

Sepsis during Pregnancy and Postpartum

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1. Purpose of guideline

This guideline applies to all woman / wāhine who are pregnant or up to six weeks postpartum (or after the end of a pregnancy if pregnancy did not end in a birth) who have a suspected infection or clinical observations outside normal limits (e.g. Maternity Early Warning Score (MEWS) ≥ 1).

This guideline includes:

- Clinical assessment of woman / wāhine who are pregnant and up to six weeks postpartum who have a suspected infection
- Use of the clinical form CR5825: Maternity Early Warning Score (MEWS)
- Use of the clinical form CR3170: Maternal Sepsis Screening and Action Tool
- Investigations required to identify and characterize sepsis
- Antibiotic and supportive management strategies
- Use of a severity tool to determine indications for admission to higher care area.

Background:

- Both internationally and throughout Australasia, sepsis is consistently one of the leading causes of maternal morbidity and mortality.
- The commonest cause of maternal death from sepsis is infection with Group A streptococcus species.
- Sepsis was the third leading cause of admission to a higher care area (Maternal Morbidity Working Group [MMWG], 2019)
- Pregnancy related infection accounts for 5.2% of maternal deaths in New Zealand (Perinatal and Maternal Mortality Review Committee [PMMRC], 2019).

2. Guideline management principles and goals

- The CR3170: Maternal Sepsis Screening and Action Tool ([Appendix 1](#)) should be started for all pregnant and postpartum woman / wāhine where MEWS is ≥ 1 where infection is a possible cause. If in doubt use the tool.
- Treatment of sepsis is time critical and needs to be started within the first hour of sepsis being suspected (Bowyer et al., 2017). This includes all aspects of the sepsis 6+2 pathway as indicated on CR3170 (see [Clinical forms](#)).
- MEWS can identify potential sepsis but the score does not reliably reflect its severity.
- Follow MEWS escalation pathway when triggered.

3. Definitions

Term	Definition
IBW	Ideal body weight
Bacteraemia	Presence of bacteria in blood
Sepsis	Life threatening organ dysfunction caused by a dysregulated host response to infection
Septicaemia	Presence of microbes and their toxins in blood
Septic shock	Clinical diagnosis of sepsis with associated hypotension (systolic

Term	Definition
	blood pressure <90mmHg or drop >40mmHg from normal)

4. Presenting signs and symptoms

<ul style="list-style-type: none"> • Fever, rigors 	<ul style="list-style-type: none"> • Breast engorgement/redness
<ul style="list-style-type: none"> • Heavy lochia (delay in involution) 	<ul style="list-style-type: none"> • Cellulitis around surgical wound and/or discharge
<ul style="list-style-type: none"> • Non- specific – malaise, lethargy, confusion, reduced appetite 	<ul style="list-style-type: none"> • Perineal repair with signs of infection/breakdown/haematoma
<ul style="list-style-type: none"> • Urinary symptoms 	<ul style="list-style-type: none"> • Rash
<ul style="list-style-type: none"> • Abdominal / pelvic pain and tenderness 	<ul style="list-style-type: none"> • Productive cough
<ul style="list-style-type: none"> • Flank/back pain 	<ul style="list-style-type: none"> • Diarrhoea and or vomiting
<ul style="list-style-type: none"> • Uterine or renal angle pain and tenderness 	<ul style="list-style-type: none"> • Abdominal or chest pain
<ul style="list-style-type: none"> • Offensive vaginal discharge / lochia (offensive may indicate anaerobes, serosanguinous, streptococcus infection) 	<ul style="list-style-type: none"> • Fetal tachycardia

5. Risk factors for maternal sepsis

General	Pregnancy-specific
<ul style="list-style-type: none"> • Obesity 	<ul style="list-style-type: none"> • Vaginal discharge
<ul style="list-style-type: none"> • Impaired glucose tolerance / diabetes 	<ul style="list-style-type: none"> • History of pelvic infection
<ul style="list-style-type: none"> • Impaired immunity / immunosuppressant medication 	<ul style="list-style-type: none"> • Amniocentesis and other invasive procedures
<ul style="list-style-type: none"> • Anaemia 	<ul style="list-style-type: none"> • Cervical cerclage
<ul style="list-style-type: none"> • Minority ethnic group origin 	<ul style="list-style-type: none"> • Extremes of maternal age
<ul style="list-style-type: none"> • Prolonged rupture of membranes (spontaneous or artificial) 	<ul style="list-style-type: none"> • Vaginal trauma, caesarean section, wound haematoma
<ul style="list-style-type: none"> • Smoking 	<ul style="list-style-type: none"> • Retained products of conception
<ul style="list-style-type: none"> • Group A Streptococcus/ Gram-positive cocci in a close contact or family member 	<ul style="list-style-type: none"> • Risk factors for Group B Streptococcus (GBS) as per guideline.

6. Clinical assessment

- Undertake COVID screening as per current alert level. Test if indicated.
- Record full set of observations on the MEWS chart, including respiratory rate*.
- Review obstetric history including antenatal concerns, prolonged pre-labour rupture of membranes, mode of delivery, requirement for Group B Streptococcus (GBS) prophylaxis and complications of labour/ birth or the postpartum period
- Review woman / wāhine clinical alerts, microbiology results and document previous infection or colonization with multi resistant organisms (MROs)
- Review the clinical course and laboratory results from the neonate;

- Undertake a clinical examination including:
 - Heart and lung auscultation/percussion
 - Breast examination - mastitis should not be overlooked
 - Abdominal palpation
 - Look for any signs of deep vein thrombosis (DVT)
 - Examination of wound or other areas of possible soft-tissue infection
 - Examination of epidural/spinal site if applicable.

* Increased respiratory rate is an important feature of sepsis which is frequently overlooked.

7. Fetal surveillance

- Consider the most appropriate method of monitoring fetal wellbeing during maternal sepsis e.g. cardiotocography (CTG), ultrasound, Doppler auscultation.
- If preterm delivery is required, corticosteroids should be considered for fetal indications.
- Chorioamnionitis onset may be non-specific or insidious, but rapid deterioration is possible. Chorioamnionitis requires urgent delivery on both maternal and fetal grounds as well as treatment for sepsis.
- Preterm delivery may be required for fetal or maternal indications. Where this is at periviable or previable gestation, Obstetric SMO consultation with the patient is required in a clinically appropriate timeframe.
- CTG monitoring for gestations ≤ 25 weeks will be at the discretion of the most senior Obstetrics & Gynaecology (O&G) clinician present.
- See [Appendix 2: Fetal monitoring and surveillance](#) for additional information.

8. Differential diagnoses

• Appendicitis	• Pelvic collection/infected hematoma
• Urinary tract infection (UTI) /pyelonephritis	• Pneumonia
• Endometritis	• Mastitis, breast abscess
• Episiotomy or caesarean wound infection	• Meningitis
• Gastroenteritis	• Necrotizing fasciitis
• Influenza or other viral infections including COVID-19	• DVT, pelvic thrombophlebitis, pelvic vein thrombosis
• Infection from regional anaesthesia	

9. Follow correct pathway (use [Maternal Sepsis Screening and Action tool](#))

Is the Maternal Amber Flag or Low risk of sepsis?

- Discuss with Obstetric registrar or Senior Medical Officer (SMO)

Is one or more Maternal Red Flag present?

- Start Sepsis Six pathway now!
- Inform Obstetric Registrar/SMO and Anaesthetic registrar

Sepsis Six pathway (complete ALL within one hour);

- Administer oxygen if required to maintain SpO₂ 94-98%
- Take blood cultures
- Give intravenous (IV) antibiotics as per [Antibiotic regimen](#) below
- Give IV fluids
- Check serial lactates
- Measure urine output.

Also consider the ‘+2’ for obstetrics:

- Assess fetal state and consider delivery or evacuation of retained products of conception for either fetal or maternal indications.
- Chemical and/or mechanical thromboprophylaxis.

If after delivering the Sepsis Six, woman / wāhine still has:

- Systolic blood pressure (BP) < 90mmHg
- Reduced level of consciousness despite resuscitation
- Respiratory rate < 25 per minute
- Lactate not reducing or >2 mmol/l
- Or if woman / wāhine is clearly critically ill at any time.

Then call DCCM team immediately via a Code Red

Maternal collapse

- Perimortem caesarean section (resuscitative hysterotomy) should be undertaken in cases of maternal cardiorespiratory arrest where visibly pregnant/beyond 20 weeks’ gestation.

Immediate actions to be taken:

Step	Action
1.	Administer oxygen aiming to keep saturations between 94% - 98%.
2.	Take blood cultures, at least a peripheral set. Consider e.g. urine, sputum, vaginal swabs, breast milk cultures, throat swabs, wound swabs. Think source control and timing of birth. Start cardiotocography (CTG). When antibiotic therapy is required immediately, obtain two sets from different sites (see LabPlus Test Guide on HIPPO for instructions on how to take blood cultures).
3.	Give IV antibiotics according to sepsis guidelines (see below). Do not delay if unable to obtain blood cultures. Consider ‘allergies’ prior to administration.
4.	If hypotensive/lactate > 2mmol/l, give 500 mL stat crystalloid (can repeat up to 30 mL/kg) Consult senior clinician regarding fluids before giving if woman / wahine has pre-eclampsia or cardiac disease.
5.	Check serial lactates, if lactate > 2mmol/l for fluid challenge and serial lactates every two hours until normal. If lactate not reducing or remains >4 despite fluid challenge for escalation to critical care.

Step	Action
6.	Measure urine output, may require urinary catheter and hourly urometer, ensure fluid balance chart commenced and completed hourly. Urine output should at least 30 mLs per hour i.e. at least 0.5-1 mL/kg/hour.

10. Initial antibiotic management

Antibiotics should be administered within 60 minutes of first assessment and should not be delayed while waiting for microbiology results or other investigations. Blood cultures are the key to directing on-going antimicrobial therapy and should be taken prior to starting antibiotics.

Empirical Therapy

Maternal sepsis antibiotics:

Cefuroxime 750 mg IV q6h + Gentamicin 5 mg/kg estimated IBW (max 500 mg) q24h

Maternal sepsis with severe penicillin allergy:

Clindamycin 600 mg IV q8h + Gentamicin 5 mg/kg estimated IBW (max 500 mg) q24h

An Ideal Body Weight Table can be found in the Regional Clinical Portal (RCP).

Go to Éclair, 'All Data' then 'New'. Select CrCl calculator then 'Create'. The IBW table opens if the ⓘ is clicked on.

For more information on gentamicin, see the gentamicin Medication Administration Guide (MAG). The Medication Administration Guides are available under 'M' on Hippo.

Where the source of sepsis is identified (see [Appendix 3](#)), de-escalate to appropriate antibiotics (see [below](#)). Adjust initial treatment if pathogen(s) identified and susceptibility results available.

Note: If known to have acquired a Multidrug-Resistant Organism (MRO) contact SMO on call for Infectious Diseases (ID) via switchboard for appropriate antibiotics.

Antibiotic regimen for identified source:

Presumptive diagnosis	Antibiotic regimen	Other management
Endometritis	cefuroxime 750 mg IV q6h + metronidazole oral 400 mg BD	Consider need for Dilation and curettage (D&C) if retained products
Wound infection	flucloxacillin 1 g IV q6h	Consider need for wound exploration +/- drainage of collection(s)
Pyelonephritis	cefuroxime 750 mg IV q6h (if severe add gentamicin 5 mg/kg IBW IV q24h (max 500 mg))	Consider renal ultrasound
Pneumonia (hospital acquired)	cefuroxime 750 mg IV q6h + gentamicin 5 mg/kg IBW IV q24h (max 500 mg)	Refer to community acquired pneumonia guideline if appropriate
Mastitis	flucloxacillin 1 g IV q6h	Refer to lactation consultant
Adjust initial treatment if pathogen(s) identified and susceptibility results available		

11. Additional investigations

- Full blood count, coagulation studies, C-reactive protein (CRP), urea, creatinine, electrolytes and liver function tests.
- Pneumococcal and legionella urinary antigens, sputum culture and nasopharyngeal respiratory viral swab PCR for respiratory signs. If influenza is considered likely the case should be discussed with the clinical virologist or microbiologist to ensure that testing occurs in a timely manner.
- Chest X-ray if respiratory symptoms or signs.
- Pelvic ultrasound if Retained Products of Conception (RPROC) / pelvic collection is suspected. Followed by further imaging as recommended by Radiologist.
- Computed tomography (CT) scan if concerned about collections or pelvic abscess.
- Stool sample for culture, viral PCR if diarrhoea; Clostridium difficile if recent antibiotics followed by diarrhoea.

Note: The absence of retained products of conception on ultrasound does not exclude endometritis.

12. Determining clinical placement and senior obstetrician review timeframe

See [Appendix 4](#): Determining clinical placement for the severity tool to determine the clinical placement of woman / wāhine and senior obstetrician review timeframe.

13. Timing and mode of delivery

- Obstetric factors to consider:
 - Presence of intrauterine sepsis
 - Need for steroids <34+6 but do not delay delivery if maternal condition demands it
 - Maternal response to resuscitation efforts
 - Gestation of the pregnancy and fetal status
 - Preterm delivery may be required for either maternal or fetal indications
- Anaesthetic factors to consider:
 - Epidural/spinal anaesthesia should be avoided in woman / wāhine with sepsis and a general anaesthetic will usually be required for caesarean section.
- Neuraxial blocks in women with untreated sepsis would only be undertaken after consultation with an anaesthetic SMO, who would balance the increased risk of infectious complications against the risk of general anaesthesia in pregnancy. An epidural for labour analgesia would not normally be offered to a woman with untreated sepsis. Pregnant women with sepsis experience increased haemodynamic instability during general anaesthesia.
- Anaesthesia during pregnancy in a woman with sepsis does not increase mortality but may be associated with other adverse obstetric events (Bowyer et al., 2017).

14. Management of associated organ dysfunction

Maintain blood pressure (BP) (SBP>90, MAP>65) and urine output ≥ 30 mL/hourly. Significant fluid replacement may be required but be aware that woman / wāhine are more at risk of developing pulmonary oedema from fluid overload in the immediate postpartum period. Regular consultant (SMO) review of woman / wāhine with moderate or severe sepsis is essential.

Department Critical Care Medicine (DCCM) review if fluid requirements for circulatory support exceed 4litres in the first 12 hours (see [Appendix 5: Toxic/Septic shock syndrome classification table](#)).

15. Unique considerations when caring for the pregnant and postnatal woman / wāhine in an Intensive Care Unit setting

- Fetal well-being should be considered when setting physiological targets and monitoring should be undertaken by the obstetric team.
- Care with medication prescribing both for the pregnant and breastfeeding woman / wāhine.
- Avoidance of unnecessary radiological procedures for pregnant woman / wāhine and care with radiation exposure when radiology is necessary.
- Avoidance of supine positioning in pregnant woman / wāhine, maintaining a lateral tilt if visibly pregnant/after 20 weeks' gestation.
- Delivery may be required for maternal or fetal indications.
- For postnatal woman / wāhine ensure access to and assistance with breastfeeding/hand expressing/pumping.
- Perineal recovery and uterine involution should be carefully monitored.

- Contact between the woman / wāhine and baby / pēpi should be facilitated where appropriate.

16. Supporting evidence

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- Drake, M. (2019). Early flags of concern and warning scores. *Women's Health*, 21(4).<https://www.ogmagazine.org.au/21/4-21/early-flags-of-concern-and-warning-scores/>

17. Associated documents

- Antibiotic Prophylaxis for Obstetric & Gynaecology Surgical Procedures
- Group B Streptococcus (GBS) - Prevention of Early-Onset Neonatal Infection
- Mastitis -Treatment, Management and Prevention
- Postpartum Haemorrhage
- Pneumonia - Community Acquired Pneumonia (CAP) in Adults

Clinical forms

- CR5825: Maternity Early Warning Score (MEWS)
- CR3170: Maternal Sepsis Screening and Action Tool

18. Disclaimer


No guideline can cover all variations required for specific circumstances. It is the responsibility of the health care practitioners using this Auckland DHB guideline to adapt it for safe use within their own institution, recognise the need for specialist help, and call for it without delay, when an individual patient falls outside of the boundaries of this guideline.

19. Corrections and amendments

The next scheduled review of this document is as per the document classification table (page 1). However, if the reader notices any errors or believes that the document should be reviewed **before** the scheduled date, they should contact the owner or [Document Control](#) without delay.

Appendix 1: Maternal sepsis screening and action tool





AUCKLAND
DISTRICT HEALTH BOARD
Te Toka Tumai

**Maternal Sepsis
Screening and Action Tool**

MUST ATTACH PATIENT LABEL HERE

SURNAME: _____ NHI: _____

FIRST NAMES: _____ DOB: _____

Please ensure you attach the correct visit patient label

MATERNAL SEPSIS SCREENING AND ACTION TOOL

To be applied to all women who are pregnant or up to six weeks after the pregnancy ends who have a suspected infection or have clinical observations outside normal limits

STAFF MEMBER COMPLETING FORM

Date: _____ Name (print): _____

Designation: _____ Signature: _____

1. Has MEWS triggered (1 or more)? Tick

OR does woman look sick?

OR is fetus tachycardic (≥ 160 bpm)?

OR more than 2 temperatures greater than 37.5°C

OR $1 \geq 38^{\circ}\text{C}$

Yes

Low risk of sepsis. Use standard protocols, consider discharge with safety netting. Consider obstetric needs.

No

2. Could this be an infection? Tick

Yes, but source unclear at present

Chorioamnionitis/endometritis

Urinary Tract Infection

Infected caesarean or perineal wound

Influenza, severe sore throat, or pneumonia

Abdominal pain or distension

Breast abscess/mastitis

Other (specify): _____

Yes

3. Is ONE maternal Red Flag present? Tick

Responds only to voice or pain/unresponsive

Systolic B.P ≤ 90 mmHg (or drop > 40 from normal)

Heart rate > 130 per minute

Respiratory rate ≥ 25 per minute

Needs oxygen to keep $\text{SpO}_2 \geq 95\%$

Non-blanching rash, mottled/ashen/cyanotic

Not passed urine in last 18 hours

Urine output less than 0.5 mL/kg/hr

Lactate $\geq 2 \text{ mmol/L}$

(Note - Lactate may be raised in & immediately after normal labour & delivery)

Yes

4. Any Amber Flag Criteria? Tick

Relatives worried about mental status

Māori and/or Pacific Ethnicity

Acute deterioration in functional ability

Respiratory rate 21-24 OR breathing hard

Heart rate 100-130 OR new arrhythmia

Systolic B.P 91-100 mmHg

Not passed urine in last 12 hours

Temperature $< 36^{\circ}\text{C}$

Immunosuppressed/diabetes/gestational diabetes

Has had invasive procedure in last 6 weeks (e.g. CS, forceps delivery, ERPC, cerclage, CVS, miscarriage, termination)

Prolonged rupture of membranes

Close contact with Group A Strep or Gram positive cocci

Bleeding/wound infection/vaginal discharge

Non-reassuring CTG/fetal tachycardia > 160

Yes

Discuss with senior clinician and decide either:

	Time complete	Initials
Start Sepsis Six pathway (see page 2)	<input type="text"/>	<input type="text"/>
OR		
Take bloods and review within 1 hr (FBC, U&E, CRP, LFT, coag, lactate)	<input type="text"/>	<input type="text"/>
OR		
Hold off bloods and review within 1 hr	<input type="text"/>	<input type="text"/>

Yes

Clinical deterioration or AKI (Acute Kidney Injury) or lactate > 2

YES NO

No

Clinician to make antimicrobial prescribing decision within 3 hours

	Time complete	Initials
	<input type="text"/>	<input type="text"/>


Red Flag Sepsis!! Start Sepsis Six pathway NOW (see overleaf)

This is time critical, immediate action is required.

PAGE 1
06/21

Adapted from The UK Sepsis Trust and Sepsis Trust NZ for ADHB use

CR3170

M A T E R N A L S E P S I S S C R E E N I N G A N D A C T I O N T O O L	 <p>AUCKLAND DISTRICT HEALTH BOARD Te Toka Tumai</p> <p>Maternal Sepsis Screening and Action Tool</p>	<p>MUST ATTACH PATIENT LABEL HERE</p> <p>SURNAME: _____ NHI: _____</p> <p>FIRST NAMES: _____ DOB: _____</p> <p>Please ensure you attach the <u>correct</u> visit patient label</p>		
	<p>To be applied to all women who are pregnant or up to six weeks after the pregnancy ends who have a suspected infection or have clinical observations outside normal limits</p>			
	<p>Inform Consultant Obstetrician and Level 9 Anaesthetist (use ISBAR) state woman has Red Flag Sepsis</p>			
	<p>Consultant informed?</p> <p>Time complete Tick Initials</p>			
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Action (complete ALL within 1 hour)</td> <td style="width: 50%;">Reason not done/variance</td> </tr> </table>		Action (complete ALL within 1 hour)	Reason not done/variance
	Action (complete ALL within 1 hour)	Reason not done/variance		
	<p>1. Administer oxygen Aim to keep saturations 94% - 98%</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>		
	<p>2. Take blood cultures At least a peripheral set. Consider e.g. urine, sputum, vaginal swabs, breast milk culture, throat swabs. Think source control & timing of birth of baby - start CTG!</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>		
	<p>3. Give IV antibiotics According to maternal sepsis guideline (see below) Consider allergies prior to prescribing</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>		
	<p>4. Give IV fluids If Hypotensive/lactate > 2 mmol/L, 500 mL Plasma-Lyte 148 stat (can repeat up to 30 mL/kg). Ask doctor regarding fluids if not hypotensive and lactate normal. Consult senior clinician regarding fluids before giving if woman has pre-eclampsia</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>		
<p>5. Check serial lactates If lactate > 2 for fluid challenge and serial lactates every 2 hours until normal. If lactate not reducing or remains > 4 despite fluid challenge for escalation to critical care.</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>			
<p>6. Measure urine output May require urinary catheter Ensure fluid balance chart commenced and completed hourly Urine output should be at least 30 mL/hr</p>	<p>Time complete <input style="width: 100%;" type="text"/></p> <p>Initials <input style="width: 100%;" type="text"/></p>			
<p>Also consider:</p>	<ol style="list-style-type: none"> 1. Assess fetal state and consider delivery or evacuation of retained products of conception 2. Chemical/mechanical thromboprophylaxis 			
<p>If after delivering the Sepsis Six, patient still has:</p> <ul style="list-style-type: none"> • systolic B.P < 90 mmHg • reduced level of consciousness despite resuscitation • respiratory rate over 25 breaths per minute • lactate not reducing or > 2 mmol/L <p>If escalation remains clinically appropriate. Consider vasopressor support and call DCC (021 472 823) IMMEDIATELY</p>	<p>Maternal sepsis antibiotics: Cefuroxime 750 mg IV q6h + Gentamicin 5 mg/kg estimated IBW (max 500 mg) q24h</p> <p>Maternal sepsis with severe penicillin allergy: Clindamycin 600 mg IV q8h + Gentamicin 5 mg/kg estimated IBW (max 500 mg) q24h</p>			

CR3170

Appendix 2: Fetal monitoring and surveillance

It is important to consider the well-being of the fetus whilst treating the woman / wāhine with sepsis. The decision to undertake fetal surveillance and the mode of fetal surveillance during maternal sepsis will be determined by fetal gestation. Fetal surveillance at pre-viable gestations (i.e. prior to 24 weeks) may be limited to ultrasound assessment of fetal viability, whereas assessment at later gestations beyond 26 weeks may include electronic fetal monitoring (EFM).

In the setting of extra-uterine sepsis (e.g. respiratory or urinary sepsis), fetal well-being will largely be determined by maternal status. EFM may demonstrate an uncomplicated fetal tachycardia characterised by acceptable short term variability and absence of decelerations. These findings will often improve with maternal fluid resuscitation and treatment of maternal pyrexia and may increase the possibility of a relatively reassuring fetal heart rate pattern despite acute maternal sepsis. In cases of intrauterine sepsis there is a lack of sensitivity and specificity in the EFM findings observed but features suggestive of fetal acidosis including reduced or absent variability, baseline tachycardia and/or the presence of persistent late decelerations warrant further assessment and expedited delivery.

Factors to consider:

- The most appropriate method of monitoring fetal well-being during maternal sepsis e.g. cardiotocography, Doppler heart rate monitoring, ultrasound.
- If preterm delivery is required, corticosteroids should be considered for fetal indications. Sepsis is not a contra-indication to steroids.
- The onset of chorioamnionitis may be non-specific or insidious, but rapid deterioration is common. Chorioamnionitis requires urgent delivery on both maternal and fetal grounds.
- Preterm delivery may be required for either maternal or fetal indications.

In cases of extra-uterine sepsis, efforts to treat maternal sepsis and prolong gestation should be considered at gestations remote from term, although it is reasonable to consider delivery in term pregnancies as a means of improving maternal resuscitation efforts. Assessing the response to maternal resuscitation and treatment is a vital component of the assessment and management of sepsis in pregnancy. Delivery should be considered in any case where the maternal response to treatment is felt to be compromised by continuing the pregnancy.

When a mother has been found to have invasive group A streptococcal infection in the peripartum period, the neonatologist should be informed and prophylactic antibiotics administered to the baby.

Appendix 3: Source of sepsis

Group A Streptococcus (GAS)

Group A Streptococcus is the most common pathogen related to maternal mortality from sepsis worldwide (Bowyer et al., 2017). New Zealand reports up to 50% of maternal deaths from sepsis were related to GAS.

Pregnancy, in particular, post-partum are a higher risk occasions for GAS incidence. For postpartum woman / wāhine there is a 20-fold increased incidence of GAS compared to non-pregnant woman / wāhine (Gustafson et al, 2017).

Rapid deterioration is the key characteristic distinguishing GAS from other sepsis with sudden onset of shock and organ dysfunction including renal failure and acute respiratory distress syndrome. GAS can cause invasive infections, namely;

- Endometritis
- Necrotizing fasciitis
- Toxic shock syndrome.

Group A streptococcus infection typically presenting with fever, abdominal pain and also diarrhoea.

It can also cause Streptococcal Toxic Shock Syndrome – hypotension, tachycardia and leucocytosis – also refer to section Toxic shock syndrome classification table.

Priority treatment is antibiotics (penicillin + clindamycin) to inhibit exotoxin production and aggressive fluid resuscitation (with caution) (Stevens & Bryant, 2019).

Other organisms/ causes of sepsis in pregnancy and postpartum (Bowyer et al., 2019)

Bacterial - Common

Gram-positive cocci

- Group B streptococcus
- Streptococcus pyogenes (see above Group A streptococcus)
- Staphylococcus aureus
- Streptococcus pneumonia
- Gardnerella vaginalis

Gram-negative cocci

- Escherichia coli,
- Proteus mirabilis
- Klebsiella pneumonia
- Neisseria

Bacterial – less common

- Haemophilus influenza
- Listeria monocytogenes
- Clostridium species
- Mycobacterium tuberculosis
- Chlamydia Trachomatis

Anaerobic organisms:

- Bacteroides, Peptostreptococcus

Viral

- Influenza
- Varicella zoster virus
- Herpes simplex virus
- Cytomegalovirus

Appendix 4: Determining clinical placement

This tool **does not** replace the MEWS but gives guidance where the MEWS is less than four regarding where the woman / wāhine is best managed within Maternity and when senior obstetric (SMO) review is required.

Give one point each for:

- Respiratory rate > 20
- Temperature ≥ 38C
- Systolic BP <90
- Heart rate > 100
- Oxygen saturation < 93% in room air.

Severity points		Initial ward for admission	Senior review and referral <i>Must have clearly identified team responsible for care</i>
0-1	Low	Inpatient ward	<ul style="list-style-type: none"> • Senior obstetrician (SMO) review within six hours of admission and ongoing reviews at four to six hourly intervals by obstetric team. • SMO review 12 hourly.
2-3	Moderate	Obstetric Maternity Complex Care Area (MCCA) Review MEWS – see below	<ul style="list-style-type: none"> • Senior obstetrician (SMO) review within two hours • Obstetric medicine team review within two hours • Ongoing reviews at two to four hourly intervals by obstetric team • SMO at least 12 hourly
4-5	High	Obstetric MCCA or higher care area Review MEWS – see below	<ul style="list-style-type: none"> • Senior obstetrician (SMO) and obstetric physician review within one hour of admission • Request DCCM consult.

- Woman / wāhine with positive blood cultures are reviewed routinely by the bacteraemia team.
- In cases of severe sepsis, stabilization or improvement in clinical condition should be within 24 hours. If this is not the case, refer the woman / wāhine to the Infectious Disease (ID) team by calling the ID consult registrar on 021 938 403 or extension 22974.

Appendix 5: Toxic / Septic shock syndrome classification table

Staphylococcal toxic shock syndrome (TSS)	Streptococcal toxic shock syndrome (STSS)
<ul style="list-style-type: none"> • Fever $\geq 39.9^{\circ}\text{C}$ • Rash: diffuse macular erythema • Desquamation: 10 – 14 days after onset of illness, especially palms and soles • Hypotension: systolic BP < 90 mmHg • Multisystem involvement - three or more of the following systems affected: <ul style="list-style-type: none"> ○ Gastrointestinal: vomiting or diarrhoea at onset of illness ○ Muscular: severe myalgia or elevated creatinine phosphokinase plus ○ Mucous membranes: vaginal, oropharyngeal or conjunctival hyperaemia ○ Renal: creatinine twice the upper limit of normal ○ Hepatic: total bilirubin twice the upper limit of normal ○ Haematological – platelets $\leq 100 \times 10^9/\text{l}$ ○ Central nervous system – disorientation or alterations in consciousness without focal neurological signs. 	<ul style="list-style-type: none"> a) Isolation of group A Streptococcus from: <ul style="list-style-type: none"> • Normally sterile site: blood, cerebrospinal fluid, peritoneal fluid, tissue biopsy • Non-sterile site: throat, vagina, sputum b) Clinical case definition Multi-organ involvement characterised by: <ul style="list-style-type: none"> • Hypotension • Two or more of the following: <ul style="list-style-type: none"> ○ Renal impairment – creatinine > 176 $\mu\text{mol/l}$ ○ Coagulopathy – platelets < $100 \times 10^9/\text{l}$ or disseminated intravascular coagulation ○ Liver involvement: alanine transaminase or aspartame transaminase or bilirubin levels twice the normal upper limit for age ○ Acute respiratory distress syndrome ○ Generalized erythematous macular rash (present in 10%): may desquamate ○ Soft tissue necrosis including necrotizing fasciitis, myositis or gangrene.
Case classification	Case classification
<ul style="list-style-type: none"> • Probable: four of the five clinical findings positive. • Definite: all five clinical findings. 	<ul style="list-style-type: none"> • Probable: meets clinical case definition (above) plus isolation from non-sterile site. • Definite: meets clinical case definition (above) plus isolation of group A Streptococcus from a normally sterile site.

Woman / wāhine with clinical features of toxic shock syndrome secondary to Streptococcus pyogenes or Staphylococcus aureus infection (toxic shock syndrome classification table) should promptly trigger a request for DCCM consult.