possible in ways which are likely to be useful for practitioners and policy makers. Steering and Reference Group meetings provide the perspective of those highly motivated to become involved in research, but the qualitative data, given that we aimed to include a range of staff working in diverse Critical Care settings, was essential for understanding the perspectives of those managing and providing services on precisely what research questions are most urgent, and how research findings are likely to be used. In our data, professionals discussed in particular the growing research culture of critical care, but noted, for instance, the perceived lack of data on the added value of care bundles over and above that of individual protocols. Data on this are likely to be particularly welcome to those delivering services.

6 Key findings and recommendations

6.1 Key findings

From late 2000, the capacity of adult critical care in England increased and this was associated with a reduction in the severity of admissions, fewer transfers and discharges for non-clinical reasons, and better risk-adjusted outcomes. Although the cost of care increased, major improvements in outcome meant the cost-effectiveness of critical care improved. Comparison of critical care units revealed: those that increased in capacity the most experienced greater changes in case-mix and processes of care but no concomitant improvement in outcome; adoption of the ventilator care bundle was associated with improvement in outcome; and involvement in critical care networks was associated with somewhat inconsistent changes in processes or outcomes of care. One of the challenges that this type of evaluation faces is determining whether any observed associations are causal and, if so, the direction of causality.

Although they did not generally use the term itself, 'modernisation' was a salient concept for the interviewees. Evidence of modernisation, as well as its perceived impact on the organisation, delivery and culture of critical care emerged in three overarching, but inter-related, themes:

(i) the drive towards the standardisation of clinical practice and service delivery associated with a growing culture of audit, research and the use of evidence based practice

(ii) the re-framing of boundaries around the intensive care unit and new ways of communicating with the rest of the hospital

(iii) new and expanded roles and ways of working for members of the multi-professional critical care team.

The study shows that 'modernisation' activities were generally taken up by critical care units and networks and that there have been overall improvements in the effectiveness and cost-effectiveness of adult critical care services since 2000. However, there was no consistent pattern in how involvement in modernisation activities related to changes in processes or outcomes of care. The qualitative research found that the concept of 'modernisation' is implicit in reports of the changes that have occurred. Although the formal critical care modernisation programme ended some years ago, the impacts of the initiatives continue to be felt by staff.

6.2 Recommendations

6.2.1 Recommendations for policy

The findings from this study are limited to the impact of the modernisation of adult critical care services. The changes that have been examined in this study represent only part of the investment and changes that occurred as a result of the NHS Plan. The Department of Health should consider commissioning a synthesis of studies that have evaluated the different aspects of these changes in different clinical areas in order to place these findings in context and identify wider lessons for the implementation of large-scale organisational change in the NHS.

6.2.2 Recommendations for practice

The ventilator care bundle appears to be an effective and cost-effective intervention and its continued use or implementation should be considered (section 3.5.5).

Clinical and managerial staff should seek to maintain and develop a culture of audit, research, and evidence-based practice that draws on clinical and professional networks where appropriate to ensure future innovations are evaluated and, if beneficial, adopted (section 4.3.2).

The trend towards increasing delayed discharges should be investigated locally in order to identify any problems and their potential impact on critical care use and costs (section 3.3.3).

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Appendix 1 Modernisation Agency network success criteria

1. Total Engagement with Acute Trust, PCT and SHA Boards.

- Minutes of Board Meetings make reference to the programme and it's relevance and progress.

- Each Health Partnership Board is aware of the National Programme and local delivery.

- Each Trust is improving/redesigning services and is seen to be both active and supportive within the Network.

2. Projects are seen and demonstrated to be mainstream.

- Projects are suggested and led by local improvement leads or champions with minimal intervention from the Network.

- Improvements are implemented and shared across the network.

- Each Trust has as part of its core business a culture of improving services for patients and staff.

- Trusts are looking at Care Bundles and patient and carer experience. Other techniques are being used such as observations of care, use of comments/complaints/suggestions etc.

3. A Critical Care Delivery Group is in place.

- Each Acute Trust can demonstrate links to the Hospital Management Team.

- Both Clinical and Service Delivery improvements are evidenced, recorded and celebrated.

- Each Acute Trust shows evidence of planning systematic audit, development, and incremental improvements.

- Capacity and demand mapping and prioritisation is undertaken that feeds into the network plan.

4. Network management arrangements are in place.

- Roles and responsibilities are defined and effective.

- Performance management arrangements are explicit, both for individuals and the Network.

- There should be a line of accountability where by the SIL reports to the Network Manager, the Manager to the Chair of the Network Steering Group, and the Chair to the Strategic Health Authority.

5. The Network has a strategic an operational and a quality plan in place.

- Each Network can show clear strategic and operational documentation.

- This is linked with the local Service and Financial Framework arrangements and commissioning mechanism.

- The quality plan should include all the service improvement work. There is a communication strategy. There is a clear and explicit Clinical Governance framework. There should be agreed values to how the Network functions.

- There is clear evidence of risk assessments at each Trust and generically across the Network. Risks are understood, identified and minimised. There are clear escalation procedures; proper contingency planning is carried out.

6. There is a balanced team.

- All key posts are filled.

- Each individual has a clear Job Description.

- A training needs analysis exists for individuals and the team. There are team objectives.

- To ensure appropriate accountability, the chair of the Steering Group or Executive Board should be a Chief Executive.

7. Links are demonstrated to other programmes.

- Any funding requests show reference to the Critical Care Programme.

- There is an explicit mechanism to capture initiatives, plans, business cases etc and their impact to Critical Care.

- The Network Manager is involved with other local and regional events.

- The SIL is consulted and helps facilitates other events external to the programme. Collaboration is demonstrated and there is sharing of learning across programmes.

8. The Network has the ability to function independently.

- There is a local vision agreed by all stakeholders and owned by the Steering Group. Key staff are engaged and the Network is progressing towards it's aims and objectives with clear action planning.

- Problems are recognised early and solved locally.

- Networks should have appropriate representation at Update days and National Events.

9. Local sharing events are organised.

- The National team is made aware of these events and opportunities exist to attend.

- Outcomes are made explicit and action plans from the event are drawn up and actioned. Events should include or be specific for Nursing, Medical, AHP and other key groups of staff.

10. Information collected within the Network is timely, informative, and constructive, and reported nationally.

- Reports are on time each month or advance warning given of any delays. Reports must not be missed more than one month in four.

- New projects meet the criteria for improvement, and the appropriate methodology is used and recorded. Clear outcomes are agreed and measured.

- Spread is evident.

- Information collected locally is acted upon. Each Trust is signed up to data being shared and used across the Network.

- There is a culture of data collection and this is clearly used to inform and action change.

source: NHS Modernisation Agency

Evaluation of the Modernisation of Adult Critical Care Services In England

ICNARC
Intensive Care National Audit & Research Centre

Implementation of the Ventilator Bundle

Name of hospital:

Name of person completing form:

Job role of person completing form:

Ventilator Bundle
• elevation of the head of the bed to 30-45°   • daily "sedation vacations" and assessment of readiness to extubate   • peptic ulcer disease prophylaxis   • deep vein thrombosis prophylaxis

Have you implemented the Ventilator Bundle in your unit?
Please tick one of (a) to (d) below and indicate the date of implementation and level of compliance if applicable.

(a) ☐ **Yes, in full**

- **Date implemented in full** (select from the drop-down)
    - ○ **Quarter:**   **Year:**

- **Please indicate percentage compliance by year** (tick the relevant boxes)

		2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
	>90%	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
level of compliance	75-90%	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	<75%	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments on implementation

(b) ☐ **Yes, in part i.e. some elements** (please explain)

(c) ☐ **No, alternative protocol/guideline for ventilated patients in use** (please explain)

(d) ☐ **No, other reason** (please explain)

Please use this space for any additional information

If you have any queries, please contact Kathy Rowan at icnarc@icnarc.org or on 020 7554 9779.

Please complete this form electronically and email to icnarc@icnarc.org or fax to 020 7388 3759