Acutely ill patients in hospital: recognition of and response to acute illness in adults in hospital

Full guideline

Draft for consultation, April 2007

This guideline was developed following the short clinical guidelines process. This document includes all the recommendations, details of how they were developed and summaries of the evidence they were based on.

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1 Summary

1.1 Foreword

[To be inserted in final version]

1.2 Patient-centred care

This guideline offers best practice advice on the care of acutely ill adult patients within the acute hospital setting.

Treatment and care should take into account patients' needs and preferences. People with an acute illness should, where appropriate, have the opportunity to make informed decisions about their care and treatment, in partnership with their healthcare professionals. If patients do not have the capacity to make decisions, healthcare professionals should follow the Department of Health (2001) guidelines – 'Reference guide to consent for examination or treatment' (available from www.dh.gov.uk). From April 2007 healthcare professionals will need to follow a code of practice accompanying the Mental Capacity Act (summary available from www.dca.gov.uk/menincap/bill-summary.htm).

Good communication between healthcare professionals and patients is essential. It should be supported by evidence-based written information tailored to the patient's needs. Treatment and care, and the information patients are given about it, should be culturally appropriate. It should also be accessible to people with additional needs such as physical, sensory or learning disabilities, and to people who do not speak or read English.

Carers and relatives should have the opportunity to be involved in decisions about the patient's care and treatment, unless the patient specifically excludes them.

Carers and relatives should also be given the information and support they need.

1.3 List of recommendations and care pathway

1.3.1 Key priorities for implementation

Recommendation 1 (chapter 2.1.3)
Adult patients in acute hospital settings should have:

- all appropriate physiological observations recorded at the time of admission/initial assessment
- their physiological observations measured, recorded and acted upon by staff specifically trained to undertake these procedures and understand their clinical relevance
- a clear monitoring plan that specifies which physiological observations to be recorded and how often they should be recorded. This will take account of the:
  - patient's diagnosis
  - presence of comorbidities
  - agreed treatment plan.

Recommendation 3 (chapter 2.1.4)
Physiological 'track and trigger' systems should be used to monitor all adult patients in acute hospital settings, including patients in the emergency department for whom a clinical decision to admit has been made.

- The minimum monitoring frequency of physiological observations should be every 12 hours.
- The frequency of monitoring should increase when abnormal physiology is detected (see recommendation 11).

Recommendation 8 (chapter 2.2.3)
Staff working with acutely ill patients should have the necessary competencies in monitoring, measurement, interpretation and prompt response to the acutely ill patient, appropriate to the level of care they are providing. Education and training should be offered to ensure staff can demonstrate they have these competencies.

Recommendation 11 (chapter 2.2.3)

A graded response strategy for patients identified as being at risk of clinical deterioration should be agreed and delivered locally. The response strategy should consist of the following three levels.

- Low:
  - Increased frequency of observations and the nurse in charge alerted.
- Medium:
  - Urgent call to team with primary medical responsibility for the patient.
  - Simultaneous call to personnel with core competencies for acute illness. These competencies can be delivered by a variety of models at a local level; such as critical care outreach team, hospital-at-night team, specialist trainee in an acute medical or surgical specialty.
- High:
  - Emergency call to team with critical care competencies and diagnostic skills. This team should include a medical practitioner with a minimum of intermediate-level competencies in critical care, and there should be an immediate response.

Recommendation 14 (chapter 2.2.3)

If the team caring for the patient considers that admission to a critical care area is clinically indicated, then the decision to admit should involve both the consultant caring for the patient on the ward and the consultant in critical care.

Recommendation 16 (chapter 2.3.3)

After the decision to discharge has been made, patients should be discharged from critical care areas to the general ward as early as possible during the day. They should not be discharged from critical care areas to the general ward between 22.00 and 07.00.

Recommendation 17 (chapter 2.3.4)

The critical care area discharging team and the receiving ward team have shared responsibility for the care of the patient being discharged. They should jointly:

- ensure there is continuity of care through a formal structured hand-over of care from critical care area staff to ward staff, supported by a written plan
- ensure that the receiving ward, with support from critical care (if required), can deliver the agreed plan.

The formal structured hand-over of care should include:

- a summary of critical care stay including diagnosis and treatment
- a monitoring and investigation plan
- an ongoing treatment plan including drugs and therapies, nutrition plan, infection status, limitations of treatment
- physical and rehabilitation needs
- psychological and emotional needs
- specific communication or language needs.

1.3.2 List of all recommendations

Recommendation 1 (chapter 2.1.3)
Adult patients in acute hospital settings should have:

- all appropriate physiological observations recorded at the time of admission/initial assessment
- their physiological observations measured, recorded and acted upon by staff specifically trained to undertake these procedures and understand their clinical relevance
- a clear monitoring plan that specifies which physiological observations to be recorded and how often they should be recorded. This will take account of the:
  - patient's diagnosis
  - presence of comorbidities
  - agreed treatment plan.

Recommendation 2 (chapter 2.1.3)
The following physiological observations should be carried out as part of routine monitoring:

- heart rate
- respiratory rate
- blood pressure
- level of consciousness
- oxygen saturation
- temperature.

Recommendation 3 (chapter 2.1.4)
Physiological 'track and trigger' systems should be used to monitor all adult patients in acute hospital settings, including patients in the emergency department for whom a clinical decision to admit has been made.

- The minimum monitoring frequency of physiological observations should be every 12 hours.

- The frequency of monitoring should increase when abnormal physiology is detected (see recommendation 11).

Recommendation 4 (chapter 2.1.5)
Multi-parameter or aggregate weighted scoring systems, which allow a graded response, should be used to monitor patients.

Recommendation 5 (chapter 2.1.5)
These systems should include:

- parameters to be measured and frequency of observations
- a clear and explicit statement of the parameters, cut points or scores that should prompt a request for review.

Recommendation 6 (chapter 2.1.6)
The chosen scoring system should measure the following parameters for monitoring purposes:

- heart rate
- respiratory rate
- systolic blood pressure
- level of consciousness
- oxygen saturation
- temperature.

Recommendation 7 (chapter 2.1.6)
Additional monitoring may be required in specific clinical circumstances, for example:

- hourly urine output
- biochemical analysis (for example, lactate, blood glucose, base deficit, arterial pH).

Recommendation 8 (chapter 2.2.3)
Staff working with acutely ill patients should have the necessary competencies in monitoring, measurement, interpretation and prompt response to the acutely ill patient, appropriate to the level of care they are

providing. Education and training should be offered to ensure staff can demonstrate they have these competencies.

Recommendation 9 (chapter 2.2.3)
The response strategy delivered to the patient identified as being at risk of clinical deterioration should be triggered either by physiological 'track and trigger' score or by clinical concern.

Recommendation 10 (chapter 2.2.3)
The thresholds for the 'track and trigger' system should be set at a local level, informed by patient case mix.

Recommendation 11 (chapter 2.2.3)
A graded response strategy for patients identified as being at risk of clinical deterioration should be agreed and delivered locally. The response strategy should consist of the following three levels.

- Low:
  - Increased frequency of observations and the nurse in charge alerted.
- Medium:
  - Urgent call to team with primary medical responsibility for the patient.
  - Simultaneous call to personnel with core competencies for acute illness. These competencies can be delivered by a variety of models at a local level, such as critical care outreach team, hospital-at-night team, specialist trainee in an acute medical or surgical specialty.
- High:
  - Emergency call to team with critical care competencies and diagnostic skills. This team should include a medical practitioner with a minimum of intermediate-level competencies in critical care, and there should be an immediate response.

Recommendation 12 (chapter 2.2.3)
Patients identified as 'clinical emergency' should bypass the graded response system and be treated in the same way as the high-score group.

Recommendation 13 (chapter 2.2.3)
Both the high- and medium-score groups should receive:

- initiation of appropriate intervention
- assessment of response
- formulation of management plan, including location and level of care.

Recommendation 14 (chapter 2.2.3)
If the team caring for the patient considers that admission to a critical care area is clinically indicated, then the decision to admit should involve both the consultant caring for the patient on the ward and the consultant in critical care.

Recommendation 15 (chapter 2.2.3)
No specific service configuration can be recommended as a preferred response strategy for individuals identified as having a deteriorating clinical condition.

Recommendation 16 (chapter 2.3.3)
After the decision to discharge has been made, patients should be discharged from critical care areas to the general ward as early as possible during the day. They should not be discharged from critical care areas to the general ward between 22.00 and 07.00.

Recommendation 17 (chapter 2.3.4)
The critical care area discharging team and the receiving ward team have shared responsibility for the care of the patient being discharged. They should jointly:

- ensure there is continuity of care through a formal structured hand-over of care from critical care area staff to ward staff, supported by a written plan
- ensure that the receiving ward, with support from critical care (if required), can deliver the agreed plan.

The formal structured hand-over of care should include:

- a summary of critical care stay including diagnosis and treatment
- a monitoring and investigation plan

- an ongoing treatment plan including drugs and therapies, nutrition plan, infection status and limitations of treatment
- physical and rehabilitation needs
- psychological and emotional needs
- specific communication or language needs.

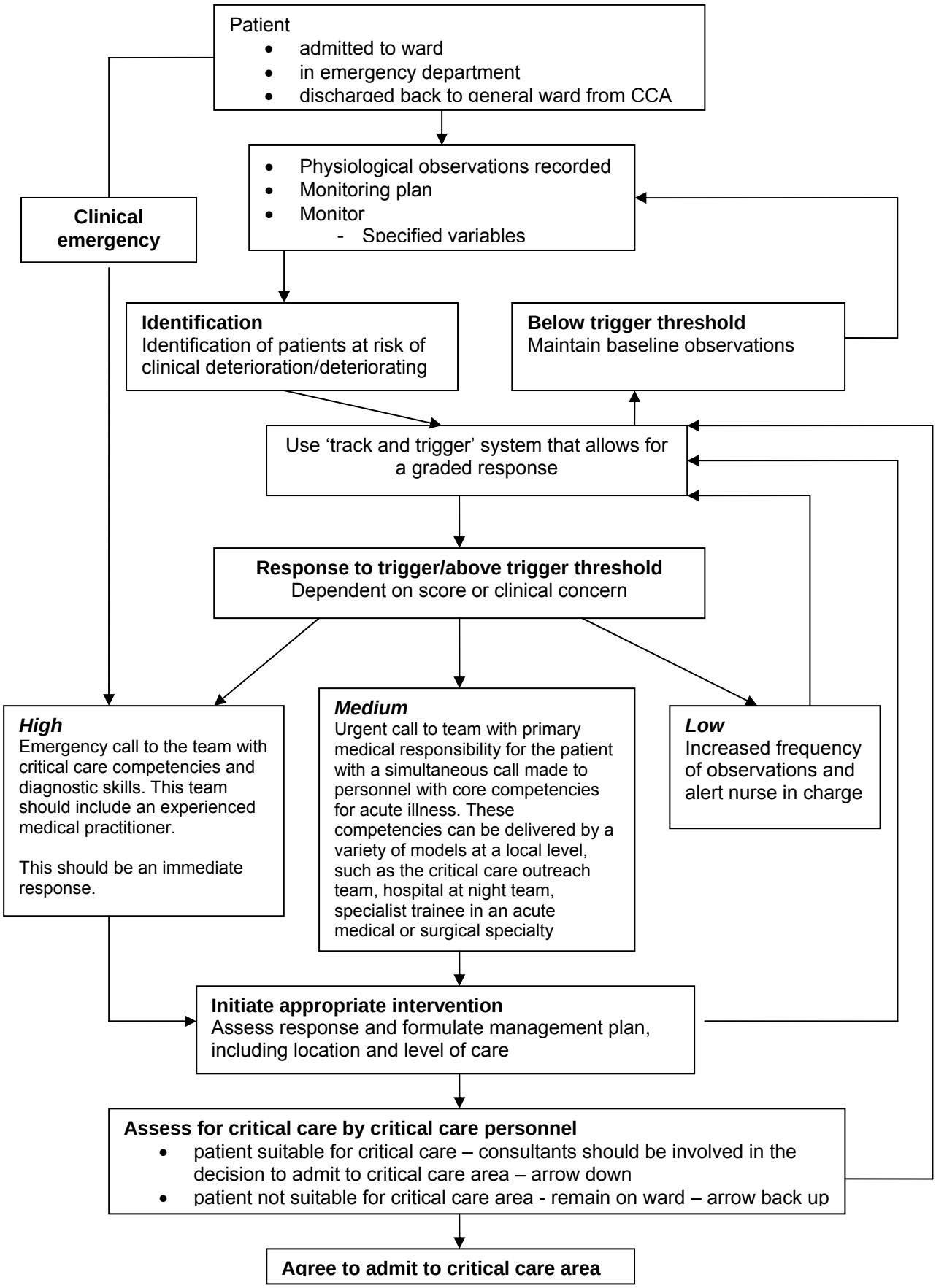
Recommendation 18 (chapter 2.3.4)

Patients and their carers/families should be offered information on their condition and should actively participate in decisions that relate to their recovery. The information should be tailored to individual circumstances.

Recommendation 19 (chapter 2.3.4)

Staff working with acutely ill patients on general wards should be provided with education and training to recognise and understand the physical, psychological and emotional needs of patients on discharge from critical care areas.

1.3.3 Care pathway



1.4 Overview

1.4.1 Recognition and response to acute illness in adults in hospital

The care of the acutely ill patient in hospital may require input from critical care. Critical care in the NHS is provided within the continuum of primary, secondary and tertiary care with the majority of services delivered in the secondary care setting. The Department of Health in 2000 (Department of Health 2000) recommended that this care should be classified based on the level of care that individual patients need, regardless of location. It identified four levels of care. 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; and 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.

The aging population, increasing complexity of medical and surgical interventions, and shorter inpatient hospital length of stays have meant that patients in hospital are at increasing risk of becoming acutely ill and may require admission to critical care areas. This has led to increasing demand for level 1 and level 2 care. Clinical deterioration can occur at any stage of a patient's illness, although there will be certain periods during which a patient is more vulnerable, such as at the onset of illness, during surgical or medical interventions and during recovery from critical illness. Patients on general adult wards and emergency departments who are at risk of deteriorating may be identified before a serious adverse event by changes in physiological observations recorded by healthcare staff. The interpretation of these changes, and timely institution of appropriate clinical management once physiological deterioration is identified, is of crucial importance if the likelihood

of serious adverse events including cardiac arrest and death is to be minimised. Should a patient be admitted to critical care areas for further care, then care on general adult wards following discharge from critical care areas may also have a significant impact on patient outcomes.

There is, however, a consistent body of evidence which shows that patients who become, or who are at risk of becoming, acutely unwell on general hospital wards receive suboptimal care (McQuillan et al. 1998; NCEPOD 2005; Seward et al. 2003). The 'National Confidential Enquiry into Patient Outcome and Death' (NCEPOD 2005) identified delayed recognition and institution of inappropriate therapy which subsequently culminated in a late referral as prime causes of the substandard care of the acutely unwell in hospital. The report found that on a number of occasions this was aggravated by poor communication between the acute medical and critical care medical teams. It also identified examples in which there was a lack of awareness by medical consultants of their patients' deteriorating health and their subsequent admission to critical care. Admission to an intensive care unit (ICU) was thought to have been avoidable in 21% of cases, and the authors felt that sub-optimal care contributed to about a third of the deaths that occurred.

Any intervention delivered to patients in hospital who deteriorate clinically, or who show signs that they may deteriorate unexpectedly, should aim to reduce patient mortality, morbidity and length of stay both in the hospital overall and in a critical care area should they be admitted to critical care. It is apparent that such interventions could potentially have substantial health economic implications, through, for example, reductions in ICU admission and re-admission. A level 3 ICU bed for example, costs approximately £1716 per day (Department of Health 2006).

This short clinical guideline aims to improve the care of the acutely ill in hospital by making evidence-based recommendations on the best way to identify and manage this group of patients. It is intended that its implementation will improve the quality of care received by these patients and address current shortcomings in care identified by the NCEPOD report.

1.4.2 The NICE short clinical guideline programme

'Acutely ill patients in hospital: recognition of and response to acute illness in adults in hospital' (NICE clinical guideline XX) is the first NICE short clinical guideline.

The Institute has established a 'short' clinical guideline programme that will allow the rapid (9–11 month) development of clinical guidelines that address only part of a care pathway for which the NHS requires guidance rapidly.

Short clinical guidelines are developed by an internal NICE technical team (short clinical guidelines team) to the same rigorous methods as existing clinical guidelines developed by NICE's National Collaborating Centres. This will be achieved by narrowing down the scope of the guideline so that it addresses a small number of key clinical questions. This will allow the evidence reviews prepared by the guideline developers to be of the same high quality as those produced in standard clinical guidelines. These reviews will be presented to the Guideline Development Group (GDG) and used to make recommendations for clinical practice in exactly the same way as is done by NICE's National Collaborating Centres currently.

The short clinical guideline programme consists of four phases which follow those of the standard guideline programme:

1. Referral of topic to NICE by the Department of Health.
2. Scoping the short clinical guideline topic.
3. The development phase, which begins with the first meeting of the GDG and ends when a draft document is submitted by the GDG for stakeholder consultation.
4. The validation phase, which consists of consultation with stakeholders and the public on the draft guidance, receiving advice from the guideline review panel and expert reviewers, preparation of the final draft, and sign off by Guidance Executive and publication.

To meet the time requirements and minimise the complexity of development key stages of the current standard guidelines process have, however, been

adapted. The key changes that are required to the current standard guidelines process relate to the scoping and development stages. An interim process guide to the short guidelines programme setting out in detail the short guideline development methods has been the subject of public consultation (30 January 2007–24 April 2007).[1] It is intended that the revised version of the interim process guide, which will take account of the public consultation comments, will be incorporated into the 2008 update of the NICE Guidelines Manual.

1.4.3 Using this guideline

This document is intended to be relevant to healthcare professionals within acute hospitals that have direct contact with patients. The target population is adult patients in hospitals. This includes patients in the Emergency Department, once a decision to admit the patient has been made.

The full version of the guideline is available to download free of charge from the NICE website (www.nice.org.uk) and a printed version will be available. The institute makes available summary versions of this guideline that are also available from the website: a version and a quick reference guide.

1.4.4 Using recommendations and supporting evidence

The Guideline Development Group has taken into consideration the overall benefits, harms and costs of the evidence it has reviewed. It has also considered issues of implementability and equity when drafting the recommendations set out within this guideline. However, healthcare professionals need to apply their general medical knowledge and clinical judgement when applying recommendations which may not be appropriate in all circumstances. Decisions to adopt any particular recommendation should be made in the light of individual patients' views and circumstances as well as available resources. To enable patients to participate in the process of decision making to the extent that they are able and willing, clinicians need to be able to communicate information provided in this guideline. To this end,

[1] www.nice.org.uk/page.aspx?o=402416

recommendations are often supported by evidence statements which provide summary information to help clinicians and patients discuss options.

1.4.5 Using flowcharts

Deriving an evidence based rationale for care for acutely ill patients in hospital brings together an understanding of healthcare delivery and a vast literature providing evidence about tests and treatments. Flowcharts are inevitably a simplification and cannot capture all the complexities and permutations affecting the clinical care of individuals managed within the hospital setting. Flowcharts presented in this guideline are designed to help communicate the key elements of treatment, but are not intended for rigid use or as protocol.

2 Evidence review and recommendations

2.1 Identification and evaluation of risk scoring tools

2.1.1 Introduction

Physiological 'track and trigger' warning systems (TT systems) are used to identify patients on general wards (outside critical care areas) at risk of clinical deterioration. Their main function is to ensure timely recognition of all patients with potential or established critical illness so that timely attendance from appropriately skilled staff can be ensured (Gao et al. 2007). In addition, their use has been shown to increase the frequency of recording of physiological parameters on general wards (McBride et al. 2005).

Physiological 'track and trigger' systems are operated based on periodic observation of selected basic physiological signs ('tracking') with predetermined calling or response criteria ('trigger') for requesting the attendance of staff who have specific competencies in the management of acute illness and/or critical care. The TT systems allow a large number of patients to be monitored without incurring major additional workload. There are a number of physiological 'track and trigger' systems that are used internationally to detect patients at risk of deteriorating, for example:

Single parameter system	Periodic observation of selected vital signs which are compared with a simple set of criteria with predefined thresholds, with a response algorithm being activated when any criterion is met
Multiple parameter system	Response algorithm requires more than one criterion being met or differs according to the number of criteria met
Aggregate scoring system	Where weighted scores are assigned to physiological values and compared with predefined trigger thresholds
Combination system	Involving single or multiple parameter systems in combination with aggregate weighted scoring systems.

2.1.2 Overview

The Gao et al. (2007) review, a sub-study of the work commissioned by the SDO from ICNARC (see section 3.3.10), was used as the basis of this

evidence review. This review included 36 papers, and reported the results of one primary study of data from acute hospitals in England and Wales. The search strategies developed by Gao et al. (2007) were obtained from the authors and re-run to identify studies from 2004 onwards. The updated literature search (see Appendices) identified a further 10 studies that met our inclusion criteria (see Appendices), making a total of 46 papers. The systematic review classified these papers as either concerned with the development and testing of a 'track and trigger' system, or describing the use of such a system. From the latter category, we identified studies that looked at the effect of introducing a TT system on patient outcomes, and considered these as a third category (intervention studies). Hence there were three categories of study included in this review.

- Development/validation – These studies were analysed as diagnostic studies. Studies were only included in this category if they included patients both with and without the reference outcome (such as, cardiac arrest, ICU admission, mortality). Studies where the population included patients with the reference outcome only were classified as descriptive. A key distinction between development and validation is that, in development studies, identification of parameters, cut-offs, and/or design of scoring systems are determined based on the outcomes of the study sample (such as, through the use of ROC curves). For validation studies, these criteria have already been determined and their predictive ability is evaluated in a new sample of patients. Several included studies fall into both categories.
- Intervention studies – These studies considered the effect on patient outcomes of introducing a scoring tool (either alone or in combination with a critical care response team). Studies were only included in this category if they permitted a comparison of outcomes both with and without the scoring tool, for example randomised controlled trials, non-randomised controlled trials, before-and-after studies, cohort studies with historical control. Studies that reported the implementation of a scoring tool but did not permit this comparison were classified as descriptive.
- Descriptive studies – These were studies included in the systematic review (Gao et al. 2007) that described the use of a scoring tool, but did not fit into

the categories outlined above. An overview of these studies is presented in the Topic 1 track and trigger Systems evidence table (see appendices 5.4).

2.1.3 What physiological observations should be undertaken in acute hospital settings?

2.1.3.1 Recommendation 1

Adult patients in acute hospital settings should have:

- All appropriate physiological observations recorded at time of admission/initial assessment
- Their physiological observations measured, recorded and acted upon by staff specifically trained to undertake these procedures and understand their clinical relevance
- A clear monitoring plan that specifies which physiological observations to be recorded and how often they should be recorded. This will take account of the:
  - patient's diagnosis
  - presence of comorbidities
  - agreed treatment plan.

2.1.3.2 Recommendation 2

The following physiological observations should be carried out as part of routine monitoring:

- heart rate
- respiratory rate
- blood pressure
- level of consciousness
- oxygen saturation
- temperature.

2.1.3.3 Evidence review

The evidence relating to whether or not physiological abnormalities are a marker for clinical deterioration was not subjected to formal review in this

guideline. It is well recognised that abnormal physiology is associated with adverse clinical outcomes. A multi-centre, prospective, observational study found that the majority (60%) of primary events (deaths, cardiac arrests and unplanned ICU admissions) were preceded by documented abnormal physiology, the commonest being hypotension and a fall in Glasgow coma scale (Kause et al. 2004). In the NCEPOD report (2005), the majority (66%) of inpatients who had been in hospital more than 24 hours prior to ICU admission exhibited physiological instability for more than 12 hours. Another study (Goldhill and McNarry 2004) found that mortality increased with the number of physiological abnormalities ($p < 0.001$), being 0.7% with no abnormalities, 4.4% with one, 9.2% with two and 21.3% with three or more.

Through informal consensus of opinion, the Guideline Development Group agreed that measurement of physiological observations was important and all adult acute patients should receive basic physiological observations and a clear monitoring plan at time of admission/initial assessment. Such measurements provide the necessary input data for the physiological 'track and trigger' systems reviewed in the next section.

2.1.3.4 Evidence statement

(IV) Physiological abnormalities are a marker for clinical deterioration.

2.1.3.5 Health economics

While the number and type of observations may have important economic implications, any analysis should probably concentrate on evaluating existing 'track and trigger' tools (See section 2.1.5.5 for further details). Economic evaluation was not considered necessary by the Guideline Development Group within the context of developing these particular recommendations.

2.1.3.6 Evidence to recommendations

Through informal consensus of opinion, the Guideline Development Group agreed that measurement of physiological observations was important and all adult acute patients should receive basic physiological observations and a clear monitoring plan at time of admission/initial assessment. Such

measurements provide the necessary input data for the physiological 'track and trigger' systems reviewed in the next section.

The Guideline Development Group considered that it was important to specify what physiological monitoring should be provided to all adult patients in acute hospital settings so as to ensure prompt identification of those at risk of clinical deterioration.

It is important to note that most physiological 'track and trigger' systems draw data from the routine observations of physiology (vital signs) carried out by ward and emergency department staff. These observations are carried out on admission/initial assessment and repeated as indicated.

Thus it is important to specify what observations should be recorded and what the frequency of recording should be, in advance of considering specific physiological 'track and trigger' systems.

2.1.4 Can physiological 'track and trigger' systems correctly identify those patients whose clinical condition is deteriorating or who are at risk of deterioration?

2.1.4.1 Recommendation 3

Physiological 'track and trigger' systems should be used to monitor all adult patients in acute hospital settings, including patients in the emergency department for whom a clinical decision to admit has been made.

- The minimum monitoring frequency of physiological observations should be every 12 hours.
- The frequency of monitoring should increase when abnormal physiology is detected (see recommendation 11).

2.1.4.2 Evidence review

Twelve studies were identified that were concerned with the development and/or testing of 'track and trigger' systems. All studies were cohort designs, with the exception of two, one (Gao et al. 2007) was a cohort study embedded in a systematic review and the other one (Hodgetts et al. 2002) was a case

control design. Another eleven studies were also identified that evaluated the effect on patient outcomes of introducing a physiological 'track and trigger' system (Bellomo et al. 2004; Bristow et al. 2000; Buist et al. 2002; DeVita et al. 2004; Foraida et al. 2003; Hillman et al. 2005; Odell et al. 2002; Paterson et al. 2006; Pittard 2003; Priestley et al. 2004; Subbe et al. 2003). There were two cluster-randomised controlled trials (Hillman et al. 2005; Priestley et al. 2004), and the rest of the studies were observational studies (the majority used a before-and-after study design).

2.1.4.3 Evidence statements

(III) Physiological 'track and trigger' systems (single parameter, multiple parameter, aggregate weighted scoring and combination) have been developed and evaluated in selected patient populations.

The majority of identified studies were set on hospital wards. Three studies had a hospital-wide setting (including critical care areas) (Gao et al. 2007; Goldhill et al. 2005; Hodgetts et al. 2002), two studies were based on a medical admissions unit (Subbe et al. 2001; Subbe et al. 2003), and two on an emergency department observation ward (Lam et al. 2006; Subbe et al. 2006). Fourteen studies were based in the UK (Cuthbertson et al. 2007; Gao et al. 2007; Garcea et al. 2006; Goldhill et al. 1999; Goldhill et al. 2005; Goldhill and McNarry 2004; Hodgetts et al. 2002; Odell et al. 2002; Paterson et al. 2006; Pittard 2003; Priestley et al. 2004; Subbe et al. 2001; Subbe et al. 2003; Subbe et al. 2006), five in Australia (Bellomo et al. 2004; Bristow et al. 2000; Buist et al. 2004; Buist et al. 2002; Hillman et al. 2005), two in the United States (DeVita et al. 2004; Foraida et al. 2003), one in Hong Kong (Lam et al. 2006) and one in Sweden (Bell et al. 2006).

(II) Physiological 'track and trigger' systems, as currently used, have variable performance in measures of diagnostic test accuracy for detecting the following key outcomes:

- **hospital mortality**
- **cardiac arrest**
- **do not attempt resuscitation orders**

- **admission to critical care.**

There were six UK based diagnostic studies (Gao et al. 2007; Garcea et al. 2006; Goldhill et al. 1999; Goldhill and McNarry 2004; Hodgetts et al. 2002; Subbe et al. 2001). One study, a systematic review (Gao et al. 2007) investigated the diagnostic accuracy of various TT systems in detecting composite outcomes of mortality, critical care admission, DNR orders or the need for CPR. There were two studies (Goldhill et al. 1999; Subbe et al. 2001) that used critical care admission as an outcome measure, three studies (Garcea et al. 2006; Goldhill and McNarry 2004; Subbe et al. 2001) used mortality and one study (Hodgetts et al. 2002) used the need for cardiopulmonary resuscitation. Apart from UK studies, there was also one study from Hong Kong (Lam et al. 2006) that used mortality and critical care admission as outcome measures, and two studies (Buist et al. 2004 from Australia and Bell et al. 2006 from Sweden) that used mortality as key outcome. In summary, considerable variation in the published literature exists among the type of systems evaluated, physiological parameters included, choice of trigger, and the chosen patient outcomes (reference criteria).

(III) Physiological 'track and trigger' systems, as currently used in the NHS in England and Wales, have low sensitivity and positive predictive values but high specificity and negative predictive values. The low sensitivity can be improved by reducing the trigger threshold.

Five specific diagnostic studies carried out in the UK were identified (Garcea et al. 2006; Goldhill et al. 1999; Goldhill and McNarry 2004; Hodgetts et al. 2002; Subbe et al. 2001). One case-control study (Hodgetts et al. 2002) assessed the ability of a 'track and trigger' system (based on 10 parameters) to predict in-hospital cardiac arrest. The study was carried out to inform the development of MET calling criteria. A panel of experts grouped and weighted the activation criteria and a cumulative scoring system was developed. A ROC analysis determined that a score of 4 has 89% sensitivity and 77% specificity for cardiac arrest; a score of 8 has 52% sensitivity and 99% specificity. All patients scoring greater than 10 suffered a cardiac arrest.

A second study (Goldhill et al. 1999) evaluated the ability of a patient-at-risk team (PART) to predict admission to ICU in hospital ward patients. Patients triggered the system if they had three out of six abnormal physiological parameters (or reduced consciousness with increased heart or respiratory rate). Sensitivity and specificity for patients with three abnormal observations were 27% and 57% respectively. For patients with one abnormal observation only, sensitivity was 97% (specificity 18%) and for two abnormal observations, sensitivity was 80% (specificity 41%). In a third study (Goldhill and McNarry 2004), also based on the PART calling criteria, stepwise multiple regression identified five significant predictors of 30-day mortality (consciousness, heart rate, age, blood pressure, and respiratory rate), sensitivity and positive predictive value of the model were 7.7% and 66.7% respectively. Specificity was 99.8%.

There were also two studies that evaluated aggregate scoring systems. One study (Subbe et al. 2001) evaluated the modified early warning system (MEWS) and found that a trigger score (of 5 or more) was associated with increased risk of death (OR 5.4, 95% CI 2.8 to 10.7), ICU admission (OR 10.9, 95% CI 2.2 to 55.6), and HDU admission (OR = 3.3, 95% CI 1.2 to 9.2). However, diagnostic test accuracy data were not reported. The other study (Garcea et al. 2006) that looked at the ability of EWS to predict mortality in a sample of 110 patients admitted with acute pancreatitis. Sensitivities for the tool on days one, two and three following admission were 85.7%, 71.4% and 100%. Specificities were 28.3%, 67.4% and 77.4% respectively.

(II) There is inter-rater and intra-rater variation in the measurement of the physiological variables although better agreement exists in the thresholds to trigger.

One study (Subbe et al. 2007) evaluated the reproducibility of MET (single parameter), MEWS (aggregate scoring system) and ASSIST (Assessment Score for Sick patient Identification and Step-up in Treatment – aggregate scoring system) for identifying at-risk patients on the ward. It found that there was significant variation in the reproducibility of the three examined systems and that all three systems examined showed better agreement on triggers

than aggregate scores. MET achieved higher percentage agreement than ASSIST, and ASSIST higher than MEWS in the sub-inter-rater analysis in the study [MET: Kappa = −0.03 (95% CI −0.05 to 0.00); MEWS: Kappa = 0.18 (95% CI 0.09 to 0.27); ASSIST: Kappa = 0.20 (95% CI 0.04-0.38)]. While in the sub-intra-rater analysis in the study [MET: Kappa = −0.01 (95% CI −0.02 to −0.01); MEWS: Kappa = 0.64 (95% CI 0.46 to 0.84); ASSIST: Kappa = 0.66 (95% CI 0.04 to 0.38)]. The study also showed that simpler systems had better reliability and that intra-rater reliability was better than inter-rater reliability.

2.1.4.4 Health economics

An economic analysis of whether physiological 'track and trigger' system should be used to monitor patients or not was not available in the existing literature and was not considered necessary (for a fuller explanation and a discussion of the economic issues relating to evaluating alternative 'track and trigger' systems, see section 2.1.5.5)

2.1.4.5 Evidence to recommendations

The generalisability of the physiological 'track and trigger' systems was discussed within the Guideline Development Group. Although the primary studies were from selected population groups the effects seen were consistent across groups. In addition, the cohort studies used routine data collected from a wide range of settings, including general wards or medical admissions units.

The use of a physiological 'track and trigger' system increases the number of observations made by healthcare professionals (McBride et al. 2005), which the Guideline Development Group considered increased the likelihood of healthcare professionals identifying and acting on abnormal observations.

Implementability of this recommendation was not considered problematic as the majority of acute hospitals in England and Wales already use Physiological 'track and trigger' systems.

2.1.5 What is the role of specific physiological 'track and trigger' systems in identifying patients whose clinical condition is deteriorating or who are at risk of clinical deterioration?

2.1.5.1 Recommendation 4

Multi-parameter or aggregate weighted scoring systems, which allow a graded response, should be used to monitor patients.

2.1.5.2 Recommendation 5

These systems should include:

- parameters to be measured and frequency of observations
- a clear and explicit statement of the parameters, cut points or scores that should prompt a request for review.

2.1.5.3 Evidence review

Single parameter systems

Two studies (Bell et al. 2006; Buist et al. 2004) evaluated the MET 'track and trigger' tools with a single parameter trigger. One study (Buist et al. 2004) evaluated a system based on the MET (medical emergency team) calling criteria, to predict in-hospital mortality in general ward patients. The MET team responded to all abnormal observations. The study reported positive predictive values for mortality with a trigger of one or more abnormal observations (PPV = 35%), one abnormal observation only (PPV = 16.2%), and four or more abnormal observations (PPV = 88.2%). The second study (Bell et al. 2006) considered the accuracy of a system based on four physiological parameters to predict mortality at 30 days and six months in general ward patients. If a patient obtained a trigger score on any of the parameters observed the nurse in charge was informed. For 30 day mortality the system had a sensitivity of 33.3% and specificity of 96.5%; PPV = 33.3% and NPV = 33.3%. For 6 month mortality the system correctly identified 37.5% of patients (sensitivity = 37.5%, PPV = 12.1%; specificity = 87.3%, NPV = 96.8%). In summary, a single parameter system tends to have low sensitivity

(range between 16.2% and 37.5% depending on trigger thresholds) and high specificity (range between 87.3% and 96.5%).

A further intervention study (Hillman et al. 2005) (cluster-RCT) has also shown that due to the low sensitivity of the MET system, the introduction of the system in 12 Australian hospitals substantially increased call-out rates for the MET when compared with traditional cardiac arrest team (CAT) (CAT = 3.1 [1.3 SD], MET = 8.7 [3.5 SD], p = 0.0001), and the mean number of calls not associated with an adverse event was also significantly higher in hospitals with the MET system (CAT =1.2 [0.8SD], MET = 6.3 [2.4SD], p < 0.0001).

Multiple parameter systems

Multiple parameter systems were evaluated in three studies (Goldhill et al. 1999; Goldhill et al. 2005; Goldhill and McNarry 2004), all three studies were based on the PART (patient-at-risk team) calling criteria. One study (Goldhill et al. 1999) evaluated the ability of the system to predict admission to ICU in hospital ward patients. Patients triggered the system if they had three out of six abnormal physiological parameters (or reduced consciousness with increased heart or respiratory rate). Sensitivity and specificity for patients with three abnormal observations were 27% and 57% respectively. For patients with one abnormal observation only, sensitivity was 97% (specificity 18%) and for two abnormal observations, 80% (sensitivity 41%). A second study (Goldhill and McNarry 2004), also based on the PART calling criteria, stepwise multiple regression identified five significant predictors of 30-day mortality (consciousness, heart rate, age, blood pressure, and respiratory rate), Sensitivity and positive predictive value of the model were 7.7% and 66.7% respectively (specificity 99.8%). In the third study (Goldhill et al. 2005), the ability of PAR scoring system was tested on its association with patient's need of intervention and hospital mortality. The findings showed significant association between PAR score (of > 0) and hospital mortality (chi-squared for trend, p < 0.0001), and its ability to discriminate between patients who needed intervention from those who did not was: area under ROC curve = 0.822.

Aggregate weighted scoring systems

Four studies (Garcea et al. 2006; Hodgetts et al. 2002; Lam et al. 2006; Subbe et al. 2001) used 'track and trigger' tools with aggregate scoring systems, one of which was based on the early warning score (EWS) and two on the modified early warning score (MEWS). The first study (Garcea et al. 2006) looked at the ability of EWS to predict mortality in a sample of 110 patients admitted with acute pancreatitis. Sensitivities for the tool on days one, two and three following admission were 85.7%, 71.4% and 100% (specificities were 28.3%, 67.4% and 77.4% respectively). A ROC curve analysis found that EWS was the best predictor of adverse outcomes (defined as death, pancreatic necrosectomy, or critical care admission) in the first 24 hours of admission compared with APACHE scores, ASA grade, Ranson score, Imrie score, and CT grades.

A second study (Lam et al. 2006) evaluated the ability of a five-parameter, modified early warning system (MEWS) to predict serious outcome (death and/or ICU admission) in a sample of patients on an emergency department observation ward. A score of 4 or more triggered the system, with a sensitivity of 60% (and specificity of 97%). A ROC curve analysis suggested that the system performed best with a score of more than 3 (sensitivity 100%, specificity 97%).

A third study (Subbe et al. 2001) also evaluated the MEWS system on its ability to predict ICU/HDU admission, attendance of cardiac arrest team, and 60-day mortality, in patients in an acute medical admissions unit. Diagnostic test accuracy data were not reported, but a trigger score (of 5 or more) was associated with increased risk of death (OR 5.4, 95% CI 2.8 to 10.7), ICU admission (OR 10.9, 95% CI 2.2 to 55.6), and HDU admission (OR = 3.3, 95% CI 1.2 to 9.2).

The fourth study had a case-control design (Hodgetts et al. 2002) (case-control designs have been shown to result in biased, usually inflated, estimates of test accuracy). A 'track and trigger' system based on 10 parameters was assessed for its ability to predict in-hospital cardiac arrest (defined as CPR attempted) in hospital patients (including both wards and

critical care areas). The study was carried out to inform the development of MET calling criteria. A panel of experts grouped and weighted the activation criteria and a cumulative scoring system was developed. A ROC analysis determined that a score of 4 had 89% sensitivity and 77% specificity for cardiac arrest; a score of 8 had 52% sensitivity and 99% specificity. All patients scoring greater than 10 suffered cardiac arrest.

Furthermore, there was one cohort study embedded in a systematic review (Gao et al. 2007) that looked at the ability of 15 physiological 'track and trigger' systems, used within acute NHS hospitals in England and Wales, to predict a composite outcome, presence of critical illness (defined as death, admission to critical, care, 'do not attempt resuscitation', or cardiopulmonary resuscitation). Ten systems used an aggregate scoring system, one used a single parameter system, and four used combination systems. All included heart rate, respiratory rate, systolic blood pressure, and level of consciousness, but systems varied in terms of the other physiological parameters assessed, assignment of scores to physiological values, and the trigger thresholds used. There were also considerable differences in the response initiated if a patient obtained a trigger score. The diagnostic accuracy of the systems varied widely. Sensitivities and positive predictive values were low (median sensitivity = 43.3%, IQ range 25.4 to 69.2%; median PPV = 36.7% IQ range 29.3 to 43.8%). Specificities and negative predictive values were higher (median specificity = 89.5%, IQ range 64.2 to 95.7%; median NPV = 94.3% IQ range 89.5 to 97.0%). Within hospitals there were some differences in the discrimination of 'track and trigger' systems in different age groups, wards and specialities, but these were not consistent across hospitals. A random-effects meta-regression was used to explore the heterogeneity amongst the datasets. Differences in diagnostic accuracy were not explained by the physiological parameters included in the system, the outcome variables recorded in the dataset, or the inclusion of critical care follow-up versus all ward/medical admissions unit patients.

2.1.5.4 Evidence statements

(II) Single parameter systems, as used by MET systems, have low sensitivity, low positive predictive values but high specificity.

(II) Multiple parameter systems require the presence of one or more abnormal physiological variables. These systems have high sensitivity but low specificity when one abnormal observation is present. Sensitivity reduces and specificity increases as the number of abnormal variables increase.

(II) Multiple parameter systems require the presence of one or more abnormal physiological variables. These systems have comparatively high sensitivity but relatively low specificity when one abnormal observation is present (that is, at low scores). Sensitivity reduces and specificity increases as the number of abnormal variables increase.

(II) Aggregate weighted scoring systems demonstrate a range of sensitivities and specificities depending on the 'cut off' score used. It is possible to achieve high sensitivity and specificity at defined 'cut off' scores.

Physiological 'track and trigger' systems have been examined in a variety of settings to determine their ability to identify patients at risk of deterioration. Considerable variation exists between the type of systems evaluated, physiological parameters included, choice of trigger, and the patient outcomes (reference criteria) considered. No physiological 'track and trigger' system was identified that had been validated in a variety of populations and settings. However, it could be summarised that:

(II) Single parameter systems trigger a single response strategy. Multiple parameter and aggregate warning systems allow for monitoring of a patient's condition and allow for a graded response strategy to be triggered, depending on the score.

See table 1 for a comparison of the advantages and disadvantages of different types of TT system.

Table 1: Advantages and disadvantages of different types of TT system

TT Systems	Advantages	Disadvantages
Single parameter (MET calling criteria)	• Simple to use. • Simple system with better reproducibility.	• Does not allow a patient's progress to be tracked. • Does not allow a graded response strategy. • Current evidence suggested that the system has low sensitivity, low PPV but high specificity. This could potentially cause increased triggers that are not related to an adverse event. • Not widely adopted in UK hospitals.
Multiple parameter (PART)	• A more complete assessment that takes into account urine output and relative changes in blood pressure. • Allow monitoring of clinical progress. • Allow for a graded response strategy. • Widely used in UK hospitals.	• May lack reproducibility and reliability as systems are prone to human calculation errors. • These systems have high sensitivity but low specificity when one abnormal observation is present, but sensitivity reduces and specificity increases as the number of abnormal variables increase.
Aggregate scoring system (EWS, MEWS)	• A more complete assessment that takes into account urine output and relative changes in blood pressure. • Allow monitoring of clinical progress. • Allow for a graded response strategy. • Widely used in UK hospitals.	• May lack reproducibility and reliability as systems are prone to human calculation errors. • A range of sensitivities and specificities depending on the 'cut-off' score used, but it is possible to achieve high sensitivity and specificity at defined 'cut-off' point.

(II) Simpler scoring systems may have better reproducibility than more complex ones.

One study (Subbe et al. 2007) has shown that simpler TT systems such as MET calling criteria have better reproducibility compared with more complex systems such as PART, EWS and MEWS. Another study (Prytherch et al. 2006) has also shown that more complex systems such as EWS were prone to human calculation errors. However, the study also showed that this

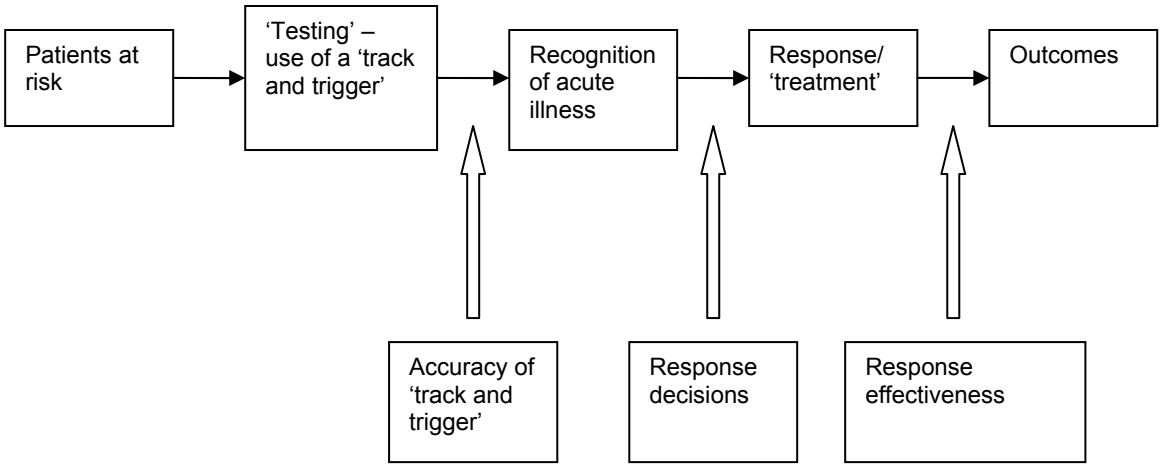
problem could be rectified by adopting electronic devices to calculate and chart EWS. In this study, a classroom comparison study of traditional 'pen and paper' method and 'hand-held computer' method on calculating and charting EWS was carried out. The findings have suggested that traditional 'pen and paper' method has made more errors compared with 'hand-held computer' method [pen/paper: error = 28.6% (24/84), computer: error = 9.5% (8/84); pen/paper: incorrect clinical action = 14.3% (12/84), computer: incorrect clinical action = 4.8% (4/84)]. The study also showed that the average time for participants to calculate and chart a set of EWS scores was significantly faster in the 'hand-held computer' group compared with the traditional 'pen and paper' group (mean difference of average time = 24.5 ±12.2s, 95% CI 19.3 to 29.8, $p < 0.0001$). Hence, there was evidence suggesting that the reproducibility of more complex TT systems such as EWS could be improved by adopting electronic devices to calculate and charting the aggregate scores.

2.1.5.5 Health economics

As noted above, no published or unpublished health economic evidence on physiological 'track and trigger' systems was identified.

TT systems can be viewed as diagnostic technologies. The clinical effectiveness of a diagnostic technology is determined by the extent to which incorporating it into clinical practice improves health outcomes. So, in most instances, the effectiveness of the technology will depend on whether the overall accuracy of identification is improved by its inclusion, its impact on therapeutic decisions, and the effectiveness of the treatments subsequently chosen (the response strategies in this instance) (Medical Services Advisory Committee 2005). A simplified clinical/evidence pathway for this short guideline is shown in figure 1.

Figure 1



Ideally, randomised controlled trials (such as, cluster RCTs in this instance, randomised by hospital rather than ward) of a diagnostic technology's ability to improve outcomes should be conducted. When such direct evidence is unavailable, it may be possible to link together separate pieces of evidence from the pathway. As noted above, in many cases, physiological TT systems have been introduced in combination with a response strategy, such as outreach services. Chapter 2.2 discusses more fully the evidence available on response strategies. The underlying purpose of introducing a TT system is that it would aid early identification of patients at risk, with the assumption that early identification leads to improved outcomes.

One approach to assessing the economic implications of TT systems is to develop a model to estimate the incremental cost per correct 'diagnosis' for each type of TT. At it simplest, there will be a limited range of costs included, for example, the cost of monitoring (that is, clinical contact time) and the cost of any tests or measurements necessary, related to, for example, the use of thermometers and other equipment. The costs of monitoring in terms of patient contact time (such as, healthcare professional time spent collecting and recording data, the frequency of observations, and so on) may be very important in terms of NHS resources. Multiple/aggregate parameter systems are likely to be more resource intensive in this limited respect than simpler systems

The basic model described will need prevalence data of the reference outcome of interest. The relevant diagnostic outcomes could be mortality, admission to critical care, or some composite measure such as 'established critical illness' (as per the Gao et al. [2007] review). Clearly, the model will need to include estimates sensitivity and specificity. (Cost effectiveness may also be influenced by the 'trigger' threshold.) The evidence however is insufficient to distinguish between the available TT systems. The cost effective estimates produced would be highly speculative and difficult to interpret from a decision makers' perspective.

To meaningfully address the issue of the cost effectiveness of TT systems, data on the link between the TT system and the associated response will need to be incorporated into an analysis, together with an estimate of the effectiveness of that response in improving patient outcomes. As discussed further in section 2.2.3.12, it was unfortunately not possible to fully explore this in the guideline.

2.1.5.6 Evidence to recommendations

The ROC curve plots all types of physiological 'track and trigger' systems along curve which suggests that all TT Systems have similar sensitivities, PPV, specificities and NPV once allowance is made for trigger threshold.

The decision to recommend one system against another depends, amongst other factors, on their clinical utility. Multiple parameter systems and aggregate scoring systems have the advantage of allowing monitoring of a patient's condition and allow for a graded response strategy to be triggered, depending on score.

Implementability of this recommendation was not considered problematic as the majority of acute hospitals in England and Wales already use physiological 'track and trigger' systems.

The Guideline Development Group noted that automated/electronic systems allow for better recording of data and may result in increased reproducibility. However, they identified a need for further research that evaluates the

effectiveness and cost-effectiveness of automated/electronic systems before their widespread use can be recommended.

2.1.6 Physiological parameters to be used by 'track and trigger' systems

2.1.6.1 Recommendation 6

The chosen scoring system should measure the following parameters for monitoring purposes:

- heart rate
- respiratory rate
- systolic blood pressure
- level of consciousness
- oxygen saturation
- temperature.

2.1.6.2 Recommendation 7

Additional monitoring may be required in specific clinical circumstances, for example:

- hourly urine output
- biochemical analysis (for example, lactate, blood glucose, base deficit, arterial pH).

2.1.6.3 Evidence review

Twelve of the identified studies (Bell et al. 2006; Buist et al. 2004; Cuthbertson et al. 2007; Gao et al. 2007; Garcea et al. 2006; Goldhill et al. 1999; Goldhill et al. 2005; Goldhill and McNarry 2004; Hodgetts et al. 2002; Lam et al. 2006; Subbe et al. 2001; Subbe et al. 2006) were concerned with the development and/or testing of 'track and trigger' systems. The number of physiological parameters included by the systems within these studies ranged from 4 to 10. All of the 'track and trigger' systems evaluated included heart rate, respiratory rate and systolic blood pressure, and all but one (Hodgetts et al. 2002) also included level of consciousness. Temperature and/or oxygen

saturation were often included in systems. Urine output was less frequently included (only four out of twelve studies used urine output as parameter).

2.1.6.4 Evidence statements

(III) The following parameters were used in the majority of systems reviewed:

- **heart rate**
- **respiratory rate**
- **systolic blood pressure**
- **level of consciousness**
- **temperature**
- **oxygen saturation**
- **urine output.**

All twelve validation/development studies included heart rate, respiratory rate and systolic blood pressure as parameters. One study (Subbe et al. 2001) had level of evidence Ib, six studies (Bell et al. 2006; Buist et al. 2004; Goldhill et al. 2005; Goldhill and McNarry 2004; Hodgetts et al. 2002; Lam et al. 2006) had level of evidence II and five studies (Cuthbertson et al. 2007; Gao et al. 2007; Garcea et al. 2006; Goldhill et al. 1999; Subbe et al. 2006) had level of evidence III.

Eleven studies included level of consciousness as a parameter, one (Subbe et al. 2001) was grade Ib, five studies (Bell et al. 2006; Buist et al. 2004; Goldhill et al. 2005; Goldhill and McNarry 2004; Lam et al. 2006) were graded II and five studies (Cuthbertson et al. 2007; Gao et al. 2007; Garcea et al. 2006; Goldhill et al. 1999; Subbe et al. 2006) were graded III.

There were eight studies that included temperature as a parameter. There was one study graded Ib (Subbe et al. 2001), four studies graded II (Goldhill et al. 2005; Goldhill and McNarry 2004; Hodgetts et al. 2002; Lam et al. 2006) and three studies graded III (Cuthbertson et al. 2007; Garcea et al. 2006; Subbe et al. 2006).

Six studies included oxygen saturation in the systems evaluated. Four studies were graded II (Buist et al. 2004; Goldhill et al. 2005; Goldhill and McNarry 2004; Hodgetts et al. 2002) and two studies were graded III (Goldhill et al. 1999; Subbe et al. 2006).

Urine output was the least frequently included parameter in the review. Four studies have used urine output as parameter. Two studies were graded II (Goldhill et al. 2005; Goldhill and McNarry 2004) and two studies were graded III (Goldhill et al. 1999; Subbe et al. 2006).

2.1.6.5 Evidence to recommendation

The GDG considered that the chosen scoring system should measure a core set of physiological parameters. It was decided that urine output should not be a core parameter as reliable assessment of urine output requires bladder catheterisation and this is only performed in specific clinical circumstances.

2.2 Response strategies for patients identified as having a deteriorating clinical condition

2.2.1 Introduction

Response strategies for patients identified as having a deteriorating clinical condition on general medical and surgical wards and emergency department in the NHS fall into two groups. Firstly, a ward level response which ranges from an increased level of physiological monitoring by ward staff to call out of the medical or surgical staff responsible for the patient's care. Secondly, the specific use of a dedicated hospital team with specific skills in managing the critically ill patient.

In the NHS, dedicated hospital teams, called critical care outreach services (CCOS) were identified as an important component of future critical care services in the Department of Health's 2000 report: 'Comprehensive critical care' (Department of Health, 2000). These services aim to prevent or ensure appropriate admission to critical care, to enable discharges from critical care and to share skills with ward and community staff. Critical care networks and NHS trust critical care delivery groups were encouraged to develop their own

locally customised service. Since 2000, a wide range of CCOS have been introduced at local level in the NHS (Department of Health and NHS Modernisation Agency 2003). In a recent survey NHS acute hospitals in England that routinely provide care for Level 1 patients 73% had a formal critical care outreach service (McDonnell et al. in press).

CCOS cover a wide range of activities undertaken for critically ill patients:

- education and training for general ward staff on the recognition of critical illness
- the introduction of and response to physiological 'track and trigger' warning systems in general wards
- telephone 'hotline' advice for ward staff
- follow-up of patients on general wards after discharge from critical care
- direct bedside clinical support on general wards
- audit and evaluation of critical care outreach activity
- delivery of rehabilitation programmes (inpatient and outpatient)/or patients after a period of critical illness.

2.2.2 Overview

The Esmonde et al. (2006) review, a sub-study of the work commissioned by the SDO from ICNARC (see section 3.3.10), was used as the basis of this evidence review. Critical care outreach services were defined broadly (as above) and the search strategy allowed papers that offered as their 'intervention' both CCOS (as defined above) and ward level responses to be identified. The Esmonde et al. (2006) review included 23 published and unpublished papers, 15 were set in England and Wales, seven were in Australia and one was in United States. After further study selection, six papers were excluded from the review due to their unpublished status (one unpublished paper, two abstracts, three presentations). The search strategies developed by Esmonde et al. (2006) were obtained from the authors and re-run to identify studies from 2004 onwards. The updated literature search (see appendices) identified three extra studies that met our inclusion criteria (see

appendices), making a total of 20 papers (10 England and Wales, nine Australia, one United States) to be included in the review.

The systematic review analysed the included papers based on reported outcomes regardless of the type of outreach services or which 'track and trigger' system they used. For instance, the outcomes analyses in the review included 1) impact on mortality, 2) impact on length of stay (LOS), 3) impact on cardiac arrest rate, 4) impact on unplanned admissions to the critical care unit, and 5) impact on readmissions to the critical care unit. The study design, 'track and trigger' system used, composition of outreach services and interventions provided by outreach services within the 19 studies that were identified by the update search varied widely. These are presented in table 1 and are also summarised in the following section.

- Randomised controlled trials (RCTs) – There were two RCTs which used a cluster-randomised design. One study was set in England and Wales (Critical care outreach team [CCOT] with 'PAR' as track and trigger system – multiple parameter system) and the other one was set in Australia (MET with single parameter system). The outcomes that were measured in these two studies were: cardiac arrest rate, unplanned ICU admissions, hospital mortality and hospital LOS. Information on composition of the team and interventions provided by the team between the two studies was of variable quality.
- Observational studies – there were 17 observational studies (uncontrolled before-and-after). Nine studies were set in the UK (five studies were CCOT using MEWS; one study was PART; one study was MET; two other studies were CCOT but type of track and trigger system not mentioned), seven studies were set in Australia (six studies with MET using single parameter system and one study looked at the effectiveness of CCOT on top of MET) and one study in United States (MET with single parameter system). The outcomes that were measured in these studies were: hospital mortality, ICU mortality, ICU mortality for unplanned admissions, surgical mortality, cardiac arrest mortality, hospital mortality associated with readmissions, hospital mortality after cardiac arrest, critical care mortality associated with

readmissions, 30-day mortality associated with readmissions, 30-day surgical mortality, ITU mortality with tracheostomy tube in situ, cardiac arrest, hospital LOS, ICU LOS, hospital LOS after cardiac arrest, ICU LOS after cardiac arrest, hospital LOS following readmissions, ICU LOS following readmissions, LOS after major surgery, unplanned ICU admissions and ICU readmissions.

- Service evaluation – there was one service evaluation study from Australia. The study looked at the effect of an education programme on the utilisation of MET.

Overall, the quality of the evidence was poor, with only two RCTs (using a cluster randomised design) being identified. These two studies were of acceptable quality (level of evidence 1+) and provided the evidence statements that formed the basis for the recommendations. The majority of the other reported studies were retrospective uncontrolled before and after studies. These are susceptible to a large number of biases that make it very difficult to ascribe causality to the intervention. These have been graded as meriting an evidence level of 2−. Such studies are reported in the evidence tables only because they should not be used as the basis for making clinical guideline recommendations (National Institute for Health and Clinical Excellence 2006).

There were particular challenges in summarising and presenting the evidence of effectiveness of response strategies. CCOS is a complex intervention with a variety of different components delivered at different times during the care pathway. It is therefore difficult to ascribe any observed effect to any particular part of the intervention and, conversely, to determine which aspects of the intervention may be ineffective. As far as considering the intervention in terms of population, intervention, comparison group and outcomes the following issues were identified. The populations reviewed tended to be set in either England and Wales or Australia. In the Australian studies the intervention used involved a multidisciplinary medical emergency team (MET) delivering CCOS responding to a single parameter ‘track and trigger’ system. In the studies set in England and Wales the intervention was more variable,

involving multi-disciplinary teams that were often nurse led, and was initiated by the use of a multiple parameter (PART) or an aggregate scoring system (MEWS) 'track and trigger'. There was also variability in terms of the timing of the evaluation, particularly in the before and after studies reported. The literature on ward level response, as opposed to CCOS, was very limited with only one study identified as eligible for inclusion in the review.

In terms of economic evaluations, a systematic search was carried out for any publications that considered the costs or cost-effectiveness of response strategies including outreach services. Although the criteria for inclusion were comparatively broad, no relevant published evaluation studies were identified, although some limited data on the costs of outreach services were found. An unpublished economic evaluation of outreach services was identified, however, and made available to the GDG.

The limited available evidence on the effectiveness of CCOS has also been highlighted by other researchers in the field (Winters et al. 2006). A particular area of concern has been that the implementation of CCOS or rapid response systems (RRS) in different healthcare systems (including the UK) has occurred in the absence of clear evidence of effectiveness (Price et al. 2007; Teplick and Anderson 2006; Winters et al. 2006).

2.2.3 Does a specific response strategy – provision of a critical care outreach service – improve outcomes for patients identified as having a deteriorating clinical condition?

2.2.3.1 Recommendation 8

Staff working with acutely ill patients should have the necessary competencies in monitoring, measurement, interpretation and prompt response to the acutely ill patient, appropriate to the level of care they are providing. Education and training should be offered to ensure staff can demonstrate they have these competencies.

2.2.3.2 Recommendation 9

The response strategy delivered to the patient identified as being at risk of clinical deterioration should be triggered either by physiological 'track and trigger' score or by clinical concern.

2.2.3.3 Recommendation 10

The thresholds for the 'track and trigger' system should be set at a local level, informed by patient case mix.

2.2.3.4 Recommendation 11

A graded response strategy for patients identified as being at risk of clinical deterioration should be agreed and delivered locally. The response strategy should consist of the following three levels.

- Low:
  - Increased frequency of observations and the nurse in charge alerted.
- Medium:
  - Urgent call to team with primary medical responsibility for the patient.
  - Simultaneous call to personnel with core competencies for acute illness. These competencies can be delivered by a variety of models at a local level; such as critical care outreach team, hospital-at-night team, specialist trainee in an acute medical or surgical specialty.
- High:
  - Emergency call to team with critical care competencies and diagnostic skills. This team will include a medical practitioner with a minimum of intermediate level competencies in critical care and there should be an immediate response.

2.2.3.5 Recommendation 12

Patients identified as 'clinical emergency' should bypass the graded response system and be treated in the same way as the high-score group.

2.2.3.6 Recommendation 13

Both the high- and medium-score groups should receive:

- initiation of appropriate intervention
- assessment of response
- formulation of management plan, including location and level of care.

2.2.3.7 Recommendation 14

If the team caring for the patient considers that admission to a critical care area is clinically indicated, then the decision to admit should involve both the consultant caring for the patient on the ward and the consultant in critical care.

2.2.3.8 Recommendation 15

No specific service configuration can be recommended as a preferred response strategy for individuals identified as having a deteriorating clinical condition.

2.2.3.9 Evidence review

Two good quality cluster-RCT studies (Hillman et al. 2005; Priestley et al. 2004) with the level of evidence (1+) were included as the basis for recommendations.

One cluster RCT (Hillman et al. 2005) (randomised at hospital level) was set in Australia using a Medical Emergency Team (MET), with a single parameter 'track and trigger' system. This study included 23 hospitals in Australia (12 with MET – intervention group, 11 without MET – control group) with study period of 6 months. There was education/training for all staff within the 12-hospital (intervention) group prior to the introduction of the MET system. The composition of the medical emergency team varied in the twelve participating hospitals but it was required to be at least the equivalent of the pre-existing cardiac arrest team (CAT) and to consist of at least one doctor and one nurse from emergency department or intensive care unit (ICU). The type interventions provided by the MET was not reported in this study.

The other cluster RCT (Priestley et al. 2004) (with a stepped wedge trial design – Brown and Lilford 2006) was set in an acute hospital in England using a nurse-led critical care outreach team (CCOT) with a multiple parameter 'track and trigger' system (patient-at-risk score – PAR). There was

also education/training introduced to staff sequentially based on ward level prior to the implementation of CCOT with PAR to that particular ward. The composition of the CCOT in this study was: a 24-hour service with one nurse consultant and a team of experienced nurses. The intervention protocol of the CCOT in this study was: ward staff used PAR to trigger referral to CCOT and involvement of the admitting team's consultant. CCOT would also to be called if there was concern about patient, irrespective of PAR scores. The level of CCOT involvement was determined by the ward staff and the admitting team. As circumstances required, CCOT might support and advise ward staff, remain with the patient and provide individual nursing care on the ward during crisis period, or facilitate the admission to ICU.

2.2.3.10 Review findings

Composite outcomes

One cluster-RCT study (Hillman et al. 2005) had as its primary outcome the following composite outcomes: incidence of cardiac arrest, unplanned ICU admission (without NFR) and unexpected death (without NFR). However, the study found no difference in composite outcome (per 1000 admissions: control = 5.86, intervention = 5.31, difference = −0.264 [−2.449 to 1.921], adj p = 0.640, adj OR = 0.98 [95% CI 0.83-1.16]).

Mortality rates

One cluster-RCT study (Priestley et al. 2004) from the UK investigated the effectiveness of critical care outreach team (CCOT) on hospital mortality using PAR (multiple parameter system) as calling criteria. There was an education/training phase prior to the implementation of the CCOT in the intervention group. The study found a significant reduction in hospital mortality in patients in the intervention wards at cluster level (OR = 0.523 [95% CI 0.322 to 0.849]). On the other hand, the cluster-RCT study from Australia (Hillman et al. 2005) found no difference in unexpected death (without NFR) (secondary outcome) between control group and intervention group (per 1000 admissions: control = 1.18, intervention = 1.06, difference = −0.093 [−0.423 to 0.237], adj p = 0.752, adj OR = 1.03 [95% CI 0.84 to 1.28]).

Cardiac arrest rates

Only the MERIT study (Hillman et al. 2005) included cardiac arrest rates as secondary outcome measure. The other cluster-RCT from the UK did not include cardiac arrest as a variable in their study. In the MERIT study (Hillman et al. 2005), the analysis showed no significant difference in cardiac arrest rates between the control group and intervention group (control = 1.64, intervention = 1.31, difference = −0.208 [−0.620 to 0.204], adj p = 0.736, adj OR = 0.94 [95% CI 0.79-1.13]).

Length of stay

Only the cluster-RCT study (Priestley et al. 2004) (UK study) included hospital length of stay as outcome measure. The MERIT study did not investigate hospital length of stay in their study. In the Priestley et al. (2004) study, the findings showed a possible increased hospital length of stay associated with outreach services but the results were not fully supported by confirmatory and sensitivity analyses. Consequently, hospital length of stay adjusted for clustering in this study was reported as yielding a non-significant effect.

Unplanned intensive care unit admissions

Only the MERIT study (Hillman et al. 2005) included unplanned ICU admissions as secondary outcome measure. The Priestley et al. (2004) study did not include unplanned ICU admission as an outcome measure in their study. The MERIT (Hillman et al. 2005) study showed no significant difference in the rates of unplanned ICU admission (without NFR) between the control group and intervention group (control = 4.68, intervention = 4.19, difference = −0.135 [−2.330 to 2.060], adj p = 0.599, adj OR = 1.04 [95% CI 0.89 to 1.21]).

Number of call-outs to an outreach service

In the process data reported in the MERIT study (Hillman et al. 2005), there was a significant increase in the number of call outs to the Medical Emergency Team (MET) after the implementation of the team (control = 3.1 [1.3 SD], intervention = 8.7 [3.5 SD], p = 0.0001). The mean number of call outs not associated with an event – that is, admission to critical care – was also significant higher in the intervention group compared with the control group (per 1000 admissions: control = 1.2 [0.8 SD], intervention = 6.3 [2.4

SD], p < 0.0001). On the other hand, the process measures were not reported in the Priestley et al. (2004) study.

Educational training

Both studies have a component of education/training preceding the implementation of critical care outreach services. In the MERIT study (Hillman et al. 2005), the education programme was provided to all staff (over a 4-month period prior to introduction of MET) using lectures, MET videotape and books. The content of the education programme included the identification of patients at risks, the use of calling criteria, the need to call quickly if criteria were met and how to call MET. A 4-week training programme facilitated by the critical care outreach team was also given to all nurses and doctors in the Priestley et al. (2004) study. This training preceded the formal implementation of the critical care outreach team. The training programme included formal and informal sessions on the use of an in-house 'patient-at-risk' score (PAR) as calling criteria.

Composition of, and the interventions provided by, the critical care outreach services

The composition of the Medical Emergency Team (MET) and critical care outreach team (CCOT) in the two studies varied. In the MERIT study (Hillman et al. 2005), the MET in the 12 intervention hospitals were different from each other but it was required to be at least the equivalent of the pre-existing cardiac arrest team (CAT) and to consist of at least one doctor and one nurse from emergency department or ICU. In the Priestley et al. (2004) study, the composition of the CCOT consisted of a team led by a nurse consultant with five nurses (4.5 whole time equivalents) from various specialities and eight sessions per week of support from consultant anaesthetists with special interest in critical care. The five nurses were all senior and experienced and were seconded into the team from their posts in critical care, theatre recovery, general surgery, medicine and orthopaedics. Ward staff and the admitting team's consultant were also involved at ward-level during the calling process.

The type of interventions provided by the MET in the MERIT study (Hillman et al. 2005) was not reported. However, in the Priestley et al. (2004) study, the

level of CCOT involvement was determined by ward staff and the admitting team. As circumstances required, CCOT might support and advise ward staff, remain with the patient and provide individual nursing care on the ward during crisis period, or facilitate the admission to ICU. There was also emphasis on 'sharing skills', on collaboration with the admitting team and on provision of practical 'hands on' help to ward staff.

2.2.3.11 Evidence statements

(1+) Overall the two included studies were different from each other with regard to the population under study, what was delivered as an intervention, the control group and outcomes under study. The intervention in each case was a complex intervention.

(1+) Both included studies delivered educational training on how to recognise and manage the acutely ill patient to ward staff before the implementation of critical care outreach services. In addition, both studies delivered critical care outreach services by healthcare professionals with appropriate training and competencies in the management of critically ill patients.

(1+) One study (MERIT) reported a composite outcome, which comprised the incidence of cardiac arrest, unplanned ICU admission (without NFR) and unexpected death (without NFR). It found no difference between the intervention group and the control group for this composite outcome.

(1+) There were conflicting findings in the two included studies on mortality rates: the UK study found a significant reduction in mortality, but MERIT found no difference between the two arms of the study for this outcome.

(1+) The MERIT study reported cardiac arrest data, finding no difference in arrest rates between the intervention group and the control group. In addition, MERIT showed no difference in 'unplanned intensive care unit admissions' between the intervention group and the control group. The

Priestley et al. (2004) study did not include unplanned ICU admission as an outcome measure.

(1+) The MERIT study reported a large increase in the number of call outs to the critical care outreach service (Medical Emergency Team 0 single parameter calling criteria) that did not require admission to critical care areas.

(1+) Only the UK study reported data on length of stay: it showed no difference in the 'length of stay' between the intervention group and the control group.

No studies were identified as being of sufficient quality to be included as the basis for clinical recommendations on the use of ward level interventions as a response strategy.

2.2.3.12 Health economics

Response strategies can be quite complex and are often introduced alongside a 'track and trigger' system, although responses can be initiated in the absence of a score if there is adequate 'concern'. Ideally an economic evaluation would therefore wish to link the effectiveness of the 'track and trigger' system with the appropriate response, and estimate incremental costs per Quality Adjusted Life Year (QALY) gained. At a basic level, an economic model could consider three alternatives:

- TT + 'outreach'
- TT + 'ward level response'
- 'conventional management'.

Since many 'track and trigger' systems allow for graded responses, typically increasing the frequency of observations at a relatively low threshold and informing more senior staff or an outreach team at higher thresholds, it would be important to incorporate this aspect of response in any model. Important parameters in this model would include length of hospital stay, the risk of cardiac arrest and death, and quality of life.

However, the data to convincingly inform such a model is largely absent (at least in the published literature). Of the effectiveness studies reviewed, the overwhelming majority considered the impact of introducing some form of outreach service. Only one identified study (a 'before and after' investigation by Paterson et al. [2006]) considered a form of ward level response. Because of the substantial risks of bias in that study, however, it would be impossible to draw any robust conclusions from its findings. Ward level responses are not 'simple' interventions, since as noted above, the precise details will depend amongst other things on the thresholds put in place during patient monitoring. No study was identified that assessed the impact of the use of a particular response strategy on health-related quality of life.

Outreach services are complex interventions with no apparently consistent typology. Generalisability is therefore a significant problem based on the available data. Any data on the effectiveness of such a service is likely to be specific to the particular characteristics of the intervention in an individual study. Since outreach services as assessed in the studies have actually multiple components (that is, a 'track and trigger' system, educational elements, and the outreach team itself), it's unclear how these individual components might separately influence outcomes. No robust effectiveness evidence currently exists showing that the introduction of outreach services actually improves outcomes versus 'conventional' management.

Outreach services are primarily nurse driven and mostly funded out of critical care budgets. It is considered that the ideal service is one that provides 24 hour availability, although the majority appear to operate within office hours only. In the Priestley et al. (2004) study described above, the outreach team provided a full service from 8.00 a.m. to 8.30 p.m., with a more limited service after this time provided by the night bed managers. Since its introduction however, there have been some alterations in coverage (Watson et al. 2006). In this particular instance, the direct costs of an outreach service appear potentially quite high. A senior staff nurse, for example, has an annual salary of approximately £26,546 per year, and a consultant's time is worth about £79 per patient-related hour (PSSRU 2006).

Whiting and Edbrook (2006) cited mean annual outreach nursing and physiotherapy costs of £4427.20 per ICU bed (2003/04 prices) based on audit data sourced from the Medical Economics and Research Centre, Sheffield (MERCS). There was considerable variation around that estimate however. In addition, the mean cost of medical staff input into an outreach service was estimated at £456 per ICU bed per year.

An economic evaluation would, however, need to consider the wider costs of the use of an outreach service, such as the impact of inappropriate call-outs, as well as savings that may arise, through for example changes in cardiopulmonary resuscitation rates or length of stay. Unpublished and ongoing economic analyses on the impact of outreach services post ICU discharge undertaken by ICNARC do not provide clear evidence of whether outreach services are associated with an overall difference in costs compared with management strategies in the absence of this intervention.

The weight of evidence is at best equivocal with respect to the effectiveness of outreach services on patient outcomes such as mortality, although aspects of its sub components (such as, education and training, use of a 'track and trigger' system) may be very important. In addition, interpreting the evidence is further complicated by the diversity of outreach service configurations. On this basis, it is not possible to state that outreach services are a cost effective option compared with care in its absence.

2.2.3.13 Evidence to recommendations

The Guideline Development Group noted that response strategies in the included studies were triggered by both physiological 'track and trigger' scores and by 'clinical concern' on the part of the relevant healthcare professional.

The Guideline Development Group noted that the two included studies that evaluated the effectiveness of a response strategy (critical care outreach) provided education and training on the recognition and response to critical illness to ward staff as well as delivering a specific response strategy. The Guideline Development Group considered the delivery of education and training of ward staff of key importance, one underpinning the correct

measurement of physiological variables, the correct use of 'track and trigger' systems and the correct response to a patient at risk of clinical deterioration.

The Guideline Development Group considered that there should be a graded response strategy based on the type of aggregate scoring 'track and trigger' systems used. In view of the difficulties documented below with current evidence on the effectiveness of response strategies the recommendations were developed by group consensus.

The Guideline Development Group noted the conflicting findings of the two included studies on response strategies. They considered there was no firm evidence of effectiveness and an absence of evidence of cost-effectiveness of critical care outreach services. They were therefore unable to recommend any specific service configuration as a preferred response strategy for individuals identified as having a deteriorating clinical condition.

The Guideline Development Group also considered that the components of the complex intervention in both included studies – education of ward staff and a response strategy – should form the basis of their consensus recommendations in this area. They considered that a range of service configurations could deliver these components and that NHS trusts should decide which configuration was most appropriate to local NHS service needs.

2.3 Discharge of patients from critical care areas

2.3.1 Introduction

Critical care area discharge planning ought to seek safe and efficient transition from the critical care area to general medical and surgical wards. Poor planning may result in discontinuity of care, delayed recovery, adverse health outcomes and re-admission to critical care areas. The timing of transfer from critical care areas to general wards is an important issue in critical care area discharge planning and is specifically included in the scope for this guideline. Thus the first part of this evidence review specifically addresses the question as to whether the timing of transfer from critical care areas to the general ward, specifically 'in hours' as opposed to 'out of hours' or 'night'

transfer, has an impact on health outcomes for patients. This question is asked in the context of the decision to discharge on clinical grounds having already been made. The decision to discharge a patient from critical care areas is outside the scope of this guideline.

Patients being treated in a critical care area will be recovering from a serious illness and will have required a level of dependency from medical, nursing and allied health professionals which is much greater than that found on general wards. Consequently the transition in care back to the general wards can be anxiety provoking for many patients. The situation can be exacerbated if healthcare professionals on the general wards are not fully aware of the patient's physical, emotional and psychological condition. A period of critical illness can have a significant impact on a patient's quality of life and functional status. The longer the period of illness and the greater the complexity of care required in critical care the greater the potential for residual physical, emotional and psychological morbidity. In addition the on-going care issues which are relevant to the reason for admission to the critical care area will also need to be addressed in the discharge planning from a critical care area back to the general ward.

Unfortunately the step down of nursing care from 'one-to-one' to 'one-to-many' is sometimes also accompanied by a lack of continuity of care from the critical care and parent teams and a reduction in the depth and breadth of care provided. These factors in combination commonly lead to patient distress. It is therefore important to address the question as to what elements of care on general wards are viewed as important by patients and healthcare professionals following discharge from critical care areas. The second part of this evidence review specifically addresses the evidence of patients' experiences of care received and focuses on the immediate post-critical care area discharge period.

As well as the timing of transfer and patients' experiences of care, it is also important to establish whether there are any interventions, such as routine ward-based follow-up from critical care outreach teams or other response strategies, that can be delivered to this particular group of patients on general

wards following discharge that have been shown to improve health outcomes. Therefore, the third key clinical question this evidence review sought to address was what interventions can be delivered to patients **who have been discharged from critical care areas** in the immediate post discharge phase on general wards.

A systematic review of the economic literature was undertaken where relevant. Further details are provided in the sections below.

2.3.2 Overview

Regarding the timing of transfer, seven studies were identified that investigated the effect on patient outcomes of the time of discharge from a critical care area to the general ward. All seven studies were observational studies (cohort studies) and no randomised control trials were identified. After full review of the paper, one study (Hixson et al. 2005) was excluded due to its study population not being covered by the scope (age range of study population was 0–21, and specific data on age range 16–21 was not available in the study). Consequently, there were six studies included in this review. Two studies were set in the UK (one is a single hospital study while the other one is a study using national databases), two studies from Australia, one study from Canada and one study from Finland. The patient outcomes that were measured in these six studies were hospital mortality, ICU length of stay and unplanned ICU readmission. However, hospital mortality was the only outcome that was analysed after case-mix adjustment and hence this narrative summary focuses on this particular patient outcome. Overall all studies were of acceptable quality (level of evidence: 2+). These six studies provided the evidence statements which formed the basis for the recommendations.

For the second review, on patients' experiences of care, six studies were identified on the basis of title and abstract as addressing aspects of care considered important by patients following discharge from critical care areas. All studies used a qualitative design. After full review of these papers, four were excluded from the review as they addressed care given in critical care

areas and concerns regarding transfer, as opposed to providing accounts of the care given in the immediate post-discharge period on general wards. Both studies were set in the UK. A further relevant unpublished study was identified by the NICE Patient and Public Involvement Unit from the Database of Individual Patient Experiences team (DIPEx). In total, three studies addressed the review question. Qualitative studies were assigned evidence level 3 in accordance with NICE technical guidance (National Institute for Health and Clinical Excellence 2006).

In terms of the final evidence review in this section, what interventions can be delivered to patients **who have been discharged from critical care areas** in the immediate post discharge phase on general wards, the search strategy for section 2.2, 'Does a specific response strategy improve outcomes for patients identified as having a deteriorating clinical condition?', identified a subgroup of studies that specifically looked at this specific patient population (patients discharged from critical care areas). Four studies (Ball et al. 2003; Bellomo et al. 2004; Garcea et al. 2004; Pittard 2003) were identified that investigated the impact or effect of critical care services on mortality rates and ICU readmission for this patient subgroup. Three studies were from the UK and one from Australia. All four studies were uncontrolled before-and-after studies with level of evidence of grade (2−). Such intervention studies were considered to be at high risk of bias and confounding factors and therefore could not be used to make recommendations for clinical practice in this guideline. These studies are therefore presented in the relevant evidence table but not presented in this review.

2.3.3 Does the timing of transfer of patient from critical care areas to general wards affect health outcomes?

2.3.3.1 Recommendation 16

After the decision to discharge has been made patients should be discharged from critical care areas to the general ward as early as possible during the day and should not be discharged from critical care areas to the general ward between 22.00 and 07.00.

2.3.3.2 Evidence review

Six studies were identified for this particular key clinical question. Five out of six studies (Beck et al. 2002; Duke et al. 2004; Goldfrad and Rowan 2000; Priestap and Martin 2006; Tobin and Santamaria 2006) (with level of evidence: 2+) found that the timing of transfer from ICU to general ward was associated with increased hospital mortality. Two of the studies were from the UK (Beck et al. 2002; Goldfrad and Rowan 2000), one from Canada (Priestap and Martin 2006) and two from Australia (Duke et al. 2004; Tobin and Santamaria 2006). One study from Finland (Uusaro et al. 2003) found no associations between times of discharge and death. Apart from hospital mortality, two studies (Duke et al. 2004; Priestap and Martin 2006) also found that the timing of transfer had an impact on ICU re-admission.

2.3.3.3 Evidence statement

(2+) The timing of transfer of patients from critical care areas (ICU) to general wards is associated with adverse patient outcomes. Discharge at night is associated with:

- **an increased hospital mortality rate**
- **a higher ICU re-admission rate.**

All six studies have an outcome measure of hospital mortality while only two studies have included ICU re-admission as an outcome measure. In terms of hospital mortality, one cohort study (Goldfrad and Rowan 2000) from the UK investigated the consequences of discharges from intensive care at night. This study used data from a national database (Intensive Care National Audit and Research Centre's Case Mix Programme Database – CMPD) from 1995 to 1998 to examine the effect of night discharges on hospital mortality rates compared with day discharges. There were two definitions of 'night discharge' in the study: from 22:00 to 06:59 and from 00:00 to 04:59. Both 'night' definitions were analysed as separate variables.

The analysis showed that both night discharges (from 22:00 to 06:59 and from 00:00 to 04:59) had significantly higher unadjusted odd ratios of hospital mortality compared with day discharge. After case-mix adjustment using the

APACHE II method, the study also found that both definitions of night discharge had a higher hospital mortality rate compared with day discharge ('22:00 to 06:59': adj OR = 1.33 [95% CI 1.06 to 1.65]; '00:00 to 04:59': adj OR = 1.53 [95% CI 1.11 to 2.13]). When looking at the data on 'direct discharge to the wards', both definitions of night discharge also had a higher case-mix adjusted hospital mortality rate compared with day discharge ('22:00 to 06:59': adj OR = 1.37 [95% CI 1.06 to 1.78]; '00:00 to 04:59': OR = 1.73 [95% CI 1.19 to 2.53]). However, when further adjustment was made for 'premature discharge', the findings of both groups were statistically not significant (overall discharge: '22:00 to 06:59': adj OR = 1.17 [95% CI 0.92 to 1.49]; '00:00 to 04:59': adj OR = 1.33 [95% CI 0.95-1.87]; direct discharge to the wards: '22:00 to 06:59': adj OR = 1.18 [95% CI 0.90 to 1.56]; '00:00 to 04:59': adj OR = 1.47 [95% CI 0.97 to 2.17]). It should be noted that, 'premature discharge' in this particular study was based on an analysis of the data collected under the heading of 'reason for discharge from ICU' and was based on a clinician's subjective assessment of a patient's readiness for discharge in the light of the needs of other patients for the ICU beds. There was no attempt made to impose standard explicit criteria for this variable. The decision to discharge is a clinical judgement based on physiological variables, concurrent treatment and clinical assessment. This model of care could potentially be strengthened by statistical modelling of physiological, organ dysfunction and other clinical data (Daly et al. 2001).

In another single-hospital UK cohort study (Beck et al. 2002), the findings showed that both crude (unadjusted) mortality risk and adjusted mortality risk were significantly higher for 'late' discharge compared with 'early' discharge. In this study, 'early' discharge was defined as from 08:00 to 19:59 and 'late' discharge was defined as from 20:00 to 07:59. The results of the study after adjusting for disease severity suggested that 'late' discharges from ICU would increase the mortality risk of patients ('late' discharges compared with 'early' discharges: adj RR = 1.70, 95% CI 1.28 to 2.25). When looking at the adjusted mortality risk for patients 'discharged directly to general wards', the study also found 'late' discharge would increase the mortality risk of patients compared with 'early' discharge (adj RR = 1.87, 95% CI 1.36 to 2.56). On the

other hand, the mortality risk of patients 'discharged directly to HDU' did not reach statistical significance ('late' discharges compared with 'early' discharges: adj RR = 1.35, 95% CI 0.77 to 2.36).

The third cohort study (Priestap and Martin 2006) was a Canadian study. Data was extracted from a Canadian national database that involved thirty one Canadian hospitals. Again, both crude (unadjusted) and adjusted in-hospital mortality rates were significantly higher for night-time discharge compared with day-time discharge. The definition of 'day-time' discharge was from 07:00 to 20:59 while there were two different definitions for 'night-time' discharge (from 21:00 to 06:59 and from 00:00 to 06:59) and both 'night-time' definitions were analysed as separate variables. After adjusting for severity of illness, the analysis of the study indicated that patients discharged from ICU at night have an increased risk of dying in hospital compared with those discharged during the day (adj $OR_{21:00\text{-}06:59}$ = 1.22 (95% CI 1.10-1.36); adj $OR_{00:00\text{-}06:59}$ = 1.26, 95% CI 1.07 to 1.49).

There were two cohort studies from Australia and both studies were single-hospital cohort studies. In one study (Duke et al. 2004), the times of discharge were defined as 'day' (from 07:30 to 15:00), 'evening' (from 15:00 to 22:00) and 'night' (from 22:00 to 07:30). The crude (unadjusted) analysis showed that the case-fatality rate for 'night' discharge was significantly higher compared with 'day' discharge and 'evening' discharge. After adjusting for severity of illness, limitation of medical treatment status (LMT), premature or delayed ICU discharge, logistic regression analysis found that 'night' discharge, together with APACHE II_{pm} and LMT order were significant predictors for hospital death ('night' discharge: adj RR = 1.7, 95% CI 1.03 to 2.9, p = 0.03; APACHE II_{pm}: adj RR = 3.3, 95% CI 1.3 to 7.6, p < 0.001; LMT order: adj RR = 5.1, 95% CI 2.2 to 12, p < 0.001). From the findings, this study suggested that the timing of ICU discharge, in addition to the (initial) severity of illness and LMT order, influenced the outcome of ICU survivors.

In the second Australian study (Tobin and Santamaria 2006), the times of discharge were defined as morning shift (07:00 to 14:59), afternoon shift (from 15:00 to 21:59) and night shift (from 22:00 to 06:59). Unadjusted odd ratios

showed that both afternoon shift and night shift had significantly higher hospital mortality compared with morning shift. After adjusting for severity of illness, multivariate analysis also showed that hospital mortality was significantly higher for afternoon shift and night shift compared with morning shift (afternoon: adj OR = 1.36, 95% CI 1.08 to 1.70; night: adj OR = 1.63, 95% CI 1.03 to 2.57).

The last study was a cohort study of 18 ICUs in Finland (Uusaro et al. 2003). There were two categories of 'times of discharge'. Category one defined 'times of discharge' as 'out of office hours' (from 16:00 to 08:00) and 'office hours' (from 08:00 to 16:00). Category two defined 'times of discharge' as 'weekday' (from 00:01 Monday to 15:59 Friday) and 'weekend' (from 16:00 Friday to 24:00 Sunday). In category one, analysis showed that crude (unadjusted) hospital mortality rate was significantly higher for 'out of office hours' discharge compared with 'office hours' discharge. However, logistic regression analysis (after adjustment) showed no difference between 'office hours' discharge and 'out of office hours' discharge on hospital mortality rate (adj OR = 1.11, 95% CI 0.93 to 1.31, p = 0.24). In terms of 'weekday' discharge and 'weekend' discharge, both crude (unadjusted) and logistic regression analysis (after adjustment) showed no differences on hospital mortality rate between 'weekday' and 'weekend' discharge (logistic regression: adj OR with 'weekend' discharge = 0.88, 95% CI 0.73 to 1.07, not significant, p-value not reported).

Apart from hospital mortality rate, two studies (Duke et al. 2004; Priestap and Martin 2006) also included unplanned ICU re-admission as outcome measure. In Priestap and Martin's (2006) study, the crude (unadjusted) unplanned ICU re-admission rate within 48-hour of ICU discharge to the ward was significantly higher for night-time discharge (from 21:00 to 06:59) compared with day-time discharge (from 07:00 to 20:59) (day = 1.7%, night = 2.4%, p < 0.001). In another study (Duke et al. 2004), crude (unadjusted) unplanned ICU re-admission rate for day discharge to the ward was also significantly lower compared with evening discharge and night discharge (day 3.5%, compared with evening 5.1%, and night 7.5%, p = 0.015).

2.3.3.4 Health economics

The timing of discharge may have important patient related and economic consequences, although no study was identified that specifically examined this issue. It appears from the evidence that issues related to 'premature discharge' and bed availability may be important factors influencing outcomes. An economic analysis therefore would be best focussed on interventions (such as outreach services) that may have an impact on premature discharge and the timing of discharge. No specific economic analysis was undertaken for this question.

2.3.3.5 Evidence to recommendation

The Guideline Development Group noted that discharge at night was consistently associated with increased mortality in the reviewed studies and considered this justified a recommendation not to discharge patients at night. They also noted, however, that 'night discharge' is generally viewed by UK clinicians as a consequence of pressure for ICU beds and is a proxy for premature discharge. This is supported by one UK study (Goldfrad and Rowan 2000) which specifically used discharge at night as a proxy measure to investigate pressure on ICU beds and which found that night discharge was not significantly associated with increased mortality once adjustment was made for premature discharge.

The Guideline Development Group considered that it was possible to specify a 'core' night time range on the basis of the evidence reviewed during which one could be reasonably certain that there was a likelihood of adverse outcomes.

2.3.4 What elements of care on the general ward are viewed as important by patients following discharge?

2.3.4.1 Recommendation 17

The critical care area discharging team and the receiving ward team have shared responsibility for the care of the patient being discharged. They should jointly:

- ensure there is continuity of care through a formal structured hand-over of care from critical care area staff to ward staff, supported by a written plan
- ensure that the receiving ward, with support from critical care (if required), can deliver the agreed plan.

The formal structured hand-over of care should include:

- a summary of critical care stay including diagnosis and treatment
- a monitoring and investigation plan
- an ongoing treatment plan including drugs and therapies, nutrition plan, infection status and limitations of treatment
- physical and rehabilitation needs
- psychological and emotional needs.
- specific communication or language needs.

2.3.4.2 Recommendation 18

Patients and their carers/families should be offered information on their condition and should actively participate in decisions that relate to their recovery. The information should be tailored to individual circumstances.

2.3.4.3 Recommendation 19

Staff working with acutely ill patients on general wards should be provided with education and training to recognise and understand the physical, psychological and emotional needs of patients on discharge from critical care areas.

2.3.4.4 Evidence review

All three studies used a qualitative design (phenomenological approach with purposive sampling) and all three studies were set in the UK (two from Northern Ireland and one from England). Qualitative studies were assigned evidence level 3 in accordance with NICE technical guidance. The findings of these three studies were reviewed and synthesised into four themes.

2.3.4.5 Evidence statements

(3) During the immediate post-critical care area discharge period on general wards patients identified four areas which they considered to require specific attention.

- **Lack of continuity of care between critical care area staff and ward staff owing to poor communication.**
- **Help with managing their physical and emotional experiences.**
- **Help with managing the transition between 'one to one' care in critical care areas to the lower staffing levels on general wards.**
- **Lack of information on their condition and process of recovery that was tailored to their individual circumstances.**

The four themes that were identified were continuity of care and co-ordination on the ward, physical and emotional experiences, provision of care on the ward, and information for patients. In terms of continuity of care and co-ordination on the ward, patients reported in two studies (DIPEx ; Strahan and Brown 2005) that this lack of continuity was caused by inadequate communication between ICU staff and those in the general wards and had led to unnecessary stress from them. For instance, some patients said that communication was poor between ICU staff and ward staff, and occasionally, as when nurses on the ward were unaware of their medications or dietary restrictions, they felt this had affected their treatment and progress. However, there were also positive experiences as a few patients recalled being visited by outreach nurses and felt that this had made the transition easier.

All three qualitative studies (DIPEx ; McKinney and Deeny 2002; Strahan and Brown 2005) presented details on patients' physical and emotional experiences. In terms of physical experiences following transfer from ICU to general ward, patients generally reported physical weakness/frailty, lack of mobility, sleep disturbances, minor to moderate pain, bowel complications and feelings of sickness, nausea and lack of appetite. On the other hand, in terms of emotional experiences, there were mixed positive and negative feelings among patients following transfer from ICU. Some patients were very positive about being transferred to a general ward as it was associated with

progression towards physical recovery and equipped patients with a feeling of control. However, following transfer some patients also felt anxious, lonely and isolated, depressed, insecure, exhausted, confused and worried because they were extremely weak physically.

Patients in all three studies (DIPEx ; McKinney and Deeny 2002; Strahan and Brown 2005) also reported their experiences of the differences in level of care between ICU and general wards. Overall, patients commented that attitude, attention and organisation were important aspects of care management on the ward and they desired a high quality of individualised care. Many patients felt that ward nurses had unrealistic expectations about how much they could do for themselves (such as, ward nurses were reported as lacking understanding on the degree of physical weakness/frailty of patients following transfer from ICU). In general, patients acknowledged the differences in staffing levels between ICU and general wards but they still found the transition from ‘one-to-one care’ in ICU to ‘one patient among many’ on a general ward, and less monitoring (either by ward staff or monitoring machines) difficult to adjust. For example, some patients felt ‘abandoned’ and some patients experienced being left unattended for varying lengths of time when they needed to go to the toilet or be washed or cleaned on the general ward. Patients found these experiences hard to cope with some reported that they felt themselves 'go downhill'.

Finally, two studies (DIPEx ; Strahan and Brown 2005) also reported the need for information from patients. Patients stressed the importance of information about their own critical illness and the need for an explanation of the recovery process (information at different stages of illness and recovery and on different topics). For example, some patients were given information about recovery before they were discharged from hospital, particularly on diet, exercise and drug management, while others said that the only information they really wanted was to know if they were improving. Moreover, most patients who had been given diaries of their ICU stay, either when leaving the hospital or at a follow-up appointment, said they learnt a lot more about their

stay after reading these, including information about the illness, treatments, changes and improvements, family reactions and visitors.

2.3.4.6 Health economics

This was not considered to be a question for which an economic analysis would be relevant.

2.3.4.7 Evidence to recommendations

The Guideline Development Group considered that the transition of care between critical care areas and general ward settings needed a specific recommendation as it was considered important that patients receive continuity of care and that patients must not be transferred from critical care areas unless the receiving ward has the resources to be able to deliver the agreed care plan.

The Guideline Development Group considered that a formal structured hand-over of care would address the patient needs identified in the reviewed qualitative evidence.

The Guideline Development Group noted that the need for information tailored to individual circumstances was a consistent finding of the reviewed qualitative literature.

The Guideline Development Group considered the reported experiences of patients on general wards following their discharge from critical care areas justified a specific recommendation on educational and training needs for relevant healthcare staff.

2.3.5 What interventions can be delivered to patients on general wards following discharge from critical care areas to improve health outcomes?

2.3.5.1 Recommendation

No specific recommendation made.

2.3.5.2 Evidence review

No evidence is presented as no studies were of sufficient quality to be used as the basis for making clinical guideline recommendations.

2.3.5.3 Evidence statement

None made.

2.3.5.4 Health economics

A single unpublished study was identified that undertook an economic analysis of outreach services following ICU discharge. This study is discussed further in section 3.2.3.5. No other economic evidence is available.

2.3.2.1 Evidence to recommendations

The Guideline Development Group noted the lack of good quality evidence on the effectiveness of specific interventions in the immediate post discharge phase on general wards to improve health outcomes for the specific subgroup of patients who have been discharged from critical care areas.

The Guideline Development Group considered that all the recommendations made in chapter 2.2 ('Response strategies') applied to this subgroup of patients.

2.4 Research recommendations

Chapter 2.1 Identification and evaluation of risk scoring tools

- What is the clinical effectiveness and cost effectiveness of automated (electronic) monitoring systems compared with manual recording systems in identifying people at risk of clinical deterioration in general hospital ward settings?
- What are the sensitivities and specificities of 'track and trigger' systems in varied clinical settings?
- Can 'track and trigger' systems be developed and validated that have higher sensitivities and specificities than existing scores?

Chapter 2.2 Response strategies for patients identified as having deteriorating clinical condition

- What is the clinical and cost effectiveness of a structured educational programme to improve recognition of and response to acute illness compared with no structured programme in improving outcomes for people who clinically deteriorate in general hospital ward settings?
- What is the clinical and cost effectiveness of critical care outreach services compared with usual care or educational outreach in improving health outcomes for patients who clinically deteriorate in general hospital ward settings? Such research should: a) use a cluster RCT design conducted on multiple sites, so the level of analysis of the cluster is hospital level rather than ward level; b) investigate a range of health outcomes including mortality, morbidity, quality of life measures and patient satisfaction; c) include a parallel qualitative process evaluation to help establish which components of outreach (a complex intervention) are likely to be most effective; d) consider both 24 hour critical care outreach as well as daytime outreach.

Chapter 2.3 Discharge of patients from critical care areas

- What is the clinical and cost effectiveness of providing structured educational advice (such as an information booklet) compared with usual care to patients who have been discharged from critical care areas back to general hospital ward settings?
- What is the clinical and cost effectiveness of a discharge facilitator for patients transferred from critical care to a general ward environment? Such research could include the following outcome measures: patient satisfaction, time to discharge from acute hospital and where discharged to.

3 Methods

3.1 Scope and purpose

3.1.1 Scope

The guideline was developed in accordance with a scope given by National Institute for Health and Clinical Excellence (NICE). The scope set the remit of the guideline and specified those aspects of recognition and response to acute illness in adults in hospital to be included and excluded. The scope was published in 2006 and is reproduced here in appendix 5.1.

3.1.2 Guideline objectives

Clinical guidelines are defined as 'systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances' (Institute of Medicine Committee to Advise the Public Health Service on Clinical Practice Guidelines, Field MJ and Lohr KN eds. 1990). The aim of this guideline is to provide evidence-based recommendations to guide healthcare professionals in the appropriate care of acutely ill patients in hospital.

3.1.3 Areas covered by this guideline

This guideline provides guidance on:

a) Identification of patients who are at risk of clinical deterioration or whose clinical condition is deteriorating. This will include assessment of:
   - scoring tools that record physiological parameters and neurological state
   - the level of monitoring needed and the recording and interpretation of the data obtained.

b) Response strategies to manage patients who are at risk of clinical deterioration or whose clinical condition is deteriorating, including:
   - the timing of response and patient management

- the communication of monitoring results to relevant healthcare professionals, including the interface between critical care and acute specialties.

c) Discharge of patients from critical care areas. This will include:

- monitoring requirements
- timing of transfer.

3.1.4 Areas outside the remit of this guideline

This guideline does not address care that should be provided to: children, dying patients receiving palliative care or patients in critical care areas who are directly under the care of critical care consultants. It does not address the decision to discharge a patient from a critical care area.

3.1.5 Disclaimer

The Guideline Development Group assumes that the healthcare professionals will use general medical knowledge and clinical judgement in applying the general principles and specific recommendations of this document to the management of individual patients. Recommendations may not be appropriate in all circumstances. Decisions to adopt any particular recommendation must be made by the practitioner in light of the circumstances presented by individual patients and available resources. Clinicians will need to share appropriately the information within this guideline to enable patients to participate in the decision making to the extent that they are able and willing.

3.2 Contributors

3.2.1 The Guideline Development Group (GDG)

The Guideline Development Group (GDG) was composed of three types of members: relevant healthcare professionals, patient representatives and NICE technical staff.

The members of the development group are:

Name	Title	Specialist area
Mrs Sheila Adam	Nurse Consultant in Critical Care	Critical Care and Outreach Nursing
Dr Mary Armitage	Consultant Physician	GDG Chair
Mr Peter Brewer	Carer	Patient/Carer Representative
Dr Brian Cuthbertson	Clinical Senior Lecturer and Consultant in Intensive Care	Intensive Care
Dr Jane Eddleston	Consultant in Intensive Care Medicine	GDG Clinical Adviser
Mr Peter Gibb	Patient	Patient/Carer Representative
Dr Paul Glynne	Consultant Physician in Acute Medicine and Critical Care	Acute Medicine/Critical Care
Dr David Goldhill	Consultant in Anaesthesia	Anaesthetics and Intensive Care
Dr John Hindle	Geriatrician/Consultant Physician and Clinical Director for Medicine	Medicine for the Elderly
Dr Paul Jenkins	Consultant in Acute Medicine	Acute Medicine
Dr Simon Mackenzie	Consultant in Critical Care	Critical Care
Dr Patrick Nee	Consultant in Emergency Medicine and Intensive Care Medicine	Emergency Medicine
Professor Brian J Rowlands	Consultant Surgeon	Hepato-pancreatico-biliary and General Surgery
Mrs Kirsty Ward	Registered Nurse	Nursing
The following individuals were not full members of the Guideline Development Group but were co-opted onto the group as expert advisers:		
Dr David Harrison	Statistician and Health Services Researcher	Expert Adviser (co-opted)
Professor Gary Smith	Consultant in Critical Care	Expert Adviser (co-opted)

3.2.2 The Short Guidelines Programme Technical Team

The Short Guidelines Programme Technical Team was responsible for this guideline throughout its development. It was responsible for preparing information for the Guideline Development Group (GDG), for drafting the

guideline and for responding to consultation comments. The technical team, who are employees of NICE, working on this guideline, consisted of:

Dr Tim Stokes – **Guideline Lead and Associate Director** – Centre for Clinical Practice (from December 2007), who had overall responsibility for managing the guideline development process.

Nicole Elliott – Guidelines Commissioning Manager, who had an overview of the process and provided knowledge and expertise in the development of the guideline.

Janette Boynton - Senior Information Scientist, who searched websites and bibliographic databases to support scoping and to identify evidence to answer the questions posed by the GDG.

Francis Ruiz – Technical Adviser in Health Economics, who reviewed the economic evidence, constructed economic models in selected areas and assisted the GDG in considering cost effectiveness.

Toni Tan – Technical Analyst (from January 2007) who appraised the literature and abstracted and prepared the relevant evidence for the GDG.

Emma Banks – Coordinator, who was responsible for organising and administering the meetings of this group.

Michael Heath - Project Manager (from December 2006) who was responsible for organising and planning the development, for meetings and minutes and for drawing the final document together.

Dr Jayne Spink – **Associate Director** – Centre for Clinical Practice (until December 2007), who had overall responsibility for managing the early stages of the guideline development process.

Dr Philippa Davies – Technical Analyst (until January 2007) who appraised the literature and abstracted and prepared the relevant evidence for the GDG.

Dr Françoise Cluzeau – Technical Adviser (until December 2007), who advised on the early stages of the guideline development process

3.2.3 Acknowledgements

To be inserted into final guideline

3.3 Development methods

This section sets out in detail the methods used to generate the recommendations for clinical practice that are presented in the previous chapters of this guideline. The methods used to develop the recommendations are in accordance with those set out by the National Institute for Health and Clinical Excellence ('NICE' or the 'the Institute') in The Guideline Development Process – Information for National Collaborating Centres and Guideline Development Groups (2005) (available at: www.nice.org.uk) . As noted in section 1.4.2, the interim process guide for the short clinical guideline programme has been the subject of public consultation and the revised version will be incorporated into the 2008 Guidelines manual update.

3.3.1 Developing the guideline scope

The draft scope, which defined the areas the guideline would and would not cover, was prepared by the short guidelines programme technical team on the basis of the remit from the Department of Health, consultation with relevant experts and a preliminary search of the literature to identify existing clinical practice guidelines, key systematic reviews and other relevant publications. The literature search facilitated an overview of the issues likely to be covered by the guideline – the clinical need for the guideline and the clinical management of acutely ill patients – and helped define key areas. It also informed the short clinical guidelines team of the volume of literature likely to be available in the topic area, and therefore the amount of work required.

The draft scope was tightly focused and covered three clinical topic areas.

The draft scope was presented to a representative group of stakeholders and potential GDG members at a 1-day workshop. The workshop consisted of

presentations in the morning and facilitated parallel-running working groups in the afternoon. The aim was to obtain detailed feedback on the draft scope and agree core areas of care to be covered in the guidance, to seek input about the composition of the GDG and to request the attendees' help in encouraging applications for GDG membership.

The draft scope was amended to address issues raised by the workshop and the revised scope was signed off by the Director of the Centre for Clinical Practice, NICE. Stakeholders were notified once the final version of the scope was available on the NICE website. On this occasion the scope was not the subject of public consultation but this is planned for subsequent short guideline scopes (see interim process guide for the short clinical guideline programme).

3.3.2 Forming and running the Short Clinical Guideline GDG

The short clinical guideline on acutely ill patients in hospital was developed by a unique GDG consisting of 14 members, two co-opted experts who attended two of the GDG meetings) plus the short clinical guidelines team. The GDG had a chair, professional members and patient/carer members who were recruited through open advertisement. A clinical adviser, who had specific content expertise, was also appointed. Development took 4 months and the GDG met on three occasions every 6 weeks.

3.3.3 Developing key clinical questions

The third step in the development of the guidance was to refine the Scope into a series of key clinical questions. The key clinical questions formed the starting point for the subsequent evidence reviews and facilitated the development of recommendations by the GDG.

The key clinical questions were developed by the GDG with assistance from the technical team. As necessary, the questions were refined into specific research questions by the project teams to aid literature searching, appraisal and synthesis. The full list of key clinical questions is shown in appendix 2.

The GDG and technical team agreed appropriate review parameters (inclusion and exclusion criteria) for each question or topic area. A full table of the included and excluded studies is shown in appendix 4.

3.3.4 Developing recommendations

For each key question, recommendations were derived from the evidence summaries and statements presented to the GDG.

3.3.5 Literature search

The evidence reviews used to develop the guideline recommendations were underpinned by systematic literature searches, following the methods described in 'The guidelines manual' (National Institute for Health and Clinical Excellence 2006). The purpose of systematically searching the literature is to attempt to comprehensively identify the published evidence to answer the key clinical questions developed by the GDG and Short Clinical Guidelines Technical Team.

The Gao et al. (2007) and Esmonde et al. (2006) reviews, sub-studies of the work commissioned by the SDO to ICNARC (see section 3.3.10), were used as the basis of two of the evidence reviews. The search strategies underpinning these systematic reviews were obtained from the authors and re-run, across a number of databases, to identify studies indexed from 2004 onwards.

The search strategies for the evidence reviews on discharge from critical care areas were developed by the Short Clinical Guidelines Technical Team, in consultation with the GDG. Structured clinical questions were developed using the PICO model, and reflecting the inclusion criteria, which were translated in to search strategies using subject heading and free text terms. The strategies were run across a number of databases with no date restrictions imposed on the searches.

To identify economic evaluations the NHS Economic Evaluation Database (NHS EED) and the Health Economic Evaluations Database (HEED) were searched, and search filters to identify economic evaluations were appended

to the strategies developed by Gao et al. (2007) and Esmonde et al. (2006) to interrogate a range of bibliographic databases. There were no date restrictions imposed on the searches.

In addition to the systematic literature searches, the GDG were asked to alert the Short Clinical Guidelines Technical Team to any additional evidence, published, unpublished or in press, that met the inclusion criteria.

The searches were undertaken in the period Oct 2006 – Feb 2007. Full details of the systematic search, including the sources searched and the MEDLINE strategies for each evidence review, are presented in appendix 3.

3.3.6 Reviewing the evidence

The aim of the literature review was to systematically identify and synthesise relevant evidence in order to answer the specific key clinical questions developed from the guideline scope. The guideline recommendations were evidence based, where possible; if evidence was not available, informal consensus of opinion within the GDG was used. The need for future research was also specified. This process required four main tasks: selection of relevant studies; assessment of study quality; synthesis of the results; and grading of the evidence. The Technical Analyst had primary responsibility for reviewing the evidence but was supported by the Project Lead, Information Scientist and Health Economist.

After the scope was finalised, searches based on individual key clinical questions were undertaken. The searches were first sifted by the Short Clinical Guidelines Technical Team using title and abstract to exclude papers that did not address the specified key clinical question. After selection based on title and abstract, the full text of the papers were obtained and reviewed by the Short Clinical Guidelines Technical Team in order to determine which studies should be included in the literature review. Studies suggested or submitted by the GDG and expert advisers were also reviewed for relevance to the key clinical questions and included if they met the inclusion criteria.

The papers chosen for inclusion were then critically appraised by the Short Clinical Guidelines Technical Team for their methodological rigour against a number of criteria that determine the validity of the results. These criteria differed according to study type and were based on the checklists included in 'The Guidelines Manual' (2006) by NICE (available from www.nice.org.uk). The checklists that were used in this particular guidance included Checklist C for randomised control trials, Checklist B for cohort studies, Checklist F for diagnostic studies, and Checklist F for qualitative studies. The 'Data Collection Checklist' by EPOC on controlled before-and-after studies was also used to assess before-and-after studies in this review.

The data were extracted to standard evidence table templates. The findings were summarised by the Short Guidelines Technical Team into both a series of evidence statements and an accompanying narrative summary.

3.3.7 Grading the evidence

Intervention studies

Studies that meet the minimum quality criteria were ascribed a level of evidence to help the guideline developers and the eventual users of the guideline understand the type of evidence on which the recommendations have been based.

There are many different methods of assigning levels to the evidence and there has been considerable debate about what system is best. A number of initiatives are currently under way to find an international consensus on the subject. NICE has previously published guidelines using different systems and is now examining a number of systems in collaboration with the NCCs and academic groups throughout the world to identify the most appropriate system for future use.

Until a decision is reached on the most appropriate system for the NICE guidelines, the short guidelines technical team used the system for evidence shown in table 7.1.

Table 7.1 Levels of evidence for intervention studies.
Reproduced with permission from the Scottish Intercollegiate Guidelines Network; for further information, see 'Further reading'.

Level of evidence	Type of evidence
1^{++}	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1^{+}	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1^{-}	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias[a]
2^{++}	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
2^{+}	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal
2^{-}	Case–control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal[a]
3	Non-analytic studies (for example, case reports, case series)
4	Expert opinion, formal consensus
[a] Studies with a level of evidence '–' should not be used as a basis for making a recommendation	

It was the responsibility of the GDG to endorse the final levels given to the evidence.

Diagnostic studies

The system described above covers studies of treatment effectiveness. However, it is less appropriate for studies reporting diagnostic tests of accuracy. In the absence of a validated ranking system for this type of test, NICE has developed a hierarchy for evidence of accuracy of diagnostic tests that takes into account the various factors likely to affect the validity of these studies (table 7.2). Because this hierarchy has not been systematically tested, NICE recommends that the NCCs use the system when appropriate, on a pilot basis, and report their experience to us.

This evidence grading system was applied to the evidence review of 'track and trigger' systems set out in chapter 2.1.

Table 7.2 Hierarchy for evidence of accuracy of diagnostic tests

Levels of evidence	Type of evidence
Ia	Systematic review (with homogeneity)[a] of level-1 studies[b]
Ib	Level-1 studies[b]
II	Level-2 studies[c] Systematic reviews of level-2 studies
III	Level-3 studies[d] Systematic reviews of level-3 studies
IV	Consensus, expert committee reports or opinions and/or clinical experience without explicit critical appraisal; or based on physiology, bench research or 'first principles'

[a] Homogeneity means there are no or minor variations in the directions and degrees of results between individual studies that are included in the systematic review.

[b] Level-1 studies are studies:
- that use a blind comparison of the test with a validated reference standard (gold standard)
- in a sample of patients that reflects the population to whom the test would apply.

[c] Level-2 studies are studies that have **only one** of the following:
- narrow population (the sample does not reflect the population to whom the test would apply)
- use a poor reference standard (defined as that where the 'test' is included in the 'reference', or where the 'testing' affects the 'reference')
- the comparison between the test and reference standard is not blind
- case–control studies.

[d] Level-3 studies are studies that have **at least two or three** of the features listed for level-2 studies.

3.3.8 Evidence to recommendations

In preparation for each GDG meeting, the evidence tables and narrative summaries for the key clinical questions being discussed were made available to the GDG one week before the scheduled GDG meeting. These documents were circulated through email and sent by post to those members who requested it.

All GDG members were expected to have read the evidence tables and narrative summaries before attending each meeting. The review of the evidence had three components. First, the GDG discussed the evidence tables and narrative summaries and corrected any factual errors or incorrect interpretation of the evidence. Second, evidence statements, which had been drafted by the Short Guidelines Programme technical team were presented to

the GDG and the GDG agreed the correct wording of these. Third, from a discussion of the evidence statements and the experience of GDG members recommendations were drafted. The Short Guidelines Technical team explicitly flagged up with the GDG that they should consider the following criteria (considered judgement) when developing the guideline recommendations from the evidence presented:

- internal validity
- consistency
- generalisability (external validity)
- clinical impact
- cost effectiveness
- implementability
- patient's perspective
- overall synthesis of evidence.

The GDG was able to agree recommendations through informal consensus. The process by which the evidence statements informed the recommendations is summarised in an 'evidence to recommendations' section in the relevant evidence review. Each recommendation was linked to an evidence statement, where possible. Where there was a lack of evidence of effectiveness, but the GDG was of the view that a recommendation was important based on the GDG members' own experience this was noted in the 'evidence to recommendations' section.

3.3.9 Health economics

An economic evaluation aims to integrate data on the benefits (ideally in terms of quality adjusted life years, or QALYs), harms and costs of alternative options. An economic appraisal will not only consider if a particular course of action is clinically effective, but also if it is cost-effective (that is, value for money). If a particular treatment strategy were found to yield little health gain relative to the resources used, then it could be advantageous to redirect resources to other activities that yield greater health gain.

To assess the cost-effectiveness of strategies associated with the identification and response to acute illness a systematic review of the economic literature relating to acutely ill patients was conducted. In addition, the GDG and expert advisers were questioned over any potentially relevant unpublished data. The search of the published literature yielded no relevant economic studies, save for one book chapter that simply cited some cost estimates of outreach services. However, relevant ongoing and unpublished data were identified (ICNARC 'sub-study 7': See chapter 3.3.10 for further details) and made available to the GDG and the technical team at NICE.

Despite limitations of the unpublished research (such as, its focus on outreach activity post ICU discharge), further economic modelling by the NICE health economist was considered unnecessary. The key features of this research are presented within the relevant clinical chapter.

Health economics statements are made in the guideline in sections where the use of NHS resources is considered.

3.3.10 Relation between this guideline and ongoing national research in the field of critical care outreach

In July 2004 the NHS National Institute for Health Research Service Delivery and Organisation (SDO) Programme commissioned the Intensive Care National Audit and Research Centre (ICNARC) to undertake a rigorous, scientific evaluation of outreach services in critical care (SDO/74/2004). At present the findings of this research programme are currently being written up for submission to the funding body by 31 March 2007.

A member of the ICNARC research team (Dr David Harrison) was co-opted onto the GDG as a technical expert and the agreement of ICNARC and the funding body was sought and granted for the incorporation of published and unpublished work from this research programme into the NICE guideline on acutely ill patients in hospital.

The following sub-studies from the SDO work have been incorporated into this guideline.

- Sub-study 1 (a systematic review of the evidence base for outreach services). This published review (Esmonde et al. 2006) forms the basis for the review of critical care outreach services presented in chapter 2.2.
- Sub-studies 2 and 3 (a systematic review of the evidence base for current 'early warning systems' and an analysis of available databases on 'early warning systems'). This review (Gao et al. 2007) forms the basis for the review of 'track and trigger' systems presented in chapter 2.1. The primary research study (Subbe et al. 2007) is also used in the review.
- Sub-study 4 (survey of outreach services). This survey (McDonnell et al. in press) is cited in the introduction section to chapter 2.3.
- Sub-study 5 (qualitative study of a number of case studies of different models of outreach services), sub-study 6 (interrupted time series analysis of the impact of outreach services on critical care admissions at the unit level) and sub-study 7 (a non-randomised, case mix adjusted comparison of outreach care at the patient level, within which, an economic evaluation forms an important part). At the time of submission of the first draft of the acutely ill patients in hospital guideline for consultation these studies were unpublished and in the process of being written up. Permission was obtained for the use of selected parts of the health economic analysis in the draft guideline. It is intended that the final published version of the acutely ill patients in hospital guideline will present the results of these three sub-studies in chapter 2.

3.3.11 Relation between this guideline and ongoing work on this area by the National Patient Safety Agency

The National Patient Safety Agency has an ongoing working group on the area of 'patient deterioration not recognised or not acted upon' in acute hospital settings. Several members of the Guideline Development Group for the acutely ill patients in hospital guideline are members of this working group (Dr Mary Armitage, Dr Jane Eddleston) as is the NICE Guideline Lead (Dr Tim Stokes). It is intended that this arrangement will facilitate the NPSA and the NICE acutely ill patients in hospital short clinical guideline issuing complementary guidance in this area.

3.3.12 Piloting and implementation

It is beyond the scope of the work to pilot the contents of this guideline or validate any approach to implementation. These limitations accepted, every effort has been made to maximise the relevance of recommendations to the intended audience through the use of a guideline development group with relevant professional and patient involvement, by use of relevant experienced expert reviewers and the stakeholder process facilitated by the NICE Short Clinical Guidelines Team. Implementation support tools for this guideline will be available from the Implementation Team at NICE.

3.3.13 Audit methods

The guideline recommendations have been used to develop clinical audit criteria for use in practice. An audit criterion can be defined as ‘a systematically developed statement that can be used to assess the appropriateness of specific healthcare decisions, services and outcomes (Institute of Medicine, Field MJ and Lohr KN eds. 1992). Audit criteria are essential implementation tools for monitoring the uptake and impact of guidelines and thus need to be clear and straightforward for organisations and professionals to use.

NICE has commissioned the Clinical Accountability, Service Planning and Evaluation (CASPE) Research Unit and Health Quality Service (HQS) to develop the audit criteria for all its guidance as part of its implementation strategy. CASPE will draft audit criteria for all guidelines for which stakeholder consultation starts on or after 1 April 2006.

3.3.14 Scheduled review of this guideline

The guidance has been developed in accordance with the NICE guideline development process for short clinical guidelines. This has included allowing registered stakeholders the opportunity to comment on the draft guidance. In additional the first draft was reviewed by an independent Guideline Review Panel (GRP) established by NICE.

The comments made by stakeholders, peer reviewers and the GRP were collated and presented anonymously for consideration by the GDG. All comments were considered systematically by the GDG and the Project Team recorded the agreed responses.

A provisional review date set for this guideline is July 2009]. Any agreed update would be carried out by the short clinical guidelines team in conjunction with the GDG. Alternatively the topic may be referred to the NICE topic selection panel for it to consider developing as a standard clinical guideline.

3.4 Declarations

3.4.1 Authorship and citation

Authorship of this full guideline document is attributed to the NICE Short Guidelines Programme technical team and members of the Guideline Development Group under group authorship.

The guideline should be cited as: [to be inserted].

3.4.2 Declarations of interest

A full list of all declarations of interest made by this GDG is available at the NICE website (www.nice.org.uk).

4 References and glossary

4.1 References

Ball C, Kirkby M, Williams S (2003) Effect of the critical care outreach team on patient survival to discharge from hospital and readmission to critical care: non-randomised population based study. BMJ 327 (7422): 1014-1016.

Beck DH, McQuillan P, Smith GB (2002) Waiting for the break of dawn? The effects of discharge time, discharge TISS scores and discharge facility on hospital mortality after intensive care. Intensive Care Medicine 28 (9): 1287-1293.

Bell MB, Konrad D, Granath F et al. (2006) Prevalence and sensitivity of MET-criteria in a Scandinavian University Hospital. Resuscitation 70 (1): 66-73.

Bellomo R, Goldsmith D, Uchino S et al. (2004) Prospective controlled trial of effect of medical emergency team on postoperative morbidity and mortality rates. Critical Care Medicine 32 (4): 916-921.

Bristow PJ, Hillman KM, Chey T et al. (2000) Rates of in-hospital arrests, deaths and intensive care admissions: the effect of a medical emergency team. Medical Journal of Australia 173 (5): 236-240.

Brown C, Lilford R (2006) The stepped wedge trial design: a systematic review. BMC Medical Research Methodology 6 (54): doi:10.1186/1471-2288-6-54-.

Buist M, Bernard S, Nguyen TV et al. (2004) Association between clinically abnormal observations and subsequent in-hospital mortality: a prospective study. Resuscitation 62 (2): 137-141.

Buist MD, Moore GE, Bernard SA et al. (2002) Effects of a medical emergency team on reduction of incidence of and mortality from unexpected cardiac arrests in hospital: preliminary study. BMJ 324 (7334): 387-390.

Cuthbertson BH, Boroujerdi M, McKie L et al. (2007) Can physiological parameters and early warning scoring systems allow early recognition of the deteriorating surgical patient? Critical Care Medicine 35 (2): 402-409.

Daly K, Beale R, Chang RW (2001) Reduction in mortality after inappropriate early discharge from intensive care unit: logistic regression triage model. BMJ 322 (7297): 1274-1276.

Department of Health (Curriculum framework for the foundation years in postgraduate medical education [In Press].

Department of Health (2000) Comprehensive critical care: a review of adult critical care services. London: Department of Health.

Department of Health (2001) Reference guide to consent for examination or treatment. London: Department of Health.

Department of Health (2006) NHS Reference Costs 2005. London: Department of Health.

Department of Health and NHS Modernisation Agency (2003) The National Outreach Report. London: Department of Health.

DeVita MA, Braithwaite RS, Mahidhara R et al. (2004) Use of medical emergency team responses to reduce hospital cardiopulmonary arrests. Quality and Safety in Health Care 13 (4): 251-254.

DIPEx intensive care module: talking about experiences in the general ward [online]. Available from: www.dipex.org [accessed 23 February 2007].

Duke GJ, Green JV, Briedis JH (2004) Night-shift discharge from intensive care unit increases the mortality-risk of ICU survivors. Anaesthesia and Intensive Care 32 (5): 697-701.

Esmonde L, McDonnell A, Ball C et al. (2006) Investigating the effectiveness of critical care outreach services: a systematic review. Intensive Care Medicine 32 (11): 1713-1721.

Foraida MI, DeVita MA, Braithwaite RS et al. (2003) Improving the utilization of medical crisis teams (Condition C) at an urban tertiary care hospital. Journal of Critical Care 18 (2): 87-94.

Gao H, McDonnell A, Harrison DA et al. (2007) Systematic review and evaluation of physiological track and trigger warning systems for identifying at risk patients on the ward. Intensive Care Medicine 33 (4): 667-679.

Garcea G, Jackson B, Pattenden CJ et al. (2006) Early warning scores predict outcome in acute pancreatitis. Journal of Gastrointestinal Surgery 10 (7): 1008-1015.

Garcea G, Thomasset S, Mcclelland L et al. (2004) Impact of a critical care outreach team on critical care readmissions and mortality. Acta Anaesthesiologica Scandinavica 48 (9): 1096-1100.

Goldfrad C, Rowan K (2000) Consequences of discharges from intensive care at night. Lancet 355 (9210): 1138-1142.

Goldhill DR, McNarry AF (2004) Physiological abnormalities in early warning scores are related to mortality in adult inpatients. British Journal of Anaesthesia 92 (6): 882-884.

Goldhill DR, McNarry AF, Mandersloot G et al. (2005) A physiologically-based early warning score for ward patients: the association between score and outcome. Anaesthesia 60 (6): 547-553.

Goldhill DR, Worthington L, Mulcahy A et al. (1999) The patient-at-risk team: identifying and managing seriously ill ward patients. Anaesthesia 54 (9): 853-860.

Hillman K, Chen J, Cretikos M et al. (2005) Introduction of the medical emergency team (MET) system: a cluster-randomised controlled trial. Lancet 365 (9477): 2091-2097.

Hixson ED, Davis S, Morris S et al. (2005) Do weekends or evenings matter in a pediatric intensive care unit? Pediatric Critical Care Medicine 6 (5): 523-530.

Hodgetts TJ, Kenward G, Vlachonikolis IG et al. (2002) The identification of risk factors for cardiac arrest and formulation of activation criteria to alert a medical emergency team. Resuscitation 54 (2): 125-131.

Institute of Medicine - Field MJ and Lohr KN eds. (1992) Guidelines for clinical practice: from development to use. Washington, DC: National Academy Press.

Institute of Medicine Committee to Advise the Public Health Service on Clinical Practice Guidelines - Field MJ and Lohr KN eds. (1990) Clinical practice guidelines: directions for a new programme. Washington, DC: National Academy Press.

Kause J, Smith G, Prytherch D et al. (2004) A comparison of antecedents to cardiac arrests, deaths and emergency intensive care admissions in Australia and New Zealand, and the United Kingdom--the ACADEMIA study. Resuscitation 62 (3): 275-282.

Lam TS, Mak PSK, Siu WS et al. (2006) Validation of a Modified Early Warning Score (MEWS) in emergency department observation ward patients. Hong Kong Journal of Emergency Medicine 13 (1): 24-30.

McBride J, Knight D, Piper J et al. (2005) Long-term effect of introducing an early warning score on respiratory rate charting on general wards. Resuscitation 65 (1): 41-44.

McDonnell A, Esmonde L, Morgan R et al. The provision of critical care outreach services in England: findings from a national survey (NHS Service Delivery and Organisation (SDO) Research and Development Programme Funded Research Project (SDO/74/2004) - Sub-study 4). Journal of Critical Care [In Press] .

McKinney AA, Deeny P (2002) Leaving the intensive care unit: a phenomenological study of the patients' experience. Intensive and Critical Care Nursing 18 (6): 320-331.

McQuillan P, Pilkington S, Allan A et al. (1998) Confidential inquiry into quality of care before admission to intensive care. BMJ. 316 (7148): 1853-1858.

Medical Services Advisory Committee (2005) Guidelines for the assessment of diagnostic technologies. Canberra: Medical Services Advisory Committee.

National Institute for Health and Clinical Excellence (2006) The guidelines manual. London: National Institute for Health and Clinical Excellence.

NCEPOD (2005) An acute problem? A report of the National Confidential Enquiry into Patient Outcome and Death (NCEPOD). London: NCEPOD.

Odell M, Forster A, Rudman K et al. (2002) The critical care outreach service and the early warning system on surgical wards. Nursing in Critical Care 7 (3): 132-135.

Paterson R, MacLeod DC, Thetford D et al. (2006) Prediction of in-hospital mortality and length of stay using an early warning scoring system: clinical audit. Clinical Medicine 6 (3): 281-284.

Perkins GD, Barrett H, Bullock I et al. (2005) The Acute Care Undergraduate TEaching (ACUTE) Initiative: consensus development of core competencies in acute care for undergraduates in the United Kingdom. Intensive care medicine. 31 (12): 1627-1633.

Pittard AJ (2003) Out of our reach? Assessing the impact of introducing a critical care outreach service. Anaesthesia 58 (9): 882-885.

Price R, Cuthbertson B, Cairns C (2007) The findings of the International Conference on Medical Emergency Teams are biased and misleading. Critical Care Medicine 35 (3): 992-.

Priestap FA, Martin CM (2006) Impact of intensive care unit discharge time on patient outcome. Critical Care Medicine 34 (12): 2946-2951.

Priestley G, Watson W, Rashidian A et al. (2004) Introducing Critical Care Outreach: a ward-randomised trial of phased introduction in a general hospital. Intensive Care Medicine 30 (7): 1398-1404.

Prytherch DR, Smith GB, Schmidt P et al. (2006) Calculating early warning scores - A classroom comparison of pen and paper and hand-held computer methods. Resuscitation 70 (2): 173-178.

PSSRU (2006) Unit costs of health and social care 2006. Canterbury: PSSRU.

Seward E, Greig E, Preston S et al. (2003) A confidential study of deaths after emergency medical admission: issues relating to quality of care. Clinical Medicine. 3 (5): 425-434.

Strahan EH, Brown RJ (2005) A qualitative study of the experiences of patients following transfer from intensive care. Intensive and Critical Care Nursing 21 (3): 160-171.

Subbe CP, Davies RG, Williams E et al. (2003) Effect of introducing the Modified Early Warning score on clinical outcomes, cardio-pulmonary arrests and intensive care utilisation in acute medical admissions. Anaesthesia 58 (8): 797-802.

Subbe CP, Gao H, Harrison DA (2007) Reproducibility of physiological track-and-trigger warning systems for identifying at-risk patients on the ward. Intensive Care Medicine 33 (4): 619-624.

Subbe CP, Kruger M, Rutherford P et al. (2001) Validation of a modified Early Warning Score in medical admissions. QJM - Monthly Journal of the Association of Physicians 94 (10): 521-526.

Subbe CP, Slater A, Menon D et al. (2006) Validation of physiological scoring systems in the accident and emergency department. Emergency Medicine Journal 23 (11): 841-845.

Teplick R, Anderson AE (2006) Rapid response systems: Move a bit more slowly. Critical Care Medicine 34 (9): 2507-2509.

Tobin AE, Santamaria JD (2006) After-hours discharges from intensive care are associated with increased mortality. Medical Journal of Australia 184 (7): 334-337.

Uusaro A, Kari A, Ruokonen E (2003) The effects of ICU admission and discharge times on mortality in Finland. Intensive Care Medicine 29 (12): 2144-2148.

Watson W, Mozley C, Cope J et al. (2006) Implementing a nurse-led critical care outreach service in an acute hospital. Journal of Clinical Nursing 15 (1): 105-110.

Whiting P, Edbrook D (2006) Evaluation of critical care outreach: are the resources for outreach justified. In: Cutler L, editor. Critical Care Outreach. Chichester: John Wiley & Sons, Ltd, p 269-281.

Winters BD, Pham J, Pronovost PJ et al. (2006) Rapid response teams--walk, don't run. JAMA 296 (13): 1645-1647.

4.2 Glossary and abbreviations

4.2.1 Glossary

Co-morbidity
Two or more diseases or conditions occurring at the same time, such as depression and anxiety.

Confidence Interval

The range within which the 'true' values (e.g. size of effect of an intervention) are expected to lie with a given degree of certainty (e.g. 95% or 99%). (Note: confidence intervals represent the probability of random errors, but not systematic errors or bias).

Guideline Development Group

The group of academic experts, clinicians and patients responsible for developing the guideline.

ROC curve
In signal detection theory, a Receiver Operating Characteristic (ROC), or simply ROC curve, is a graphical plot of the sensitivity vs. (1-specificity) for a binary classifier system as its discrimination threshold is varied. The ROC can also be represented equivalently by plotting the fraction of true positives (TP) vs. the fraction of false positives (FP). ROC analysis provides tools to select possibly optimal models and to discard suboptimal ones independently from (and prior to specifying) the cost context or the class distribution.

Randomised Control Trial
(also termed **randomised clinical trial**)**:** An experiment in which investigators randomly allocate eligible people into groups to receive or not to receive one or more interventions that are being compared. The results are assessed by comparing outcomes in the different groups. Through randomisation, the groups should be similar in all aspects apart from the treatment they receive during the study.

Cohort study
(also known as **follow-up**, **incidence**, **longitudinal**, or **prospective study**): An observational study in which a defined group of people (the cohort) is followed over time. Outcomes are compared in subsets of the cohort who were exposed or not exposed (or exposed at different levels) to an intervention or other factor of interest.

Relative Risk
Also known as risk ratio; the ratio of risk in the intervention group to the risk in the control group. The risk (proportion, probability or rate) is the ratio of people with an event in a group to the total in the group. A relative risk (RR) of 1 indicates no difference between comparison groups. For undesirable outcomes, an RR that is less than 1 indicates that the intervention was effective in reducing the risk of that outcome.

Generalisability
The degree to which the results of a study or systematic review can be extrapolated to other circumstances, particularly routine healthcare situations in the NHS in England and Wales.

Systematic Review
Research that summarises the evidence on a clearly formulated question according to a pre-defined protocol using systematic and explicit methods to identify, select and appraise relevant studies, and to extract, collate and report their findings. It may or may not use statistical meta-analysis.

Case control study
Comparative observational study in which the investigator selects individuals who have experienced an event (for example, developed a disease) and others who have not (controls), and then collects data to determine previous exposure to a possible cause.

Before-and-after study
A study design that involves of intervention and control groups other than by random process, and inclusion of baseline period of assessment of main outcomes. There are two minimum criteria for this study design which are: (i) pre and post intervention periods for study and control sites are the same, and

(ii) studies using second site as controls and the control sites are comparable with respect to dominant reimbursement system, level of care, setting of care and academic status.

Sensitivity (of a test)
The proportion of people classified as positive by the gold standard, who are correctly identified by the study test.

Specificity (of a test)
The proportion of people classified as negative by the gold standard, who are correctly identified by the study test.

Positive predictive value
The proportion of people with a positive test result who actually have the disease.

Negative predictive value
The proportion of patients with negative test results who are correctly diagnosed.

Heterogeneity
A term used to illustrate the variability or differences between studies in the estimates of effects.

Kappa
Kappa coefficient, is a statistical measure of inter-rater reliability. It is generally thought to be a more robust measure than simple percent agreement calculation since kappa takes into account the agreement occurring by chance.

Phenomenological approach
Phenomenology is one of many types of qualitative research that examines the lived experiences of humans. Phenomenological researchers hope to gain understanding of the essential "truths" (ie, essences) of a phenomenon as experienced by people.

Purposive sampling
A purposive sample is one which is selected by the researcher subjectively. The researcher attempts to obtain sample that appears to him/her to be representative of the population and will usually try to ensure that a range from

one extreme to the other is included.

Cost-effectiveness analysis
An economic evaluation that compares alternative options for a specific patient group looking at a single effectiveness dimension measured in a non-monetary (natural) unit. It expresses the result in the form of an incremental (or average or marginal) cost-effectiveness ratio.

Economic Evaluation
Technique developed to assess both costs and consequences of alternative health strategies and to provide a decision making framework.

Guideline Development Group (GDG)
An independent group set up on behalf of NICE to develop a guideline. They include healthcare professionals and patient and carer representatives.

Odds Ratio
A measure of treatment effectiveness. The odds of an event happening in the intervention group, divided by the odds of it happening in the control group. The 'odds' is the ratio of non-events to events.

Quality-adjusted life year (QALY)
A measure of health outcome which assigns to each period of time a weight, ranging from 0 to 1, corresponding to the health-related quality of life during that period, where a weight of 1 corresponds to optimal health, and a weight of 0 corresponds to a health state judged equivalent to death; these are then aggregated across time periods.

4.2.2 Abbreviations

CCA	Critical Care Area
ICU	Intensive Care Unit
HDU	High Dependency Unit
GDG	Guideline Development Group
TT	Track and Trigger
SDO	National Institute for Health Research Service Delivery & Organisation
ICNARC	Intensive Care National Audit and Research Centre
RCT	Randomised Control Trial
DNR	Do-not-resuscitate

CPR	Cardiopulmonary Resuscitation
PPV	Positive Predictive Value
NPV	Negative Predictive Value
PART	Patient-At-Risk-Team
PAR	Patient-At-Risk Score
MET	Medical Emergency Team
EWS	Early Warning Score
MEWS	Modified Early Warning Score
ASSIST	Assessment Score for Sick patient Identification and Step-up in Treatment
CI	Confidence Interval
CAT	Cardiac Arrest Team
SD	Standard Deviation
APACHE	Acute Physiology and Chronic Health Evaluation
CCOS	Critical Care Outreach Services
CCOT	Critical Care Outreach Team
LOS	Length of Stay
RRS	Rapid Response Systems
OR	Odds Ratio
adj	adjusted
QALY	Quality Adjusted Life Year
DIPEx	Database of Individual Patient Experiences
LMT	Limitation of Medical Treatment Status
PICO	Population, Intervention, Comparison, Outcome
EED	Economic Evaluation Database
HEED	Health Economic Evaluations Database
EPOC	Effective Practice and Organisation of Care Group
NCC	National Collaborating Centre
NPSA	National Patient Safety Agency
CASPE	Clinical Accountability, Service Planning and Evaluation
HQS	Health Quality Service
GRP	Guideline Review Panel
RR	Relative Risk
ROC	Receiver Operating Characteristic