The Irish Maternity Early Warning System (IMEWS)
National Clinical Guideline No. 4

November 2014
Guideline Development Group
The National Clinical Guideline was developed by a Guideline Development Group from the Clinical Strategy and Programmes Division, Health Service Executive as a collaborative project between the Office of Nursing and Midwifery Director and the National Clinical Programme in obstetrics and gynaecology. Professor Michael Turner, National Clinical Lead, National Clinical Programme for Obstetrics and Gynaecology chaired the Guideline Development Group.

The guideline was first published as an obstetrics and gynaecology clinical programme guideline in June 2013. It was subsequently updated by Dr Karen Power and Dr Patrick Maguire, under the aegis of the National Clinical Programme for Obstetrics and Gynaecology, to include a customised Sepsis 6 Box and to align it with other national EWS guidelines, and the revised version published in July 2014. The support of the Clinical Effectiveness Unit, Department of Health is acknowledged (Dr Kathleen Mac Lellan and Dr Mary O’Riordan) in developing this guideline further to become a National Clinical Guideline quality assured by the NCEC.

Using this National Clinical Guideline
This guideline is relevant to all healthcare professionals involved in the hospital in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period irrespective of age, location or reason for admission. A summary version of the National Clinical Guideline outlining the recommendations, is available on the following websites:
www.health.gov.ie/patient-safety/ncec
http://www.hse.ie/eng/about/Who/clinical/natclinprog/obsandgynaeprogramme/imews
http://www.rcpi.ie

Recommendations are presented with practical guidance. The recommendations are linked to the best available evidence and/or expert opinion using the grades for recommendations outlined in Section 1.7. The National Clinical Guideline recommendations have been cross-referenced where relevant with other National Clinical Guidelines.

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Disclaimer
Healthcare staff should use clinical judgement and medical, midwifery and nursing knowledge in applying the general principles and recommendations in this guideline. Recommendations may not be appropriate in all circumstances and the decision to adopt specific recommendations should be made by the clinician taking into account the individual circumstances presented by each patient and available resources. The National Clinical Guideline recommendations do not replace or remove clinical judgement or the professional care and duty necessary for each specific patient case. Clinical decisions and therapeutic options should be discussed with a senior clinician on a case-by-case basis as necessary.
National Clinical Effectiveness Committee (NCEC)

The National Clinical Effectiveness Committee (NCEC) is a Ministerial committee established as part of the Patient Safety First Initiative. The NCEC role is to prioritise and quality assure National Clinical Guidelines and National Clinical Audit so as to recommend them to the Minister for Health to become part of a suite of National Clinical Guidelines and National Clinical Audit.

National Clinical Guidelines which have been quality assured and recommended by NCEC for implementation provide robust evidence-based approaches to underpin or define models of care as appropriate. They provide guidance and standards for improving the quality, safety and cost-effectiveness of healthcare in Ireland. The implementation of clinical guidelines can improve health outcomes, reduce variation in practice and improve the quality of clinical decisions.

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

In response to the HIQA Patient Safety Investigation Report into Services at University Hospital Galway (2013), the NCEC was requested by the Minister for Health to commission and quality assure a number of National Clinical Guidelines. The National Clinical Guideline for a maternity early warning system is one of these guidelines. The National Clinical Guideline – Irish Maternity Early Warning System has been quality assured by NCEC and endorsed by the Minister for Health for implementation in the Irish health system.

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1.1 Need for a National Clinical Guideline

Critical illness is an uncommon but potentially devastating complication of pregnancy. (1) It may be devastating, not only for the woman who becomes ill, but also for her family and for those healthcare professionals responsible for her care. At its most extreme, critical illness may lead to the death of the woman during pregnancy or shortly afterwards. The Confidential Maternal Deaths Enquiry published in 2012 confirmed that Ireland continues to have a low maternal mortality ratio by international standards. (2) There is, however, no room for complacency and efforts to improve the quality of clinical care in the maternity services must continue.

As critical care has evolved worldwide, attempts to identify early the clinically deteriorating patient has led to the introduction, in hospitals, of early warning scores and systems. In Ireland, this has led to the National Early Warning Score (NEWS) being developed in collaboration with the HSE Acute Medicine Clinical Care Programme. The NEWS was the first National Clinical Guideline to be approved by the NCEC and it was endorsed and launched in February 2013 by the Minister for Health. The NEWS is applicable to adult patients and is not applicable to pregnant women.

The HSE Clinical Strategy and Programmes strategic plan for the acutely ill patient in obstetrics and gynaecology has been pro-active in developing a clinical practice guideline - the Irish Maternity Early Warning System (IMEWS). This maternity early warning system provides guidance and processes for the early detection of life threatening illness in pregnancy and up to 42 days in the postnatal period. The first version was published in June 2013 and it was updated in July 2014.

In response to the HIQA Galway Report (2013), the NCEC was requested by the Minister for Health to commission and quality assure a number of National Clinical Guidelines. (3) A maternity early warning system is one of these guidelines. In collaboration with the HSE Clinical Strategy and Programmes and Quality and Patient Safety divisions the clinical practice guideline IMEWS was developed to the status of a National Clinical Guideline quality assured by the NCEC.

A systematic clinical literature review was commissioned. This identified that a maternity early warning score system does appear to improve recording of observations. Relatively little high quality evidence on developing and testing the predictive ability of maternity early warning scores emerged. The literature is in the main related to selected high-risk populations using mortality or severe morbidity outcomes. Studies included found a wide variation in predictive components depending on the maternity early warning score used. This limits the extent of evidence available to inform decisions on implementation of MEWS routinely on an unselected maternity population. The content and grade of recommendations for the National Clinical Guideline (IMEWS) therefore reflects the strength of evidence and the expert consensus opinion of the Guideline Development Group.

This guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach across all hospital maternity services in Ireland. A standard national patient observation chart and escalation triggers are recommended. Clinical material in this guideline does not replace or remove clinical judgement or professional care and duty. Clinical decisions and therapeutic options should be discussed with a senior clinician on a case-by-case basis as necessary.
The IMEWS patient observation chart is purple and contains a pregnancy silhouette to distinguish the chart from the NEWS. The colour coding for triggers/escalation on the IMEWS is aligned as closely as possible with the NEWS.

Regular audit of not only implementation but also impact of the National Clinical Guideline should occur as the guideline is being implemented across all relevant services.

1.2 Critical illness in maternity care

Critical illness in pregnancy may be due to conditions unique to pregnancy, due to conditions exacerbated by pregnancy or due to coincidental conditions. This is reflected in the classification of maternal deaths into direct, indirect and coincidental deaths. (4) The conditions unique to pregnancy include obstetric haemorrhage, pre-eclampsia/eclampsia, pulmonary embolism (venous and amniotic fluid), chorioamnionitis/endometritis, uterine rupture, placenta accreta and acute fatty liver. (5)

It has been estimated that for every maternal death there are nine women who develop severe maternal morbidity. (6) In a study of severe maternal morbidity for 2004/5 in the three Dublin maternity hospitals, the rate of severe maternal morbidity was 3.2 per 1,000 maternities. (7) The commonest cause was haemorrhage. A national review of postpartum haemorrhage in Ireland over 11 years between 1999 and 2009, found that there were increasing rates of atonic postpartum haemorrhage. (8)

1.3 Aim of National Clinical Guideline

The purpose of this guideline is to improve the management of the in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period through the use of a standard maternity early warning system.

1.4 Scope of National Clinical Guideline, target population and target audience

This National Clinical Guideline relates to the hospital in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period irrespective of age, location or reason for admission. The National Clinical Guideline No. 1 NEWS is for utilisation for non-pregnant adults in gynaecological services.

This guideline is relevant to all healthcare professionals, who are working with hospital in-patient care of women with a confirmed clinical pregnancy and up to 42 days in the postnatal period, irrespective of age, location or reason for admission.

It is designed to guide clinical judgement but not replace it. In individual cases a healthcare professional may, after careful consideration, decide not to follow guideline recommendations if it is deemed to be in the best interests of the woman. Clinical decisions and therapeutic options should be discussed with a senior clinician on a case-by-case basis as necessary.

1.5 Guideline Development Group

The National Clinical Guideline was developed by the Guideline Development Group from the Clinical Strategy and Programmes Division, Health Service Executive as a collaborative project between the Office of Nursing and Midwifery Director and the National Clinical Programme in obstetrics and gynaecology. Professor Michael Turner, National Clinical Lead, National Clinical Programme for Obstetrics and Gynaecology chaired the Guideline Development Group. Efforts were made to ensure that all the relevant professional groups and patients were represented.
A patient information leaflet was developed by the HSE Patient Advocacy Unit in collaboration with service users – see Appendix 5.

The Guideline Development Group members’ names, areas of the document they were primarily responsible for drafting and any potential conflicts of interest are outlined in Appendix 1.

The guideline was endorsed by the Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and the Clinical Strategy and Programmes Division, Health Service Executive in July 2014.

1.6 Methodology and literature review

To assist in rigour of development of this National Clinical Guideline, a systematic review of both clinical and economic literature was performed by a multidisciplinary group from National University of Ireland, Galway led by Professor Declan Devane. This review compiled the totality of clinical and economic evidence on early warning systems for use in maternity care. The literature which informed each recommendation is outlined in the rationale for the recommendation. The review adhered to the Preferred Reporting in Systematic Reviews and Meta-Analysis (PRISMA) criteria. Full methodology is described in Appendix 6.

Specific research questions

The following specific research questions directed this review:

1. What early warning systems or trigger systems (including escalation protocols and communication tools such as ISBAR) are currently in use internationally in pregnant women or women who delivered in the previous 42 days, for the detection of deterioration/timely identification of deterioration in maternity patients?
   a. What is the level of clinical validation of these scoring systems including escalation protocols and communication tools?

2. What education programmes have been established to train healthcare professionals in the delivery of MEWS?
   a. What level of evaluation has been used for these education programmes?

3. What are the findings from the economic literature of cost effectiveness, cost impact and resources involved with early warning or trigger systems in the detection of deterioration/timely identification of deterioration in pregnant women or women who delivered in the previous 42 days, including implementation costs?

1.7 Grading of recommendations

The recommendations are followed by a grade. This is a consensus grade agreed by the Guideline Development Group. It reflects the strength of the evidence supporting the recommendation and discussion of the evidence amongst the Guideline Development Group. The system was agreed to best meet the needs of the guideline and the Guideline Development Group, given the absence of randomised controlled trials (RCTs) in many of the areas covered.
The grades are as follows:

**Grade A** – Evidence from a meta-analysis/systematic review of RCTs or from at least one RCT.

**Grade B** – Evidence based on one controlled trial without randomisation (e.g., cohort study) or quasi-experimental study, or extrapolated from RCT.

**Grade C** – Evidence from comparative studies, correlation studies, case control studies or extrapolated from category A or B.

**Grade D** – Evidence from expert committees, reports or opinions, the clinical experience of respected authorities, and the conclusions of the Guideline Development Group.

**No recommendation.**

### 1.8 External review

As part of the guideline design work, multidisciplinary consultation meetings were held involving clinical staff from all 19 maternity units in Ireland. Strong support was received from Ms Eilish Croke and her team from the National Early Warning Score (NEWS).

The guideline was peer reviewed by Ms. Margurite Hogan (Therapy Professionals), Ms. Eithne Coen (NMPDU, South East), Ms. Mary O’Reilly (Rotunda Hospital) and the Programme’s Clinical Advisory Group. Sepsis considerations were added to the guideline in July 2014. The guideline was reviewed and endorsed by the Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland and Clinical Strategy and Programmes Division, Health Service Executive in July 2014.¹

IMEWS resources for service users were developed in partnership with service users and the HSE Patient Advocacy Unit. The resources were aligned to the patient resource for National Clinical Guideline No. 1 (NEWS). A patient forum established in 2012 proposed the development of patient empowerment resources for the National Early Warning Score and Maternity Early Warning System. The proposal was put forward by the Chair of the Patient Forum, Mr. Michael Brophy. Patient representatives on the Forum included, a patient advocate from Patient Focus, patients from primary care services, palliative care, mental health, chronic disease and acute hospital services.

The IMEWS patient information resource was drafted, proofed by the patient group and the National Adult Literacy Association. The IMEWS resource was circulated to ten women who had a recent experience of maternity services for their feedback and input.

The IMEWS patient information resource was finalised in partnership with patients and members of the Guideline Development Group.

### 1.9 Procedure for update of National Clinical Guideline

It was agreed by the Guideline Development Group that it will review the National Clinical Guideline IMEWS publication on a three-yearly basis and update as appropriate. Therefore, this guideline will be reviewed again in 2017 by the Clinical Care Programme in Obstetrics and Gynaecology.

¹ IMJ Article S-5780 Editorial accepted
1.10 Implementation of National Clinical Guideline

The potential barriers and enablers for implementation are not an exhaustive list, and each obstetric and gynaecology service must identify site-specific issues and manage these appropriately.

Barriers to implementation

The following outlines barriers to implementation of the National Clinical Guideline. Barriers include lack of:

- Leadership
- Governance arrangements in the organisation
- Clearly identified roles and responsibilities
- Communication processes
- Resources for the Emergency Response System, such as staff and equipment suitable for IMEWS recording and transfer of information
- Education, training and information for clinical staff on the early detection and management of the deteriorating patient
- Technological supports for evaluation, audit and feedback processes.

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

Enablers for implementation

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

- Good leadership
- Good governance arrangements
- Clearly identified roles and responsibilities
- Multi-disciplinary team working
- Good communication processes
- Effective education and training of staff
- Good arrangements for safely transferring patients to higher levels of care.

For full implementation of this guideline, it is essential that all healthcare professionals, understand and appreciate that they are responsible for improvement of the management of hospital in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period.

This must be supported by clear lines of accountability which include systems that can detect and correct lapses in appropriate care in a timely basis as outlined in this guideline.

Many recommendations in this National Clinical Guideline represent a re-iteration of previous good practice and are therefore cost-neutral as outlined in the budget impact assessment Appendix 8. However, the Guideline Development Group wishes to highlight the following steps that will help to ensure full implementation of the National Clinical Guideline:

- Distribution of guideline to all members of the Institute of Obstetricians and Gynaecologists and to all maternity units.
- Implementation through HSE Obstetrics and Gynaecology Programme local implementation boards.
- Distribution to the Director of the Acute Hospital Services for dissemination and implementation through line management in all acute hospitals.
- Distribution to other interested parties and professional bodies.

1.11 Roles and responsibilities

This guideline should be reviewed by the healthcare facilities senior management teams in conjunction with the relevant specialists to plan implementation of the recommendations. This
will enable the facility to ensure that the management of the hospital in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days is at an optimal level irrespective of age, location or reason for admission.

**Organisational responsibility**

Within each healthcare facility the CEO/General Manager has corporate responsibility for implementation of the National Clinical Guideline to ensure that there is a system of care in place for the prompt identification and management of the clinically deteriorating patient.

**Senior managers should:**
- Provide a local governance structure to support the implementation and on-going evaluation of the guideline
- Assign personnel with responsibility, accountability and autonomy to implement the guideline
- Provide managers with support to implement the guideline and ensure that staff undertake the education programme as appropriate
- Ensure local policies and procedures are in place in each maternity hospital to support implementation
- Monitor the implementation of the guideline to support on-going evaluation and any actions required following the evaluation
- Link the implementation group/committee with corporate responsibility.

**All healthcare staff should:**
- Comply with this National Clinical Guideline and related policies, procedures and protocols
- Adhere to their code of conduct and scope of practice guidelines as appropriate to their role and responsibilities
- Maintain competency in the management of the pregnant patient between confirmed pregnancy and up to 42 days postpartum
- In using this guideline be aware of the role of appropriate delegation.

This guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. Clinical material in this guideline does not replace or remove clinical judgement or professional care and duty.

This guideline does NOT address all elements of standard practice and assumes that individual clinicians are responsible for:
- Discussing care with women in an environment that is appropriate and which enables respectful, confidential discussion
- Advising women of their choices and ensuring that informed consent is obtained
- Meeting all legislative requirements and maintaining standards of professional conduct
- Applying standard precautions and additional precautions, as necessary, when delivering care
- Documenting all care in accordance with local and mandatory requirements.

**1.12 Implications for research**

The systematic clinical literature review concludes that the majority of work developing and testing the predictive ability of maternity early warning systems has been related to selected high-risk populations using mortality or severe morbidity outcomes. Additional research is required to develop predictive models that are appropriate for unselected pregnant women. Little evidence emerged on the process of implementation or of clinician’s views of maternity early warning systems. Findings indicate that maternity early warning systems can facilitate effective structuring of referrals but its discretionary use limits its universal risk screening potential. Research exploring barriers and facilitators to successful implementation is needed to inform robust implementation strategies.
2 National Clinical Guideline recommendations

2.1 National recommendations

Table 1 Summary of National Clinical Guideline (IMEWS) recommendations

<table>
<thead>
<tr>
<th>Section</th>
<th>Recommendation/Subsection</th>
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| Measurement and documentation of observations | • The Irish Maternity Early Warning System (IMEWS) should be used for the in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period irrespective of age, location or reason for admission. **Grade C**  
  • IMEWS should be used to complement clinical care and it is not designed to replace clinical judgment. Clinical concern about an individual woman should trigger a call to medical staff irrespective of the IMEWS. **Grade D**  
  • The blood pressure (BP) should be measured with the correct cuff size. In women with a mid-arm circumference (MAC) > 33 cms, the use of a standard cuff may overestimate the BP and lead to unnecessary interventions. **Grade B**  
  • Any fall in the level of consciousness (AVPU scale) should always be considered significant and acted on immediately. **Grade C**  
  • The timing of clinical observations will depend on the woman’s individual clinical circumstances. **Grade D** |
| Clinical communication and escalation of care  | • The ISBAR communication tool should be used when communicating information in relation to deteriorating and/or critically ill patients. Where a situation is deemed to be critical, this must be clearly stated at the outset of the conversation. **Grade B**  
  • The designation of who should be the senior doctor called should be agreed locally by the midwifery and medical senior management. **Grade D**  
  • Depending on the acute illness, early consideration should be given to seeking professional assistance from other medical specialties either within or from outside the maternity unit. **Grade D** |
| Suspected maternal sepsis                    | The Sepsis 6 Tool customised for pregnancy should be utilised for consideration of maternal sepsis. **Grade C**                                                                                                                                |
| Implementation of IMEWS                     | • Organisational supports and governance structure  
  • Education  
  • Evaluation and audit                                                                                                                                                                                                                 |
2.1.1 Measurement and documentation of observations

The following are responsible for implementation of recommendation 1:
Doctors, Midwives and Nurses.

Recommendation 1
The Irish Maternity Early Warning System (IMEWS) should be used for the in-patient care of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period irrespective of age, location or reason for admission.

The IMEWS should NOT be used for women in labour and women in high dependency, recovery and critical care settings. Vital signs for women in labour should be recorded on the partogram. The last set of vital signs for each of these areas should be documented on the IMEWS prior to transfer to the postnatal ward. Grade C

Rationale
Evidence from descriptive studies (9-13), favours the introduction of MEWS for reducing late detection of maternal illness, especially haemorrhage. There is consensus that, at a minimum, the parameters of HR, RR, BP, temperature and level of consciousness should be included in a MEWS. There is variation in choice of MEWS scoring systems (i.e. colour coded or numerical scoring). The most common parameter triggered in MEWS in the reported studies was BP.

MEWS appears to be used widely in current maternity care (14-18), although data on this use was available from the UK only and there is evidence of heterogeneity in the MEWS systems used and parameters therein. Inclusion of HR, RR, BP, temperature and SpO$_2$ parameters in MEWS is consistent across charts; however, the inclusion of other parameters such as pain and urine output, for example, is inconsistent. Diverse barriers to the successful implementation of MEWS were identified, the most common being, overlap with other charts and concurrent recording of vital sign observations on other charts such as the partogram. (16)

Twelve studies provided data related to compliance with MEWS. (19-30) MEWS does appear to improve recording of observations; however, in the main, compliance rates were sub-optimal. Education and training appears to assist improved compliance rates, yet compliance diminishes as the duration of inpatient stay lengthens. (19, 24, 30)

In a pre- and post-intervention design study conducted in a medium-sized (4000 births/annum, approximately) maternity unit in the Republic of Ireland, outcomes in women 6 months pre-introduction of a Physiological Observation Track and Trigger System (POTTS) were compared with those of women 6-months post-introduction of the POTTS. (31) The reported results suggest that observation documentation was better with POTTS and a POTTS score of 6 or more was significantly associated with a higher level of medical involvement (p < 0.05).

Validation of MEWS scores
Six studies, reported across nine citations, (32-40) on the development/validation of MEWS were identified for inclusion. Four studies were from the UK and two from the United States. All studies were retrospective cohort designs with the exception of one prospective cohort. (39, 41) The majority of studies included high-risk populations. Two studies included women admitted to intensive care. (37, 42) two included women with chorioamnionitis (34, 35) and two included unselected maternity admissions. (38, 40) Studies used a variety of outcome measures (reference criteria) including mortality, (42) composite outcomes of morbidity, ICU admission, (38) or sepsis (35) or severe sepsis. (34) Although sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) are reported, it is unclear how the outcome of classification into ‘normal, High Dependency Unit (HDU) admission, Intensive Care Unit (ICU) admission or any of the agreed end-point morbidities’ was used in generating data in the study by Stephanou and this study is not considered further here. (40)
Carle et al (42) used separate samples of women admitted to ICU to develop (n=2240) and subsequently validate (n=2200) an EWS specific to the obstetric population. The EWS was developed initially from statistical analysis of physiological variables collected during the first 24hrs of critical care admission. However, to improve the ‘clinical acceptability’ of the statistical EWS, the authors added additional physiological variables (e.g., diastolic blood pressure) to create a new EWS containing systolic and diastolic blood pressure, respiratory rate, heart rate, % $\text{O}_2$ required to maintain $\text{SpO}_2 > 96\%$, temperature and conscious level. The authors note that incorporating additional, clinician required physiological variables did not result in a significant decrease in score discrimination. Results indicate that a cut-off value of 12 gives sensitivity of 97%, specificity of 87% and total accuracy of the score of 88%. However, as noted by the authors, all patients in their dataset had been admitted to ICU and much lower thresholds are necessary to detect the patient at risk of deterioration in this setting.

In the only included prospective study, Singh et al (38) evaluated the predictive value of a MEWS on unselected women admitted between 20 weeks’ gestation and 6 weeks postpartum against the composite outcome of morbidity, death, intensive care unit (ICU) admission or discharged alive at 30 days. Physiological parameters included in the MEWS were temperature, systolic BP, diastolic BP, heart rate, respiratory rate, oxygen saturation, pain score and neurological response. Sensitivity, specificity, PPV, NPV for the outcome were 89% (95% CI 81–95%), 79% (95% CI 76–82%), 39% (95% CI 32–46%) and 98% (95% CI 96–99%) respectively. The most frequent trigger was high BP (42%), followed by tachycardia (28%) and low BP (18%).

Using data from 913 women with chorioamnionitis, Edwards et al (34) compared the predictive ability of four MEWS charts for severe sepsis. Findings demonstrated wide ranges in predictive ability with ranges of sensitivity from 40% to 100%, specificity 3.9% to 96.9%, PPV 1.43% to 15.4% and NPV from 99.1% to 100%. The authors conclude that the MEWS charts evaluated lack of diagnostic power for severe sepsis in an obstetric population. It is important this is considered in the context of the population under study already having chorioamnionitis and the likelihood that an unselected maternity population would likely produce even poorer predictive results.

In a companion study, Lappen et al (35) examined the predictive ability of a MEWS containing the parameters systolic blood pressure, heart rate, respiratory rate, temperature and mental status in women with chorioamnionitis against the outcome of mortality, ICU admission or sepsis. Using a MEWS score of >= 5, of which 92 patients (10.1%; 95% CI, 8.3–12.2%) at some time during their labour, the MEWS had a sensitivity, specificity, PPV and NPV of 100%, 90.4%, 0.05% and 100% respectively. The authors conclude that the MEWS criteria would not identify accurately women who are at risk for ICU transfer, sepsis, or death. However, the definitions for sepsis differ from that of the surviving sepsis campaign.²

Shields et al (37) reviewed the frequency of abnormal MEWS triggers in obstetrical patients admitted to ICU (n=75) and compared them with women with normal deliveries (n=50). Two or more triggers were significantly more frequent in the ICU group than in the control (72% v 20%, OR 10.3, P<0.001). Importantly, the authors note that overall no action was noted in 41% of patients with triggers and in 62% of ICU admissions, the reviewer felt that earlier intervention might have minimised morbidity.

In summary, there is relatively little high quality evidence on developing and testing the predictive ability of MEWS and the majority of work that has been conducted has been performed with selected high-risk populations using mortality or severe morbidity outcomes. Studies included here find wide variation in predictive components depending on the MEWS used. This limits the applicability of the evidence to inform decisions on implementation of MEWS routinely on an unselected maternity population.

The following are responsible for implementation of recommendation 2: Doctors, Midwives and Nurses.

Recommendation 2
IMEWS should be used to complement clinical care and it is not designed to replace clinical judgment. Clinical concern about an individual woman should trigger a call to medical staff irrespective of the IMEWS. Grade D

Practical Guidance
Completing the IMEWS
The nationally agreed IMEWS is included in Appendix 2. For convenience a sample antenatal observation sheet is included in Appendix 3 and a sample postnatal observation sheet is included in Appendix 4. These should be filed beside the IMEWS in the maternity chart so that all clinical observations are easily accessible to the different disciplines.

IF CONCERNED ABOUT A WOMAN, ESCALATE CARE REGARDLESS OF TRIGGERS

Total Yellow/Pink Scores
- All triggers should be added up and documented at the bottom of the IMEWS each time observations are recorded.
- If the woman scores any yellow or pink scores, the escalation process should be initiated (See section 2.1.2).
- The initials of the person that has completed and recorded the observations should be clearly written in the initials box on the IMEWS.
- An Initials/Signature Bank should be maintained in each hospital as per local guidelines.

Physiological observations for the IMEWS

Respiration
Respiratory rate is a mandatory observation as changes in respiratory rate have been identified as being the earliest and most sensitive indicator of deterioration in wellbeing. (43) Respiratory rate should be recorded on all monitoring events.

Tachypnoea is strong evidence of sepsis until proven otherwise. (4)

Practical Guidance
An assessment of respiration should be carried out for 60 seconds following the assessment of heart rate, as making the woman aware of counting her respirations will cause her to be conscious of her breathing and lead to a false reading. If the wrist is supported across the woman’s chest, it is possible to count the pulse and then to either feel the rise and fall of the chest, or observe it, counting respirations. Factors such as sound, depth and regularity are observed at the same time. If respirations are regular, the rate is counted for 30 seconds and doubled. If any abnormalities are detected, respiration is counted for a whole minute. (43)

The rate should be documented as a numerical value in the appropriate box e.g. respiratory rate of 16 per minute should be documented numerically in to the white box allocated to a respiratory rate of 11-19. Likewise, a respiratory rate of 20 should be documented numerically in the yellow box allocated to respiratory rate of 20-24.

The accepted normal parameters for respiration rate on IMEWS are 11-19 respirations/min.
Oxygen Saturation

Oxygen saturation levels reflect the percentage of arterial haemoglobin saturated with oxygen in the blood, and is referred to as $\text{SpO}_2$. (43)

**Practical Guidance**

- Oxygen saturation levels are not routinely measured on all women, and only measured in the following circumstances:
  - If the respiration rate is outside the normal parameters and within the ‘trigger’ pink or yellow values
  - If a medical/obstetric condition necessitates measurement of oxygen saturation levels e.g. respiratory disorder, High Dependency Care.

- Accuracy of the measurement depends on an adequate flow of blood through the light probe i.e. if peripheral circulation has shut down and a woman is in a critical condition, the $\text{SpO}_2$ result may be inaccurate or unobtainable.

- Artificial nails and nail polish will affect the accuracy of results.

- The $\text{SpO}_2$ should be documented as a percentage in the appropriate box i.e. $\text{SpO}_2$ of 94% should be documented numerically in the pink box allocated to $\text{SpO}_2$ readings of $\leq$95%. Likewise the $\text{SpO}_2$ of 96% should be documented numerically in the white box allocated to 96-100%.

- The accepted parameters for $\text{SpO}_2$ on IMEWS are 96-100%.

Temperature

**Practical Guidance**

- Temperature should be recorded at the appropriate site (i.e. oral, axilla, tympanic) according to local guidelines, ensuring correct use of the appropriate thermometer and equipment.

- The recorded temperature should be documented numerically in the appropriate box. Therefore, the temperature of 35.8°C should be documented numerically in the yellow box allocated to 35.1-35.9°C. Likewise 38.1°C should be documented numerically in the pink box allocated to $\geq$38°C.

- The accepted temperature parameters on the IMEWS are 36.0-37.4°C.

- A fall or rise in temperature or swinging pyrexia may indicate sepsis.

- Hypothermia is a significant finding that may indicate infection and should not be ignored.

- Pyrexia may be masked if antipyretics have been administered.

- If pyrexial, a sepsis screen and appropriate antibiotic therapy should be considered at an early stage. See section 2.1.3 for more detail.
Heart Rate
The most commonly used site to assess heart rate in the adult is the radial artery as it is readily accessible. The brachial artery is used in the measurement of blood pressure and the carotid and femoral arteries may be palpated in the case of collapse, where cardiac output cannot be detected in the peripheral circulation. (43)

Practical Guidance
- The radial artery should be palpated using the index and middle finger, supporting the woman’s wrist across her chest, and the rate counted for 30 seconds and doubled if the rate is regular, or sixty seconds if irregular. (44)
- Pulse oximeters also give a heart rate reading. However, if the woman has a bradycardia or tachycardia detected electronically, the pulse should be assessed manually for noting rate, rhythm and strength.
- The heart rate should be documented numerically on the IMEWS in the appropriate box i.e. heart rate of 86 bpm should be documented into the white box area allocated to 80-89 bpm. A heart rate of 102 bpm should be documented numerically in the yellow box allocated to 100-109 bpm.
- The accepted parameters for heart rate on IMEWS are 60-99 bpm.
- Persistent tachycardia over 100 bpm is an important sign that may indicate serious underlying disease and warrants investigation.

Blood Pressure
The following are responsible for implementation of recommendation 3: Doctors, Midwives and Nurses.

Recommendation 3
The blood pressure (BP) should be measured with the correct cuff size. In women with a mid-arm circumference (MAC) > 33 cms, the use of a standard cuff may overestimate the BP and lead to unnecessary interventions. Grade B

Practical Guidance
Systolic and diastolic blood pressure, are recorded separately to facilitate the appropriate triggers to be assigned to two separate results from one recording.

Blood pressure must be measured using the correct cuff size, and the size of the cuff used should be documented in the woman’s notes.

It is recommended that the mid-arm circumference (MAC) should be measured in all pregnant women particularly those with BMI > 29.9 kg/m² at their first antenatal visit. If the MAC is > 33 cms, a large cuff should be used for BP measurements subsequently. (45)

The mid-arm point is determined by measuring the length of the upper arm from the shoulder joint to the antecubital fossa. The mid arm point is taken as the point halfway between these two landmarks. (45)

Systolic blood pressure should be documented at Korotkoff I or first clear sound, and the diastolic blood pressure at Korotkoff V, when sounds are no longer audible.

Electronic recording of blood pressure can underestimate readings. It is recommended good practice that if a blood pressure is raised with an electronic reading, the BP should be rechecked manually at least once using an aneroid sphygmomanometer.
Findings should be documented as a numerical value in the appropriate box i.e. systolic blood pressure of 156mmHg is written into the yellow box representing 150-159mmHg. The diastolic reading of 86mmHg should be documented numerically in the white box allocated to 80-89mmHg.

It is recommended that a dotted line between the systolic and diastolic numbers is used, to display a graphic trend.

The acceptable parameters for systolic blood pressure on the IMEWS are 100-139mmHg. The acceptable parameters for diastolic blood pressure on the IMEWS are 50-89mmHg (i.e. 100/50mmHg to 139/89mmHg). Hypotension is a late sign of deterioration as it signifies decompensation. The physiological changes caused by pregnancy and childbirth can mean that early signs of impending collapse are not easily recognised.

Hypertension: The conventional definition of hypertension in pregnancy is:

- Two readings of 140/90mmHg taken at least 4 hours apart, (46) or
- An increase or 15mm/Hg above the booking blood pressure, or
- One reading of 160/100mmHg or greater.

Concerns regarding blood pressure readings should be discussed with the Obstetrician/AAnaesthetist as appropriate.

Urine

Practical Guidance
Urinalysis of freshly voided urine should be undertaken for the purpose of screening, diagnosis or assessment of management and documented on the IMEWS on the following occasions:
- On admission to the hospital for any reason as a baseline observation
- Specific maternal disorders or treatment, e.g. hypertensive disease, diabetes
- Clinical symptoms, e.g. dysuria.

The frequency of urinalysis following admission depends on the clinical assessment and diagnosis of the woman i.e.
- An antenatal woman admitted with hypertensive disease or urinary tract infection may require a minimum of daily urinalysis or more frequently if her clinical condition deteriorates
- However, an antenatal or postnatal woman without risk factors may not require daily urinalysis.

All urinalysis findings should be documented as they appear on the dipstick or urinalysis machine printout e.g., neg, trace, +, ++, ++++,++++.
Box 1 Summary of urinalysis findings and associated potential diagnoses

**Urinalysis Results**

- **Proteinuria** may indicate infection, underlying renal disease which may be as a result of hypertension or may be a contaminated specimen (from liquor or vaginal discharge). Transient positive tests are usually insignificant, due to the physiological changes in pregnancy resulting in the presence of small amounts of albumin and globulin in the urine. To exclude infection a midstream specimen (MSU) should be obtained, tested and sent for laboratory analysis.

- **Glucose** is common in pregnancy due to the physiological changes of pregnancy resulting in altered renal function. However, glucose also appears in the urine
  - When blood glucose levels rise (hyperglycaemia).
  - If renal absorption lowers.
  - Transiently following the administration of corticosteroids e.g. Betamethasone / Dexamethasone.

- **Others:** (this list is not exhaustive)
  - **Ketones:** Mild ketonuria is a normal physiological change in pregnancy, and provided it is mild, is insignificant. However ketonuria is also indicative of women who are fasting, vomiting or with uncontrolled diabetes mellitus. Some drugs may also give a positive result.
  - **Blood:** Blood should not appear in the urine; its presence may be indicative of infection, trauma or calculi or may be due to contamination by blood from another part of the body, e.g. vaginal discharge or haemorrhoids. A positive result warrants further investigation.
  - **Nitrites:** Nitrites in the urine are indicative of urinary tract infection and an MSU should be sent for laboratory analysis.

The following are responsible for implementation of recommendation 4: Doctors, Midwives and Nurses.

**Recommendation 4**

Any fall in the level of consciousness (AVPU scale) should always be considered significant and acted on immediately. **Grade C**

Assessment of Neurological Response - AVPU Scale

- A neurological response is a measure of consciousness and the best response of the following should be measured and documented on all women using the AVPU scale, indicating
  - **A** – Alert and orientated to person, place, time and event.
  - **V** – Responds to voice/verbal stimuli (e.g. post operative recovery).
  - **P** – Responds to painful stimuli with a purposeful or non-purposeful movement.
  - **U** – Unresponsive - The patient does not respond to any stimuli.

- The neurological response assessment should be documented in the appropriate box:
  - Alert (A): white box (accepted neurological response parameter)
  - Responds to Voice (V): Pink box
  - Responds to Pain (P): Pink box
  - Unresponsive (U): Pink box.
**Pain Score**

**Practical Guidance**
Women should be asked to score their pain on a scale of 0-10 (0: No pain, 10: extreme pain) when a full set of observations is recorded and the numerical value recorded on the IMEWS. The following tools may also be used:

<table>
<thead>
<tr>
<th>No pain</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Pain as bad as it could be</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

**Wong-Baker FACES® Pain Rating Scale**

- **0**: No Hurt
- **2**: Hurts Little Bit
- **4**: Hurts Little More
- **6**: Hurts Even More
- **8**: Hurts Whole Lot
- **10**: Hurts Worst

Timing of observations for IMEWS
The following are responsible for implementation of **recommendation 5:**
Doctors, Midwives and Nurses.

### Recommendation 5
The timing of clinical observations will depend on the woman’s individual clinical circumstances.

**Grade D**

### Practical Guidance
- All women who present to or are admitted to a maternity unit should have a full set of vital signs recorded as a baseline on the IMEWS.

- The frequency that subsequent observations should be recorded is then determined by the results of the initial observations and the presenting clinical condition.

- All yellow and pink triggers should be added up and documented at the bottom of the IMEWS each time observations are recorded.

- If the woman scores any yellow or pink scores, the escalation process should be initiated.

- The IMEWS should be used for all pregnant women with a confirmed clinical pregnancy and up to 42 days postnatal who are admitted or transferred to a general hospital.

- The IMEWS should NOT be used for women in labour and women in high dependency, recovery and critical care settings. Vital signs for women in labour should be recorded on the partogram. The last set of vital signs for each of these areas should be documented on the IMEWS prior to transfer to the postnatal ward.

---

**Table 2 IMEWS frequency table**

<table>
<thead>
<tr>
<th>Triggers</th>
<th>Minimum frequency of recording observations on IMEWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Yellow trigger</td>
<td>Repeat full set of observations on the IMEWS after 30 minutes and before 60 minutes.</td>
</tr>
<tr>
<td>2 Yellow triggers or 1 Pink trigger</td>
<td>Call the obstetrician to review. Repeat a full set of observations after 30 minutes.</td>
</tr>
<tr>
<td>&gt; 2 Yellow triggers or &gt;2 Pinks triggers</td>
<td>Call the obstetrician and request immediate review. Repeat a full set of observations within 15 minutes or monitor continuously.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clinical situation</th>
<th>Minimum frequency of recording observations on IMEWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antenatal low risk (in-patient) woman with an uncomplicated pregnancy</td>
<td>Full set of vital signs recorded on the IMEWS on admission. Thereafter as clinically required.</td>
</tr>
<tr>
<td>Postnatal low risk in-patient woman with an uncomplicated pregnancy and birth</td>
<td>Full set of observations following the birth of the baby as clinically required.</td>
</tr>
</tbody>
</table>

**Antenatal or Postnatal**

- Hypertensive disorders of pregnancy | Full set of vital signs including urinalysis recorded daily. Thereafter BP recorded 4 hourly. |
### Post caesarean section or post surgery during pregnancy/postnatal period (including recovery)

Full set of vital signs (urinalysis only if applicable) to be recorded:
- Every 5 minutes for 15 minutes
- Thereafter, every 15 minutes for 1 hour
- Thereafter, every 30 minutes for 1 hour
- Thereafter, every hour for 2 hours
- Thereafter, every 4 hours for 48 hours
- Thereafter, daily until discharge.

### Evidence on compliance with MEWS

Studies were identified that described compliance with recording observations and/or escalation of care. (19, 25, 48-57) All were described as audits with the exception of Maguire et al., (19) which was a retrospective before and prospective after design and O’Connor and Reid, (57) which was a retrospective before-after design. All studies were reported within the last 4 years and all in abstract format only.

Outcomes reported varied from overall compliance, to compliance with documenting individual parameters, to compliance at particular time-points, for example, 1st, 2nd and 3rd hour post-operative, to accuracy of documentation, and to changes in compliance rates after education and training or changes in observations documentation after the introduction of a MEWS. Information on the parameters included in the MEWS was available from three studies. (49, 51, 57) The parameters of heart rate (HR), respiratory rate (RR), blood pressure (BP), temperature (T) and oxygen saturation (SpO\textsubscript{2}) were included in all three MEWS. Pain, neuro-response/conscious level, lochia and ‘looks well’ were additionally recorded in one MEWS. (49) Urine and neuro-response/conscious level was recorded in one MEWS. (51) For those studies that provided clear population data, two studies included antenatal women, (23, 26) three included intrapartum women, and four included women who were postnatal. (20, 22, 24, 29) Two studies included women from the general population. (24, 27) The remaining nine studies included women from ‘high risk’ populations; that is from HDU, (21, 25, 26, 28) from ICU/ITU, (24) from post-operative recovery (20-22, 29) and women with proven maternal bacteraemia. (47)

Compliance rates varied significantly across studies, but, in the main, compliance was low. In studies that reported overall MEWS chart compliance rates (6 studies, all reporting on MEWS in ‘high-risk’ women), compliance ranged from < 50% in three studies (21, 25, 27) through 82% in one study (47) to 100% in two studies. (24, 28) In one study, (20) an audit of compliance rates resulted in further training of midwives with a consultant anaesthetist. A re-audit of compliance was conducted eight months later. Compliance rates improved significantly after training from 15% to 63% of one-hour post-operative observations recorded and from 42% to 60% observations recorded at two-hours post-operatively. Compliance in recording of observations also improved significantly after the introduction of a MEWS (47, 57) and during the audit period. (24) In one study, for example, four hourly observations improved on all parameters after the introduction of a MEWS chart (30) (BP 20% to 93%, HR 20% to 93%, RR 8% to 74%, SpO\textsubscript{2} 7% to 66% and temperature 18% to 97%). A z-test score was calculated for differences in proportions for each of the parameters. The results demonstrated a statistically significant improvement in recordings in all parameters following the introduction of a MEWS (p<0.05 for each individual parameter z-test score).
Auditing MEWS charts also had an impact on compliance rates. In Fitzpatrick et al.’s (23) study, for example, although information on the duration of the audit was not provided, compliance on all parameters increased to 100% (from 73% for RR, from 32% for urine output, from 74% for SpO₂ and from 11% for conscious level) during the audit period.

Compliance with MEWS, however, does appear to diminish over the duration of a woman’s inpatient stay. For example, the number of MEWS where no observations were recorded over a number of consecutive hours ranged from 64% for 2 hours to 2% for 7 hours (21) and from an 11% ‘poor’ recordings rate at 1 hour post-operative to 27% at 2 hours and a 91% ‘poor’ recordings rate from 3-24 hours post-operative. (29) Of concern in one audit, 40% of MEWS scores were found to be inaccurate. (22) Only two studies provided data related to escalation of care (23, 29) and the findings from these studies differed. Fitzpatrick et al (23) reported that 80% of women who required escalation were reviewed within thirty minutes by medical staff. In contrast, Helme et al (29) reported that in 69% of cases where clinical observations were triggered, no action was taken.

In summary, twelve studies provided data related to compliance with MEWS. MEWS does appear to improve recording of observations; however, in the main, compliance rates were sub-optimal. Education and training appears to assist improvement in compliance rates, yet compliance diminishes as the duration of inpatient stay lengthens.

2.1.2 Clinical communication and escalation of care

The following are responsible for implementation of recommendation 6:
Healthcare facility Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director), Doctors, Midwives and Nurses.

**Recommendation 6**

The ISBAR communication tool should be used when communicating information in relation to deteriorating and/or critically ill patients. Where a situation is deemed to be critical, this must be clearly stated at the outset of the conversation. Grade B
Practical Guidance

All maternity units should have effective communication systems in place to ensure that there is minimal delay between the triggering of a call for a review and the arrival of a medical doctor. The designation of who should be “senior doctor” called should be agreed locally by the midwifery and medical senior management and should be clearly communicated to staff members. The designation may depend on the availability of staff resources.

Depending on the acute illness, early consideration should be given to seeking professional assistance from other medical specialities such as an anaesthetist, haematologist or microbiologist either from within or from outside the maternity unit. Once the patient is clinically stable, it may be necessary to transfer the patient to an Intensive Care Unit (ICU). If this is anticipated, early communications with the ICU is important. Follow local care pathway for ICU admission.

Attention should also be paid to staff handovers in all disciplines. This is particularly important at weekends and holidays when staffing levels may be lower than usual.

A structured communication system for patients may be helpful, such as the ISBAR system. Further information on the ISBAR is also available from the Training Manual for the NEWS³ and can be downloaded as a smart app for the iPhone, iPod Touch and iPad available from https://itunes.apple.com/us/app/isbar-hd/id465890794

Refer to:

Care pathway for the deteriorated critically ill pregnant woman

Detection of clinical deterioration, recognition of critical illness
- Early Warning System
- Clinical evaluation

RESPONSE:
Multidisciplinary Care Plan
- Obstetrics
- Midwifery
- Anaesthesia/Critical Care

Components - ABCDE
ABC - airway breathing circulation, D - Delivery, E - Early transfer

Consultant-led decision making

Level2 Care
Location-
Delivery Suite, Maternity Hospital

Level3 Care
Location-
ICU- Critical Care Service, General Hospital, mandatory transfer
Requirement-
Inter-hospital critical care transport/retrieval

http://www.hse.ie/go/nationalearlywarningscore/
Table 3 ISBAR communication tool

<table>
<thead>
<tr>
<th>ISBAR Communication Tool SAMPLE</th>
<th>Patient Deterioration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong> Identify</td>
<td>Identify:</td>
</tr>
<tr>
<td>You</td>
<td></td>
</tr>
<tr>
<td>Recipient of handover information</td>
<td></td>
</tr>
<tr>
<td>Patient</td>
<td></td>
</tr>
<tr>
<td><strong>S</strong> Situation</td>
<td>Situation:</td>
</tr>
<tr>
<td>Why are you calling?</td>
<td>(Identify your concerns)</td>
</tr>
<tr>
<td><strong>B</strong> Background</td>
<td>Background:</td>
</tr>
<tr>
<td>What is the relevant background?</td>
<td></td>
</tr>
<tr>
<td><strong>A</strong> Assessment</td>
<td>Assessment:</td>
</tr>
<tr>
<td>What do you think is the problem?</td>
<td></td>
</tr>
<tr>
<td><strong>R</strong> Recommendation</td>
<td>Recommendation:</td>
</tr>
<tr>
<td>What do you want them to do?</td>
<td></td>
</tr>
</tbody>
</table>

Reproduced and adopted with permission from Dr S. Marshall, Monash University, Australia.

**Rationale**
The ISBAR communication tool is considered to assist more effective referral between staff members and is a useful tool in structuring and developing shared understandings of maternal complications.

The following are responsible for implementation of recommendation 7: Healthcare facility Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director) and Doctors, Midwives and Nurses.

Recommendation 7
The designation of the senior doctor to be called should be agreed locally by the midwifery and medical senior management. Grade D

The following are responsible for implementation of recommendation 8: Doctors, Midwives and Nurses.

Recommendation 8
Depending on the acute illness, early consideration should be given to seeking professional assistance from other medical specialties either within or from outside the maternity unit. Grade D
The IMEWS escalation chart as shown in practical guidance section gives guidance on when to seek professional assistance. For the most up-to-date version of the IMEWS chart see: http://www.hse.ie/eng/about/who/clinical/natclinprog/obsandgynaeprogramme/imews and http://www.health.gov.ie/patient-safety/ncec

**Practical Guidance**

**Irish Maternity Early Warning System (IMEWS) Escalation Guideline**

**ALL IMEWS TRIGGERS**
Consider context and complete full clinical assessment. Implement measures to reduce triggers if appropriate. Complete a full set of observations on IMEWS immediately. Inform the Midwife in charge.

**1 YELLOW**
Repeat full set of observations on IMEWS after 30 and before 60 minutes.

**2 YELLOWS OR 1 PINK**
Call the obstetrician to review. Repeat a full set of observations after 30 minutes.

**>2 YELLOWS OR ≥2 PINKS**
Call the obstetrician and request immediate review. Repeat a full set of observations within 15 minutes or monitor continuously.

**ALL IMEWS TRIGGERS**
Liaise with the Midwife in charge. Document all communication including:
- Redefined plan of care
- Ongoing frequency of observations

**IMPORTANT:**
1. If concerned about a woman, escalate care regardless of triggers.
2. If action is not carried out as above, CMM/Midwife in charge must contact the senior obstetrician on duty.
3. Document all communication and management plans in notes.

**CONSIDER MATERNAL SEPSIS**
Are 2 or more of the following SIRS criteria present?
- Temperature ≥38°C or <36°C
- Respiratory rate ≥20 breaths per min
- Heart rate ≥100 beats per min
- White cell count >16.9 or <4.0 x 10⁹/L
- Bedside glucose >7.7 mmol/L (in the absence of diabetes)
- Acutely altered mental status

**AND**
If infection is suspected after medical review

**Intervention:** within one hour

<table>
<thead>
<tr>
<th>COMPLETE SEPSIS</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Appropriate cultures*</td>
<td></td>
</tr>
<tr>
<td>2. FBC +/- lactate</td>
<td></td>
</tr>
<tr>
<td>3. Start urine output chart</td>
<td></td>
</tr>
<tr>
<td>4. Maintain O₂ (94-98%)</td>
<td></td>
</tr>
<tr>
<td>5. Consider IV fluid bolus**</td>
<td></td>
</tr>
<tr>
<td>6. IV antibiotics</td>
<td></td>
</tr>
</tbody>
</table>

*e.g. blood, wound, vaginal swab, urine etc
**exercise caution in presence of pre-eclampsia
2.1.3 Suspected maternal sepsis

In pregnancy, sepsis in the obstetric patient is uncommon in Ireland and the clinical outcomes are usually successful. (85) It is, however, important to be clinically vigilant for sepsis in the obstetric patient.

Pregnant women are, in general, healthy however they may get the same infections as other adults. In addition, women are at risk of pregnancy-specific infections and the risk of certain infections may be exacerbated during pregnancy (Table 4). Whatever the cause of the infection, it may lead to sepsis and thus increase the risks of fetomaternal morbidity and mortality.

**Table 4 Classification of infections in pregnancy**

<table>
<thead>
<tr>
<th>A. Infections specific to pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chorioamnionitis</td>
</tr>
<tr>
<td>2. Endometritis (with or without retained products)</td>
</tr>
<tr>
<td>3. Wound infection post caesarean section</td>
</tr>
<tr>
<td>4. Perineal infection</td>
</tr>
<tr>
<td>5. Lactational mastitis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Infections exacerbated during pregnancy, for example,</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Urinary tract infection including pyelonephritis</td>
</tr>
<tr>
<td>2. Pneumonia</td>
</tr>
<tr>
<td>3. Rubella</td>
</tr>
<tr>
<td>4. Listeria</td>
</tr>
<tr>
<td>5. Influenza</td>
</tr>
<tr>
<td>6. Varicella</td>
</tr>
<tr>
<td>7. Toxoplasmosis</td>
</tr>
<tr>
<td>8. Herpes infection</td>
</tr>
<tr>
<td>9. Parvovirus</td>
</tr>
<tr>
<td>10. Cytomegalovirus (CMV)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Infections incidental to pregnancy, for example,</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Viral hepatitis</td>
</tr>
<tr>
<td>2. Human Immunodeficiency Virus (HIV)</td>
</tr>
<tr>
<td>3. Sexually Transmitted Diseases (STDs)</td>
</tr>
<tr>
<td>4. Tuberculosis</td>
</tr>
<tr>
<td>5. Endocarditis</td>
</tr>
</tbody>
</table>

Source: Turner 2014
The following are responsible for implementation of recommendation 9: Doctors, Midwives and Nurses.

**Recommendation 9**  
The Sepsis 6 Box customised for pregnancy should be utilised for consideration of maternal sepsis.  
Grade C

### Practical Guidance
The escalation guide outlines the Systemic Inflammatory Response Syndrome (SIRS) criteria that are indicative of sepsis. If two or more SIRS criteria are present and infection is suspected after a medical review, the sepsis 6 needs to be completed within 1 hour.

**Systemic Inflammatory Response Syndrome (SIRS)** is the presence of 2 or more SIRS criteria

**Infection** is defined as a pathological process caused by invasion of normally sterile tissue or fluid or body cavity by pathogenic or potentially pathogenic micro-organisms. It is important to point out that, frequently, infection is strongly suspected without being microbiologically confirmed.

**Sepsis** Sepsis is the clinical syndrome defined by the presence of both infection and a systemic inflammatory response syndrome (SIRS). However, since infection cannot be always microbiologically confirmed, the diagnostic criteria are infection, suspected or confirmed and the presence of 2 or more SIRS criteria.

**Severe sepsis** refers to sepsis complicated by organ dysfunction. In the 8th Edition of the ICD-10-AM/ACHI/ACS this is extended to include organ failure. This difference does not affect the National Clinical Guideline (Sepsis Management) diagnostic criteria which identify a minimum level of organ dysfunction beyond which severe sepsis is diagnosed.

**Septic shock** is defined as severe sepsis with circulatory shock with signs of organ dysfunction or hypoperfusion in the 8th Edition of the ICD-10-AM/ACHI/ACS.

Pregnancy poses additional challenges in the prevention and management of sepsis. As part of the normal physiological response in pregnancy, a woman’s white cell counts may increase. The immune response to infection is modulated and the pharmacokinetics of antibiotics are different compared with the non-pregnant adult. Thus, it has been necessary to develop an Irish Maternity Early Warning System (IMEWS) with customised SIRS criteria, see Appendix 2.

The customised maternal Sepsis 6 takes into consideration the possibility of additional sites of infection that may need to be considered in maternity patients and when giving an IV fluid bolus, caution needs to be exercised in the presence of pre-eclampsia.

Special considerations with regard to escalation of care in response to Systemic Inflammatory Response Syndrome (SIRS) criteria is required to take into account the physiological changes of pregnancy on the women.

Guidance for pregnancy-specific infections including antibiotic regimens tailored for pregnancy is being developed and will be published by the Institute of Obstetrics and Gynaecology, Royal College of Physicians and HSE Clinical Programme in Obstetrics and Gynaecology.

*The customised SIRS criteria and further detail on sepsis management is available in National Clinical Guideline No. 6 Sepsis Management available at www.health.gov.ie/patient-safety/ncec

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4 Australian Modification of ICD-10 incorporating the Australian Classification of Health Interventions and the Australian Coding Standards.
2.1.4 Implementation of IMEWS

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

Organisational supports and governance structures

Recognition and response systems should be part of standard clinical practice. Nonetheless, the introduction of new systems to optimise care of patients whose condition is deteriorating requires organisational support and executive and clinical leadership for success and sustainability. Each maternity unit should set up an IMEWS group/committee to consider and agree the processes and stages of implementation for IMEWS and the IMEWS process for escalation (Appendix 2).

The following are responsible for implementation of recommendations 10-12: Healthcare facility Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance) and Doctors, Midwives and Nurses.

Recommendation 10
A formal governance process (such as an IMEWS group/committee) should oversee the development, implementation and ongoing review of IMEWS recognition and response systems locally.

Practical Guidance
An IMEWS group/committee should:

- Have appropriate responsibilities delegated to it and be accountable for its decisions and actions.
- Monitor the effectiveness of interventions and education.
- Have a role in reviewing performance data, and audits.
- Provide advice about the allocation of resources.

Recommendation 11
Any new recognition and response systems or procedures should be integrated into existing organisational safety and quality systems to support their sustainability and offer opportunities for organisational learning.

Recommendation 12
Organisations should have systems in place to ensure that the resources required to provide emergency assistance (such as equipment and pharmaceuticals) are always operational and available.

Education

An IMEWS education programme should be available to healthcare staff such as doctors, nurses and allied health professionals. The education and training needs should be coordinated by designated staff within, or supporting, the maternity unit.

Having an educated and suitability skilled and qualified workforce is essential in providing appropriate care to patients whose condition is deteriorating. Education should provide knowledge of observations and identification of clinical deterioration, as well as appropriate clinical management skills. Skills such as communication and effective team working are needed to provide appropriate care to a patient whose condition is deteriorating, and should also be part of staff development.
The following are responsible for the implementation of recommendation 13: Healthcare facility Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance) and Doctors, Midwives and Nurses.

**Recommendation 13**  
All clinical staff should receive education and training in IMEWS and the local escalation protocol relevant to their position. They should know how to call for emergency assistance if they have any concerns about a patient, and know that they should call under these circumstances. This information should be provided at the commencement of employment and as part of regular refresher education and training.

**Practical Guidance**  
A ‘train the trainer’ model is to be adopted for implementation of the IMEWS education programme, that is, suitable staff, doctors, midwives, nurses and physiotherapists train as trainers and deliver the multi-disciplinary programme to staff. Delivering an education session is estimated to take 2 hours. On average, the education sessions will include 10 trainees (2 trainers). The number of trainers required is estimated as 2 trainers per maternity unit (total of 38 trainers) however the distribution of trainer per trainee may vary depending on trainee number at each maternity unit location.

All medical, midwifery and nursing staff should be able to:
- Systematically assess a patient
- Understand and interpret abnormal physiological parameters and other abnormal observations
- Understand and operationalise IMEWS and IMEWS process for escalation of care
- Initiate appropriate early interventions for patients who are deteriorating
- Respond with life-sustaining measures in the event of severe or rapid deterioration pending the arrival of emergency assistance
- Communicate information about clinical deterioration in a structured and effective way to the primary medical practitioner or team, to clinicians providing emergency assistance and to patients, families and carers
- Undertake tasks required to properly care for patients who are deteriorating such as developing a clinical management plan, writing plans and actions in the healthcare record and organising appropriate follow up.

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

For process audits the recommended standard required is 100% compliance. Where the compliance is less than 80% it is proposed that local action plans are put in place, e.g. increase frequency of audits and identify problem areas. The recommended sample size for the audit is one third of patients’ charts in the ward/unit/department.

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

- Number of times IMEWS is triggered annually,
- Basic patient outcome measures (e.g. hospital length of stay (HLOS), transfer to HDU, ICU, ICU length of stay, unexpected death.
- Number of cases of serious adverse clinical outcomes when the IMEWS was not triggered.
- Clinical outcomes of adverse outcomes when IMEWS was triggered.
- Identification of the location to which the patient has been transferred or otherwise, for those triggering a response.

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

The following are responsible for implementation of recommendation 14: Relevant HSE Corporate Directorates and Divisions, Healthcare facility Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance) and Doctors, Midwives and Nurses in consultation with the IMEWS multi-disciplinary group/committee once established (Recommendation 10).

**Recommendation 14**
Audit data should be collected and reviewed locally and pooled nationally regarding the implementation and effectiveness of IMEWS.

The following are responsible for implementation of recommendations 15-16. HSE National Clinical Programme for Obstetrics and Gynaecology and Quality and Patient Safety Division.

**Recommendation 15**
A key performance indicator for the implementation of IMEWS and its associated education programme is included in the HSE Service Plan.

**Recommendation 16**
The IMEWS parameters are reviewed annually and updated as new information becomes available either from national or international audits or research.
Appendices and references

Appendix 1: Guideline Development Group

Terms of Reference
Project Lead is Professor Michael Turner Lead for Obstetric and Gynaecology Clinical Programme. Ms Sheila Sugrue is chairperson of the Reference Group. Ms Ina Crowley is the named Project Manager and chairperson of the Programme Design Team. Please see Organisational Structure and Project Governance Chart.

Terms of Reference for the Reference Group

1. Approve the outline proposal, Terms of Reference and governance structures for the project

2. Review and approve an EWS prepared by the design team and endorsed by the Governance Group for Obstetrics and Gynaecology services in Ireland

3. Approve the final training programme and audit tool prepared by the design team for use in Obstetrics and Gynaecology services in Ireland.

Terms of Reference for the Programme Design Team

1. Design an EWS with a training programme and evaluation for the implementation of a national standardised Early Warning System for Obstetric and Gynaecology services in Ireland within the agreed timeframe.

2. Prepare and present the EWS training programme and audit tool for approval by the Reference Group and the Governance Group.
Organisational Structure and Project Governance Chart

Clinical Strategy and Programmes Division
Quality and Patient Safety Division
Nursing and Midwifery Services

Project Governance:
Professor Michael Turner
Dr Philip Crowley
Dr Michael Shannon

Reference Group
A small high level multidisciplinary group with responsibility to approve a national early warning system appropriate for Obstetric and Gynaecology services and provide guidance to the programme design team as required
Chairperson: Ms Sheila Sugrue

Programme Design Team
A multidisciplinary working group to prepare an EWS training programme and audit tool to enable Obstetric and Gynaecology services commence the implementation of an agreed standardised National Early Warning System as guided by the Reference Group.
Chairperson: Ms Ina Crowley
Membership and Conflicts of Interest
Chair:
Professor Michael Turner, Clinical Lead for the National Clinical Programme in Obstetrics and Gynaecology

IMEWS Design Team

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>1 Prof. Michael Turner</td>
<td>Lead for Obstetrics and Gynaecology Clinical Programme, Clinical</td>
</tr>
<tr>
<td></td>
<td>Strategy and Programmes Division</td>
</tr>
<tr>
<td>2 Ms Mary Doyle</td>
<td>Midwifery Practice Development Coordinator, Regional Maternity Hospital, Ennis Road, Limerick</td>
</tr>
<tr>
<td>3 Ms Triona Cowman</td>
<td>Director of the Centre for Midwifery Education, Located at the Coombe Women &amp; Infants University Hospital, Cork Street, Dublin 8</td>
</tr>
<tr>
<td>4 Ms Sheila Sugrue</td>
<td>National Lead Midwife, Office of Nursing &amp; Midwifery Services. Clinical Strategy and Programmes Division HSE.</td>
</tr>
<tr>
<td>5 Ms Eilish Croke</td>
<td>Programme Manager National Acute Medicine Programme, Clinical Strategy and Programmes Division HSE.</td>
</tr>
<tr>
<td>6 Dr Paula Connolly</td>
<td>Consultant Anaesthetist Our Lady of Lourdes Hospital Drogheda, HSE Dublin North East.</td>
</tr>
<tr>
<td>7 Ms Una Carr</td>
<td>Assistant Director of Midwifery, Galway University Maternity Hospital, Galway.</td>
</tr>
<tr>
<td>8 Ms Anna Deasy O Connor</td>
<td>Clinical Tutor (Midwifery), Trinity College Dublin.</td>
</tr>
<tr>
<td>9 Ms Marie Horgan</td>
<td>Clinical Nurse Specialist Chest Pain, St Luke’s Hospital, Kilkenny (representing the NEWS team).</td>
</tr>
<tr>
<td>10 Mr Mikey O Brien</td>
<td>Clinical Midwife Manager, Rotunda Maternity Hospital, Dublin.</td>
</tr>
<tr>
<td>11 Ms Ina Crowley (chairperson)</td>
<td>Assistant Director of Nursing and Midwifery (Prescribing), Dublin/Mid Leinster.</td>
</tr>
</tbody>
</table>

IMEWS Reference Team

<table>
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<td>4 Dr Paula Connolly</td>
<td>Consultant Anaesthetist, Our Lady of Lourdes Hospital, Drogheda, HSE Dublin North East.</td>
</tr>
<tr>
<td>5 Ms Geraldine Keohane</td>
<td>Director of Midwifery, Cork University Maternity Hospital, Cork.</td>
</tr>
<tr>
<td>6 Ms Patricia Hughes</td>
<td>Director of Midwifery, Coombe Women &amp; Infants University Hospital, Cork Street, Dublin 8.</td>
</tr>
<tr>
<td>7 Dr Ailish Quinlan</td>
<td>Clinical Indemnity Scheme, State Claims Agency Treasury Building, Grand Canal Street, Dublin 2.</td>
</tr>
<tr>
<td>8 Ms Mary Wynne</td>
<td>Acting Area Director Nursing and Midwifery Planning and Development, Dublin North East.</td>
</tr>
<tr>
<td>9 Mr Brian Lee</td>
<td>Programme Manager, National Obstetrics and Gynaecology Clinical Programme.</td>
</tr>
<tr>
<td>10 Ms Ina Crowley</td>
<td>Assistant Director of Nursing and Midwifery (Prescribing), Dublin/Mid Leinster.</td>
</tr>
</tbody>
</table>
Conflicts of Interest
Membership of the Guideline Development Group was voluntary, no member was paid a fee for his/her contribution.

No conflicts of interest were declared.

International Peer Review
The National Clinical Guideline was kindly reviewed by Dr. Melissa Bauer D.O., Director of Obstetric Anesthesiology Research, University of Michigan Health System.

In summary, the guideline was reviewed in a very positive light. It was thought to be user-friendly, practical and suitable for routine use. The Guideline Development Group was acknowledged for their efforts to decrease maternal mortality and morbidity by creating a National Clinical Guideline. In particular the reviewer felt it was laudable that audits are in progress to refine maternity early warning system practices and parameters. The reviewer concluded that from the efforts and improvements that Ireland has accomplished with the first IMEWS guideline, and with monitoring of the practices set out by the guideline, it will make a significant contribution to the international evidence.

In terms of the use of quality evidence to support the guideline, the expert reviewer asked for two additional references to be considered:


The reviewer asked to clarify why the IMEWS chose an aggregate-weighted scoring system instead of a single-parameter risk assessment as proposed by Mhyre et al, 2014. The Guideline Development Group felt that in Ireland, ease of use and standardisation are central to the potential benefits of early warning systems. The Guideline Development Group also were not satisfied to delete temperature from their proposed criteria as this may compromise the simultaneous recording of the woman’s vital signs and compromise potential improvements in pregnancy outcome.

The other significant point that the expert reviewer wished to be addressed was in relation to a meta-analysis of maternal SIRS by Bauer et al. The Guideline Development Group reviewed this evidence and concluded that the meta-analysis did not reach any firm conclusions regarding definitive MEWS parameters and SIRS. However, the Guideline Development Group agree that further evaluation is required to show whether obstetric early warning systems will improve outcomes for women. However, in order to be able to evaluate their role in improving pregnancy outcomes, it is essential to standardize both maternal vital signs parameters and escalation responses to any triggers.

The reviewer also suggested that the pink category be changed to red, however the Guideline Development Group chose pink so that the IMEWS would be standardised with other early warning systems in the Irish setting, such as NEWS. Using similar colour coding across charts was thought to be prudent from a patient safety perspective.

The reviewer made the comment that if a patient is triaged with sepsis then the Surviving Sepsis Campaign Guidelines should be followed. The Guideline Development Group noted that the Surviving Sepsis Campaign has been adapted to the Irish context and should further advice on sepsis management be required, the National Clinical Guideline No 6 – Management of Sepsis in Ireland may be consulted.
In summary the guideline was reviewed positively. The guideline was identified as clearly written allowing for individual clinical decisions, albeit within a framework of low level evidence to support benefit. Links between decisions and evidence were made where possible and the reviewer considered that the Guideline Development Group did a very good job of highlighting where evidence is lacking. The reviewer made the comment that given the lack of evidence of validation of maternity MEWS, MEWS should not be rolled out on the basis of assumption of benefit.

The reviewer identified the importance of ensuring that signs of sepsis are also identified in women postnataally. Additional guidance on information for women and their partners/families on signs and symptoms of escalating poor health that they should urgently report to their midwife or family doctor was suggested by the reviewer. Additions to evaluation and audit were proposed.

The guideline recommendations do not appear to conflict with other evidence considered by the reviewer.
Appendix 2: IMEWS chart sample (front and back cover)

For the most up-to-date version of the IMEWS chart see: http://www.hse.ie/eng/about/who/clinical/natclinprog/obsandgynaeprogramme/imews and http://www.health.gov.ie/patient-safety/ncec

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### Escalation Guideline

**ALL IMEWS TRIGGERS**

Consider context and complete full clinical assessment. Implement measures to reduce triggers if appropriate. Complete a full set of observations on IMEWS immediately. Inform the Midwife in charge.

**1 YELLOW**

Repeat full set of observations on IMEWS after 30 and before 60 minutes.

**2 YELLOWS OR 1 PINK**

Call the obstetrician to review. Repeat a full set of observations after 30 minutes.

**>2 YELLOWS OR ≥2 PINKS**

Call the obstetrician and request immediate review. Repeat a full set of observations within 15 minutes or monitor continuously.

**IMPORTANT:**

1. If concerned about a woman, escalate care regardless of triggers.
2. If action is not carried out as above, CMM/Midwife in charge must contact the senior obstetrician on duty.
3. Document all communication and management plans in notes.

### CONSIDER MATERNAL SEPSIS

Are 2 or more of the following SIRS criteria present?

- Temperature ≥38°C or ≤36°C
- Respiratory rate ≥20 breaths per min
- Heart rate ≥100 beats per min
- White cell count >16.9 or <4.0 x 10⁹/L
- Bedside glucose >7.7 mmol/L (in the absence of diabetes)
- Acutely altered mental status

If infection is suspected after medical review

**AND**

Intervention: within one hour

**COMPLETE SEPSIS 6**

1. Appropriate cultures*
2. FBC +/- lactate
3. Start urine output chart
4. Maintain O₂ (94-98%)
5. Consider IV fluid bolus**
6. IV antibiotics

---

* e.g. blood, wound, vaginal swab, urine etc
** exercise caution in presence of pre-eclampsia
The Irish Maternity Early Warning System

### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>IMEWS Trigger</th>
<th>Normal Values</th>
<th>Yellow Zone</th>
<th>Pink Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate (bpm)</td>
<td>11-19</td>
<td>20-24</td>
<td>≤10 or ≥25</td>
</tr>
<tr>
<td>SpO2 (%)</td>
<td>96-100</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>36.0-37.4</td>
<td>35.1-35.9 or 37.5-37.9</td>
<td>≤35 or ≥38</td>
</tr>
<tr>
<td>Maternal HR (BPM)</td>
<td>60-99</td>
<td>50-99 or 100-119</td>
<td>≤50 or ≥120</td>
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<tr>
<td>Systolic BP (mmHg)</td>
<td>100-139</td>
<td>90-109 or 140-159</td>
<td>≤90 or ≥160</td>
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<tr>
<td>Diastolic BP (mmHg)</td>
<td>50-89</td>
<td>40-49 or 90-99</td>
<td>≤40 or ≥100</td>
</tr>
<tr>
<td>AVPU</td>
<td>Alert</td>
<td>Voice</td>
<td>Pain or Unresponsive</td>
</tr>
</tbody>
</table>

### Woman’s Name:

### Date of Birth:

### Healthcare Record No:

### Document Number (eg. 1, 2):

### Booking BP: __________/_________

### Gestation at Booking (weeks):

### Year:

### Date:

### Time:

#### Select trigger zone:

- **Yellow Zone**
- **Pink Zone**
- **Alert**

#### Triggers:

- **Respiratory rate (bpm)**
- **SpO2 (%)**
- **Temperature (°C)**
- **Maternal HR (BPM)**
- **Systolic BP (mmHg)**
- **Diastolic BP (mmHg)**

#### Symptoms:

- **Other**
- **Protein**
- **Glucose**
- **Other**

#### Pain Score 0-10

- **Alert**
- **Y**
- **P**
- **U**

#### Total Yellow Zones

#### Total Pink Zones

#### Initials

Contact appropriate doctor for early intervention if the woman triggers one **PINK** or two **YELLOW** zones at any one time.
## Appendix 3: Antenatal observation record (sample)

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (24hr Clock)</th>
<th>Legible ID Band</th>
<th>Vital Signs to be recorded on IMEWS Chart</th>
<th>Abdominal Examination:</th>
<th>Ant D Administered</th>
<th>Weight</th>
<th>B.M.I.</th>
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<tbody>
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<td>Fetal Wellbeing:</td>
<td>If SROM Please Record</td>
<td>Date _____________</td>
<td>Time_____________</td>
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<td>Maternal Wellbeing:</td>
<td>Emotional State</td>
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<td>Intake Output chart</td>
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<td>Other:</td>
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</tr>
</tbody>
</table>
Antenatal observational chart (reverse side)

Any concerns / deviations from the norm should be reported to the appropriate Midwife / Obstetrician.

<table>
<thead>
<tr>
<th>Agreed EDD</th>
<th>Refer to agreed EDD (confirmed with early dating ultrasound scan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight / BMI</td>
<td>All women should have their weight, height and BMI calculated and documented at booking. Women with a BMI &gt; 29.9kg/m² should commence a pregnancy/obesity care pathway / action plan.</td>
</tr>
</tbody>
</table>

### Vital Signs on IMEWS

All physiological observations must be recorded on the Irish Maternity Early Warning System

#### Abdominal Examination

| Inspection | NAD, size, shape, scars, striae |
| Fundal Height | Equal to dates, height measured in cms, small for dates / gestational age, large for dates / gestational age |
| Lie | Longitudinal, transverse, oblique, unstable |
| Presentation | Cephalic, breech, shoulder |
| Position | OA, LOA, ROA, LOT, ROT, OP, LOP, ROP |
| Fifth palpable Engaged / Not | Engaged, 1/5, 2/5, 3/5, 4/5, 5/5, ballotable, free |

#### Auscultate: Fetal Heart Rate

Average rate measured in beats per minute with Pinard Stethoscope / Doppler / CTG.

#### Fetal Wellbeing:

- **Fetal Movement**: Normal pattern, increased activity, reduced fetal movements, absence of fetal movements.
- **Membranes / Liquor / P.V. Loss**: Membranes intact, ruptured, suspected ruptured membranes. 
  - Liquor / PV Loss: **Colour**: clear, pink, blood stained, meconium, **Volume**: small / large amount, **Odour**: no odour, foul smelling.
- **CTG Recorded (Yes / No) (If applicable)**: If applicable record CTG and comment on the features / findings in the woman’s notes.

#### Maternal Wellbeing:

- **Emotional State**: Coping well, anxiety, tearful, low mood.
- **Eating & Drinking**: Normal intake, fasting, restricted fluid intake, reduced appetite, special diet, nausea, vomiting.
- **Intake / Output Chart required (Yes / No)**: (Yes / No) if Intake / Output chart or Fluid Balance chart required.
- **Bowels**: B.O (bowels opened), BNO (bowels not opened), constipation, diarrhoea, leakage, urgency, haemorrhoids.
- **Sleep / Rest**: Sleeping / resting well, insomnia, fatigue.
- **Oedema**: NAD, Facial generalised leg, ankle. (Comment x 2 or indicate (L) Left & (R) Right) Mild, moderate, severe.

#### Investigations Performed:

Document if any investigations are performed by inserting date and initials in the appropriate box.
**Appendix 4: Postnatal observation record: mother (sample)**

**Orientation to Ward** *(carried out by the Midwife accepting the transfer to the postnatal ward)*

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes</th>
<th>No</th>
<th>Visiting arrangements explained</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Midwife</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Ward Layout</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information on Baby Security</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Discussion re expected date of discharge**

- **Yes**
- **No**

**Expected date of discharge**

- 
- 

**Signature**

- 
- 

**Special Requirements:**

- **Anti D Required**
  - **Yes**
  - **No**
  - If yes: _____/_____/_______ date administered
  - Signature

- **MMR Required**
  - **Yes**
  - **No**
  - If yes: _____/_____/_______ date administered
  - Signature

**Postnatal Day**

<table>
<thead>
<tr>
<th>Postnatal Day</th>
<th>Admission</th>
<th>Day</th>
<th>Day</th>
<th>Day</th>
<th>Day</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (24hr clock)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legible I.D Band (Yes / No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Vital Signs to be recorded on IMEWS Chart**

- Wellbeing/ mood
- Sleep
- Breasts
- Nipples
- Breastfeeding
- Uterus
- Wound
- Perineum
- P.V Loss/ Lochia
- Micturition
- Bowels
- Legs
- Postnatal Exercise
- Bonding

**Signature, Printed Name & Job Title**

**Postnatal Education:**

- **Yes**
- **No**

*(See reverse for list of same to be completed)*

*(If all complete) Signature________________________ Date________________________*
### Suggested postnatal observations (reverse side)
(This list is not exhaustive and is only intended for useful reference)

<table>
<thead>
<tr>
<th>Observation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vital Signs:</strong></td>
<td>All physiological observations must be recorded on the IMEWS</td>
</tr>
<tr>
<td><strong>Wellbeing / Mood:</strong></td>
<td>Coping well, baby blues, excessive anxiety, postnatal depression.</td>
</tr>
<tr>
<td><strong>Sleep:</strong></td>
<td>Good, intermittent, little, none, excessive sleep, inability to get sleep, premature waking</td>
</tr>
<tr>
<td><strong>Breasts:</strong></td>
<td><em>Indicate (L) Left &amp; (R) Right or Comment x 2:</em></td>
</tr>
<tr>
<td></td>
<td>Soft, filling, full, engorged, sore</td>
</tr>
<tr>
<td><strong>Nipples:</strong></td>
<td><em>Indicate (L) Left &amp; (R) Right or Comment x 2:</em></td>
</tr>
<tr>
<td></td>
<td>NAD, cracked, bleeding, bruised, healing, sore,</td>
</tr>
<tr>
<td><strong>Breastfeeding:</strong></td>
<td>Confidence with positioning, attachment, support required, expressing, any problems?</td>
</tr>
<tr>
<td><strong>Uterus:</strong></td>
<td>W/C (well contracted), abdominal tenderness, involuting, sub- involution, boggy, high</td>
</tr>
<tr>
<td><strong>Wound:</strong></td>
<td>Clean and dry, healing, moist, inflammed, infected, suture / clip removal.</td>
</tr>
<tr>
<td><strong>Perineum:</strong></td>
<td>Soreness, bruising, swelling, sutures, infection</td>
</tr>
<tr>
<td><strong>P.V.Loss/Lochia:</strong></td>
<td>Type (rubra, serosa, alba), amount (minimal, average, heavy), colour (red, brown, pink), offensive odour, presence of clots</td>
</tr>
<tr>
<td><strong>Micturition:</strong></td>
<td>Pain on passing urine, leakage, stress incontinence, urgency.</td>
</tr>
<tr>
<td></td>
<td><em>Time and volume (mls) of first 2 voids to be documented.</em></td>
</tr>
<tr>
<td></td>
<td>If either of first 2 voids is less than 200mls, consult Bladder Care Guideline</td>
</tr>
<tr>
<td><strong>Bowels:</strong></td>
<td>B.O (bowels opened), BNO (bowels not opened), constipation, diarrhoea, leakage, urgency, haemorrhoids</td>
</tr>
<tr>
<td><strong>Legs:</strong></td>
<td><em>Comment x 2 or indicate (L) Left &amp; (R) Right.</em></td>
</tr>
<tr>
<td></td>
<td>NAD, oedema, redness, swelling, pain, varicose veins, thrombophlebitis, cramps, deep vein thrombosis</td>
</tr>
<tr>
<td><strong>Postnatal Exercises:</strong></td>
<td>Explained and encouraged (Ex/ENC), doing them, not doing them</td>
</tr>
<tr>
<td><strong>Bonding:</strong></td>
<td>Good, reassured, mother expressing difficulty</td>
</tr>
</tbody>
</table>

### Postnatal Education
(Please provide this education from the time of admission and clearly document same below)

<table>
<thead>
<tr>
<th>Information Given and Discussed with Mother</th>
<th>Date</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest/Hygiene/Nutrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postnatal “Blues“ / Depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breastfeeding Support/Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical Smear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaccination/ Immunisation/BCG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Instruction on the safe use of formula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(if required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changing / Top and tail/ Handling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cord Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye Care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevention of SIDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signs of effective feeding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plagiocephaly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin D Supplementation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 5: Patient information leaflet

This leaflet was produced as a recommendation of a patient working group on ways to promote improved safety in patient care and to empower patients to take greater control over their health and well-being whilst in hospitals in Ireland.

Get involved!

Find out about how you can get involved in improving health services in Ireland.

The HSE is actively inviting service users to get involved on patient forums and quality improvement initiatives. To find out more contact:

National Advocacy Unit, HSE, Quality & Patient Safety Directorate, Health Service Executive, Oak House, Millennium Park, Naas, Co. Kildare

Tel: (045) 880 400
Email: yoursay@hse.ie
www.hse.ie

Find out about (IMEWS)
Irish Maternity Early Warning System

people caring for people
To ensure that any change in your condition is picked up early, maternity hospitals in Ireland have an early warning system in place called IMEWS. This system is used along with clinical assessment to detect any change in your condition and to improve the decision making about the care that you might need if you are ill during your pregnancy.

**Pregnancy is a normal healthy event**
Most healthy women have a normal pregnancy and birth and do not suffer any illness as a result of pregnancy. However, for a minority of women this is not the case. To ensure that any change in a woman's condition is picked up early, maternity hospitals in Ireland have a system in place called the Irish Maternity Early Warning System (IMEWS).

**Get involved!**
The responsibility for patient safety remains with your healthcare team. However, you also play a vital role in the decision making about your care. We encourage you to ask questions and become fully informed and involved in the decision making about your care. **Remember - it’s safer to ask.**

**Your vital signs**
The maternity team assess your vital signs while you are in hospital. Vital signs are signs that are essential for life, for example breathing and heart rate.

**The maternity team:**
- Assess your breathing, your heart rate and your level of consciousness
- Take your blood pressure and temperature
- Assess the level of oxygen in your blood.

All of these measurements are recorded in your observation chart for ongoing monitoring.

**What is IMEWS?**
IMEWS is a system for the early detection of illness during pregnancy and after a woman has had a baby. This system is in place across all maternity hospitals in Ireland. Due to the changes which take place in a woman’s body during pregnancy and after the baby is born, it is often difficult to detect a severe illness. IMEWS helps to detect earlier if a woman has developed a severe illness and it helps provide safe, high quality care in a timely manner for all women using our maternity services.

**IMEWS helps maternity teams to make decisions in relation to the care that women might need if they are ill during pregnancy.**
It also alerts the maternity team to:
- Carry out a full review of your condition
- Carry out tests or investigations
- Make a plan for ongoing care
- Make the right decision in relation to the type of care that is needed.

**Let your midwife know, if you are feeling unwell**
The midwifery/nursing staff will inform the doctor requesting that they intervene early to prevent your condition from getting worse.
Appendix 6: Literature review

Background
Maternity early warning systems (MEWS) or physiological track and trigger systems (TTS) are bedside tools that have been developed for use in maternity care to assess basic maternal physiological parameters, and in doing so, to identify women with developing, established or deteriorating critical illness. While there is some evidence to suggest that modified early obstetric warning systems (MEOWS) may be useful in predicting morbidity,(33) concerns have also been expressed about the lack of validated systems for use in maternity populations.(58) This systematic review brings together all of the available and relevant literature, in one report, so that the totality of the evidence on early warning scores for use in maternity care is made available to inform this National Clinical Guideline.(59) The reporting of this systematic review adheres to the Preferred Reporting In Systematic Reviews and Meta-Analysis (PRISMA) criteria in as far as was possible.(60)

Research questions
The following specific research questions directed this review:

1. What early warning systems or trigger systems (including escalation protocols and communication tools such as ISBAR) are currently in use internationally in pregnant women or women who delivered in the previous 42 days, for the detection of deterioration/timely identification of deterioration in maternity patients?
   a. What is the level of clinical validation of these scoring systems including escalation protocols and communication tools?

2. What education programmes have been established to train healthcare professionals in the delivery of MEWS?
   a. What level of evaluation has been used for these education programmes?

3. What are the findings in the economic literature of cost effectiveness, cost impact and resources involved with early warning or trigger systems in the detection of deterioration/timely identification of deterioration in pregnant women or women who delivered in the previous 42 days, including implementation costs?

Objectives
To answer the review questions, seven discrete, yet complimentary, objectives, operationalised within five work packages, were defined:

1. To describe the use internationally, including the level of use and the variety of systems in use, of early warning or track and trigger systems in pregnant women or women who gave birth in the previous 42 days, for the detection of deterioration/timely identification of deterioration (work package 1);

2. To describe escalation protocols and communication tools (e.g., ISBAR) in use alongside such early warning or track and trigger systems (work package 1);

3. To describe the education programmes, including their evaluation that have been established to train healthcare professionals, and other non-professional staff, in the delivery of MEWS (work package 1);

4. To identify and quality assess clinical guidelines on the use of early warning or track and trigger systems in pregnant women or women who gave birth in the previous 42 days, for the detection of deterioration/timely identification of deterioration (work package 2);

5. To evaluate the clinical effectiveness of early warning or track and trigger systems on pregnancy, labour and birth, postpartum (up to 42 days) and neonatal outcomes (work package 3);

6. To describe the development and validation of such early warning or track and trigger systems (work package 4);

7. To evaluate the cost effectiveness, cost impact and resources involved with early warning or track and trigger systems (work package 5).
Criteria for considering studies for this review
Criteria for considering studies for inclusion in this review are:

Types of participants
- Women who are clinically pregnant or who were delivered at any gestation within the previous 42 days.
- Participants for the education programmes, including their evaluation are healthcare professionals using early warning systems, track and trigger systems, escalation protocols or communication tools in maternity care settings.

Types of intervention/exposure/comparators
- Early warning systems or track and trigger systems, which rely on periodic observation of selected basic physiological signs with predetermined calling or response criteria for escalating care to facilitate prompt recognition of clinical deterioration.
- Escalation protocols or communication tools used in combination with, or as an adjunct to, early warning systems or track and trigger systems.
- Comparators include non-use of the systems or the use of alternative systems of physiological monitoring.

Types of outcomes
- Use of early warning systems, triggers systems and escalation protocols or communication tools nationally and internationally.
- Types of systems in use.
- Types of education programmes.
- Evaluation strategies/methods for education programmes.
- Number and type of clinical guidelines (regional, national, international).
- Pregnancy, labour and birth, and postpartum outcomes
  - Maternal death
  - Maternal critical illness (maternal collapse – cardiac or respiratory arrest, haemorrhage, sepsis, eclampsia, etc.)
  - Admission to ICU
  - Length of hospital stay (days).
- Sensitivity of early warning system or track and trigger system for adverse outcome/critical illness criterion.
- Specificity of early warning system or track and trigger system for adverse outcome/critical illness criterion.
- Positive predictive value of early warning system or track and trigger system for adverse outcome/critical illness criterion.
- Negative predictive value of early warning system or track and trigger system for adverse outcome/critical illness criterion.
- Measures of healthcare economics
  - Healthcare resource use and expenditure including costs associated with direct medical resource use (staff time, education input, additional referrals), indirect costs (associated with lost or reduced productivity) and other non-medical costs (such as patient out of pocket expenses) associated with early warning system or track and trigger system use; cost savings, cost effectiveness measures e.g. ICERs, QALYs.

Types of studies/reports
Five categories of studies/reports were included in this review, and are reflective of work packages 1-5.

1. Descriptive studies: These studies describe the extent of use and types/variety of early warning systems, track or trigger system, escalation protocols or communication tools in use in clinical practice. They include studies (summarised separately) that describe education programmes, including their evaluation, that have been established to train healthcare professionals in the delivery of MEWS.
2. **Guidelines:** These describe identified regional, national and international reports of guidelines on early warning systems, trigger systems and escalation protocols or communication tools.

3. **Effectiveness studies:** These studies consider the effectiveness of introducing an early warning or trigger system on outcomes for women and/or their infants. Studies were included in this category only if they have a controlled design i.e. randomised controlled trials, non-randomised controlled trials, controlled before-and-after studies and interrupted time series designs. Studies that evaluate the effects of the system on relevant outcomes, but do not include a controlled element i.e. case series, were included in the descriptive category.

4. **Development and validation studies:** For the purpose of this category, development studies were defined as studies that focus on the development of early warning or trigger systems while validation studies focus on the predictive ability of such systems. Studies in this category included women both with and without the reference outcome (such as sepsis, admission to intensive care or mortality). Studies with women with the reference outcome only were classified as descriptive. For the purpose of classification, studies were recorded as ‘development’ studies if reference ranges, parameters, cut-offs, and/or design of scoring systems were identified based on the outcomes of the study sample (for example, through the use of receiver operating characteristics [ROC] curves). In validation studies, such reference criteria have already been determined and their predictive ability is evaluated in a new sample of women.

5. **Health economics:** The health economics component considered full economic evaluation studies (cost-effectiveness analysis, cost-utility analysis and cost-benefit analysis), cost analysis and comparative resource use studies comparing early warning or trigger system to one or more standard treatments. These included randomised controlled trials or any study that meets the eligibility criteria for the review of intervention effects.

**Search methodology**

To identify relevant studies/reports, a comprehensive search methodology for both published and unpublished (grey) literature was developed and executed through routine scientific database searches and extensive grey literature retrieval mechanisms. Language restrictions were not applied to the search strategy; however, given the timeframe available, selection of relevant papers was restricted to English language.

Comprehensive search strategies were developed for each database searched based on search strategies developed for Medical Literature Analysis and Retrieval System Online (MEDLINE), The Cumulative Index to Nursing and Allied Health Literature (CINAHL) and Exerpta Medica Database (EMBASE).

The following electronic databases were searched in April 2014:

- Medical Literature Analysis and Retrieval System Online (MEDLINE)
- The Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- Exerpta Medica Database (EMBASE)
- Maternity and Infant Care (MIDIRS)
- Applied Social Sciences Index and Abstracts (ASSIA)
- The Health Management Information Consortium (HMIC)
- Cochrane Database of Systematic Reviews (CDSR)
- Cochrane Central Register of Controlled Trials (CENTRAL)
- Database of Abstracts of Reviews of Effects (DARES)
- Health Technology Assessment Database
- NHS Economic Evaluation Database (NHSEED)
- Health Economic Evaluation Database (HEED)
- Global Health
- Cochrane Methodology Register
- World Health Organisation Global Health Library (Global Index Medicus).
As different study designs were required to meet the different objectives of this review, no study design delimiter was utilised thus ensuring that the likelihood of finding relevant studies irrespective of design was increased. The search for economic evaluations was also supplemented with searches of the following websites:

- NHS Service Delivery and Organisation (SDO) Research and Development Programme
- National Coordinating Centre for Health Technology Assessment (NCCHTA).

**Other sources**

The electronic database search was supplemented with a comprehensive search for grey literature including clinical evaluations, economic evaluations, validation studies and guidelines. The handbook produced by the Canadian Agency for Drugs and Technology in Health (CADTH) on searching for grey literature guided this search.\(^{(61)}\)

Established grey literature databases including OpenGrey System for Information on Grey Literature in Europe [http://www.opengrey.eu/](http://www.opengrey.eu/), OpenSIGLE, which provides access to all the former SIGLE records, new data added by EAGLE members and information from Greynet [opensigle.inist.fr](opensigle.inist.fr), the Open University dedicated grey literature site [http://library.open.ac.uk/resources/reports.html](http://library.open.ac.uk/resources/reports.html) and the Dutch based GreyNet (Grey Literature Network Service, [http://www.greynet.org/](http://www.greynet.org/)) were searched. In addition, the following grey literature sources were searched:

- Dissertation Abstracts
- ERIC database
- GrayLit Network
- Networked Digital Library of Theses.

The following professional bodies were contacted to seek information on the development, validation and clinical or economic evaluation of early warning systems in maternity care including guidelines and educational programmes to support their implementation:

- Association of Anaesthetists of Great Britain & Ireland
- Irish Society of Obstetric Anaesthesia
- Royal College of Obstetricians and Gynecologists
- American College of Obstetricians and Gynecologists
- Society of Obstetricians and Gynaecologists of Canada
- Royal Australian and New Zealand College of Obstetricians and Gynaecologists
- European Board and College of Obstetrics and Gynaecology
- Royal College of Midwives
- International Confederation of Midwives.

In addition to the above searches, we also searched the following websites for guidelines on the use of early warning or track and trigger systems in pregnant women or women who gave birth in the previous 42 days:

- National Institute for Health and Clinical Excellence (NICE)
- Agency for Healthcare Research and Quality
- National Library for Health (NLH) Guidelines Finder
- National Library for Health (NLH) Protocols and Care Pathways database
- TRIP Database
- Scottish Intercollegiate Guidelines Network (SIGN)
- National Guideline Clearinghouse (USA)
- Guidelines International Network (GIN)
- New Zealand Guidelines Group
- NHS Institute for Innovation and Improvement
- Royal College of Physicians
- Royal College of Surgeons
- Royal College of Anaesthetists
- Royal College of Midwives
- Royal College of Nursing
In addition clinical trial registers were searched (e.g., World Health Organisation Clinical Trials Search Portal: [http://apps.who.int/trialsearch/](http://apps.who.int/trialsearch/), which allowed searching multiple databases simultaneously) for completed but unpublished and ongoing clinical trials. Manual searching of the reference list of any included study and performed forward citation searching for all included studies using Scopus or Web of Science was completed. Finally, experts in the field were contacted via email to identify additional relevant studies.

**Screening and selection for inclusion**

Two reviewers screened titles and abstracts independently based on the ‘Criteria for considering studies for this review’. Discrepancies were resolved through discussion and consensus. During the screening and selection process, citations were tagged against the relevant work packages above (e.g., as development/validation study, descriptive, guidelines, economic, etc). Full texts of all papers included on title and abstract screening were retrieved and reviewed. Final decisions for inclusion in the review were determined through discussion.

**Assessment of methodological quality/risk of bias**

Two reviewers independently, using standardised critical appraisal instruments, assessed the methodological quality or risk of bias of included studies. Any disagreements that arose between the reviewers were resolved through discussion. As different study designs warrant different tools to assess methodological quality/risk of bias, we used the following critical appraisal instruments as appropriate (Table 1):

**Table 1: Critical appraisal instruments**

<table>
<thead>
<tr>
<th>Study category</th>
<th>Critical appraisal instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomised controlled trial</td>
<td>Cochrane Risk of Bias tool (62)</td>
</tr>
<tr>
<td>Non-randomised controlled trials (NRCTs); Controlled before-after (CBA) studies; Interrupted time series (ITS) studies</td>
<td>Risk of bias criteria for Cochrane Effective Practice and Organisation of Care (EPOC) reviews (62)</td>
</tr>
<tr>
<td>Clinical practice guideline</td>
<td>AGREE II tool (63) and ‘rigour of development’ domain as described by the ‘National Quality Assurance Criteria for Clinical Guidelines’ (64)</td>
</tr>
<tr>
<td>Observational designs</td>
<td>Newcastle Ottawa Scale</td>
</tr>
<tr>
<td>Systematic reviews</td>
<td>AMSTAR (65, 66)</td>
</tr>
</tbody>
</table>
| Economic evaluations                                   | 1. The British Medical Journal Checklist for authors and peer reviewers of economic submissions. (67)  
2. Checklist for quality assessment in economic decision-analytic models. (68) |
| Development and validation studies                     | The QUADAS 2 Tool (69)                                                                      |
Data extraction
Two independent reviewers extracted the data from included papers. Data extraction tables were pre-designed to extract relevant data, where available, according to the category of study design as follows:

Descriptive
- Design features, prospective or retrospective etc.
- Study setting: ante/intra/postnatal care, emergency department, other acute care, primary care, home, other
- Participant characteristics and numbers
- Parameters contained in the early warning or trigger system
- Early warning or track and trigger system scoring method
- Criteria for initiating escalation
- Details of escalation protocol
- Details of communication tool
- Details of education programme to support early warning or trigger systems
- Evaluation process of education programmes

Guidelines
- Country/region of origin
- Year developed
- Qualifications of guideline team
- Guideline development strategy/method
- Key recommendations of guideline

Effectiveness studies
- Study design (RCT, CCT, ITS, etc.)
- Study setting
- Participant characteristics and numbers
- Intervention, i.e. early warning, track and trigger system, escalation protocol or communication tool under evaluation
- Comparator (no system, alternative system, etc.)
- Outcomes measures
- Effect estimates (number of specific outcome events/total in group for intervention and comparator groups)

Development/validation studies
- Study design (prospective, retrospective, etc.)
- Study setting
- Participant characteristics and numbers
- Outcomes measures
- Predictive ability (the data for each outcome measure was extracted and entered into 2 x 2 data extraction tables classified according to the results of the early warning system score and according to the presence or absence of an outcome measure (e.g. sepsis) in each individual study)

Health economic studies
- Study design (prospective, retrospective, etc.)
- Study setting
- Participant characteristics and numbers
- Measures of ‘cost’ data including capital and non-capital resources
- Outcome measures
Data synthesis

Work package 1: Description
Descriptive statistics are used to summarise the data. Individual systems' parameters are explored where possible and specific physiological parameters (e.g. respirations, $\text{SpO}_2$, blood pressure, etc.) identified. It was intended to provide a comparative description of identified education programmes including a description of their evaluation but no programmes were identified.

Work package 2: Clinical guidelines
A narrative synthesis of the results from identified national clinical guidelines is provided. It was planned to include a comparative summary of the key recommendations from the individual guidelines but only one national guideline was identified.

Work Package 3: Effectiveness studies
For identified effectiveness studies, it was not possible to perform a meta-analysis of outcomes and provide a short narrative synthesis of study results.

Work package 4: Development and validation studies
The predictive ability of the early warning system or track and trigger system of an event occurring (e.g. sepsis, maternal death, etc.,) using sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) was determined.

Work package 5: Health economics
It was planned to assess the cost-effectiveness of Maternity Early Warning Systems (MEWS) using the evidence on effectiveness assembled in the systematic review detailed in work package 3. This would, it was considered, provide the best estimates of the effectiveness of introducing an early warning system or trigger system on outcomes for women and/or their infants. However, despite comprehensive searching, no studies reporting on any aspect of economic analysis of MEWS were identified for inclusion in this review.

Results

Search and selection results
The search strategy identified 511 citations (476 from database searches and 35 from searches of other sources) for potential inclusion in the review. Following removal of duplicates ($n = 117$), 288 citations were excluded on title and abstract. A full-text review of the remaining 106 citations was performed, following which a further 69 were excluded. Reasons for exclusion were: 46 were not about MEWS or did not contain data relevant to the review, 6 duplicates not identified previously as duplicates, 1 protocol of an on-going study registered with a trial database (no data available), 2 ACOG committee opinion pieces that had been updated in later citations, 1 was a local policy, 3 were guidelines that did not include reference to a MEWS, 8 were guidelines that made reference to MEWS but were not MEWS-specific and 2 were excluded for other reasons.

This resulted in 37 citations reporting 33 studies identified as eligible and included in this review (see Table 2 for categories of studies/records and Figure 1 for the PRISMA search and selection Flow Diagram). Abstracts were included only where there were sufficient data to extract for analyses or reporting in the systematic review.

Twenty-seven included studies provided descriptive data. These data were divided into four major data types as follows: compliance, extent of use, views/experience, and other.
Table 2: Categories of included studies/reports

<table>
<thead>
<tr>
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<th>Number included</th>
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<td>Description</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Extent of use = 5</td>
<td></td>
</tr>
<tr>
<td>Views/experiences = 2 (reported across 3 citations)</td>
<td></td>
</tr>
<tr>
<td>Description other = 6</td>
<td></td>
</tr>
<tr>
<td>Donor references = 1</td>
<td></td>
</tr>
<tr>
<td>Guidelines</td>
<td>1</td>
</tr>
<tr>
<td>Effectiveness studies</td>
<td>1</td>
</tr>
<tr>
<td>Development/validation studies</td>
<td>9</td>
</tr>
<tr>
<td>Individual studies = 6</td>
<td></td>
</tr>
<tr>
<td>Donor references = 3</td>
<td></td>
</tr>
<tr>
<td>Health economic studies</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
</tr>
</tbody>
</table>
Figure 1: Search and selection flow diagram

- Records identified through database searching (n = 476)
- Additional records identified through other sources (n = 35)
- Records after duplicates removed (n = 394)
- Records screened (n = 394)
- Records excluded (n = 288)
- Full-text records assessed for eligibility (n = 106)
- Records excluded (n = 69)
  - 46 = not about MEWS/data
  - 6 = not relevant
  - 1 = protocol ongoing study
  - 2 = updated opinions
  - 1 = local policy
  - 3 = guidelines no mention of MEWS
  - 8 = other guidelines but not MEWS-specific
  - 2 = other
- Records included in review (n = 37)
Sample Search Strategies

**Database: MEDLINE(R)**

1. exp Pregnancy/ (706274)
2. exp Pregnancy Complications/ (336946)
3. exp Obstetric Surgical Procedures/ (103311)
4. exp Prenatal Care/ (20015)
5. exp Postpartum Period/ (48210)
6. Hospitals, Maternity/ (2091)
7. exp Maternal Health Services/ (34265)
8. Nurse Midwives/ or Midwifery/ (19120)
9. exp Obstetrics/ (15406)
10. (antenatal or prenatal or perinatal or puerperal or puerperium or postnatal or postpartum or peripartum or post-natal or post-partum or ante-natal or ante-partum or obstetric*).tw. (277051)
11. or/1-10 (902285)
12. (mews or meows or moews).tw. (81)
13. (early adj warning).mp. (2485)
14. (warning adj systems).mp. (394)
15. (warning adj system).mp (823)
16. (warning adj score*).mp. (184)
17. (track adj2 trigger).tw. (45)
18. (trigger* adj4 score*).tw. (59)
19. (escalation adj protocol*).mp. (88)
20. (escalation adj policy).mp. (3)
21. (escalation adj policies).mp. (1)
22. POTTS.ti,ab. (1223)
23. or/12-22 (4285)
24. 11 and 23 (108)

***************

[mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
Database: EMBASE

1. EMBASE; exp PREGNANCY/ OR exp PREGNANCY COMPLICATION/; 571607 results.

2. EMBASE; exp POSTNATAL CARE/; 73730 results.

3. EMBASE; exp OBSTETRIC PROCEDURE/; 319253 results.

4. EMBASE; exp MIDWIFE/; 21277 results.

5. EMBASE; exp OBSTETRICS/; 27544 results.

6. EMBASE; exp CHILDBIRTH/; 44883 results.

7. EMBASE; exp MATERNAL CARE/; 28666 results.

8. EMBASE; (antenatal OR prenatal OR perinatal OR puerperal OR puerperium OR postnatal OR postpartum OR peripartum OR post-natal OR post-partum OR ante-natal OR ante-partum).ti,ab; 267530 results.

9. EMBASE; exp PREGNANCY DISORDER/; 392828 results.

10. EMBASE; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9; 988675 results.

11. EMBASE; (mews OR meows).ti,ab; 185 results.

12. EMBASE; (early ADJ warning).ti,ab; 3547 results.

13. EMBASE; (warning ADJ system).ti,ab; 1144 results.

14. EMBASE; (warning ADJ systems).ti,ab; 545 results.

15. EMBASE; (warning ADJ score*).ti,ab; 382 results.

16. EMBASE; (warning ADJ scoring).ti,ab; 81 results.

17. EMBASE; (track ADJ trigger).ti,ab; 75 results.

18. EMBASE; (escalation ADJ protocol).ti,ab; 124 results.

19. EMBASE; (trigger* adj4 score*).ti,ab; 120 results.

20. EMBASE; moews.ti,ab; 5 results.

21. EMBASE; (escalation ADJ policy).ti,ab; 10 results.

22. EMBASE; (escalation ADJ policies).ti,ab; 4 results.

23. EMBASE; POTTS.ti,ab; 1370 results.

24. EMBASE; 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23; 5730 results.

25. EMBASE; 10 AND 24; 193 results.
Database: CINAHL

1. CINAHL; exp PREGNANCY/; 94248 results.
2. CINAHL; exp PREGNANCY COMPLICATIONS/; 35830 results.
3. CINAHL; exp OBSTETRICS/; 2051 results.
4. CINAHL; exp MIDWIVES/; 7861 results.
5. CINAHL; exp MIDWIFERY/; 13324 results.
6. CINAHL; exp CHILDBIRTH/; 14099 results.
7. CINAHL; exp MATERNAL-CHILD CARE/; 27878 results.
8. CINAHL; exp PRENATAL CARE/; 7791 results.
9. CINAHL; exp PERINATAL CARE/; 1792 results.
10. CINAHL; exp POSTNATAL CARE/; 2577 results.
11. CINAHL; (antenatal OR prenatal OR perinatal OR puerperal OR puerperium OR postnatal OR postpartum OR peripartum OR post-natal OR post-partum OR ante-natal OR ante-partum OR obstetric*).ti,ab; 34811 results.
12. CINAHL; 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11; 127521 results.
13. CINAHL; (mews OR meows).ti,ab; 30 results.
14. CINAHL; (early ADJ warning).ti,ab; 606 results.
15. CINAHL; (warning ADJ system).ti,ab; 190 results.
16. CINAHL; (warning ADJ systems).ti,ab; 97 results.
17. CINAHL; (warning ADJ score*).ti,ab; 103 results.
18. CINAHL; (warning ADJ scoring).ti,ab; 40 results.
19. CINAHL; (track ADJ2 trigger).ti,ab; 25 results.
20. CINAHL; (escalation ADJ protocol).ti,ab; 8 results.
21. CINAHL; (trigger* adj4 score*).ti,ab; 23 results.
22. CINAHL; moews.ti,ab; 0 results.
23. CINAHL; (escalation ADJ policy).ti,ab; 1 results.
24. CINAHL; (escalation ADJ policies).ti,ab; 1 results.
25. CINAHL; POTTS.ti,ab; 36 results.
26. CINAHL; 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25; 757 results.
27. CINAHL; 12 AND 26; 36 results.
Appendix 7: Glossary of terms and abbreviations

Definitions within the context of this document

Clinician
A healthcare professional such as a doctor, midwife or nurse involved in clinical practice.

Early Warning Score (EWS)
An early warning score is a bedside track and trigger system which midwifery/nursing staff calculate from the vital signs recorded, and aims to indicate early signs of a patient's deterioration.

Healthcare staff
Includes medical doctors, midwives, nurses, healthcare assistants, biomedical scientists, pharmacists, allied health and social care professionals and healthcare management.

IMEWS Irish Maternity Early Warning System
IMEWS is a nationally agreed scoring system developed for early detection of life threatening illness in hospital in-patient care in obstetric and gynaecological services of a woman with a confirmed clinical pregnancy and up to 42 days in the postnatal period.

ISBAR
ISBAR is a communication tool, and the acronym stands for Identify, Situation, Background, Assessment, and Recommendation. This technique is used for prompt and appropriate communication within healthcare organisations.

Full set of Vital Signs
Where a full set of vital signs is indicated, this includes recording respiratory rate, temperature, maternal heart rate, blood pressure, neurological response and pain score.

Urinalysis is required on admission. Thereafter, the frequency of urinalysis following admission depends on the clinical assessment, diagnosis and care plan for the woman.
Abbreviations

AVPU: Alert, Voice, Pain, Unresponsive
BPM: Beats per minute
BP: Blood Pressure
CI: Confidence Interval
DoH: Department of Health
EWS: Early Warning Score
GDG: Guideline Development Group
GP: General practitioner
HIQA: Health Information and Quality Authority
HIPE: Hospital In-Patient Enquiry
HLOS: Hospital Length of Stay
HSE: Health Services Executive
ICU: Intensive care unit
IMEWS: Irish Maternity Early Warning System
ISBAR: Identify Situation - Background - Assessment - Recommendation
ITU: Intensive therapy unit
LOS: Length of stay
MAC: Mid-arm circumference
MEOWS: Modified Early Obstetric Warning System
N/A: Not applicable
NEWS: National Early Warning Score
NICE: National Institute for Health and Clinical Excellence
NHS: National Health Service
NPV: Negative Predictive Value
NUIG: National University of Ireland Galway
OR: Odds Ratio
PPV: Positive predictive value
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: Randomised controlled trial
SD: Standard deviation
SPHM: Specialist in Public Health Medicine
US: United States
UK: United Kingdom
WHO: World Health Organisation
Appendix 8: Budget impact assessment

Economic Impact Report

Key message
This budget impact analysis supports the clinical guideline recommendations.

The report was completed by Dr. Michelle O’Neill, Health Technology Assessment Directorate, Health Information and Quality Authority and Dr. Mary O’Riordan, Specialist in Public Health Medicine, Clinical Effectiveness Unit, Department of Health.

1. Economic literature review results
A systematic economic literature search for evidence of clinical and cost effectiveness, cost and resource impact, including primary (research studies) and secondary (reviews and economic evaluations) sources was undertaken in conjunction with the clinical literature review, Appendix 6. The literature sources searched included relevant resources, such as trial/guideline registries and relevant citation databases (e.g. Medline, EMBASE, Database of Abstracts of Reviews of Effects (DARE), NHS Economic Evaluation Database, Health Technology Assessment Database and Cochrane Database of Systematic Reviews).

Using a comprehensive literature search as outlined in Appendix 6, no studies reporting on any aspect of economic analysis of MEWS were identified for inclusion in this review.

2. Budget impact of National Clinical Guideline
The main cost in implementing this guideline is the structured initial and on-going training and education for healthcare staff in maternity units. This is considered in more detail below.

2.1 Initial phase
Costs – staff
There are approximately 2165 WTE staff (1856 nurses, 240 doctors, 164 allied professionals) working in the 19 maternity units that require IMEWS training.

Midpoint salaries scales, adjusted to include overheads and employer PRSI and pensions contributions, were used to estimate staff costs.

The burden of costs relative to staff is calculated for maternity units only in this budget impact assessment. While it is recognised that there will be a cost associated for education for acute services where the IMEWS is required, the process for provision of education for IMEWS in this sector is yet to be decided. It is likely there will be opportunity for collaboration across other National Clinical Guidelines for the provision of this education which will minimise additional costs.

To cost the staff time for education an average salary (HSE, 2014) for each of the three staff groups was assumed as follows: nurses were midwives, doctors were a mix of consultants and registrars, and allied health professionals were physiotherapists. Using these estimates the approximate cost for staff time spent on education (estimated as 3 hours for each trainee) for IMEWS is €196,346.

A ‘train the trainer’ model is to be adopted for implementation of the IMEWS education programme, that is, suitable staff, doctors, nurses and physiotherapists train as trainers and deliver the multi-disciplinary programme to staff. Delivering an education session is estimated to take 2 hours. On average, the education sessions will include 10 trainees (2 trainers). The number of trainers required was estimated as 2 trainers per maternity unit (total of 38 trainers) for cost

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6 [http://www.hse.ie/eng/staff/Benefits_Services/pay/](http://www.hse.ie/eng/staff/Benefits_Services/pay/) and [http://www.hse.ie/eng/staff/Benefits_Services/Timeoff/Annual_Leave.html](http://www.hse.ie/eng/staff/Benefits_Services/Timeoff/Annual_Leave.html)
calculation purposes, however the distribution of trainer per trainee may vary depending on trainee number at each maternity unit location. Assuming the same average salary costs as before the staff time cost involved to deliver education is an estimated €37,679.

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

**Costs – Materials**
Simple materials are required to deliver the IMEWS education programme. These include PowerPoint presentations and sample IMEWS charts. The costs of these are deemed to be negligible.

**2.2 On-going intervention costs**

**Costs – Staff**
Using the IMEWS consists of taking a number of observations, charting these and calculating a score. The time taken to chart and calculate the score is expected to be minimal (approx. 15 seconds) and as such no additional staff time is envisioned to be required for the tracking element of the intervention.

Additional staff time may be incurred as there is evidence that introducing an early warning score system can lead to additional work for emergency response systems (Mitchell et al, 2010). The model of emergency response system varies by institution thus the change to the workload will not be uniform across the system.

Ongoing education will consist of a short refresher course to be completed every 2 years. Assuming this refresher education programme takes approximately 1 hr with no additional material costs, the ongoing education would cost approximately €49,086 annually. This is based on the same number of staff estimated to need the initial education.

**Costs – materials**
The IMEWS chart will replace currently used charts which vary across sites; in some cases this may lead to a reduction in printing and related costs and in others potentially an increase, depending on the use of colour and number of sheets in the currently used charts. Nationally, it was assumed that the change to the IMEWS chart will have a negligible cost implication.

**Savings**
It is anticipated that IMEWS implementation will lead to reduced ICU admissions however, there is currently no available evidence to support this assumption.

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### Table 1 Calculation of Staff training costs

<table>
<thead>
<tr>
<th>Profession</th>
<th>Annual Salary*</th>
<th>Hourly cost</th>
<th>Initial costs for trainees</th>
<th>Initial cost for trainers</th>
<th>Refresher training costs</th>
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</thead>
<tbody>
<tr>
<td>Nurses (Midwives)</td>
<td>€28,065</td>
<td>€36.3</td>
<td>€135,398.7</td>
<td>€25,137</td>
<td>€33,849.7</td>
</tr>
<tr>
<td>Doctors (mix of Consultants and Registrar grade)</td>
<td>€109,381</td>
<td>€103.9</td>
<td>€49,894</td>
<td>€8,998</td>
<td>€12,473</td>
</tr>
<tr>
<td>Allied health professional (Physiotherapist)</td>
<td>€42,191</td>
<td>€40.9</td>
<td>€11,054.2</td>
<td>€3,544</td>
<td>€27,63.5</td>
</tr>
<tr>
<td><strong>Total initial training costs trainees</strong></td>
<td>–</td>
<td>–</td>
<td><strong>€196,346.9</strong></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>Total initial costs trainers</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td><strong>€37,679</strong></td>
<td>–</td>
</tr>
<tr>
<td><strong>Total ongoing refresher training costs</strong></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td><strong>€49,086.2</strong></td>
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*Adjusted to account for overhead and employer PRSI and pensions contributions

### Table 2 Summary of annual economic impact of IMEWS

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<th>Category</th>
<th>Item</th>
<th>Approximate cost</th>
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<tr>
<td><strong>Initial Phase</strong>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non staff</td>
<td>Materials (sample observation charts, presentation materials)</td>
<td>Negligible</td>
</tr>
<tr>
<td>Staff</td>
<td>Trainees**</td>
<td>€196,346</td>
</tr>
<tr>
<td></td>
<td>Trainers</td>
<td>€37,679</td>
</tr>
<tr>
<td><strong>On-going intervention costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non staff</td>
<td>IMEWS charts</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td>Charting score</td>
<td>Negligible</td>
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<tr>
<td></td>
<td>Additional resources to respond to triggers</td>
<td>Unknown but likely to increase</td>
</tr>
<tr>
<td></td>
<td>On-going education</td>
<td>€49,086</td>
</tr>
<tr>
<td><strong>Total Costs (initial and on-going phase)</strong></td>
<td></td>
<td><strong>€283,111</strong></td>
</tr>
<tr>
<td><strong>Savings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It is anticipated that IMEWS implementation will lead to reduced ITU admissions however there is currently no available evidence to support this assumption.</td>
<td></td>
</tr>
</tbody>
</table>

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

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


31. Daly N, Summerhill N, Shortall E, et al. „That was then, this is now.“ the effect of introduction of an early warning score system: A retrospective cohort study of maternal morbidity at Our Lady of Lourdes Hospital, Drogheda. Irish Journal of Medical Science. 2011;180.


