A NATIONAL CROSS SECTIONAL SURVEY OF HEADS OF MIDWIFERY SERVICES OF UPTAKE, BENEFITS AND BARRIERS TO USE OF OBSTETRIC EARLY WARNING SYSTEMS (EWS) BY MIDWIVES

ABSTRACT

Objective. To identify the extent to which Early Warning Systems (EWS) are used by midwives in the United Kingdom (UK), the maternity settings they are used in, physiological parameters used to 'trigger' referral, training provision, barriers to implementation and role in preventing maternal morbidity.

Design. Cross-sectional survey of heads of midwifery services. An email questionnaire was sent in September 2012.

Setting. UK NHS secondary care organisations providing maternity care.

Findings

Heads of midwifery from 107 (68%) of 157 NHS organisations responded, with 108 questionnaires returned as two organisations had recently merged. All organisations, apart from one which only had a free-standing midwifery unit, had introduced EWS. Nearly all respondents (99%) reported EWS were used by midwives antenatally, 76% in labour and 100% on the postnatal ward. All EWS charts included body temperature, heart rate, respiratory rate, systolic blood pressure and oxygen saturation although parameters for escalation varied widely. Barriers to use of EWS by midwives included overlap with the partogram in labour, and staff shortages and delays obtaining clinical review when referral was triggered. Two thirds considered EWS prevented maternal morbidity although few could provide supporting evidence, for example audit findings. Training for midwives in use of EWS was available in 83% of organisations.

Conclusion

Most UK midwives are using EWS, with the highest use in obstetric units. The heterogeneity of EWS currently used potentially limits collation of evidence to inform appropriate system level responses. Research is needed to evaluate the role of EWS to prevent maternal morbidity during and after pregnancy in different maternity settings.

INTRODUCTION

With a decline in maternal mortality in the UK (Centre for Maternal and Child Enquiries (CMACE) 2011), the focus has now shifted to reducing maternal morbidity. One approach in achieving this reduction is through the use of Early Warning Systems (EWS). EWS use physiological parameters to 'track' an individual's condition to detect early deterioration and 'trigger' timely clinical intervention. The concept of 'track and trigger' systems in maternity care is relatively new, however several UK professional and policy organizations recommend implementation of EWS following concerns that rapid deterioration in maternal health may not be recognised (Confidential Enquiry into Maternal and Child Health (CEMACH) 2007, CMACE 2011, Royal College of Anaesthetists 2011, Royal College of Obstetricians and Gynaecologists 2012, NHS Litigation Authority 2013). The Clinical Negligence Scheme for Trusts (CNST) introduced by the NHS Litigation Authority requires maternity services to have a *'process for the use of a modified early obstetric warning scoring system (MEOWS)'* in its standard to support the recognition of severely ill women (p75)(NHS Litigation Authority 2013).

No groups have yet developed a tool validated for use in the maternity population in the UK or internationally. A UK survey of lead obstetric anaesthetists in consultant-led obstetric units in 2007 showed only 19% of units regularly used EWS with inconsistency in physiological variables and trigger thresholds (Swanton et al 2009). The Royal College of Physicians (RCP) recommends use of a National Early Warning Score (NEWS) to standardise assessment of acute-illness severity, but does not recommend its use in children (ie ≤16 years old) or women who are pregnant because the physiological response to acute illness can be modified in children and by pregnancy (RCP 2012). Carle *et* al (2013) designed and internally validated an aggregate-weighted obstetric EWS based on maternal mortality using secondary analysis of physiological data collected during the first 24 hours of admission of maternity patients to UK-based critical care units. Logistic regression analysis for mortality in the model development set informed a statistically based risk model for admissions, which was modified with addition of other physiological variables to create a clinical obstetric EWS. The statistical and clinical EWS were compared in the validation set with the CEMACH EWS example (CEMACH 2007), a EWS introduced into one tertiary maternity centre (Swanton et al 2009) and RCP NEWS (RCP 2012). This showed some degree of construct validity with the ability to discriminate survivors from non-survivors in a critical care dataset. However data from women already admitted to critical care are unlikely to represent women admitted to general obstetric or midwife-led units, or who have a home birth.

Since the UK anaesthetists survey (Swanton et al 2009) there has been limited research into use of maternity EWS in the UK or other countries (Lappen et al 2010, Singh et al 2012, RCOG 2011), despite international recommendations to implement them (Institute of Obstetricians and Gynaecologists, Royal College of Physicians of Ireland, Health Service Executive, 2013; Australian Commission on Safety and Quality in Health Care 2010; New South Wales Government 2013). The EWS charts recommended in these guidelines and reports are similar to the UK CEMACH EWS example (CEMACH 2007).

As Mackintosh and colleagues highlighted in a recent ethnographic study of implementation of EWS in two UK maternity units, despite over a decade of use of EWS in acute care settings, research into their effectiveness has yielded conflicting results, with policy support for EWS based on intuitive appeal (Mackintosh et al 2014). It is also important to consider that the EWS chart itself should not be viewed as the only intervention to detect patient deterioration but as an 'alert' to the need for further patient assessment, used alongside other 'triggers' such as patient or clinician reported health concerns (Smith et al 2013).

Given the consistent professional and policy recommendations for EWS use in UK maternity settings, we wished to explore the extent to which EWS are used by UK midwives, the settings where used, types of chart used, drivers for implementation, parameters for triggering, barriers to use and role in reducing maternal morbidity. EWS refers here to all systems used, including modified obstetric ones.

METHODS

Research ethics committee approval was not required, as this was a multicentre service evaluation project conducted to explore the views of current service provision by those responsible for delivering care. Questionnaires adapted from one originally developed for the UK anaesthetists survey (Swanton et al 2009) (Appendix 1) were sent electronically to all heads of midwifery of NHS secondary care organisations providing maternity care. NHS secondary care organisations in England are managed by NHS trusts and in Scotland, Wales and Northern Ireland by unified health boards. Health organisations vary in size and may include one or more hospitals with one or more obstetric units (OUs), free standing midwifery units (FMU) or alongside midwifery units (AMU), with the head of midwifery responsible for managing clinical midwifery services across an organisation. Heads of midwifery for NHS organisations were asked to return their completed questionnaire electronically or by post. Two reminders were sent.

Additionally, we requested a copy of the EWS chart used within each organisation if this was different to the example recommended by CEMACH (2007). Descriptive statistical analysis was conducted using IBM SPSS v.19.

RESULTS

One hundred and fifty seven heads of midwifery from 168 NHS secondary care organisations were contacted in September 2012 (no individual contact details could be identified for one organisation and emails to ten individuals were returned unopened by email servers). Heads of midwifery of 107 (68%) organisations returned questionnaires, with responses from 16 Scottish organisations, five from Wales, three from Northern Ireland and 92 from England. The head of midwifery of one English NHS organisation returned two questionnaires following a recent merger of her organisation with another. As the use of EWS was different in what had previously been two separate NHS organisations, 108 questionnaires informed the study denominator where relevant.

Table 1 includes all the abbreviated survey questions and results with the corresponding numerator and denominator. All NHS organisations had an OU except for one that only had an FMU. Some organisations also provided maternity services with an AMU (57%) and/or FMU (30%). The majority of responders' organisations (61%) had more than 4,000 births per year. In all but the single FMU site, midwives used EWS. As explained by the head of midwifery at this FMU, "*the use of EWS charts would not be appropriate in a community setting*''. Midwives noted if the woman felt/looked well, and if the response was 'no', a community early warning score was generated which included lower threshold parameters to trigger referral into the obstetric services.

In response to a question on *when* midwives used EWS charts, nearly all organisations reported charts were used antenatally and postnatally, with three quarters reporting use during labour. In some cases, the denominators in the following sections were less than 108, as data were missing from the survey response and/or were not applicable to the organisation described. In most cases where numbers were provided, these refer to the number of respondents to the particular question.

When asked what prompted the introduction of EWS charts into their maternity services, 70% (n=73/105) indicated it was due to CEMACH (2007) or CMACE (2011) recommendation and/or a critical incident/risk management directive. During pregnancy, EWS charts were used for the majority of women admitted to OUs (97% n=102/105). During labour and birth, EWS charts were used in 94% (n=74/81) of OUs, 68% (n=32/47) AMUs, and 60% (n=14/23) FMUs. The use

of EWS during a home birth was less common with only 23% (n=22/96) of respondents reporting this. The inclusion of EWS within the labour partogram was uncommon (13% n=13/104), although 48% (n=49/102) of respondents reported in response to another question that their midwives used EWS charts *and* a partogram in labour.

During the postnatal inpatient stay, 25% of respondents (n=26/106) reported that in their maternity services EWS charts were only used postnatally for high-risk women ('high-risk' was not defined in the questionnaire given the lack of a standard definition and potential wide range of conditions which could be reported). EWS charts were used less commonly postnatally in women's homes or in day assessment units but were used in the majority of organisation for post-operative women and for postnatal women admitted to High Dependency Units (HDUs). Only 3% of respondents used a different EWS chart in their midwifery units from the one used in their OUs.

Over a third of respondents (39% n=41/104) reported that their EWS charts included a 'Situation, Background, Assessment, Recommendation' (SBAR) or other system for communication when action was 'triggered', while 73% (n=77/105) reported that their unit EWS charts included an action/trigger line. While the simpler colour-coded track and trigger scoring systems (e.g. 2 'yellow' scores or 1 'red' score would trigger an action) were most frequently used as opposed to aggregate-weighted scoring systems, thresholds or cut-offs for clinical referral varied widely. Most respondents (88%) considered that trigger thresholds were appropriate (n=90/102).

Most EWS charts were reported to include specific instructions on use, including what to do (94% n=85/90), who to contact (96% n=86/90), and in what timescale (68% n=61/90). However, 21% (n=23/107) reported problems with obtaining clinical review after triggering the EWS and instigating appropriate action. The most commonly reported delay was due to workload of medical staff for example *'if medical staff are busy in theatre and cannot attend in time'* and/or because medical staff considered women were clinically well. In addition, 12% (n=12/104) reported delays with obtaining treatment response after triggering and clinical review. Unclear guidance on escalation process was also reported.

Respondents were asked for their opinion on which physiological parameters should ideally be documented on an obstetric EWS (Table1). The top six parameters from 106 respondents included temperature, heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate and oxygen saturation. Other parameters that respondents thought *should* be documented on an obstetric EWS chart and contribute to the score included uterine tone, amniotic fluid,

reflexes, wound site and a 'general concerns' box. When asked whether EWS charts should include 'midwife concerns' as a 'trigger', 80% (n= 85/106) answered positively. Those who thought EWS should include a trigger based on a woman's concern or concerns raised by her partner/family were 62% (n=61/99) and 49% (n= 48/97) respectively.

Around two-thirds (66% n=69/104) of respondents reported their units used their own adapted version of a EWS chart, 31% (n=32/104) used the CEMACH (2005) example, and the remainder (3% n=3/104) another form of EWS chart. All EWS charts (n=53) received and reviewed included respiratory rate, heart rate, temperature, systolic blood pressure and oxygen saturation (all but two EWS charts returned also included level of consciousness). However some EWS charts included other variables, some specific to parturient women including lochia (68% n=36/53), amniotic fluid (36% n=19/53) proteinuria (57% n=30/53) and uterine tone (6% n=3/53). Other included variables were more general such as urine output (87% n=46/53), diastolic blood pressure (81% n=43/53), pain score (79% n=42/53), 'looks unwell' (43% n=23/53), nausea (15% n=8/53) and wound condition (8% n=4/53). A number of these were included in the EWS score to trigger referral, however some were only included to provide additional information on a woman's condition.

There was a lack of consistency in parameters to trigger referral and some charts required detailed scoring to monitor escalation. The method of scoring varied with 72% (n=38/53) of charts reviewed using colour bands alone (pure track and trigger systems), 17% (n=9/53) of charts including individual variables which were scored e.g. 0-3 (aggregate-weighted scoring systems) and 11% (n=6/53) using a combination of track and trigger and aggregate-weighted scoring systems. Charts listed a range of normal limits for included variables with no consensus for normality. For respiratory rate, the normal lower limits varied from 8 to 15 and upper normal limits 14 to 20 before triggering. For temperature the normal upper limit varied from 37°C to 37.9°C and lower limits 35°C to 36°C and systolic blood pressure upper normal limit ranged from 130 to 160 and normal lower limit for oxygen saturation from 90% to 96%. There was a wide variation in the use of urine output as a trigger, with 40% (n=21/53) of EWS charts documenting 'yes' or 'no' urine passed and 47% (n=25/53) employing a specific urine volume ranging from <20mls/hr to <40mls/hr. We found 13 variations in how this should be reported. A wide range of pain scores was also used.

Just under half of the charts reviewed included similar instructions to those in the CEMACH (2007) example regarding when and who to call if the EWS triggered. However, in the remainder, instructions varied regarding trigger levels and subsequent actions. For example the

instructions on one EWS included '*scoring 3 or above inform the senior house officer and midwife in charge, scoring 3 or above must have a medical review, scoring 3 or above in one single parameter requires medical review, scoring 4 or above senior registrar review, scoring 6 or above consultant review, medical review should be undertaken within 30 minutes'*.

The most common barriers to use of EWS included overlap with the use of the partogram and other charts, (43% n=46/107); the lack of teaching/training provision (22% n=23/106) and staff shortages (20% n=21/107). Other reasons are detailed in Table1.

Midwives in only 9% (10/107) of units used EWS charts alone. In the majority of units midwives also used Situation, Background, Assessment, Recommendation (SBAR) (87% n=93/107); Medical Emergency Team Criteria (7% n=7/107), and other charts (20% n=21/107) such as HDU chart and partogram. A Physiological Track and Trigger System (POTTS) was only reported as used by midwives in one unit.

Most respondents reported that their units provided dedicated midwifery training on use of EWS (83% n=88/106), in addition to training for their obstetricians (83% n=69/83), maternity support staff (80% n=68/85), with slightly lower responses with respect to training for obstetric anaesthetists (58% n=46/79). Respondents were asked to indicate from a list of potential responses what training included (more than one response was possible). The majority indicated training included action to take if the EWS score 'triggered' (97% n=85/88) and accurate assessment/measurement of parameters (85% n=75/88). Training on audit and feedback (67% n=59/88), case study review (51% n=45/88), and listening to concerns of women (40% n=35/88) were less frequently reported.

Two thirds of respondents (66%) considered that the use of EWS prevented severe maternal morbidity in their unit but were unable to provide any evidence to support this. When asked to explain their response, examples included anecdotal evidence such as clinical experience of improvement in rapid escalation and early and appropriate referral and/or action to prevent deterioration of women in clinical settings. One respondent wrote: '*We have been able to escalate and intervene with the deteriorating patient in a more timely fashion. Use of the EWS means everyone understands the same clinical picture'*. Some respondents reported difficulty collating evidence of benefit with several referring to lack of audit, that their unit "*have not yet worked out a way of effective auditing this since "triggering" happens relatively infrequently*" and *'anecdotal evidence only – not formally evaluated at present'*. Another respondent wrote '*I strongly believe that early recognition and timely senior review will improve outcomes – I don't*

have any audit results to reflect this'. The lack of audit was surprising, given the positive views of the role of EWS.

DISCUSSION

This is the first study to describe reported use of EWS by UK midwives. All but one NHS organisation had introduced EWS, highlighting their rapid introduction into practice in response to policy and safety drivers (CEMACH 2007, CMACE 2011, NHS Litigation Authority 2013) Evidence of benefit from participating units was negligible despite perceptions that EWS prevent maternal morbidity and mortality, with wide variation in charts used, physiological parameters, trigger thresholds and escalation procedures.

Physiological parameters and triggers varied widely highlighting absence of a validated EWS for the general maternity population. One validation study in a single tertiary obstetric unit in England (Singh et al 2012) prospectively reviewed EWS in 676 consecutive obstetric admissions for triggers and patient records for evidence of morbidity to evaluate use of EWS to predict maternal morbidity. Two hundred women (30%) triggered and 86 (13%) had morbidity, including haemorrhage, hypertension or suspected infection. The most frequent triggers were hypertension (42%), tachycardia (28%) and hypotension (18%). Overall sensitivity in predicting morbidity was 89% (95% CI 81-95%), specificity 79% (95% CI 76-82%), positive predictive value 39% (95% CI 32-46%) and negative predictive value 98% (95% CI 96-99%). As the authors recognise, their triggers, which were based on the 2007 CEMACH report, were set close to values that define morbidity, such that a positive trigger often became a *'self-fulfilling prophecy'* (Singh et al 2012)

Evidence to support when referral should be triggered was unclear from our survey. For example, NICE guidance (2006, 2007) defined maternal pyrexia as ≥38°C or ≥37.5°C on two occasions two hours apart. Carle *et al* (2013) included an initial cut-off temperature of 38°C based on systemic inflammatory response criteria of obstetric patients admitted to critical care, while in the EWS charts reviewed for this study, the upper limit was 37.9°C. In addition a range of scoring systems were used, some quite complex. Lack of time and clinicians' lack of support for EWS were reported as barriers to implementation, with complex scoring systems likely to decrease compliance (Subbe et al 2007). Future research should determine if validated track and trigger systems or aggregate-weighted scoring systems are more acceptable to clinicians. A simple track and trigger system will not stratify risk, which an aggregate-weighted scoring system could do. However, a more complex system may be a barrier to use with greater potential for error.

There were gaps in maternity settings where EWS were used, most notably in the community. Sepsis was the leading cause of direct maternal death in the UK during 2006-2008, with an increase in community-acquired Group A streptococcal infection (CMACE 2011) highlighting that monitoring of maternal health is not only a priority for in-patient care. A community EWS, developed as part of the 1000 Lives Plus Healthcare Improvement Programme for Wales, is recommended as part of the clinical assessment of all pregnant and postnatal women receiving community-based care (NHS Wales 2013). Only one of our respondents referred to a community EWS. If maternal morbidity and mortality are to be prevented, women's health needs should be monitored across all settings, with information offered to enable women to monitor their own health and recovery (NICE 2006, NICE 2013) alongside ensuring community midwives and general practitioners can quickly identify and respond to those whose health is deteriorating.

The lack of evidence to support views that EWS prevented maternal morbidity was surprising. The assumption of benefit among respondents may reflect a belief in the benefit of EWS as a simple 'checklist' to support safety and risk management strategies in their organisations. However checklists introduced with no consideration of social or cultural issues, attitude changes required or potential barriers are unlikely to lead to anticipated improvement in outcome (Bosk et al 2009). Furthermore, the opportunity cost in terms of resource employed, and unintended consequences are rarely considered (Landefield et al 2008). Few respondents reported that audits of EWS use had been completed, with anecdotal evidence that this was because so few women 'triggered'. Nevertheless, it is important that EWS are not viewed by healthcare organisations or by clinicians as a replacement for clinical decision making or existing methods of identifying deterioration in a woman's health such as observation of signs and symptoms of ill health, or concerns raised by the woman or her family.

Until data are routinely collated on process and shorter and longer-term outcomes of use of EWS, compliance and benefit will be difficult to assess. Similar issues with respect to introduction of protocols to support normal birth in maternity units in Wales (Hunter 2007) and England (Bick et al 2009), which were also introduced on assumption of benefit, resulted in a number of unintended consequences, including negative impact on working relationships in the multi-disciplinary team and failure to engage women in decision-making. A potentially useful approach could be comparison of risk management reports with audit of EWS use to assess if earlier triggers improved potential outcome, with further research needed to develop a EWS chart with evidence of predictive value. As Berg (1997) observes, decision support systems redefine parameters and activation lines. Poor sensitivity and specificity of early warning criteria could reinforce the lack of belief by staff of its added value. For example, the

ethnographic study in two UK maternity units by Mackintosh and colleagues (2014) found maternity staff had mixed opinions about the role of EWS, with poor monitoring of physiological parameters. Some midwives considered EWS did not need to be implemented post-birth, as in their view, women were not patients and EWS medicalised birth.

Whilst the top six physiological variables the heads of midwifery considered should be included on a EWS concurred with those recommended by NEWS (Royal College of Physicians 2012) and Carle *et al* (2013), what is unknown from this survey was the extent to which a woman's care could be escalated because of a midwife's subjective assessment or concerns raised by a woman or her family, an area which warrants further consideration in light of recent reports into NHS care (Francis 2013). Unlike physical parameters, the inclusion of a parameter in the trigger score to reflect woman and/or midwife concern had a higher level of support in the midwives survey compared to the concurrent survey by the Obstetric Anaesthetists' Association (80% 'v' 55%, Isaacs et al in press). This should be considered further as there is some evidence of the potential for women and family concerns to contribute to escalation at an earlier stage (Rance et al 2013).

In addition, the inclusion of a parameter for clinician concern on a trigger chart also needs to be considered (Ray et al 2009) as exclusion may miss the contribution of clinical wisdom and judgement. Another issue not yet addressed is whether EWS are appropriate for each stage of pregnancy and postnatal care. NICE (2007) guidance for EWS in acute care settings recommended a graded response strategy using low, medium and high scores with appropriate responses to each. Carle *et al* (2013) included thresholds for a graded response in their tool in line with the RCP NEWS (2012) however such an escalation protocol requires testing in the general obstetric population, including appropriate escalation trigger points. Further validation could potentially enable the targeting of EWS at women with known risk of adverse health outcome rather than all women.

The response rate of 68% was respectable for a UK wide survey of heads of midwifery and was higher than recent UK wide surveys of the same group, which achieved response rates of 47% and 56% respectively (Royal College of Midwives 2011, 2013). We also had good representation from obstetric and midwifery-led units in different settings across the UK. Our choice to use an email-based questionnaire meant that we could target individual midwifery managers, reducing the costs and time associated with postal surveys. Cross-sectional surveys enable data capture from a large sample at one point in time, but not capture of in-depth details. Data were only provided on the *reported* use of EWS by midwives and it would have been useful to obtain feedback from those directly using EWS and the women monitored. It is

possible that non-responders did not use EWS in their organisations however this is unlikely. Review of EWS charts provided an insight into the heterogeneity of systems although this only represented charts from half of the organisations included, with no information on extent to which organisations using the CEMACH (2007) example of a EWS had altered parameters. Rapid response systems require standardisation, universality and uniformity if targeted health outcomes are to improve (Francis 2013). Our findings highlight the current fragmentation of EWS in maternity care, with the need for audit highlighted.

CONCLUSION

Most UK midwives are using EWS in inpatient maternity settings, with infrequent use in community settings. There was concurrence in the top six physiological parameters with other proposed obstetric and non-obstetric EWS. However, triggers for escalation varied widely with no uniformity. The heterogeneity of maternity EWS potentially limits collation and analysis of evidence to inform appropriate system-level responses. Future evaluations should be undertaken within the context of local escalation policies, clinical responses generated, barriers and facilitators to use and environment of care. Further research should address the development of a validated EWS for general obstetric use. This should determine if simple track and trigger or more complex risk-stratified aggregate-weighted systems are more appropriate, which groups of women EWS should be used for and in which maternity settings.

DETAILS of ETHICAL APPROVAL

Ethical approval was not required**.**

FUNDING

None

TABLE 1

Table 1: Frequency and percentage of responses to an electronic survey of 107 UK Heads of Midwifery about midwife use of obstetric early warning systems.

Question (total response in brackets)	Number of responses	Percentage
Maternity service provision (n=108)		
Obstetric unit	107	99.1
Alongside midwifery-led unit	62	57.4
Free standing midwifery-led unit	29	26.9
Approximate number of births per year in maternity service (n=108)		
<2499 births	18	16.7
2500-3999 births	24	22.2
4000-5499 births	25	23.1
5500-6999 births	28	25.9
≥7000 births	13	12.0
Use of an Early Warning System by midwives (n=108)		
Yes	107	99.1
No	1	0.9
When EWS charts used (n=107)#		
During pregnancy (n=106)	105	99.1
During labour and birth	81	75.7
During the postnatal period	107	100
Where EWS charts used; during pregnancy (n=105)		
Community clinic (n=102)	6	5.9
Hospital	102	97.1
Home (n=103)	16	15.5
HDU admissions (n=90)	74	82.2
High-risk women only (n=103)	27	26.2
Day Assessment Unit (n=99)	36	36.4
Other	9	8.6
Where EWS charts used; during labour and birth (n=81)#		
Obstetric unit	74	93.7
Alongside midwifery unit (n=47)	32	68.1
Free standing midwifery unit (n=23)	14	60.9
Home (n=70)	22	22.9
Other	6	7.4
Where EWS charts used; during the postnatal period (n=107)#		
Obstetric unit (n=105)	98	93.3
Alongside midwifery unit (n=62)	41	66.1
Free standing midwifery unit (n=28)	17	60.7
Home (n=106)	29	27.4
All post-operative women (n=106)	98	92.5
High Dependency Unit (n=99)	80	80.8
High-risk women only (n= 106)	26	24.5
Day Assessment Unit (n=96)	36	37.5
Other (n=107)	9	8.4
EWS charts included in partogram (n=104)		
Yes	13	12.5
No	91	87.5
EWS charts used as well as partograms (n=102)		
Yes	49	48

No	53	52
Type of chart used (n=104)		
CEMACH recommended version	32	30.8
Own version of EWS chart	69	66.3
Other	3	2.9
A different EWS chart used in FMU or AMU (n=59)		
Yes	2	3.4
No	57	96.6
EWS chart includes :		
Recommendations for action (n=103)	97	94.2
SBAR or other system for communication (n=104)	41	39.4
An action / trigger line (n=105)	77	73.3
Sensitivity of trigger thresholds thought to be (n=102);		
Too sensitive	9	8.9
Appropriate	90	88.2
Not sensitive	3	2.9
Parameters that should ideally be documented (n=106)		
Temperature	106	100
Heart rate	105	99
Systolic blood pressure	105	99
Respiratory Rate	104	98
Diastolic blood pressure	103	97.2
Blood Pressure	102	96.2
Oxygen saturation	97	91.5
Urine output	90	84.1
Lochia	86	81.1
Pain score	83	78.3
Proteinuria	83	78.3
Looks unwell	70	66
AVPU score	61	57.5
Other	12	11.2
Criteria that should be included on EWS chart to trigger referral*		
Midwife concern(n=106)	85	80.2
Woman's concern (n=99)	61	62
Woman's partner / family concern (n=97)	48	49.5
Prompt for introduction of EWS chart (n=105)		
Critical incident / risk management	72	68.6
CMACE recommendation	73	69.5
CNST requirement	43	41
Other	11	10.5
Dedicated training*		
Midwives (n=106)	88	83
Obstetricians (n=83)	69	83.1
Anaesthetists (n=79)	46	58.2
Maternity support workers (n=85)	68	80
Other (n=88)	11	12.5
Included in training (n=88)*		
Audit and feedback	59	67
Actions to take if the score triggers	85	96.6
Case study review	45	51.1
Accurate assessment / measurement of parameters	75	85.2
Listening to concerns of women	35	39.8
EWS chart included specific instruction for use by midwives (n=107)		
Yes	97	90.7
No	10	9.3

Instructions included (n=90)		
What to do	85	94.4
Who to contact	86	95.6
Time scale	61	67.8
Problems obtaining clinical review after EWS chart triggering (n=107)		
Yes	23	21.5
No	84	78.5
Problems obtaining clinical actions after EWS chart triggers (n=107)		
Yes	12	11.5
No	92	88.5
Perceived barriers to implementation of EWS chart (n=107)		
Overlap with use of partogram	46	43.4
Lack of teaching / training (n=106)	23	21.7
Staff shortage to adequately complete EWS chart	21	19.6
Lack of support for EWS charts by midwives	18	16.8
Lack of support for EWS charts by doctors	17	15.9
Current use of a standard TPR chart	15	14
Lack of evidence and validation of EWS in maternity care	14	13.1
Lack of priority compared with other clinical care	13	12.1
Other	13	12.1
Too time-consuming	10	9.3
Inappropriate trigger points for pregnant women	9	8.4
Impact on the woman of frequent interruptions	4	3.7
EWS helped prevent morbidity/mortality in own maternity unit (n=107)		
Yes	70	66
Unsure	36	34
No	0	0
Other charts/tools used (n=107)		
POTTS (n=106)	1	0.9
SBAR	93	86.9
Medical Emergency Team Criteria	7	6.5
No other tool/chart used	10	9.3
Another chart/tool used	21	19.6

*Only the 'yes' option is presented but other responses include 'no'
#Only the 'yes' option is presented but other responses included 'no' or 'not applicable'

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