

WHAT'S THE SCORE?

Regional Audit of Physiological Early Warning Scoring Systems (PEWSS)

August 2011

CONTENTS

Preface	1
Introduction, Background & Methodology	7
Summary Findings	10
Summary Recommendations	14
Main Recommendations	16
Strand 1 Results – Organisational Questionnaire	21
Strand 2 Results – Retrospective Case Note Review	47
Acknowledgements	103
Appendix 1 – Strand 1 Audit Tool	106
Appendix 2 – Strand 2 Audit Tool	115
Appendix 3 – Help Notes	130
References	134

PREFACE

A failure to recognize patient deterioration and respond in a timely fashion is seen as a crucial patient safety issue in hospitals across the world, as it causes potentially avoidable morbidity and mortality. In recent years, many organizations with responsibility for setting standards for healthcare delivery in developed countries have implemented strategies for improving this important part of hospital care. Crucial to improving care for sick or deteriorating patients are staff education, the regular monitoring of patients' physiological state, tools to facilitate early detection of deterioration, systems for the successful communication of information about a patient's condition, and an assured, timely and appropriate response. An understanding of the human factors responsible for the failure of these components is also crucial to improving performance.

Ensuring regular vital signs monitoring, guaranteeing detection of deterioration and delivering an effective, timely response by staff with the necessary, advanced, clinical skills requires the existence of clear fail safe processes. At admission to hospital, there should be an agreed, clear, documented, vital signs assessment plan that specifies which vital signs observations should be recorded, and how often for each patient. This needs to be an appropriate plan, updated (and documented) throughout the patient's spell in hospital, in line with their (changing) severity of illness assessment. Current best practice suggests that the patient's severity of illness should be assessed using a physiological early warning scoring system (PEWSS) and that this should be used to drive subsequent monitoring and clinical intervention. Whenever the plan dictates that a standard assessment of vital signs is due, a complete set of the vital signs parameters necessary for the calculation of a PEWSS score must be recorded. Calculation and documentation of the PEWSS score need to be accurate. The PEWSS should be used to determine the frequency of subsequent vital signs observations and any necessary escalation in care. Finally, for each patient, there should be an agreed, documented, plan for triggering an assured clinical response of specified speed and content (including specific staff grades and skill level). This needs to be an appropriate plan, updated (and documented) throughout the patient's spell in hospital, in line with their (changing) severity of

illness assessment. A method of escalation in the event of non-attendance of the specified clinical response is also essential.

This report into the compliance of practice relating to patient deterioration studies activity across a whole health care network and compares it with existing regional and local guidance, and with an internationally recognized model of good practice in dealing with the acutely ill and/or deteriorating patient. Taking into account the unavoidable limitations of questionnaire-based audits, the authors of the report have uncovered examples of good practice in certain aspects of care. However, perhaps inevitably given the fact that poor monitoring practices have become endemic in most healthcare organizations over several decades, their findings also demonstrate significant opportunities for improvement.

Overall, the results of the audit presented in this document provide no real surprises, as the findings mirror those seen in other international healthcare systems. Strand 1 of the audit, a general questionnaire on PEWSS and its use, identified that most Trusts believe that they have systems in place for the monitoring of patients' vital signs, the detection of patient deterioration and the delivery of a suitable clinical response, where necessary. Whilst all Trusts declared that they monitor severity of illness using a Physiological Early Warning Scoring System (PEWSS) and have an escalation protocol used in conjunction with their PEWSS, there was variation between sites with regard to the components of individual PEWSS, the weightings used to define patient severity of illness and the escalation cut off values. Similarly, although some Trusts used the same PEWSS for all adult admissions, others used different versions in different clinical areas and for different patient groups. In some organisations, certain groups of adult patients received no surveillance using a PEWSS, thereby potentially undermining the impact of PEWSS across the organisation. Variation also existed in the nature of the clinical response to high PEWSS scores and, in a few sites, there appeared to be no involvement of ward consultant staff at any stage of the response. Most worrying were the apparent inadequacies in education for staff involved in the processes of calculating PEWSS scores, escalating care and responding to high PEWSS values.

Strand 2 of the audit, a retrospective case note audit, compared the monitoring and treatment practice for a sample of patients immediately prior to intensive care unit (ICU) admission against several components of existing accepted guidance and against local Trust protocols/guidance. This section of the work produced more detailed insight into the implementation of the policies described by Trusts in Strand 1. In particular, it confirmed that human factors play a vital part in the failure of complex hospital systems such as recognising and responding to deterioration.

Patients admitted to ICU can be expected to have physiological abnormalities and hence abnormal PEWSS scores. However, there was evidence in the audit that many sick patients had vital signs observation and PEWSS assessments performed less frequently than their sickness level demanded. In many cases vital signs datasets were inadequate making it impossible to calculate a PEWSS score. In others, there were a wide range of errors in the scoring process. There also appeared to be evidence of PEWSS scores reaching or exceeding the escalation threshold, but failing to initiate an adequate or in some cases any, appropriate clinical response. For some patients, there were repeated instances of high PEWSS that led to no obvious, clinically appropriate activity. In contrast, high PEWSS scores often led to a more holistic approach to patient care with consideration of broader aspects of care, including spiritual needs and the appropriateness of treatment limitation.

The findings of the Northern Ireland Audit of PEWSS make it difficult not to conclude that greater attention is required to the processes of monitoring vital signs, recognizing patient deterioration and delivering an appropriate clinical response in many Trusts. Of fundamental importance is that the data implies that many Trusts need to investigate why PEWSS are not being successfully utilized. The establishment of standards and suitable targets, together with regular standardized audit would assist in these respects. The standards should start by identifying the necessary regular training required for staff involved in the use of PEWSS scores and should classify the necessary competencies for all related PEWSS activities expected of particular grades of staff.

Whilst the authors of the report do not formally recommend standardization of the PEWSS and escalation strategy used for adult patients across a healthcare locality, this has obvious advantages, particularly as healthcare staff often move from one clinical area or hospital site to another. Indeed, it is difficult to provide a good argument as to why it would be appropriate, based on patient safety, for the continued use of several different PEWSS within a hospital or across a healthcare economy, especially as there is no scientific evidence to suggest that different systems are necessary for (non-obstetric) adults. Evidence of the performance of different types of early warning scores in different clinical settings and clinical specialties is now emerging (but at the time of writing is as yet unpublished), and seems to imply that there is an argument for using a single system. The choice of system should be based upon the ability to discriminate between at risk patients and those not at risk of a particular adverse outcome. Standardization would reduce confusion and misunderstanding between staff; allow standardisation of training; facilitate consistent clinical decision making; facilitate transfer of data at handovers; facilitate 'standardisation' of speed and nature of response; facilitate resource planning; permit standardised audit; and provide a research tool to assess the impact of interventions and quality of care. Whilst PEWSS and escalation protocols could be universal across a healthcare system, there will almost always be a need, determined by local staffing, for differences in the response to deterioration. Although the response could be delivered by individuals from different backgrounds in different organisations, it is vital that these staff should all possess the necessary competencies to deal with acutely ill patients. The involvement of senior staff in the management of sick patients is to be commended, as evidence suggests that their involvement improves patient outcomes.

It should be recognised that PEWSS scoring, with an agreed minimum frequency of measurement, should be regarded as the minimum level of monitoring that should occur for hospitalised patients. Other assessment modalities should be used in addition, where appropriate. Similarly, escalation of care should not be based exclusively on PEWSS scores, as a small percentage of patients deteriorate without showing physiological abnormalities captured by PEWSS. Escalation may also be on the basis of symptoms and signs such as chest pain, diaphoresis or 'nurse concern'. In supporting these, and to ensure patient safety, the culture of the organisation should be such that staff are never criticised for calling for help.

The authors of this report are to be congratulated on completing a large study that identifies both good care and elements of practice that could be improved. Organisations involved in healthcare delivery would do well to take note of the nature and content of the authors' findings, as they describe clear opportunities to improve patient safety in hospital.

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INTRODUCTION

Physiological Early Warning Scoring Systems (PEWSS), in which routine observations are given a score, can help staff to recognise when a patient's condition is a cause for concern or requires additional assessment and possibly intervention.

Following a successful 2008 competitive funding applicationⁱ to the Guidelines and Audit Implementation Network (GAIN), the audit tools were designed, and invitation letters issued to all HSC Trust Chief Executives (with the exception of the Ambulance Trust) in October 2008, requesting the identification of "in-house" data collectors with the requisite skills. Data collector training on the audit tool was held in November 2008, and data collection for the Northern Ireland Audit of Physiological Early Warning Scoring System (PEWSS) commenced in January 2009. The audit's purpose was to assess compliance of Northern Ireland hospital PEWSS practice with existing regional and local guidance, and with an internationally recognized model of good practice in dealing with the acutely ill and/or deteriorating patient.

BACKGROUND

There has been increasing international recognition over the last 10-15 years that patients in hospital may deteriorate to the point of a life-threatening event and that this deterioration may either not be detected, or not responded to appropriately or with sufficient speed, and that the consequence of these may be avoidable morbidity and mortality.^{ii,iii}

METHODOLOGY

The audit utilised local Trust policies/guidance, existing CREST and NICE guidance, and standard Acute Life-threatening Events: Recognition and Treatment (ALERT^M)^v course practice as audit standards/comparators. It also encompassed review of the published scientific literature and personal communication with internationally recognised experts in the field.

The invitation letter to Trust Chief Executives included an overview of the audit purpose and method, alongside suggestions to assist in identification of individuals with the necessary skills to report the data. All Chief Executives signed up to the audit.

Trust Clinical and Audit leads were identified to assist in the collection of the information. It was deemed necessary to use staff working in their own Trusts to collect the data as (i) they would be best placed to understand local practices and environments, and (ii) Trust duties in terms of patient confidentiality were facilitated in the context of review of clinical records.

Funding to offset the extra work was made available to reporting Trusts, in proportion to the size of their audit samples. The audit comprised two strands. The tools for each of the two strands were developed by Dr Trinder and South Eastern HSC Trust (SET) Audit staff.

STRAND 1 - ORGANISATIONAL QUESTIONNAIRE (APPENDIX 1)

The Strand 1 questionnaire is a general questionnaire on PEWSS and its use within each Trust. It was highlighted to Trust Audit Leads that it was important that the individual completing the questionnaire had knowledge/experience of the use of PEWSS within their Trust, was deemed competent in this respect within their organisation, and felt confident in answering on behalf of the organisation as a whole (e.g. an ALERT[™] Trainer). If the responses differed for each hospital site within a Trust, a separate questionnaire was requested to be completed for each site. A copy of the Trust's PEWSS chart(s) and PEWSS algorithm(s) was also requested. In addition to assessing the position in 2007 (i.e. shortly following implementation of the re-organisation of Health and Social Care Trusts), Trusts were asked to report any changes that were made to their PEWSS/algorithm during the period from November 2007 to the end of the audit period (June 2009).

STRAND 2 - CASE NOTE AUDIT (APPENDIX 2)

The Strand 2 questionnaire is a retrospective case note audit. Information collected is from the 24 hour time period immediately prior to the patient's admission to ICU. Agreement to conduct this part of the audit in ICU patients was secured in advance from the Lead Clinicians Group within the Critical Care Network, Northern Ireland (CCaNNI). The audit tool included several (non-research) elements of a tool currently being used to research PEWSS practice.^{vi} The Strand 2 tool assessed monitoring and treatment practice in each case against components of existing guidance (CREST, NICE & ALERT[™]) and against local Trust protocols/guidance. Following a pilot in two sites, and modifications informed by the pilot exercise, a training day for data collectors was held on 25th November 2008 and the finalised Strand 2 tool used by each assessor team on two example cases after initial training.

The total planned audit sample was 800 inpatients from medical/surgical wards admitted to Intensive Care Units (ICU)/High Dependency Units (HDU) across Northern Ireland from 1st November 2007 to 31st October 2008. This was as recent a data collection period as was feasible, as it was important for data collectors, who were reporting from January 09, to have access to hospital outcome of patients who had been admitted to critical care. In order to achieve representative sample size according to Trust ICU workload, ICU activity data from CCaNNI was used to allocate the number of returns proportionately in accordance with each Trust's activity. Funding to conduct the audit was made available proportionately to each Trust in the same manner.

Data collection proformas and accompanying help notes (see Appendix 3), developed from feedback on the training day, were distributed to the five Trusts at the end of December 2008. It was hoped that data collection would be completed over the months of January – February 2009. However, due to pressure of clinical work in several Trusts, this target had to be extended to the end of June 2009. Cross-checking of returned data, and follow-up to resolve any contradictions/ambiguities then took several months, after which data were analysed by SET Safe & Effective Care Department using the analytical tool Statistical Package for Social Services (SPSS). The report was completed and sent for external expert comment in May 2010.

SUMMARY FINDINGS

STRAND 1

- 1. All HSC Trusts have a Physiological Early Warning Scoring System in place.
- 2. All HSC Trusts have an action protocol/response algorithm used in conjunction with the scoring system.
- 3. Variation exists between Trusts regarding the locations where PEWSS is employed and the types of patients in whom it is used, and in whom it is not.
- 4. There is variation by site in the groups/seniority of staff prompted by the local response algorithm to be involved in patient care.
- 5. Variation exists in the timing of staff training in PEWSS, and the means by which it is delivered. Some medical staff are not trained in use of PEWSS, and refresher training/updating does not appear to be widely practised.
- 6. The same PEWSS is not in use across Northern Ireland and submitted example charts demonstrate that, for some Trusts (shortly following reorganisation), PEWSS differ between sites within the same organisation.
- 7. PEWSS in use vary by (i) the physiological parameters contributing to the score, (ii) the numerical component score generated by a given physiological measurement, (iii) the maximum total score achievable and (iv) the response that a given total PEWSS score prompts within the response algorithm.
- A minority of sites use both the model scoring system and model response algorithm issued by CREST in 2007. Some sites reported that deviation in practice from CREST guidance was because of limitation in medical staffing of wards.
- Oxygen saturation is not part of the PEWSS score in all Trusts (although it is monitored and documented), despite it being a recommended component in NICE guidance.
- 10. All sites utilising PEWSS report that regular PEWSS audit occurs.

STRAND 2

- Overall, almost 10% of patients admitted to a critical care unit (from an area in which PEWSS is expected to be practised) did not have a PEWSS chart. There was notable variation between Trusts in this regard.
- 2. There is room for improvement in labelling of PEWSS charts with the patient's hospital/HSC number and date of birth, and with the date on which the observations and scores were recorded.
- 3. Overall, in the 24 hour period prior to critical care unit admission, and where a PEWSS chart existed, there was 95% compliance with the NICE recommendation (covering the full range of acute hospital inpatients) that PEWSS scoring be conducted at least 12 hourly. Guidance also indicates that the frequency should change in accordance with the condition of the patient concerned. Hence the 12 hour audit measure here is an absolute minimum frequency, and likely not indicative of what is required in many ill or deteriorating patients.
- 4. All Trusts showed poor (19.5% overall) compliance with existing guidance that PEWSS charts/clinical notes should contain an indication of the required frequency of observations for that patient.
- 5. Frequency of performance of PEWSS scoring was found to fall short of the frequency deemed to be required (where the latter was documented) in more than one quarter of patients in the 24 hours prior to ICU admission overall. In one Trust this fraction exceeded 50%.
- 6. For the five physiological parameters recorded as part of PEWSS in all Trusts, peak frequency of measurement was 6 times in the 24 hours prior to ICU admission, with a range from zero to 36.
- 7. When observations were performed in the 24 hours prior to ICU admission, all the physiological data components required to calculate the PEWSS score on each occasion (as required by Trust guidance and training) were present in 34% of patients, compared with a target of 100%.
- 8. Having performed the observations, the presence of ≥1 incorrectly calculated score in the 24 hours prior to ICU admission was found in 69% of patients. One contributor to such error was suboptimal compliance with allocation of the component parameter score to the correct zone on the PEWSS chart, on every occasion in the same 24 hour period (65% v target of 100%). In one Trust, over

90% of patients showed ≥ 1 error in calculation of PEWSS scores in the 24 hours prior to ICU admission.

- 9. Overall, one quarter of patients admitted in emergency circumstances to critical care units did not breach a PEWSS threshold for action in the 24 hours prior to ICU admission i.e. they were not identified by the PEWSS in use as requiring either an intervention or communication beyond the resident ward team. (This level of insensitivity may be contributed to by suboptimal PEWSS practice identified elsewhere in this audit. However, a clinically determined need for surgery was also an important factor). Variation was noted between Trusts on this issue; in one Trust the figure was 13%.
- 10. Reports in the scientific literature that patients who require ICU admission frequently have demonstrated prior physiological disturbance are shown to be pertinent to Northern Ireland. This audit found that three quarters of patients admitted to critical care had breached a trigger which required involvement of staff beyond ward level nurses on at least one occasion in the 24 hours prior to critical care admission. Among patients admitted to critical care units almost half did not remain on the general ward with ongoing repeated triggering of PEWSS for more than 4 hours. One quarter had shown evidence of significant physiological disturbance for between 12 and 24 hours prior to ICU admission (although not necessarily of sufficient magnitude to require ICU admission for much/all of that time, given that a graduated scoring system is generally used).
- 11. Having reached a trigger score, repeat scoring did not occur at the frequency given in the local Trust guidance/protocol in 45% of patients subsequently admitted to ICU. It is not possible to conclude from the data generated by the audit whether, e.g., these figures indicate suboptimal frequency of observations performed, or unrealistic guidance/protocol requirements, or a combination of the two.
- Overall compliance with Trust guidance on whom to contact when a threshold is breached was relatively high, at around 90%. However, considerable variation between Trusts was found.
- 13. In approximately half of the occasions when trigger scores were reached, treatment changes were prompted by the response algorithm, and delivered; in approximately one quarter, communication only was prompted.
- 14. Alteration of PEWSS thresholds (the score which triggers a given action) in individual patients, in response to a trigger, occurred not infrequently overall.

Considerable variation between Trusts was detected, ranging from around 40% to 0%.

- 15. Among interventions prompted by PEWSS, those aiming to support adequacy of oxygenation and/or breathing were the most common, closely followed by those to maintain blood pressure and circulation. Treatment directed at more than one organ system at a time was not uncommon. Variation between Trusts was noted in how frequently PEWSS triggering resulted in review of resuscitation status. PEWSS triggers also prompted further investigation and some broader aspects of good care which are not part of existing response algorithms, including addressing of spiritual needs.
- 16. In general, failure to comply with response algorithms appears to be a problem of much smaller magnitude than those identified in performing PEWSS monitoring and documentation. The commonest reported deficiency in complying with both Trust response algorithms and with ALERT[™] practice was failure to review resuscitation status of the patient. In one Trust this seemed to be a problem of disproportionate magnitude.
- 17. In less than a third of cases of patients breaching PEWSS triggers, and admitted to ICU, there was evidence of improvement at ward level prior to ICU admission. Spontaneous improvement was a relatively rare event (1% overall). Considerable variation between Trusts was noted, ranging from 26% not improving pre-ICU in one Trust to 96% in another.
- 18. Among patients breaching PEWSS triggers, clinical management was deemed by respondents to fall short of ALERT[™] practice standard in 16% of patients, which suggests some room for improvement. One Trust stood out from others with a much higher fraction of 68% of patients deemed to have been managed sub-optimally prior to ICU admission. Conversely, the lowest incidence reported by any Northern Ireland Trust in this regard was 1.6%.
- The commonest deviation from ALERT[™] practice was delay in communication between staff of the patient being at-risk. Other reported deviations included failure to document patient instability, and suboptimal treatment plan.
- 20. The consequences of deviation from ALERT[™] practice, in terms of substantial contribution to adverse patient outcome, seem modest in number (if not severity) when considered as a fraction of patients triggering PEWSS, at 2.8%. However, this fraction of patients in whom harm was deemed attributable rises to at least 13.6% of those in whom there had been a deviation from ALERT[™] practice.

SUMMARY RECOMMENDATIONS

General

New evidence-based GAIN guidelines for Early Warning Scoring Systems are required.

Choice of System should be based on an agreed hierarchy of information/ evidence –taking into account the limitations of the latter, particularly with respect to specific patient populations.

A firm recommendation for a standardised Scoring System across all Trusts/ patient groups is precluded at the time of writing.

Decisions regarding the setting of response thresholds should encompass a review of the relative importance of all other (non-PEWSS) elements of staff workload. Relative priorities within that workload should be explicitly documented.

Trusts should address the deficiencies exposed by this audit in:

- staff training and skills
- prescription of frequency of PEWSS in individual patients, and related compliance
- alteration of PEWSS thresholds/DNAR decisions
- incomplete observation sets/incorrect entry and/or calculations
- non-compliance with local and national guidance, both in monitoring and in treatment

Failure to achieve considerable reduction of the PEWSS error rate is likely to prevent PEWSS achieving its goals of optimising patient care and resource use.

Electronic systems may assist.



Service evaluation/audit is to be encouraged within each Trust to determine:

- sensitivity and specificity of the scoring system in its population(s)
- among ward patients not admitted to ICU, the proportion of patients responding/not responding to algorithm-prompted (and other) ward-based interventions

Regional audit procedures for PEWSS across Northern Ireland should be standardised, and robust means established to close the 'audit loop.' Such audit should include assessment of patients who die without admission to critical care. Deficiencies of this audit, including failure to secure suitable proportionate sampling from all Trusts, should be addressed.

RECOMMENDATIONS

GENERAL

- New GAIN guidelines for Early Warning Scoring Systems are required, in order (i) to address evidence which has emerged since the publication of CREST and NICE guidance, (ii) to help to address areas identified by this audit which were not covered by previous guidance.
- Multidisciplinary input to PEWSS choice/design and utilisation is commended. Choice/design should be on the basis of an agreed hierarchy of information, in order that opinion alone does not determine practice at the expense of evidence base.
- 3. All staff groups who input and/or respond to PEWSS scores must possess the necessary clinical skills to fulfil the function(s). Trust managers should ensure that all staff who need PEWSS training receive it, including refresher training. Any groups of medical staff deemed not to require PEWSS training should be documented and justifiable.
- 4. Trusts should assess the locations or circumstances where ward consultant involvement is not part of the response to any level of PEWSS trigger, and satisfy themselves that appropriate arrangements are in place.

CHOICE AND VALIDATION OF SYSTEM

5. Whilst a standardised scoring system across Northern Ireland would offer some obvious advantages, existing systems may not optimally identify at risk patients in all patient groups and/or may not make best use of staff resources. Thus a firm recommendation for a standardised scoring system is precluded at this point in time. It may be that a scoring system will emerge which identifies at risk patients equally well in all clinical areas. Ideally, scoring systems and thresholds should be validated in the populations of patients and location where they are to be used. Failing that, or the development of a universally applicable system, all Trusts should choose a PEWSS - comprising a particular parameter set, scoring thresholds and relative weighting - on the basis of its

discriminatory power (validated ability to identify at risk patients) among a population comparable to that it wishes to monitor. Such choice may need to be tempered by feasibility of use, but an informed and justifiable choice should be made, and should include consideration of whether or not to use a system incorporating patient age.

6. Those responsible for decisions to use PEWSS in obstetric, outpatient and paediatric populations of patients should be aware, and take account, of the limitations of the current evidence base for use in these populations.

CHARTING

7. Trusts should aim to avoid unnecessary duplication of the same observations across multiple different charts, and should explore the feasibility of combined charts. In doing so, care should be taken not to dilute or compromise the components summed to generate the PEWSS, whilst retaining the ability to perform and record independently other specialised observations, according to patient need/diagnostic group. In some settings it may be necessary to record both a condition-specific score (e.g. Glasgow Coma Scale) and a general PEWSS score.

WORKLOAD ISSUES

8. Early detection and treatment of patients at risk of death or organ failure should receive appropriate prioritisation in the deployment of medical and other staff. Given the limitations in discriminatory ability of currently available scoring systems, trigger thresholds need to be set to strike a balance between (i) optimal ability to detect at risk patients and (ii) workload, to which "false alarms" contribute. However, trigger thresholds should not be selected to compensate for inadequate staffing levels. Decisions regarding the setting of response thresholds should encompass a review of the relative importance of all other (non-PEWSS) elements of staff workload. Relative priorities within that workload should be explicitly documented.

PEWSS USE

- 9. Trusts should raise awareness of the need to document the required frequency of performance of PEWSS scoring in individual patients. Default increases in frequency as part to the response algorithm to a raised score should also be considered.
- 10. Alteration of PEWSS thresholds in individual patients should not be done lightly, or by inexperienced staff. Instead, prospective identification of groups of patients who will trigger inappropriately is encouraged, such that PEWSS triggers can be optimally set. *Ad hoc* exclusion of groups of general medical patients from PEWSS by individual medical staff (of whatever seniority) should be discouraged, as it threatens to compromise the optimal functioning of PEWSS. Instead, groups of patients who may not benefit from PEWSS or who may require different thresholds should be identified prospectively, preferably on the basis of robust local data, and agreed across a discipline.
- 11. Repeat triggering may be deemed inappropriate in some patients because of perceived limited benefit from intervention. For some such patients a Do Not Attempt Resuscitation (DNAR) order or a documented decision not to escalate therapy is a potentially superior means to deal with "false alarms" than resetting threshold scores, particularly if a DNAR/non-escalation decision would render ongoing PEWSS monitoring unnecessary.
- 12. Trusts should consider whether or not it is appropriate to record individual observations which contribute to PEWSS score independently of the others, and be in a position to justify their conclusions. This seems particularly pertinent in patients who are causing sufficient concern as to prompt clinicians to request an increase in monitored frequency of one particular element.

QUALITY ASSURANCE

- 13. Reasons why PEWSS is not being implemented in line with local Trust guidance and training must be identified and addressed. Potential areas which could be looked at include:
 - a. availability and content of training

- b. competence/skillmix/motivation of those responsible for implementing PEWSS
- c. staff levels, workload and prioritisation of tasks.
- 14. Trusts should use all means possible to minimise errors in, and ensure completion of, PEWSS calculations. Specifically, Trusts should assure the quality of data entry in order that scores are not (i) rendered incorrect by data entry in the wrong location on PEWSS charts, (ii) summed incorrectly through simple mathematical error. Trusts should consider moving to an electronic PEWSS (subject to it employing one of the better validated scoring systems) in order to reduce these forms of error, and so reduce the risk of suboptimal treatment. Failure to achieve considerable reduction of the error rate is likely to prevent PEWSS being a satisfactory means to optimise patient care and resource use.
- 15. All Trusts should assure that the opportunities presented by PEWSS triggering to review resuscitation status and document timely treatment decisions, including palliation, are taken advantage of for the benefit of patients.

AUDIT, SERVICE EVALUATION & RESEARCH

- 16. Service evaluation/audit is to be encouraged within each Trust to determine sensitivity and specificity of the scoring system in its population(s). Analysis and plot of such data (e.g. using the Receiver Operator Characteristic) should be used to set score thresholds which strike an acceptable and informed balance of workload/false alarms versus missed "at risk" patients. Research and validation of serial scoring is to be encouraged. Service evaluation and research of PEWSS use in outpatients, obstetric inpatients and paediatrics would be welcome.
- 17. Standardised regional audit procedures for PEWSS across Northern Ireland are encouraged. A relatively low detection rate in this audit of harm as a consequence of deviation from best clinical practice should not be allowed to result in complacency. This is particularly the case as only patients who survived to reach critical care were assessed. As part of standard quality assurance, Trusts should endeavour to maximise detection of deviation from best practice, assess any associated harm and, where necessary, change

procedures, staffing levels, training and skillmix to minimise harm. Utilisation of suitable audit tools is essential to such a process.

- 18. All Trusts should audit compliance with the specified frequency of observations, and explore the reasons why specified frequency of observations is not met.
- 19. PEWSS audit/service evaluation/research could usefully be conducted among ward patients not admitted to ICU, as well as those who are, to determine the proportion of patients responding/not responding to algorithm-prompted (and other) ward-based interventions.
- 20. Regional PEWSS audit among patients who die without admission to critical care should be conducted to determine whether or not there is room for improvement in scoring/algorithm responses which could impact favourably on potentially avoidable deaths, or on provision of palliative care.
- 21. This regional audit should be repeated within 1-2 years, after Trusts have had an opportunity to implement changes in response to the audit findings. Resource should be identified to allow this to occur. Deficiencies in this audit, including failure to secure suitable proportionate sampling from all Trusts, should be addressed at that time.

STRAND 1 ORGANISATIONAL QUESTIONNAIRE RESULTS (n=13, unless otherwise stated)

Audit targets or areas of expected qualitative performance are presented with coloured banners. The basis for the target is coded as follows: A = CREST, B = NICE, C = local Trust protocol/guidance. Service evaluation components (which may be equally important despite the absence of an identifiable target) are presented in numbered sequence but without coloured banners.

LOCATION OF PEWSS USE AND STAFF INVOLVED

Evidence of Quality	Expected	Actual Achieved
 Respondent states there is a physiological early warning scoring system (PEWSS) in use within their Trust. [A, B] 	100%	100%

1.1 DISCUSSION

All sites indicate that a PEWSS is in place. Respondent comment described crossdirectorate and multidisciplinary input to the generation of PEWSS chart and policy. This is suggestive of good consultative processes.

1.2 RECOMMENDATION

Multidisciplinary input to PEWSS design and function is commended. Practice should be guided by an agreed hierarchy of information, in order that opinion alone does not determine practice at the expense of evidence base.

2.1 Group(s) of Staff who Input Observations into the PEWSS

	No. of sites	%*
Medical, Nursing, Healthcare Assistants	5	38.5
Nursing, Healthcare Assistants	4	30.8
Medical, Nursing	2	15.4
Nursing	2	15.4
*Due to rounding rules % adds to more than 100%		

2.2 Broad Group(s) of staff who respond to the scores generated by the PEWSS

	No. of sites	%
Medical, Nursing	7	53.8
Medical, Nursing & Healthcare Assistants	6	46.2

2.2.1 Breakdown of staff involved in Response Algorithm (at some level of score)



Staff Involved at any Level of Score to Response Algorithm

Other = "Medical physicians," "Out of hours – Clinical Nurse Practitioner," "Outreach response to 'pilot' wards."

2.3 DISCUSSION

There appears to be variation between sites with respect to which staff groups enter and total data on the PEWSS chart, and also variation in whether or not Healthcare Assistants respond to scores.

The absence of involvement of Ward Consultant staff at any stage in the response on some sites was noted. This seems to occur in the following settings:

- (i) GP beds, where the GP will be the senior medic contacted
- a minor injuries unit, where a senior doctor in the Emergency Department will be involved
- (iii) a pilot critical care outreach service.

However, this may not explain all the occasions where ward consultant involvement is not part of the response.

The involvement of ICU outreach nurses and ICU doctors (in keeping with EWS and ALERT[™] principles) is limited. This is likely a reflection either of the limited funding which has been available to develop such outreach and support for ward staff, or of the absence of such staff on-site, e.g. on those sites without an ICU.

2.4 RECOMMENDATION

All staff groups who input and/or respond to PEWSS scores must possess the necessary clinical skills to fulfil the function(s). The value of further expansion of outreach services should be explored, including the potential to improve responses to PEWSS triggers.

Trusts should assess the locations or circumstances where Ward Consultant involvement is not part of the response to any level of PEWSS trigger, and satisfy themselves that appropriate arrangements are in place.



Other: Psychiatry, Orthopaedics, Cancer centre, Recovery Ward, GP Wards & Minor Injuries Unit. Whilst the graph above is quantitative in terms of the number of sites where PEWSS is used in a given area, it is non-quantitative in terms of patient volume.



Whilst the graph above is quantitative in terms of the number of sites where PEWSS is used in a given

24

area, it is non-quantitative in terms of patient volume. 3.3 PATIENTS EXCLUDED FROM PEWSS

All sites except one excluded some patients from PEWSS. The following patient groups were excluded on one or more sites:

- Head Injury
- Severely Thrombocytopenia
- Mental Health, Learning Disability, Physical Disability
- Those on Care of the Dying Pathway

3.4 DISCUSSION

Patients Included

It is reassuring that PEWSS are in place wherever medical and surgical hospital inpatients are managed in Northern Ireland. Any sites reporting non-use in surgical patients do not provide inpatient surgery. The response from site H12 does not indicate any use of PEWSS in medical inpatients or in elderly care. However, personal contact with the respondent, following data analysis, has revealed that the site response was incomplete, with data only provided on surgical patients. The respondent has since confirmed the presence of PEWSS in medical in patients and in elderly care on that site.

The apparent discrepancy, of ICU being an area where PEWSS is used on site H09 in the first graph and ICU/HDU being an area where it is not used in the second graph, is explained by the respondent's comment that PEWSS is used at the point of ICU discharge as a baseline measure for the wards but not otherwise during ICU or HDU stay. Similarly, for site H10, the respondent's comment explains that, whilst PEWSS is not routinely used in obstetrics, it is used for obstetric patients following Caesarian Section.

The 2007 CEMACH Report^{vii} included recommendation of the use of an Early Warning Scoring System in pregnant women. Nevertheless, the use of a score (and associated responses) developed in other populations is of uncertain value in the general obstetric population, and requires validation. There could be value in producing a score more targeted to detecting the causes of deterioration in obstetric patients, or modified scoring thresholds optimised for this patient group. It is possible that those undergoing operative interventions may benefit in the postoperative period, in a manner analogous to post-operative surgical patients in other disciplines.

The possibility of use in (unspecified) outpatients is noted on some sites. Pertinent issues here include:

- (a) the selection of patients for outpatient care
- (b) the duration of time outpatients are on the hospital site and the frequency of performance of PEWSS scoring in this context
- (c) the frequency of useful triggers in this population
- (d) the responses to triggers and whether these are tailored to the outpatient population and the staff able to respond.

In the meantime, given that PEWSS have been developed and validated (in a different population) to identify patients at increased risk of death or of needing critical care, it would be of concern if such endpoints were reached in the outpatient population, and reached by deterioration of PEWSS parameters sufficiently often to merit the use of PEWSS. If such a set of circumstances were found to exist, it might indicate inappropriate patient selection for outpatient management. There is obvious need to identify promptly outpatients who have developed a complication which requires emergency intervention/hospital admission, but whether PEWSS is the best means to do this is uncertain. Once admitted to hospital, such patients could then benefit from PEWSS in a situation where its performance has been better assessed.

Patients excluded

Intensive care patients, paediatric patients, and patients who were dying were the most frequently reported groups in which PEWSS is not practised.

It can be argued that patients in the ICU already are in an environment with frequent close monitoring and immediate access to appropriately skilled nursing and medical staff. Response algorithms designed to work in the setting of a general ward are unlikely to be transferrable to the ICU where responses which the algorithm is designed to prompt are arguably already part of the culture and practice, and where illness severity may be indicated by the degree of organ support needed to achieve acceptable vital signs rather than by the vital signs themselves. Certainly, patients who achieve vital signs in the normal range without support are very different from those in ICU who have vital signs in the normal range only because of organ support therapies such as mechanical ventilation and dialysis.

Many would view at least some of the responses (which PEWSS is designed to prompt) to be inappropriate and interfering with comfort and dignity in the setting of a dying patient. Hence the exclusion of this group from PEWSS seems appropriate. There may be legitimate reasons for continuing to include such patients in PEWSS monitoring but clinicians and Trusts should be in a position to justify such practice. One of the potential benefits of PEWSS has been identified as the prompting of appropriate and timely decision-making on non-escalation of treatment to best meet the interests of individual patients who are judged to be unlikely to benefit from treatment escalation, including cardiopulmonary resuscitation and ICU admission.^{viii}

Omission of children from PEWSS may be viewed by some as potentially alarming but the utility of the systems used in general adult wards has not been well assessed in the paediatric population. Further consideration of the needs of this population in terms of monitoring and triggered responses is to be encouraged.

One respondent indicated that any group of patients which the consultant felt was inappropriate could be excluded. This has the potential to undermine the perceived benefit of PEWSS. It is important not to interfere with clinical decision-making by senior staff at the bedside, but the exclusion of patients could in theory occur without a bedside assessment by the consultant. In the context of groups of patients, it would be best if such groups were explicitly identified (preferably on the basis of robust local data which supports the decision) and agreed across a discipline, rather than left to individual consultants.

3.5 RECOMMENDATION.

Exclusion of groups of general medical patients from PEWSS by individual medical staff (of whatever seniority) should be discouraged, as it threatens to compromise the

optimal functioning of PEWSS. Instead, groups of patients who may not benefit from PEWSS or who may require different thresholds should be identified prospectively, preferably on the basis of robust local data, and agreed across a discipline.

Research and/or service evaluation of PEWSS use in outpatients, obstetric inpatients and paediatrics would be welcome. Those responsible for decisions to use PEWSS in these populations of patients should be aware and take account of the limitations of the current evidence base for use in the population concerned.

4.1 Clinical areas where the PEWSS and the Routine Physiological Observation Charts have been integrated (n=12)

Site/Trust responses reported considerable integration and are presented verbatim:

- All areas integrated (2 responses)
- All except ICU, Theatres, Recovery, Day Surgery, Renal Unit Day Care
- All observation charts except head injury (2 responses)
- Neurovascular, has been integrated within EWS chart
- None (2 responses)
- Pain score has been integrated with Trust wide EWS form (2 responses)
- PEWSS became the standard observation chart for this site all charts integrated except for Glasgow Coma Scale and pain chart
- Three charts available 1) Standard, 2) Patient Controlled Analgesia (PCA) incorporates PCA observation and prescription 3) Epidural as for no. 2. Also C-section incorporates PV loss.

4.2 Clinical areas where the PEWSS runs in parallel with existing Observation Charts

Site/Trust responses reported considerable integration and are presented verbatim:

- Accident & Emergency, UCC
- All integrated (2 responses)
- Central nervous system observation, blood observation
- Head injury patients (2 responses)
- None

- Only with neurological observations
- Separate PCA and Epidural charts at present but we are working on an amalgamation
- Separate PCA and Epidural charts
- Separate PCA/Epidural/LA observation charts
- Stroke Unit
- TPR charts used for blood transfusions.

4.3 DISCUSSION

It is clear that PEWSS charts have not replaced all other observations charts, and the degree to which they have been integrated varies. Trusts reported the variation both in terms of patient type and physical location. It is probable that standard PEWSS charts are not suitable for some purposes, e.g. detailed neurological observations, or assessment of pain/nausea.

4.4 RECOMMENDATION

Trusts should aim to avoid unnecessary duplication of the same observations across multiple different charts, and should explore the feasibility of combined charts, whilst not diluting or compromising the components summed to generate the PEWSS, and whilst retaining the ability to perform and record specialised observations according to patient need.

STAFF TRAINING

Evidence of Quality	Expected	Actual Achieved
5.1 Nursing staff receive training on the use of PEWSS. [A, B]	100%	100%

5.1.1 Point at which Nursing Staff Trained



Other includes monthly sessions, and during ILS/ALERT™ training

Evidence of Quality	Expected	Actual Achieved
5.2 Medical staff receive training on the use of PEWSS. [A, B]	100%	92.3%

5.2.1 Point at which Medical Staff Trained



Other includes monthly sessions, and during ILS/ALERT™ training

Evidence of Quality	Actual Achieved
5.3 Healthcare Assistants receive training on the use of PEWSS	84.6%

Since Healthcare Assistants do not uniformly take part in PEWSS, there was no "expected" figure for training of this staff group.





Other includes monthly sessions, and during ILS/ALERT™ training

5.3.2 Discussion

No Trust which uses Healthcare Assistants to deliver PEWSS fails to provide them with training. From responses given, it appears that some may be trained despite not being directly involved with PEWSS. Health care assistants' training appears to be more dependent on "on-the-job" training than is the case with other staff groups.

5.4 Other healthcare professionals receive training on the use of PEWSS

Forty-six point two percent of Trusts stated that other healthcare professionals receive training on the use of PEWSS. Training for these other staff is as part of ongoing on-the-job training (33.3%) or during ALERT[™]/ILS/CPR course or one off training sessions (66.7%).

Respondent comments indicate that other staff groups who receive PEWSS training on at least some sites include: Cardiac Physiologists, Physiotherapists, Cardiac Technical Staff, and Pharmacists.

Evidence of Quality	Expected	Actual Achieved
5.5 Respondent states staff receive refresher courses/training updates on the use of PEWSS. [A]	100%	53.8%

5.5.1 Frequency of Refresher/Update Training

Responses are presented verbatim:

Nursing Staff

- If and when they attend ILS/ALERT
- ILS/ALERT. ILS annual
- Inconsistent; training programme is being reviewed
- Monthly sessions available during the year no set requirement for updating
- Ongoing monthly sessions at which all staff are invited to attend
- Requested by staff and delivered by Outreach.

Medical Staff

- If and when they attend ILS/ALERT
- ILS/ALERT on appointment and ILS yearly for non-consultant staff
- No set requirement for updating.

Healthcare Assistants

- Monthly sessions available during the year no set requirement for updating
- Ongoing monthly sessions at which all staff are invited to attend.

In many sites staff do not receive refresher courses or updates. In some of those that do there does not appear to be a requirement for staff to demonstrate that training/ refresher course has occurred within any particular time-frame.
5.6 DISCUSSION

Variation exists in the point of delivery of training for each group of staff identified. There appears to be overlap with training for specific other purposes (e.g. ILS). Less than 100% delivery of training was found generally to correspond to some staff groups not being involved in either PEWSS observations, their interpretation, or delivery of treatment prompted by PEWSS, rather than a failure to train necessary staff.

Nevertheless the responses indicating that almost 8% of medical staff do not receive such training require further exploration.

5.7 RECOMMENDATION

Trust managers should ensure that all staff who would need PEWSS training receive it, and receive documented refresher training as necessary. If some groups of medical staff are deemed not to require PEWSS training, the reason should be documented and available for quality assurance and audit purposes.

33

PEWSS CONSTITUENTS

Evi	dence of Quality	UTILISED								
6.	6. Parameters used to generate component scores which contribute									
	to the total PEWSS score [A, B]:									
	Respiratory rate	100%								
	Pulse/HR	100%								
	Conscious level	100%								
	Urinary output	53.8%								
	SpO ₂	76.9%								
	Temperature	100%								
	Blood pressure – Systolic	100%								

Two sites included pain scores and nausea scores as parameters contributing to the total PEWSS score.

6.1 Scoring System(s) used to measure Consciousness Level

Responses to this question were inconsistent, possibly due to inconsistent following of the guidance notes. Nevertheless, all submitted examples of site PEWSS charts use AVPU as part of the total score; some use GCS as a supplementary observation for more detailed neurological observations, but it is not included in the PEWSS total score.



6.2. Maximum Total Score achievable on each Trust's PEWSS

The variance in maximum PEWSS score achievable seems to be a direct consequence of variance in the number of parameters scored. Such variance may result from a combination of the limited evidence base for the CREST model score (or for any score), and differing clinical views regarding what is important to measure routinely at the bedside. Some variance in maximum score is also created by some sites scoring progressive derangement of physiological observations "1, 2, 4" whereas most sites scored the progression "1, 2, 3."

6.3 Alternative component Score Thresholds used to generate score for particular Patient Groups

Only one site reported the use of a different component score threshold for particular patient groups. In the follow-up question requesting information on the patient group/physiological parameters with alternative thresholds the same respondent stated "Each patient assessed on individual basis – Pulse, Respiratory Rate, Blood Pressure, SAT O2."

35

6.3.1 Commentary

Assessing each patient on an individual basis to determine the appropriate threshold for given physiological parameters would seem to miss the fundamental reason which has prompted Early Warning Scoring in the first place – that individual patients are often not recognised as being seriously ill/deterioriating. It is acknowledged that certain groups of patients may trigger false alarms on PEWSS, but they would best be identified and PEWSS thresholds modified appropriately on the basis of locally-collected (non-anecdotal) data. Data underpinning such decisions for specific groups should demonstrate that the thresholds in use are too sensitive, and that raising the threshold does not result in missing too many at-risk patients.

6.4 DISCUSSION

The same PEWSS is not in use across Northern Ireland and submitted example charts demonstrate that, for some Trusts (shortly following reorganisation), PEWSS differ between sites within the same organisation. There are disadvantages associated with this, including potential problems as healthcare staff move from one site/Trust to another. All sites' PEWSS include common parameters: Conscious Level, Heart rate, Systolic Blood Pressure, Temperature, and Respiratory Rate. Some Trusts also include Urine Output (which is not part of the CREST model chart) and/or Pulse Oximetry; others measure them but do not include them in the score. Maximum achievable scores vary widely between systems, suggesting that different numeric thresholds would be likely to be used to trigger the same kind of responses, or that a given PEWSS value in one Trust should prompt a different action in another. Review of submitted examples of action protocols/response algorithms confirmed this to be the case. Recommendations contained within previous CREST guidance on PEWSS (examples of suitable responses to specific scores) would therefore seem to be not pertinent to at least some of the systems in use. Although CREST provided a model scoring system, no references were given within the document to justify the particular model presented, or the presented levels at which the suggested responses should occur.

Some published PEWSS incorporate pain scoring but this has not been shown to improve PEWSS ability to identify those at risk of death or organ failure, and may impair this predictive function. Similar limitations may apply to nausea scores. Whilst pain and nausea scores are very useful in the management these symptoms, the merit of their inclusion within PEWSS scoring is questionable, and they have been excluded from analysis of performance.^{ix}

NICE has published guidance on the use of scoring to identify ill patients.[×] Whilst various physiological parameters are recommended to be measured, and aggregate weighted systems are clearly preferred to the "all-or-nothing" nature of Medical Emergency Team "calling criteria," NICE guidance does not assist in determining which components are most useful, or the appropriate weighting which might need to be applied to individual parameters. Further data has become available in the scientific literature since the publication of the NICE guidance, and this new information may prompt alternative practice.

Use of Pulse Oximetry (SpO2) in scoring is controversial, in part because of the breakpoint for its predictive ability seems to lie within the range normally regarded as acceptable.^{xi} A further problem is that its measuring in some published scores occurs whilst oxygen is withheld. This is regarded by some as falling short of good medical practice and ethically questionable.^{9,xii} Conversely, if SpO2 is used in conjunction with oxygen administration, it seems intuitive that the score would need to factor in the dose delivered to/required by the patient. A suitable validated means to do this has not yet been established. Nonetheless, limitations in terms of the predictive and practical value of SpO2 data within PEWSS should not be seen as undermining the important role of SpO2 monitoring in the titration of appropriate oxygen therapy. It should be noted that the maximum that a low SpO2 can influence the PEWSS score is by a component score of 3. Thresholds for action chosen to achieve a necessary balance between sensitivity (ability to detect the ill patient) and specificity (with its influence on workload) may result in dangerously low oxygen saturation not being treated promptly enough. One site's PEWSS chart, which does not incorporate SpO2 into the total PEWSS score, facilitates recording of SpO2 and prompts immediate action if it is low, independently of the PEWSS score.

Inclusion of urine output within PEWSS is perceived by many as potentially problematic since the majority of those in whom PEWSS is used will not have a urinary catheter or hourly urinometry. This then creates problems with the comparability of scores and levels of responses between those patients who have urinary catheters, and those who do not. One way to mitigate against this could be to include within the scoring system algorithm a standardised prompt for when the patient should be catheterised, and for the frequency of urine output monitoring. It may be more satisfactory to include urine output monitoring as part of a response algorithm, thus tailoring it to those who need it, rather than as a routine part of the PEWSS score.

Inclusion of a component score for patient age has been found to improve the discriminatory power of some PEWSS. No site in Northern Ireland currently incorporates patient age within its scored parameters, although one indicated that it was considering its introduction.

The performance of alternative PEWSS/MEWS have been formally compared,⁹ but it should be noted that most published assessment/validation of scores has been in the Medical Assessment Unit population and it is uncertain if the findings are applicable to patients in other settings. Disadvantages of different scorings systems and thresholds across Northern Ireland have already been highlighted but ideally scoring systems should be validated in and/or adjusted to the population in which they are to be used.^{xiii} Hence different scoring systems/thresholds/responses could prove to be appropriate in different patient populations or locations. This is consistent with NICE guidance. However, it seems unwise for scoring systems and thresholds to vary merely because of *ad hoc* development, or on the basis of opinion uninformed by local data.

In only a limited number of publications has serial scoring (ie the score being repeated over an number of hours or days) been assessed. Serial scoring is how PEWSS/MEWS is being used in practice, and is implicit in DHSC requirements of HSC Trusts in Northern Ireland, because of a desire to observe physiological trends.

There may be merit in combining the best performing scoring system with an Institute of Healthcare Improvement "change" and audit/bundle strategy. Performance of individual systems, however, are best assessed in local populations rather than importing perception of what is the best scoring system in the context of other healthcare delivery models internationally.

6.5 RECOMMENDATION

Whilst a standardised scoring system would offer some advantages, currently published options may not optimally identify at risk patients in all patient groups and/or may not make best use of staff resources. Thus a firm recommendation for a standardised scoring system across Northern Ireland is precluded at this point in time.

Ideally, scoring systems and thresholds should be validated in the populations of patients and locations where they are to be used. This would provide some justification for differences between sites. Unless an evidence-based universally applicable scoring system emerges, Trusts should endeavour to employ a scoring system which has been shown to perform well (ie discriminates between those at risk and those not at risk) in a similar population of patients to their own. Consideration should be given to the inclusion of patient age within PEWSS, as it may improve discriminatory power. However, it is evident that this would be an element which will not change with serial scoring. Research and validation of serial scoring is to be encouraged.

39

PEWSS RESPONSE ALGORITHMS

Evidence of Quality	Expected	Actual Achieved
7. An action protocol/response algorithm is used along with PEWSS monitoring. [A, B]	100%	100%

Evidence of Quality

7.1 Differences between the Protocol/Response Algorithm and CREST Guidelines

Four of the 13 sites indicated no difference between their sites and CREST guidance, and others reported differences in either the numerical value of some scores or response thresholds.

Some sites use action protocol triggers which are numerically consistent with CREST, but use scoring systems which differ from the CREST model. In such circumstances, it is likely that different physiological circumstances are prevailing at a given threshold in these differing applications of the CREST model action protocol.

7.1.1 Deviation for CREST guidelines due to Limitation in Staffing

Two sites reported that their deviation from CREST guidance was because of limitation in medical staffing of wards.

7.1.2 Other reason(s) given for deviation from CREST Guidelines

- (a) a scoring system already in use predates CREST guidance
- (b) a perceived need to "streamline and simplify" the response algorithm, and
- (c) an alternative model (Institute for Healthcare Improvement), suggesting that CREST model scoring system was deemed not one best suited to the needs of local patients. The audit did not find evidence of lack of awareness of the CREST guidance.



7.2 Practice perceived by respondents to be improvements beyond CREST Recommendations

Verbatim responses:

- Development of an un-funded outreach team from critical care
- Obstetrics within the Trust have developed a PEWSS observation chart beyond the CREST guidelines, which includes PCA and epidural monitoring. The Trust has developed a standardised approach in the use of PEWSS (2 responses)
- Patient's consultant is informed. Resuscitation status of patient is considered. Guidance for frequency of observations is given
- Score of 4 (instead of 3) for 'red zones'. Currently reviewing all MEWS charts to introduce one standardised trust chart, which may include patient age as a score due to current literature (2 responses)
- Simplification of action protocol is working well. Don't have 7 categories was looked at. Training for nursing auxiliaries
- System in place prior to CREST
- Urinary output, wound ooze, neurovascular observations, pain score, nausea score, BM
- Use of communication tools e.g. SBAR and Safety briefings within ward environment
- We have incorporated pain score. We have added step-by-step guidelines to use.

7.3 Response to PEWSS affected by duration of time that a score remains at a particular level

	No.	%
Yes	5	38.5
No	8	61.5

7.4 DISCUSSION

The presence of a PEWSS-associated response algorithm in 100% of sites using PEWSS is reassuring. It was beyond the scope of this audit formally to determine the fitness-for-purpose of such algorithms, and Trusts are encouraged to assure this locally through ongoing literature review and quality assurance processes.

Trust responses in this section indicate that many sites have elected to use a PEWSS/ response which differs from the model presented in CREST guidance. Of particular concern was the report from two sites that the reason their response algorithm differed from CREST's is because of a lack of ward-based medical staff. The implication is that current medical staffing levels on the wards in those sites are felt to render implementation of CREST guidance impractical. Since the fundamental purpose of PEWSS is to get appropriate treatment delivered to vulnerable patients by appropriately skilled staff in a timely fashion, consideration should be given urgently to whether it is more appropriate to change the algorithm or to change the medical staffing levels.

In the section relating to perceived improvements in practice beyond CREST recommendations, several sites indicated incorporation of pain/analgesia/nausea/ wound ooze/blood sugar/neurovascular observations. It is easy to see drivers for this. Clearly duplication of recording of the same observations is undesirable, and a single chart (whilst paper charting remains a necessity) has advantages over multiple charts. Nevertheless, it is important not to mix observations recorded for differing purposes in the context of PEWSS.

Review of the sample charts submitted show that in most sites these additional observations are not summed into the total PEWSS score and therefore do not influence triggering of PEWSS response thresholds. However, on two sites pain and nausea scores were added into the PEWSS. If the justification for EWS remains identification of the patient at risk of life/threatening deterioration, who might not otherwise be identified using traditional practice, then the best validated score, in terms of identifying such patients amidst the general mix of hospital inpatients, should be used. One Trust's consideration of inclusion of age within the score fits

with an attempt to maximise discriminatory power^{xiv} within their institution (but does raise ethical debate).

There is no reason why other important observations (which may be patient-specific and cover a particular life/limb-threatening risk) should not be included on the same chart but to include it within a PEWSS score risks reducing the discriminatory power of the latter. PEWSS scores need not (and should not) be the only means to raise concern in an individual patient, and they should not replace clinical judgment of an experienced clinician. However, they may be useful to experienced clinicians as a tool in helping them reach decisions supported by physiological observations, and useful to less experienced clinicians, especially "out-of-hours" in helping to identify priorities among a pool of many inpatients.

One site highlighted integration into Trust Patient Safety Quality Improvement procedures, and another the use of specific communication tools in the ward environment. These seem to be examples of good practice which are commended to all Trusts.

A higher score threshold for response than that in CREST recommendations was perceived by one respondent to be an improvement. It is not possible to assess the validity or otherwise of this perception. Higher thresholds may reduce workload/ false alarms, but may also reduce the sensitivity of detection of at risk patients. Given that scoring systems vary across sites, a given threshold score on one site may represent different physiological perturbation than the same score on another site, or in an exemplar scoring system.

The majority of sites indicated that the response within their PEWSS algorithm did not alter depending on whether or not a given elevation in score was sustained in consecutive measurements. It is conceivable that this could have implications in terms of the predictive value/false alarm performance of the system, in that it is possible that some deviations in physiological measurements from normal may not have prognostic significance if they are not sustained. However, insufficient data are available to allow this to be pursued.

7.5 RECOMMENDATION

After determining the most appropriate scoring system to identify their atrisk patients, Trusts should not allow its implementation to be compromised by inadequate staffing. Trusts should ensure that early detection and treatment of patients at risk of death or organ failure gets appropriate place in the prioritisation of where medical and other staff are deployed.

Given the limitations in discriminatory ability of currently available scoring systems, it is recognised that response thresholds need to be set to strike a balance between (i) optimal ability to detect at risk patients and (ii) workload to which "false alarms" contribute. Decisions regarding the setting of response thresholds should encompass a review of the relative importance of all other (non-PEWSS) elements of staff workload.

Observations or scores which are specific and necessary for particular diagnostic groups of patients should be recorded in addition to PEWSS. Since they serve different functions, one should not preclude the other. However, additional parameters beyond those recognised as beneficial for PEWSS should not be included within the calculation of the PEWSS score.

PEWSS AUDIT

Evi	dence of Quality	Expected	Actual Achieved
8.	Respondent states regular audit activity occurs in the use of PEWSS within their Trust [A, B]	100%	100%

8.1 DISCUSSION

All sites report that PEWSS use is audited but the extent of audit, and the comparability of audit findings between sites, is beyond the scope of this audit.

8.2 RECOMMENDATION

Standardised regional audit procedures for PEWSS which facilitate standardised data collection across Northern Ireland are encouraged. Audit design which ensures comparable data collection would assist in assessing/assuring equity of monitoring and triggered responses across the region.



STRAND 2 CHART REVIEW RESULTS (n = 413)

Audit targets or areas of expected performance are presented with coloured banners. The basis for the target is coded as follows: A = CREST, B = NICE, C = local Trust protocol/guidance, $D = ALERT^{TM}$. Service evaluation components (which may be equally important despite the absence of an identifiable target) are presented in numbered sequence but without coloured banners.

Allocation of Audit sample size using Non-elective admissions to critical care units across Northern Ireland (ICU & HDU admissions unless stated otherwise) for year ending March 2007*

Trust	Hospital Site	Total per Hospital	% of Regional ICU Activity per Hospital Site*	Sample size and funding allocation by Hospital Site	Trust Returns by end of Audit period
T01	H01	441	13.8%	111	111
T02	H05	203	6.3%	50	100
	H06	293	9.1%	73	100
T03	H07	260	8.1%	65	02
	H08	258	8.0%	64	72
T04	H09	441	13.8%	110	
	H10	734	22.9%	183	27
	H11	231	7.2%	58	
T05	H13	346	10.8%	86	83
	Total	3207	100%	800	413
*data kinc	lly provided by C	CaNNI (some are	adjusted to comp	ensate for HDU ad	missions not

*data kindly provided by CCaNNI (some are adjusted to compensate for HDU admissions not reported to CCaNNI for that year)

The following groups of patients were excluded as they were not pertinent to the area of interest:

- All elective admissions to critical care units
- Children under 14 years
- Patients admitted to ICU from any part of the hospital where the Trust does not use PEWSS
- Patients admitted to ICU from a HDU where a PEWSS score and algorithm is not used.

Limitations of this strand

- In addition to avoidance of unnecessary ICU admission (and improvement of outcome in patients admitted to ICU), one of the arguments for introduction of PEWSS has been to reduce the incidence of unexpected cardiac arrests and hospital deaths. This audit confined itself to looking retrospectively at PEWSS practice prior to ICU admission and no attempt was made to assess PEWSS practice retrospectively in patients who had suffered a cardiorespiratory arrest (or hospital death) at ward level and who were not admitted to ICU.
- Since PEWSS use was not assessed in all patients at ward level (including low risk patients), assessment of appropriateness of trigger thresholds is beyond the scope of this audit.
- Audit of a wide breadth of application of PEWSS (among patients subsequently admitted to ICU) in a sufficiently large sample prevented the even greater detailed data capture which would be necessary to answer some specific questions more definitively.
- Most Trusts succeeded in returning close to their representative allocation. However, one Trust (TO4) was only able to identify/release personnel to complete a token sample (6% of its allocated sample), despite the availability of funding. This is disappointing, given the prior agreement of the Trust to participate, and had a substantial effect on the total number of returns across Northern Ireland. The TO4 sample provides some information regarding PEWSS processes prior to admission to critical care within that Trust but there is uncertainty regarding its representativeness of practice both within the Trust and in comparison with other Trusts.

 Despite training of respondents for this audit, and issuing of help notes alongside the audit proforma, some respondents deviated at times from optimal reporting practice. This has required some data adjustment during analysis to minimise confounders. Any such adjustment is made explicit in the relevant sections.

1. Breakdown of source of patients in the Audit

1.1 OVERALL, ACROSS NORTHERN IRELAND:



1.2 DETAILED RESULTS BY TRUST:



For both charts, Other = "Recovery." This is likely to be a surgical patient but was not identified as such by the respondent & could be a medical endoscopy patient.

49

1.3 DISCUSSION

There is a fairly even representation of patients from both medical and surgical wards overall, but the balance of medical versus surgical was reversed in some Trusts in comparison to others. It is beyond the scope of this audit to determine whether this is a consequence of different admission profiles in different units, or a result of the sampling not reflecting the admission profiles in some units.

Evidence of Quality	Expected	Actual Achieved
2. PEWSS chart was completed. [A, C]	100%	90.8%

2.1 DETAILED RESULTS BY TRUST

PEWSS Overall chart Result completed (total n=413)		erall sult otal 13)	T((to n=1)1 Hal 11)	T((to n=1)2 otal 00)	T03 T04 (total (total n=92) n=27))4 tal 27)	T05 (total n=83)		
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	375	90.8	97	87.4	97	97.0	84	91.3	27	100	70	84.3
No	37	9.0	14	12.6	3	3.0	8	8.7	-	-	12	14.5
Unknown*	1	0.2	-	-	-	-	-	-	-	-	1	1.2

*Response was verbatim as follows: "?Post op observations recorded on spinal sheet. ?area that needs looked at. Had PEWSS chart in ward before going to theatre; patient suffered brain stem infarct post THR surgery; required vasopressors to maintain blood pressure."

Where respondents indicated that no chart was completed, they were asked to list the reason, if known. The commonest answers given were that the patient was on CNS (Central Nervous System) observations or that no chart could be found in the clinical notes.

2.2 DISCUSSION

Almost 10% of the audit sample patients admitted to a critical care area (ICU or HDU) in NI did not have a PEWSS chart completed. There was some variation between Trusts, with the TO2 sample demonstrating a relatively high compliance rate

(97%) of PEWSS use pre-ICU admission. The apparently high compliance rate of TO4 would require verification across a greater number of patients.

The lack of PEWSS charts in almost 10% of returns may be related to 20% of patients in the survey having been admitted directly from the Emergency Department. It is noted that Strand 1 found that 2 sites do not use a PEWSS in their A&E Department. Nevertheless, patients were only included in the audit if they were admitted to the Critical Care Unit from an area using PEWSS (ie no charts were included from A&E Departments where PEWSS is not used). It is possible that some patients presented so acutely that it may have been deemed there was insufficient opportunity to commence a chart. Nevertheless, it would be expected that all patients should have at least one set of observations recorded in the Emergency Department. Timeframes reported (when charts were not completed) do not support lack of opportunity.

It is also possible that some charts may have been completed but were missing at the time of audit. Some comments state that Glasgow Coma Scale was recorded instead of PEWSS. Since these address different (albeit overlapping) aims, it is questionable that one can adequately replace the other. NICE guidance indicates that GCS monitoring alone is inadequate in patients with head injury.^{xv} Other comments record that no explanation could be found, either for the absence of a PEWSS chart, or for the absence of data entry on a PEWSS chart.

One respondent stated that the reason for omission of a PEWSS chart was that the patient was on an "Integrated care pathway for the dying." Whilst non-use of PEWSS in this situation is consistent with CREST guidance, admission of such a patient to the ICU would seem to be at odds with longstanding expected use of intensive care,^{xvi} and is also at odds with the recently developed (ie post-audit) regional CCaNNI Admission Policy for critical care.^{xvii}

2.3 RECOMMENDATION

Transport to the ICU should occur once a patient has been stabilised as far as possible.^{xviii} Stability cannot be assessed or demonstrated in the absence of vital

sign observations. Therefore all patients should have at least one set of observations recorded prior to ICU admission. Trusts should consider whether or not it is justifiable to record observations in such patients on anything other than a PEWSS chart. In some areas (e.g. perhaps Neurosurgical or Obstetric Departments), Trust clinicians may deem an alternative observation/scoring system better to meet the needs of patients. Nevertheless, such processes should ensure that generic observations are addressed as well as specialty-specific observations. In some settings there may be advantage in recording both a condition-specific score (e.g. Glasgow Coma Scale) and a general PEWSS score.

Trusts should quality assure the completeness and timeliness of filing of all elements of medical records, so that necessary information for patient management is available to those staff treating the most severely ill patients in the hospital.

All the subsequent audit assessments were performed on the 375 patients where	a
PEWSS chart was completed, unless otherwise indicated.	

Trust	n
T01	97
T02	97
ТОЗ	84
T04	27
T05	70
Total	375

Evidence of Quality	Target	Actual Achieved
3. The following are documented on PEWSS chart [A]:		
a) Patient's hospital number	100%	81.3%*
b) Surname	100%	98.7%
c) First name	100%	98.9%
d) Date of birth	100%	81.0%**
*% calculated from 374 responses **% calculated from 373 responses		

3.1 DETAILED RESULTS BY TRUST



3.2 DISCUSSION

Identification of patient charts, in terms of carrying patients' names, is fairly complete but further improvement is desirable in supplementing this with hospital numbers and dates of birth. This is particularly a problem in TO1, where more than one chart in three lacked a hospital number.

3.3 RECOMMENDATION

All Trusts should assure completion of patient identifier data on all PEWSS charts.

Evidence of Quality	Target	Actual Achieved
4.1 Patient notes/observation chart clearly indicate how often observations are supposed to be carried out. [B]	100%	19.5%

Patient Notes/Observation Chart Clearly Indicate How Often Observations are Supposed to be Carried Out



4.1.1 Detailed Results by Trust

Written plan of required frequency	WrittenOveraplan ofResurequired(totafrequencyn=37		T((to n=') 1 tal 97)	T((to n=)2 otal 97)	TO3 (total n=84)		T04 (total n=27)		T05 (total n=70)	
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	73*	19.5	10	10.3	26	26.8	14	16.7	11	40.7	12	17.1
No	302	80.5	87	89.7	71	73.2	70	83.3	16	59.3	58	82.9
*~ //\\/			1 .6.		,, ,,		1.					

*One "No" response was reclassified as a "yes" since compliance with instructions in the help notes would have prompted a yes response.

4.1.2 Discussion

The majority of charts/notes in all 5 Trusts contained no indication of the required frequency of observations. This may reflect a lack of awareness that this is a NICE recommendation. T01 was the worst performing in this respect but all Trusts fell well short of recommended practice. T03 had the second lowest compliance with this audit standard, despite its PEWSS charts incorporating a space to document the appropriate time to the next set of observations.

The authors consider that the term "PRN" does not fulfil the recommendation for stated frequency in that it is not explicit, and relies on a decision by an undesignated individual. There is no assurance evident that whomever the decision is being delegated to has the necessary skills or insight to decide what is the appropriate frequency.

PEWSS offers advantages over more limited observations in that (i) patient risk is highlighted in relation to both the size of deviation of a given physiological parameter from normal, and the number of different parameters which lie outside the normal/desirable range and (ii) disturbance of one physiological parameter can produce disturbance in another. Documented requests that only an individual observation (e.g. Blood Pressure) be performed at a particular frequency, when a patient is causing some concern, therefore seem to fall short of what PEWSS has to offer.

4.1.3 Recommendation

Trusts should raise awareness of the need to specify the required frequency of performance of PEWSS scoring in individual patients, and record this in either the patient's notes or on the PEWSS chart.

The required frequency of observations should be decided by someone with the skills necessary to make this clinical judgment. It may be appropriate to have default increases in frequency as part to the response algorithm to a raised score. Respondent comment from one site (to the next question) suggests that this is already in place on that site.

Trusts should consider whether or not it is appropriate to record individual elements of a PEWSS score independently of the others, and be in a position to justify their conclusions. This seems particularly pertinent in patients who are causing sufficient concern as to prompt clinicians to request an increase in monitored frequency of one particular element.



Observations Carried Out in Accordance with the Agreed Frequency



4.2.1 Detailed Results by Trust

Agreed frequency employed	Ove Re: (to n=	Overall Result (total n=73)		TO1 (total n=10)		T02 (total n=26)		TO3 (total n=14)		TO4 (total n=11)		T05 (total n=12)	
	n	%	n	%	n	%	n	%	n	%	n	%	
Yes	53	72.6	7	70.0	21	80.8	6	42.9	10	90.9	9	75.0	
No	20	27.4	3	30.0	5	19.2	8	57.1	1	9.1	3	25.0	

4.2.2 Discussion

In those patients in whom a specific frequency of observations was set, this was delivered in the majority (approaching 75%) of cases overall. However, this is suboptimal in all Trusts, and Trust 03 appears to have a particular problem in that it had more charts where the set frequency was not delivered than where it was delivered. Possible reasons for non-compliance with a specified frequency include (a) excessive workload relative to staffing levels and/or failure to identify priorities within workload, (b) a view by those performing the observations that the specified frequency is inappropriate.

4.2.3 Recommendation

All Trusts should audit compliance with requested frequency of observations, and explore reasons why specified frequency of observations is not met.

Evi	dence of Quality	Target	Actual Achieved
5.	Full set of parameters comprising PEWSS completed/ recorded at least 12 hourly in the 24 hours prior to ICU. [B]	100%	95.4%*
+0/			

*% calculated from 372 responses

Full Set of Parameters Comprising PEWS Completed/Recorded at Least 12 Hourly in the Last 24 hours



5.1 DETAILED RESULTS BY TRUST

12 hourly PEWSS	Ove Re: (to n=3	erall sult otal 372)	T((to n=) 1 Hal 97)	T((to n=	02 otal 97)	T03 T04 (total (tota) n=83) n=26)4 otal 26)	T((to n=)5 otal 69)	
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	355	95.4	91	93.8	94	96.9	80	96.4	25	96.2	65	94.2
No	17	4.6	6	6.2	3	3.1	3	3.6	1	3.8	4	5.8

5.2 DISCUSSION

Whether or not staff are aware of the NICE recommendation that PEWSS scoring should generally be carried out at least every 12 hours, this is happening in the vast

majority of cases admitted to ICU. The CREST recommendation was for a minimum of once daily scoring. Both sets of guidance state that the frequency should change in accordance with the patient's condition. Hence the audit target of 100% for 12 hourly scoring was not a stringent target for patients referred to critical care.

5.3 RECOMMENDATION

Trusts should ensure that staff are aware of the national guidance on frequency of PEWSS scoring and that the frequency should increase in patients at risk of deterioration. Ongoing audit should occur to ensure that compliance remains high with this on all acute hospital sites.

Evidence of Quality	Target	Actual Achieved		
6. Documented evidence that the following were recorded on the PEWSS chart in the 24 hours prior to ICU. [A, C]				
a) Time of all sets of observations	100%	90.8%*		
b) Date of observations	100%	72.8%**		
*% calculated from 371 responses **% calculated from 364 responses				

Documented Evidence that the following have been Recorded on the PEWSS Chart in the Last 24 Hours: a) Time of all Sets of Observations



Documented Evidence that the following have been Recorded on the PEWSS Chart in the Last 24 Hours: b) Date of Observations



58

6.1 DETAILED RESULTS BY TRUST Time of Overall T01 T02 **TO3** T04 **T05** observations Result (total (total (total (total (total recorded (total n=96) n=97) n=82) n=26) n=70) n=371) % % % % % n n n n n n Yes 90.8 89.6 89.7 84.6 337 86 87 78 95.1 22 64 9.2 34 10 10.4 10.3 4 4.9 15.4 No 10 4 6

Date of observations recorded	Ove Res (to n=3	erall sult tal 164)	T((to n=')1 tal 91)	T((to n=')2 otal 96)	T((to n=)3 ital 82)	T((to n=:)4 Mal 26)	T((to n=4)5 tal 69)
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	265	72.8	80	87.9	66	68.8	50	61.0	21	80.8	48	69.6
No	99	27.2	11	12.1	30	31.3	32	39.0	5	19.2	21	30.4

6.2 DISCUSSION

Recording of the time and date of PEWSS scoring falls short of desired levels in all Trusts. In Trusts 02, 03 & 05, absence of date occurs in over 30% of patients. It is recognised that several successive charts may be present for an individual patient - omission of the date from only one of these in the 24 hour period prior to ICU admission counted as "omitted" with respect to date. Nevertheless, the importance of being able to identify and demonstrate timely response to altered physiology is self-evident. Absence of either date or time makes this difficult and may also result in data being recorded on the wrong chart.

6.3 RECOMMENDATION

All PEWSS charts should carry the time of all observations, and the date to which all sets relate should be evident on each chart.

%

91.4

8.6

Evidence of Quality	Target	Actual Achieved
7. Unplanned gaps in sets of observations in the 24 hours prior to ICU admission. [C]	0%	21.1%*
*% calculated from 71 responses (If respondents have alread frequency, they were excluded from this answer; 2 of 73 did	ly indicated no re not answer this c	ecord of a planned question).

7.1 DETAILED RESULTS BY TRUST



Unplanned Gaps between Datasets

7.2 DISCUSSION

There is some uncertainty about the representativeness/accuracy of figures in this section. There could have been over-reporting, since comments of some respondents seem to indicate that they reported missing a physiological observation within a dataset as a gap, rather than a missing dataset (contrary to help notes) - any data recorded was to count as a set of observations for the purpose of this particular question. Some of those who had indicated, in answer to Question 4, that there was no documented planned frequency responded "yes" to this question - they may have deemed that there were unplanned gaps because of deviation from a perceived standard eg once/twice daily.

7.3 RECOMMENDATION

The responses to this question render any conclusions sufficiently uncertain that a recommendation based on the data would be unwise. Nevertheless, it would seem wise to encourage Trusts to audit compliance with the recommended frequency of observations, and ensure that compliance is satisfactory.

Evidence of Quality	Target	Actual Achieved
8. All parameters were completed <i>within</i> each set of observations, in line with Trust guidance and training for completion, in the 24 hours prior to admission to ICU. [B, C]	100%	34.1%*
*% calculated from 370 responses		



8.1 DETAILED RESULTS BY TRUST

8.2 DISCUSSION

The findings in this part of the audit are of particular concern. In only 34% of returns was PEWSS being performed in keeping with Trust guidance and training, during the 24 hour period prior to admission to the critical care unit. The best currently available PEWSS still have limitations in their ability to identify patients at risk of death and/or likely to need critical care. However since PEWSS is not

being implemented as intended in the majority of cases during the 24 hours prior to admission to ICU, it cannot be expected to deliver the early identification of at risk patients that it otherwise might. In the absence of timely identification and treatment of at risk patients, it will not deliver what DHSC and Trusts expect it to deliver ie minimisation of risk, prompting of early treatment, monitoring of the effect of that treatment, and avoidance of preventable deaths and unnecessary admissions to critical care units.

This is a major issue affecting all Trusts.

8.3 RECOMMENDATION

All Trusts must explore and address the reasons why PEWSS is not being implemented in line with local Trust guidance and training. It would seem wise to explore what are the obstacles/impediments to successful implementation so that they might be overcome. Potential areas which could be looked at include:

- (a) availability and content of training
- (b) competence/skillmix of those responsible for implementing PEWSS
- (c) staff levels, workload and prioritisation of tasks.



9. Parameters recorded, and distribution of frequency of recording.



9.1 DISCUSSION

The number of PEWSS observation sets (complete/incomplete with respect to 5 common physiological parameters used in all 5 Trusts) performed in the 24 hours immediately preceding ICU admission peaked at 6. The range was from several patients with no set or a single set through to one patient with 36 sets. Clearly the number of observation sets prior to ICU admission may constitute either insufficient or unnecessarily excessive observation. The number of sets is a function of multiple factors including: the source of the patient (e.g. A&E, ward) and/or the suddenness of the deterioration of the patient; the treatments delivered at ward level, and the patient's response to such treatment; the availability of a critical care bed. If is not possible to tease apart these factors in the context of the responses to this audit question. Other observations showed a very similar distribution.

It is worth noting that Oxygen Saturation was recorded substantially less frequently (n = 270) than any of the 5 commonest parameters (n = 373-5), despite the fact that it is one of the parameters recommended by NICE to be measured as part of an aggregate weighted track and trigger system. It is important to distinguish between the substantial benefit of Oxygen Saturation in guiding oxygen therapy, and its potential value as part of an early warning score. The latter is likely dependent

on both (i) any discriminatory power it might add to an early warning score by its inclusion and (ii) the consistency of its additional discriminatory power. The latter is likely to be adversely influenced by variation in oxygen therapy between patients, unless the practice for oxygen therapy can be standardised and there is factoring in of the "dose" used to achieve a particular level of arterial oxygen saturation.

The NICE guidance does not define the relative importance of the 6 physiological parameters it recommended on the basis of consensus. The scientific literature provides clues that some (e.g. respiratory rate) might be better than others. Giving equal weighting to parameters with different predictive values is not likely to be the best way to achieve a PEWSS with good discriminatory function. Subsequent to the publication of the NICE guidance, several papers have highlighted practical and scientific problems with including Oxygen Saturation as a component of an early warning score.^{11,12} There are issues surrounding (i) the legitimacy of the saturation being scored independently of the inspired Oxygen concentration, (ii) the fact that many scoring systems which use it do so when the patient is not receiving oxygen, and some see the withholding/removal of oxygen in order to perform serial scoring as ethically questionable, (iii) whether in fact arterial desaturation provides a relatively late rather than a relatively early warning (iv) the breakpoint for identifying an at risk patient seems to lie within the range normally deemed acceptable.

All Trusts' PEWSS charts facilitate recording of Oxygen Saturation, whether or not it contributes to the total PEWSS score. Those Trusts which do utilise oxygen saturation as part of their PEWSS score vary in the scores allocated for a given level of desaturation. This differential practice was also found on different sites within the same Trust. Many sites do not record on the PEWSS chart the dose of oxygen associated with the SpO2. Recording the Oxygen Saturation, of course, does not equate with maintaining its adequacy. One site's chart incorporates guidance in the SpO2 section that arterial desaturation should immediately prompt upward titration of oxygen therapy.

9.2 RECOMMENDATION

All Trusts should choose a PEWSS - comprising a particular parameter set, scoring thresholds and relative weighting - on the basis of its discriminatory power (validated ability to identify at risk patients) among a population comparable to that it wishes to monitor. The choice may need to be tempered by feasibility of use but an informed and justifiable choice should be made.

Evidence of Quality	Target	Actual Achieved
10. Each parameter allocated to the correct	100%	64.7%*
scoring zone for all sets of observations. [C]		
*% calculated from 371 responses		

10.1 DETAILED RESULTS BY TRUST



Each Parameter Allocated to the Correct Scoring Zone for All Sets of Observations

65

10.2 FREQUENCY OF OBSERVATIONS ALLOCATED TO AN INCORRECT ZONE, AMONG THOSE CHARTS WITH AT LEAST ONE INCORRECT ALLOCATION.



Incorrect Zone (absolute numbers)	Overall Result (total n=131)	TO1 (total n=34)	TO2 (total n=27)	TO3 (total n=48)	TO4 (total n=7)	T05 (total n=15)
	n	n	n	n	n	n
Less than 10%	114	32	25	43	6	8
10% – 50%	12	1	2	4	1	4
Not stated	5	1	-	1	-	3

10.3 DISCUSSION

This is another area of considerable concern. Since in more than a third of returns physiological parameters were allocated by staff at the bedside to the wrong scoring zone for that parameter, this is likely to have resulted in incorrect total scores, further reducing the ability of the PEWSS to (i) indentify at risk patients, (ii) help target therapy appropriately and (iii) monitor the response to therapy. All Trusts show substantial evidence of this problem but Trust 03 has it to the greatest degree, with more patients having charts with incorrect zone allocation (58.5%) than patients whose parameter scores were all correctly allocated.

Focusing on the 131 returns with at least one incorrectly allocated parameter, the audit attempted to get a semi-quantitative sense of how commonly this was occurring in individual patients. In the vast majority (~90%) where incorrect allocation was reported, less than 10% of parameters were entered in the wrong zone. Definitive conclusions cannot be drawn from any breakdown by Trust as numbers are small, but Trust 05 did seem to have a disproportionate number of such charts, 26.7% (n=4) having 10-50% of entries in an incorrect zone.

10.4 RECOMMENDATION

Trusts should review processes, training and skillmix to assure the quality of data entry in order that scores are not rendered incorrect by data entry in the wrong location on PEWSS charts. Electronic data systems are a tool which Trusts could usefully consider, as they could preclude data being allocated the wrong score as a result of entry into an incorrect zone (but obviously will not avoid all other forms of erroneous data entry). Trusts should consider moving to an electronic PEWSS (subject to it employing one of the better validated scoring systems) in order to reduce this form of error, and so reduce the risk of suboptimal treatment.

Evidence of Quality	Target	Actual Achieved
 Total score for each set of observations calculated correctly in the 24 hours prior to ICU admission. [C] 	100%	31.4%*
*% calculated from 373 responses		

11.1 DETAILED RESULTS BY TRUST

	Overall Result (total n=373)		T((to n=) 1 Hal 97)	T((to n=)2 Hal 97)	T((to n=)3 otal 84)	T((to n=)4 otal 27)	T((to n=)5 tal 68)
	n	%	n	%	n	%	n	%	n	%	n	%
Yes	117	31.4	9	9.3	40	41.2	24	28.6	15	55.6	29	42.6
No	256	68.6	88	90.7	57	58.8	60	71.4	12	44.4	39	57.4



11.1.1 PEWSS Charts with incorrect or missing scores.

11.2 DISCUSSION

Further to the issues highlighted in the discussion on the responses to Question 8 in Strand 2 (completion of data entry) and Question 10 (entry into correct scoring zone), assessments in this section demonstrate that more than two thirds (~69%) of charts contain incorrect/missing total scores. Since the score, and the trend of the score, are the means by which patients' risk/need is identified, this incidence of error is of great concern. Error in totalling scores is a problem well documented in the scientific literature.^{xix,xx}

Whilst this is an important issue for all Trusts, analysis of individual Trust data show that the problem is most severe in Trust 01, where over 90% of returns showed error in calculation of PEWSS scores in the 24 hours prior to ICU admission.

11.3 RECOMMENDATION

Trusts should use all means possible to ensure minimise errors in, and ensure completion of, PEWSS calculations. Failure to achieve considerable reduction of the error rate is likely to prevent PEWSS being a satisfactory means to optimise patient care and resource use.
Electronic PEWSS could reduce mathematical and other errors in calculation of scores, ^{12,xxi} and serious consideration should be given to their prioritisation in the context of HSC resources.

12. Number of times PEWSS Score reached a Threshold for Action in the 24 Hours prior to ICU admission.



Number of Times PEWSS Score Reached a Threshold for

12.1 DISCUSSION

As with the number of observation sets prior to ICU admission, the number of times a threshold score (for action) is reached is a function of multiple factors, including the frequency of scoring, the choice of thresholds, and the effectiveness or otherwise of therapeutic interventions. Since scoring systems and thresholds were likely to differ between sites, and the model of delivery of care may have also differed, this service evaluation element was confined to assessing if patients were deemed (by local PEWSS algorithms) to be requiring repeated intervention at ward level. If thresholds are set too high, individual patients may not trigger a response sufficiently early in their clinical course and the opportunity for relatively simple intervention may be missed – hence multiple triggers before ICU admission could be seen as indicating

sufficiently sensitive trigger thresholds within a graduated scoring system, rather than a deficiency in ward management or timeliness of admission to a critical care unit. Conversely, serial triggering or protracted triggering followed by ICU admission could suggest that interventions at ward level were not timely or were ineffective. (Subsequent questions in the audit sought to assess these issues further.)

Responses to this question indicate that a quarter of patients admitted in emergency circumstances to critical care units did not breach a PEWSS threshold for intervention in the 24 hours prior to ICU admission i.e. they were not identified by the PEWSS in use as requiring an intervention. This may, in part, be a consequence of various aspects of suboptimal PEWSS practice identified by this audit. Some respondent comments suggest that part of the reason is a result of failure of some staff to sum the scores correctly (i.e. failure to use the system properly) - this has been highlighted already and requires to be addressed. However, the scientific literature demonstrates that the best current PEWSS will still miss some at risk patients and that, in practice, there has to be a trade-off between false alarms/excessive workload and patients not being identified as at risk/requiring intervention.^{13,xxii}

If no PEWSS threshold scores for action were breached, respondents were asked to describe how the patient's need for action of any kind (including need for admission to ICU) was recognised in the absence of a threshold score. Of the 89 occasions when no score threshold was breached, respondent comment described the circumstances in 56, and details of how the patient came to be referred to ICU were reported in 33. Relatively common responses were: in the context of a need for surgery; a need for orotracheal intubation – often in the setting of reduced conscious level; and influence of investigations such as blood results and radiology.

PEWSS has useful potential to identify at risk patients early, when clinical observation/assessment by ward staff may not do so. However, scoring systems *should* never replace clinical judgement that a patient *should* receive an intervention (including admission to critical care), and respondent comments indicate that a number of patients were admitted to critical care units for clear clinical reasons, ahead of significant disturbance of vital signs comprising the scoring system, and likely to the benefit of the patients concerned. This may be particularly the case in

surgical patients: ≥29/56 of respondents' comments for this group relate to surgical patients, with admission to ICU often from theatre. It may be that some of these patients would have triggered on PEWSS, but they were in this environment with alternative monitoring for a while rather than PEWSS. If early appropriate admission occurs, prompted by signs or investigations not captured by the scoring system, even better scoring systems will never prospectively identify all patients subsequently admitted.

Ideally, Trusts should monitor both their false alarm rates/workload, and the proportion who were demonstrably at risk patients but were not identified by PEWSS thresholds in use. The denominator for this purpose could be the total of those who are not on a care of the dying pathway or who have a "do not escalate/do not attempt resuscitation order" in place and who suffer cardiorespiratory arrest or have unexpected death at ward level, in addition to those who require urgent admission to a critical care unit without breaching a PEWSS threshold. In the light of such local data, the thresholds could then be adjusted to optimise the trade-off¹³ mentioned above, pending the development of better performing PEWSS. It is self-evident that (i) what may be seen as excessive workload is determined in part by staffing levels and (ii) that readjusting thresholds to compensate for inadequate staffing levels would be a poor means to address such a situation.

There was some variation between Trusts, ranging from almost one third of patients in Trust 01 not breaching a PEWSS intervention threshold in the 24 hours prior to critical care unit admission, to only 13% in Trust 05. This suggests that either the PEWSS, or the way it is being implemented (or both) in Trust 05 is more sensitive for its population of patients, than is the case in Trust 01. However, as there is no descriptor of workload or level of false alarms in this audit, it is not possible to draw conclusions in this audit whether the thresholds are optimal/suboptimal in either Trust, or indeed in any Trust.

The 13.6% of patients who breached an intervention threshold only once prior to ICU admission might seem to be a group whose need for admission to ICU is unlikely to be modifiable (assuming PEWSS was used correctly – several respondent comments indicated that, had all scores been totalled, thresholds would have been breached on more than on occasion). It might be argued that the need for ICU admission, or any subsequent suboptimal outcome, was un-modifiable in these patients on the basis that either (i) an improvement in subsequent scores (spontaneously or following treatment) did not avoid the need for ICU admission, or (ii) ICU admission had to occur before a score was repeated. However such conclusions cannot be reached from the audit data as the method did not assess whether thresholds or frequency of scoring were optimal, or indeed whether the response algorithm was appropriate in these patients specifically.

Multiple accounts were received of patients breaching intervention thresholds more than once (in the 24 hours prior to ICU admission), in which patients continued to breach the thresholds despite the continuous presence of medical staff with the patient.

The medical literature has shown for many years that patients who suffer "cardiac" arrests and/or come to require ICU admission frequently demonstrate physiological disturbance in advance of further deterioration, xxiii,xxiv,xxvi,xxvii,xxvii,xxvii,xxiii,xxix and this has been a driver for the use of early warning scores. Clinicians often question whether findings reported in the literature are pertinent to their local population of patients. This regional audit provides evidence that such findings are applicable to acute hospitals in Northern Ireland in that, overall, three quarters of patients admitted to critical care had breached a trigger threshold which required involvement of staff beyond ward level nurses on at least one occasion in the 24 hours prior to admission to a critical care unit. It would be useful (but beyond the scope of this audit) to have a denominator for this information in order to get a sense of what proportion of patients who trigger actually end up in critical care. Nevertheless, with a graduated, weighted scoring system (as recommended by NICE¹⁰), it should be expected that a significant number of patients would breach the lower thresholds and either (i) receive a relatively modest intervention which may prevent a further deterioration requiring critical care admission, or (ii) result in a timely decision that it is in the patient's best interests not to escalate therapy further. Therefore such a denominator cannot be seen as a means to determine the rate of false alarms; rather, false alarms/workload could be quantified by the fraction of patients breaching a given threshold who are demonstrated (including by ultimate outcome) not to require any intervention. This is more complex than might at first be apparent, since NICE has deemed it important to maintain a graduated warning scale, with a series of thresholds rather than an all-or-nothing trigger.

12.2 RECOMMENDATIONS

- a) Indicators in the scientific literature of frequent incidence of physiological disturbance prior to ICU admission should be regarded as pertinent to the Northern Ireland inpatient population.
- Each HSC Trust providing inpatient care should use the best performing PEWSS suitable for its population of patients. The scientific literature contains comparative work, albeit with limitations, which will assist in the choice of system.
- c) Following initial choice of PEWSS, rollout and demonstration (by audit) of appropriate use, service evaluation/audit is to be encouraged within each Trust to determine sensitivity and specificity of the scoring system in its population(s). Analysis and plot of such data (e.g. using the Receiver Operator Characteristic) should be used to set score thresholds which strike an acceptable and informed balance of workload/false alarms versus missed "at risk" patients.
- d) Thresholds should not be set to control "excessive" workload when the reason the workload is excessive is a deficiency in staffing levels; rather staff should be deployed in sufficient numbers and with appropriate skills on the basis of the number of patients at risk. Local audit/service evaluation and sensitivity and specificity analysis should help in the determination of what is necessary workload for patient welfare and what is excessive workload resulting from false alarms generated by the scoring system in use.
- e) Failure of a patient to breach a scoring system trigger threshold should not preclude early treatment or appropriate referral on the basis of clinical judgment alone. Referral/treatment algorithms should therefore facilitate clinical concern as a prompt for referral/treatment. However, it should be remembered that one of the problems in the literature which underpins the need for PEWSS seems to be deficiencies of clinical judgement so, whilst false alarms will frequently occur given the limitations of existing PEWSS, there should not be casual disregarding by junior clinicians of scores which breach warning thresholds.

f) It should be understood that, because of the limitations of scoring systems, a failure to predict or prevent deterioration in an individual patient does not necessarily indicate a deficiency in care. However, Trusts should consider whether failure to implement properly the PEWSS they choose might be perceived to be a deficiency of care, particularly if a patient were to suffer harm as a result.

Evidence of Quality	Target	Actual Achieved
 Time period between each threshold score reached and the next full set of observations is in accordance with Trust's PEWSS protocol/ guidance [C] 	100%	54.9%*

*% calculated from 257 responses, having excluded 18 responses which had already stated no threshold score was reached in the 24 hours immediately pre-ICU.

13.1 DETAILED RESULTS BY TRUST



Time period between Each Threshold Score Reached and the Next Full Set of Observations is in Accordance with Trust's PEWSS protocol/Guidance

Compliance with time interval (absolute numbers)	Overall Result (total n=257)	TO 1 (total n=6 1)	TO2 (total n=71)	TO3 (total n=52)	TO4 (total n=18)	TO5 (total n=55)
	n	n	n	n	n	n
Yes, on each occasion	141	15	44	31	11	40
No, not on each occasion	116	46	27	21	7	15

13.2 DISCUSSION

It is of concern that overall, following a threshold score being breached, repeat scoring did not occur within the timeframe given in local Trust guidance/protocol in 45.1% of patients subsequently admitted to ICU. Concern might also be generated by the apparent variation between Trusts on this issue – ranging from 75% of patients admitted to ICU in Trust 01 not receiving repeat scoring compliant with its guidance to 27% in Trust 05. However, examination of the PEWSS and response algorithms supplied by respondents reveals that some Trusts do not have a prescribed frequency of observations, instead leaving it to ward staff to decide. Hence Trusts which have a more stringent/prescriptive PEWSS algorithm may be expected to fall below their arbitrary standard more frequently than those with a less measurable/prescriptive practice.

It is not possible to conclude from the data generated by the audit whether these figures (i.e. overall and individual Trust figures) indicate suboptimal frequency of observations performed, or unrealistic guidance/protocol requirements, or a combination of the two. Caution in interpretation of Trust differences is also important since a few responders' comments suggested that they had deemed practice compliant with Trust guidance despite either the timings of observations being missing or the observations incomplete (i.e. in a small number of cases the responder did not follow the guidance provided for answering the question in a standardised manner). It is also important to understand that the audit standard was stringent in that a single occurrence of failure to conduct a full set of observations

within the required time period resulted in that patient being recorded as a failure of compliance. Although stringent, it was difficult to identify a suitable alternative audit standard without making the audit considerably more onerous e.g. by quantifying the magnitude and frequency of deviation from Trust guidance. Furthermore, this stringent standard was only applied to the 24 hour period immediately preceding ICU admission; and in individual patients, even a single clinically significant delay in repeating scoring could have adverse consequences. Future audits could look at this in more detail and apply a less stringent standard if they were more constrained in breadth of the area of interest.

13.3 RECOMMENDATION

All Trusts should review their protocols/guidance/algorithms to assure the clinical appropriateness of the required timelines for repeat scoring at score thresholds, or whether they should introduce such timelines. Following this, further similar audit should be conducted and the causes of any failure to meet the timelines should be identified and addressed. Steps should also be taken to ensure completeness of sets of observations and totalling of scores.

Evidence of Quality	Target	Actual Achieved	
14. Appropriate person contacted in line with Trust's PEWSS protocol/guidance for each of the following occasions a threshold was reached:			
a) Occasion 1	100%	92.7%*	
b) Occasion 2	100%	91.2%**	
c) Occasion 3	100%	90.0%†	
d) Occasion 4	100%	85.7%††	
e) Occasion 5	100%	86.1%§	
f) Occasion 6	100%	87.4%§§	
15 responses were excluded as they had already not indicated a threshold being reached.			

*calculated from 233 responses **calculated from 192 responses

†calculated from 160 responses ††calculated from 126 responses

§calculated from 101 responses §§calculated from 87 responses



14.1 DETAILED RESULTS BY TRUST

14.2 DISCUSSION

This element assessed the involvement of appropriate staff, as defined by locally set triggers. Up to 6 triggering occasions in the 24 hour period were assessed – if more than 6 occurred, the 6 closest to ICU admission were used.

Fifteen responses which indicated an action was taken in line with the PEWSS algorithm, but which had earlier not indicated that a threshold was reached, were excluded. (These respondents may have concluded for the purposes of this question that a PEWSS threshold was reached by summing or correcting the sum of PEWSS components).

Overall compliance with Trust guidance on whom to contact when a threshold is breached was relatively high, at around 90%. There may be a tendency for this compliance to fall off slightly with recurring breaches of score thresholds but, if this is the case, the effect seems modest. Hence compliance has been displayed averaged across all 6 occasions.

It is not possible to comment on the significance of changes/lack of changes in compliance over successive breaches of threshold score since no attempt was made to capture whether these successive breaches represented (a) instances of a progressively increasing score, which might be expected to prompt enhanced concern, perhaps increasing the compliance or (b) recurrences of the same score, which progressively might generate a degree of indifference in staff recording the score, if the patient did not appear to be deteriorating or if the staff contacted previously delivered no new intervention.

14.3 COMPLIANCE WITH TRUST PROTOCOL FOLLOWING MORE THAN 3 TRIGGERS



Appropriate Person Contacted in Line with Trust's PEWSS Protocol/Guidance

14.4 DISCUSSION

There appeared to be considerable variation between some Trusts, in that the compliance rate was noted to be 100% in the event of more than three triggers in Trusts 02, 03 and 05, whereas it ranged from 57% to 73% across Trusts 01 and 04. The numbers of responses in this category were relatively small and, as mentioned already, it is not possible to draw conclusions on the significance of this. However, there would be merit in further investigation of this area, since an important principle of acute care is getting the appropriate member of staff to review the patient, in order to ensure both that appropriate intervention is delivered and that it is delivered in an appropriate environment, and that each occurs in a timely fashion.

14.5 RECOMMENDATION

Each Trust should continue to review its guidance/protocol/algorithms to ensure that guidance on when appropriate categories of staff should be notified is appropriate. Following this, Trusts should aim to maximise adherence to their internal guidance. Data from this audit suggests that these may be issues for Trusts 01 & 04 in particular.

15. Action taken for each of the Threshold Scores reached



Pooled Trust data for each response prompted, over serial triggers:

Some respondents indicated Communication Only, but also recorded other actions taken. Displayed data has therefore been censored for such audit responses to ensure that it represents communication as the only action taken.



Occasion When Threshold Reached in 24 hours Prior to ICU Admission



Occasion When Threshold Reached in 24 hours Prior to ICU Admission



Occasion When Threshold Reached in 24 hours Prior to ICU Admission





15.1 DISCUSSION

This part of the audit was essentially service evaluation, designed to get an impression of what triggers were prompting – there was no "expected frequency" for the respective actions.

In approximately one quarter of instances (range 20-28% across repeat triggers) the triggers merely prompted communication, and this was in line with the Trust response algorithm. This element was not designed to measure compliance with the Trust response algorithm – the question was formed to get a sense of how often threshold breach *required* only communication, as deemed by Trust algorithms, and which was delivered (as opposed to *resulted* only in communication, independent of algorithm). This gives a qualitative impression of the sensitivity of the thresholds in use: if the number/fraction of triggers requiring only communication (that the patient was at risk) was very low, this would indicate that the PEWSS in use was not aimed at identifying at risk patients until the point when they require intervention. It might be argued that this would not give an early warning and patients could receive intervention later than would be the case if, e.g., communication were to occur that the patient required more frequent observations. However, the fraction observed where only communication was required does not seem low, and hence does not suggest that thresholds are set too high.

Intuitively it seems encouraging that treatment changes were prompted by threshold scores in around half of cases (range 40-55% across Occasions 1 to 6) - a low

frequency might suggest that the thresholds could be set too low but this part of the audit was not designed to assess whether treatment alteration should/should not have occurred. Respondent comments show that involvement of critical care staff and/or admission to ICU/HDU were prompted in multiple (\geq 32) cases by PEWSS triggering, and presumably these form a proportion of the Calls for Help which PEWSS triggers prompted. Calls for Help are differitated from Communication only in that the latter were those occurring only within the usual ward-based team, whereas the former were calls beyond this team to include, e.g., critical care unit staff.

A new treatment plan was also prompted in a substantial number of patients (29-48% across Occasions 1 to 6). It is possible that some of these new treatment plans represented decisions to put in place "Do not attempt resuscitation" orders (DNAR), or decisions not to escalate therapy. Respondent data in the next question demonstrate that breaching of PEWSS thresholds prompted review of resuscitation status not infrequently.

In general, for each of the types of action, there was no significant change in the frequency of action taken when serial triggering occurred. However, there did appear to be a modest progressive reduction in treatment changes with subsequent triggers. There may also be a reduction in the frequency of changing of the overall treatment plan after the first trigger. It is of interest to note specifically that, after the first trigger (in the data sample, which may not have been the first trigger in a given patient), subsequent triggers did not result in a reduction of the frequency of communication as the only action prompted. This might be misinterpreted as an indication of a level of triggering which is unlikely to influence patient outcome, since no treatment response appears to have been prompted at ward level. However, all of these patients were subsequently admitted to the critical care unit. Hence it is not legitimate to conclude that no therapeutic action was taken.

It is assumed, on the basis of experience, that alteration of PEWSS thresholds occurred to reduce workload or to prevent what was perceived would be repeated "false alarms." Upwards alteration of PEWSS thresholds in individual patients would suggest that those altering the threshold perceive that the threshold is set inappropriately low for each of those patients. This may or may not be the case in reality. It is possible that some groups of patients may trigger repeatedly on a given physiological parameter which does not indicate acute deterioration or a need for intervention (e.g. those with a non-acute neurological deficit). However, given that the purpose of PEWSS triggers is to highlight at risk patients (whose severity of illness and need for prompt intervention has often in the past not been recognised by bedside staff), there is a risk that alteration of trigger thresholds in individual patients may undermine the risk reduction function of PEWSS.

15.2 RESULTS BY TRUST - RESPONSES TO FIRST 2 TRIGGERS IN DATA SAMPLE:



Proportions are not mutually exclusive ie >1 action may have been taken on the same occasion, so percentages sum to > 100%.

Some respondents answered (a) communication only, but also recorded other actions taken in (b) to (e). Data for communication only has therefore been censored for such responses to ensure that it represents communication as the only action taken.

In the calculation of percentages, the denominator is the number of times a threshold for action was reached for that occasion ie for occasion 1, it is the sum of the yes and no responses to each occasion in Question 14. Fifteen responses which indicated an action was taken in line with the PEWSS algorithm, but had earlier not indicated that a threshold was reached, were excluded. (These respondents may have concluded that a PEWSS threshold was reached by summing or correcting the sum of PEWSS components).



15.3 DISCUSSION

The pattern of variation between Trusts did not differ significantly across Occasions 1 to 6. Hence for reasons of brevity and clarity, only individual data for the first two Occasions are displayed. Caution is advised in interpretation of variation between Trusts, given the possibility of differences in patient population and lack of knowledge of superiority/ inferiority (if any) of one algorithm over another in the respective populations. Nonetheless, Trust 04 does seem to stand out from the others in the relatively high proportion of triggers which prompted communication only. There is also considerable variation between Trusts in the practice of alteration of PEWSS thresholds in individual patients, ranging from a relatively high incidence in Trust 04 (of the order of 40%) to a zero incidence in Trust 01.

15.4 RECOMMENDATION

Alteration of PEWSS thresholds in individual patients should not be done lightly, or by inexperienced staff. Prospective identification of groups of patients who will trigger inappropriately is encouraged, such that PEWSS triggers can be optimally set. Best practice would be conduct of validation work to facilitate setting of appropriate thresholds for groups of patients, rather than practice *ad hoc* alteration of thresholds for individual patients.

A DNAR order or a documented decision not to escalate therapy should be considered in individual cases as potentially a superior means to deal with "false alarms" than resetting threshold scores, particularly if the DNAR/non-escalation decision would render ongoing PEWSS monitoring unnecessary.

As one element of setting appropriate trigger thresholds and/or response algorithms, Trusts may find it useful to include monitor/review of the proportion of prompts for communication only.

16. Organ Systems for which Action/Treatment occurred (in line with Response Algorithm)



Pooled Trust data – Intervention Frequency among all prompts for action:

The denominator in the calculation of percentage is the number of questionnaires which indicated a threshold was reached for action beyond communication only. Percentages sum to >100% since more than one may have been prompted simultaneously.

16.1 DATA AS PRESENTED AS ABSOLUTE NUMBER OF INTERVENTIONS:





Organ Systems for which Action/Treatment was given in Line with Response Algorithm

16.2 DISCUSSION

This section also was service evaluation in nature i.e. there was no expected standard to be met. Nonetheless, it is important to get a sense of what forms of treatment (as determined by response algorithm) were prompted, and how frequently each was being prompted. Any responses which had already indicated that no PEWSS thresholds had been reached were excluded, as the intention was only to assess those interventions prompted by PEWSS.

Interventions to support adequacy of oxygenation and/or breathing were the most common, closely followed by those to maintain blood pressure and circulation. Respondent comments show that treatment directed at more than one system was not uncommon. Urinary catheterisation and/or treatment of low urine output was more common than the impression given in some of the published scientific literature.^{9,11,21}

Data is also presented as absolute numbers of interventions so that individual Trusts can look at the relative frequency of the interventions within their organisation and compare the breakdown with the overall relative frequency. Since the number of questionnaires returned differed between Trusts, in general, it is not helpful to compare absolute numbers between Trusts. However, PEWSS prompted 60 instances of review of resuscitation status and, even allowing for differing numbers of questionnaires returned, there appeared to be very disparate practice between Trusts in this regard. Note that Trust 03 carried out such review in more patients than all the other Trusts combined.

Respondents listed a wide range of other interventions. It is not clear (and unlikely) that these would all have been prompted by a local/Trust PEWSS response algorithm, as suggested in the question. The more common other actions/treatments were antibiotics, investigations, and addressing of analgesic issues.

However, respondent comments suggest that PEWSS triggers did prompt further investigation and some broader aspects of good care which might not be part of existing response algorithms, including addressing of spiritual needs.

16.3 RECOMMENDATION

Trusts should examine whether they are maximising the opportunity presented by PEWSS triggering to review resuscitation status of ill or deteriorating patients.

Evidence of Quality	Target	Actual
 Organ System-directed action/treatment that did not occur which should have occurred, according to either Site Algorithm or ALERT[™] practice. [C, D] 	0%	3.4%*



17.1 DISCUSSION

Given the number of patients in the audit, failure to comply with response algorithms does not appear to be a problem of the same magnitude as those identified in performing PEWSS monitoring and documentation. Of 271 returns indicating that a threshold for action was met, there were 39 instances (in 27 patients) where action was not taken in line with the site algorithm, and even less where it was not taken in line with ALERT[™]. Note, however, that deficiencies in monitoring which have already been highlighted suggest that there may be further patients in whom ALERT[™] (or sitedriven) treatments should have occurred, but the need was not detected.

The commonest reported deficiency in complying with both Trust response algorithms and ALERT[™] practice was failure to review resuscitation status of the patient. This seemed to be a problem of disproportionate magnitude in Trust 04, given the size of the sample provided by that Trust (9 occurrences in 27 responses, compared to 14 of 271 responses across Northern Ireland). A similar pattern was observed in instances of failing to comply with ALERT[™] guidelines. There appears also to be opportunity in several Trusts to improve compliance with response algorithms in the context of monitoring of urine output and/or treatment of oliguria.

There were only 4 instances where deviation from ALERT[™] practice was recorded in the absence of deviation from site algorithm, whereas there were 21 instances of deviation from site algorithm in absence of deviation from ALERT[™] practice. Possible explanations for this include (i) site algorithms may be deemed by respondents to be more aggressive than ALERT[™] practice, (ii) respondents were more familiar with local algorithms than with ALERT[™] and therefore under-reported deviation from ALERT[™] practice. Whatever the explanation, it rendered separate analysis (of deviation from each) to be of no practical value.

17.2 RECOMMENDATION

All Trusts should assure through appropriate process, and audit that the opportunities presented by PEWSS triggering to review resuscitation status and document timely treatment decisions, including palliation, are taken advantage of for the benefit of patients.

18. Patient Improvement prior to ICU admission (across Northern Ireland) when PEWSS Thresholds for Action reached repeatedly



Patient Improvement (NI) When Thresholds for Action Reached Repeatedly



Patient Improvement for Repeated Score Thresholds Reached

18.1 DISCUSSION

The purpose of this section was to get a general sense *among ICU admissions* of whether in Northern Ireland patients who trigger PEWSS repeatedly at ward level improve, or do not improve, prior to ICU admission. Factors which may impact on this include the levels at which PEWSS triggers are set, the effectiveness of the responses prompted, whether or not responses are delivered at all/in a timely fashion, and the rapidity of admission to the critical care unit.

The data show that in less than a third of cases of patients breaching PEWSS triggers and admitted to ICU was there improvement at ward level prior to ICU admission. Spontaneous improvement was a relatively rare event (1% overall), possibly suggesting (but not demonstrating[†]) that PEWSS intervention thresholds are not set too low.

[†] It is possible that a higher proportion of patients who did not require ICU admission breached triggers at ward level and improved spontaneously. It is also possible that staff are being called to patients in whom intervention could not be expected to produce clinical improvement eg those who either have a chronic, stable physiological disturbance, or those who are in an irreversible terminal decline. Triggers in the former example could constitute false alarms; in the latter example, PEWSS triggers may usefully prompt timely review of resuscitation status and improved palliative care. The fact that all patients in this audit were deemed suitable for ICU admission presumably shows that they were deemed by experienced clinicians not to be clearly in terminal decline.

It should be remembered that all patients in this audit sample were admitted to the critical care unit, and the audit was therefore not designed to answer the question of whether thresholds were set appropriately, since patients who were not admitted to the ICU/HDU were not included. It is possible that many of these improved following response algorithm-directed intervention (avoiding the need for admission to a critical care unit), or were deemed not to benefit from more aggressive intervention.

The report that two thirds of patients did not improve should be interpreted with caution – this refers to failure to improve at ward level but (as indicated by respondent comments) does not preclude the possibility of subsequent clinical improvement e.g. following appropriate management in critical care +/- surgery. Nevertheless it does give an indication of a substantial number of patients who trigger and who cannot be improved with appropriate timely ward intervention alone, or are not getting such intervention, or are being admitted to a critical care unit rapidly and getting such intervention there.[§] The latter could occur if PEWSS thresholds are set too high, or because algorithm-directed responses are not effective at preventing ICU admission/death. Audit data presented earlier (Q17) does not support another potential contributor – failure to comply with the response algorithm – being a major factor.

Considerable variation between Trusts is noted regarding pre-ICU improvement: in Trusts 01 and 03, 96% and 87% respectively of patients admitted to ICU showed no improvement at ward level prior to ICU admission, whilst the corresponding figure for Trust 04 was 26%. Higher levels of non-improvement at ward level could reflect excellent patient selection for critical care (if patients benefit from critical care admission), poor patient selection for critical care (if patients do not subsequently survive to hospital discharge), or ineffective ward level care. It is beyond the scope of this audit to discriminate between these possibilities.

§ Audit data in the next section indicate that this last explanation is not applicable here.

18.2 RECOMMENDATION

PEWSS audit/service evaluation/research could usefully be conducted among ward patients not admitted to ICU, as well as those who are, to determine the proportion of patients responding/not responding to algorithm-prompted (and other) wardbased interventions. Trusts should review their PEWSS processes both pending and subsequent to such audit, in order to ensure that patients are not receiving suboptimal care.



Responses were excluded if the respondent had already indicated zero thresholds for action reached; those who did not respond to this question were also excluded from the denominator used in calculations.



Length of Time Repeated Thresholds for Action Existed by Trust

19.1 DISCUSSION

The aim of this element was to gain an impression of the duration of physiological disturbance present prior to ICU admission.

Overall, it seems encouraging that almost half of patients admitted to ICU did not remain at ward level with ongoing triggering of PEWSS thresholds for more than 4 hours. However, since we did not attempt to collect data in patients who died prior to ICU admission, it cannot be concluded that PEWSS is functioning as intended. Furthermore there was considerable variation between Trusts.

More than one quarter of the sample of patients admitted to ICU across Northern Ireland had shown evidence of significant physiological disturbance for greater than 12 hours prior to ICU admission. However, it is important to note that aggregate weighted scoring systems are recommended by NICE, and used in all Trusts in this audit. Therefore breaching of some thresholds should not necessarily prompt early admission to critical care. (See 19.3 for more data on this issue). In Trust 03, approximately half of the patients admitted to ICU had protracted deranged physiology (43% for 12-24 hours, plus 8% for >24 hours). A relatively high proportion was also noted in the Trust 01. This would seem to exclude rapid admission to critical care as one of the potential explanations given in the previous section (18.1) for why high proportions of patients in these two Trusts did not improve prior to ICU admission. Inappropriately delayed admission to critical care is known to be associated with adverse ultimate clinical outcome. However, another possible explanation is that PEWSS thresholds in these Trusts are set relatively low, and that PEWSS is not fulfilling/intended to fulfill a discriminatory function in terms of need for ICU admission. In order to investigate this possibility further, it would be desirable to assess the length of time that repeated thresholds for action existed in patients not admitted to ICU, in addition to amongst those who are.

A further factor, which could impact on protracted repeat triggering at ward level, is critical care bed availability. It is possible that ward/critical care clinicians desired that some of these patients remained for a shorter period of time on the

general ward than occurred but high occupancy of/delayed discharge from critical care beds precluded earlier ICU admission.

19.2 RECOMMENDATIONS

- Regional PEWSS audit among patients who die without admission to critical care should be conducted to determine whether or not there is room for improvement in scoring/algorithm responses which could impact favourably on potentially avoidable deaths, or on provision of palliative care.
- b) It would be useful for future audits/service evaluations to look more closely at those who breach PEWSS intervention thresholds for more than 12 hours to determine the nature of the physiological disturbance and whether, e.g., this group has chronically altered parameters (e.g. relating to long-standing co-morbidity). Given that there was substantial variation between Trusts in the proportion of patients with protracted physiological disturbance (ranging from 5.6% to 49%), such audit would seem to be a greater priority in some Trusts than in others.
- c) Further Trust-specific PEWSS audit should be encouraged to assess the duration of persistence of breaching of PEWSS thresholds among patients not admitted to a critical care unit (in addition to those who are). This would help Trusts determine if it is their PEWSS thresholds or the quality/timeliness of their treatment which need to be altered.
- d) All Trusts should ensure that any problems related to timely access to critical care unit beds are identified and addressed. Adequate numbers of staffed critical care beds is obviously important, as is best use of currently funded beds. The regional Critical Care Network in Northern Ireland (CCaNNI) has identified that patients fit for discharge from critical care frequently have discharge delayed/prevented because they have to compete for ward beds with elective admissions and with patients being admitted to general ward beds from A&E departments. In order to address this, CCaNNI generated a regional Policy which has been formally adopted by all 5 HSC Trusts.^{xxx} Trusts should measure and assess compliance with this policy in order to minimise risk to ward patients who require timely admission to critical care units.



19.3 Threshold for action reached repeatedly was one which, according to Trust/ site algorithm, should prompt immediate ICU referral

Percentages calculated following exclusion of those had already indicated zero thresholds for action reached; those who did not respond to this question were also excluded from the denominator used in calculations.

19.4 DISCUSSION

This question aimed to assess the nature of the thresholds for action which were triggering repeatedly, rather then whether or not timely ICU referral occurred. Hence there is no target.

Overall, it might seem reassuring that immediate referral to ICU was deemed appropriate by the response algorithm in only 2 patients out of 10 who triggered repeatedly. In theory, this would mean that detection was usually (ie in the remainder) sufficiently early that an opportunity was provided to improve the patients' condition, and potentially avoid the need for admission to critical care. However, review of submitted Trust response algorithms demonstrates that many do not explicitly require referral to critical care, some suggesting merely that this is considered. Hence, only limited conclusions can be reached from this question's data on the level of physiological disturbance at which patients were triggering repeatedly.

19.5 RECOMMENDATION

Further audit should be encouraged which looks in detail at (i) the appropriateness or otherwise of protracted repeat triggering in the ward settings concerned (ii) best use of discriminatory capability of PEWSS by best choice of triggers, including in the context of repeat triggering, and (iii) the utility and effectiveness of algorithmprompted responses to repeat triggering.

Evidence of Quality	Target	Actual	
20. Identified areas of concern, in terms of clinical management not being consistent with ALERT™ practice [D]	Zero%	15.7%*	
*This figure represents a fraction of 286 patients who triggered. More than one deviation from ALERT [™] practice may have been identified in a given patient, but this will not be reflected in the percentage, as a patient was included in the numerator if any deviation from ALERT [™] practice prompted concern in the audit respondent.			



Proportion of triggering patients in whom response fell short of ALERT ™ standard



Number of ALERT [™] management concerns/patients with same

Total number of concerns identified

20.1



Specific Areas of Concern: Clinical Management v ALERT ™ Practice

20.1.1

Specific Areas of Concern: Clinical Management v ALERT [™] Practice



20.2 DISCUSSION

Overall, the percentage of patients who had met a triggering threshold prior to ICU admission and whose clinical management was deemed to fall short of the audit standard was of the order of 16%, which suggests some room for improvement. Numbers are small within each Trust, so caution should be exercised in comparing between Trusts, even having allowed for differing numbers of returns. Nonetheless, Trust 04 reported the greatest number of concerns (44, amounting to 45% of all concerns in the Northern Ireland sample), whilst at the same time having provided the smallest number of returns. The level of practice reported by Trust 04 as falling short of the audit standard therefore seems disproportionate, and is worthy of further investigation/action.

When concerns are broken down into specific aspects, numbers are much too low to permit valid comparisons between Trusts. Hence only absolute numbers of specific concerns for the region are presented for comparative purposes; breakdown of specific areas of concern within each Trust are included for the benefit of the Trust, rather than for comparative purposes. Where concerns were expressed/identified, the commonest (n=19) related to delay in communication of the at-risk nature of the patient to the appropriate staff. The next two most common concerns were failure to document the patient instability, and suboptimal treatment plan. One might speculate that some reported concerns could be inter-related. For example a factor common to several might be a view of bedside staff that there was no real cause for concern; alternatively, if a limited number of staff find themselves with multiple tasks/duties, PEWSS process may not be followed if it is not prioritised over other tasks.

The possibility of several concerns being related raises the further possibility that addressing some may further expose the extent of problem in relation to others. For example, if communication improved, there may be a consequent rise in detection of the absolute number of instances of sub-optimal therapeutic response. Hence, care should be taken to address all the deficiencies identified by this audit so that a decrease in one area of concern does not increase another.

20.3 RECOMMENDATION

- a) Trusts should review PEWSS processes to ensure they are both feasible and implemented. This will likely require an assessment of staff levels and workload, and explicit determination of priorities within that workload.
- b) Individual Trusts should satisfy themselves that their staff are appropriately trained in good practice with respect to identification and early treatment of patients exhibiting evidence of acute potentially life-threatening events. This may be a particular issue for Trust 04.

Evidence of Quality	Target	Actual	
 In patients triggering PEWSS, deviation from ALERT[™] principles contributed substantially to adverse patient outcome 	Zero%	2.8%**	
*Adverse outcome includes potentially avoidable: ICU/HDU admission, organ dysfunction, cardiac arrest, mortality **Denominator is number of responses to this question minus those which already indicated 'zero' threshold scores in 24 hrs prior to ICU admission and minus responses indicating "N/A" to this question (289-40-35=214)			

EXPRESSED AS A PROPORTION OF PATIENTS TRIGGERING A PEWSS THRESHOLD:

Deviation from ALERT principles contributed substantially to an adverse patient outcome



Many respondents who had already reported that there had been no deviation from ALERT™ practice answered this question "No"

21.1 EXPRESSED AS A PROPORTION OF THE SUBSET OF 44 PATIENTS IN WHOM THERE WAS A DEVIATION FROM ALERT™ PRACTICE:





21.2 DISCUSSION

This was a challenging question to answer, one which required professional competence and integrity, as well as courage on the part of the organisations to have it answered in a regional audit. All Trusts should be commended in this regard.

In six patients in the total sample, it was stated with confidence by a healthcare professional that suboptimal practice contributed substantially to an adverse outcome. This was reported to be the case in only two of five Trusts. There were a further four patients in the overall sample in whom it was felt that suboptimal practice *may* have contributed to an adverse outcome. Three of these four patients were in the same two Trusts as those where a contribution to adverse outcome was reported with confidence. Given data which has appeared in the literature previously highlighting suboptimal medical management prior to ICU admission, and the scale of its adverse effect on outcome, the figures in this audit are relatively reassuring. However, the figures can be considered in various ways – when considered as a proportion of those patients in whom there was a deviation from ALERT[™] practice, the likely adverse consequences of such deviation become more apparent. Furthermore, there is no room for complacency as the audit did not assess quality of care or outcome on the wards among patients who did not reach the ICU.

There are at least two possible explanations why respondents may not have answered this question: (a) they may have felt no need to answer it if there had been no deviation from ALERT[™] practice – the proforma allowed a "Not Applicable" response to this question if there was no adverse outcome, but did not carry a "No deviation from ALERT[™] practice" option, (b) there may have been deviation from ALERT[™] practice but respondents were either unsure or unwilling to state causality – four volunteered that they were unsure but "unsure" was not a solicited response and additional comments (beyond the four) suggest more may have been unsure of causality.

The numbers of instances where deviation from ALERT[™] principles was deemed to be clearly contributory to adverse outcome was sufficiently low as to render inter-Trust comparisons unhelpful. There is also a need to recognise the possibility that staff in some Trusts might have had more confidence in attributing harm caused than staff in other Trusts, or that records were insufficiently complete to allow such a conclusion. Hence a degree of under-reporting could have occurred.

21.3 RECOMMENDATION

A relatively low detection rate in this audit of harm as a consequence of deviation from best clinical practice should not be allowed to result in complacency. This is particularly the case in this audit as only patients who survived to reach critical care were assessed. As part of standard quality assurance, Trusts should endeavour to maximise detection of deviation from best practice, assess any associated harm and, where necessary, change procedures, staffing levels, training and skillmix to minimise harm. Utilisation of suitable audit tools is essential to such a process.

CLOSING COMMENT

The best-performing PEWSS are still lacking in discriminatory power. Hopefully better scores will be developed, and validated in the context of serial scoring. It seems likely that improvement of discriminatory performance is likely to require electronic data capture and weighting of risk. In the meantime it is incumbent on all institutions managing acutely ill inpatients to select the best scoring system to meet their patient population's needs, continually audit its use and, ideally validate it in its local population of patients, setting/resetting thresholds (on the basis of adequate local data) which strike an acceptable balance between excess false alarms and sensitivity in identifying at risk patients. Until better performing scores emerge, there will inevitably be a trade-off between acceptable workload (including that due to false alarms) and maximising the identification of at-risk patients.

ADVISORY STATEMENT

Data should not be extracted from this audit (or quoted for other purposes or extrapolated) in a manner inconsistent with the commentary recorded within it, including the limits of confidence surrounding interpretation.

ACKNOWLEDGMENTS & THANKS

Project Lead

Dr John Trinder, Consultant Anaesthetist, South Eastern HSC Trust

Chief Executives of the 5 HSC Provider Trusts

Local auditors who assessed charts and provided returns from each Trust: E Magee, E Welch, B Carson, U McCollum, L Fields, D Hughes, M McNally, M Donaghy, K Baxter, S Pullins, J McCormick, F McErlean, E McAlea, B Burnside, C Clarke, M Lennon, P Fearon, J Lutton, D Connolly, A Quinn. In addition we wish to record our gratitude to members of the audit departments in all 5 Trusts for their assistance. ICU Lead Clinicians: Drs S Austin, R Bailie, M Brady, C Clarke, M Cody, P Glover, M Kelly, B McCloskey, M Reid, C Watters Jennifer McGaughey, PhD student, Queen's University Belfast.

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APPENDICES

Appendix 1:	Strand 1 Audit Tool	106
Appendix 2:	Strand 2 Audit Tool	115
Appendix 3:	Help Notes	130

APPENDIX 1

(Note that for presentational reasons, the main text numbering differs from this questionnaire, and Question 6 was deleted)





PHYSIOLOGICAL EARLY WARNING SCORING SYSTEMS ORGANISATIONAL QUESTIONNAIRE

Completed by:	Telephone number:
Trust ID Code:	Hospital ID Code:

Please respond to each question in terms of the position in November 2007.

In addition to assessing the position in 2007 we would also like to capture any changes that have been made to your PEWSS/algorithm during the period November 2007 to date. This should be recorded in the right hand column.

J de anice be cho ho hu ticline the india. 2

Please indicate your answer by ncking the appropriate box and using the spaces allocated for comme	1
GENERAL	Please indicate any changes that have been made to your PEVVSS/algorithm since Nov 07.
Q.1 Do you have a physiological early warning scoring system (PEWSS) in use within your Trust?	
N	
Q.2 Please indicate which group/s of staff input information into the PEWSS.	
Medical Nursing Healthcare Assistants	
Other, please indicate:	

GENERAL	Please indicate any changes that have been made to your PEWSS/algorithm since Nov 07.
Q.3 Please indicate which group/s of staff respond to the scores generated by the PEWSS.	
Medical Nursing Healthcare Assistants	
Other, please indicate:	
Q.4 Please indicate within which clinical areas the PEWSS is used.	
Medical in-patients	
ICU Obstetrics Deediatrics	
Elderly Care Other	
If other please indicate:	
Q.5 Please indicate any clinical areas, within the acute hospital setting, where the PEWSS is not used.	
Q.7 Please indicate any areas where the PEWSS and the routine physiological observational charts have been integrated.	
Q.8 Please indicate any clinical areas where the PEWSS runs in parallel to existing observational charts (i.e. duplication of the recording of physiological observations).	

GENERAL	Please indicate any changes that have been made to your PEWSS/algorithm since Nov 07.
 Q.9 Please indicate if you have a policy/guideline or protocol on the use of PEWSS in place within your Trust. Yes 	
TRAINING	
 Q. 10 Please indicate if nursing staff receive training on the use of PEWSS. Yes \begin{bmatrix} \lambda \be	
Q. 11 Please indicate if medical staff receive training on the use of PEWSS. Yes No Yes, please indicate at what point/s they receive this training: During undergraduate/pre-registration training During corporate/Trust induction As part of ongoing on-the-job training Other If other please indicate During	

GENERAL		Please indicate any changes that have been made to your PEVVSS/algorithm since Nov 07.
 Q.12 Please indicate if Health Care Assistants receive training on the use o Yes Yes If yes, please indicate at what point/s they receive this training: During corporate/Trust induction As part of ongoing Other If other please indicate 	of PEWSS ng on-the-job training	
 Q 13 Please indicate if any other health care professionals (HCP) receive th of PEWSS Yes Yes If yes, please indicate which other HCP receive training: If yes, please indicate at what point/s they receive this training: During undergraduate/pre-registration training During undergraduate/pre-registration training As part of ongoing on-the-job training If other please indicate: 	training on the use borate/Trust induction	

GENERAL	² lease indicate any changes that have been made o your PEVVSS/algorithm since Nov 07.
Q.14 Please indicate if staff receive any refresher courses or training updates on the use of PEWSS.	
Yes No	
If yes please indicate how often staff receive refresher/update training:	
Nursing	
Medical	
Health Care Assistants	
Other HCP	
PEWSS	
Q.15 Please indicate which of the following parameters are used to generate a score which contributes to the total PEWSS score (please do not include parameters which may be measured and recorded simultaneously on the same chart but which do not contribute to the PEWSS score).	
Respiratory rate Pulse/HR Conscious level	
Urinary output 5 SpO2 Temperature	
Blood pressure	
Systolic	
Mean	
Other, please indicate:	

PEWSS	Please indicate any changes that have been made to vour PEVVSS/algorithm since Nov 07.
 Q. 16 Please indicate the maximum / total score that can be achieved on your Trust's PEWSS. (Highest total score including all parameters that could generate a score) (Please include a copy of your Trust's PEWSS chart with this questionnaire) 	
Q.17 Please indicate below which scoring system(s) you use to measure consciousness level (e.g. Alert, response to voice, response only to pain, unresponsiveness (AVPU), Glasgow coma score (GCS)).	
Q.18 Please indicate if the PEWSS generates an action protocol/response algorithm.	
 Q. 19 Please indicate if the protocol/response algorithm differs from CREST guidelines. Yes Yes, please indicate how the protocol/response algorithm differs from CREST guideli (Please provide a copy of your Trust's PEWSS protocol/response algorithm) 	ŝ
If yes, please indicate if this deviation is due to a limitation in staffing in relation to: Ward nursing staff Ward medical staff ICU nursing staff ICU nursing/outreach staff ICU medical staff Other	

PEWS	SS	Please indicate any changes that have been made to your PEVVSS/algorithm since Nov 07.
	If other please indicate:	
	Please indicate if there are any other reason(s) other than above for deviation from CREST guideline requirements.	
Q.20	 Please indicate if the response (by algorithm) to PEWSS is affected by duration of time that a score remains at a particular level. Yes 	
Q.21	 Please indicate if the response algorithm involves (at any level of score). *please tick all that apply Ward nursing staff	
Q.22	 2 Please indicate if any hospitalised patient groups are excluded from PEWSS. Yes Mo If yes, please indicate which patient groups are excluded: 	

GEN	IERAL	Please indicate any changes that have been made to your PEWSS/algorithm since Nov 07.
Q23	8 Please indicate if you use alternative component score (e.g. heart rate, respiration rate) thresholds to generate score for particular patient groups . Yes	
	If yes , please indicate which patient groups.	
	If yes, please indicate which physiological parameters have alternative thresholds.	
	E.	
Q.21	4 Please indicate if regular audit activity occurs in the use of PEWSS within your Trust. Yes	
	If yes , please indicate if the Trust would be prepared to provide information in relation to the problem cause analysis and action planning that results from this audit activity. Yes	

AUDIT	Please indicate any changes that have been made to your PEWSS/algorithm since Nov 07.
OVERALL	
Q.25 CREST guidelines were established to define minimum standards for PEWSS. Please indicate any areas of your Trust's approach to the use of PEWSS, which you believe improves the system beyond these minimum standards.	
Q.26 If as a result of RPA your hospital/site has adopted the PEWSS/algorithm of another site please indicate which site(s) applies in the box below.	

If you have any queries in relation to completion of the questionnaire please do not hesitate to call.

May I take this opportunity to thank you for completing this questionnaire. Please return in the enclosed freepost envelope.







Patient audit number []

REGIONAL AUDIT OF PHYSIOLOGICAL EARLY WARNING SCORING SYSTEM (PEWSS) IN ACUTE HOSPITALS

Strand 2: PEWSS Chart Audit

Trust ID Code:	Completed by:	
Hospital ID Code:	Telephone number:	

The following information is based on the 24 hour time period prior to the patient's admission to ICU.

Please indicate your answer by ticking the appropriate box and use the spaces allocated for comment.

1. Please indicate from which clinical area the patient was admitted to ICU.

	Please tick
Medical Ward	
Surgical Ward	
Accident & Emergency	
Obstetrics	
Elderly Care	
Other, please indicate:	

2. Strand 2 of this audit is restricted to patients admitted to ICU from areas where PEWSS is used, therefore it is expected that all patients will have a PEWSS chart completed. Was a PEWSS chart completed for this patient?

Yes	No	Comments			

If no, please indicate the reason for this if known and **include this patient in the returns from** your Trust/site.

If yes, please continue with the following questions.

3. Are the following documented on PEWSS chart?

	Yes	Νο	Comments
a) Patient's hospital number			
b) Surname			
c) First names			
d) Date of birth			

4. Do the patient notes/observation chart clearly indicate how often observations are **supposed** to be carried out?

Yes	No	Comments

If yes, were observations carried out in accordance with the agreed frequency?

Yes	No	N/A	Comments

5. Have a full set of parameters comprising PEWSS been completed/recorded at least 12 hourly in the last 24 hours?

Yes	No	Comments	

6. Have the following been documented on the PEWSS chart in the last 24 hours?

	Yes	No	Comments
a) Time of all sets of observations			
b) Date of observations			

7. Are there any unplanned gaps in sets of observations in the 24 hours prior to ICU admission?

Yes	Νο	Comments			

8. Have all parameters been completed within *each set* of observations, in line with your Trust guidance and training for completion, in the previous 24 hours prior to admission to ICU?

Yes	No	Comments

9. What parameters were recorded and how often were these recorded in the last 24 hours?

Parameter	Example Temp	Conscious Level	Systolic Blood Pressure	Pulse/ Heart Rate	Temp	Respiratory Rate	Other	Other
Number recorded in last 24 hours	6							
Comments								

10. Was each parameter allocated to the correct scoring zone for all sets of observations?

Yes	No	Comments

If no, please indicate broadly (eyeball) what percentage of entries were allocated to an incorrect zone?

Less than 10%	10% - 50%	Greater than 50%

11. Was the total score for each set of observations calculated correctly in the 24 hours prior to ICU admission (i.e. either wrong zone or maths error)?

Yes	No	Comments			
, please	e indicate	how many scores were	Incorrect	Missing	

If no, please indicate how many scores were incorrect or missing?

Incorrect	I
/ Total	1
Ioiai	

Total

12. How many times did the PEWSS score reach a threshold for action in the last 24 hours?

No. of times	Comments
If no threshold a of any kind wa	scores for action were reached please describe how the patient's need for action s recognised in the absence of a threshold score.

13. Was the *time period between* each threshold score reached and the next full set of observations, in accordance with your Trust's PEWSS protocol/guidance?

Yes, on each occasion	No, not on each occasion	Comments

14. Please indicate below for each occasion a threshold score was reached, whether the appropriate person was contacted in line with your Trust's PEWSS protocol/guidance? (If more than 6 occasions please detail those that occurred closest to the time of admission to ICU)

	Occasion 1	Occasion 2	Occasion 3	Occasion 4	Occasion 5	Occasion 6
Yes						
No						
Comments						

15. For each of the threshold scores reached above, please detail the action taken. (Please tick all that apply)

	Occasion 1	Occasion 2	Occasion 3	Occasion 4	Occasion 5	Occasion 6
In line with algorithm, communication only						
Treatment changes						
Change in PEWSS threshold						
New treatment plan						
Call for help						

16. Please indicate systems for which action/treatment was given in line with response algorithm.

	Please tick all that apply	Comments
Conscious level / Airway		
Oxygen / Breathing		
Cardiovascular		
Catheter /		
Urine output measurement /		
Action in response to oliguria		
Review of resuscitation status		
Other (please detail):		

17. Please indicate any systems where the action, which should have occurred according to either site algorithm or ALERT® practice, did not occur.

	Please tick here if deviation from site algorithm	Please tick here if deviation from ALERT® practice	Comments
Conscious level / Airway			
Oxygen / Breathing			
Cardiovascular			
Catheter / Urine output measurement / Action in response to oliguria			
Review of resuscitation status			
Other (please detail): e.g. Patient put on palliative care pathway			

18. If score thresholds for action were being reached repeatedly, please indicate (tick) if the patient ...

Improved* spontaneously OR	[
Improved* following intervention	[
Did not improve		

Please tick Comments

*i.e. subsequent reduction in score

19. If score thresholds for action above increased frequency and communication within ward nursing team were being reached repeatedly, please indicate how long that situation existed.

0-4 hours	4-8 hours	8-12 hours	12-24 hours	>48 hours	Other

Was the threshold for action reached repeatedly above one that should have prompted immediate ICU referral according to your Trust/site algorithm?

Yes	No	Comments

20. List any areas of concern in terms of ALERT® management for the care of this patient under the following categories?

	Please tick all that apply	Comments
Evidence of failure to assess		
Timeliness of request for assistance (at any level)		
Documentation of patient instability		
Identification of cause of instability		
Care management / treatment plan		
Investigations		
Failure to determine resuscitation status		
Appropriateness of escalation of therapy		

We encourage you to provide any supporting information that you feel is relevant to this section in this space provided.

21. Do you consider deviation from ALERT® principles, contributed substantially to adverse patient outcome?

	Yes	No	N/A = No adverse patient outcome Adverse outcome includes potentially avoidable: ICU/HDU admission, organ dysfunction, cardiac arrest, mortality
22.	Please	provide a	ny additional comments in the space provided below.

Thank you for completing this data proforma.

Please return in the freepost envelope.



HELP NOTES) notes	alidated indicator of the severity of a ent's condition used to prompt the Ilation of observations and/or tment. Also known as 'Modified Early ning Score' (MEWS).	^F who carry out observations, input Its onto PEWSS charts and total the es.	f who respond to threshold scores that ire intervention with appropriate nges in clinical management.
ING SYSTEMS IAIRE	Completed by:	Telephone number	Help	your Trust? A verting path path esco	Staf resu scor	WSS. Staf
OLOGICAL EARLY WARNING SCOR	As indicated on covering letter	As indicated on covering letter		scoring system (PEWSS) in use within	information into the PEWSS.	nd to the scores generated by the PEV Healthcare Assistants
PENDIX 3	Trust ID Code:	Hospital ID Code:	IERAL	Do you have a physiological early warning s Yes No	Please indicate which group/s of staff input i Medical Nursing Other, please indicate:	Please indicate which group/s of staff respon Medical Nursing Other, please indicate:

GENE	ERAL	Help notes
Q	Please indicate within which clinical areas the PEWSS is used. Medical in-patients Surgical Accident & Emergency ICU Obstetrics Paediatrics Elderly Care Other If other please indicate:	This question relates to locations. Q.22 will allow you to detail patient groups that may be excluded from PEWSS for example: coronary care patients, children under 14 years
Q.5	Please indicate any clinical areas, within the acute hospital setting, where the PEWSS is not used.	For example some hospitals may omit ICU/HDU, coronary care, maternity. If an alternative scoring system is used in some areas to detect specific complications e.g. post-partum haemorrhage, please record here along with how it differs from CREST model chart.
Q.7	Please indicate any areas where the PEWSS and the routine physiological observational charts have been integrated.	If elements (e.g. GCS, pain/nausea scores) have been added to the same sheet as PEWSS, such that they are not recorded on a further chart, please record this here.
Ø.	Please indicate any clinical areas where the PEWSS runs in parallel to existing observational charts (i.e. duplication of the recording of physiological observations).	E.g. Separate PCA or epidural analgesia observation charts.
0.9	Please indicate if you have a policy/guideline or protocol on the use of PEWSS in place within your Trust. Yes No	Please tick 'yes' if there is a written local policy/guideline or protocol on the use of PEWSS, if you are unsure please ask the policies/guidelines department for advice.

TRAINING	Help notes
Q.10 Please indicate if nursing staff receive training on the use of PEWSS. Yes No If yes, please indicate at what point/s they receive this training:	Please tick 'yes' if your Trust/Hospital site has a supported training programme in place for the training of nursing staff.
During undergraduate/pre-registration training During corporate/Trust induction As part of ongoing on-the-job training Other If other please indicate	
Q.11 Please indicate if medical staff receive training on the use of PEWSS.	Please tick 'yes' if your Trust/Hospital site has a supported training programme in place for the training of medical staff.
If yes, please indicate at what point/s they receive this training: During undergraduate/pre-registration training As part of ongoing on-the-job training If other please indicate	
 Q.12 Please indicate if Health Care Assistants receive training on the use of PEWSS Yes Yes If yes, please indicate at what point/s they receive this training: During corporate/Trust induction As part of ongoing on-the-job training Other If other please indicate 	Please tick 'yes' if your Trust/Hospital site has a supported training programme in place for the training of Health Care Assistants.

TRAINING		Help notes
 Q 13 Please indicate if any other health care professionals of PEWSS Yes Yes If yes, please indicate which other HCP receive trainir 	s (HCP) receive training on the use ing:	Please tick 'yes' if your Trust/Hospital site has a supported training programme in place for the training of other health care professionals.
If yes, please indicate at what point/s they receive thi During undergraduate/pre-registration training As part of ongoing on-the-job training If other please indicate	his training: During corporate/Trust induction Other	
Q. 14 Please indicate if staff receive any refresher courses o Q. 14 Please indicate if staff receive any refresher Ness indicate how often staff receive refresher Nursing Medical Health Care Assistants	or training updates on the use of PEWSS. er/update training:	Please tick 'yes' if your Trust/Hospital site has a supported training programme for refresher courses or training updates on the use of PEWSS.
Other HCP		

Q.15 Please indicate which of the following parameters are used to generate a score which contributes to the total PEWSS score (please do not include parameters which may be measured and recorded simultaneously on the same chart but which do not contribute to the PEWSS score).	Physiological parameters as per your Trust/Hospital site PEWSS chart that are measured and used to calculate a score that at a certain threshold will
Respiratory rate Pulse/HR Conscious level	prompt staff to activate an urgent medical review.
Urinary output SpO ₂ Temperature	
Blood pressure	
Systolic Systolic	
Other:	
If other please indicate:	
Q.16 Please indicate the maximum / total score that can be achieved on your Trust's PEWSS. (Highest total score including all parameters that could generate a score) (Please include a copy of your Trust's PEWSS chart with this questionnaire)	Total of highest score achievable for each parameter that creates a score e.g. Five parameters x highest possible score (3) = Maximum total score achievable 15
Q.17 Please indicate below which scoring systems you use to measure consciousness level (e.g. Alert, response to voice, response only to pain, unresponsiveness (AVPU), Glasgow coma score (GCS))	This relates to the conscious level element within the PEWSS score only. It is recognised that in specific circumstances other scores may be used too e.g. Ramsey, GCS, but these latter types of scores should not be recorded here.

PEWSS	Help notes
Q.18 Please indicate if the PEWSS generates an action protocol/response algorithm.	Protocol/response algorithm detailing action to be taken when a threshold score is reached. This might prompt treatment or prompt staff to request urgent medical review, or both.
 Q.19 Please indicate if the protocol/response algorithm differs from CREST guidelines. Yes No If yes, please indicate how the protocol/response algorithm differs from CREST guidelines (Please provide a copy of your Trust's PEWSS protocol/response algorithm) 	CREST Guidelines – Model Action Protocol Total score 0 – 1 – Continue observations as before. Total score 2 – 3 – Inform nurse in charge, Nurse in charge to decide on frequency of observations.
If yes, please indicate if this deviation is due to a limitation in staffing in relation to: Ward nursing staff Ward medical staff ICU nursing staff ICU nursing/outreach staff ICU medical staff Other If other please indicate: ICU medical staff ICU medical staff	Total score 4 – 6 – Inform medical staff within maximum response time. Medical staff to assess within maximum response time. Medical staff to initiate a management plan, and consider referral to ICU or outreach. Total score 7 or more – Medical staff to assess patient within maximum response time. Contact senior/specialist staff, stay with patient.
Please indicate if there are any other reason(s) other than above for deviation from CREST guideline requirements.	Full detail of CREST guidelines can be found on their website: www.crestni.org.uk IT IS RECOGNISED THAT, IF THE SCORE THRESHOLDS OR TOTALS ON YOUR SCORE DIFFER FROM THAT IN CREST SCORING SYSTEM, THE RESPONSE ALGORITHM MAY DIFFER APPROPRIATEIY. HOWEVER, PLEASE ENSURE YOU IDENTIFY IF ANY OF THE ABOVE ACTIONS ARE NOT INCLUDED IN YOUR HOSPITAL/TRUST ALGORITHM.

PEWSS	Help notes
 Q.20 Please indicate if the response (by algorithm) to PEWSS is affected by duration of time that a score remains at a particular level. Yes 	Some levels of score may be deemed insufficient to prompt a given action if they are only transient.
 Q.21 Please indicate if the response algorithm involves (at any level of score). *please tick all that apply Ward nursing staff Ward nursing staff Ward consultants ICU medical staff ICU medical staff (any grade) If other please indicate: 	If one clinical area or specialty differs in terms of who are the identified responders, please mention this under "other" along with the reason.
 Q.22 Please indicate if any hospitalised patient groups are excluded from PEWSS. Yes Yes, please indicate which patient groups are excluded: 	For example: Paediatrics, Obstetrics, patients who are on care of the dying pathway
 Q23 Please indicate if you use alternative component score (e.g. heart rate, respiration rate) thresholds to generate score for particular patient groups. Yes If yes, please indicate which patient groups. 	Some patients with chronic conditions may constantly trigger some elements of a PEWSS such as heart rate, so that they may not be regarded as appropriate triggers for escalation of observations or treatment.

PEWS	S	Help notes
	If yes, please indicate which physiological parameters have alternative thresholds.	
AUDIT		
Q.24	Please indicate if regular audit activity occurs in the use of PEWSS within your Trust. Yes O	Please tick 'yes' if you are aware of regular audit activity, If you are unsure please ask the audit department to
	If yes , please indicate if the Trust would be prepared to provide information in relation to the problem cause analysis and action planning that results from this audit activity. Yes	commune.
OVER	ALL	
Q.25	CREST guidelines were established to define minimum standards for PEWSS. Please indicate any areas of your Trust's approach to the use of PEWSS, which you believe improves the system beyond these minimum standards.	We hope to capture examples of best practice and/or innovation here.
Q.26	If as a result of RPA your hospital/site has adopted the PEWSS/algorithm of another site	We hope to capture any changes that
	Site	have been made to your PEWSS/ algorithm.





HELP NOTES

REGIONAL AUDIT OF PHYSIOLOGICAL EARLY WARNING SCORING SYSTEM (PEWSS) IN ACUTE HOSPITALS

Strand 2: PEWSS Chart Audit

This is a retrospective case note audit. When data collection is requiring comparison against Trust algorithm, it is important to ensure that, if there are different PEWSS and/or algorithms in different hospitals in your Trust or in different parts of a given hospital for example A&E, ensure that your assessment is against the appropriate algorithm.

The information is based on the 24 hour time period prior to the patient's admission to ICU.

The audit sample includes inpatients from medical/surgical wards admitted to Intensive Care Units (ICU)/High Dependency Units (HDU) across the province from 1st November 2007 to 31st October 2008 (Non-elective admissions only). Emergency admissions to ICU from theatre will also be included provided the patient met Trust criteria for having a PEWSS chart (i.e. location, patient group, etc). No assessment will be attempted of the quality of surgery itself.

Exclusions:

- All elective admissions
- Children under 14 years
- Patients admitted to ICU from any part of the hospital where the Trust does not use PEWSS
- Patients admitted to ICU from a HDU where a PEWSS score and algorithm is not used.

Please avoid bias in selection of patients, ideally these should be a random selection but must ensure that notes of deceased patients are not disproportionately excluded for example if they are more difficult to retrieve.

The following help notes are from feedback from the training day and we hope that you find these useful during data collection.

Patient audit number

Please keep a confidential and secure record of the patient audit number and name separately from the data forms. This will allow follow up of learning for individual patients if necessary

Q4. Do the patient notes/observation chart clearly indicate how often observations are to be carried out?

This can be documented within the medical/nursing notes or can be found on the PEWSS chart.

- Q7. Are there any unplanned gaps in *sets* of observations in the 24 hours prior to ICU admission? See below.
- Q8. Have all parameters been completed within *each set* of observations, in line with your Trust guidance and training for completion, in the previous 24 hours prior to admission to ICU?

Question 7 relates to sets not performed when they should have been as opposed to missing data within individual data sets. For the purposes of question 7, any set of parameters, even if incomplete, constitutes a set since question 8 picks up incomplete data collection within data sets. Q11. Was the total score for each set of observations calculated correctly in the 24 hours prior to ICU admission (i.e. either wrong zone or maths error)?

This relates to an incorrect score regardless of means i.e. either wrong zone or maths error (quantified separately).

Q12. How many times did the PEWSS score reach a threshold for action in the last 24 hours?

Definition

'Threshold for Action'– Prompt for action to be taken where action is not confined to treatment but could alternatively be communication beyond the ward/nursing team.

Auditors should NOT sum missing total scores – The figure required is the number of scores totalled which achieved a threshold for action as defined above.

Q15. For each of the threshold scores reached above, please detail the action taken.

If treatment is ongoing this can be written within the appropriate boxes.

Q17. Please indicate any systems where the action, which should have occurred according to algorithm, was not taken.

Two columns are provided to address the possibility that site algorithm is at odds with ALERT[®] practice. However, for Trust's whose site algorithms conform to ALERT[®] training we anticipate the answers in each of these two columns will be identical.

Q20. List any areas of concern in terms of ALERT[®] management for the care of this patient under the following categories?

Q21. Do you consider deviation from ALERT® principles, contributed substantially to adverse patient outcome?

Definition

ALERT® principles – As contained in the ALERT® course manual.

We do not anticipate answers given in this section will create problems in terms of clinical governance since:

- 1. The data collection is retrospective
- 2. The Trust will be informed of its own results
- 3. Capacity to investigate any individual patients care remains with the Trust, which holds the list of identifiers - any issues of concern should be dealt with by the Trust's risk management process
- 4. It is understood that someone with sufficient expertise to form a professional opinion will complete this section.

If concerns remain feel free to discuss with those responsible for governance within your organisation highlighting the above four points.

REFERENCES

- i Individual HSC Trusts were invited to propose regional audits in a bid for funding. The competitive nature of this precluded detailed discussion of the design with other Trusts until after the application was successful. Nevertheless approval in principle had been secured from the Lead Clinicians of the Critical Care Units in each of the 5 Trusts prior to the application for GAIN funding.
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