

The early detection of maternal deterioration in pregnancy

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Introduction

The early detection of severe illness in pregnant women is challenging because of the relative rarity of such events, combined with the normal changes in physiology associated with pregnancy and childbirth that may be considered abnormal in the non-pregnant state. Early recognition is essential because deterioration can be alarmingly rapid, with catastrophic consequences. The challenge is to balance the identification of women needing intervention without 'over-medicalisation' of an otherwise physiological process.

Background

Any maternal death is a tragic event for families and clinical staff. Advances in the prevention, recognition, and response to several leading causes of direct maternal deaths - thromboembolism, hypertensive disorders, haemorrhage and sepsis - have seen a general downward trend in maternal mortality in the United Kingdom (UK).¹ Substandard care has been an on-going finding of confidential enquiries. Between 2009-12, 106 (52)% of the 203 direct maternal deaths in the UK had treatment where improvements to their care may have made a difference to their outcome.¹

In comparison with mortality, there are estimated to be 8 times the number of women who suffer from severe maternal morbidity in the UK. Critical care admissions are estimated at 26/10,000 maternities but a definitive number is difficult to ascertain and may be as high as 12/1000.²

In many cases the early warning signs and symptoms of impending severe maternal illness or collapse go unrecognised. The regular recording and documentation

of vital signs, using a Modified Early Obstetric Warning System (MEOWS) was a top recommendation in the UK confidential enquiries into maternal deaths in 2007³ and 2011.⁴

There is no fully validated early warning system for use in obstetrics and practical experience reported in the literature is mixed. Kodikara *et al*⁵ established that MEOWS identifies potentially sick women but that there is a high false positive rate. The blood pressure parameters are also reportedly set incorrectly. Carle *et al*⁶ concluded that the *general* early warning system was sensitive to predict obstetric mortality, but that the obstetric MEOWS did not confer any additional benefit. Lappen *et al*⁷ disagreed with this and concluded that the general early warning systems should not be applied to the obstetric population. They also reported that the relative infrequency of sepsis among pregnant women limits the positive predictive value of any general scoring system, precluding the development of a clinically useful obstetric model. However, it is agreed that most critically ill pregnant women have early triggers, which continue throughout their illness.⁸

A UK wide obstetric anaesthetist survey in 2009 revealed consensus of opinion on the need for a nationally agreed early warning tool for obstetrics with the associated training, skills and resources.⁹

National Early Warning System (NEWS) – non obstetric

Early detection, timeliness, and competency of the clinical response are determinants of clinical outcome in people with acute illness.¹⁰ A range of early warning systems are in use across the UK, for example, the all-Wales National

Early Warning System (NEWS) provides a consistent approach to the recognition and response to acutely ill patients. It also provides the *same language* especially for clinicians who work between different hospitals and it has been extensively validated within the UK and Canada.¹¹ NEWS is surveillance based on a simple scoring system, with scores allocated to physiological measurements. The scores are aggregated and the clinical team is alerted to any clinical deterioration and a triggered timely, appropriate response. The track and trigger of NEWS should be mirrored in the observation charts in use.

Agreeing the physiological parameters in obstetrics - what is normal and abnormal – and does it matter?

It is unsurprising that there are a number of existing obstetric early warning charts in use across the United Kingdom; MEOWs has been adapted to ‘work’ locally and there are also a number of numerical warning systems in use.

Maternity clinical staff know there are changes to physiological parameters in pregnancy, which leads to difficulties reaching agreement and consensus for exact figures, ranges and significance of particular values. This creates a tension when trying to link early warning system for obstetrics to the general NEWS, because the specificities and sensitivities are different, un-quantified and do not map directly for either symptoms or signs.

Clinicians from all Welsh health boards at a Maternity National Learning Session (November 2011) were invited to add their knowledge and experience and suggest what they thought were the appropriate scoring values. This suggested that the development of consensus was possible,

but the process created a range for most parameters that would need further testing and validation. It was recognised that the search for validity, that may not apply universally to all pregnant women at all times, risked missing the essential aims in tracking maternal condition (deterioration), triggering review and escalation to appropriate expert care in a timescale that improves outcomes.

This group concluded the focus was NOT about exact figures, but more the response that would provoke escalation to prompt senior review by the appropriate multidisciplinary team (MDT) member. Consequently they were able to reach consensus based on an exemplar’ format (A Policy Exemplar Guide¹²). This allowed local variation and adaptation, leading to ownership and use, rather than obstacles and delay - tools of practical use for practising clinical staff with an identified need. Such ‘bottom-up’ development has been considered highly effective in Wales.¹³

All obstetric units should have trained obstetric anaesthetists available and many hospitals have critical care outreach teams. It is emphasised that ANY concern about a woman should lead to escalation, regardless of a score. An MEOWS example used in Wales is given in Figure 1. Although colour-coded charts may trigger review or intervention, an objective scoring system would allow the grading of progressive responses and monitoring of progression of disease or success of treatment. Many MEOWS charts remain unvalidated, although some progress towards this was made by Singh *et al*¹⁴ who found maternal morbidity could be predicted with a sensitivity of 89% and a specificity of 79%. Recognising charts need to be monitored for their use and value irrespective of their validity helps justify their implementation whilst waiting for validity studies. This surveillance can

be achieved through existing validated improvement methods such as PDSA cycles.¹⁵

To improve the recognition *and response* to the acutely deteriorating pregnant woman, robust escalation guidance (and the response it provokes) is paramount, and this has been based on a Royal College of Anaesthetists Report.² Explicit guidance is available about when to request appropriately skilled multi-disciplinary senior help (Table 1). A formal communication tool such as SBAR (Figure 2) is recommended for use when requesting assistance during escalation.¹⁶

The early detection of women with sepsis

Additional tools are available for the recognition and treatment of severe sepsis in the deteriorating pregnant woman.¹⁷ Maternal sepsis rose to become a leading cause of maternal death in the UK, sparking the need for urgent consideration¹⁸ and it has been the specific focus of the latest maternal mortality report.¹ Although the RCOG have published guidelines on maternal sepsis^{19,20} there is a need for practical tools to implement them.

The importance of these tools is seen when one considers the 83 women in the UK and Republic of Ireland who died of infection related causes between 2009 and 2012.¹ Twenty women died of genital sepsis, a significant reduction from the 2006-8 figure. Infection where Group A Streptococcus is isolated is the most important factor associated with progression from systemic inflammatory disease (SIRS) to septic shock (Where there is refractory hypotension after fluid resuscitation). The rapidity of deterioration is demonstrated by the observation that half of the women with group A

streptococcal infection died within 2 hours of signs of SIRS (75% within 9 hours). The United Kingdom Obstetric Surveillance System (UKOSS) reported on 365 women with severe sepsis, giving a rate of 4.7 women / 10,000 maternities. 71 had septic shock (19.5%) confirming the strong association with group A streptococcal infection in those who survive also.²¹

The diagnosis of sepsis in the non-pregnant woman has been widely agreed through work by the surviving sepsis campaign,²² with a validated tool for management – the Sepsis Six Bundle.

Being unwell with, for example, an upper respiratory tract infection (URTI) is common in pregnancy and many innocuous and self limiting infections occur all the time in the community. Mortality from severe sepsis is RARE, but early warning signs may go unrecognised.

Not all women with a high temperature or flu-like symptoms in pregnancy or the puerperium have, or are at risk of developing, sepsis. Many individuals and groups would strongly wish for pregnancy and childbirth to be promoted as a 'natural' event, and hence there is also a need to avoid over diagnosis and unnecessary medicalisation of well women. It is the presence of the systemic inflammatory response with an actual or potential source of infection that leads to the diagnosis of sepsis. It is relatively straightforward to add to the list used in diagnosing sepsis in adults, in order to account for possible additional causes of pregnancy-specific infection, including prolonged ruptured membranes or offensive liquor, unexplained fetal tachycardia in the absence of a maternal tachycardia (looking for chorioamnionitis), recent delivery and / or offensive lochia and breast redness and / or tenderness or mastitis. It is important to be wary that women with a history of sore throat may have Group A Streptococcal infection.¹

Although the PCO_2 can reflect the associated metabolic acidosis (with respiratory compensation) found in sepsis (with a cut off of 7.34kPa) the relative hyperventilation of pregnancy, in order to maintain a diffusion gradient of waste CO_2 from the feto-placental unit, means many normal women exhibit this relative respiratory alkalosis as part of the normal physiological changes of pregnancy, but have a reduced buffering capacity for metabolic acidosis when it does occur.²³

What does this mean in practice?

In the absence of an adequate tool validated for pregnancy, the two most important questions would seem to be:

Is the woman unwell?

COULD she have SEPSIS?

In this context, track and trigger tools (such as MEOWS) aid the diagnosis and management of the acutely deteriorating woman with sepsis. However, Edwards *et al*²⁴ found poor prediction using such charts alone (the positive predictive values for the 6 MEOWS charts they identified ranged from <2-15%.

Just as with MEOWS charts, there are a variety of tools being implemented for pregnant women, that use some or all of the physiological parameters from a non-pregnancy specific context through to tools that attempt to modify the parameters to account for maternal physiological changes. The pragmatic approach would be to not argue for uniformity, but rather agree upon using whichever tool will actually be used in clinical practice (monitoring compliance and outcomes). Ownership and buy-in are critical. If clinical staff perceive deficiencies in what

they are being 'told' to use, compliance is likely to be reduced.

When looking to record severe sepsis in pregnancy, the United Kingdom Obstetric Surveillance System (UKOSS) also took a largely pragmatic approach and found that the patients identified matched the numbers expected at the start of the study²¹ This is a strong argument for consideration and recognition of severe sepsis, rather than precision, in its exact diagnosis.

A pragmatic approach

In drawing up a local policy or guideline, there should be an agreed set of parameters *beyond which* everyone would agree that further investigation and management is required. This can be formulated graphically (Figure 3) into an exemplar flow chart.

These parameters probably apply to pregnancy AFTER the first 20 weeks and up until 48 hours after delivery. Outside this period, is probably safer to use the non-pregnant values, especially if the woman reports feeling unwell.

As so much of pregnancy care occurs outside of the hospital setting, knowledge of the potential for sepsis and recognition of potential maternal deterioration is important. A screening tool for use in a community setting is being used in Powys, Wales.²⁵ Antenatal and postnatal women are asked how they are feeling at each contact with midwife. If they feel unwell, observations are taken (including temperature, pulse and respiration rate). Early warning triggers are calculated. Signs and Symptoms of infection and the Systemic Inflammatory Response Syndrome are actively sought. To enable appropriate and timely escalation, an 'aide

memoir' card for maternal sepsis also acts as a prompt for midwives. (Figure 4)

Any woman who is obviously unwell is referred or admitted for further assessment. There is an explicit mechanism and audit trail for following up any woman NOT admitted e.g. the next day to make sure that the woman is getting better. It should be emphasised to the woman and her relatives that, if she is getting worse, she should seek hospital attention immediately.

A key feature of this work was to explore the application to pregnancy of the sepsis six care bundle from the Surviving Sepsis Campaign.²² However, pregnancy needs further consideration in relation to the fetus/retained products of conception and the inherent thromboembolic risk of pregnancy and sepsis risk together. This culminated in the collaborative approach of the '*Sepsis Six plus Two*' maternity sepsis response tool.

Measurement played an important part in the implementation of these tools. In the short term, this was around process change and being able to demonstrate reliable implementation. Outcome data however is long term but an example of this would be a reduction in the numbers of women escalated to a higher level of care.

Conclusions

The physiological parameter least likely to be affected by pregnancy itself, and acts as a marker of severity of maternal condition is respiratory rate. Many women have minor illnesses with changes to physiological parameters that could be alarming outside of pregnancy. This leads to asking whether a woman feels fundamentally 'well' or 'unwell' and being particularly aware of maternal tachypnoea, especially if associated with a significant rise in the lactate level. This may indicate the need for rapid escalation to a critical care environment where prompt intervention may materially alter outcome.

Use of track and trigger tools depend on effective recognition of gradual deterioration and appropriate escalation in order to mobilise the appropriate level of expertise across disciplines. This is aided by assessing ill pregnant women regularly with effective clinical communication via objective discussion in formal handovers (a safety brief).

Early intervention by 'thinking sepsis' and instituting appropriate investigations promptly, and the sepsis six plus two care bundle completes a set of tools for clinical staff to recognise and manage deteriorating women in a structured and logical manner, with clear pathways to requesting senior and multidisciplinary help.

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Figure 1: Exemplar MEOWS Chart,
1000 Lives Transforming Maternity Care mini-collaborative

OBSTETRIC EARLY WARNING CHART

CONTACT DOCTOR FOR EARLY INTERVENTION IF PATIENT TRIGGERS ONE RED OR TWO YELLOW SCORES AT ANY ONE TIME													
Date:													
Time:													
RESP (write rate in corresp. box)	>30											>30	
	21-30											21-30	
	11-20											11-20	
	0-10											0-10	
Saturations	95-100%											11-20	
	<95%											95-100%	
Administered O ₂ (L/min.)												%	
TEMP	39											39	
	38											38	
	37											37	
	36											36	
	35											35	
HEART RATE	170											170	
	160											160	
	150											150	
	140											140	
	130											130	
	120											120	
	110											110	
	100											100	
	90											90	
	80											80	
	40											40	
Systolic blood pressure	200											200	
	190											190	
	180											180	
	170											170	
	160											160	
	150											150	
	140											140	
	130											130	
	120											120	
	110											110	
	50											50	
Diastolic blood pressure	130											130	
	120											120	
	110											110	
	100											100	
	90											90	
	80											80	
	70											70	
	60											60	
	50											50	
	URINE	passed (Y/N)											passed (Y/N)
		Amount											Amount
Proteinuria	protein ++											protein ++	
	protein >++											protein >++	
Amniotic fluid	Clean/Pink											Clean/Pink	
	Green											Green	
NEURO RESPONSE (✓)	Alert											Alert	
	Voice											Voice	
	Pain											Pain	
	Unresponsive											Unresponsive	
Pain Score (no.)	0-1											0-1	
	2-3											2-3	
Lochia	Normal											Normal	
	Heavy/ Fresh/ Offensive											Heavy/ Fresh/ Offensive	
Looks unwell	NO (✓)											NO (✓)	
	YES (✓)											YES (✓)	
Total Yellow Scores													
Total Red Scores													

Table 1: Exemplar escalation policy (with acknowledgement)

ESCALATION Obstetric NEWS	Minimal Monitoring	Alert ...	Medical Review
0- 2	12 hourly*	Nil	
3-5	1-4 hourly	Midwife in charge and Obs SHO	Within 30 mins: Increased frequency of obs. Inform obs ST3 and obs anaes ST3 (or equiv) & of review outcome. Could this woman have sepsis?
6-8 6 = SICK!	1-2 hourly	Obstetric ST3 and Obs anaesthetist	Urgent call to team with primary medical responsibility for the patient (maternity). Simultaneous call to personnel with core competences for acute illness. These competences can be delivered by a variety of models at local level, such as a critical care outreach team, a hospital-at-night team or a specialist trainee in anaesthesia, obstetrics, acute medical or surgical specialty.
≥9 9 = NOW	30 mins	Team with critical care competencies & Obs ST3/Obs anaes ST3/Consultant obstetrician	Emergency call to team with critical care competences and maternity team. The team should include a medical practitioner skilled in the assessment of the critically ill patient, who possesses advanced airway management and resuscitation skills.

* or as per local guidance

Note of Caution: Frequency of observations can be increased at the discretion of the clinical team. Equally, concern about a patient should lead to escalation, regardless of the score.

Figure 2: Example of SBAR communication

Obstetric SBAR Referral



S Situation	Date Time Drs name My name is From Ward/Dept I am calling about The problem is
B Background	The woman was admitted with on/...../..... Gravida: Para: EDD: Gestation: Past med/obs history
A Assessment	The MEOWS is Clinical Impression/Actions/observations Other relevant factors, e.g. Sepsis screening, blood results, urine output
R Recommendation	I request you review this woman within the nexthrs/mins Document any initial instructions Patient reviewed by Dr at

All handovers, referrals and reporting should use the SBAR format.

Obstetric Sepsis diagnosis & sepsis bundle CR July 2012 (V3)

Figure 3: Exemplar screening tool for sepsis in pregnancy and Sepsis Six Plus**
Two recognition and response bundle for use in pregnancy
(20 weeks to 48hrs postnatal)



Obstetric Sepsis / Severe Sepsis Screening Tool

Does the woman have 2 Signs and Symptoms of Infection?

Temperature <36 or >38 °c		Respiratory rate > 20bpm	
Heart rate >100 bpm (AN & Intrapartum) > 90bpm (PN)		Acutely altered mental state	
WCC >12 or <4 x10 ⁹ /l (higher threshold in labour)		Hyperglycaemia (Blood sugar >7.7) in the absence of diabetes	

If YES

Does the woman have a history or signs of a new infection or infective source ?

Prolonged ruptured membranes or offensive liquor		Breast redness and / or tenderness / mastitis	
Unexplained fetal tachycardia in the absence of a maternal tachycardia		Fetal demise	
Recent delivery / offensive lochia		Cough / sputum / chest pain	
Catheter or Dysuria		Abdominal pain distension/diarrhoea	
Line infection		Cellulitis/wound infection/septic arthritis	
Headache with neck stiffness		Other	
Endocarditis			

If Yes the woman has SEPSIS

Does the woman have any signs of organ dysfunction ?

SBP < 90 or MAP <70 mmHg		Lactate > 2mmols/l	
Urine output<0.5 ml/kg/hr for 2 hours		New need for Oxygen to keep SaO ₂ >90%	
Platelets < 100 x 10 ⁹ /l		INR > 1.5 or aPTT > 60s	
Creatinine rise of > 44.2mmol/l or level of >177 mmol/l		Bilirubin > 70µmol/l	

NO

YES

<p>If NO, treat for SEPSIS:</p> <p><u>Start Sepsis Six**Plus Two</u></p> <ul style="list-style-type: none"> • Oxygen • Blood cultures • Lactate • IV antibiotics • Fluid therapy • Fluid balance and catheter • **Consideration of delivery & VTE prophylaxis 	<p>If YES, the woman has SEVERE SEPSIS:</p> <p><u>Start Sepsis Six**Plus Two</u></p> <ul style="list-style-type: none"> • Start the clock..... • Refer the woman to Critical Care. • Give IV Antibiotics within 1 hour • Start with Stat Dose
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Obstetric Sepsis diagnosis & sepsis bundle CR July 2012 (V3)

Figure 4: Exemplar aide memoire for recognition and management of sepsis in pregnancy

1000 LIVES 
O FYWYDAU

Obstetric Prompt

Could this woman have sepsis?

Signs and Symptoms of Sepsis

- Temperature < 36°C or > 38°C
- Heart rate > 100 bpm (AN & Intrapartum) >90bpm (PN)
- Respiratory rate > 20/min
- WCC > 12 or < 4 x 10⁹/l (higher threshold in labour)
- Acutely altered mental state
- Hyperglycaemia (>7.7 mmol/l)

Two or more of the above plus a history or signs of new infection:
Start Sepsis SixPlus Two**

Obstetric Sepsis Six **Plus Two

- Oxygen
- Blood cultures
- Lactate
- IV antibiotics
- Fluid therapy
- Fluid balance and catheter

Re-assess
hourly for
severe sepsis

- ** Consider delivery or ERPC
- ** VTE Prophylaxis

1000 LIVES 
O FYWYDAU