NATIONAL CLINICAL EFFECTIVENESS COMMITTEE

Tús Áite do Shábháilteacht Othar
Patient Safety First

National Early Warning Score

National Clinical Guideline No. 1

An Roinn Sláinte
DEPARTMENT OF HEALTH

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The National Early Warning Score and COMPASS© Education programme project is a work stream of the National Acute Medicine Programme, HSE, in association with the National Critical Care Programme, HSE, the National Elective Surgery Programme, HSE, the National Emergency Medicine Programme, HSE, the Quality and Patient Safety Directorate, HSE, Patient Representative Groups, Nursing and Midwifery Services Directorate, HSE, the Clinical Indemnity Scheme (State Claims Agency), the Irish Association of Directors of Nursing and Midwifery (IADNAM), and the Therapy Professionals Committee.

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Appendix 3 Updated National Patient Observation Chart.

Disclaimer
The National Governance/National Clinical Guideline Development Group's expectation is that healthcare professionals will use clinical judgement, medical and nursing knowledge in applying the general principles and recommendations contained in this document. Recommendations may not be appropriate in all circumstances and decisions to adopt specific recommendations should be made by the practitioner taking into account the circumstances presented by individual patients and available resources.

National Clinical Effectiveness Committee (NCEC)

The National Clinical Effectiveness Committee (NCEC) was established as part of the Patient Safety First Initiative in September 2010. The NCECs mission is to provide a framework for national endorsement of clinical guidelines and audit to optimise patient and service user care. The NCEC has a remit to establish and implement processes for the prioritisation and quality assurance of clinical guidelines and clinical audit so as to recommend them to the Minister for Health to become part of a suite of National Clinical Guidelines and National Clinical Audit.

National Clinical Guidelines are **"systematically developed statements, based on a thorough evaluation of the evidence, to assist practitioner and service users' decisions about appropriate healthcare for specific clinical circumstances across the entire clinical system"**. The implementation of clinical guidelines can improve health outcomes, reduce variation in practice and improve the quality of clinical decisions.

The aim of National Clinical Guidelines is to provide guidance and standards for improving the quality, safety and cost effectiveness of healthcare in Ireland. The implementation of these National Clinical Guidelines will support the provision of evidence based and consistent care across Irish healthcare services.

The oversight of the National Framework for Clinical Effectiveness is provided by the National Clinical Effectiveness Committee (NCEC). The NCEC is a partnership between key stakeholders in patient safety and its Terms of Reference are to:

- Apply criteria for the prioritisation of clinical guidelines and audit for the Irish health system
- Apply criteria for quality assurance of clinical guidelines and audit for the Irish health system
- Disseminate a template on how a clinical guideline and audit should be structured, how audit will be linked to the clinical guideline and how and with what methodology it should be pursued
- Recommend clinical guidelines and national audit, which have been quality assured against these criteria, for Ministerial endorsement within the Irish health system
- Facilitate with other agencies the dissemination of endorsed clinical guidelines and audit outcomes to front-line staff and to the public in an appropriate format
- Report periodically on the implementation of endorsed clinical guidelines.

It is recognised that the health system as a whole, is likely to be able to effectively implement and monitor only a small number of new national clinical guidelines each year. Not all clinical guidelines will be submitted for national endorsement and clinical guideline development groups can continue to develop clinical guidelines using an evidence based methodology in response to the needs of their own organisations.

Information on the NCEC and endorsed national clinical guidelines is available on the Patient Safety First website at www.patientsafetyfirst.ie

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1.0 Definition of Early Warning Scores and Scope of the National Clinical Guideline

1.1 Definition of Early Warning Scores

Early Warning Scores have been developed to facilitate early detection of deterioration by categorising a patient's severity of illness and prompting nursing staff to request a medical review at specific trigger points (Mitchell *et al*., 2010) utilising a structured communication tool while following a definitive escalation plan. Adopting a National Early Warning Score (NEWS) is beneficial for standardising the assessment of acute illness severity, enabling a more timely response using a common language across acute hospitals nationally.

1.2 How Early Warning Scores work in practice

Patient's vital signs (blood pressure, pulse, respirations etc.) are routinely recorded in acute hospitals. With the early warning score system each vital sign is allocated a numerical score from 0 to 3, on a colour coded observation chart (A score of 0 is most desirable and a score of 3 is least desirable). These scores are added together and a total score is recorded which is their early warning score. A trend can be seen whether the patient's condition is improving, with a lowering of the score or dis-improving, with an increase in the score. Care can be escalated to senior medical staff as appropriate.

1.3 Scope of the National Clinical Guideline

The National Clinical Guideline relates to the situation in an acute hospital setting, where an adult patient's physiological condition is deteriorating. The general provision of care in an acute hospital is outside the scope of this document.

The National Clinical Guideline focuses on ensuring that a 'track and trigger' system is in place for adult patients whose condition is deteriorating, and outlines the clinical processes and organisational supports required to implement the guideline.

The National Clinical Guideline does not apply to children or patients in obstetric care, as early detection of deterioration in these two groups of patients are identified by different physiological parameters and signs to those of adult patients in acute hospitals.

The National Clinical Guideline applies to all adult patients in acute hospitals. This includes:

- All inpatients on initial assessment and as per clinical condition and clinical treatment.
- Any outpatient/day service patients who attend acute hospitals for an invasive procedure or who receive sedation.
- All patients attending an Acute Medical Unit/Acute Medical Assessment Unit/Medical Assessment Unit.

The National Clinical Guideline applies to healthcare professionals, doctors, nurses, physiotherapists and other staff involved in the clinical care of patients and managers responsible for the development, implementation, review and audit of deteriorating patient recognition and response systems in individual hospitals or groups of hospitals.

The National Clinical Guideline also applies to education and training support staff involved in the organisation and delivery of the education programme.

2.0 National Clinical Guideline Recommendations

The recommendations are linked to the best available evidence and/or expert opinion.
See Appendices 1 and 2 for grading of evidence linked to each recommendation.

2.1 Essential elements

These elements describe the essential features of the systems of care required to implement the NEWS System, (using the VitalPAC™ Early Warning Score (ViEWS) Parameters) and the NEWS escalation protocol, to recognise and respond to clinical deterioration. Four elements relate to clinical processes that need to be locally delivered, and are based on the circumstances of the acute hospital in which care is provided. A further three elements relate to the structural and organisational prerequisites that are essential for recognition and response systems to operate effectively. The seven core elements to implement the NEWS System are as follows:

Clinical processes
- Measurement and documentation of observations.
- Escalation of care.
- Emergency Response Systems.
- Clinical communication.

Organisational prerequisites for implementation
- Organisational supports.
- Education.
- Evaluation, audit and feedback.

The elements do not prescribe how this care should be delivered. Hospitals need to have systems in place to address all elements in the National Clinical Guideline. The application of the elements in an individual acute hospital will need to be carried out in a way that is relevant to its specific circumstances.

Action required when a patient's condition is deteriorating does not present options for staff who must follow an escalation protocol and act swiftly to prevent further deterioration of the patient's condition.

The recommendations are numbered 1 to 60.

2.2 Clinical processes

The following recommendations relate to clinical processes that need to be locally delivered, and are based on the circumstances of the acute hospital in which care is provided.

2.2.1 Measurement and documentation of observations

Measurable physiological abnormalities occur prior to adverse events such as cardiac arrest. These signs can occur both early and late in the clinical deterioration process. Regular measurement and documentation of physiological observations is an essential requirement for recognising clinical deterioration.

The following are responsible for implementation of recommendations 1-11: doctors and nurses in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 1
Observations should be taken on all patients admitted to an acute hospital.

Recommendation 2
Observations should be taken on patients at the time of admission or initial assessment if appropriate or as per organisation guideline/protocol, and then documented in the patient's healthcare record and recorded on a chart that incorporates the NEWS System.

Recommendation 3
For every patient, a clear monitoring plan should be developed and documented, that specifies the observations to be recorded and the frequency of observations, taking into account the patient's diagnosis and proposed treatment.

Recommendation 4
The frequency of observations should be consistent with the clinical situation and history of the patient. In the hospital setting the minimum standard for the assessment of vital signs, utilising the NEWS parameters, is every 12 hours. The frequency of patient observations must be reconsidered and modified according to changes in the patient's clinical condition. This should be documented in the monitoring plan and detailed in the medical notes and nursing care plan. This decision should be made in collaboration between nursing staff and the medical team.

Recommendation 5
Physiological observations should include:
- Respiratory rate
- Oxygen saturation - SpO_2
- Heart rate
- Blood pressure
- Temperature
- Level of consciousness
- Where a patient is on inspired oxygen (F_iO_2,) a score of 3 is added.

Recommendation 6
In some circumstances, and for some groups of patients, some observations will need to be measured more or less frequently than others, and this should be specified in the monitoring plan, and documented in the medical notes and nursing care plan.

Recommendation 7
The minimum observations should be documented in a structured observation chart, incorporating the NEWS System.

Recommendation 8
Patient observation charts should display physiological information in the form of a graph. A patient observation chart should include:
1. A system for tracking changes in physiological parameters over time.
2. Thresholds for each physiological parameter or combination of parameters that indicate abnormality.
3. Information about the response or action required when thresholds for abnormality are reached or deterioration identified.
4. The key NEWS parameters are based on the ViEWS system as per the NEWS Observation Chart (Appendix 3).

Practical Guidance
Screen for Sepsis using the Sepsis Screening Form when a patients NEWS is ≥ 4 or (5 on supplementary O_2) or if infection is suspected.

Recommendation 9
Clinical staff may choose to document other observations and assessments to support timely recognition of deterioration. Examples of additional information that may be required include; fluid balance, occurrence of seizures, pain, chest pain, respiratory distress, Glasgow Coma Scale, pallor, capillary refill, pupil size and reactivity, sweating, nausea and vomiting, as well as additional biochemical and haematological analyses.

Recommendation 10
There are also patients for whom the use of the NEWS may be inappropriate, such as during the end stages of life and advanced palliative care. Although the majority of patients will benefit from utilisation of NEWS the clinician's own clinical judgement dictates whether the patient will require to be regularly scored for the NEWS, and how regularly vital signs assessment is required. A note should also be made in the patient's healthcare record documenting why the decision was made not to use the NEWS.

Recommendation 11
When a patient is being continuously monitored using electronic technology, a full set of vital signs must be documented on the observation chart.

See Appendix 3 for the NEWS Observation Chart and Appendix 4 for recommended audit tools with specific audit criteria.

2.2.2 Escalation of care

An escalation protocol sets out the organisational response required in dealing with different levels of abnormal physiological measurements and observations. This response may include appropriate modifications to nursing care, increased monitoring, review by the primary medical practitioner or team or "on call team" or calling for emergency assistance from intensive care or other specialist teams or activating the Emergency Response System. The National Governance Group/National Clinical Guideline Development Group recommend that the escalation protocol be outlined on the National Patient Observation Chart (Appendix 5).

It is the responsibility of each acute hospital service to outline clearly their escalation protocol for patients whose condition is deteriorating at present and in the future, taking into account the recommendations of the National Acute Medicine Programme (HSE, 2011) and other relevant clinical programmes in line with requirements of the Health Information and Quality Authority and the Clinical Indemnity Scheme.

Primary responsibility for caring for the patient rests with the primary medical practitioner or team. In this context, the escalation protocol describes the additional supporting actions that must exist for the management of all patients. Although these actions should be tailored to the circumstances of the acute hospital, it should include some form of emergency assistance where advanced life support can be provided to patients in a timely way. A protocol regarding escalation of care is an essential requirement for responding appropriately to clinical deterioration.

An audit tool for the utilization of the escalation protocol response to the NEWS for all patients (or a sample of patients) who trigger a NEWS of 3 or more is set out in Appendix 4.

The following are responsible for implementation of recommendations 12-22: doctors and nurses in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 12
A formal documented escalation protocol is required that applies to the care of all patients at all times.

Recommendation 13
The escalation protocol should authorise and support the clinician at the bedside to escalate care until the clinician is satisfied that an effective response has been made.

Recommendation 14
The escalation protocol should be tailored to the characteristics of an acute hospital, including consideration of issues such as:
1. Size and role (e.g. a tertiary referral centre or a small community hospital).
2. Location (relative to other acute hospitals).
3. Available resources (e.g. staffing mix and skills, equipment, telemedicine facilities and external resources such as ambulances).
4. Potential need for transfer to another acute hospital.

Recommendation 15
The escalation protocol should allow for a graded response commensurate with the level of abnormal physiological measurements, changes in physiological measurements or other identified deterioration. The graded response should incorporate options such as:
1. Increasing the frequency of observations.
2. Appropriate interventions from nursing and medical staff on wards and review by the primary medical practitioner or team in an acute hospital.
3. Obtaining emergency assistance or advice.
4. Transferring patients to a higher level of care locally, or to another acute hospital.

Recommendation 16
The escalation protocol should specify:
1. The levels of physiological abnormality or abnormal observations at which patient care is escalated.
2. The response that is required for a particular level of physiological or observed abnormality.
3. How the care of the patient is escalated.
4. To whom care of the patient is escalated, noting the responsibility of the primary medical practitioner or team in an acute hospital.
5. Who else is to be contacted when care of the patient is escalated.
6. The timeframe in which a requested response should be provided.
7. Alternative or back up options for obtaining a response.

Practical Guidance
In the 4-6 score section of the Escalation Protocol an alert to screen for Sepsis should be included.

Recommendation 17
The way in which the NEWS protocol for escalation is applied should take into account the clinical circumstances of the patient, including both the absolute change in physiological measurements and abnormal observations, as well as the rate of change over time for an individual patient.

Recommendation 18
The escalation protocol may specify different actions depending on the time of day or day of the week, or for other circumstances.

Recommendation 19
The escalation protocol should allow for the capacity to escalate care based only on the concern of the clinician at the bedside in the absence of other documented abnormal physiological measurements ('staff member worried' criterion).

Recommendation 20
The escalation protocol should allow for the concerns of the patient, family or carer to trigger an escalation of care.

Recommendation 21
The escalation protocol should include consideration of the needs and wishes of patients where treatment-limiting decisions (ceilings of care) have been made.

Recommendation 22
The escalation protocol should be disseminated widely and included in education programmes. On induction to an organisation all staff should be made aware of the escalation protocol.

2.2.3 Emergency Response Systems

To effectively manage patients whose clinical condition is deteriorating, or patients with complex clinical requirements, it is essential that the system of care ensures timely decision making and emergency response by appropriately qualified clinical personnel (HIQA, 2011). Different models that have been used to provide this assistance include senior medical staff, Emergency Response System, and critical care outreach (if available). The generic name for this type of emergency assistance is 'Emergency Response System'. The emergency assistance provided as part of a rapid response is additional to the care provided by attending medical personnel or primary medical team.

For most facilities, the Emergency Response System will include clinicians or teams located within the hospital who provide emergency assistance. In some acute hospitals the system may be a combination of on-site and external clinicians or resources (such as the ambulance service or local general practitioner). However comprised and however named an Emergency Response System should form part of an organisation's escalation protocol.

The following are responsible for implementation of recommendations 23-33: doctors and nurses in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 23
Some form of Emergency Response System should exist to ensure that specialised and timely care is available to patients whose condition is deteriorating.

Recommendation 24
Criteria for triggering the Emergency Response System should be included in the escalation protocol. Where severe deterioration occurs it is important to ensure that the capacity exists to obtain appropriate emergency assistance or advice prior to the occurrence of an adverse event such as a cardiac arrest.

Recommendation 25
The nature of the Emergency Response System needs to be appropriate to the size, role, resources and staffing mix of a hospital.

Recommendation 26
The clinicians providing emergency assistance as part of the Emergency Response System should:
1. Be available to respond within agreed timeframes.
2. Be able to assess a patient and provide a provisional diagnosis.
3. Be able to undertake appropriate initial therapeutic intervention.
4. Be able to stabilise and maintain a patient, pending decisions on further management.
5. Have authority to make transfer decisions and to access other care providers to deliver definitive care.

Recommendation 27
As part of the Emergency Response System there should be access, at all times, to at least one clinician, either on-site or accessible, who can practice advanced life support.

Recommendation 28
The clinicians providing emergency assistance should have access to medical staff members of sufficient seniority to make treatment-limiting decisions. Where possible these decisions should be made with input from the patient, family and the primary medical practitioner or team in an acute hospital.

Recommendation 29
In cases where patients need to be transferred to another acute hospital to receive emergency care, appropriate care needs to be provided until such assistance is available.

Recommendation 30
When a call is made for emergency assistance, the attending medical practitioner or team should be notified at the same time that the call has been made, and where possible, they should attend to provide relevant medical information regarding their patient, provide support and learn from the clinicians providing assistance.

Recommendation 31
All opportunities should be taken by the clinicians providing emergency assistance to use the call as an educational opportunity for ward staff and pre-registered medical, nursing and therapies students.

Recommendation 32
The clinicians providing emergency assistance should communicate in an appropriate, detailed and structured way with the primary medical practitioner or team in an acute hospital about the consequences of the call for emergency assistance, including documenting information in the healthcare record.

Recommendation 33
Events surrounding a call for emergency assistance and actions resulting from a call should be documented in the healthcare record and considered as part of on-going quality improvement processes. Records should be suitable for audit purposes.

2.2.4 Clinical communication

Effective communication and team work among clinicians is an essential requirement for recognising and responding to clinical deterioration. Poor communication at handover and in other situations has been identified as a contributing factor to incidents where clinical deterioration is not identified or properly managed. A number of structured communication protocols exist that can be used for handover and as part of on-going patient management. The recommended communication tool for healthcare professionals, particularly when communicating in relation to the deteriorating patient, is ISBAR (Appendix 6). A data collection tool for ISBAR communication audit with specific criteria is outlined in Appendix 4.

The following are responsible for implementation of recommendations 34-36: doctors and nurses in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 34
Formal communication protocols should be used to improve the functioning of teams when caring for a patient whose condition is deteriorating.

Recommendation 35
The value of information about possible deterioration from a patient, family or carer should be recognised.

Recommendation 36
Information about deterioration should be communicated to the patient, family or carer in a timely and ongoing way, and documented as appropriate in the healthcare record.

2.3 Implementation

The following recommendations are essential for recognition and response systems to operate effectively.

2.3.1 Organisational supports

Recognition and response systems should be part of standard clinical practice. Nonetheless, the introduction of new systems to optimise care of patients whose condition is deteriorating requires organisational support and executive and clinical leadership for success and sustainability. An acute hospital should set up a NEWS group/committee to consider and agree the processes and stages of implementation for the NEWS system and the NEWS protocol for escalation (Appendix 5).

The following are responsible for implementation of recommendations 37-43: the multi-disciplinary group/committee and senior management in an acute hospital.

Recommendation 37
This National Clinical Guideline should be implemented across all acute hospitals, and the planned variations in the escalation protocol and responses that might exist in different circumstances (such as for different times of day or at night) identified.

Recommendation 38
A formal guideline/policy framework for the implementation of the National Clinical Guideline should include issues such as:
1. Governance arrangements.
2. Roles and responsibilities.
3. Communication processes.
4. Resources for the Emergency Response System, such as staff and equipment.
5. Education and training requirements.
6. Evaluation, audit and feedback processes.
7. Arrangements with external organisations that may be part of a rapid response system.
8. Documentation regulation and management of records.
9. Patient and service user involvement.

Recommendation 39
Any new recognition and response systems or procedures should be integrated into existing organisational safety and quality systems to support their sustainability and opportunities for organisational learning.

Recommendation 40
Recognition and response systems should encourage healthcare staff to react positively to escalation of care, irrespective of circumstances or outcome.

Recommendation 41
There should be appropriate policies and documentation regarding 'Do Not Resuscitate' decisions; treatment-limiting decisions (ceilings of care); and end-of-life decision making as they are critical in ensuring that the care delivered in response to deterioration is consistent with appropriate clinical practice and the patient's expressed wishes.

Recommendation 42
A formal governance process (such as a NEWS System group/committee) should oversee the development, implementation and ongoing review of recognition and response systems locally. It should:
1. Have appropriate responsibilities delegated to it and be accountable for its decisions and actions.
2. Monitor the effectiveness of interventions and education.
3. Have a role in reviewing performance data, and audits.
4. Provide advice about the allocation of resources.
5. Include service users, clinicians, managers and executives.

Recommendation 43
Organisations should have systems in place to ensure that the resources required to provide emergency assistance (such as equipment and pharmaceuticals) are always operational and available.

2.3.2 Education

The education programme recommended by the National Governance/National Clinical Guideline Development Group is the COMPASS© programme. This should be available to healthcare staff such as doctors, nurses and allied health professionals. The COMPASS© programme should be delivered in full (see more details in Appendix 7). In addition, education in the use of the national patient observation chart incorporating the NEWS should be facilitated. The education and training needs should be coordinated by designated staff within, or supporting, the acute

hospital. In addition continuation of training in basic life support and professional development training in advanced life support programmes, appropriate to the acute hospital, is advised.

Having an educated and suitability skilled and qualified workforce is essential in providing appropriate care to patients whose condition is deteriorating. Education should provide knowledge of observations and identification of clinical deterioration, as well as appropriate clinical management skills. Skills such as communication and effective team working are needed to provide appropriate care to a patient whose condition is deteriorating, and should also be part of staff development.

The following are responsible for the implementation of recommendations 44-47: doctors, nurses, senior management, healthcare educators and physiotherapists (where appropriate) in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 44
The education programme recommended by the National Governance/National Clinical Guideline Development Group is the COMPASS© programme and must be delivered in full. All clinical and non-clinical staff should receive education about the local escalation protocol relevant to their position. They should know how to call for emergency assistance if they have any concerns about a patient, and know that they should call under these circumstances. This information should be provided at the commencement of employment and as part of regular refresher education and training.

Recommendation 45
All medical and nursing staff should be able to:
1. Systematically assess a patient.
2. Understand and interpret abnormal physiological parameters and other abnormal observations.
3. Understand and operationalise the NEWS system and NEWS protocol for escalation of care.
4. Initiate appropriate early interventions for patients who are deteriorating.
5. Respond with life-sustaining measures in the event of severe or rapid deterioration pending the arrival of emergency assistance.
6. Communicate information about clinical deterioration in a structured and effective way to the primary medical practitioner or team in an acute hospital, to clinicians providing emergency assistance and to patients, families and carers.
7. Understand the importance of, and discuss, end-of-life care planning with the patient, family and/or carer.
8. Undertake tasks required to properly care for patients who are deteriorating such as developing a clinical management plan, writing plans and actions in the healthcare record and organising appropriate follow up.

Practical Guidance
Commence Sepsis Screening using the Sepsis Screening Form when the patient has a NEWS of ≥4 (5 on supplementary O_2) or if infection is suspected.

Recommendation 46
As part of the Emergency Response System, competency in advanced life support should be ensured for a sufficient number of clinicians who provide emergency assistance to guarantee access to these skills according to local protocols.

Recommendation 47
A range of methods should be used to provide the required knowledge and skills to staff. These may include provision of information at orientation and regular refresher programmes using face-to-face and online techniques, as well as simulation centres and scenario-based education and training.

2.3.3 Evaluation and audit

Evaluation and audit are an important part of the implementation of this initiative. It is recommended that the audit process is coordinated locally in each acute hospital by the local NEWS group/ committee. The audit process should be undertaken from a multidisciplinary perspective where appropriate. In planning the audits to be undertaken, consideration should be given to the frequency of the audits. For example, these could occur 6 weekly initially then quarterly, once the implementation process has become established.

For process audits the recommended standard required is 100% compliance. Where the compliance is less than 80% it is proposed that local action plans are put in place, e.g. increase frequency of audits and identify problem areas. The recommended sample size for the audit is one third of patients' charts in the ward/unit/department. More detailed audits can be carried out on the patients triggering a score of 3 or more from the sample obtained.

Measuring outcomes are particularly important to demonstrate the effectiveness or otherwise of the intervention for patients. These include:

1. Basic patient outcome measures (e.g. hospital length of stay (HLOS), transfer to HDU, ICU, ICU length of stay, unexpected death.
2. Identification of the location to which the patient has been transferred or otherwise, for those triggering a response.
3. Scope of care decisions i.e. 'Do Not Resuscitate' or 'Palliative care' order.

The audit results and reports should be discussed at the NEWS group/committee initially, and thereafter linking into appropriate hospital forums as required. The clinical audit cycle as part of the continuous quality improvement process should inform the audit plan.

The following are responsible for implementation of recommendations 48-60: doctors, nurses, senior managers and audit staff, in consultation with the NEWS multi-disciplinary group/committee in an acute hospital.

Recommendation 48
Evaluation of new systems is important to establish their efficacy and determine what changes might be needed to optimise performance. Therefore on-going monitoring is necessary to track changes in outcomes over time and to check that these systems are operating as planned.

Recommendation 49
Data should be collected and reviewed locally and over time regarding the implementation and effectiveness of recognition and response systems, namely the NEWS system.

Recommendation 50
The NEWS and escalation of care protocol should be evaluated to determine whether it is operating as planned. Evaluation may include checking the existence of required documentation, guidelines, policies and protocols and compliance with same (such as completion rates of observation charts or proportion of staff who have received education and training).

Recommendation 51
Clinical audit is recommended to support the continuous quality improvement process in relation to implementation of the NEWS system (Appendix 4). The recommended minimum for audit includes:
1. Utilization of the ISBAR communication tool.
2. Utilization and accuracy of completion of the patient observation chart incorporating the NEWS.
3. Utilization of the 'track and trigger' response – the NEWS protocol.

Recommendation 52
Systems should be evaluated to determine whether they are improving the recognition of, and response to, clinical deterioration. Evaluation may include collecting and reviewing data about calls for emergency assistance, and adverse events such as cardiac arrests, unplanned admissions to intensive care and hospital deaths.

Recommendation 53
The following data should be collated for each call for emergency assistance that is made to the Emergency Response System:
1. Patient demographics.
2. Date and time of call.
3. Response time.
4. Reason for the call.
5. The treatment or intervention required.
6. Outcomes of the call, including disposition of the patient.

Recommendation 54
Regular audits of triggers and outcomes should be conducted for patients who are the subject of calls for emergency assistance. Where these data are available, this could include longer-term outcomes for patients (such as 30 and 60 day hospital mortality).

Recommendation 55
Evaluation of the costs and potential savings associated with recognition and response systems could also be considered.

Recommendation 56
Information about the effectiveness of the recognition and response systems may also come from other clinical information such as incident reports, root-cause analyses, cardiac arrest calls and death reviews. A core question for every death review should be whether the escalation criteria for the Emergency Response System were met, and whether care was escalated appropriately.

Recommendation 57
As part of the implementation of new systems, feedback should be obtained from frontline staff about the barriers and enablers to change. Issues and difficulties regarding implementation should be considered for different acute hospitals.

Recommendation 58
Consistent with any implementation process, information collected as part of on-going evaluation and audit should be:

1. Part of a feedback process to ward staff and the primary medical practitioner or team in an acute hospital regarding their own calls for emergency assistance.
2. Part of a feedback process to the clinicians providing emergency assistance.
3. Reviewed to identify lessons that can improve clinical and organisational systems.
4. Used in education and training programmes.
5. Used to track outcomes and changes in performance over time.
6. Used to implement remedial actions.

Recommendation 59
Indicators of the implementation and effectiveness of recognition and response systems should be monitored at senior governance levels within the organisation (such as by senior executives or relevant quality committees). It is recommended that the audit process in each acute hospital is overseen by the NEWS group/committee at local level.

Recommendation 60
It is recommended that the NEWS parameters are reviewed annually and updated as new information becomes available either from national or international audits or research.

Specific audit criteria are outlined in sample audit tools set out in Appendix 4.

2.4 Using this National Clinical Guideline

This document is intended to be relevant to healthcare professionals in acute hospitals nationally who are involved in direct clinical care of adult patients. It is also relevant for hospital managers, risk managers and quality and patient safety personnel. The target group is adult patients in acute hospitals.

3.0 National Clinical Guideline

3.1 Overview

Patient safety and the quality of care are central to the delivery of healthcare. The National Early Warning Score (NEWS) and associated education programme for the early detection and management of deteriorating patients is about improving outcomes for patients by improving the safety record in the health services.

Patients are entitled to the best possible care and need to be confident that should their clinical condition deteriorate they will receive prompt and effective treatment. Early recognition of clinical deterioration, followed by prompt and effective action, can minimise the occurrence of adverse events such as cardiac arrest, and may mean that a lower level of intervention is required to stabilise a patient.

More recent evidence, and international experience, has identified that a systematic approach to identification and management of the deteriorating patient can improve patient outcomes (Steen, 2010). Early warning scores have been developed to facilitate early detection of deterioration by categorising a patient's severity of illness and prompting nurses, and other healthcare professionals, to request a medical review at specific trigger points, utilising a structured communication tool whilst following a definitive escalation plan.

This National Clinical Guideline defines the nationally agreed practice for recognising and responding to clinical deterioration. The recommended scoring system for recognising clinical deterioration of adult patients in acute hospitals is the National Early Warning Score, using the VitalPAC™ Early Warning Score (ViEWS) parameters. This system provides a point in time for communicating the changes in patients' vital signs and empowers nurses and junior doctors to take appropriate action. It does not replace clinical judgement where staff must escalate care regardless of the score if they are concerned about a patient. The NEWS escalation protocol provides guidance on the response required for the deteriorating patient. Both the NEWS system and the escalation protocol should be implemented in acute hospitals. To achieve this, acute hospitals need to have systems in place to address all the elements of this National Clinical Guideline.

Consistent use of a NEWS ensures standardisation in the assessment of acute illness severity, enabling a more timely response using a common language across acute hospitals nationally. "This will ensure that severity of illness and the rate of clinical deterioration can be explicitly stated and understood throughout the entire Irish hospital service. This will facilitate the early detection and transfer of patients who are likely to deteriorate. The NEWS will also facilitate reverse flow of stabilised patients. This should ensure improved inter-professional communication and facilitate better and more uniform patient care. It will also enable audit of outcomes and performance comparison between different healthcare facilities" (HSE, 2010).

This National Clinical Guideline directs staff towards best practice and must always be used in conjunction with clinical judgement. Each healthcare professional is individually accountable to keep up to date with advances in the use of the NEWS, observation recording, recognition of the deteriorating patient and must acknowledge any limitations in their own competence. Accountability is an integral part of professional practice. Practising in an accountable manner requires a sound knowledge base upon which to make decisions in conjunction with clinical judgement.

3.2 Purpose/objectives

The purpose of the National Clinical Guideline is to describe the elements that are essential for prompt and reliable recognition of, and response to, clinical deterioration of patients in acute hospitals.

The National Clinical Guideline should guide staff in acute hospitals in developing recognition and response systems tailored to their adult patient population, and to the resources and personnel available.

The National Clinical Guideline supports; the implementation of the NEWS, the multidisciplinary education programme COMPASS©, and the standard communication tool 'ISBAR' (**I**dentification; **S**ituation; **B**ackground; **A**ssessment; **R**ecommendation).

3.3 Legislation and other related policies

- An Bord Altranais (2000), The Code of Professional Conduct for each Nurse and Midwife.
- An Bord Altranais (2000), Scope of Nursing and Midwifery Practice Framework.
- An Bord Altranais (2002), Recording Clinical Practice Guidance to Nurses and Midwives.
- Government of Ireland, The Health Act 2004.
- Health Information and Quality Authority (2012), National Standards for Safer Better Healthcare.
- Health Service Executive (2007), Quality and Risk Management Standard.
- Health Service Executive (2008), Code of Practice for Integrated Discharge Planning HSE.
- Health Service Executive (2009), Framework for the Corporate and Financial Governance of the HSE, Document 1.1 (V3).
- Health Service Executive (2010), Report of the National Acute Medicine Programme.
- National Hospitals Office (2007), Code of Practice Standards for Healthcare Records Management.

3.4 Guiding principles for the National Clinical Guideline

The following are guiding principles identified as part of the National Clinical Guideline:

- Recognising patients whose condition is deteriorating and responding to their needs in an appropriate and timely way are essential components of safe and high quality care.
- Recognition and response systems should apply to all adult patients, in all patient care areas, at all times in acute hospitals.
- Primary responsibility for caring for the patient rests with the primary medical practitioner or team in an acute hospital. The utilisation of a NEWS system and the NEWS escalation protocol/response system should, therefore, promote effective action by ward staff and the primary medical practitioner or team, or the attending medical practitioner or team. This includes calling for emergency assistance when required utilising the Emergency Response System as appropriate.
- Effectively recognising and responding to patients whose condition is deteriorating requires appropriate communication of diagnosis, including documentation of diagnosis in the healthcare record and verbal handover. Ideally the ISBAR tool should be used as this promotes effective communication (Appendix 6).
- Effectively recognising and responding to patients whose condition is deteriorating requires development and communication of plans for monitoring of observations and on-going management of the patient.
- Recognition of, and response to, patients whose condition is deteriorating requires access to appropriately qualified, skilled and experienced staff.
- Recognition and response systems should encourage a positive, supportive response to escalation of care, irrespective of circumstances or outcome.

- Care should be patient-focused and appropriate to the needs and wishes of the individual and their family or carer.
- Organisations should regularly review the effectiveness of the recognition and response systems they have in place.

3.5 Implementation

The HSE is in the process of dissemination and implementation of the NEWS and education programme.

3.5.1 Barriers to implementation

The following include barriers to implementation of the National Clinical Guideline. One of the main barriers to implementation of the NEWS and education programme is unwillingness to change a culture that has been in place for over a century.

Others barriers include lack of:

- Leadership in acute hospitals
- Governance arrangements in the organisation
- Clearly identified roles and responsibilities
- Communication processes
- Resources for the Emergency Response System, such as staff and equipment suitable for NEWS recording and transfer of information
- Education, training and information for clinical staff on the early detection and management of the deteriorating patient
- Technological supports for evaluation, audit and feedback processes
- Arrangements with external organisations that may be part of a rapid response system for the safe transfer of patients.

Multi-disciplinary teams in organisations examining solutions to improve patient care will need to address the barriers identified.

3.5.2 Enablers for implementation

The main enabler for successful and sustained implementation is committed staff at senior level as well as in the clinical areas of the health service as follows:

- Good leadership in acute hospitals
- Good governance arrangements
- Clearly identified roles and responsibilities
- Preliminary data identifying success of the programme e.g. resuscitation in cardio-respiratory arrests
- Multi-disciplinary team working
- Good communication processes
- Technological support for the programme
- Sharing of information
- Effective education and training of staff (at induction, at undergraduate level and for current staff)
- Good arrangements for safely transferring patients to higher levels of care.

The potential barriers and enablers for implementation are not an exhaustive list, and each acute hospital site must identify site specific issues and manage these appropriately.

3.6 Dissemination

The National Clinical Guideline is available on the websites:
www.hse.ie/go/nationalearlywarningscore/ and www.patientsafetyfirst.ie

In the HSE a communication will be sent to: all clinical directors, acute hospital managers, directors of nursing and midwifery, NEWS contacts in all acute hospitals, former members of the Advisory Group and patient groups. Communication will also be made with the Royal College of Physicians and Royal College of Surgeons.

3.7 Updating the National Clinical Guideline

This National Clinical Guideline is due for review in January 2014. At that time a systematic search of the literature for new evidence will be conducted. External colleagues and international experts in this area will be circulated with the current National Clinical Guideline and their views sought for updates. Any agreed update will be approved by the National Governance/National Clinical Guideline Development Group. Following this it will be submitted to the National Clinical Effectiveness Committee for review and endorsement.

3.8 Roles and responsibilities

The NEWS is a clinical assessment tool and does not replace the clinical judgement of a qualified healthcare professional. Where there are concerns regarding a patient's condition, staff should not hesitate in contacting a senior member of the patient's medical team to review the patient, irrespective of the NEWS.

3.8.1 Organisational responsibility

Within each organisation corporate responsibility is required for the implementation of the NEWS to ensure that there is a system of care in place for the prompt identification and management of clinically deteriorating patients.

3.8.1.1 Senior managers

- Assign personnel with responsibility, accountability and autonomy to implement the NEWS.
- Provide managers with support to implement the NEWS.
- Ensure local policies and procedures are in place in each acute hospital to support implementation.
- Monitor the implementation of the NEWS System to support on-going evaluation and any actions required following the evaluation.
- Link the implementation group/committee with corporate responsibility.

3.8.1.2 Senior management – acute hospitals

- Provide a local governance structure to support the implementation and on-going evaluation of the NEWS.
- Ensure clinical and educational staff are supported to implement the NEWS.
- Ensure development of local policies to support the NEWS implementation, management of the clinically deteriorating patient, and associated audit and evaluation.

3.8.1.3 Heads of department

- Ensure all relevant staff members are aware of this National Clinical Guideline and supporting policies.
- Monitor local implementation of the NEWS System, incorporating the NEWS Protocol and its outcomes.
- Ensure staff are supported to undertake the COMPASS© education programme and related training, as appropriate to an acute hospital.

3.8.2 All clinical staff

All clinical staff should comply with this National Clinical Guideline and related policies, procedures and protocols. Clinical staff should adhere to their professional scope of practice guidelines and maintain competency, in recognising and responding to patients with clinical deterioration, including the use of the NEWS System, where this is within their scope of practice. In using this guideline professional healthcare staff must be aware of the role of appropriate delegation.

4.0 Background to the development of the NEWS and associated education programme

The Royal College of Physicians in Ireland in conjunction with the Health Service Executive were instrumental in setting up of a number of clinical programmes under the Clinical Strategy and Programmes Directorate, Health Service Executive (HSE), in 2010. The National Acute Medicine Programme was one such programme.

As patient safety and quality are central to the delivery of healthcare, the National Acute Medicine Programme identified that agreement of a NEWS and associated education programme was a priority, making it one of its main work streams.

The body of evidence is increasing with regard to the failure to recognize and manage deteriorating patients on general ward areas. There is evidence to demonstrate that patients who have become acutely unwell on general wards may have received suboptimal care and that action taken during these early stages can prevent deterioration progressing to cardiac arrest (Smith *et al*., 2006).

Recent evidence identified that a systematic approach to early detection and management of patients, whose condition deteriorates, improves outcomes for patients (Steen, 2010).

A national lead was identified and a National Governance Group/National Clinical Guideline Development Group supported by a National Advisory Group was set up with representation from a wide group of stakeholders. The National Governance Group/National Clinical Guidline Development Group is the high level decision making group.

The overall aim of the NEWS Programme was to develop one integrated solution for a NEWS and associated education programme and to develop a National Clinical Guideline in support of this. The scope of the work includes adult patients in acute hospital services and does not apply to children or patients in obstetric care, as early detection of clinical deterioration in these two groups of patients are identified by different physiological parameters and signs to those of adult patients in acute healthcare settings.

A fundamental part of any patient assessment is the accurate recording of, and interpretation of, vital signs and yet it is this crucial step that is often omitted, in particular the recording of respiratory rate (Van Leuvan and Mitchell, 2008).

A large proportion of patients who suffer cardio-respiratory arrest in hospital have recognisable changes in routine observations during the preceding twenty-four hours including changes in vital signs, level of consciousness and oxygenation (Hillman *et al*., 2001).

The National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2005) reported that patients often had prolonged periods of physiological instability prior to admission to ICU. Of the in-patients admitted to hospital more than 24 hours prior to ICU admission, 66% exhibited physiological instability for more than 12 hours. This 2005 study of 1,677 admissions to general ICUs across England, Wales, Northern Ireland, Guernsey and the Isle of Man also reported that 27% of hospitals did not use an early warning system. In addition one in four hospitals did not use some form of 'track and trigger' system to allow early identification of deteriorating patients. ICU admission was thought to be avoidable in 21% of cases and communication failures between teams contributed to delays in referrals and in delivering appropriate essential care, which contributed to increased morbidity and mortality. The NCEPOD team recommended that more

attention should be paid to patients exhibiting physiological abnormalities as this is a marker of increased mortality. In addition robust 'track and trigger' systems should be in place to cover all inpatients. These should be linked to a response team that is appropriately skilled to assess and manage a patient whose condition is deteriorating.

More recently the NCEPOD (2012) report – *'Time to Intervene'* was published. This report identified a study of 593 patients who underwent cardio-pulmonary resuscitation in 585 areas of acute hospitals (incl. emergency departments), as a result of an in-patient cardio-respiratory arrests in England, Wales, Northern Ireland, Isle of Man, Guernsey and Jersey. Results showed that 28% of cardio-pulmonary resuscitation occurred in surgical areas, 27% in medical areas, 12% in coronary care units, and 8% in Emergency Departments. The reported findings were as follows:

1. 68% of patients had been in hospital for longer than 24 hours prior to cardiac arrest.
2. Warning signs for cardiac arrest were present in 75% of cases. These warning signs were recognised poorly, acted on infrequently, and escalated to more senior doctors infrequently.
3. Cardiac arrest was predictable in 64% of cases and potentially avoidable in 38% of cases.

The National Institute for Health and Clinical Excellence (NICE) *National Clinical Guideline 50: Acutely ill patients in hospital* (NICE, 2007) recommended physiological 'track and trigger' systems should be used to monitor all adult patients in acute hospital settings, including patients in the emergency department.

HIQA issued a recommendation as part of an investigative report, in 2011, stating that "the HSE should, as a priority, agree and implement a national early warning score to ensure that there is a system of care in place for the prompt identification and management of clinically deteriorating patients" (HIQA, 2011). A second recommendation was issued by HIQA in 2012, following a further investigative report into an adverse incident.

The Clinical Indemnity Scheme (part of the State Claims Agency) identified the implementation of a National Early Warning Score as a priority in 2011.

4.1 Benefit of using a NEWS

The main benefit of adopting a NEWS is the standardisation in the assessment of acute illness severity, enabling a more timely response to patients who are deteriorating, using a common language across acute hospitals nationally.

The potential for standardisation of an education programme for the early detection and management of deteriorating patients as well as the development of a National Patient Observation Chart was identified. This means that staff moving between hospitals will be familiar with the National Early Warning Score, the education programme as well as the charts in use, thus reducing the risk of errors and education costs. This will contribute to the reduction in variation of care and improvement in communication.

The National Governance Group/National Clinical Guideline Development Group highlighted that using the NEWS does not replace clinical judgement of experienced staff where they can escalate care regardless of the score if they are concerned about a patient.

5.0 Methodology for the development of the NEWS and associated education programme

A National Lead was identified. A multi-disciplinary National Governance/National Clinical Guideline Development Group and Advisory Group were set up. The National Governance/ National Clinical Guideline Development Group is the high level decision making group and includes stakeholders from key areas within and outside the HSE.

The National Advisory Group included key stakeholders with representation invited from each Director of Nursing and Clinical Director in all public and voluntary acute hospitals in the country. This group was set up to carry out specific work elements to advise the National Governance Group/National Clinical Guideline Development Group on issues relating to the agreement of a NEWS and education programme. The work of this group was completed when the NEWS and education programme were agreed.

5.1 Aim of the National Early Warning Score project

The overall aim of the NEWS project and National Governance/National Clinical Guideline Development Group was to develop one integrated solution for a NEWS and associated education programme and to develop a National Clinical Guideline in support of this.

5.2 NEWS National Governance/National Clinical Guideline Development Group and Advisory Group

NEWS National Governance/National Clinical Guideline Development Group

This Group was set up as the high level decision making group and includes stakeholders from key areas within and outside the HSE. This group is the National Clinical Guideline development group. It is planned that at least one meeting of this group will be held annually to provide oversight for the programme.

Ms. Eilish Croke, Chair	National Lead for the National Early Warning Score and COMPASS© Programme, HSE
Prof. Garry Courtney,	Co-sponsor for the NEWS Project and National Clinical Lead - National Acute Medicine Programme, HSE
Prof. Shane O'Neill	Co-sponsor for the NEWS Project. Consultant Physician, Beaumont Hospital, Dublin
Dr. Michael Shannon	Director, Office of Nursing and Midwifery Services Directorate (ONMSD), Asst. National Director Clinical Strategy and Programmes, HSE
Dr. Siobhan O'Halloran	Former Asst. National Director, Acute Hospital Services, HSE
Ms. Avilene Casey	Chair – NEWS Advisory Group, HSE and IADNM Representative
Dr. Michael Power	National Lead, National Critical Care Programme, HSE and Consultant Critical Care Beaumont Hospital, Dublin
Dr. David Vaughan	Clinical Programmes, HSE.
Mr. John Kenny	Programme Manager, Quality and Patient Safety Directorate, HSE
Ms. Noreen Curtin	Therapy Professionals Committee representative
Ms. Anne Marie Keown	Programme Manager, National Acute Medicine Programme, HSE
Ms. Carmel Cullen	Communications Department, HSE
Dr. Maria Donnelly	Critical Care Consultant, Tallaght Hospital, Dublin
Prof. Frank Keane	National Lead, National Elective Surgery Programme, HSE and past president of the Royal College of Surgeons

Ms. Mary Wynne	Area Director, ONMSD, HSE
Ms. Liz Roche	Area Director, ONMSD, HSE
Ms. Maura Flynn	Clinical Informationist, National Acute Medicine Programme
Ms. Ellen Whelan	CNM 2, Acute Medicine Unit, Beaumont Hospital, Dublin
Ms. Siobhan Scanlon	Asst. Director of Nursing, Cork University Hospital, Cork
Ms. Anne Marie Oglesby	Clinical Risk Advisor, Clinical Indemnity Scheme, State Claims Agency
Dr. Una Geary	National Lead, Emergency Medicine Programme, HSE and Consultant Emergency Medicine, St James's Hospital, Dublin
Dr. John Cullen	Consultant Physician, Tallaght Hospital, Dublin
Patient Representation	Ms. June Boulger, National Lead, Service User Involvement, National Advocacy Unit, Quality and Patient Safety Directorate, HSE

Advisory Group

This group was set up to complete specific elements of work and advise the National Governance Group on issues relating to the agreement of a NEWS and Education Programme.

Ms. Avilene Casey (Chair)	Director of Nursing, National Acute Medicine Programme, HSE and IADNM Representative
Dr. Maria Donnelly	Critical Care Consultant, Tallaght Hospital, Dublin
Mr. Gerry Allen	ANP Cardiology, South Infirmary, Cork
Ms. Deirdre Brennan	A/Practice Development Co-ordinator, Connolly Hospital, Dublin
Ms. Helena Butler	Practice Development Co-ordinator, Kerry General Hospital
Ms. Noreen Curtin	Physiotherapy Manager, Tallaght Hospital, Dublin
Ms. Mary Forde	Asst. Director of Nursing, Cork University Hospital, Cork
Ms. Margaret Gleeson	Asst. Director of Nursing, Nenagh Hospital, Co. Tipperary
Ms. Dolores Heery	Asst. Director of Nursing, Mater Hospital, Dublin
Ms. Marie Horgan	Chest Pain Nurse, St Luke's Hospital, Kilkenny
Ms. Marie Laste	Practice Development, South Tipperary General Hospital
Ms. Aine Lynch	Practice Development, Tallaght Hospital, Dublin
Ms. Fiona McDaid	CNM 3, Emergency Department, Naas General Hospital, Co. Kildare
Ms. Paula McElligott	Asst. Director of Nursing, MRH Mullingar, Co Westmeath
Dr. John McInerney	Consultant, Mater University Hospital, Dublin
Ms. Emma Mulligan	CNM 2, Acute Medicine Unit, Waterford Regional, Hospital, Co. Waterford
Ms. Elizabeth Neely	Practice Development, Letterkenny General Hospital, Co. Donegal
Ms. Nora O'Mahony	Asst. DoN, Practice Development, Naas General Hospital, Co. Kildare
Ms. Katie Sheehan	Asst. DoN, Mid-West Regional Hospital, Limerick
Ms. Valerie Small	ANP Emergency, St James's Hospital, Dublin
Ms. Ellen Whelan	CNM 2, Acute Medicine Unit, Beaumont Hospital, Dublin
Dr. John Cullen	Consultant Physician, Tallaght Hospital, Dublin
Ms. Dolores Ryan	Practice Development, Connolly Hospital, Dublin
Ms. Anne Marie Oglesby	Clinical Risk Advisor, Clinical Indemnity Scheme, State Claims Agency
Ms. Kathleen McMahon	Practice Development, Cavan General Hospital, Co. Cavan
Dr. David Vaughan	Clinical Programmes, HSE.
Ms. Marina O'Connor	Practice Development, Our Lady of Lourdes Hospital, Drogheda, Co. Louth
Ms. Cait Kenny	Practice Development, St. Vincents University Hospital, Dublin.
Ms. Mary Forde	CNM 2 Emergency Department, Cork University Hospital, Cork
Ms. Siobhan Scanlon	A/Director of Nursing, Cork University Hospital, Cork
Ms. Ann Scahill	Resuscitation Training Officer, Roscommon Hospital, Co. Roscommon
Mr. Patrick Coakley	CNM 2 Medical Ward, Mercy University Hospital, Cork
Ms. Kay Chawke	Asst. Director of Nursing, Croom Hospital, Co. Limerick

5.3 Patient representation

As part of the consultation process, patient representative groups were consulted. The process identified was that the National Lead would attend a number of meetings with the patient representative groups to facilitate exchange of information. The meetings were organized by the Service User Group representative, Patient Advocacy Unit, HSE. Three meetings were attended. At the first meeting there was extensive discussion about what the NEWS would mean for patients. The second meeting provided an update for the group. The third meeting provided further information and feedback was received. The patient group requested that an information leaflet explaining the programme be developed and placed on the internet and this was agreed.

5.4 Acknowledgements

The National Governance/National Clinical Guideline Development Group wish to acknowledge the contribution of a number of people and groups to this project, (no particular order was used). The National Advisory Group is acknowledged for their work supporting the National Governance/ National Clinical Guideline Development Group.

- The Patient Representative Groups for their advice and support for the programme.
- Dr. Nicola Dunbar, Programme Manager, Australian Commission on Safety and Quality in Healthcare for sharing their document: 'National Consensus Statement: essential elements for recognising and responding to clinical deterioration'.
- Associate Prof. Imogen Mitchell and Heather McKay, RN, Canberra Australia for sharing their work on the COMPASS© Programme
- Dr. Samantha Hughes PhD, Team Leader, Clinical Audit and Research in Dublin Mid-Leinster for her work on the Literature Review.
- Dr. John Kellett, Consultant Physician for continuous advice and support.
- Dr. Chris Subbe, Consultant Physician, Ysbyty Gwynedd, Bangor, Wales, for continuous advice and support.
- Prof. Garry Smith, UK, for providing advice on aspects of the programme.
- Dr. Mairin Ryan, Health Information and Quality Authority (HIQA) and Ms. Michelle O'Neill, Senior Health Economist, HIQA, for providing an economic impact report.
- Ms. Helen Duffy and Ms. Grainne Glacken, representing Nurse Tutors input into the education programme.
- Ms. Joan Gallagher, National Clinical Programmes Liaison, ONMSD, for continuous support for the programme.
- The Directors of Nursing Reference Group for the Clinical Programmes, HSE.
- Ms. Gillian Whyte, Cavan General Hospital for additional input into the audit tools.
- Mr. Patrick Glackin, and Ms. Catherine Killilea (who replaced Ms. Joan Phelan), ONMSD, Area Directors (not on the National Governance/National Clinical Guideline Development Group) but who supported the programme.
- The Directors of Nursing and Managers for the release of staff to attend meetings, 'Train the Trainer' Programmes and deliver education and training programmes.
- Ms. Laverne McGuinness, National Director of Integrated Services Directorate, HSE, Dr. Philip Crowley, HSE National Director, Quality and Patient Safety Directorate and Dr. Barry White, former National Director Clinical Strategy and Programmes, Dr. Aine Carroll, National Director, Clinical Strategy and Programmes, for their support.
- Ms. Edwina Dunne and Ms. Petrina Duff, Quality Patient Safety Audit, for advice on the audit section.
- Ms. Sheila O'Malley, Chief Nurse in the Department of Health and Children.
- Dr. Maura Pidgeon, CEO, and the staff of An Bord Altranais.
- Ms. Shauna Ennis, Tallaght Hospital, Ms. Marie Horgan, HSE, Ms. Elizabeth Neely, HSE and Ms. Margaret Gleeson, HSE who carried out work on amending the education programme to suit the Irish context. Later in the programme Ms. Mairead O'Sullivan, HSE, Mr. Adrian Higgins, HSE and Ms. Fiona Willis, HSE also carried out further amendments.
- The National Clinical Effectiveness Committee and working group, Department of Health.

New members of the National Governance Group/National Clinical Guideline Development Group some of whom previously contributed to the work of the programme:

- Dr. Ciaran Browne, National Lead for Acute and Palliative Care Services, HSE.
- Ms. Maureen Flynn, National Lead for Clinical Governance, HSE.
- Ms. Deirdre Staunton - Chair of the Irish Association of Resuscitation Officers.
- Ms. June Boulger, HSE – Service User Group representative, Patient Advocacy Unit, HSE.
- Dr. Sarah Condell, Nursing and Midwifery Research and Development Lead, ONMSD, contributed to the work of the programme up to September 2012.
- Ms. Anne Marie Barnes - Emergency Response System Co-ordinator, Tallaght Hospital, Dublin.
- Ms. Ciara Buckley, National Acute Medicine Programme Co-ordinator, HSE.
- Ms. Mary Frances O'Reilly, Ms. Anne Gallen, Ms. Mary Manning, Mr. Mark White, Ms. Eithne Cusack, Ms. Susanna Byrne, Ms. Deirdre Mulligan and Ms. Carmel Buckley, Nursing and Midwifery Planning and Development Directors, HSE.

5.5 The evidence

Collection and analysis of evidence formed an important part of the decision making process in agreeing the NEWS and associated education programme and developing the National Clinical Guideline. This included:

- A baseline audit of early warning scores and education programmes in use in acute hospitals nationally.
- A strengths, weaknesses, opportunities, threats analysis and risks identification.
- A systematic search and review of literature.
- A comparative analysis of education programmes.
- An economic impact study.
- Evidence to support inclusion of early detection and treatment of sepsis.
- Identification of the level of evidence and grading of recommendations.
- National Clinical Guideline external review on elements of the programme including national and international expert opinion and consultation.
- Identification of barriers and enablers for implementation.

5.5.1 Baseline audit

At the outset of the project an audit of acute hospitals was carried out to establish the number of hospitals using early warning scores and/or education programmes for the early detection and management of deteriorating patients. It was reported that 12 hospitals were using early warning scores. However, different early warning scores were in use. The ALERT™ Education Programme was reported as being delivered in 10 hospitals. It was noted that the ALERT™ programme did not incorporate education on the use of an early warning score, a communication tool or the early detection and treatment of sepsis.

5.5.2 Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis

A strengths, weaknesses, opportunities and threats analysis and an identification of risks was completed (Appendix 9). The purpose of the SWOT analysis was to identify the strategies to create a model that would best align the HSE's resources and capabilities to the requirements of the operating environment. The SWOT analysis also provided a foundation for evaluating the internal potential and limitations, and the likely opportunities and threats from the external environment. Identifying the risks heightened awareness of points that needed to be emphasised throughout the education programme. Overall it assisted the decision-making process of the National Governance Group/National Clinical Guideline Development Group.

5.5.3 Literature search and review

A systematic search and review of literature was undertaken (Appendix 10) to establish the national and international evidence base for early warning scores and associated education programmes. The strengths and limitations of the body of evidence are identified in Appendix 10.

The review established that there were numerous early warning scores many with modifications, some made locally, therefore consistency with regard to comparability results was difficult. Two education programmes the ALERT™ and COMPASS© Programmes were identified.

While the ViEWS system (Prytherch *et al*., 2010) provided evidence of being the most accurate predictor hospital mortality for the first 24 hours, when compared to 33 other aggregate weighted track and trigger systems (AWTTS) systems, the 2010 study was conducted exclusively on medical patients and therefore could not be considered applicable to a surgical group of patients.

The National Governance Group/National Clinical Guideline Development Group identified the need to include the use of a validated national early warning score for surgical as well as medical patients. One of the few pieces of research carried out on both groups of patient was conducted in Australia. This was termed a Modified Early Warning Score (MEWS) and was selected initially as being the most suitable for the purposes of the National Governance/National Clinical Guideline Development Group.

However, the National Governance/National Clinical Guideline Development Group identified two large studies conducted on the ViEWS system in October 2011, and updated the literature review accordingly. While the original EWS recommended the MEWS using the physiological parameters used in the Australian study (Mitchell, 2010), the two more recent large validation studies on the ViEWS system (Bleyer *et al*., 2011 and Kellett *et al*., 2011), validated the score for use on both medical and surgical patients. Therefore it was recommended that the ViEWS system be adopted as the NEWS for the Irish healthcare context.

The Team Leader for Clinical Audit and Research, who conducted the literature review was not a member of either the National Governance Group/National Clinical Guideline Development Group or Advisory Group. The National Lead for the NEWS project assisted with the review.

5.5.4 Comparative analysis of the ALERT™ and COMPASS© education programmes

Changing practice needs to be supported by education and requires competent leadership in each acute hospital. The ALERT™ education programme from the UK and an education programme available on the web and developed in Australia called the COMPASS© Education Programme for the early detection and management of the deteriorating patient were reviewed. The cost of an ALERT™ programme was identified by a Nursing and Midwifery Planning and Development Unit Director. The ALERT™ system has been in place in some hospitals in the country.

The developers of the COMPASS© programme were contacted to discuss the programme further and they gave permission to use and adapt this programme, if necessary. Given the cost implications of the programmes a comparative analysis of the COMPASS© and ALERT™ programmes was carried out by a sub-group of the National Advisory Group (see Appendix 11). This group included some ALERT™ trainers. The analysis revealed that the COMPASS© programme had many advantages, for example, it incorporated education on an early warning score and the use of the ISBAR (Identification; Situation; Background; Assessment; Recommendation) communication tool. In addition the cost of providing the programme was substantially less.

However the National Governance Group/National Clinical Guideline Development Group identified a number of other issues with the COMPASS© Programme including:

- the terminology used in the COMPASS© documents was unfamiliar in the Irish context e.g. "Code Blue", "Hudson Mask"
- the titles assigned to medical and nursing personnel in Australia were unfamiliar in the Irish context e.g. "CNC"
- the partial pressure of Oxygen was expressed in millimetres of mercury pressure (mmHg) in the COMPASS© programme as opposed to kilopascals (kPa's) which is the unit of measurement used in the European hospital setting.

It was decided that these issues could easily be addressed and the sub-group adapted the programme with permission from the COMPASS© programme development team to the standard appropriate to the Irish context.

5.5.5 Economic impact of a NEWS and COMPASS© education programme

Given the economic climate, the National Governance Group/Clinical Guideline Development Group were conscious of getting the best value for money without compromising patient safety and quality. These considerations were relevant to the selection of the COMPASS© versus the ALERT™ Education Programmes.

From the literature review the National Governance/National Clinical Guideline Development Group anticipated that introducing a NEWS will improve patient outcomes by reducing the number of unplanned admissions to ICU and reducing the number of cardiac-respiratory arrests.

Further analysis of the economic impact was carried out by a Senior Economist in the Health Information and Quality Authority (Appendix 12). This report indicated that savings would be expected due to the reduction of ICU bed day use, along with potential savings on follow-up treatments for disability that the patient may suffer if clinical deterioration is not appropriately identified and responded to. There could be potential savings of an estimated €4.2 million or 3,200 ICU bed days. The savings to be made from a reduction in ICU bed day utilisation, will likely not be realised as a cash saving to the system but rather as an efficiency saving through freeing up of ICU resources to be available for use to other patients in the system.

5.6 Linking evidence to recommendations

The National Governance/National Clinical Guideline Development Group took into consideration the available evidence, expert opinion, patient opinion, economic considerations and potential benefits for the patients in identifying the NEWS and associated education programme when developing the National Clinical Guideline recommendations. In addition to evidence collected at the outset and that outlined as part of the literature review, additional, and in some cases updated, evidence was identified, in support of the National Clinical Guideline recommendations.

The National Clinical Guideline makes detailed and important recommendations in relation to the following areas:

Clinical processes:
1 Measurement and documentation of observations.
2 Escalation of care.
3 Emergency Response Systems.
4 Clinical communication.

Organisational prerequisites for implementation:
5 Organisational supports.
6 Education.
7 Evaluation, audit and feedback.

Audit tools with specific criteria are linked with the recommendations of the National Clinical Guideline (Appendix 4).

5.6.1 Level of evidence and grading of recommendations

Linking the best available evidence and/or expert opinion to the recommendations was an important part of developing the National Clinical Guideline. The Scottish Intercollegiate Guidelines Network (SIGN, 2002) levels of evidence, and grades for recommendations were used (Appendix 1). The levels of evidence were then linked to the recommendations (Appendix 2).

The most desirable level of evidence is the 1++, high quality meta-analyses, systematic reviews of Random Controlled Trials (RCT's), or RCT's with a very low level of bias. Yet many authors agree that conclusive double blinded RCT's of these initiatives are not feasible (DeVita and Bellomo, 2007; Laurens and Dwyer, 2010). Instead, observational, or before and after studies and inductive reasoning will slowly build the effectiveness evidence (Tee *et al*., 2008).

It is acknowledged by Winters and Pham (2011) "…that level 1 evidence should always be the goal; however, it may not always be available to answer a particular question or may be impractical to carry out in a research setting. There may be situations where the 'best' attainable evidence may only be level 2 quality or lower, leaving us to rely on this best available evidence to guide our decisions". They further assert that while we should not be dogmatic or insisting on Level 1 or even Level 2 data when it is not practical or possible, we must be very critical in our appraisals, especially if the intervention carries great cost or risk.

5.6.2 Sign off of the NEWS and COMPASS© education programme

In April 2011, the NEWS and COMPASS© education programme were agreed and signed off by the National Governance/National Clinical Guideline Development Group. The programme was continuously reviewed during initial implementation in a number of hospitals. An 'issues log' was made available on email for staff nationally to feedback information on the education programme and the NEWS implementation.

5.6.3 New evidence

The National Governance Group/National Clinical Guideline Development Group identified additional research due to be published. This new evidence from Canada and the US validated the ViEWS system for both medical and surgical patients (Kellett *et al*., 2011; Bleyer *et al*., 2011).

The final decision to adopt the ViEWS parameters as the NEWS was taken in the knowledge that this scoring system performed the best when compared to 33 other aggregate weighted track and trigger systems (AWTTS) in medical patients (Prytherch, 2010). In addition the Bleyer *et al*., (2011) study was based on 1.15 million individual vital sign determinations obtained on 27,722 patients, with the Kellett *et al*., study (2011), based on 75,419 consecutive patients admitted to an acute hospital in Canada. These two studies validated the scoring system for both medical and surgical patients.

5.6.4 Inclusion of early detection and initial treatment of sepsis in the programme

Sepsis is a complex syndrome that is difficult to define, diagnose and treat. It is a range of clinical conditions caused by the body's systemic response to an infection, which if it develops into severe sepsis is accompanied by single or multiple organ dysfunction or failure which can lead to death. The 'Surviving Sepsis Campaign' website contains evidence based figures identifying that up to 135,000 Europeans and 215,000 Americans die each year from sepsis. Each year sepsis costs €7.6 billion in Europe and €17.4 billion in the US.

The "Surviving Sepsis Campaign" is an international effort organized by physicians that developed and promoted widespread adoption of practice improvement programmes grounded in evidence-based guidelines (Levy *et al*., 2011). The goal is to improve diagnosis and treatment of sepsis using six simple steps.

A number of acute hospital services highlighted sepsis as an issue to be addressed. This was supported by the international effort to diagnose and treat sepsis early. Therefore the National Governance Group/National Clinical Guideline Development Group made the decision to incorporate education of the early detection and initial treatment of sepsis known as the SEPSIS SIX Regimen, into the education Programme. It was also incorporated into the National Patient Observation Chart.

5.6.5 International consultation

International consultation was undertaken. Contact was established with Dr. Chris Subbe, national lead for NEWS in Wales and Prof. Gary Smith in England, who was part of the team that conducted the original ViEWS studies on medical patients. There was on-going contact with Heather McKay, RN, and A/Prof. Imogen Mitchell, Critical Care Consultant in Canberra, Australia.

Dr. Chris Subbe had been working on a Patient Observation Chart prototype incorporating the Airway, Breathing, Circulation, Disability, Environment (ABCDE) assessment with the Early Warning Score. The National Governance Group/Clinical Guideline Development Group further developed this and with input from Australian colleagues produced a NEWS Patient Observation Chart.

5.6.6 National Clinical Guideline external review

An external review of the National Clinical Guideline in its entirety was not carried out. However, an external review on specific elements of the programme was conducted with the following external experts:

- Prof. Gary Smith, Clinician, Portsmouth Hospital, UK, (part of team who researched the ViEWS system in 2010)
- Dr. John Kellett, Consultant Physician (formerly Nenagh General Hospital, Co. Tipperary), co-author of research on ViEWS in Canada
- Dr. Chris Subbe, Senior Clinical Lecturer in Acute and Critical Care Medicine at the School of Medical Sciences, Bangor, Wales – Lead in Wales for the NEWS Project. Dr. Subbe is an advocate of the *Save 1,000 lives Sepsis campaign*.
- Associate Prof. Imogen Mitchell, Critical Care Consultant, Canberra Hospital, Australia.
- Ms. Heather McKay, RN, Programme Manager for the Early Recognition of the Deteriorating Patient Programme for the ACT Government, Canberra, Australia.

The following outlines specific elements of the programme that were reviewed by external experts:

1. Prof. Gary Smith (UK), one of the original ViEWS researchers in 2010, was contacted for clarification on the systolic blood pressure parameter. Initially some staff considered that the Systolic BP score of 111-249 attracting a score of 0 was incorrect. Prof. Smith explained that it was correct, he advised that the ViEWS is a risk prediction model, therefore the weightings have been chosen based on achieving the best AUROC[1] for predicting death within 24 hours of a given observation set. Changing any of the weightings invalidates the score and the performance of a 'modified' system is likely to be harmed. More importantly, it may lead to excessive workload, which is something that should be avoided as it tends to undermine

1 AUROC – Area Under a Receiver Operating Characteristic (AUROC) Curve

the whole concept of early intervention. The BP range is weighted based on evidence relating to the chosen outcome. It doesn't mean that extreme BPs are unimportant and do not need a doctor's involvement, in the same way that a nurse who is concerned about a patient should exclude a review by a doctor. The approach of placing a note on the chart that if any specific parameter exceeds a given value that a doctor should be called to review the patient is acceptable.

The National Governance Group/National Clinical Guideline Development Group decided to place Prof. Smith's advice in the training manual and place a note on the National Patient Observation Chart that a systolic BP greater than or equal to 200 requires a doctor to review.

2. Dr. John Kellett (Irl) advised the National Governance Group/Clinical Guideline Development Group of two new large pieces of research on the ViEWS system, accepted for publication, which validated this early warning score for both medical and surgical patients. His advice was adopted which assisted the group with making the decision to change from the original modified early warning score to the ViEWS system as the NEWS. He also advised on the levels of evidence.

3. Prof. Chris Subbe, (Wales) was consulted in relation to the National Patient Observation Chart. He advised using the Airway, Breathing, Circulation, Disability and Exposure (ABCDE) prompts on the patient observation chart to guide staff. He had developed a prototype, for Wales. The National Governance Group/National Clinical Guideline Development Group developed this further with his permission and in consultation with National Governance Group/Clinical Guideline Development Group. The National Governance Group/National Clinical Guideline Development Group identified that Dr. Subbe was and is an advocate of the Save 1,000 lives campaign focussed on the early detection and treatment of Sepsis. This along with other requests from clinical staff around the country prompted the group to include a section on the early detection and initial treatment of sepsis on the National Patient Observation Chart and in the education programme.

4. A/Prof. Imogen Mitchell, (Australia), provided advice referring to the Australian 'National Consensus Statement, essential elements for recognising and responding to clinical deterioration', as extensive experience had been gained in Australia over 10 years. The National Governance Group/National Clinical Guideline Development Group sought permission to adapt this to suit the Irish context, from Dr. Nicola Dunbar, Programme Manager, Recognising and Responding to Clinical Deterioration Programme, Australian Commission on Safety and Quality in Healthcare. This formed the basis of the National Clinical Guideline for the NEWS System to recognise and respond to clinical deterioration.

   As well as providing advice from the Australian experience, A/Prof. Mitchell, reviewed the proposed national patient observation chart and advised on additional prompts. This advice was taken and following consultation with colleagues on the National Governance/ National Clinical Guideline Development Group the National Patient Observation Chart was developed. A/Prof. Mitchell visited Ireland on two occasions, spoke at conferences and delivered a series of lectures around the country.

5. Heather McKay, RN, (Australia), provided on-going advice on issues that arose, especially at the outset. Ms. McKay visited Ireland, and delivered a lecture at the national NEWS conferences in June 2012, supported by the Australian Government.

5.6.7 Sign off and national launch

The final decisions were made to incorporate the ViEWS parameters, as the NEWS to include early detection and treatment of SEPSIS and on the format of the NEWS Patient Observation Chart at a National Governance/National Clinical Guidance Development Group meeting in late October 2011.

The updated programme was signed off by the National Governance/National Clinical Guideline Development Group and at senior level in the HSE in early February 2012 (see signatories Appendix 13).

The programme was launched by Dr. Barry White, National Lead for Clinical Strategy and Programmes in the Royal College of Physicians in Ireland in March 2012.

In addition to considering the best available evidence and expert opinion, key published national documents and guideline documents from individual hospitals using an early warning score were utilized in developing the National Clinical Guideline for the NEWS System to recognise and respond to clinical deterioration.

5.6.8 NEWS website

A website, with all the materials and resources required to deliver the programme and assist implementation of the NEWS, was developed. This website allows accessibility for public, private and voluntary hospital staff as well as the general public and patients. The National Governance Group/National Clinical Guideline Development Group are working with the patient groups to develop a patient friendly information leaflet, which will be placed on the website. The website address is www.hse.ie/go/nationalearlywarningscore/.

5.7 Conclusion

The NEWS is a significant safety and quality initiative for patients. The National Governance/ National Clinical Guideline Development Group took into consideration the available evidence, expert opinion (national and international), patient opinion, economic considerations and potential benefits for the patients in identifying the NEWS and associated education programme, and developing the National Clinical Guideline. The guideline development group highlighted that NEWS does not replace clinical judgement of experienced staff where care can be escalated regardless of the score if they are concerned about a patient. Studies identify reduction in cardio-respiratory arrests, unplanned admissions to ICU and unexpected deaths following the introduction of the initiative. The National Clinical Guideline is a significant development as part of a generational change in how acute hospitals in Ireland deliver care by standardisation of the assessment of acute illness severity, enabling a more timely response using a common language. However changing practice needs to be supported by education and requires competent leaders in each acute hospital.

The body of knowledge for this intervention can be increased by further research on clinical outcomes.

5.8 The future

On-going evaluation is required to determine whether the efferent limb (response to the call) is sufficiently sensitive or over sensitive to the afferent arm (trigger) of the scoring system in alerting the appropriate clinical response. Further research is needed particularly in relation to the escalation protocol. The balance of having the correct response to effectively manage deteriorating patients without overburdening medical staff with unnecessary calls has yet to be established internationally. Standardisation of the NEWS and education programme will assist with further research in evaluating the effectiveness of this intervention.

There are many factors that will affect the clinical outcome of patients, and further research on clinical outcomes, such as cardio-respiratory arrests, unplanned admissions to ICU and unexpected deaths in acute hospitals along with cost effectiveness of the initiative will provide a body of knowledge to guide interventions in the future for safer higher quality of care for patients.

A number of process and outcome audits are recommended in the guideline. Technology to support the recording of patient's vital signs and in some cases triggering responses will be key to providing a platform for future research and audit.

The National Governance/National Clinical Guideline Development Group has identified a National Clinical Guideline review date in January 2014, or sooner if required.

5.9 Conflict of interest

It was noted that there was a preference expressed by some members of the National Advisory Group to select the ALERT™ Education Programme, as the national programme, for the early detection and management of the deteriorating patient. Some members of the Advisory Group were trainers on the ALERT™ programme. A subgroup of the National Advisory Group which included the ALERT™ trainers carried out a comparative analysis of the ALERT™ and the COMPASS© Programmes. The COMPASS© programme was identified as being similar to the ALERT™ Programme, but was available free of charge with some notable advantages. Optimal quality and patient safety were to the forefront at all times in the decision making process. Agreement was sought to amend the COMPASS© Programme to suit the Irish context from the group who developed it in Australia. The sub-group were key to amending the COMPASS© Programme to a high standard. On realising the cost implications of the ALERT™ Programme and with amendments to the COMPASS© programme to suit the Irish Health Service, agreement was reached to recommend the COMPASS© Education Programme as the national programme.

Subsequently a section for the early detection and initial treatment of sepsis was added. The amended COMPASS© Programme was signed off by the National Governance/National Clinical Guideline Development Group as the national programme for acute hospital services, HSE.
No other conflict of interest or biases were noted.

Glossary of Terms

This glossary details key terms and a description of their meaning within the context of this document.

Acute hospital: A hospital providing healthcare services to patients for short periods of acute illness, injury or recovery.

Advanced life support: The preservation or restoration of life by the establishment and/or maintenance of airway, breathing and circulation using invasive techniques such as defibrillation, advanced airway management, intravenous access and drug therapy.

ALERT™: Acronym for Acute Life-threatening Events, Recognition and Treatment) and education programme developed in the United Kingdom (UK) in 2000 for the early detection and management of deteriorating patients.

Acute Medical Unit (AMU): A facility whose primary function is the immediate and early specialist management of adult patients (i.e. aged 16 and older) with a wide range of medical conditions who present to a model 4 (tertiary) hospital ((refer to hospital models in the *Report of National Acute Medicine Programme (HSE, 2010)*). Its aim is to provide a dedicated location for the rapid assessment, diagnosis and commencement of appropriate treatment.

Acute Medical Assessment Unit (AMAU): Operates as an AMU with the following exceptions: It will be located in a model 3 (general) hospital ((refer to hospital models in the *Report of National Acute Medicine Programme (HSE, 2010)*); the hours of operation may vary from 12 to 24 hours, 7 days per week, depending on service need; and it will not have contiguous short stay medical beds.

Attending medical practitioner or team: The medical practitioner or team who is responsible for the medical care of a patient at a given time. This may or may not be the primary medical practitioner, this may occur at weekends or out of hours, and includes locums.

AWTTS: Aggregate Weighted Track and Trigger System. An aggregate score is a collection of scores from individual physiological observations that are added together to form a total score. Each of the physiological parameters are weighted e.g. for the most part physiological observations considered normal are allocated a score of 0, those outside this are allocated higher scores, i.e. they are weighted according to the deviation from the norm. See Track and Trigger explanation.

Ceiling of care: Limit of care. The aim is to provide guidance to staff, so that there is clarity about the patients' previously expressed wishes, and/or limitations to their treatment. It may need review from time to time in line with the organisation's guidelines and the wishes of the patient and/or family as appropriate.

Clinician: A health professional, such as a physician, or nurse, involved in clinical practice.

COMPASS©: An education programme for the early detection and management of deteriorating patients developed in Australia in 2006.

Early Warning Score (EWS): A bedside score and 'track and trigger' system that is calculated by clinical staff from the observations taken, to indicate early signs of deterioration of a patient's condition.

Emergency Response System: A generic name given to the emergency assistance provided as a response to patient deterioration in acute hospitals. The Emergency Response System should form part of an organisation's escalation protocol and be identified in each acute hospital for daytime, out-of-hours and weekends as appropriate to the hospital model ((refer to hospital models in the *Report of the National Acute Medicine Programme (HSE, 2010)*).

Escalation protocol: A protocol that sets out the organisational response required for different early warning scores identified or other observed deterioration. The protocol applies to the care of all patients at all times. Minor local modifications may be required within an acute hospital based on available resources.

HDU: A High Dependency Unit is an area in a hospital usually located close to the intensive care unit, where patients can be cared for more extensively than on a normal ward, but not to the point of intensive care.

HSE: Health Service Executive. The organisation was established under the Health Act 2004 as the single body with statutory responsibility for the management and delivery of health and personal social services in Ireland.

ICU: Intensive Care Unit is a specialist department of an acute hospital that provides intensive care to patients with the most serious injuries and illnesses, most of which are life-threatening and need constant, close monitoring and support from specialist staff, equipment and medication in order to maintain normal bodily functions.

ISBAR: An acronym for Identify, Situation, Background, Assessment, and Recommendation. The tool consists of five standardised prompt questions to ensure staff are sharing focused and concise information reducing the need for repetition.

- **IDENTIFY:** Identify yourself, who you are talking to and who you are talking about.
- **SITUATION:** What is the current situation, concerns, observation and NEWS.
- **BACKGROUND:** What is the relevant background? This helps set the scene to interpret the situation above accurately.
- **ASSESSMENT:** What do you think the problem is? This requires the interpretation of the situation and background information to make an educated conclusion about what is going on.
- **RECOMMENDATION:** What do you need them to do? What do you recommend should be done to correct the current situation?

LOC: Loss of Consciousness is the condition of being not conscious i.e. in a mental state that involves complete or near-complete lack of responsiveness to people and other environmental stimuli.

Medical Assessment Unit (MAU): Located in a model 2 (local) hospital and will see GP referred, differentiated medical patients who have a low risk of requiring full resuscitation ((refer to hospital models in the *Report of National Acute Medicine Programme (HSE, 2010)*). It will have assessment beds in a defined area and serve a clinical decision support function. Admissions will be to in-patient beds in a model 2 hospital. Patients who deteriorate unexpectedly will have guaranteed transfer to a model 3 or model 4 hospital.

Monitoring plan: A written plan that documents the type and frequency of observations to be recorded in the patients medical records and progress notes in the healthcare record.

Observations: A patient's physiological observations such as Blood Pressure, Pulse, Temperature, Respirations, Oxygen Saturation and Central Nervous System (CNS) Status. In addition it is noted that if the patient is on supplemental oxygen, for the purposes of the NEWS system, a score of 3 is added to the patients score.

Primary medical practitioner or medical team: The treating doctor or team with primary responsibility for caring for the patient in an acute hospital.

Track and trigger (TT): A 'track and trigger' tool refers to an observation chart that is used to record vital signs or observations graphically so that trends can be 'tracked' visually and which incorporates a threshold (a 'trigger' zone) beyond which a standard set of actions is required by health professionals if a patient's observations breach this threshold (Clinical Excellence Commission NSW Health, 2010).

Treatment-limiting decisions: Decisions that involve the reduction, withdrawal or withholding of life-sustaining treatment. These may include 'no cardiopulmonary resuscitation' (CPR), 'not for resuscitation' and 'do not resuscitate' orders.

VitalPAC Early Warning Score (ViEWS): This is the evidenced based early warning score, the parameters of which, have been agreed as the NEWS.

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Resources

The material and resources, developed as part of this project, are publically available from the following website: www.hse.ie/go/nationalearlywarningscore/.

Additional Resources include:

An Education Toolkit

- Education Facilitators Guide
- Programme Education Equipment List
- Sample Education Programme Equipment List
- Sample Education Programme Evaluation Forms
- Training Manual
- Interactive CD
- Quiz Questions
- Power point Presentation for Education Programme Facilitator
- Power point Presentation in Handout Format for Education Programme participants
- Four Case Studies to be worked through at the Education Programme Sessions

Implementation Resources

- Sample Project Plan
- Deteriorating Patient Flow Chart for display in Ward/Unit areas
- ISBAR Communication Tool Chart for display in Ward/Unit areas

Appendix 1
Levels of Evidence and Grade of Recommendations (SIGN, 2002)

Levels 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, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2++	High quality systematic reviews of case control or cohort or studies
	High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2+	Well-conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Grades of Recommendations

A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; *or* A body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; *or* Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; *or* Extrapolated evidence from studies rated as 2+

Good practice points

✓	Recommended best practice based on the clinical experience of the guideline development group

Appendix 2

Levels of Evidence and Grade of Recommendations NEWS

(See page 63 for list of references)

Clinical Guideline Recommendations
Measurement and Documentation of Observations

Measurable physiological abnormalities occur prior to adverse events such as cardiac arrest, unanticipated admission to intensive care and unexpected death. These signs can occur both early and late in the deterioration process. Regular measurement and documentation of physiological observations is an essential requirement for recognising clinical deterioration.
References 1,2

Level of Evidence: 2+
Grade of Recommendation: C

Recommendation 1
Observations should be taken on all patients admitted to an acute hospital.

Level of Evidence: 4
Grade of Recommendation: D

References 3,5 (Consensus and Expert Opinion)

Recommendation 2
Observations should be taken on patients at the time of admission or initial assessment if appropriate or as per organisation guideline/protocol, and then documented in the patient's healthcare record and recorded on a chart that incorporates the NEWS System.

Level of Evidence: 4
Grade of Recommendation: D

References 3,4,5 (Expert Opinion)

Recommendation 3
For every patient, a clear monitoring plan should be developed and documented, that specifies the observations to be recorded and the frequency of observations, taking into account the patient's diagnosis and proposed treatment.

Level of Evidence: 4
Grade of Recommendation: D

References 3,4,5 (Expert Opinion)

Recommendation 4
The frequency of observations should be consistent with the clinical situation and history of the patient. In the hospital setting the minimum standard for the assessment of vital signs, utilising the NEWS parameters, is every 12 hours. The frequency of patient observations must be reconsidered and modified according to changes in the patient's clinical condition. This should be documented in the monitoring plan and detailed in the medical notes and nursing care plan. This decision should be made in collaboration between nursing staff and the medical team.

Level of Evidence: 4
Grade of Recommendation: D

References 3,5 (Expert Opinion)

Recommendation 5
Physiological observations should include:
- Respiratory rate
- Oxygen saturation - SpO_2
- Heart rate
- Blood pressure
- Temperature
- Level of consciousness
- Where a patient is on inspired oxygen (F_iO_2) a score of 3 is added

Level of Evidence: 2+
Grade of Recommendation: C

References 5,6,7,8,9,10 (Internal and external validation studies of ViEWS score and extensive literature review)

Recommendation 6
In some circumstances, and for some groups of patients, some observations will need to be measured more or less frequently than others, and this should be specified in the monitoring plan, and documented in the medical notes and nursing care plan.

Level of Evidence: 4
Grade of Recommendation: D

Reference 4 (Expert opinion)

Recommendation 7
The minimum observations should be documented in a structured observation chart, incorporating the NEWS System.

Level of Evidence: 4
Grade of Recommendation: D

References 4,6,7,8 (Expert opinion)

Recommendation 8
Patient observation charts should display physiological information in the form of a graph. A patient observation chart should include:

1. A system for tracking changes in physiological parameters over time.
   References 3,10 (Expert Opinion)
2. Thresholds for each physiological parameter or combination of parameters that indicate abnormality.
   References 13 (Expert Opinion)
3. Information about the response or action required when thresholds for abnormality are reached or deterioration identified.
   References 4,5,13 (Expert Opinion)
4. The key NEWS parameters are based on the ViEWS system as per the NEWS Observation Chart.

Level of Evidence: 4
Grade of Recommendation: D

Practical Guidance
Screen for Sepsis using the Sepsis Screening Form when a patients NEWS is ≥ 4 or (5 on supplementary O_2) or if infection is suspected.

Recommendation 9
Clinical staff may choose to document other observations and assessments to support timely recognition of deterioration. Examples of additional information that may be required include; fluid balance, occurrence of seizures, pain, chest pain, respiratory distress, Glasgow Coma Scale, pallor, capillary refill, pupil size and reactivity, sweating, nausea and vomiting, as well as additional biochemical and haematological analyses.

Level of Evidence: 4
Grade of Recommendation: D

Reference 3 (Expert Opinion)

Recommendation 10
There are also patients for whom the use of the NEWS may be inappropriate, such as during the end stages of life and advanced palliative care. Although the majority of patients will benefit from utilisation of NEWS the clinician's own clinical judgement dictates whether the patient will require to be regularly scored for the NEWS, and how regularly vital signs assessment is required. A note should also be made in the patient's healthcare record documenting why the decision was made not to use the NEWS.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 11
When a patient is being continuously monitored using electronic technology, a full set of vital signs must be documented on the observation chart.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert opinion)

Clinical Guideline Recommendations
Escalation of Care

It is the responsibility of each acute hospital service to outline clearly their escalation protocol for deterioration patients at present and in the future taking into account the recommendations of the Acute Medicine and other relevant clinical care programmes in line with requirements of HIQA and CIS.
Reference 4 (Consensus)
National Governance/National Clinical Guideline Development Group (Expert Opinion).

An escalation protocol sets out the organisational response required in dealing with different levels of abnormal physiological measurements and observations.
Reference 5 (Expert Opinion)

This response may include appropriate modifications to nursing care, increased monitoring, review by the primary medical practitioner or team or "on call team" or calling for emergency assistance from intensive care or other specialist teams or activate the Emergency Response System.
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Primary responsibility for caring for the patient rests with the primary medical practitioner or team.

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

In this context, the escalation protocol describes the additional supporting actions that must exist for the management of all patients. Although these actions should be tailored to the circumstances of the acute hospital, it should include some form of emergency assistance where advanced life support can be provided to patients in a timely way.
National Governance/National Clinical Guideline Development Group (Expert Opinion)

A protocol regarding escalation of care is an essential requirement for responding appropriately to clinical deterioration
Reference 13 (Expert Opinion)

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 12
A formal documented escalation protocol is required that applies to the care of all patients at all times. *(Reference 13 Expert Opinion)*.
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 13
The escalation protocol should authorise and support the clinician at the bedside to escalate care until the clinician is satisfied that an effective response has been made.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 14
The escalation protocol should be tailored to the characteristics of an acute hospital, including consideration of issues such as:
1. Size and role (e.g. a tertiary referral centre or a small community hospital).
2. Location (relative to other acute hospitals).
3. Available resources (e.g. staffing mix and skills, equipment, telemedicine facilities and external resources such as ambulances).
4. Potential need for transfer to another acute hospital.

Level of Evidence: 4
Grade of Recommendation: D

References 4,13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 15
The escalation protocol should allow for a graded response commensurate with the level of abnormal physiological measurements, changes in physiological measurements or other identified deterioration. The graded response should incorporate options such as:
1. Increasing the frequency of observations.
2. Appropriate interventions from nursing and medical staff on wards and review by the primary medical practitioner or team in an acute hospital.
3. Obtaining emergency assistance or advice.
4. Transferring patients to a higher level of care locally, or to another acute hospital.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 16
The escalation protocol should specify:
1. The levels of physiological abnormality or abnormal observations at which patient care is escalated.
2. The response that is required for a particular level of physiological or observed abnormality.
3. How the care of the patient is escalated.
4. To whom care of the patient is escalated, noting the responsibility of the primary medical practitioner or team in an acute hospital.
5. Who else is to be contacted when care of the patient is escalated.
6. The timeframe in which a requested response should be provided.
7. Alternative or back up options for obtaining a response.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Practical Guidance
In the 4-6 score section of the Escalation Protocol an alert to screen for Sepsis should be included.

Recommendation 17
The way in which the NEWS protocol for escalation is applied should take into account the clinical circumstances of the patient, including both the absolute change in physiological measurements and abnormal observations, as well as the rate of change over time for an individual patient.

Level of Evidence: 4
Grade of Recommendation: D

Reference 5 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 18
The escalation protocol may specify different actions depending on the time of day or day of the week, or for other circumstances.

Level of Evidence: 4
Grade of Recommendation: D

Reference 5 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 19
The escalation protocol should allow for the capacity to escalate care based only on the concern of the clinician at the bedside in the absence of other documented abnormal physiological measurements ('staff member worried' criterion).

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 20
The escalation protocol should allow for the concerns of the patient, family or carer to trigger an escalation of care.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 21
The escalation protocol should include consideration of the needs and wishes of patients where treatment-limiting decisions (ceilings of care) have been made.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 22
The escalation protocol should be disseminated widely and included in education programmes. On induction to an organisation all staff should be made aware of the escalation protocol.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Clinical Guideline Recommendations
Emergency Response Systems

Where severe deterioration occurs it is important to ensure that the capacity exists to obtain appropriate emergency assistance or advice prior to the occurrence of an adverse event such as a cardiac arrest. A deteriorated patient should activate a direct on-site response (HIQA, 2011). Reference 14

Different models that have been used to provide this assistance include senior medical staff, Emergency Response System (ERS), (NGG Expert Opinion) and critical care outreach (if available). The generic name for this type of emergency assistance is 'Emergency Response System'. The emergency assistance provided as part of a rapid responses additional to the care provided by attending medical personnel or primary medical team.
National Governance/National Clinical Guideline Development Group (Expert Opinion)**.**

For most facilities, the Emergency Response System will include clinicians or teams located within the hospital who provide emergency assistance. In some facilities the system may be a combination of on-site and external clinicians or resources (such as the ambulance service or local general practitioner). However comprised, and however named, an Emergency Response System should form part of an organisation's escalation protocol.
National Governance/National Clinical Guideline Development Group (Expert Opinion)**.**

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 23
Some form of Emergency Response System should exist to ensure that specialised and timely care is available to patients whose condition is deteriorating.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 24
Criteria for triggering the Emergency Response System should be included in the escalation protocol. Where severe deterioration occurs it is important to ensure that the capacity exists to obtain appropriate emergency assistance or advice prior to the occurrence of an adverse event such as a cardiac arrest.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 25
The nature of the Emergency Response System needs to be appropriate to the size, role, resources and staffing mix of a hospital.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 26
The clinicians providing emergency assistance as part of the Emergency Response System should:
1. Be available to respond within agreed timeframes.
2. Be able to assess a patient and provide a provisional diagnosis.
3. Be able to undertake appropriate initial therapeutic intervention.
4. Be able to stabilise and maintain a patient, pending decisions on further management.
5. Have authority to make transfer decisions and to access other care providers to deliver definitive care.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 27
As part of the Emergency Response System there should be access, at all times, to at least one clinician, either on-site or accessible, who can practice advanced life support.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 28
The clinicians providing emergency assistance should have access to medical staff members of sufficient seniority to make treatment-limiting decisions. Where possible these decisions should be made with input from the patient, family and the primary medical practitioner or team in an acute hospital.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 29
In cases where patients need to be transferred to another acute hospital to receive emergency care, appropriate care needs to be provided until such assistance is available.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 30
When a call is made for emergency assistance, the attending medical practitioner or team should be notified at the same time that the call has been made, and where possible, they should attend to provide relevant medical information regarding their patient, provide support and learn from the clinicians providing assistance.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 31
All opportunities should be taken by the clinicians providing emergency assistance to use the call as an educational opportunity for ward staff and pre-registered medical, nursing and therapies students.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 32
The clinicians providing emergency assistance should communicate in an appropriate, detailed and structured way with the primary medical practitioner or team in an acute hospital about the consequences of the call, including documenting information in the healthcare record.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 33
Events surrounding a call for emergency assistance and actions resulting from a call should be documented in the healthcare record and considered as part of on-going quality improvement processes. Records should be suitable for audit purposes.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Clinical Guideline Recommendations
Clinical Communication

Effective communication and team work among clinicians is an essential requirement for recognising and responding to clinical deterioration. Poor communication at handover and in other situations has been identified as a contributing factor to incidents where clinical deterioration is not identified or properly managed.
(Reference 15)

A number of structured communication protocols exist that can be used for handover and as part of on-going patient management. The recommended communication tool for healthcare professionals, particularly when communicating in relation to the deteriorating patient, is ISBAR.

Expert Opinion (Assoc. Prof. Imogen Mitchell and Heather McKay, Australia)

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 34
Formal communication protocols should be used to improve the functioning of teams when caring for a patient whose condition is deteriorating.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 35
The value of information about possible deterioration from a patient, family or carer should be recognised.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 36
Information about deterioration should be communicated to the patient, family or carer in a timely and ongoing way, and documented as appropriate in the healthcare record.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Clinical Guideline Recommendations
Implementation - Organisational Supports

Recognition and response systems should be part of standard clinical practice. Nonetheless, the introduction of new systems to optimise care of patients whose condition is deteriorating requires organisational support and executive and clinical leadership for success and sustainability. An acute hospital should set up a NEWS Committee to consider and agree the processes and stages of implementation for the NEWS system and the NEWS Protocol for escalation.

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 37
This National Clinical Guideline should be implemented across all acute hospitals, and the planned variations in the escalation protocol and responses that might exist in different circumstances (such as for different times of day or at night) identified.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 38
A formal guideline/policy framework for the implementation of the National Clinical Guideline should include issues such as:
1. Governance arrangements.
2. Roles and responsibilities.
3. Communication processes.
4. Resources for the Emergency Response System, such as staff and equipment.
5. Education and training requirements.
6. Evaluation, audit and feedback processes.
7. Arrangements with external organisations that may be part of a rapid response system.
8. Documentation regulation and management of records.
9. Patient and service user involvement.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 39
Any new recognition and response systems or procedures should be integrated into existing organisational safety and quality systems to support their sustainability and opportunities for organisational learning.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 40
Recognition and response systems should encourage healthcare staff to react positively to escalation of care, irrespective of circumstances or outcome.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 41
There should be appropriate policies and documentation regarding 'Do not Resuscitate' decisions; treatment-limiting decisions (ceilings of care); and end-of-life decision making as they are critical in ensuring that the care delivered in response to deterioration is consistent with appropriate clinical practice and the patient's expressed wishes.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 42
A formal governance process (such as a NEWS System group/committee) should oversee the development, implementation and ongoing review of recognition and response systems locally. It should:

1. Have appropriate responsibilities delegated to it and be accountable for its decisions and actions.
2. Monitor the effectiveness of interventions and education.
3. Have a role in reviewing performance data, and audits.
4. Provide advice about the allocation of resources.
5. Include service users, clinicians, managers and executives.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 43
Organisations should have systems in place to ensure that the resources required to provide emergency assistance (such as equipment and pharmaceuticals) are always operational and available.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Clinical Guideline Recommendations
Education

Having an educated and suitability skilled and qualified workforce is essential to provide appropriate care to patients whose condition is deteriorating. Education should provide knowledge of observations and identification of clinical deterioration, as well as appropriate clinical management skills.
Reference 13 (Expert Opinion)

Skills such as communication and effective team work are needed to provide appropriate care to a patient whose condition is deteriorating, and should also be part of staff development.
Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Training in the use of the patient observation chart incorporating the NEWS should be facilitated.
National Governance/National Clinical Guideline Development Group (Expert Opinion)

The education and training needs to be coordinated by designated staff within, or supporting, the acute hospital. In addition continuation of training in basic life support and professional development training in advanced life support programmes, appropriate to the acute hospital, is advised.
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Level of Evidence: 4
Grade of Recommendation: D

Recommendation 44
The education programme recommended by the National Governance/National Clinical Guideline Development Group is the COMPASS© programme and must be delivered in full. All clinical and non-clinical staff should receive education about the local escalation protocol relevant to their position. They should know how to call for emergency assistance if they have any concerns about a patient, and know that they should call under these circumstances. This information should be provided at the commencement of employment and as part of regular refresher education and training.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 45
All medical and nursing staff should be able to:
1. Systematically assess a patient.
2. Understand and interpret abnormal physiological parameters and other abnormal observations.
3. Understand and operationalise the NEWS system and NEWS protocol for escalation of care.
4. Initiate appropriate early interventions for patients who are deteriorating.
5. Respond with life-sustaining measures in the event of severe or rapid deterioration pending the arrival of emergency assistance.
6. Communicate information about clinical deterioration in a structured and effective way to the primary medical practitioner or team in an acute hospital, to clinicians providing emergency assistance and to patients, families and carers.
7. Understand the importance of, and discuss, end-of-life care planning with the patient, family and/or carer.
8. Undertake tasks required to properly care for patients who are deteriorating such as developing a clinical management plan, writing plans and actions in the healthcare record and organising appropriate follow up.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Practical Guidance
Commence Sepsis Screening using the Sepsis Screening Form when the patient has a NEWS of ≥4 (5 on supplementary O_2) or if infection is suspected.

Recommendation 46
As part of the Emergency Response System, competency in advanced life support should be ensured for a sufficient number of clinicians who provide emergency assistance to guarantee access to these skills according to local protocols.

Level of Evidence:4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 47
A range of methods should be used to provide the required knowledge and skills to staff. These may include provision of information at orientation and regular refresher programmes using face-to-face and online techniques, as well as simulation centre and scenario-based education and training.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Clinical Guideline Recommendations
Evaluation and Audit

Recommendation 48
Evaluation of new systems is important to establish their efficacy and determine what changes might be needed to optimise performance. Therefore on-going monitoring is necessary to track changes in outcomes over time and to check that these systems are operating as planned.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 49
Data should be collected and reviewed locally and over time regarding the implementation and effectiveness of recognition and response systems, namely the NEWS system.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 50
The NEWS and escalation of care protocol should be evaluated to determine whether it is operating as planned. Evaluation may include checking the existence of required documentation, guidelines, policies and protocols and compliance with same (such as completion rates of observation charts or proportion of staff who have received education and training).

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 51
Clinical audit is recommended to support the continuous quality improvement process in relation to implementation of the NEWS system (Appendix 4). The recommended minimum for audit includes:
1. Utilization of the ISBAR communication tool.
2. Utilization and accuracy of completion of the patient observation chart incorporating the NEWS.
3. Utilization of the 'track and trigger' response – the NEWS protocol.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 52
Systems should be evaluated to determine whether they are improving the recognition of, and response to, clinical deterioration. Evaluation may include collecting and reviewing data about calls for emergency assistance, and adverse events such as cardiac arrests, unplanned admissions to intensive care and hospital deaths.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 53
The following data should be collated for each call for emergency assistance that is made to the Emergency Response System:
1. Patient demographics.
2. Date and time of call.
3. Response time.
4. Reason for the call.
5. The treatment or intervention required.
6. Outcomes of the call, including disposition of the patient.

Level of Evidence:4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 54
Regular audits of triggers and outcomes should be conducted for patients who are the subject of calls for emergency assistance. Where these data are available, this could include longer-term outcomes for patients (such as 30 and 60 day hospital mortality).

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 55
Evaluation of the costs and potential savings associated with recognition and response systems could also be considered.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 56
Information about the effectiveness of the recognition and response systems may also come from other clinical information such as incident reports, root-cause analyses, cardiac arrest calls and death reviews. A core question for every death review should be whether the escalation criteria for the Emergency Response System were met, and whether care was escalated appropriately.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 57
As part of the implementation of new systems, feedback should be obtained from frontline staff about the barriers and enablers to change. Issues and difficulties regarding implementation should be considered for different acute hospitals.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)

Recommendation 58
Consistent with any implementation process, information collected as part of ongoing evaluation and audit should be:
1. Part of a feedback process to ward staff and the primary medical practitioner or team in an acute hospital regarding their own calls for emergency assistance.
2. Part of a feedback process to the clinicians providing emergency assistance.
3. Reviewed to identify lessons that can improve clinical and organisational systems.
4. Used in education and training programmes.
5. Used to track outcomes and changes in performance over time.
6. Used to implement remedial actions.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 59
Indicators of the implementation and effectiveness of recognition and response systems should be monitored at senior governance levels within the organisation (such as by senior executives or relevant quality committees). It is recommended that the audit process in each acute hospital is overseen by the NEWS group/committee at local level.

Level of Evidence: 4
Grade of Recommendation: D

Reference 13 (Expert Opinion)
National Governance/National Clinical Guideline Development Group (Expert Opinion)

Recommendation 60
It is recommended that the NEWS parameters are reviewed annually and updated as new information becomes available either from national or international audits or research.

Level of Evidence: 4
Grade of Recommendation: D

National Governance/National Clinical Guideline Development Group (Expert Opinion)

References
(Levels of evidence and grades of recommendations)

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Appendix 3
National Patient Observation Chart

A3 format folded to A4 - punched for insertion to patient's record

Page 1 Front

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Tús Áite do Shábháilteacht Othar
Patient Safety First

Hospital Name:

.....

Document Number during this Admission ☐

Patient Name:

Date of Birth:

Healthcare Record No:

Addressograph

NATIONAL EARLY WARNING SCORE
ADULT PATIENT OBSERVATION CHART

Escalation Protocol Flow Chart

Total Score	Minimum Observation Frequency	ALERT	RESPONSE
1	12 Hourly	Nurse in charge	Nurse in charge to review if new score1
2	6 Hourly	Nurse in charge	Nurse in charge to review
3	4 Hourly	Nurse in charge & Team/On-call SHO	1. SHO to review within 1 hour
4-6	1 Hourly	Nurse in charge & Team/On-call SHO	1. SHO to review within ½ hour 2. Screen for Sepsis 3. If no response to treatment within 1 hour contact Registrar 4. Consider continuous patient monitoring 5. Consider transfer to higher level of care
≥ 7	½ Hourly	Nurse in charge & Team/On-Call Registrar Inform Team/On-Call Consultant	1. Registrar to review immediately 2. Continuous patient monitoring recommended 3. Plan to transfer to higher level of care 4. Activate Emergency Response System (ERS) *(as appropriate to hospital model)*
Note: Single Score triggers			
Score of 2 HR ≤ 40 (Bradycardia)	½ Hourly	Nurse in charge & Team/On-call SHO	1. SHO to review immediately
*Score of 3 in any single parameter	½ Hourly or as indicated by patient's condition	Nurse in charge & Team/On-call SHO	1. SHO to review immediately 2. If no response to treatment or still concerned contact Registrar 3. Consider activating ERS

*In certain circumstances a score of 3 in a single parameter may not require ½ hourly observations i.e. some patients on O_2.

- When communicating patients score inform relevant personnel if patient is charted for supplemental oxygen e.g. post-op.
- Document all communication and management plans at each escalation point in medical and nursing notes.
- Escalation protocol may be stepped down as appropriate and documented in management plan.

IMPORTANT:

1. If response is not carried out as above CNM/Nurse in charge must contact the Registrar or Consultant.
2. If you are concerned about a patient escalate care regardless of score.

Adapted from CUCORU chart

National Early Warning Score (NEWS) Key							
SCORE	**3**	**2**	**1**	**0**	**1**	**2**	**3**
Respiratory Rate (bpm)	≤ 8		9 - 11	12 - 20		21 - 24	≥ 25
SpO_2 (%)	≤ 91	92 - 93	94 - 95	≥ 96			
Inspired O_2 (FiO_2)				Air			Any O_2
Systolic BP (mmHg)	≤ 90	91 - 100	101 - 110	111 - 249	≥ 250		
Heart Rate (BPM)		≤ 40	41 - 50	51 - 90	91 - 110	111 - 130	≥ 131
AVPU/CNS Response				Alert (A)			Voice (V), Pain (P), Unresponsive (U)
Temp (°C)	≤ 35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥ 39.1	

Note: Where systolic blood pressure is ≥ 200mmHg, request Doctor to review.

Pages 2-3 Middle Pages

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Early Warning Score System

0	1	2	3

Consultant:

Patient Name:
Date of Birth:
Healthcare Record No:
Addressograph

Ward:

Screen for Sepsis if NEWS ≥4 (5 on supplementary O_2) or if infection is suspected

Frequency of observations
Year _____
Date
Time

ABCDE Assessment

A B

RESPIRATORY DISTRESS
Consider:
- Airway
- Hypoxia
- Acidosis

Intervention:
- Immediate medical review
- ABCDE assessment
- Give Oxygen to target: 90% in COPD patients, 96% or more in all other patients
- Request CXR & ABG
- Airway Obstruction: activate Emergency Response System
- Respiratory Acidosis: Consider early non-invasive ventilation

C

HYPERTENSION
Consider:
- Pain
- Hypercapnia

Intervention:
- Immediate medical review
- 12-lead ECG

HYPOTENSION
Consider:
- Bleeding
- Myocardial Infarction
- Sepsis

Intervention:
- Immediate medical review
- Check BP manually
- 12-lead ECG
- If no heart failure, stat IV fluids - 500ml
- If no improvement after 20ml/kg: immediate review by doctor
- Systolic BP ≤ 90: consider activating ERS

TACHYCARDIA
Consider:
- Seagull Sign**
- Loss of conciousness
- Myocardial ischaemia on ECG
- Heart failure. If YES – consider activating ERS

Intervention:
- Immediate medical review
- ACLS Algorithm as appropriate

BRADYCARDIA
Consider:
- Electrolyte Disturbance
- Drug Side-effect
- Complete Heart Block

Intervention:
- Immediate medical review
- 12-lead ECG
- Telemetry
- Heart Rate ≤ 40: consider activating ERS
- Document irregular Heart Rate

D

NEUROLOGICAL DETERIORATION
Consider:
- Hypoglycaemia
- Acute brain injury
- Pupil response

Intervention:
- Immediate medical review
- Capillary glucose
- Sudden fall in level of consciousness: consider activating ERS

E

PYREXIA OR HYPOTHERMIA
Consider:
- Sepsis

Intervention:
- Immediate medical review
- C-Reactive protein
- Two or more Sepsis indicators present
- Commence SEPSIS SIX Regimen

| | | |

Page 4 Back Page

Sepsis Screening Pathway

(ALWAYS USE CLINICAL JUDGEMENT)

ADULT PATIENTS

There is separate sepsis criteria for women in pregnancy

Use this Sepsis Screening Pathway if the National Early Warning Score (NEWS) is ≥ 4 (5 on supplementary O_2), or if infection is suspected

Doctor must review *within 30 mins* (use ISBAR)

Are any *2 or more modified* Systemic Inflammatory Response Syndrome (SIRS) criteria present

- **Respiratory rate > 20** (bpm)
- **Heart rate > 90** (bpm)
- **WCC < 4 or > 12 x 10^9/L**
- **Temperature <36 or >38.3** (^oC)
- **Acutely altered mental status**
- **Bedside glucose >7.7mmol/L** *(in the absence of diabetes mellitus)*

+ INFECTION SUSPECTED

Note: Some groups of patients, such as older people, may not meet the modified SIRS criteria, even though infection is suspected. Where this occurs check for signs of organ dysfunction and raised biomarkers such as C-reactive protein (CRP)

NO Following a history and examination, and in the absence of suspected infection, staff may proceed with using the NEWS protocol

YES. THIS IS SEPSIS Sepsis Six Regimen must be completed *within 1 hour*

Has a decision been made NOT to escalate care (excluding further treatment)? **NO** proceed | **YES** do not proceed

TAKE 3 — **SEPSIS SIX –** aim to complete *within 1 hour* — GIVE 3

1. **Blood cultures** before giving antibotics
   Do not delay antibiotic administration >1 hour if blood cultures are difficult to obtain. Send samples from potentially infected sites eg. sputum, urine, wounds, IVC/CVC. Consider source control.
2. **Lactate and FBC**
3. **Urine output measurement**
4. **O_2** (94-98% SpO_2 or 88-92% in COPD patients)
5. **IV fluid resuscitation**
   (500ml bolus - give up to 30ml/kg) & reassess (target systolic BP>90/MAP>65)
   Monitor response to IV fluids and titrate to effect
6. **IV antibotics** according to local guidelines

Laboratory tests must be requested as EMERGENCY and aim to have results available and *acted on within the hour*

Look for signs of **organ dysfunction:**

- **Systolic BP < 90 or Mean Arterial Pressure < 65 or Systolic BP more than 40 below patient's normal**
- **New need for oxygen to achieve saturation > 90%**
- **Lactate > 2 mmol/L** (following administration of fluid bolus)
- **Urine output < 0.5ml/kg for 2 hours – despite adequate fluid resuscitation**
- **Acutely altered mental status**
- **Glucose > 7.7 mmol/L** *(in the absence of diabetes)*
- **Creatinine > 177 micromol/L**
- **Bilirubin > 34 micromol/L**
- **PTR > 1.5 or aPTT > 60s**
- **Platelets < 100 x 10^9/L**

Any organ dysfunction: THIS IS SEVERE SEPSIS
Registrar or Consultant to review immediately.
Reassess frequently in *1st hour.*
Consider other *investigations and management*

Look for signs of **septic shock**

(following administration of fluid bolus)

- **Lactate > 4 mmol/L**
- **Hypotensive (Systolic BP < 90 or MAP < 65)**

If either present: THIS IS SEPTIC SHOCK
Critical care consult required

- **Consultant referral**
- **Consider transfer to a higher level of care**
- **Critical care consult requested**
  A critical care review may be requested at any point during this assessment, but is required for patients with Septic Shock. In a hospital with no critical care unit, a critical care consult must be made and transfer to a higher level of care considered, if appropriate, following the consult.

Pathway Modification
Not all patients meeting modified SIRS criteria have sepsis,
OR there may be additional problems requiring different management (current Congestive Cardiac Failure (CCF), Diabetic Ketoacidosis (DKA), Myocardial Infarction (MI), Gastro-Instinal (GI) Bleed etc)
OR patient may be receiving chemotherapy
OR be palliated.

File this document in patient notes - Document management plan.

NOTE: The vital signs section, should not be amended as colour coding and scoring parameters are integral to the National Patient Observation Chart The scoring parameters for the physiological signs identified in the nationally agreed National Early Warning Score (using ViEWS parameters) should be strictly adhered to in the event that an acute hospital decides to design other aspects of their own observation chart.

Appendix 4
National Early Warning Score (NEWS) System Recommendations for Audit Report (HSE 2012, Version 3)

Acknowledgement: The National Early Warning Score and associated Education Programme Audit and Evaluation sub-group worked on bringing this document to completion: Dr Maria Donnelly, AMNCH, Kathleen McMahon, Cavan General, Aine Lynch AMNCH, Dolores Ryan Connolly Hospital, Anne Marie Oglesby, CIS. Thanks to Gillian Whyte, Cavan General, Anne Marie Barnes and Dr. John Cullen, AMNCH and Simone Comiskey, Connolly Hospital, Sarah Condell, ONMSD who also contributed to the document.

1. Introduction

It is recommended that the audit process is coordinated locally in each acute hospital by the local NEWS Committee, as per the NEWS recommendations. The NEWS audit process is recommended to be undertaken from a multidisciplinary perspective where appropriate. In planning the audits to be undertaken, consideration should be given to the frequency of the audits for example, these could occur 6 weekly initially then quarterly, once the implementation process has become established.

The recommended standard required is 100% compliance - where the compliance is less that 80% it is proposed that local action plans are put in place, e.g. increase frequency of audits and identify problem areas. The recommended sample size for the audit is one third of patients' charts in the ward/unit/department. More detailed audits can be carried out on patients triggering a score of 3 or more from the sample obtained.

The audit results and reports should be discussed at the NEWS committee initially, and thereafter linking into the appropriate hospital forums as required. The clinical audit cycle as part of the continuous quality improvement process should inform the audit plan.

2. NEWS audit datasets

Two datasets of audits for the national Early Warning Score (ViEWS) System are outlined: the minimum dataset and the expanded dataset (see A and B below). It is recommended that all healthcare facilities, as a minimum requirement, undertake to audit the minimum dataset to support the implementation and monitoring of the national NEWS locally, as part of the continuous quality improvement cycle. It is important that feedback on audits undertaken is given to the relevant staff groups to ensure appropriate action plans for change are implemented.

2.1 Minimum NEWS audit dataset

2.1.1 Maintain a database of all patients triggering a NEWS response

In this way each acute hospital will be able to track frequency of utilisation and this will assist in future audits. Links to HIPE coding should be considered.

Example: The use of a removable sticker system to identify all patients triggering a NEWS of 3 or higher, has been adopted by a large teaching hospital. The sticker is placed in the patients chart and picked up by the HIPE coder, other computerised options could be used.

2.1.2 Audit the following elements of the NEWS system

- Utilization of ISBAR communication tool as part of a documentation audit. This can be achieved if the communication is documented in the patients nursing notes e.g. a sticker is placed in the patient's chart as soon as the patient has a NEWS of 3 or more, prompting a response to each section of the communication tool.
- Utilization and accuracy of completion of the Patient Observation Chart incorporating the NEWS.
- Utilization of the escalation response to the NEWS Protocol for all patients or a sample of patients who trigger a NEWS of 3 or more.
- Capture patients who did not trigger an escalation. Review non 'Do Not Resuscitate' (DNR) cardiac arrests. Information may be available from the Resuscitation Training Officer regarding unplanned admissions to ICU.

2.2.3 Measure Outcomes

- Basic patient outcome measures (e.g. Hospital length of stay (HLOS), transfer to HDU, ICU, ICU length of stay, death (unexpected death)
- Identification of the location to which the patient has been transferred or otherwise, for those triggering a response
- Scope of care decisions – 'Do Not Resuscitate' or 'Palliative care' order.

Sample audit tools to support the recommended NEWS audits above are available in the appendix section of this document. This document is available on the website: http://www.hse.ie/go/nationalearlywarningscore/

2.2 Expanded NEWS audit dataset

In addition to the minimum requirement for audit the following may be utilised to evaluate the effectiveness of the NEWS system locally, and to support the implementation and sustainability of the NEWS system, as appropriate, according to local resources and expertise. The list provided is not exhaustive:

2.2.1 Education/Training audit

- Audit of COMPASS© education/training evaluation record
- Database of staff trained - each hospital to make local arrangement

2.2.3 Staff evaluation of the system

- Should include questions to elicit knowledge and awareness of the system
- Should elicit feedback re user friendliness of observation chart
- Consider focus groups to include nurses/consultants/NCHDs/therapy professionals as appropriate.

2.2.4 Availability of resources

- Equipment
- Higher dependency beds
- Personnel

2.2.5 Evaluation of crisis antecedents

- Physiologic variables which triggered the system
- Duration of deterioration prior to call

2.2.6 *Audit hospital process improvements*

- Case discussions
- Clinical outcome review committee
- Links with palliative care

2.2.7 *ViEWS system to be re-evaluated*

At defined time periods as new information becomes available from audit feedback/research nationally or internationally.

2.2.8 *Additional databases*

Should be made available to staff undertaking NEWS audits as required e.g. cardiac arrest/stroke/ICU admissions etc.

Sample data collection tool: ISBAR communication audit

National Early Warning Score (ViEWS) System Recommendations for Audit Report (HSE 2012, Version 3)

Note: The ISBAR communication tool should be documented in the nursing notes and audited as part of a documentation audit.

Date: _____/_____/_____ **Ward:**_____

Identification

Identity of individual reporting	Yes	No
Identity of individual responding	Yes	No

Situation

Location of patient	Yes	No
Name of patient causing concern	Yes	No
Brief summary of problem	Yes	No
Is this problem acute	Yes	No

Background

Concise summary of reason for admission	Yes	No
Summary of treatment to date	Yes	No
All baseline observations (current)	Yes	No
BP; Pulse; Resps; SpO_2; Temp; AVPU		
Previous observations	Yes	No
NEWS score	Yes	No

Assessment

Nurses assessment of situation if possible	Yes	No

Recommendation

Did the nurse make any recommendations	Yes	No
If yes, what ……		
Any feedback given:	Yes	No
Time spent on feedback _____		

Patient Outcome

- ❑ Stabilised
- ❑ Transferred HDU/ICU
- ❑ Transferred other facility
- ❑ Death

Sample data collection tool: Utilization and accuracy of completion of the Patient Observation Chart incorporating the NEWS

National Early Warning Score (ViEWS) System Recommendations for Audit Report (HSE 2012, Version 3)

Note: To avoid duplication – check to see if this is being carried out as part of the productive ward series audit.

Key Performance Indicator
NEWS Score is completed correctly and at appropriate frequency.

Target Score
100%

Inclusion Criteria
Ideally patients should be admitted for ≥ 48 hours.

Audit Instructions

- Audit 1/3 of patients on Ward/Unit/Department.
- Review the previous 48 hour period.
- Review a maximum of 8 vital signs in the previous 24 hours.

Auditors Name: _____ **Ward Name:** _____

Date of Audit: _____

Number of Patients Audited: _____

Data collection tool: Utilization and accuracy of completion of Patient Observation Chart incorporating the NEWS

National Early Warning Score (ViEWS) System Recommendations for Audit Report (HSE 2012, Version 3)

Ward Name: _____ Auditor: _____

Review vital signs for the previous 48 hours.
Include a maximum of 8 sets of observations in your audit.

Date of Audit: _____

Patient Number	1	2	3	4	5	6	7	8	9	10
For questions 1 to 5: Insert 1 for YES / Insert 0 for NO and NA for questions that are not applicable or not answered										
1. Ward Name is recorded										
2. Patient Name is recorded										
3. HCRN is recorded										
4. Vital Signs are assessed at least 12-hourly in the past 48hrs										
5. There is increased frequency of monitoring in response to the detection of abnormal physiology										
For questizons 6 to 17: Enter the number A value must be entered for each question to ensure an accurate overall answer										
Number of sets vital signs audited										
6. EWS Score is dated *(No. dated in last 48hrs)*										
7. EWS Score is Timed using the 24-hour clock *(No. timed in last 48hrs)*										
8. Respiratory Rate is recorded *(No. recorded in last 48hrs)*										
9. Oxygen Saturation is recorded *(No. recorded in last 48hrs)*										
10. FiO_2 recorded as appropriate *(No. recorded in last 48hrs)*										
11. Blood Pressure is recorded *(No. recorded in last 48hrs)*										
12. Heart Rate is recorded *(No. recorded in last 48hrs)*										
13. AVPU Response is recorded *(No. recorded in last 48hrs)*										
14. Temperature is recorded *(No. recorded in last 48hrs)*										
15. EWS is totalled for each set of vital signs *(No. recorded in last 48hrs)*										
16. Calculation for each EWS Score is correct *(No. recorded in last 48hrs)*										
17. EWS Score is Initialled *(No. initialled in last 48hrs)*										

Sample data collection tool: Utilization of the Escalation Protocol response to the NEWS for all patients (or a sample of patients) who trigger a NEWS of 3 or more

National Early Warning Score (ViEWS) System Recommendations for Audit Report
(HSE 2012, Version 3)

Ward: _____ Respondent Number: _____
Date: _____

Instructions for Completing Response to NEWS Protocol

- Only relevant Score Section to be completed
- Mark **Y** for Yes, **N** for No, **NA** for Not Applicable

Response Activation	Appropriate Action		Yes	No	N/A
Score 3	1.1	Was the CNM/Nurse in charge informed of NEWS of 3? *Check nursing notes*			
	1.2	Were Observations recorded 4 hourly? *Check observation chart*			
	1.3	Did the RN contact the SHO and request review within 1 hour? *Check Nursing Notes*			
	1.4	Is there a record of the time the call was made to SHO? *Check Nursing Notes*			
	1.5	Is there a record of the time the SHO reviewed the patient? *Check medical Notes*			
	1.6	Was the patient reviewed by the SHO within 1 hour? *Check medical notes*			
	1.7	Did the SHO formulate and document management plan? *Check medical notes*			
Score 3 ***in any single parameter***	2.1	Did the RN inform the CNM/Nurse in charge? *Check Nursing Notes*			
	2.2	Did the RN inform the Team/On-call SHO for immediate review? *Check Nursing Notes*			
	2.3	Is there a record of the time the time call was made to Team/On-call SHO? *Check Nursing Notes*			
	2.4	Is there a record of the time the Team/On-call SHO reviewed the patient? *Check medical Notes*			
	2.5	Was the patient reviewed by the SHO immediately? Check medical notes			
	2.6	Were Observations recorded ½ hourly? *Check observation chart*			
	2.7	Did the Team/On-call SHO formulate and document management plan? *Check medical notes*			

Response Activation	Appropriate Action		Yes	No	N/A
Score 4-6	3.1	Did the RN inform the CNM/Nurse in charge? *Check Nursing Notes*			
	3.2	Did the RN informs Team/On-call SHO and requests review within 30 minutes? *Check Nursing Notes*			
	3.3	Is there a record of the time call sent to Team/On-call SHO?			
	3.4	Is there a record of the time Team/On-call SHO reviewed the patient? *Check medical Notes*			
	3.5	Was the patient reviewed by the SHO within 30 minutes? Check medical notes			
	3.6	Did the RN record observations hourly? *Check NEWS*			
	3.7	If no response to treatment in 60 mins or the RN was still concerned was the Registrar called? *Check Medical Notes*			
	3.8	Is there a record of the time the Registrar was informed? *Check Nursing and/or Medical Notes (Where Applicable)*			
	3.9	Is there a record of the time the Registrar reviewed the patient? *Check Medical Notes (Where Applicable)*			
	3.10	Was higher level of care considered? *Check Medical Notes (Where Applicable)*			
Score ≥ 7	4.1	Did the RN inform CNM/Nurse in charge? *Check Nursing Notes*			
	4.2	Did the RN request immediate review by Registrar? *Check Nursing Notes*			
	4.3	Is there a record of the time the Registrar was called? *Check Nursing Notes*			
	4.4	Is there a record of the time the Registrar reviewed the patient? *Review medical notes*			
	4.5	Was the patient reviewed by the Registrar immediately?			
	4.6	Did the RN record observations ½ hourly? *Check NEWS observation chart*			
	4.7	Was Consultant informed? *Check Medical Notes*			
	4.8	Was Emergency Response System activated (as per local protocol)? *Check Medical/Nursing Notes*			
	4.9	Was management plan formulated and documented? *Check Medical Notes*			
	4.10	Was patient transferred to higher level of care? *Check Medical/Nursing Notes*			

Appendix 5
National Early Warning Score Escalation Flow Chart

Tús Áite do Shábháilteacht Othar
Patient Safety First

NATIONAL EARLY WARNING SCORE

Escalation Protocol Flow Chart

Total Score	Minimum Observation Frequency	ALERT	RESPONSE
1	12 Hourly	Nurse in charge	Nurse in charge to review if new score1
2	6 Hourly	Nurse in charge	Nurse in charge to review
3	4 Hourly	Nurse in charge & Team/On-call SHO	SHO to review within 1 hour
4-6	1 Hourly	Nurse in charge & Team/On-call SHO	1. SHO to review within ½ hour 2. If no response to treatment within 1 hour contact Registrar 3. Consider continuous patient monitoring 4. Consider transfer to higher level of care
≥ 7	½ Hourly	Nurse in charge & Team/On-Call Registrar Inform Team/On-Call Consultant	1. Registrar to review immediately 2. Continuous patient monitoring recommended 3. Plan to transfer to higher level of care 4. Activate Emergency Response System (ERS) *(as appropriate to hospital model)*
Note: Single Score triggers			
Score of 2 HR ≤ 40 (Bradycardia)	½ Hourly	Nurse in charge & Team/On-call SHO	SHO to review immediately
*Score of 3 in any single parameter	½ Hourly or as indicated by patient□s condition	Nurse in charge & Team/On-call SHO	1. SHO to review immediately 2. If no response to treatment or still concerned contact Registrar 3. Consider activating ERS

*In certain circumstances a score of 3 in a single parameter may not require ½ hourly observations i.e. some patients on O_2.

- When communicating patients score inform relevant personnel if patient is charted for supplemental oxygen e.g. post-op.
- Document all communication and management plans at each escalation point in medical and nursing notes.
- Escalation protocol may be stepped down as appropriate and documented in management plan.

IMPORTANT:

1. If response is not carried out as above, CNM/Nurse in charge must contact the Registrar or Consultant.
2. If you are concerned about a patient, escalate care regardless of score.

Adapted from CUCHFT chart

Appendix 6
ISBAR Communication Tool
(Adapted with permission from Australian COMPASS© Education Programme)

ISBAR

IDENTIFY	Identify yourself, who you are talking to and who you are talking about
SITUATION	What is the current situation, concerns, observations, EWS
BACKGROUND	What is the relevant background? This helps to set the scene to interpret the situation above accurately
ASSESSMENT	What do you think the problem is? This requires the interpretation of the situation and background information to make an educated conclusion about what is going on
RECOMMENDATION	What do you need them to do? What do you recommend should be done to correct the current situation?

Adapted from COMPASS© Programme

Tús Áite do Shábháilteacht Othar
Patient Safety First

National Early Warning Score and COMPASS Programme

ISBAR
Communication Tool

I **Identify**	**Identify: You, Doctor, Patient** Is this Dr. _____? This is _____ *(e.g Mary, I am team leader on 7A)* I am calling about _____ *(e.g Mr David Jones)*
S **Situation**	**Situation: Why are you calling?** I am calling because _____ *(e.g Total NEWS of 6 or 3 in a single parameter)* Resp Rate _____ Sats _____ O_2 Delivery _____ Temp _____ Heart Rate _____ BP _____ Urinary Output _____ LOC _____ *(only use abnormal reading initially)*
B **Background**	**Background: What is relevant background?** They are _____ years old Admitted for _____ Recent surgery or procedures _____ Relevant past medical/surgical history _____ They currently have _____ *(e.g. IV fluids, Urinary Catheter, PCA)*
A **Assessment**	**Assessment: What do you think is the problem?** I think _____ *(e.g they are hypovolaemic)* *(you can skip this if they don't know what is wrong)*
R **Recommendation**	**Recommendation: What do you want them to do?** I would like you to _____ *(e.g come and review him please)* Is there anything you would like me to do before you get here?

Appendix 7
COMPASS© Education Programme
(Adapted with permission from Australian COMPASS© Education Programme)

COMPASS© is a multidisciplinary education programme designed to enhance our understanding of the deteriorating patient and the significance of altered observations. It also seeks to improve communication between healthcare professions and enhance timely management of patients. The COMPASS© Education Programme incorporating the National Early Warning Score should be delivered in full.

Programme learning outcomes
On completing the COMPASS© education programme the learner will knowledgeable in the recognition and management of clinically deteriorating patients. They will be able to utilise their skills and competencies to provide supportive symptom management until a definitive diagnosis has been made and treatment initiated.

Aims and objectives
1. Prioritise Care using:
   - Clinical judgement - apply prior and acquired knowledge to enable early recognition of the deteriorating patient
   - Decision making skills
   - Guidelines and algorithms
   - Initiate an appropriate and timely response.

2. Show Clinical Reasoning:
   - Recognise, interpret and act on abnormal clinical observations e.g. escalate care as appropriate
   - Understand the importance and relevance of clinical observations and the underlying physiology
   - Interpret results of investigations
   - Recognise own limitations.

3. Appropriate referral of patients:
   - Assess severity of illness
   - Recognise the need for specialist assistance
   - Identify the most appropriate environment for the patient.

4. Use evidence-based medicine:
   - Utilise most recent scientific evidence agreed with healthcare colleagues
   - Work within local and national guidelines and protocols.

5. Improve communication and team working:
   - Promote the use of more focussed communication between healthcare professionals
   - Communicate the patient status effectively with colleagues (to the right people at the right time)
   - Facilitate teamwork within the multi-disciplinary team for enhanced patient outcomes
   - Develop and action management plans for patients in conjunction with colleagues.

How it works

There are three phases to the package to be completed in the following order:
- The CD and manual to be worked through independently
- A multiple choice quiz
- A face to face session.

Details of the COMPASS© education programme are available on the HSE website: www.hse.ie

Acknowledgement: The COMPASS© programme has been modified to suit the Irish healthcare system with the kind permission of the Health Directorate, ACT Government, Australia.

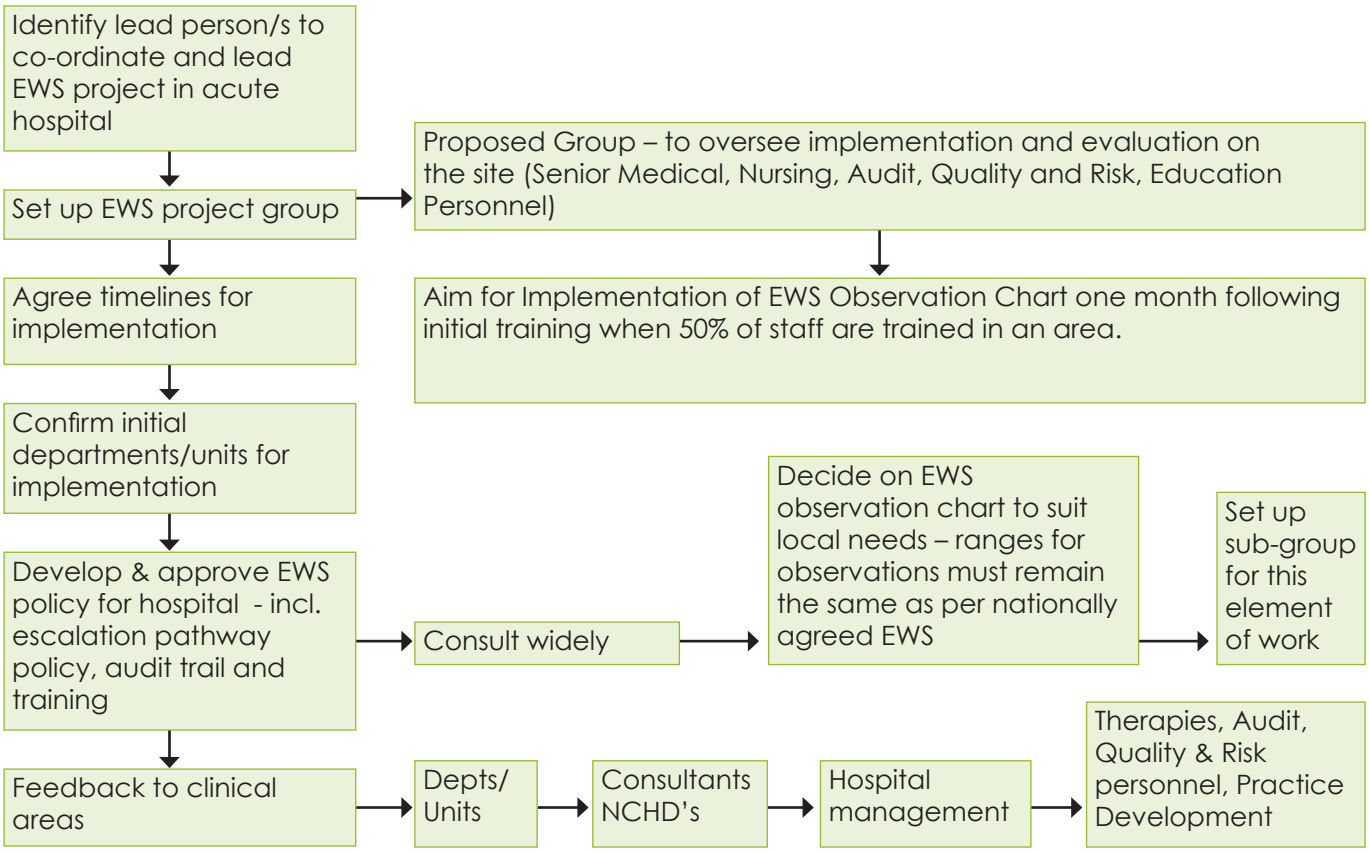
Appendix 8

The National Early Warning Score and associated Education Programme (COMPASS©) Implementation Guide

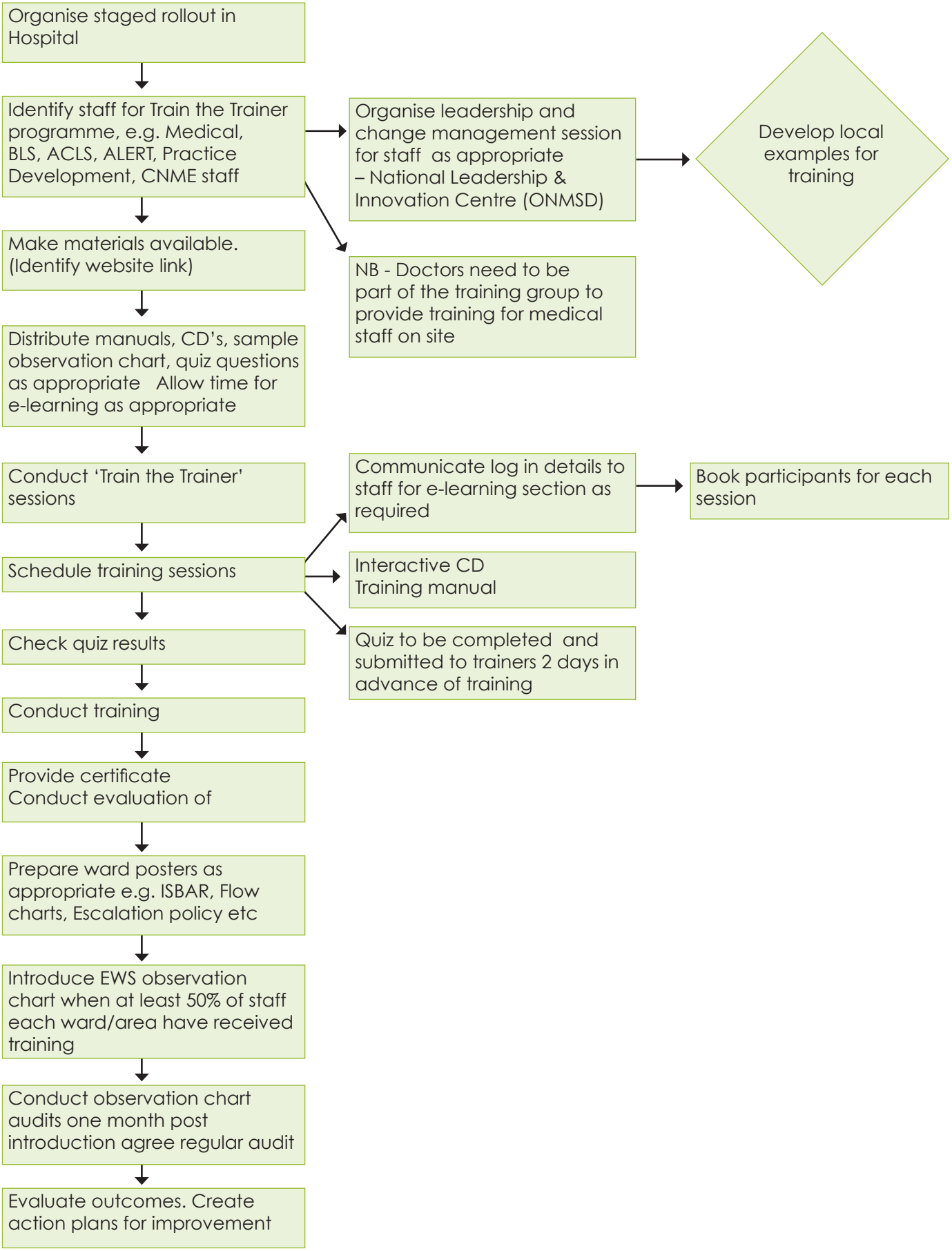
(Developed by HSE)

(Adapted with permission from Australian COMPASS© Education Programme)

Planning Stage



Training, Implementation, Audit and Evaluation Stage



Appendix 9
SWOT Analysis - The National Early Warning Score & Education Programme

The National Advisory Group completed a SWOT analysis of the National Early Warning Score and Education Programme March 2011. This was discussed, amended and agreed by the National Governance/National Clinical Guideline Development Group April 2011.

Strengths

1. Reduces mortality
2. Reduce cardiac arrest outside ICU
3. Right patient in the right place at the right time
4. Cost effective (relatively), minimal training, manpower and IT requirements
5. Empowers staff
6. Reduces family/staff stress
7. Reduces litigation
8. Standardisation of approach have a common taxonomy

Weaknesses

1. Absence of strong evidence
   - Cochrane review (2007) found two good quality studies, one from Australia showed no benefit across 23 hospitals; a ward level (16 wards) study in UK found a reduction in in-hospital mortality, (odds ratio 0.52). It is likely that randomized controlled trials may not be the optimal way of demonstrating benefit of such interventions.
2. Number of distinct early warning systems
   - Strengths and weaknesses of each - need to define
   - Whether different systems have been compared head to head.
   - Cost and training requirements and on-going validation of competence
   - Hospital consultants, depending on location of international training, may have preference for one system over another in absence of definitive evidence
   - Requirement for some systems to deploy MET, e.g. COMPASS©; this could be interpreted by some as implying a need for a separate MET if NEWS to be successful which is likely unfeasible in hospitals at present
3. Lack of congruence between tool and chart

Opportunities

1. Absence of national policy in this area
2. Quick win possible
3. Easy to mandate (though less easy to implement)
4. Simple message for all
5. Outcomes easy to audit, (relatively) i.e. number of cardiac arrests outside ICU, number of crash calls, in-hospital mortality (?30 day); consider collecting baseline measure data, pre-introduction of NEWS in some early adopter hospitals
6. Choosing early adopters and publicize their data will make it easier to persuade others of the benefits
7. Should identify senior individual clinicians (nursing, AHP, medical) who can champion this locally/nationally
8. Needs to be seen as having senior HSE management explicit support which it will do
9. Align opportunities and message with HIQA, DoH, CIS
10. Consider opportunity provided by private hospitals - ideally there would be one system across all hospitals

11. Consider patient advocate on Steering Group, ideally someone articulate with a story to tell
12. Should the use of a NEWS be a requirement for hospital licensing?
13. Single NEWS documentation throughout hospital and country (also threat, see below)
14. Necessary to redefine MET as the current arrest team?
15. 'Train the Trainers' model of delivering the education programme
16. Ensure Education and Training bodies mandate this as part of training, to specify benefits (outcomes, communication, team roles etc.)
17. Have pro-active communication strategy especially with media, to promote good publicity

Threats

1. To work effectively, needs to be rolled out across continuum of hospital care; this may be challenging; one needs to consider carefully the units/wards where first introduced, i.e. the high risk areas may not be the ones most receptive to this. Local knowledge and expertise critical here
2. Hospitals with existing systems may not accept an "imposed" new system
3. Some staff may challenge the evidence base; may be seen as yet more "paperwork" imposed from the centre.
4. To work effectively, a culture change may be required; e.g. junior nurse calling consultant at 2am if unhappy with a patient.
5. To work effectively, a standard system of communication e.g. ISBAR, may be required. This may meet with resistance Need to incorporate into NCHD training; will reduce need for repeated orientation
6. Is there a need to measure compliance with this tool? Locally defined?
7. Single NEWS documentation throughout hospital and country, likely will add to time scale
8. Who is responsible for implementation, monitoring, sustainability (clinical director, DON, hospital CEO)
9. Staff may consider this will add to their work, i.e. high levels of false alarms, need to consider this in positive/negative predictive values of various NEWS . Without knowing the data it is difficult to be certain, but it is likely that different systems will have different cut-offs, so that system "A" will have more false positives, (i.e. calls to patient that never arrests) to weigh against system "B" that has fewer false positives, but may miss more actual arrests
10. What measures (and operational definitions) will be used to measure successful implementation?
11. Variance in development of protocols

Risks Identified

1. Deteriorating patients are not identified early, therefore patients may suffer unexpected cardiac arrest or death
2. Care is not escalated early or at all
3. Vital signs are not accurately recorded
4. The response is not adequate
5. Senior medical staff are not informed
6. Staff become complacent
7. Lack of resources
8. Over dependence on a scoring system when the clinical judgement of experience staff must be acted upon no matter what the score

Appendix 10
Early Warning Scores - A Literature Review (April 2011 - updated October 2011)

Developed by: **Samantha Hughes, PhD**
Team Lead, Clinical Audit and Research
HSE Dublin Mid Leinster,
Tullamore, Co. Offaly

Assisted by: **Eilish Croke, MBA, BNS, National Lead, National Early Warning Score and COMPASS© Education Programme.**

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1. Methodology

A systematic literature search was performed in April 2011. The search strategy used the following PICO as guidance:

- **Population:** Adult acute patient, Adult patient, medical patient
- **Intervention:** Early Warning Score, Modified Early Warning Score, VitalPAC™ (ViEWS), Track and Trigger System, ALERT™, COMPASS©
- **Comparison:** Early Warning Score, Modified Early Warning Score, VitalPAC™ (ViEWS), Track and Trigger System, ALERT™, COMPASS© (comparison against each other or with no intervention)
- **Outcome:** Detection of deterioration/timely identification or detection of deterioration of patient

Inclusion and Exclusion Criteria

The Inclusion criteria were as follows:

- Adult acute patient (Medical or Surgical)
- Acute hospital setting
- Studies looking at EWS, MEWS, ViEWS, Track and Trigger Systems (single intervention studies or comparison studies)
- Studies which looked at other acute Early Warning or Trigger Systems
- Preference was towards:
  - Peer reviewed studies
  - Meta analysis
  - Longitudinal studies
- Preference was towards studies that enabled comparison of outcomes pre and post implementation of Early Warning Systems

Studies were excluded if they related to

- Paediatric Patients
- Obstetric Patients
- Non-acute settings
- Systems not suitable for bedside measurement and reporting
- Or if the study did not contain sufficient detail regarding intervention or outcome measures

1.1 Search methodology

The following databases were utilised in the literature search

- TRIP Database
- Cochrane Database
- Pubmed
- NICE Guideline database
- NHS Evidence database

In addition, literature was also identified via citation searching on key papers and internet searches using a general browser.

An overview of the outcome from the search strategy is as follows:

Search Criteria	Hits
Acute adult patient	14,264
(Adult acute patient OR Adult Patient OR Adult Medical Patient)	42,788
(Early Warning Score OR Modified Early Warning Score OR ViEWS	19,247
Modified Early Warning Score OR MEWS	591
Early Warning Score	4,850
VitalPAC Early Warning Score	6
Track and Trigger System	75
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR ViEWS)	4073
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR Vital PAC Early Warning Score)",	363
(Early Warning Score OR Modified Early Warning Score OR ViEWS) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)", by relevance	153
(Early Warning Score OR Modified Early Warning Score OR VitalPAC Early Warning Score) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	32
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score) AND (Early Warning Score OR Modified Early Warning Score) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	21
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score) AND (Modified Early Warning Score) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	11
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR ViEWS) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	98
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR VitalPAC Early Warning Score) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)", by relevance	21
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR (ViEWS OR VitalPAC OR VitalPAC Early Warning Score)) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)",	98
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score) AND (ViEWS OR VitalPAC OR VitalPAC Early Warning Score) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	6
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score) AND (Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	3
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score Or Modified Early Warning Score) AND (Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	3
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score Or Modified Early Warning Score OR ViEWS) AND (Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	3

Search Criteria	Hits
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score Or Modified Early Warning Score OR VitalPAC Early Warning Score OR Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)",	21
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score Or Modified Early Warning Score OR VitalPAC Early Warning Score) AND (Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)", by relevance	3
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Modified Early Warning Score) AND (Track and Trigger System) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	1
"(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score OR Modified Early Warning Score OR ViEWS) AND (ALERT™) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	23
(Adult acute patient OR Adult Patient OR Adult Medical Patient) AND (Early Warning Score Or Modified Early Warning Score OR VitalPAC Early Warning Score OR Track and Trigger System) AND (ALERT™) AND (Detection of Deterioration OR Timely detection of deterioration OR Timely identification of deterioration)	6

2. Strengths and limitations of the body of evidence

2.1 Strengths

The body of evidence was strengthened by a number of factors:

- The availability of a number of peer-review studies and meta analysis.
- There was a Cochrane Reviews undertaken in relation to the implementation and effectiveness of Early Warning Scores both in the UK and Australia (McCaughey, 2007).
- In July 2007, the National Institute for Health and Clinical Excellence (NICE) published a Guideline entitled "Acutely ill patients in hospital: Recognition of and response to acute illness of adults in hospital". The authors of these guidelines carried out a review of the literature in the area of EWS, Track and Trigger systems and Clinical Care Outreach service.
- A number of significant longitudinal studies were also identified (Bleyer *et al*., 2011).
- Many of the included studies looked at large patient sample sizes.
- There were a number of recent pre-and post intervention studies (retrospective review of outcomes pre and post implementation of early warning score systems) were also included in the literature review e.g. Mitchell *et al*., 2010; Moon *et al*., 2011).
- There was also a significant study that compared ViEWS to 33 other early warning systems for a range of outcomes (Pyrtherech *et al*., 2010).This publication also provided a detailed literature review on EWS.
- A number of studies included in the literature review provided sensitivity and specificity values to enable comparison between the various early warning systems.

2.2 Weaknesses

- A number of studies were carried out in a single ward/unit setting.
- In a number of studies, intervention and outcome relationships were uncertain due to small sample sizes e.g. Duckett *et al*, 2007.
- A number of studies were carried out on one cohort of patients only and few studies looked at medical and surgical patients in one setting (e.g. Mitchell *et al*, 2011).

- There was some variation in outcome measurement e.g. Morgan *et al*, (2007) stated that Gao *et al*, (2007) based their conclusions on use of the composite outcome measure of death, admission to critical care, "do not attempt resuscitation" or cardiopulmonary resuscitation. Morgan *et al*., (2007) were of the opinion that the data available to Gao *et al*, (2007) afforded them no estimate of the number of patients whose clinical course was positively influenced through the use of EWS at ward level and who, as a result, were not admitted to critical care and did not suffer cardiac arrest or death. Morgan *et al*, 2007 states that application of these end points describes final patient outcome as a reflection of the physiological track and trigger system and the accompanying response in addition to all other confounding variations in subsequent clinical management.

3. Findings

3.1 Vital signs monitoring

Resuscitation guidelines developed by the Resuscitation Council (UK) in 2010 state that when patients deteriorate, they display common signs that represent failing respiratory, cardiovascular and nervous systems and that this is the basis for monitoring patients' vital signs. Abnormal physiology is common on general wards (Harrison, 2005) yet the National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2005) stated that the important physiological observations of sick patients are measured and recorded less frequently than is desirable. Robb (2010) has reported that several factors have been identified as contributing to the failure to recognize clinical deterioration, including: not taking vital signs, not recognizing physiological deterioration in those vital signs, not communicating concern and not responding appropriately where physiological deterioration has been identified. DeVita (2010) outlines that to assist in the early detection of critical illness, every patient should have a documented plan for vital signs monitoring that identifies which variables need to be measured and the frequency of measurement.

A Cochrane Review published in 2009 (Mc Gaughey *et al*.) referred to a number of studies which reported that many hospital deaths are potentially predictable and preventable. Observational studies suggest that clinical deterioration of patients on general hospital wards is often preceded by changes in physiological observations that are recorded by clinical staff six to 24 hours prior to a serious adverse event (Page *et al*.,2008). McCaughey *et al*.,(2009) outline that the most common physiological abnormalities are changes in basic vital signs of respiration, pulse, oxygenation and mental function, however, these changes in clinical signs are often missed, misinterpreted or mismanaged. Mc Quillan (1998) states that the main reasons for staff failing to manage basic vital signs can be attributed to delays in seeking advice, failure to recognize clinical urgency, lack of knowledge and skills in resuscitation, inadequate supervision or organizational problems within the hospital setting.

Delays in treatment or inadequate care of patients on general hospital wards often results in unanticipated admissions to the intensive care unit, increased length of hospital stay, cardiac arrest or death (Subbe *et al*., 2001). Mc Quillan (1998) reported that up to 50% of ward based patients received substandard care prior to ICU admission and that up to 41% of ICU admissions were potentially avoidable. This was supported in a number of other studies (McCaughey *et al*., 2009). McCaughey *et al*., 2009) summarised from a number of studies that delays in treatment or inadequate care of patients on general hospital wards has major implications for critically ill patients on general wards as unanticipated ICU admissions are twice as likely to develop cardiac arrest and are associated with an increased ICU and hospital mortality.

NICE (2007) stated that the aging population, increasing complexity of medical and surgical interventions, and shorter length of hospital in patient stays have meant that patients in hospital

are at increasing risk of becoming acutely ill and may require admission to critical care areas. The authors state that 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 the onset of illness, during surgical or medical interventions and during recovery from illness.

Analysis of 576 deaths reported to the National Patient Safety Agency's National Reporting and Learning System over a one year period (2005) identified that 11% were as a result of deterioration not recognized or acted upon (NHS, 2007).

The NHS (2007) carried out a programme of work that aimed to identify the underlying causal and contributory factors in deterioration incidents and to explore how these issues interrelate. The findings indicate that consistently and effectively detecting and acting upon clinical deterioration is a complex issue. A series of points where the process can fail were identified, including not taking observations, not recognizing early signs of deterioration, not communicating observations causing concern and not responding to these appropriately.

The underlying contributing and causal factors were also found to be complex and participants in the NHS study identified a wide range of factors that contribute to the problem including challenges in prioritizing competing demands, a lack of effective team working and leadership, verbal and written communication breakdown, insufficient training to understand the relevance of the observations and a lack of successful implementation of relevant policies and procedures. The National Confidential Enquiry in to Patient Outcome and Death (NCEPOD, 2005), identified the prime cause of the substandard care of the acutely unwell in hospital as being delayed recognition and institution of inappropriate therapy that subsequently culminated in a late referral. The report found that on a number of occasions these factors were aggravated by poor communication between the acute and critical care medical teams. Admission to an ICU was thought to have been avoidable in 21% of cases and the authors felt that suboptimal care contributed to about a third of the deaths that occurred.

McCaughey *et al*., 2007) surmised that the number of preventable deaths and unanticipated ICU admissions could be reduced if deteriorating patients on general hospital wards were identified earlier. This led to this introduction of a number of innovations for early detection and treatment of deterioration in ward based patients such as the Acute Physiological and Chronic Health Evaluation (APACHE) II score (Knaus *et al*., 1985) and the Mortality Predication Model (MDM) (Lemeshow *et al*., 1985) which were tested on subgroups of medical patients with acute renal and congestive heart failure (Fiaccadori *et al*., 2000 and Poses *et al*., 2000). The Simplified Acute Physiology Score (SAPS) and the reduced version of this (SAPS.R) were also developed to predict outcome in ICU patients (Reina *et al*., 1997). A study undertaken by Franchi *et al*., (2009) identified that SAPS seemed to be a suitable tool in predicting the risk of death but not morbidity.

The aforementioned scoring systems did not seem to be suitable for bed side assessment of ward patients in a routine fashion and hence warning systems such as the Early Warning Score (EWS) (Morgan, 1997), Modified Early Warning Score (MEWS), ViEWS and the Acute Life-threatening Early Recognition and Treatment (ALERT™) course (Smith, 2000) were developed.
Early Warning Systems are also known as Track and Trigger (TT) systems.

3.2 Early Warning Systems/Track and Trigger Warning Systems (TT)

Morgan *et al*., (1997) designed Early Warning Systems to secure the timely presence of skilled clinical help by the bedside of those patients exhibiting physiological signs compatible with established or impending critical illness. The early warning score is proposed to gauge the risk of patients for catastrophic deterioration (Subbe *et al*., 2001). Early Warning Systems/TTs have predominantly evolved as a means to alert outreach services such as the Critical Care Outreach Service (CCOS) in the UK or the Medical Emergency Team (MET) in Australia.

In 2007, Gao *et al*., carried out a systematic review and evaluation of physiological track and trigger warning systems for identifying at risk patients on the wards. The objective of the study was to explore the extent to which TT systems were developed according to established procedures, to review all aspects of their reliability, validity and utility of existing systems (e.g. their sensitivity, specificity and predictive validity, and if possible to identify the best TT for timely recognition of potential or established critical illness. Of the articles reviewed, 31 papers described the use of a TT and 5 papers were studies examining the development or testing of a TT. The outcome in this study was measured by a composite of death, admission to critical care, "do not attempt resuscitation" or cardiopulmonary resuscitation.

The track and trigger early warning systems included in this review included:

- Single Parameter systems
  - Medical Emergency Team (MET) calling criteria
  - Medical Crisis Response Team: Condition C calling criteria
  - PERT (Patient Emergency Response Team) calling criteria
  - Trauma team calling criteria
- Multiple parameter systems
  - PART (Patient at Risk Team) calling criteria
- Aggregate scoring systems
  - MEWS (Modified Early Warning Score)
  - Derby MEWS
  - PARS (Patient at Risk Score)
  - Lewisham PAR-T (Patient at Risk trigger)
  - Lewisham EWS (Early Warning Score)
  - MET activation criteria
- Combination systems
  - EWSS (Early Warning Scoring System).

The authors of the review highlighted a large degree of variation between the parameters included in the TT systems used and in the application of the TTs across hospitals in the UK and highlighted that many of the TTs were developed to be specific for the particular hospital.
The development of the TT was often dependent on local preferences and the availability of patient information.

The study found that the diagnostic accuracy varied widely. Sensitivities and positive predictive values were low. Specificities and negative predictive values were generally acceptable. Of the articles included in this study there was only one study (Hodgetts *et al*.,2002) which derived a TT using recognized statistical techniques to select the most powerful predictors of outcome followed by further analysis to determine which predictors can be omitted from the TT without loss of predictive power.

The authors reported that none of the systems achieved the requirements of a level 1 clinical decision rule – a rule that has been validated for use in a wide variety of settings with confidence that it can change clinical behaviour and improve patient outcomes. The authors reported the PART calling criteria to be poor predictors of mortality or admission to critical care and are likely to result in inappropriate activation of the CCOS. The authors stated that the low sensitivity of the existing TTs means that a high number of patients requiring intervention are likely to be missed if the ward staff relies solely on these systems for identifying deteriorating patients. It is the opinion of the authors that the TT systems should be used as an adjunct to clinical judgement.

The authors were unable to recommend a TT to be standardized across the health services. However, they also did not provide sufficient evidence to discontinue the use of existing TTs.
Hospitals seeking a system suited to their local needs should consider not only measures of diagnostic accuracy, but also reproducibility and ease of use in practice, including time to complete and acceptability to patients and staff.

In response to this study, Morgan *et al*.,(2007) stated that Gao *et al*.,(2007) based their conclusions on use of the composite outcome measure of death , admission to critical care, "do not attempt resuscitation" or cardiopulmonary resuscitation. Morgan *et al*.,(2007) are of the opinion that the data available to Gao *et al*.,(2007) afforded them no estimate of the number of patients whose clinical course was positively influenced through the use of EWS at ward level and who, as a result, were not admitted to critical care and did not suffer cardiac arrest or death. Morgan *et al*.,(2007) states that application of these end points describes final patient outcome as a reflection of the physiological track and trigger system and the accompanying response in addition to all other confounding variations in subsequent clinical management.

3.2.1 Single Parameter System

Subbe *et al*.,(2007) evaluated the reproducibility of MET calling criteria, (a single parameter system), MEWS (aggregate scoring system) and ASSIST (assessment score for sick patient identification and step-up in treatment – aggregate scoring system). The study found that there was significant variation in the reproducibility of the three systems examined and that all three showed better agreement on triggers than aggregate scores. Subbe *et al*., (2007) found that MET achieved higher percentage agreement than ASSIST, and ASSIST higher than MEWS. This study indicated that the simpler systems were more reliable. However, single parameter systems such as MET calling criteria, while simple to use with better reproducibility, has disadvantages such as the inability to allow a patient's progress to be tracked, it does not allow a graded response strategy and literature would suggest that the system has low sensitivity, low positive predictive value but high specificity. This could potentially cause increased triggers that are not related to an adverse event. As a result this system is not widely adopted in UK hospitals (NHS, 2007).

3.2.2 Multiple Parameter:

The Multiple Parameter system such as PART allows the monitoring of clinical progress, it allows for a graded response strategy and is widely used in UK hospitals (NHS, 2007). 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. Gao *et al*., (2007) reported the PART calling criteria to be poor predictors of mortality or admission to critical care and are likely to result in inappropriate activation of the Critical Care Outreach Service (CCOS). The NHS has outlined the advantages of a multiple parameter system as allowing the monitoring of clinical progress and for the development of a graded response strategy. However, the disadvantages are that it may lack reproducibility and reliability because systems are prone to human calculation errors. Multiple parameter systems have low specificity when one abnormal observation is present, but sensitivity reduces and specificities increases as the number of abnormal variables increase.

3.2.3 Aggregate Scoring System

The NHS reported that the aggregate scoring systems have the advantage of allowing the monitoring of clinical progress and it allows for a graded response strategy making it widely used in UK hospitals.

EWS (Early Warning Scores)

In recent years, early warning scores (EWS), or 'calling-criteria' have been adopted by many hospitals to assist in the early detection of critical illness. The EWS system is an aggregated scoring system in which weighted scores are assigned to physiological values and compared with predefined trigger thresholds. EWS systems allocate points to routine vital sign measurements on the basis of their deviation from an arbitrarily agreed 'normal' range. The weighted score of one or more vital sign observations, or more often the total EWS, is used to alert ward staff or critical care outreach teams to the deteriorating condition of the patient. Systems that incorporate 'calling-

criteria' activate a response when one or more routinely measured physiological variables reach an extremely abnormal value.

EWS are simple algorithms (plans of action) based on bedside observations that have been recommended to identify patients at risk on general hospital wards (DoH (UK) 2000).
These EWS are tools that have been developed to record physiological parameters of systolic blood pressure, heart rate, respiratory rate, urinary output, temperature and level of consciousness.

Repeated measurements can track the patient's improvement with simple interventions such as oxygen or fluid therapy but can also track deterioration. Serial EWS readings are more informative than isolated readings as they give a picture of the patient's clinical progress over time. Once an unwell patient has been identified with a EWS scoring system of 3 or more this should stimulate a rapid assessment of the patient by the medical or ICU team as appropriate in each setting. The result of the review should be the modification of patient management to prevent further deterioration (Rees, 2003).

Garcea *et al*., 2006) looked at the ability of the early warning score to predict mortality in 110 patients admitted with acute pancreatitis. Sensitivities for the tool on days 1, 2, and 3 following admission were 85.7%, 71.4% and 100%. Specificities were 28.3%, 67.4% and 77.4% respectively. This study found EWS to be the best predictor for adverse outcomes (defined in this study as death, pancreatic necrosectomy or critical care admission) in the first 24 hours after admission compared with the following scoring systems: the Acute Physiology and Chronic Health Evaluation (APACHE) scores; the ASA grade, i.e. the American Society of Anesthesiologists (ASA) physical status classification system for assessing the fitness of patients before surgery; the Ranson score i.e the scoring system developed by Ranson in 1974 to predict the severity of acute pancreatitis; the Imrue score i.e a score developed by Imrie to predict the outcome of acute pancreatitis; and Computerized Axial Tomography (CT) or CT scan grades i.e. acute pancreatitis is graded from A to E based on a CT scan. This is correlated with duration of intensive therapy unit stay and number of ventilated days ($P < 0.05$) and selected those who went on to develop pancreas-specific complications such as pseudocyst or ascites. EWS of 3 or above is an indicator of adverse outcome in patients with acute pancreatitis. EWS can accurately and reliably select both patients with severe acute pancreatitis and those at risk of local complications.

Groarke *et al*., (2008) assessed the use of an admission early warning score to predict patient morbidity and mortality and treatment success. A prospective study was carried out on 225 consecutive medical admissions via the Medical Assessment Unit in St. Luke's hospital, Kilkenny over a 30 day period. Parameters included were:

- Pulse
- Blood pressure
- Respiratory rate
- Temperature
- Oxygen saturation
- Conscious level (AVPU score).

These parameters were recorded for each patient by nursing staff on two occasions – on initial admission to the MAU (within 10 minutes of admission) and immediately before transfer from the MAU to the ward (approx 5 hours after initial presentation). The study highlighted that for unselected medical admissions, an increased EWS on admission predicts increased mortality, increased likelihood of admission to ICU or CCU, death and a longer length of hospital stay.
The authors suggest that the EWS could be used as a triage tool in the emergency department for acute medical patients and identify "at-risk" patients from the outset. The authors also highlight, that in addition to its potential role as a triage tool, the EWS could be used in the pre-hospital setting to aid paramedics to identify those particularly ill patients and to alert the emergency departments of their imminent arrival.

Subbe *et al*.,(2007) reported that the simpler EWS had better reliability and reproducibility. Johnstone *et al*.,(2007) were of the opinion that early warning systems are not always used to their full potential and consideration should be given as to how these best meet local requirements.

Smith (2008, 2009) states that the sensitivity, specificity, and accuracy of EWS or calling-criteria systems to identify sick patients have been validated for death but not for other outcomes such as hospital length of stay, cardiac arrest, or need for higher care.

Several studies have identified abnormalities of heart rate, blood pressure, respiratory rate, and conscious level as possible markers of impending critical events. However, as not all important vital signs are, or can be, recorded continuously in general ward areas, the ability of these systems to predict cardiac arrest remains unconfirmed ((Resuscitation Council (UK) 2010)). Resuscitation Council (UK) (2010) also acknowledges that gaps in vital sign data recording are common and that the use of EWS, calling-criteria and rapid response systems can increase the completeness of vital sign monitoring.

Hucker *et al*., (2005) reported that some of the variables used in the early warning scoring systems (e.g. temperature, heart rate, arterial pressure and urine output) may not be of use in predicting deterioration and hospital mortality. This study reported that other physiological data such as oxygen saturation, not currently used in some scoring systems, are better detectors of deterioration.

A Cochrane Review carried out by McGaughey *et al*., (2007) stated that EWS have been introduced in to healthcare despite limited high quality evidence to demonstrate their sensitivity, specificity and usefulness. The authors state that to date the research evidence on EWS tools in predicting patient outcomes or impending critical illness is poor and the extent to which the existing tools are valid or reliable predictors of deterioration is unknown.

In 2008, Smith *et al*. carried out a review of the performance of aggregate weighted track and trigger systems (AWTTS) and to determine their predictive ability for serious adverse outcomes. The literature search identified 33 unique AWTSS. Out of the 33 systems, 7 (21%) included the same physiological variables as those described by Morgan *et al*., in 1997:

- Pulse Rate
- Breathing Rate
- Systolic blood pressure
- AVPU
- Temperature.

However each of these 7 systems incorporated minor changes to the cut-off points between weighting bands. Of the systems included in the study, 17/33 (51%) included an assessment of urine output, 26/33 (79%) included temperature, 4/33 (12%) allocated points for age, 6/33 (18%) allocated points for SpO_2 of which measurements were performed in air for two of these 6 AWTSS. For the remaining four systems that allocated points for SpO_2, the fractional concentration of inspired oxygen (F1O2) was not reported. The authors report that small ambiguities were present in the cut-off points between weighting bands for pulse rate, breathing rate, systolic blood pressure, temperature or SpO_2 in 21/33 (64%) of systems. Amongst the 33 different ATWSS, 19 different weighting systems were used for temperature, 15 for breathing rate, 15 for blood pressure, 12 for pulse rate and 6 for AVPU.

This study looked at the ability of each system to discriminate between survivors and non-survivors of hospital admission using the area under the receiver-operating characteristics (AUROC) curve. The study reported that the best performing AWTTS (described in Bakir *et al*., 2005) collected data on:

- Pulse rate
- Breathing rate
- Systolic BP
- AVPU

- Temp
- Age
- SpO_2
- F_1O_2 (Air).

In addition, the worst performing system (described in Allen *et al*., 2004) did not collect data on Age, SpO_2 or F_1O_2. However, this system did collect Urine Output. This study reported also highlighted the potential for transcription and calculation errors associated with manual data recording and calculations. The authors state that by using an electronic data collection system, the risk of transcription errors that may occur when paper based data are copied to electronic databases was eliminated (Smith *et al*., 2008, Prytherch *et al*., 2006). The authors were referring to the potential use of VitalPAC Early Warning Score (VIEWS).

Modified Early Warning Score (MEWS)
The Modified Early Warning Score is best regarded as a defined judgment on routinely recorded physiological data (Subbe, 2001). It is a bedside score and track and trigger system that is calculated by nursing staff from the observations taken, to try and indicate early signs of a patient's deterioration. It is an additional tool to facilitate the detection of deteriorating patients, particularly in acute wards where patients are often quite unwell and there may be inexperienced staff. Vital signs only include heart rate, blood pressure, temperature and respiratory rate. However, the MEWS takes into account other observations as well. The MEWS looks at all the observations together, not just a single observation in isolation. MEWS recognizes that patients' conditions frequently deteriorate over several hours and by regularly monitoring the basic clinical indicators of oxygen delivery (respiratory rate, heart rate, blood pressure, oxygen saturation) and tissue perfusion (capillary refill time; conscious level, oxygen saturation, urine output) ward staff can gauge relative stability, triggering assistance when necessary (Moon *et al*.,2011).

The UK-based Intensive Care Outreach Services (ICORS) found that summarising abnormal physiology into the MEWS was a particularly useful tool in identifying medical patients in need of ICU admission (Goldhill, 2006). Using the MEWS as a referral tool reduced ICU admissions and length of hospitalization (Pittard, 2003; Subbe, 2001; Subbe, 2003). Burch *et al*.,(2008) demonstrated the utility of the MEWS as a triage tool for medical emergencies seen in ED settings where resource and personnel constraints limit the use of more complex triage systems.

In 2001, Subbe *et al*.,evaluated the ability of a modified EWS (MEWS) to identify, medical patients at risk and to examine the feasibility of MEWS as a screening tool to trigger early assessment and admission to a HDU or ICU. Data were collected for all medical emergency admissions admitted to the MAU of a District General Hospital in the UK during March 2000 (709 patients). While there are limitations to the study as it was a single centre study on a limited number of patients in a specific local setting, the results showed that raised MEWS scores are associated with increased mortality in a group of medical emergency admissions. The MEWS scoring system is as follows:

Mews Scoring System (Subbe *et al*., 2001)

	3	**2**	**1**	**0**	**1**	**2**	**3**
Systolic Blood Pressure (mmHg)	<70	71-80	81-100	101-199		≥ 200	
Heart Rate (bbm)		<40	41-50	51-100	101-110	111-129	≥130
Respiratory Rate (bpm)		<9		9-14	15-20	21-29	≥30
Temp (°C)		<35		35-38.4		≥38.5	
AVPU* score				Alert	Reacting to Voice	Reacting to Pain	Unresponsive

*APVU: a measurement of the level of consciousness: **A**lert/V: Reacting to **V**oice/P: Reacting to **P**ain/U: **U**nresponsive

A score of 5 or more was associated with an increased risk of death. Primary end points were HDU admission, ICU admission, attendance of the cardiac arrest team at a cardio-respiratory emergency and death at 60 days. The Subbe *et al* (2001) study found that end points happened at a median of 4 days (0-45 days) and that patients who reached these pre-defined end points were significantly older on admission, had lower systolic blood pressure, higher pulse rate and a higher respiratory rate.

Subbe *et al*., (2003) reported MEWS as having the ability to successfully identify physiological deterioration in medical inpatients where MEWS scores of 5 or more were associated with increased risk of death, ICU and high dependency unit admission. The MEWS score identifies patients who require medical intervention. Cei *et al*., (2009) suggest that a lower threshold can be worthwhile for other purposes such as triaging patients before admission (see section on TEWS: linking MEWS to triage).

Gardner-Thorpe *et al*., (2006) looked at the value of using MEWS on surgical in-patients to identify deterioration. The study found the sensitivity of the MEWS used with a threshold score of 4 was 75% for ITU or HDU admission. The specificity was 83%. The authors concluded that the MEWS is an important part of a risk management tool that should be implemented for all surgical patients. The key reason for this recommendation is due to the fact that the MEWS improved communication between nursing staff and junior doctors and flagged up patients who needed to be given immediate priority.

Burch *et al*., (2008) reported that the proportion of patients who died in hospital increased significantly as the MEW score increased. The authors also reported that in-hospital mortality increased significantly with an increased number of abnormal parameters recorded in the ED. Interestingly, the authors also report that a comparison of in-hospital deaths with alive discharges showed that the mean MEWS was significantly higher among those who died (4.5 versus 3.8, p=0.001), but there was no significant difference between the two groups in terms of mean age, SBP, pulse rate, respiratory rate or temperature.

Quarterman *et al*., (2005) reported a link between increasing MEWS score with worse patient outcome across a range of specialties. Survival was significantly worse for MEWS scores >4 than for scores of 3-4. Urine output was included in the MEWS tool utilised in this study and the benefits of the addition of this parameter was not discussed. However, the authors reported that that the addition of age to the MEWS score did not significantly improve the predictive value of the MEWS scores.

Page *et al*., (2008) describes a project to implement an early warning scoring system within an Australian private hospital. The MEWS used in this study also included measurements of blood sugar levels, hourly urine for past two hours and report of chest pain. The authors report that the implementation of the new system improved clinical outcomes for patients on the pilot wards. Compliance with documentation was very high and nurses' satisfaction with all aspects of the new system was very high. The authors consider the MEWS as a valid tool, valuable in supporting ward nurses in the care of critically ill patients and the system was extended to all hospital wards after the pilot. Page *et al*., (2008) also tentatively report a decrease in the calls to the MET as a result of earlier and more appropriate responses by staff triggered by the MEWS. The authors state that while the MEWS cannot prevent critical illness, it can lead to earlier intervention and more rapid treatment, and to a reduction in the number of unnecessary or inappropriate emergency calls. This study highlighted the important role in the CNS who provided pivotal support to nurses implementing the MEWS, particularly after hours.

In 2009, Cei *et al*., described a study to investigate the ability of the MEWS to identify a subset a patients at risk of deterioration who might benefit from an increased level of attention. Cei *et al*., included 1107 patients in the study who were admitted to the medical ward from the emergency room or from emergency medicine after a brief clinical stabilization period (24–72 hours after

arrival). The results from this study indicated that in-hospital mortality of elderly medical patients can be accurately predicted by means of a simple score, even when calculated once on admission. Goldhill *et al*., (2004) could not demonstrate an association between either temperature or heart rate and hospital mortality. However, Cei *et al*., (2009) confirmed the importance of respiratory rate and have demonstrated that all of the parameters included in the MEWS are important – the most useful being the level of consciousness which supports the findings of Goldhill *et al*.,(2004). Cei *et al*.,(2009) were satisfied that their evidence was sufficiently valid to introduce the MEWS in to their routine however, the authors highlighted the need for randomized controlled trials to identify the capacity to prevent deaths by means of early warning scores.

Wolfenden *et al*., (2010) evaluated the use of a MEWS track and trigger system for use in community hospitals to monitor inpatients and to determine the appropriateness of patient transfer to the district general hospital. Initial feedback from the study indicated that the track and trigger system works. The authors highlighted that nurses felt more empowered to contact on-call or out of hours medical staff and they, in turn, receive better quality patient information as a result of having a full set of observations that are scored.

In 2010, Mitchel *et al*.,reported the results of a prospective controlled trial of the effect of a multi-faceted intervention on early recognition and intervention in deteriorating hospital patients in two Australian hospitals. A prospective before and after intervention of trial was conducted in all consecutive adult patients admitted to four medical and surgical wards during a four month period. The multifaceted intervention consisted of:

- A newly designed ward observation chart
- A track and trigger system
- An associated education program, COMPASS©

The observation chart was based on the MEWS system. A vital sign measurement policy was developed to mandate the frequency of vital sign measurement, 6 hourly unless otherwise specified, to summate the MEWS for every set of observations made and to trigger a medical review determined by specific MEWS (urine output included in this MEWS).The MEWS system used in this study was based on the COMPASS© MEWS which is as follows.

COMPASS© MEWS: Observation set

	3	2	1	0	1	2	3
Resp Rate per min	≤8			9–20	21-30	31-35	≥36
Oxygen Saturation (%)	≤84	85-90	90-92	≥93			
Temperature (°C)	≤34	34.1–35	35.1–36	36.1–37.9	38.0–38.5	≥38.6	
Heart Rate per min	≤40		41–50	51–99	100–110	111–130	>130
Systolic BP (mmHg)	**Dependent on the patient's usual blood pressure***						
Sedation Score				0-1	2	3	4
Urine Output	≤80	80-119			120-800	>800	

*A table to calculate the Adult Blood Pressure score is used in conjunction with the above table. This allows for normal blood pressure levels to be taken in to consideration in the calculations.

The study also described the introduction of a formalized two tier medical response for a patient with clinical instability. One medical response was triggered by a specific MEWS value being reached and prompting the bedside nurse to contact the patient's team of doctors to undertake a medical review of the patient. The MET system also continued to be the other formal medical response. Wards were only able to participate in the intervention period if 50% of their nursing staff and the majority of the allied health professionals and medical officers had undertaken the COMPASS© programme. This educational programme aimed to promote the understanding of

physiological principles of vital signs, reasons for measurement and derangement and providing a structure for succinct communication and initial resuscitation.

The results of this study indicated a 72% reduction in unexpected admissions to ICU and an 82% reduction in unexpected deaths with an associated increase in medical review (patient parent team or MET). The study also highlighted an increase in documentation of vital signs. The authors point out that the limitations of the study include the lack of a concurrent control group and the fact that there was a higher rate of unplanned admissions to ICU in this control group in comparison to other studies. In addition, the authors highlight that data was not collected to determine if decisions were made to limit a patient's admission to ICU. Despite the limitations of the study, the authors concluded that the simple, practical ward based intervention improves the process of recognizing clinical deterioration in ward patients and potentially may improve outcome. The authors also highlight the need for more studies to be carried out in this area.

(The above study is also mention in the section of this literature review describing the Outreach services/MET etc.)

In 2011, Moon *et al*., reported on an eight year audit before and after the introduction of modified early warning score (MEWS) charts, of patients admitted to a tertiary referral intensive care unit after CPR. The primary aims of the study was to assess whether there had been a reduction in the proportion of cardiac arrest calls and an improvement in outcomes of adults admitted to intensive care after CPR. The audit collected the following data over two time periods: 2002 - 2005 (control group) and 2006 – 2009 (intervention group):

- Annual adult admissions to hospital (total and emergency)
- Intensive care admission rates
- Cardiac arrest calls to adult care areas
- Admission to intensive care following in-hospital CPR and mortality rates
- Mortality rates (intensive care and in-hospital) of these patients

The secondary aims were to assess severity of illness (via APACHE II) at intensive care admission, gender and age plus any possible impact from the relocation of the acute medical services on these outcomes.

Although the primary intervention introduced to the second group (2006 – 2009) was the introduction of MEWS, a 24/7, whole hospital CCOS was also introduced to the service in 2005. Previously a limited CCOS had been in place to serve the high dependency unit and the hospital's surgical ward.

While the study was a retrospective comparison of prospectively collected data and the fact that the control and intervention groups were not parallel streams of patients (therefore open to methodology/environmental etc. variation), the results indicated that there was a significant improvement in overall hospital mortality rates, reductions in cardiac arrest calls, reductions in the proportion of patients having received in-hospital CPR prior to intensive care admission and improved hospital survival of such patients. The study concludes that the introduction of MEWS charts and a 24/7 CCOS should be considered as a positive influence and that there were improvements in outcome measures since the introduction of the MEWS charts and a 24/7 CCOS to the hospital. It should be noted that the MEWS used in this study included the collection of data on urine output).

The Simple Clinical Score (SCS)

The early warning score is proposed to gauge the risk of patients for catastrophic deterioration (Subbe *et al*., 2001). However, Subbe *et al*., (2010) reported that the proposed model lacked specificity to evaluate the risk of in-hospital death for individual patients. These authors propose an improved model with superior sensitivity and specificity in estimating mortality at 30 days which was tested by Kellet *et al*., (2006) in a general hospital in Ireland. Kellet *et al*., (2006) reported that the SCS can, at the time of admission, accurately predict the risk of death within 30 days. The

authors reported that the score can be quickly performed and requires no additional information or equipment other than a 12-lead ECG. Smith *et al*., (2008) reported that compared with other scores, the SCS is highly discriminative. The SCS has been found to be user-friendly and accurate in identifying patients at risk by the front line staff in the hospital and requires only 30-40 seconds to complete (Gleeson *et al*., 2009).

Subbe *et al*.,(2010) carried out a short term, single centre study of all patients over the age of 16 admitted through the acute medical take over a three month period (1098 patients). These patients were followed up for a minimum of 30 days. The mean age on admission was 65.

The scoring table for the Simple Clinical Score

(Kellet *et al*., 2006; Emmanuel *et al*., 2010, Subbe *et al*., 2010; Gleeson *et al*., 2009)

		Independent predictors	**Points**
A	Age	>75 ≥50 for men and ≥55 for women and ≤ 75	4 2
A	Airway	Coma (responds only to Pain or unresponsive) Oxygen saturation <90% Oxygen saturation ≥90% and 95%	4 2 1
B	Breathing	Respiratory Rate >30/min Respiratory Rate >20/min and ≤30/min Complaining of Breathlessness	2 1 1
C	Circulation	Systolic Blood Pressure ≤ 70mmHg Systolic Blood Pressure > 70mmHg and ≤ 80mmHg Systolic Blood Pressure >80mmHg and ≤ 100mmHg Pulse> systolic Blood Pressure	4 3 2 2
D	Disability	Stroke – new presentation Altered Mental Status ≥ 50 (not intoxicated)* Unable to stand unaided or a nursing home resident Prior illness – some part of daytime in bed Diabetes (Type 1 or 2)	3 2 2 2 1
E	ECG	Abnormal ECG (does not include bradycardia or tachycardia)	2
F	Fever	Temperature <35°C or ≥39°C	2
		Total	

Mortality	**Very Low Risk**	**Low Risk**	**Average Risk**	**High Risk**	**Very High Risk**
	0-3 points	**4-5 points**	**6-7 points**	**8-11 points**	**≥ 12 points**
0-24 hour	0%	0%	0.4%	1.0%	6.8%
30 days	0.1%	1.6%	3.9%	10.3%	34.4%

In this study, comparisons were made between bedside observations on admission in all patients and in those that died within 48 hours or that died during the course of the study. Age, high respiratory rate, low temperature, the presence of an abnormal ECG and coma were strong predictors of death within 48 hours. The study showed that it is practical to derive the SCS from routinely collected clinical records. Patients in the very low risk group are unlikely to benefit from hospital admission in terms of mortality and even patients in the low to average risk group might be manageable as ambulatory patients with urgent outpatient investigations and treatment. The SCS also identified a group of patients with high risk of adverse outcome that might benefit from enhanced care in a critical care setting. The results of this study were similar to the study carried out by Kellet *et al*., (2006). Subbe *et al*., (2010) conclude that the SCS exploits readily available data and combines usefulness for routine clinical triage and quality control and would facilitate audit to improve patient care.

A study on the applicability of the SCS as an assessment tool for acutely ill medical patients was also carried out by Gleeson *et al.*, (2009) in the Mid-Western Hospital in Nenagh, Ireland. The SCS was trialled in the A&E department and in a medical ward. Training and competency development was provided for all members of the MDT by the project co-ordinator over a two-week period. Support and guidance was provided by the project co-ordinator over the course of the project. All patients who presented to the A&E department that were considered likely to require admission had an ECG performed and were assessed using the SCS. For the successful and standardized implementation of the tool, modifications were made to the tool:

- Guidelines were developed to assist staff in assessing altered mental status and recognizing inability to stand unaided.
- In order to accommodate patients who were receiving oxygen therapy an additional two points were awarded to any patient whose oxygen saturation was less than 90%
- Action cards were developed and placed in prominent positions to assist staff in the interpretation of greater and lesser signs.

Three months after the implementation, feedback from staff involved in the pilot indicated that the SCS was beneficial in the following ways:

- It emphasized the importance of patients' vital signs, mental alertness and functional capacity
- It reminded nurses to value their clinical expertise and experience as an important aspect of patient assessment.
- It provided clinical staff with a system that identifies patients at risk
- It improved communication within the multidisciplinary team
- It facilitated the appropriate placement of patients within the healthcare setting

The authors of this study conclude that with the introduction of the SCS there has been a greater understanding of the importance of patients' vital signs and the importance of assessing mental alertness and functional capacity. The authors state that the SCS is a standardized systematic assessment and monitoring tool that may be implemented for all medical patients and should improve clinical care.

Worthing Physiological Scoring System (PSS)

In 2007, Duckitt *et al.*, investigated the relative contributions of the ventilatory frequency, heart rate, arterial pressure, temperature, oxygen saturation and conscious level to mortality in order to devise a robust scoring system in Worthing Hospital, UK. All data were collected on admission to the emergency unit. A total of 3184 patients were included in an initial study and 1102 patients were included in a follow up study. Patients included in the study were general medical admissions to the Emergency Admissions Unit (EAU). One of the key aims of the study was to develop precise "intervention-calling scores", a locally applicable scoring system that reflected the acute medical patient population. The physiological variables recorded were:

- Arterial Pressure
- Heart Rate
- Oxygen saturation
- Ventilatory frequency
- Level of consciousness (AVPU score).

All patients were followed up to determine length of stay, survival to hospital discharge, and incidence of cardiac arrest using the hospital's patient administration system and data from the resuscitation department. The authors compared the new scoring system with the EWS and found that the discrimination of the new scoring system was significantly better than that of the EWS and also had increased sensitivity and specificity (0.63 and 0.72) than the EWS (0.60 and 0.67). Precise intervention calling scores were derived from analysis of the data and the authors expected these to be more robust than those based on expert opinion.

The Worthing PSS

	Score			
	0	**1**	**2**	**3**
Ventilatory frequency	≤ 19	20-21	≥ 22	
Pulse	≤ 101	≥ 102		
Systolic blood pressure	≥ 100		≤ 99	
Temperature	≥ 35.3			< 35.3
Oxygen saturation in air	96-100	94 to <96	92 to <94	<92
AVPC	Alert			Other

Note: Age has been excluded as it did not influence the derivation of the Intervention Calling Scores.

Derived score (Intervention Calling Scores):
Score 2,3,4: - be alert
- Increase frequency of observations
- If score increases, then review the management plan with the doctor

Score 5 and above – urgent doctor review and management plan to be discussed with Specialist Registrar.

The authors state that their derived score has several major advantages over those currently used elsewhere:
- It is a much simpler score than any other published scoring system to date
- It has been derived directly from the observed physiological variables from general medical patients
- All major demands necessary to construct a severity of illness scoring system were met:
  - Large sample size
  - PSS was validated in a second follow up study
  - Discrimination was assessed using the AUC and calibration of the PSS was assessed by the Hosmer-Lemeshow goodness of fit test.

When compared with other studies on other scoring systems a number of issues were highlighted by the authors:
- Subbe *et al*., (2001), using the MEWS, demonstrated that the systolic blood pressure was rarely associated with increased risk until <100mm Hg
- Subbe *et al*., (2001) also reported that the presence of pyrexia again rarely increased risk whereas relative hypothermia did
- Subbe *et al*., (2001) also alluded to the greater risk associated with age, Duckitt *et al*.,(2007) states that the weighting associated with age is unrealistic. This study found age to be insignificant to the application of the derived scores. This is supported by Quarterman *et al*., (2005).
- A study carried out by Olsen *et al*., (2004) evaluated the predicted accuracy of the rapid emergency medicine score (REMS) in patients attending a non-selected accident and emergency department. The observed mortality was lower than the Duckitt s *et al*., tudy (2007) because of the differences in the patient group. The REMS score was developed using elements of APACHE II, similar to SOFA, is a validated scoring system derived from a select group of critically ill patients so may not be applicable to an adverse group of patients.
- Olsen *et al*., (2004) demonstrated that temperature and arterial pressure did not independently predict mortality in a multivariate analysis which was in keeping with Duckitt's study.

There were limitations to this study. The authors stated that the relationship between the Worthing PSS and cardiac arrest remains uncertain after this study due to small numbers in this category.

The scoring system is based on a single, unvalidated measurements taken by ward staff on admission to the EAU and so may be prone to measurement and recording errors. This is a single centre study in an acute medical setting and requires validation in other EAUs. But the authors of the study conclude that they have developed a simple, robust scoring system to predict mortality in medical patients admitted to the EAU with precise "intervention-calling scores".

ViEWS

Prytherch (2006) reported that little is known about the accuracy with which EWS are calculated and charted. The authors compared the speed and the accuracy of charting the weighted value attributed to each vital sign, and of calculating the EWS using the traditional paper and pen method with that using a specially programmed personal digital assistant (VitalPAC). The authors concluded that VitalPAC was on average 1.6 times faster at calculating EWS and offered significant advantages in relation to accuracy of the data collected.

Smith *et al*., (2008) carried out a literature review to describe the aggregate weighted "track and trigger" systems (ATWSS) and to look at their predictive ability for serious adverse outcomes. The study found 33 unique AWTSS and reported the potential for recording and calculating errors. The authors state that by using an electronic data collection system, the risk of transcription errors that may occur when paper based data are copied to electronic databases was eliminated. The authors were referring to the potential use of VitalPAC (VIEWS).

In a study published by Mohammad *et al*., (2008), the authors looked at improving accuracy and efficiency of early warning scores in acute care. The authors compared the collation and the calculation of a EWS score using traditional paper and pen methods versus a hand-held computer system, VitalPAC. The authors concluded that the traditional pen and paper method of deriving scores was less accurate and took longer than those aided by the computer based system. The authors calculated that a nurse will save, on average, about 12 seconds per EWS.
Prytherch *et al*., (2010) reported on a validated, paper-based, aggregate weighted track and trigger system, ViEWS. The authors applied ViEWS to a large vital signs database collected from 38,585 consecutive, completed acute medical admissions and also evaluated the comparative performance of 33 other AWTSS (reviewed by Smith *et al*.,2008) for a range of outcomes using the area under the receiver-operating characteristics (AUROC) curve. The results showed that the AUROC for ViEWS using in-hospital mortality within 24 hours of the observation was 0.888. The AUROCS for the other 33 AWTSS ranged from 0.803 to 0.850 indicating that ViEWS performed better than the 33 AWTSS reviewed by Smith *et al*, in 2008.

ViEWS: Observation set

	3	2	1	0	1	2	3
Pulse (bpm)		≤40	41–50	51–90	91–110	111–130	≥131
Breathing rate (bpm)	≤8		9–11	12–20		21–24	≥25
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	
Systolic BP (mmHg)	≤90	91–100	101–110	111–249	≥250		
SaO2 (%)	≤91	92–93	94–95	≥96			
Inspired O2				Air			Any O2
CNS (use AVPU scale)				Alert (A)			Voice (V) Pain (P) Unrespon-sive (U)

(This section was added in November 2011 to highlight the most up to date research)
The ViEWS system was further validated by two additional studies. The first was conducted in the USA by Bleyer *et al*., (2011) in a study of 1.15 million individual vital sign determinations obtained in 42,430 admissions on 27,722 patients. The study was able to validate the VIEWS (and a MEWS) to show that the scores are predictive not only at the time of admission but also at any point when vital signs are measured during the hospitalization.

The study also demonstrated that simultaneous presence of three critically abnormal vital signs can occur at any time during the hospital admission is associated with very high mortality.The second study was conducted by Kellett (2011) in Canada between 2005 and 2010. The early warning score derived from 198,755 vital sign sets in the Vitalpac™ database (ViEWS) has an area under the receiver operator characteristic curve (AUROC) for death of acute unselected medical patients within 24 h of 88%. This study validated an abbreviated version of ViEWS, which did not include mental status, in 75,419 consecutive patients Therefore, this external validation of the, albeit abbreviated, score suggests that ViEWS may be universally applicable to most hospitalized patients. The AUROC of the abbreviated ViEWS score for death within 48 hours for all patients was 93%, with no significant difference between surgical and medical patients, or any of the sub-specialty divisions of medical patients

Integrated Monitoring System
Hravnak *et al*., (2011) report an observational study carried out in a step-down unit. The study's goals were to determine whether the alerts of an integrated monitoring system correlated with cardio respiratory instability. They sought to answer the question of whether using the integrated system would decrease the incidence and duration of patient instability when compared to single-channel monitoring. The study looked at a system that integrated heart rate, respiratory rate, systolic and diastolic systemic blood pressure and oxygen saturation and linked it with the INDEX alert system. The two main findings of the study were as follows:

- An abnormal index value was associated with a period of cardio respiratory instability that was clinically significant
- A retrospective analysis comparing patients monitored using single-channel monitoring versus patients monitored using an integrated system showed that the cumulative number of episodes of instability decreased by 58% and the duration of the period of instability was decreased as well.

However, it is important to note that the study did not look at the effect of the utilization of rapid response teams, decreased transfers to the ICU, decreased morbidity and mortality and study included trauma patients admitted to a step down unit. The data from this study would be difficult to generalise to other patient groups such as ICU, CCU, medical emergency units etc.

Electronic Integrated Monitoring System
Cuthbertson *et al*., (2007) highlighted the issue of inaccuracies and miscalculations related to manual data collection. To overcome this, the authors suggest that it may be necessary to adopt continuous vital signs monitoring or electric data management and scoring systems. The authors state that this would minimize intra and interrater reliability error and facilitate the use of potentially more accurate discriminate functions that are less amenable to manual calculation error.

Hravnak *et al*., 2008 looked at defining the incidence of cardio-respiratory instability in patients in step down units using an electronic integrated monitoring system. The authors used a BioSign IMS which is an FDA approved non-paediatric monitoring system that usually integrates 5 vital signs to produce a single parameter BioSign Index (BSI). The input variables include HR, RR, BP, SpO_2, and temperature. Variance in the data set was used to evaluate the probability that the patient derived vital signs are considered to be in the normal range. The generated BSI ranges from 0 (no abnormalities) to 10 (severe abnormalities). A BSI of 3 or greater is deemed to reflect significant cardiovascular instability requiring medical attention. A BSI of 3 or greater can occur while no single vital sign parameter is outside the range of normal if their combined patterns are consistent

with known instability patterns. During the evaluation, the nurses continued to activate the MET using the established MET activation criteria and were blinded to the BSI values. The authors of this study reported that periodic bedside examination of the patient status is an insensitive method to identify early cardiovascular deterioration. Deterioration was evident using the IMS system before the MET in all patients and in more than 50% of the patients for whom instability resulted in MET activation, the nursing staff could potentially have activated the MET hours earlier using the IMS and BSI. The authors conclude that continuous non-invasive monitoring augmented with integrated information from multiple variables provides a more sensitive means to detect cardio-respiratory instability in step down units than bedside nursing assessment. The authors did not comment on patient outcomes relative to the earlier detection of deterioration but made a recommendation that studies were required in this area.

Hravnak *et al*., carried out a similar study in 2011. The authors looked at the detection of cardio-respiratory instability before and after implementing an integrated monitoring system. The IMS used in this study was the FDA approved Visensia IMS monitor that integrates HR, RR, BP, and SpO3 and temperature. The study found a high degree of correlation between cardio-respiratory instability and the IMS detection of an unstable state. The IMS detected instability in advance of reaching the criterion threshold for single vital sign abnormality in the majority of cases and increased the likelihood that the MET team would be called for serious instability quicker than if using bedside nursing system and single vital sign measurement.

ALERT™

Regarding standards of practice in relation to the recognition and management of acutely ill patients, McGaughey *et al*., (2007) recommended that the UK Acute Life-threatening Early Recognition and Treatment (ALERT™) best practice guidelines are utilized in the evaluation of the standard of practice in the wards in relation to the appropriateness of interventions and the documentation of care following the identification of at risk patients.

Lees *et al*., (2009) reported that the application of the ABCDEfG framework (provided as part of the ALERT™ training) in conjunction with the MEWS enabled nurses to use a systematic, recognized framework for the assessment of acutely ill medical patients. Evidence from the multiprofessional documented suggested that the information gathered by using the ABCDEfG assessment framework in conjunction with the MEWS, focused the activities of nursing staff on prioritising and co-ordinating care for acutely ill patients. The authors were also of the opinion that the ABCDEfG also provided a pivotal tool for communicating key clinical signs with doctors and allied health practitioners in a format that conveyed the urgency or non-urgency of the patient's condition.

Mortality in Emergency Medicine Score

Vorweck *et al*.,(2008) investigated the efficacy of the abbreviated Mortality in Emergency Medicine Sepsis (MEDS) score, the Modified Early Warning Score (MEW) and near-patient-test (NPT) lactate levels in predicting 28 day mortality in adult emergency department (ED) patients with sepsis. The non-abbreviated MEDS includes the requirement to measure neutrophil bands >5% - the abbreviated MEDS excludes this measurement due to the non-routine measurement of neutophil bands in UK hospitals. A total of 307 patients will sepsis (>16 years and admitted to ED over a 12 month period) were included in the study.

The abbreviated MEDS Score

Variable	Defined as	Points
Terminal Illness	Metastatic Cancer or chronic illness with >50% likelihood of fatality within 28 days	**6**
Tachypnoea/hypoxia	Respiratory Rate >20 or Sp02 <90%	**3**
Septic Shock	Sepsis plus a systolic blood pressure <90mmHg despite a 20-30ml/kg fluid bolus	**3**
Platelet count <150,000/mm^2		**3**
Age >65 years		**3**
Lower Respiratory Tract infection	Based on clinical findings	**2**
Nursing Home Resident		**2**
Altered Mental State	Glasgow coma score <15	**2**
Total Possible Score		**24**

This study found that the overall performance in predicting 28 day mortality was acceptable. However, its discriminatory power among the older and sicker cohort of patients was poor. The authors found that using a cut of MEW score of ≥ 5 to stratify patients in to low or high risk as suggested by Suppe *et al*., (2001), did not work for patients in ED with sepsis and thus determined MEWS to be a less suitable risk assessment tool for ED patients with sepsis.

The authors reported that the study found the MEDS score to be the best performing risk assessment model, a promising tool for the early identification of high-risk patients with sepsis in the ED. Parameters for the abbreviated MEDS score are readily availability as part of the standard clinical assessment and baseline blood tests that are obtained in all unwell patients in the ED. The MEDS score identified those high risk patients in need of early goal-directed therapy (EGDT). The authors also suggested that it had the potential to be used as a "rule-out" tool since patients with an abbreviated MEDS score of ≤ 5 have a very low mortality. Conversely, the authors also suggest that the abbreviated MEDS score may also have the potential to be used as a tool to identify a group of patients where aggressive therapy is futile due to their specificity for 28 day mortality.

3.2.4 NICE guidelines and Early Warning Score

In July 2007, the National Institute for Health and Clinical Excellence (NICE) published a Guideline entitled "Acutely ill patients in hospital: Recognition of and response to acute illness of adults in hospital". The authors of these guidelines carried out a review of the literature in the area of EWS, Track and Trigger systems and Clinical Care Outreach service. The guideline development group acknowledged that the physiological track and trigger system increases the number of observations made by the health professional which they considered increased the likelihood of healthcare professionals identifying and acting on abnormal observations.

The guideline made the following recommendations in relation to the identification of patients whose clinical condition is deteriorating or at risk of deterioration:

- Physiological track and trigger systems should be used to monitor all adult patients in acute hospital settings:
  - Physiological observations should be monitored at least every 12 hours, unless a decision has been made at a senior level to increase or decrease the frequency for an individual patient.
  - The frequency of monitoring should increase if abnormal physiology is detected as outlined in the recommendation on graded response strategy.

In relation to the choice of the track and trigger system, the following recommendations were made:

- Track and Trigger systems should use multi-parameter or aggregate weighted scoring systems which allow a graded response. These scoring systems should:
  - Define the parameters to be measured and the frequency of the observations
  - Include a clear and explicit statement of the parameters, cut off points or scores that should trigger a response.

The NICE guideline (2007) recommended the following physiological parameters to be used by track and trigger systems:

- Heart Rate
- Respiratory Rate
- Systolic Blood Pressure
- Level of Consciousness
- Oxygen Saturation
- Temperature.

NICE (2007) also recommended that in specific clinical circumstances, additional monitoring should be considered; for example:

- Hourly urine output
- Biochemical analysis, such as lactate, blood glucose, base deficit, arterial ph
- Pain assessment

It was the consensus view of the NICE Guidelines development (NICE 2007) that although some of the aggregate weighted scoring systems did not include oxygen saturation that it is an important early predictor of deterioration and should be included as a core parameter. It was also noted by the guideline development group that some multiple-parameter or aggregate weighting scoring systems included urine output. It was the view of the guideline development group that urine output should not be a core parameter because reliable assessment of urine output requires bladder catheterisation and this is performed only in specific clinical circumstances.

3.3 Medical Emergency Teams (MET)/Critical Care Outreach Service(CCOS)/Patient At Risk Teams (PART)

The concept of outreach as evolved in response to the recognized need for more equitable hospital wide approach to the management of "at risk" patients (McGaughey, 2007). The key component of the outreach service consists of multidisciplinary critical care teams, called critical care outreach teams (CCOT) or Patient At Risk Teams (PART) in the UK, Medical Emergency Teams (MET) in Australia and Rapid Response Teams in the United States. These critical care teams respond to call outs from general ward staff following identification of patients following an EWS score. The purpose of the outreach team is to ensure timely and appropriate management of deteriorating patients on general hospital wards. This could potentially avert the need for ICU admissions, enable more timely ICU discharges and provide educational support to extend the skills of general ward staff in identifying and managing deteriorating patients.

Gallagher *et al*., (2006) reported that the successful identification of decline provides an opportunity for timely intervention and a review of the patient's resuscitation status. Medical Emergency Teams (MET) were first established in Australia as an alternative to a cardiac arrest team. They function by assessing patients for aggressive resuscitation and management or by instituting "Do not resuscitate" orders for patients who would not benefit from intensive care and/or resuscitation.

A prospective trial in a tertiary referral hospital in Australia (Bellomo *et al*.,2003) looked at consecutive patients admitted to hospital during a "before" period and an intervention period during which

a medical emergency team was in place. This study showed that a medical emergency team was associated with a 65% reduction in cardiac arrests and a 26% overall reduction in the hospital death rate, equivalent to 3 deaths per hospital admission. Buist *et al*., (2002) also reported similar findings. Often only simple interventions such as oxygen therapy are required (Bellomo *et al*., 2003; Kenward *et al*.,2004; Gallagher *et al*., 2006). Bellomo *et al*., (2003) reported the following criteria for the initiation of a MET call:

If one of the following is present call 7777 and ask for the MET:
- Staff member is worried about the patient
- Acute change in the **heart rate** to <40 or >130 beats per minute
- Acute change in the **systolic blood pressure** to <90 mmHg
- Acute change in the **respiratory rate** to <8 or >30 breaths/min
- Acute change in pulse oximetry saturation to <90% despite oxygen administration
- Acute change in conscious state
- Acute change in urine output to <50ml in 4 hours.

The programmes described by Bellomo *et al*., (2003) and Buist *et al*., (2002) involved education of staff on the recognition and interventions for acutely ill patients. It has been suggested by Bellomo *et al*., (2003), Tibballs *et al*., 2004) and Gallagher *et al*., (2006) **that it may be the increased recognition of physiological deterioration due to staff education and the increased profile offered by the intervention that led to the improvements seen**. The results of the above studies indicate that there is a pre-arrest period where interventions may have success. Gallagher *et al*., (2006) states that the ability to recognize that a patient is at risk of critical illness, combined with the skills and the knowledge to manage these patients is essential for all medical personnel.

Note: the study undertaken by Bellomo *et al*., (2003) was excluded from the Cochrane Review carried out by McGaughey *et al*., (2009) as they had no control arm after intervention. This was also the case with the Buist *et al*., study (2002).

Esmonde *et al*., (2006) carried out a systematic review on outreach and found a lack of evidence to support the benefits of outreach as a result of the poor quality of the included studies.

In 2007, the Cochrane Review carried out by McGaughey *et al*.,(2009) to address the need for good evidence based research in the area of track and trigger systems. The objectives of the review was to determine the impact of outreach services on hospital mortality rates and the secondary objectives were to determine the effects of outreach services on ICU admission patterns (admissions and readmissions), length of hospital stay and the number of adverse events (unexpected cardiac or respiratory arrest) in adult patients who deteriorate on general hospital wards. The review of the literature found **only two** cluster-randomized control trials on this subject. The first was a randomized control trial at hospital level in Australia which included general inpatient wards in 23 hospitals over a 12 month period (Hillman, 2005). The second was a trial carried out at ward level in the UK which phased in the introduction of CCOT in 16 acute adult general wards in one hospital (Priestly *et al*., 2004).

The implementation period for MET was 4 months in the Australian study and four weeks in the UK study. Both studies introduced MET or CCOT on a 24 hour, 7 day-a-week basis. The composition of the MET required, at a minimum, a cardiac arrest team, one doctor, one ICU nurse or accident and emergency nurse. The CCOT included a nurse consultant with a team of experienced nurses and medical support when required.

The early identification of deteriorating ward patients was assessed in both studies either through the use of a PAR (Patient at Risk) score (multiple parameter scoring system) or by the use of specific MET calling criteria (single parameter).

The Australian study showed no difference between the control and MET hospitals. This study (also called the MERIT study) found no differences in cardiac arrest rates between the intervention group and the control group. In addition, the study showed no differences in unplanned intensive care unit admissions between the intervention group and the control group (Hillman, 2005).

The UK based trial did not include unplanned ICU admission as an outcome measure. However, the study found that outreach reduced in-hospital mortality compared with the control group (Priestly *et al*., 2004). McGaughey *et al*., (2007) highlighted that the CCOT nurse visited every patient within 24 hours of admission. The frequent presence of the outreach nurse within the ward environment may have allowed relationships across the ward to be established as the role of the outreach emphasizes support and collaboration. The study also included staff training in the care of the acutely ill patient which may have had an impact on the ward nurses' decision to utilized the calling criteria. In the Australian study, patients were not visited upon admission and the MET teams were only in contact with the ward staff when alerted via the calling criteria.

The results of this Cochrane Review found that the evidence to determine the effectiveness of critical care outreach and EWS on reducing hospital mortality, unplanned ICU admissions and readmissions, length of stay and adverse events is inconclusive.

The review did not highlight any difference between a nurse-led or doctor led outreach team

The studies reported in the Cochrane Review carried out by McGaughey *et al*., (2009) used 2 different EWS assessment criteria to trigger outreach and the Cochrane Review reports that there is no evidence to suggest that one early warning system is better than the other.

In 2009, Chen *et al*., carried out an analysis of the medical early response intervention and MET deployment in 23 public hospitals in Australia encompassing 700,000 admissions. The study found that MET activation, when called in advance of cardiac arrest, reduced unexpected cardiac deaths, overall cardiac arrests, and overall unexpected deaths, supporting the view that early review of instability is desirable.

In 2010, Mitchel *et al*., reported the results of a prospective controlled trial of the effect of a multi-faceted intervention on early recognition and intervention in deteriorating hospital patients in two Australian hospitals. A prospective before and after intervention of trial was conducted in all consecutive adult patients admitted to four medical and surgical wards during a four month period. The multifaceted intervention consisted of:

- A newly designed ward observation chart
- A track and trigger system
- An associated education program, COMPASS©.

The observation chart was based on the MEWS system. A vital sign measurement policy was developed to mandate the frequency of vital sign measurement, 6 hourly unless otherwise specified, to summate the MEWS for every set of observations made and to trigger a medical review determined by specific MEWS (urine output included in this MEWS).

The study also described the introduction of a formalized two tier medical response for a patient with clinical instability. One medical response was triggered by a specific MEWS value being reached and prompting the bedside nurse to contact the patient's team of doctors to undertake a medical review of the patient. The MET system also continued to be the other formal medical response. Wards were only able to participate in the intervention period if 50% of their nursing staff and the majority of the allied health professionals and medical officers had undertaken the COMPASS© programme. This educational programme aimed to promote the understanding of physiological principles of vital signs, reasons for measurement and derangement and providing a structure for succinct communication and initial resuscitation.

The results of this study indicated a 72% reduction in unexpected admissions to ICU and an 82% reduction in unexpected deaths with an associated increase in medical review (patient parent team or MET). The study also highlighted an increase in documentation of vital signs.

The authors point out that the limitations of the study include the lack of a concurrent control group and the fact that there was a higher rate of unplanned admissions to ICU in this control group in comparison to other studies. In addition, the authors highlight that data was not collected to determine if decisions were made to limit a patient's admission to ICU. Despite the limitations of the study, the authors concluded that the simple, practical ward based intervention improves the process of recognizing clinical deterioration in ward patients and potentially may improve outcome. The authors also highlight the need for more studies to be carried out in this area.

In 2011, Moon *et al*., reported on an eight year audit before and after the introduction of modified early warning score (MEWS) charts, of patients admitted to a tertiary referral intensive care unit after CPR. The primary aims of the study was to assess whether there had been a reduction in the proportion of cardiac arrest calls and an improvement in outcomes of adults admitted to intensive care after CPR. The audit collected the following data over two time periods: 2002 - 2005 (control group) and 2006 – 2009 (intervention group):

- Annual adult admissions to hospital (total and emergency)
- Intensive care admission rates
- Cardiac arrest calls to adult care areas
- Admission to intensive care following in-hospital CPR and mortality rates
- Mortality rates (intensive care and in-hospital) of these patients.

The secondary aims were to assess severity of illness (via APACHE II) at intensive care admission, gender and age plus any possible impact from the relocation of the acute medical services on these outcomes.

Although the primary intervention introduced to the second group (2006 – 2009) was the introduction of MEWS, a 24/7, whole hospital CCOS was also introduced to the service in 2005. Previously a limited CCOS had been in place to serve the high dependency unit and the hospital's surgical ward.

While the study was a retrospective comparison of prospectively collected data and the fact that the control and intervention groups were not parallel streams of patients (therefore open to methodology/environmental etc. variation), the results indicated that there was a significant improvement in overall hospital mortality rates, reductions in cardiac arrest calls, reductions in the proportion of patients having received in-hospital CPR prior to intensive care admission and improved hospital survival of such patients. The study concludes that the introduction of MEWS charts and a 24/7 CCOS should be considered as a positive influence and that there were improvements in outcome measures since the introduction of the MEWS charts and a 24/7 CCOS to the hospital.

3.3.1 NICE and Critical Care Outreach Services

The group developing the NICE Guideline "Acutely ill patients in hospital: Recognition of and response to acute illness in adults in hospital" (2007), made the following recommendations in relation to critical care outreach services:

- Staff caring for patients in acute hospital settings should have 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 provided to ensure staff have these competencies, and they should be assessed to ensure they can demonstrate them.

- The response strategy for patients identified as being at risk of clinical deterioration should be triggered by either physiological track and trigger score or clinical concern.
- Trigger thresholds for track and trigger systems should be set locally. The threshold should be reviewed regularly to optimise sensitivity and specificity.

3.3.2 NICE and Graded Response Strategy

The NICE guideline development group considered the literature in relation to this area up to 2007 (published and non-published data) and reported in the guideline that no specific service configuration can be recommended as a preferred response strategy for individuals identified as having a deteriorating clinical condition. However, the guideline recommended the following:

- A graded response strategy for patients identified as being at risk of clinical deterioration should be agreed and delivered locally. It should consist of the following three levels.
- **Low-score group:**
  - Increased frequency of observations and the nurse in charge alerted.
- **Medium-score group:**
  - 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 a critical care outreach team, a hospital-at-night team or a specialist trainee in an acute medical or surgical specialty.
- **High-score group:**
  - Emergency call to team with critical care competencies and diagnostic skills. The team should include a medical practitioner skilled in the assessment of the critically ill patient, who possesses advanced airway management and resuscitation skills. There should be an immediate response.
- Patients identified as 'clinical emergency' should bypass the graded response system. With the exception of those with a cardiac arrest, they should be treated in the same way as the high-score group.
- For patients in the high- and medium-score groups, healthcare professionals should:
  - initiate appropriate interventions
  - assess response
  - formulate a management plan, including location and level of care.
- 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.

4. Early Warning Systems for Triage

4.1 The Simple Clinical Score and The Cape Triage Score (South African triage score)

Emmanuel *et al*., 2010) examined the use of the Simple Clinical Score (SCS) and the Cape Triage Score (CTS) to determine the need for admission in to an acute unit. This study looked at 270 patients through the accident and emergency department in Nenagh Hospital and found that the CTS presentations and/or the SCS justify hospital admissions in the overwhelming majority of patients. Nearly all patients in the highest SCS classes also had urgent or very urgent CTS presentations. However, most patients admitted in the lowest risk SCS class also were considered urgent or very urgent by the CTS presentations and therefore, had presentations that justified admission. Although CTS presentations predict outcomes poorly, the study carried out by Emmanual *et al*., 2010) suggests that they could be used together with the SCS to rapidly assess the need for admission and to prioritise management.

4.2 Triage Early Warning System (TEWS)

The UK-based Intensive Care Outreach Services (ICORS) found that summarising abnormal physiology into the MEWS was a particularly useful tool in identifying medical patients in need of ICU admission (Goldhill, 2006). Using the MEWS as a referral tool reduced ICU admissions and length of hospitalization (Pittard, 2003; Subbe 2001; Subbe, 2003). Burch *et al*.,(2008) demonstrated the utility of the MEWS as a triage tool for medical emergencies seen in ED settings where resource and personnel constraints limit the use of more complex triage systems. However, the MEWS has limitations with regard to triage in that it is medically biased (Burch *et al*.,2008). Trauma patients (who were often previously healthy and therefore have greater physiological reserve) may have severe injuries and yet have a low MEWS if they have unchanged physiology. The addition of both a mobility parameter and a trauma factor increases the severity score for trauma patients, as well as for medical patients who are physiologically normal but have time-critical conditions, e.g. ischaemic stroke. These parameters have therefore been added to the MEWS score by the Cape Triage Group (CTG) in order to improve its triage capabilities, and the resulting system has been renamed the Triage Early Warning Score (TEWS) (Wallis *et al*.,2006). Fig. shows the adult version of the TEWS; similar scores have been developed by the CTG for children and infants.

Triage Early Warning Score (TEWS)
(RR = respiratory rate, HR = heart rate, SBP = systolic blood pressure, AVPU = Alert, Verbal, Pain, Unconscious).

	3	2	1	0	1	2	3
Mobility				Walking	With help	Stretch-er/	≥131
RR		Less than 9		9 – 14	15 - 20	21 - 29	More than 29
HR		Less than 41	41 - 50	51 – 100	101 - 110	111 - 129	More than 129
SBP	Less than 71	71 - 80	81 - 100	101 – 199		More than 199	
Temp		Less than 35		35 - 38.4		38.5 or more	
AVPU				Alert	Reacts to Voice	Reacts to Pain	Unresponsive
Trauma				No	Yes		

Wallis *et al*., (2006) reports that TEWS has the following advantages:

- It enables early accurate assessment of the emergency patient
- It translates measurable parameters in to a number
- Minimal equipment is required (a blood pressure cuff and a low-reading thermometer)
- It encompasses both trauma and medical emergencies
- It facilitates uniform assessment as well as communication between medical staff and enabling appropriate patient disposition
- It is user-friendly both in the pre-hospital and the emergency room setting.

Triage systems use discriminators as a core component of the decision-making process. The Cape Triage Score (CTS) has been derived by the Cape Triage Group (CTG) for use in emergency units throughout South Africa. It can also be used in the pre-hospital setting, although it is not designed for mass casualty situations. The CTS comprises a physiologically based scoring system and a list of discriminators, designed to triage patients into one of five priority groups for medical attention. Three versions have been developed, for adults, children and infants The CTG has used the following discriminators.

Presentation
This includes symptoms such as chest pain and abdominal pain; it also includes 'eyeball diagnoses' such as seizures and dislocations, which are clear at triage.

Pain
As with many triage scores,1-3 pain is regarded as an important indicator of priority. It is recorded as severe, moderate, or mild. Experienced healthcare professionals can improve the triage process by adding their opinion to other parameters.13 In the CTG protocol, a senior healthcare professional may alter the triage coding, either up- or downgrading the triage status.

Application of the triage system
The TEWS score is calculated by first measuring the physiological parameters. The discriminators are then assessed, and a triage colour category is allocated. Patients are triaged as follows:

1. Vital signs – measure, and score each against the TEWS scoring sheet, to produce a total TEWS. This score corresponds with a triage category (0 - 2 green, 3 - 4 yellow, 5 - 6 orange, > 6 red).
2. Mechanism of injury – determine if relevant.
3. Presentation – consider any relevant symptoms or eyeball diagnoses.
4. Pain – consider the patient's pain.
5. Senior healthcare professional's discretion – consider.

The triage category is selected from a five-colour coding sheet.

If the discriminators (mechanism of injury, presentation, pain) categorise a patient in a higher triage category than the TEWS score, then this higher category is regarded as the correct category. The discriminators are used as a safety net for patients who have normal vital signs, but potentially significant pathology. This triage system is not intended for mass casualty situations.

5. Educational programmes

5.1 ALERT™

ALERT™ is a stand-alone course developed in Portsmouth Hospital, United Kingdom which instructs staff on how to anticipate, recognise and prevent critical illness at an early stage. It aims to prevent unnecessary cardiac arrest and improve the quality of care for the deteriorating patients. It uses principles common to many advanced life support courses and incorporates aspects of clinical governance, multidisciplinary education and interprofessional working. It incorporates pre-course reading, informal and interactive seminars, practical demonstrations and role play during clinically based scenarios. Communication skills are covered frequently in the course, during seminars and scenarios, but also as a specific session that covers three aspects—breaking bad news, writing patient notes and interpersonal/inter professional communication. The ALERT™ course has sought to replicate this team centred environment in its teachings, attempting to facilitate coordination and collaboration by staff working with critically ill patients outside the confines of an ICU. Evaluations have found that attendance at the course increased knowledge of attendees about basic aspects of acute care, as well as increasing confidence about the management of acutely ill patients.

5.2 COMPASS©

COMPASS© is a comprehensive interdisciplinary education package that has been developed in Canberra hospital, Australia, in conjunction with the development and implementation of a Modified Early Warning Score observation chart. It is an interdisciplinary education programme designed to enhance participants' understanding of patients' deterioration and the significance of altered observations. It also seeks to improve communication between healthcare professionals,

improve collaboration between the various healthcare professionals in developing patient management plans and enhance timely management of patients. There are three phases to completing the course, beginning with a training CD to be worked through independently, followed by an online quiz and a 3 hour face to face session.

6. Discussion

There are questions raised in the literature as to whether or not monitoring will actually change outcomes. The literature search itself highlighted that there is a requirement for more research in the area of early warning scores to better prove the ability of these systems to improve patient outcomes.

Cuthbertson *et al*., (2007) published an article entitled "A warning on early-warning scores" in which he expressed concern about the accuracy of early warning systems and stated that these systems have not convincingly demonstrated that they are useful for the early detection of the deteriorating patient. This article reiterated findings from Gao *et al*., (2007) stating that these authors concluded that there was "little evidence of reliability, validity and utility" and that their "sensitivity was poor". Cuthbertson *et al*., (2007) also referred to other studies carried out by Prytherch (2006), Smith (2006) and Subbe (2007) highlighting that these studies demonstrated inaccuracies in the calculation of the scores by staff and significant intra and interrater reliability error. The authors state that unless scoring systems have appropriate sensitivity and specificity and minimize errors associated with documentation and scoring, they will fail to identify patients who need additional care and will increase workload in circumstances where no intervention is required.

In response to this article, Morgan *et al*.,(2007) highlighted the fact that the Early Warning Score was "*designed solely to secure the timely presence of skilled clinical help by the bedside of those patients exhibiting physiological signs compatible with established or impending critical illness*". The authors continue to point out that the EWS "*was not presented as a predictor of outcome as the overall course for most critically ill patients is punctuated by multiple potential confounding influences making such attempts at final outcome prediction, on the basis of early routine standard bedside observations, an unrealistic expectation*".

In response to Cuthbertson's claims that the EWS results in an increased workload for staff, Morgan *et al*., (2007) states that the calculation of the total score took only 30 seconds to complete.

Authors of a recent article in *Critical Care Medicine* (Arroliga *et al*., 2011), stated that while it is important to monitor patients to predict the deterioration of clinical status, to determine the appropriate level of care and to detect changes that would require change in treatment strategies. there has been weak evidence to date from retrospective studies showing that patients who suffer from serious deterioration or death have preceding events that were predictive of deterioration. Arroliga *et al*.,(2011) are of the opinion that the sensitivity and specificity of systems for identifying patients at risk of death is acceptable but the capacity of pointing those at risk for deterioration is inadequate. This is also supported by reports from Duckitt *et al*., (2007) and de Pennington *et al*., (2005). Arroliga *et al*., (2011) continue to say that "the level and types of monitoring are allocated based on the physician's perception of risk since the literature does not provide with clear evidence of benefit or guideline". The authors continue to say that even the most sophisticated monitoring system or algorithm cannot substitute for adequate nurse staffing. However, Prytherch *et al*., (2010) reported on a validated, paper-based, aggregate weighted track and trigger system, ViEWS. The authors applied ViEWS to a large vital signs database collected from 38,585 consecutive, completed acute medical admissions and also evaluated the comparative performance of 33 other AWTSS (reviewed by Smith *et al*, 2008) for a range of outcomes using the area under the receiver-operating characteristics (AUROC) curve. The results showed that the AUROC for ViEWS using in-hospital mortality within 24 hours of the observation was 0.888. The AUROCS for the other 33 AWTSS ranged from 0.803 to 0.850 indicating that ViEWS

performed better than the 33 AWTSS reviewed by Smith *et al*, in 2008. This study was carried out on medical patients therefore the validation of this system applies only to medical patients.

The ViEWS system was further validated by two additional studies. The first was conducted in the USA by Bleyer *et al*., (2011) in a study of 1.15 million individual vital sign determinations obtained in 42,430 admissions on 27,722 patients. The study was able to validate the VIEWS (and a MEWS) to show that the scores are predictive not only at the time of admission but also at any point when vital signs are measured during the hospitalization. The study also demonstrated that simultaneous presence of three critically abnormal vital signs can occur at any time during the hospital admission is associated with very high mortality.

The second study was conducted by Kellett (2011) in Canada between 2005 and 2010. The early warning score derived from 198,755 vital sign sets in the Vitalpac™ database (ViEWS) has an area under the receiver operator characteristic curve (AUROC) for death of acute unselected medical patients within 24 h of 88%. This study validated an abbreviated version of ViEWS, which did not include mental status, in 75,419 consecutive patients Therefore, this external validation of the, albeit abbreviated, score suggests that ViEWS may be universally applicable to most hospitalized patients. The AUROC of the abbreviated ViEWS score for death within 48 hours for all patients was 93%, with no significant difference between surgical and medical patients, or any of the sub-specialty divisions of medical patients

Kane *et al*., (2007) described a systematic review and meta-analysis which associated increased nurse staffing and lower odds of hospital related mortality and adverse patient events. An increase of one nurse per patient day was associated with a decrease in hospital acquired pneumonia, unplanned extubation, respiratory failure and cardiac arrest in an intensive care unit.

7. Conclusion

Early Warning Scores aim to work within the constraints of the workings of a hospital. If care was ideal, there would be no need for EWS and at risk patients would be flagged up the traditional systems i.e. the interpretation of regular observations by medical and nursing staff. EWS represent the best attempts to deal with the constraints of the system-mainly the number of skilled staff for an increasingly dependent patient population.

However, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2005) stated that the important physiological observations of sick patients are measured and recorded less frequently than is desirable. This interpretation explains why the MERIT trial and others have not been able to show benefit across many centres, whilst Duckitt *et al*.,(2007)are able to show the Worthing scoring system works in their own centre.

While there may not be a sufficient body of evidence to support the argument that the use of Early Warning Scores alone are the answer, many of the studies outlined above have provided evidence of improvements in early detection of deterioration and/or outcome measures since the introduction of an EWS, among others, include Subbe *et al*., (2003); Garcea *et al*., (2006); Gardner-Thorpe *et al*., (2006); Mitchel *et al*., 2010; Moon *et al*., 2011; Smith (2008, 2009); Groarke *et al*.,(2008).

In the Mitchell *et al*., (2010) study reported a multi-faceted intervention on early recognition and intervention in deteriorating hospital patients in two Australian hospitals. A prospective before and after intervention trial was conducted in all consecutive adult patients admitted to four medical and surgical wards during a four month period.

While the ViEWS system (Prytherch *et al*., 2010) has been identified as the most accurate predictor hospital mortality for the first 24 hours, when compared to 33 other AWTTS systems, the 2010

study was conducted exclusively on medical patients and therefore would not be considered applicable to a surgical group of patients.

The Mitchell *et al*., (2010) study validated the MEWS for use on both medical and surgical patients, it is recognized that this was a small study over a short period of time, but the only study which validated the EWS for both medical and surgical patients.

Given the cost identified to deliver the ALERT™ Programme to large numbers of staff in the Irish Healthcare System, The COMPASS© education programme should be looked at with the possibility of adapting it to the suit the Irish context.

An important consideration is that HIQA (2011) recommended that the HSE should, as a priority, agree and implement a national early warning score to ensure that there is a system of care in place for the prompt identification and management of clinically deteriorating patients.

Update added to literature review (October 2012)
While the original EWS recommended was the MEWS using the physiological parameters used in the Australian Mitchell (2010) study, two more recent large validation studies on the ViEWS (Bleyer *et al*., 2011 and Kellett *et al*., 2011) system, validated for use on both medical and surgical patients, it is now recommended by the National Governance/National Clinical Guideline Development Group that the ViEWS be adopted as the National Early Warning Score for the Irish Healthcare context.

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Appendix 11

Summary – Comparison COMPASS© and ALERT™ Education programmes

(Full report available on request from the Chair of the National Governance/National Clinical Guideline Development Group)

The report was completed by: Ms. Shauna Ennis, Tallaght Hospital, Dublin; Ms. Margaret Gleeson, Mid Western Regional Hospital, Nenagh, Co. Tipperary; Ms. Maria Horgan, St. Luke's Hospital, Kilkenny; Ms. Elizabeth Neely, Letterkenny General Hospital, Co. Donegal.

The group provided a comparison between two education programmes for early recognition and management of deteriorating patients for the National Governance/National Clinical Guideline Development Group to outline any significant differences between the programmes. The two programmes compared were the ALERT™ (Acute Life-threatening Events, Recognition and Treatment) programme developed in the United Kingdom (UK) in 2000 and being delivered by a number of acute hospitals in Ireland and the COMPASS© programme which was developed in 2006 in Australia and is being rolled out there.

While the content of both programmes are similar the COMPASS© programme contains unfamiliar terminology and references to, for example, Medical Emergency Teams (MET's) and Code Blue. In addition units of measurement are different to those used in Europe e.g. partial pressure of oxygen is expressed in millimetres of mercury pressure (mmHg) as opposed to kilopascals (kPa's). However, correspondence with the COMPASS© development group in Australia indicated that the programme may be amended, with prior approval.

ALERT™ includes sections on ethics in acute care and pain management, these are not included in COMPASS©. COMPASS© incorporates a framework for communication utilising the ISBAR tool and an early warning score which are not included in ALERT™. ALERT™ incorporates a programme for health care assistants whereas COMPASS© does not.

There are significant differences between the cost of both programmes. ALERT™ requires payment of an annual license fee in addition to manual and teaching material costs to a UK company for each site delivering the programme. COMPASS© materials may be downloaded, free of charge, from a website, however, there are costs associated with printing of the educational materials. The ALERT™ Programme is not available on-line. The cost of personnel requirements for the ALERT™ programme delivery is significantly higher than COMPASS© in view of the longer programme duration.

Both ALERT™ and COMPASS© can provide a 'Train the Trainer' programme and are applicable to multi-disciplinary groups. Both programmes award a Certificate of Attendance and have evaluated positively by participants.

Research has demonstrated the positive impact of ALERT™ on the confidence and knowledge of participants in the management of deteriorating patients. The COMPASS© programme demonstrated a post-implementation reduction in the number of unplanned ICU admissions and unexpected cardiac arrests when implemented concurrently with an observation chart incorporating an early warning score in Australia.

ALERT™ comprises pre-course reading and an eight hour face-to-face session consisting of informal and interactive seminars, practical demonstrations and role-play. There are three phases to completing the COMPASS© programme, beginning with a manual for pre-course reading and training CD to be worked through independently. This is followed by a quiz and a 3 hour face-to-face session which comprises the review of core material and facilitated clinical-based scenarios.

The following provides a comparison of each aspect of both programmes.

	COMPASS©	**ALERT™**
Cost of participation	Educational materials free of charge from website	Usually free to staff employed in Provider sites. There is a cost per participants for external participants, this varies between sites.
Manual Size	86 pages	93 pages
Project	3 Interventions: 1. Colour Coded Observation Chart 2. Track & Trigger system 3. Education Package	1. Education Package
Requirement	Internet terminal to access online quiz, co-ordinator checks this is completed and get results prior to face-to-face session	Providing centre must be licensed by ALERT™ Portsmouth, U.K. Trainers/facilitators attend ALERT™ TTT programme.
Education Package	1. Self directed interactive CD for independent completion 2. Manual 3. On-line Quiz 4. 3 hour Face-to-Face session.	1. Manual 2. 8 hour Face-to-Face session
Content	1. MEWS 2. Oxygen delivery 3. Airway, breathing and circulation 4. Central nervous system, urine output 5. Communication, teamwork & management plans (ISBAR) 6. Scenarios x 4 - test knowledge	1. Assessing the critically ill patient 2. Blue and breathless patient 3. Hypotensive patient 4. Disordered conscious level 5. Oliguric patient 6. Pain relief in critical illness 7. Communication 8. Ethics of acute care 9. Scenarios x 4- test knowledge
Sedation Score	Sedation score (0-4)	AVPU
Communication framework tool	ISBAR	None
Pre-Quiz	On–line prior to face to face session	Yes, in most ALERT™ provider sites.
Post-Quiz	No	Yes on completion of study day
Programme Evaluation	Yes	Yes
Duration	3 hour study day	8 hour study day
Scenario Training	4 Scenarios	4 Scenarios
Accessibility	CD, manual, face-to-face session	Manual, face-to-face session
Trainer/ Facilitator requirement per programme	Trainer: 3 hours Facilitators (no facilitator: participant ratio specified): 1 hour	Trainer: 8 hours facilitators (n=4 per group of 20): 2 hours
Participants	Interdisciplinary education: nurses, doctors, physiotherapists	Interdisciplinary education: nurses, doctors, physiotherapists, care-attendants (BEACH™)
Refresher	Annually	Not specified by ALERT™. MWRH deliver mandatory refresher programme every 2 years
Accreditation Award	Certificate of attendance	Certificate of attendance, An Bord Altranais Category 1 approved

Appendix 12

Summary – Economic Impact Report for the National Early Warning Score (NEWS) and COMPASS© Programme

(Full report is available on request from the Chair of the National Governance/National Clinical Guideline Development Group)

The report was completed by Ms. Michelle O'Neill, Senior Health Economist, Health Information and Quality Authority.

1. Economic literature search

The search strategy is based on that the one used in the clinical literature review with the addition of an economic filter (Glanville *et al*., 2009) for the Medline and EMBASE search. The PICOs are provided below along with the search strategy and the detailed search terms used in OVID (Medline and EMBASE) and the Database of Abstracts of Reviews of Effects, NHS Economic Evaluation Database, Health Technology Assessment Database, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews.

PICOs:

Population: Adult acute patient, Adult patient, medical patient

Intervention: Early warning score, Modified Early warning Score, VitalPAC™ (ViEWS), Track and Trigger System

Comparison: Early warning score, Modified Early warning Score, VitalPAC™ (ViEWS), Track and Trigger System (comparison against each other or with no intervention)

Outcome: Resources, costs

1.1 Search strategy

Detailed search terms for **EmbaseClassic+Embase** 1947 to 2012 October 09 and **Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R)** 1946 to Present, run through OVID on the 10th October 2012.

CONCEPTS:

A – Early warning score
B – Methodology filter; economic
C – A AND B Early warning score and economic filter
D – Remove duplicates from C All results, no limits, no duplicates

Concept A: Early warning score

ID	Search	Hits
1	Early warning score	297
2	Modified Early warning Score	131
3	VitalPAC	10
4	Track and Trigger System	28
5	or/1-4	315

Concept B: Methodology filter: Economic

ID	Search	Hits
6	*Economics/	21479
7	*Economics, Medical/	21559
8	*Economics, Pharmaceutical/	5872
9	exp "Costs and Cost Analysis"/	400064
10	exp Health Care Costs/	224939
11	exp decision support techniques/	64779
12	exp models, economic/	102782
13	markov chains.sh.	8346
14	montecarlo method.sh.	35519
15	uncertainty.sh.	10158
16	quality of life.sh.	308452
17	quality-adjusted life years.sh.	5950
18	exp health economics/	564180
19	exp economic evaluation/	190553
20	exppharmacoeconomics/	160770
21	exp economic aspect/	1047120
22	quality adjusted life year/	15615
23	quality of life/	308452
24	exp "costs and cost analyses"/	168352
25	(economic impact or economic value or pharmaco-economics or health care cost or economic factors or cost analysis or economic analysis or cost or cost-effectiveness or cost effectiveness or costs or health care cost or cost savings or cost-benefit analysis or hospital costs or medical costs or quality-of-life).sh.	592852
26	(econom$ or cost or costly or costing or costed or price or prices or pricing or priced or discount or discounts or discounted or discounting or expenditure or expenditures or budget$ or afford$ or pharmacoeconomic or pharmaco-economic$).ti,ab.	1046158
27	(cost$ adj1 (util$ or effective$ or efficac$ or benefit$ or consequence$ or analy$ or minimi$ or saving$ or breakdown or lowering or estimate$ or variable$ or allocation or control or illness or sharing or life or lives or affordabl$ or instrument$ or technolog$ or day$ or fee or fees or charge or charges).ti,ab.	212069
28	(decision adj1 (tree$ or analy$ or model$)).ti,ab.	20279
29	((value or values or valuation) adj2 (money or monetary or life or lives or costs or cost)).ti,ab.	8947
30	(qol or qoly or qolys or hrqol or qaly or qalys or qale or qales).ti,ab.	63557
31	(sensitivity analys$s or quality-adjusted life year$ or quality adjusted life year$ or quality-adjusted life expectanc$ or quality adjusted life expectanc$).ti,ab.	11826
32	(unit cost or unit-cost or unit-costs or unit costs or drug cost or drug costs or hospital costs or health-care costs or health care cost or medical cost or medical costs).ti,ab.	45098
33	(decision adj1 (tree$ or analy$ or model$)).ti,ab.	20279
34	or/6-33	2377303

Concept C: Early warning score and economic filter

ID	Search	Hits
35	5 and 34	21

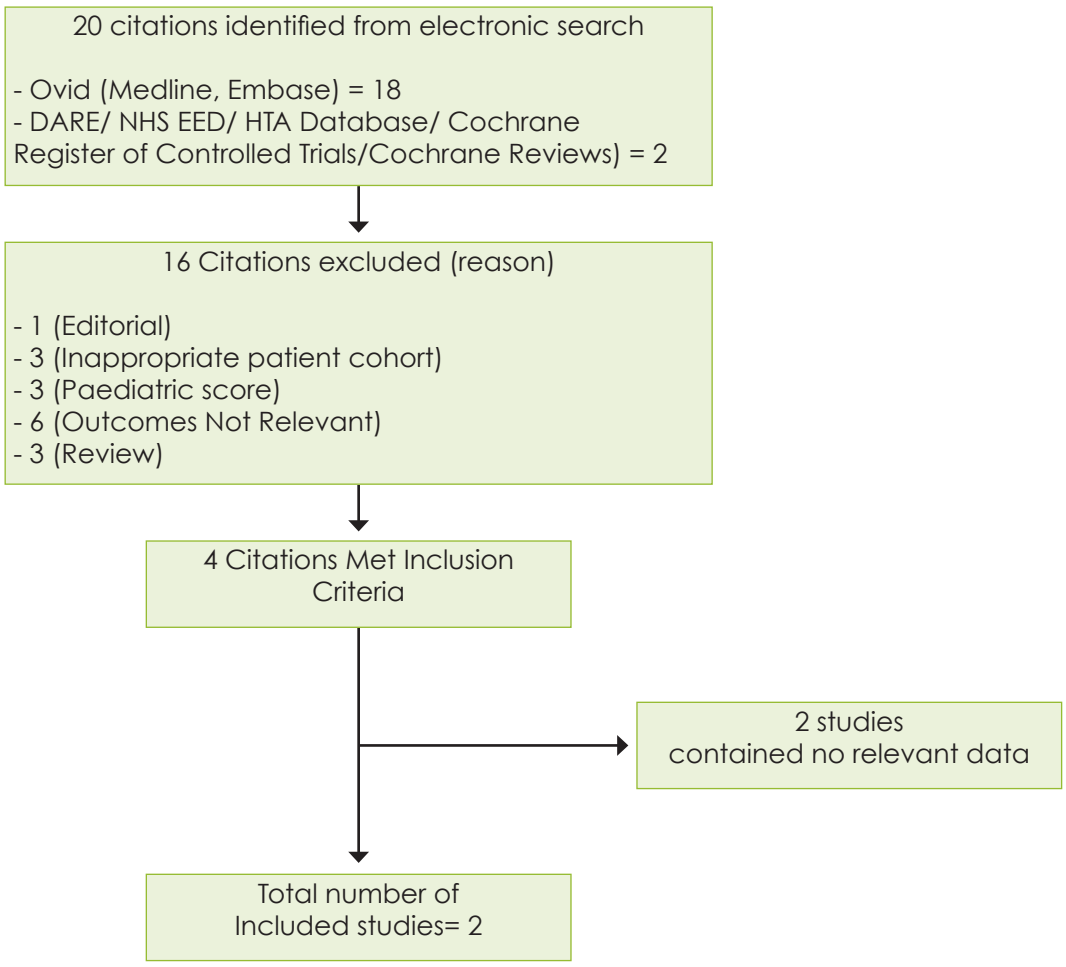
Concept D: All results no limits, no duplicates

ID	Search	Hits
36	remove duplicates from 35	18

Detailed search terms for the following databases: Database of Abstracts of Reviews of Effects, NHS Economic Evaluation Database, Health Technology Assessment Database, Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews. All searches were limited to Title, Abstract or Keyword. Search was run on 10th October 2012.

ID	Search	Hits
1	(Early warning score) OR (Modified Early warning Score) OR (VitalPAC) OR (Track and Trigger System)	2

Flow chart of Excluded studies



2. Economic literature review

A systematic review was conducted to identify existing literature on the economic evaluation of early warning score systems. The search was performed in October 2012. No economic evaluations, costing studies or studies which focused on the resource implications of introducing an early warning score systems, were found. Only two studies were found in which the cost or resource implications were considered (Patel *et al*., 2011; Jones *et al*., 2011). Detailed descriptions of the literature search terms and inclusion and exclusion criteria are provided in the full report.

Patel *et al*., (2011) states that although the cost of the early warning score system itself is inexpensive this coupled with an Intensive Care Unit (ICU) outreach service is expensive but no details on the relative costs of the two aspects of the intervention were provided. Jones *et al*., (2011) found a significant reduction in both the number of patients admitted to critical care and their length of stay in the critical care unit when they moved from a paper based EWS system to an electronic EWS system with automated alerts, this was on top of initial 2 day reduction in length of stay (LoS) seen after the introduction of the paper based system.

There is conflicting evidence on the clinical improvements which may be attributable to the introduction of a EWS system. Mitchell *et al*.,(2010) observed a relative reduction of 72% in the number of unplanned admissions to ICU along with reductions in unexpected hospital deaths after the introduction of an early warning score system. However, Subbe *et al*.,(2003) observed that the rates of cardio-pulmonary arrest, intensive care unit or high dependency unit admissions were similar both before and after introducing a modified early warning score system in Wales.
Detailed consideration of budget impact and resource implications

2.1 Initial phase

The COMPASS© Education Programme which incorporates the NEWS for the early detection and management of the deteriorating patient was chosen as the national education programme. This education programme is currently being rolled out, with full implementation expected before the end of 2013.

Savings
The COMPASS© Education Programme is replacing the previously used ALERT™ system which along with education costs also included an annual licence fee of approximately €600 for each organisation which was being paid by 10 hospitals. Thus moving to COMPASS© will result in an annual saving of €6,000.

Costs - staff
There are approximately 17,500 WTE nurses working in acute hospitals (excluding children's and maternity hospitals). Although this underestimates the full number of nurses not all will require education for instance those working in administration roles or outside the areas that are using the NEWS also some will have received the education as part of their undergraduate education. Thus it was considered a conservative estimate of the number of nurses who require education. A certain proportion of doctors and allied health professionals will also require education, using the current numbers of trained across staff groups, based on the latest NEWS audit data, it was estimated that in total an estimated 20,500 staff will require education split amongst nurses (17,500), doctors (2,000) and allied health professionals (1,000).

The amended COMPASS© Programme takes approximately 8.5 hours which consists of reading the manual (2 hours), working through an interactive education CD (15 minutes), an on-line quiz (15 minutes) and a 6 hour face to face session. To cost the staff time for education an average salary (HSE, 2012) for each of the three staff groups was assumed as follows: nurses were staff nurses, doctors were registrars and allied health professionals were physiotherapists. Using these estimates the approximate cost for staff time spent on education is €7.3 million.

A 'train the trainer' model was adopted for implementation of the COMPASS© Education Programme, that is, suitable staff, doctors, nurses and physiotherapists train as trainers and deliver the multi-disciplinary programme to staff. Approximately 300 staff have been trained to deliver the education programme consisting of 80% nurses, 10% doctor, 10% allied health professional (based on the NEWS database of trainers). Delivering an education session is estimated to take 8 hours (6 hours education and 2 hours preparation time). On average the education sessions will include 10 trainees (2 trainers) thus each trainer is required to deliver 6 or 7 session sessions. Assuming the same average salary costs as before the staff time cost involved to deliver education is an estimated €172,000.

Although the staff resources consumed during the education phase are significant these are opportunity costs, that is diverting staff members from their usual activities to attend and provide education, rather than an actual cash cost to the HSE. This cost may be realised through efficiencies and flexibility in rostering, direct staff replacement may not be required.

Costs - materials
To support the initial phase of education and training, education materials were provided by the Office of the Nursing and Midwifery Services Directorate through Nursing and Midwifery Planning and Development Units. These included 5,000 Manuals, 700 CD's, 10,000 sample observation charts and 3,000 ISBAR Charts, costing a total of €17,982

2.2 On-going intervention costs

Costs - staff
Using the NEWS consists of taking a number of observations, charting these and calculating a score. Of these observations only the AVPU score to detect neurological deterioration is not routinely taken, this consists of assessing whether a patient is alert or if not if they are responsive to voice or pain stimulus. The additional staff time to take the AVPU observation would in most cases be negligible. The time taken to chart and calculate the score is expected to be minimal (approx 15 seconds) and as such no additional staff time is envisioned to be required for the tracking element of the intervention.

Additional staff time may be incurred as there is evidence that introducing an early warning score system can lead to additional work for emergency response systems (Mitchell *et al*, 2010). The model of emergency response system varies by institution thus the change to the workload will not be uniform across the system. There is evidence however that an increase in emergency response system call outs lead to a reduction in the rate of cardiac arrests and unexpected deaths decreases (Chen *et al*., 2009).

Ongoing education will consist of a short refresher course to be completed every 2 years. Assuming this refresher education programme takes approximately 1hr with no additional material costs, the ongoing education would cost approximately €425,000 annually. This is based on the same number of staff estimated to need the initial education.

Costs - materials
The early warning score chart is likely to replace currently used charts, these vary across sites with some consisting of a single sheet, however the change to the NEWS chart will have a negligible cost implication.

Cost savings from improved outcomes
It is anticipated that introducing a NEWS will improve patient outcomes by reducing the number of unplanned admissions to ICU and reducing the number of cardiac-respiratory arrests. Patients who experience a cardiac respiratory arrest could spend a number of days on ICU thus savings are expected to arise due to the reduction of ICU bed day use, along with potential savings on follow-up treatments for disability that the patient may suffer.

For a patient admitted to ICU there is an additional cost of approximately €1,316 per day compared with remaining on a general acute hospital ward (ICU per diem cost €2225 (Dwyer, 2012), general ward per diem cost €909 (PQ, 2011). On average patients with a cardiac-respiratory arrest spend 5 days in ICU (Dwyer 2012), thus that is a saving of €6,580 per patient not admitted to ICU. In 2011, approximately 3,750 inpatients were diagnosed with a cardiac or respiratory arrest, where this was not the main reason for their admittance to hospital (ESRI, 2012) Although the evidence on reduction in cardio-respiratory arrest and ICU admissions is mixed ranging from no observed difference (Subbe, 2003) to over 70% reduction with an associated 95% CI of 26%-89% (Mitchell, 2010) we assumed a reduction of 26%, which is similar to the lower estimate observed by Mitchell *et al*., (2011). If we assume those institutions without a NEWS in place observe the full reduction in ICU utilisation for cardio-respiratory events and conservatively that the third of hospitals who already have a NEWS see no reduction in ICU utilization. Then there could be potential savings of an estimated €4.2 million or 3,200 ICU bed days.

The savings to be made from a reduction in ICU bed day utilisation, will likely not be realised as a cash saving to the system but rather as an efficiency saving through freeing up of ICU resources to be available for use to other patients in the system.

Summary of the annual economic impact.

Category	Item	Approximate Cost
*Initial Phase		
Non staff	Materials (Manuals, CDs, Sample Observation Charts and ISBAR charts)	€18,000*
Staff	Trainees	€7.3 million
	Trainers	€172,400
On-going intervention costs		
Non staff	NEWS charts	Negligible
Staff	Additional measurements	Negligible
	Charting score	Negligible
	Additional resources to respond to triggers	Unknown but likely to increase
	On-going education	€425,000 per year
Savings		
	ALERT™ license fee	€6,000
	Reduction ICU bed days, from cardiac respiratory arrests	€4.2million per year
	Follow-up disability treatment from reduction in cardiac respiratory arrests	Unknown

* These are the one off costs which will be incurred during the initial roll out of the COMPASS© education programme nationally.

** The cost for trainees refers to staff time, relates to the opportunity cost of diverting staff members from their usual activities to attend and provide education, rather than an actual cash cost to the HSE. This may be realised through efficiencies and flexibility in rostering, direct staff replacement may not be required.

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Appendix 13

HSE Signatories to the Guiding Framework/Clinical Guideline and Policy for the NEWS

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Document approved by: Ms Laverne McGuinness, National Director Integrated Services Directorate	Date: 31/1/12 Dr Barry White, National Director, Clinical Strategy and Programmes
Mr Michael Shannon, Nursing and Midwifery Services Director / Asst. National Director, Clinical Strategy Programmes Directorate, HSE.	Dr. Philip Crowley, National Director, Quality and Patient Safety
Prof. Garry Courtney, National Lead Acute Medicine Programme & National co-sponsor for EWS	Dr. Siobhan O'Halloran Assistant National Director, Acute Hospital Services
Prof. Shane O'Neill National co-sponsor for EWS	

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Department of Health, Hawkins House, Hawkins Street, Dublin, Ireland
Tel: +353 1 6354000 • Fax: +353 1 6354001 • www.dohc.ie