South Australian Perinatal Practice Guideline

Sepsis in Pregnancy

Note:

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

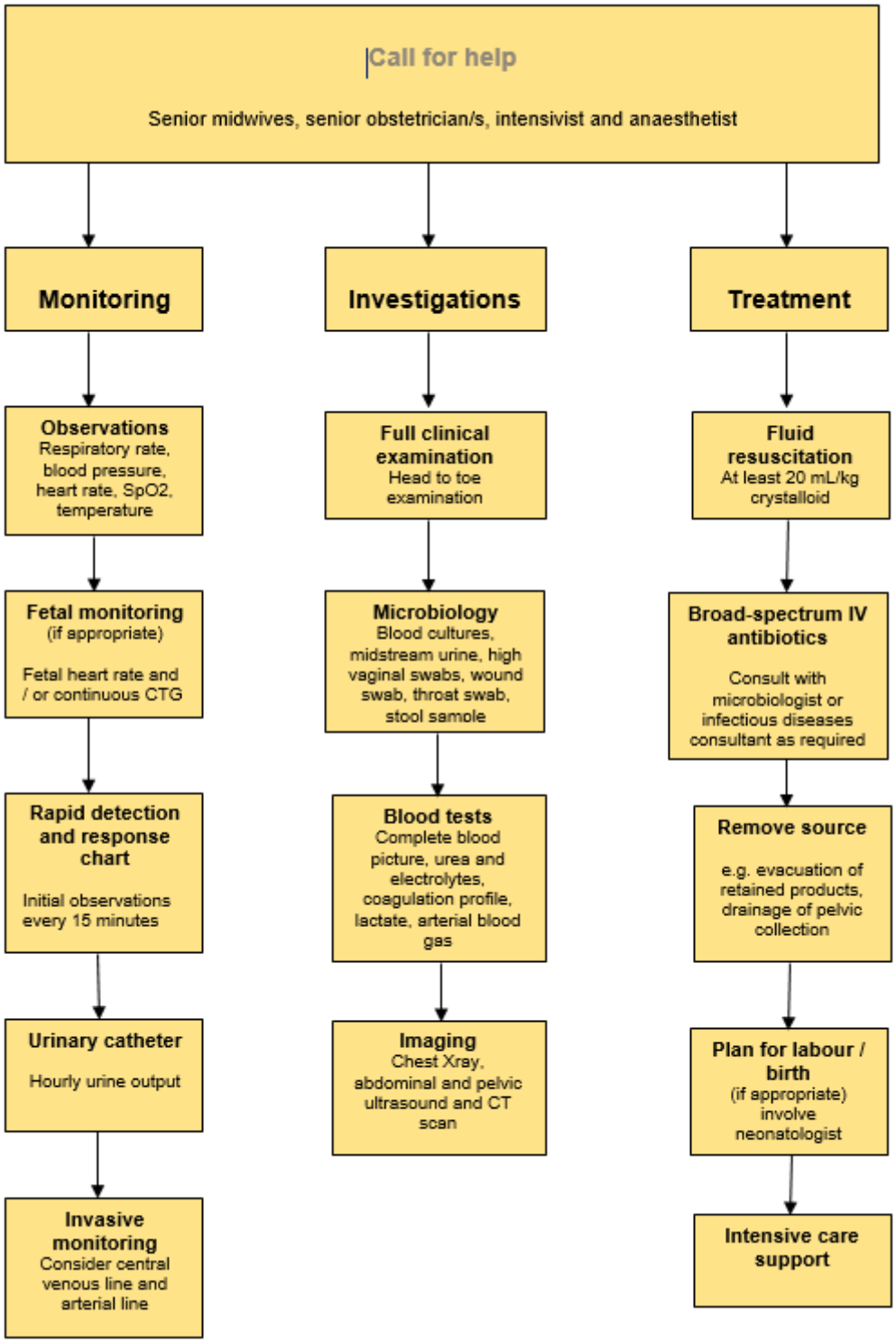
Explanation of the aboriginal artwork:
The Aboriginal artwork used symbolises the connection to country and the circle shape shows the strong relationships amongst families and the Aboriginal culture. The horse shoe shape design shown in front of the generic statement symbolises a woman and those enclosing a smaller horse shoe shape depicts a pregnant woman. The smaller horse shoe shape in this instance represents the unborn child. The artwork shown before the specific statements within the document symbolises a footprint and demonstrates the need to move forward together in unison.

Australian Aboriginal Culture is the oldest living culture in the world yet Aboriginal people continue to experience the poorest health outcomes when compared to non-Aboriginal Australians. In South Australia, Aboriginal women are 2-5 times more likely to die in childbirth and their babies are 2-3 times more likely to be of low birth weight. The accumulative effects of stress, low socio economic status, exposure to violence, historical trauma, culturally unsafe and discriminatory health services and health systems are all major contributors to the disparities in Aboriginal maternal and birthing outcomes. Despite these unacceptable statistics, the birth of an Aboriginal baby is a celebration of life and an important cultural event bringing family together in celebration, obligation and responsibility. The diversity between Aboriginal cultures, language and practices differ greatly and so it is imperative that perinatal services prepare to respectfully manage Aboriginal protocol and provide a culturally positive health care experience for Aboriginal people to ensure the best maternal, neonatal and child health outcomes.

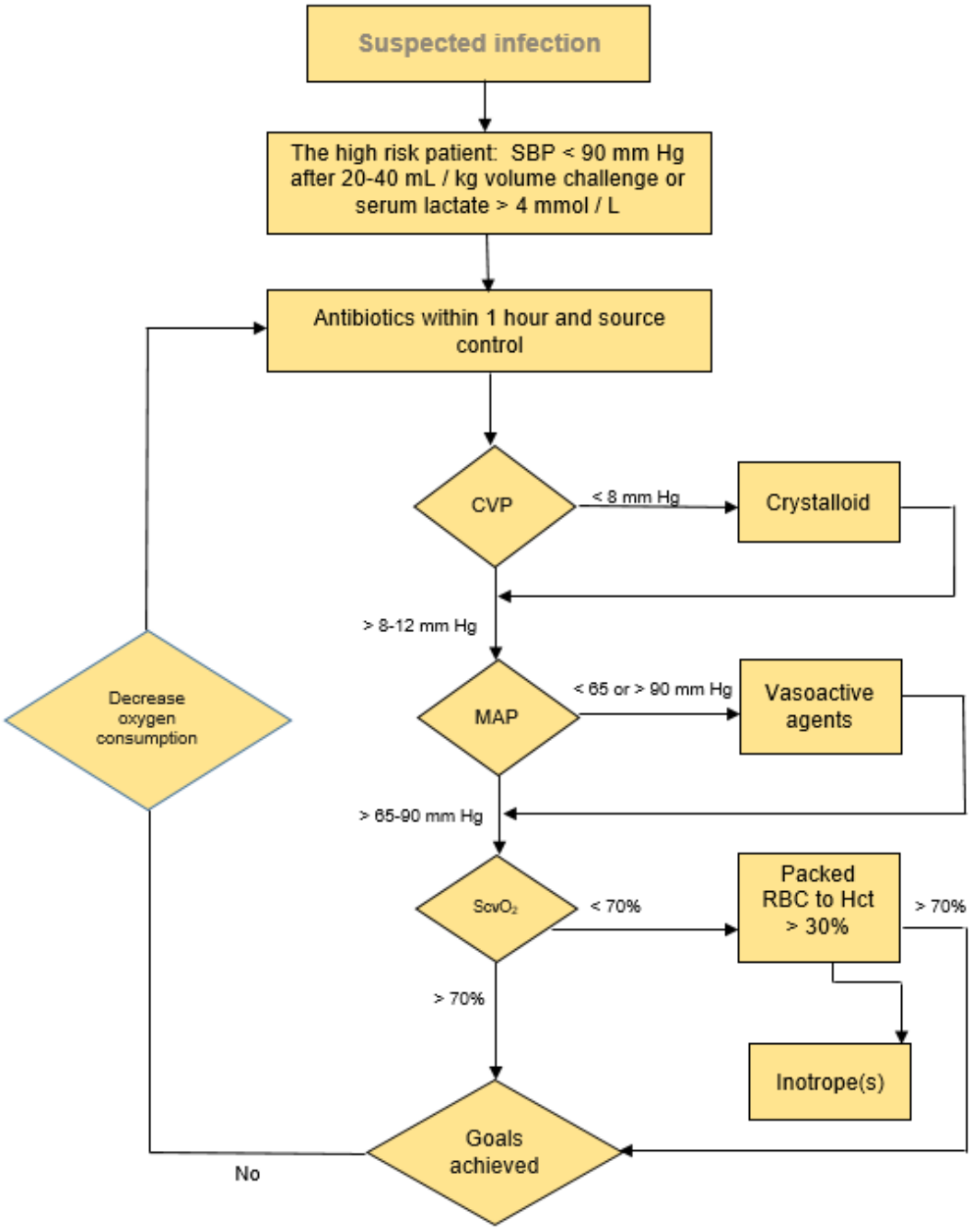
Purpose and Scope of Perinatal Practice Guideline (PPG)

The purpose of this guideline is to provide clinicians with information and treatment guidelines for sepsis in pregnancy. It particularly focuses on recognition of risk factors, diagnosis and management of sepsis in the peripartum period, including Early Goal Directed Therapy in the case of severe sepsis.

Flowchart 1: Initial management of maternal sepsis[1]



Flowchart 2: Early goal directed therapy for sepsis during pregnancy[2]



EGDT (early goal directed therapy) - goals and normal values in pregnancy chart[3]		
Measures	**Resuscitation goals**	**Normal third trimester physiologic values**
Central venous pressure	8-12 mm Hg	4-10 mm Hg
Mean arterial pressure	65 mm Hg or more	84-96 mm Hg
Urine output	More than 0.5 mL / kg / hour	Minimum 0.5 mL / kg / hour
Mixed venous oxygen saturation	More than 70 %	More than 80 %
Heart rate	Decreasing in response to treatment	83 (+/- 10) beats / minute

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Summary of Practice Recommendations

- Sepsis may arise from many sources and is not limited to infections arising from the genital tract.
- The onset of sepsis may be insidious; women with severe sepsis may appear very well before collapsing with little or no warning.
- Abdominal pain, fever (> 38°C), tachypnoea and sustained tachycardia (> 90 beats per minute) are indications for admission and intravenous antibiotics
- Diarrhoea and/or vomiting in pregnant women may be serious signs of sepsis and an indication for commencing antibiotic therapy.
- Early investigation of non-specific symptoms in pregnant women is necessary to exclude serious infection.
- Urinary tract infection and chorioamnionitis are common infections associated with septic shock in the pregnant woman.
- Signs of severe sepsis in peripartum women, particularly with confirmed or suspected Group A streptococcal infection, should be regarded as an obstetric emergency
- Early involvement of senior obstetrician / intensivist / anaesthetist / physician / microbiologist / infectious diseases consultant (as required) with appropriate referral and retrieval is essential. Suspicion of severe sepsis or septic shock should trigger urgent referral to a tertiary centre with adult intensive care facilities.
- Follow the Surviving Sepsis Campaign Resuscitation ‘Bundle’ in severe sepsis.
- Monitor and maintain airway, breathing and circulation as first priority.
- In the event of hypotension and / or lactate > 4 mmol/L initiate urgent fluid resuscitation
- Obtain blood cultures before antibiotic administration if possible but do not delay commencement of antibiotics
- Systemically ill patients should commence broad spectrum intravenous antibiotics within 1 hour of recognition of severe sepsis
- In a critically ill pregnant woman, birth of the baby may be considered if it would be beneficial to the mother or baby.

Abbreviations

ARDS	Acute respiratory distress syndrome
AVPU	Alert, verbal, pain, unresponsive
SaO_2	Arterial oxygen saturation
ASAP	As soon as possible
BP	Blood pressure
BSLs	Blood sugar levels
C	Celsius
CBP	Complete blood picture
CNS	Central nervous system
CVP	Central venous pressure
CVS	Cerebro-vascular system
EGDT	Early goal directed therapy
ECG	Electrocardiograph
GAS	Group A beta haemolytic streptococci
GCS	Glasgow coma scale
HCO_3	Bicarbonate ion
HCT	Haematocrit
HVS	High vaginal swab
ICU	Intensive care unit
kg	Kilogram(s)
LFTs	Liver function tests
LVS	Low vaginal swab
MAP	Mean arterial blood pressure
mmHg	Millimetres of mercury
mL	Millilitre(s)
MSSU	Micro specimen of urine
PCO_2	Carbon dioxide partial pressure
PO_2	Oxygen partial pressure
PPROM	Preterm prelabour rupture of the membranes
RBC	Red blood cells
RCOG	Royal College of Obstetricians and Gynaecologists
$ScvO_2$	Central venous oxygen saturation
SpO_2	Oxygen saturation measured by pulse oximetry
SBP	Systolic blood pressure
SIRS	Systemic inflammatory response syndrome
WCC	White cell count
WHO	World Health Organisation

Definitions

Systemic Inflammatory Response Syndrome (SIRS)	More than one of the following clinical findings: • Temperature > 38°C or < 36°C • Heart rate > 90 per minute • Hyperventilation (evidence by respiratory rate > 20 per minute or PCO2 < 32 mm Hg • WCC >12,000 or < 3,000
Sepsis	Presence of both infection (invasion of tissue, fluid or a body cavity by pathogenic micro-organisms) and systemic manifestations of inflammatory response syndrome (SIRS)
Severe Sepsis	Sepsis complicated by sepsis-induced organ dysfunction or developing tissue hypoperfusion
Septic shock	• Persistence of hypoperfusion (hypotension) in a septic patient, despite adequate volume resuscitation • Hypotension is defined as: • Systolic blood pressure (SBP) < 90 mm Hg, OR • mean arterial blood pressure (MAP) < 60 mm Hg, OR • reduction of SBP > 40 mm Hg from baseline
Puerperal Sepsis	The term is used to describe sepsis occurring after delivery and the World Health Organisation (WHO)9 has defined it as “infection of the genital tract, occurring at any time between rupture of membranes or labour, and the 42nd day postpartum”, in which two or more of the following are present: • pelvic pain • fever • abnormal vaginal discharge / smell of discharge • delay in postpartum reduction of size of uterus

Introduction

Sepsis may arise in pregnancy at any time: before birth, during labour or postpartum.

Sepsis may arise from many sources and is not limited to infections arising from the genital tract.

Urinary tract infection and chorioamnionitis are common infections associated with septic shock in the pregnant woman.[7]

Early identification of severe sepsis allows prompt, appropriate multidisciplinary management.

The onset of sepsis may be insidious; women with severe sepsis may appear very well collapsing, with little or no warning.

Suspicion of severe sepsis or septic shock should trigger urgent referral to a tertiary centre with adult intensive care facilities.

Up to 20 to 30 % of intensive care unit (ICU) admissions of obstetric patients result from sepsis in pregnancy.[11]
One third of early maternal mortality is due to refractory hypotension. Late maternal mortality is due to multiple organ failure.[11]

The contribution of sepsis as a cause of maternal mortality is between 3 % in developed countries and 12 % in developing countries.[11]

In the United Kingdom, the rapid course coupled with late presentation of some women with sepsis have contributed to a recent increase in direct maternal mortality due to genital tract sepsis (especially secondary to Group A streptococcal disease).[5]

Common causes of sepsis in pregnancy

Common sites of infection in pregnancy

- Urinary tract (pyelonephritis)
- Pelvic structures (chorioamnionitis and endometritis)
- Surgical wounds (caesarean section, perineal laceration)
- Breast (mastitis)

Other causes

- Infection of intravenous cannula sites
- After urological procedures in the presence of urinary tract infection
- Related to regional anaesthesia e.g. spinal / epidural abscess (rare)
- Pneumonia (viral and bacterial)
- Intrauterine fetal death
- Septic abortion
- Acute appendicitis
- Acute cholecystitis
- Pancreatitis
- Bowel perforation (more common with inflammatory bowel disease)
- Necrotising fasciitis
- Meningitis

Common pathogens

- The most prevalent bacterial organisms responsible for severe infection include:
- Group A beta haemolytic streptococci (GAS), also known as Streptococcus pyogenes
- Group B streptococcus
- Escherichia coli
- Klebsiella
- Staphylococcus aureus
- Anaerobes: peptostreptococci, peptococci, bacteroides, clostridium
- Clostridium species and listeria monocytogenes are less common
- Viral causes e.g. influenza, varicella, hepatitis and herpes simplex
- Malaria and other tropical infections

Common bacterial infections and pathogens related to septic shock[10]	
Infections and usual pathogens (in brackets – see right column*)	**Pathogens***
• Pyelonephritis (1,4) • Pneumonia (6,7) • Chorioamnionitis (1,2,8-12) • Endomyometritis (primarily after caesarean section) (1,2,5,9,12) • Sepsis after miscarriage or termination of pregnancy (1,3) • Caesarean wound infection (1,2,6,7) • Severe mastitis (7) • Necrotising fasciitis (2,3,6,9)	1. Escherichia coli 2. Bacteroides 3. Clostridium 4. Klebsiella 5. Pseudomonas aeroginosa 6. Streptococcus species 7. Staphylococcus aureus 8. Group B streptococcus 9. Peptostreptococcus 10. Enterococcus 11. Listeria monocytogenes 12. Enterobacter

Risk factors for maternal sepsis[13, 14]

- Obesity
- Impaired glucose tolerance / diabetes
- Impaired immunity / immunosuppressant medication
- Anaemia
- Vaginal discharge
- History of pelvic infection
- History of group B streptococcal infection
- Amniocentesis and other invasive procedures
- Cervical Cerclage
- Prolonged spontaneous rupture of membranes
- Diabetes Mellitus
- Group A streptococcal (GAS) infection in close contacts / family members (working with or having young children
- Of black or other minority ethnic group origin[7]
- Retained products of conception
- Caesarean birth (greater risk associated with emergency caesarean)

Diagnosis of infection

A thorough history and physical examination is required to make the diagnosis of sepsis. Important elements in making a diagnosis include:

1. Having a suspicion of the diagnosis of sepsis
2. Assessing for evidence of end organ dysfunction
3. Identifying site / source of the infection
4. The speed of onset or deterioration in symptoms and signs is important

Symptoms

- Chills, sweating, warm skin
- Faintness or syncope
- Vomiting
- Rash
- Headache
- Dyspnoea
- General weakness
- Pain related to site of infection

Signs

- Pyrexia (38°C or more): May not always be present and is not necessarily related to the severity of sepsis. Temperature may be less than 36°C in severe sepsis
- Tachypnoea (20 breaths or more per minute)
- Hypoxia
- Tachycardia (90 or more bpm)
- Arterial hypotension (systolic blood pressure less than 90 mm Hg; mean arterial pressure less than 70 mm Hg; or systolic blood pressure decrease 40+ mm Hg)
- Decreased capillary refill or mottling
- Fetal distress secondary to maternal acidosis
- Oliguria (urine output less than 0.5 mL / kg / hr for at least two hours, despite adequate fluid resuscitation
- Considerable oedema or positive fluid balance (20 or more mL/kg over 24 hours)
- Ileus (absent bowel sounds)
- Impaired mental state, altered conscious level
- Hyperglycaemia in the absence of diabetes (plasma glucose more than 7.7 mmol/L)
- Bruising or discolouration of skin suggests late fasciitis (often pain receding as cutaneous anaesthesia supervenes as nerves die)
- Failure to respond to treatment

Assessment for end-organ dysfunction	
Acute circulatory failure	Cardiovascular assessment: Peripheral perfusion, pulse, BP, CVP including signs of high or low cardiac output
Metabolic acidosis	pH, HCO_3, $PaCO_2$, lactate, anion gap
Acute hypoxaemia	SpO_2, PaO_2, PaO_2 / FIO_2
Liver dysfunction	LFTs
Coagulopathy	CBP and coagulation profile
Acute renal failure	Fluid overload, urine output Urea, creatinine, electrolytes
CNS disturbance e.g. altered mental state	Sedation score AVPU GCS Encephalopathy
Overall metabolism	Assessment for a hyper-catabolic state: negative nitrogen balance (e.g. low albumin) or raised blood glucose levels

Evaluate potential sources of infection

- Identify if any recent sore throat or respiratory illness or close contact with persons with illness (particularly streptococcal infections)
- Exclude intravenous drug misuse (high risk of staphylococcal or streptococcal sepsis)
- Recent febrile illness (especially if associated with chills and rigors -suggest bacteraemia or viraemia)
- Gastrointestinal symptoms (e.g. diarrhoea and vomiting) may be due to food borne pathogens or early toxic shock
- Consider need for vaginal examination to exclude retained tampons or swabs
- Exclude multi-resistant organisms such as ESBL-producing gram negative bacteria, vancomycin-resistant enterococci and MRSA (may affect choice of antimicrobial to combat sepsis and infection control precautions)
- Early investigation of non-specific symptoms in pregnant women is necessary to exclude serious infection[17]

Investigations

Blood tests	
Serum lactate	Greater than 4 mmol/L requires urgent action
Complete blood picture	White blood cell (WBC) count > 12 x 109 Leucopenia - WBC count < 4 x 109 Normal WBC count with > 10 % immature forms
Plasma C-reactive protein	More than 7 mg/L (usually significantly higher in bacterial sepsis)
Urea and electrolytes	Creatinine rise of > 44.2 micromol/L; sepsis is severe if creatinine level > 176 micromol/L
Plasma glucose	Hyperglycaemia in the absence of diabetes (plasma glucose > 7.7 mmol/L)
Liver function tests (LFTs)	Hyperbilirubinaemia (plasma total bilirubin > 70 micromol/L)
Coagulation profile	Coagulation abnormalities (INR > 1.5 or APTT > 60 seconds)
Blood gas Particularly for respiratory tract sepsis but also may detect acidosis from early stage shock	Arterial hypoxaemia (PaO2 / FIO2 < 300 mm Hg) Sepsis is severe if < 250 mm Hg in the absence of pneumonia or < 200 mm Hg in the presence of pneumonia Raised serum lactate ≥ 4 mmol/L

Adapted from: RCOG Diagnostic criteria for sepsis (modified from Levy[6])

Microbiology

- Blood cultures (ideally obtain before antibiotic administration)
- Obtain cultures of additional sites as indicated and as soon as possible e.g. midstream specimen urine (MSSU), wound swab (episiotomy or caesarean section), placental swabs, respiratory secretions, naso-pharyngeal aspirate (NPA), amniotic fluid, cerebrospinal fluid, HVS, LVS, endocervical, expressed breast milk
- If the methicillin-resistant Staphylococcus aureus (MRSA) status is unknown, obtain swabs from nose, groin and axilla and send for urgent screening
- Suspected pneumonia - Chest X-ray, naso-pharyngeal aspirate

Imaging

- Consider imaging modalities e.g. Chest X-ray, pelvic ultrasound, computed tomography, magnetic resonance imaging (may help define inflammation or the collection of pus).
- Echocardiography may be useful in cases of women who are intravenous drug users, particularly those with staphylococcal bacteraemia as there may be right-sided endocarditis and to assess cardiac function.

Site of infection – specific considerations

Early diagnosis can be used to determine if surgical intervention is required. May be difficult to localise the source.

Chorioamnionitis

Diagnosis of chorioamnionitis relies on the clinical presentation:

- Maternal fever > 38° C with any 2 of the following:
- Increased white cell count (>15 x 109/L)
- Maternal tachycardia (> 100 bpm)
- Fetal tachycardia (>160 bpm)
- Uterine tenderness
- Offensive smelling vaginal discharge
- C-Reactive Protein > 40
- Histological examination of placenta and membranes with evidence of acute inflammation may confirm diagnosis after birth

Treatment of chorioamnionitis

- See *Antibiotics in the Peripartum Period* PPG available at www.sahealth.sa.gov.au/perinatal for antibiotic choices
- Do not inhibit labour, but consider hastening birth under intravenous antibiotic cover
- Consider optimal mode of birth (LSCS versus vaginal birth) on the basis of the findings and the anticipated duration until birth
- Consider ongoing treatment with antibiotics postnatally (See *Antibiotics in the Peripartum Period* PPG available at www.sahealth.sa.gov.au/perinatal for guidance)

Endometritis

Common symptoms include:

- Offensive lochia / unusual bleeding
- Abdominal pain
- Uterine tenderness and/or subinvolution

Treatment

- Consider need for evacuation of retained products of conception
- See *Antibiotics in the Peripartum Period* PPG available at www.sahealth.sa.gov.au/perinatal for antibiotic choices
- If does not respond to antibiotics, consider septic pelvic thrombosis and commence on heparin

Urinary Tract Infection

Common symptoms include:

- Cystitis – dysuria, urgency, frequency, nocturia, haematuria and suprapubic discomfort
- Pyelonephritis - loin pain, tenderness to renal percussion, pyrexia, rigors, nausea/vomiting

Treatment

- Send midstream specimen of urine (MSSU)
- Treat acute pyelonephritis aggressively
- Detailed antibiotic information based on organism and clinical presentation is in the *Urinary tract infections in pregnancy* PPG available at www.sahealth.sa.gov.au/perinatal

Mastitis

- See *Antibiotics in the Peripartum Period* PPG available at www.sahealth.sa.gov.au/perinatal for practice considerations and antibiotic choices
- Immediate referral to hospital if the woman is clinically unwell, no response to oral antibiotics within 48 hours, mastitis recurs or there are severe or unusual symptoms
- Complications include breast abscess, necrotising fasciitis, toxic shock syndrome

Wound, skin and soft tissue infections

- Signs of inflammation at the site
- Fever, chills, tachycardia, tachypnoea, wound swelling, warm to touch, painful, discharge
- Closed space infections need surgical drainage
- Carefully examine intravenous cannulae or injection sites, and caesarean or episiotomy wounds
- Take a swab of any discharge
- Exclude complications of venous thrombosis or necrotising fasciitis (see below)

Necrotising fasciitis

- Extreme pain , associated with signs of prostration and severe sepsis
- Requires early surgical intervention with fasciotomy and aggressive antibiotic treatment

Bacteraemia and septic shock

- Suspected bacterial sepsis requires careful examination for skin and soft tissue infection
- If drains, vascular access devices or other indwelling devices are suspected as the source of infection, remove as soon as is practicable
- Skin and soft tissue infections are particularly associated with toxic shock syndromes
- Septicaemic seeding of streptococci from a uterine focus may give rise to a secondary focus in a limb, simulating a venous thrombosis
- Women with thrombosis who are systemically unwell with any features of sepsis should be examined very carefully. If shock or other organ dysfunction present, rapid referral to adult intensive care

Pneumonia

- Fever, chills, dyspnoea, cough, sputum production, pleuritic pain
- Consider referral to respiratory physician, medical microbiologist
- Send sputum sample, throat swab for culture
- Chest X-ray

Gastroenteritis

- Diarrhoea and vomiting may be symptoms of bacterial sepsis, due to organisms including staphylococcus and streptococcus
- Stool sample for routine culture (include C. difficile toxin testing if diarrhoea offensive after antimicrobial treatment)
- Salmonella and Campylobacter rarely cause severe systemic infection

Pharyngitis

- Usually viral
- Approximately 10 % of cases are due to GAS
- Obtain throat swab for culture
- Antibiotic treatment if 3 or more of the following: fever, tonsillar exudate, no cough, tender anterior cervical lymphadenopathy

Infection post termination of pregnancy / miscarriage

- Suspect infection in women with a history of a recent termination of pregnancy or spontaneous miscarriage who present with pyrexia, persistent bleeding or abdominal pain, especially if the pain is constant and severe
- Vaginal swabs, ultrasound scan to exclude retained products of conception and consider diagnostic evacuation of uterus (evacuation of retained products of conception) if there is still doubt
- Complete blood picture, C-reactive protein, blood cultures if pyrexia > 38° Celsius
- Commence high dose broad-spectrum intravenous antibiotics without waiting for microbiology results

Cholecystitis / Cholangitis

- Upper right quadrant pain, biliary colic after a fatty meal, jaundice, nausea / vomiting, fever
- Ultrasonography examination (USG) of abdomen

Epidural abscess

- Very rare complication
- S. aureus is the usual organism
- Severe backache
- Neurological deficit including bowel / bladder dysfunction and unexplained fever

Management

After identification of severe sepsis, in the first 6 hours, follow the Surviving Sepsis Campaign Resuscitation 'Bundle'.

Treat underlying infection and support failing organ functions.

Systemically ill patients should commence broad spectrum, intravenous antibiotics (within 1 hour of recognition of severe sepsis)

Patients with single organ failure not responding to simple measures require transfer to a tertiary centre with high dependency care.

Patients with two or more organ failures and respiratory failure require transfer to a tertiary centre with Adult Intensive Care Facilities (see 'Assess for evidence of end-organ dysfunction')

Key Practice Point for outpatients:

Abdominal pain fever (> 38°C), tachypnoea and sustained tachycardia (> 90 beats per minute) are indications for admission and intravenous antibiotics.

Surviving Sepsis Campaign Resuscitation 'Bundle'

Tasks to be performed within the first 6 hours of the identification of severe sepsis[7]

- Obtain blood cultures before antibiotic administration
- Administer broad spectrum antibiotic within one hour of recognition of severe sepsis
- Measure serum lactate
- In the event of hypotension and / or lactate > 4 mmol/L:
  - Deliver an initial minimum 20 mL / kg of crystalloid or an equivalent fluid
  - Apply vasopressors for hypotension not responding to initial fluid resuscitation to maintain mean arterial pressure above 65 mm Hg
- In the event of persistent hypotension despite fluid resuscitation (septic shock) and / or serum lactate > 4 mmol/L:
  - Achieve a central venous pressure (CVP) of ≥ 8 mm Hg
  - Achieve a central venous oxygen saturation (ScvO2) ≥ 70 % or mixed venous oxygen saturation (ScvO2) ≥ 65 %

Adapted from the Surviving Sepsis Campaign Resuscitation Bundle (group of therapies)[15]

Initial management (0-6 hours)

- Early involvement of senior obstetrician / intensivist / anaesthetist / physician / microbiologist / infectious diseases consultant (as required) with appropriate consultation, referral and retrieval
- Assess need for central venous access and initiate Surviving Sepsis Campaign Resuscitation Bundle if severe sepsis is suspected.
- Follow the A, B, C, D, E's of resuscitation

Airway

- Maintain a clear airway
- Administer oxygen via non-rebreathing mask at 12 litres per minute
- If the woman has collapsed, check her airway is patent, she is breathing and maintain her position in left-lateral

Breathing

- Assess breathing pattern, rate and colour and ventilate if required
- Attach pulse oximeter, electrocardiogram and automatic blood pressure monitors and monitor SpO2, maternal pulse and blood pressure

Circulation

- Hypovolaemia is present in almost all patients with septic shock
- Obtain intravenous access
- Take blood for blood cultures, serum lactate, complete blood count, coagulation profile, urea and electrolytes, liver function tests, blood glucose
- Immediate fluid resuscitation with either crystalloid or colloid as per medical order
- If no response to simple measures of fluid resuscitation consider the need for insertion of central venous catheter and CVP monitoring
- **Correct hypotension** – Administer vasopressors for hypotension that is not responding to initial fluid resuscitation to maintain mean arterial pressure (MAP) more than 65 mm Hg (intensivist or anaesthetic management)
- Perform arterial blood gases

Documentation and differential diagnosis

- Obtain history as soon as possible
- Document vital signs on 'Rapid deterioration and Response' chart
- Confirm diagnosis
- Commence broad spectrum intravenous antibiotic treatment within 1 hour of diagnosis of severe sepsis
- Commence fluid balance chart and monitor urine output

NB: Fluid overload may lead to fatal pulmonary or cerebral oedema in women with septic shock. Clear, accurate documentation and careful monitoring of fluid balance is essential.

Fetal wellbeing

- Assess and monitor fetal wellbeing (cardiotocography) if applicable
- Continuous fetal monitoring intrapartum
- Consider the need for birth as applicable
- In a critically ill pregnant woman, birth of the baby may be considered if it would be beneficial to the mother or the baby or to both. A decision on the timing and mode of birth should be made by a senior obstetrician after discussion with the woman if her condition allows
- If preterm birth is anticipated, cautious consideration should be given to the use of antenatal corticosteroids for fetal lung maturity in the woman with sepsis
- Epidural / spinal anaesthesia should be avoided in women with sepsis

Remove the source of the maternal infection

- Expedite birth if there are signs of chorioamnionitis
- Any retained products of conception should be removed as soon as the maternal condition is stable
- If large amounts of pelvic pus are present a laparotomy and sometimes hysterectomy may be necessary

Maternal observations

- Obtain and document temperature, pulse, respiratory rate, blood pressure, SpO_2 every 15 minutes in the initial assessment phase. Once stable, continue hourly
- Utilise 'Rapid Deterioration and Response' chart. The use of early warning charts and escalation guidelines including involvement of senior medical staff (intensivist, physician) assists in the early detection and management of the deteriorating patient
- Glasgow Coma Scale and pupil response if required
- Hourly urine output (consider insertion of indwelling catheter)
- In rapidly deteriorating cases, ensure urgent referral to critical care team and obstetric consultant

Antibiotics

Refer to the *Antibiotics in the Peripartum Period* PPG available at www.sahealth.sa.gov.au/perinatal for recommended antibiotics for treatment of chorioamnionitis, endometritis and mastitis.

Refer to the principles of managing sepsis and septic shock in the e-Therapeutic Guidelines.

- Early consult with microbiologist or infectious diseases consultant for women with evidence of systemic infection
- Commence broad spectrum intravenous antibiotic cover within 1 hour of suspicion of severe sepsis, with or without septic shock
- The choice of antibiotic depends on the clinical suspicion, local flora and culture information, if available
- If genital tract sepsis is suspected, prompt early treatment with a combination of high-dose broad-spectrum intravenous antibiotics may be lifesaving
- Empirical treatment should include broad spectrum antimicrobials active against Gram-negative bacteria, and capable of preventing exotoxin production from Gram-positive bacteria (according to local microbiology policy). Gram-positive cover is necessary if the likelihood of this infection is high

Thromboprophylaxis

- Women with sepsis are at increased risk of venous thromboembolism
- Consider prophylaxis with low molecular weight heparin. See *Thromboprophylaxis and Thromboembolic Disease in Pregnancy* PPG available at www.sahealth.sa.gov.au/perinatal
- Use of compression stockings

Staphylococcal and streptococcal toxic shock syndrome

Toxic shock syndrome is a life-threatening illness characterised by hypotension and multi-organ failure. It may be caused by Staphylococcus aureus (rarely isolated) or Streptococcus pyogenes that produce and release superantigenic exotoxins. The exotoxins activate T-cells on a large scale resulting in a massive release of inflammatory cytokines.[16]

Staphylococcal toxic shock syndrome	Streptococcal toxic shock syndrome
1. Fever ≥ 39.9°C 2. Rash: diffuse macular erythema 3. Desquamation: 10-14 days after onset of illness, especially palms and soles 4. Hypotension: systolic BP < 90 mmHg 5. Multisystem involvement - 3 or more of the following systems affected: ○ GIT: vomiting or diarrhoea at onset of illness ○ Muscular: severe myalgia or elevated creatinine phosphokinase ○ Mucous membranes: vaginal, oropharyngeal or conjunctival hyperaemia ○ Renal: creatinine twice the upper limit of normal ○ Haematological – platelets ≤ 100 x 109/L ○ Central nervous system – disorientation or alterations in consciousness without focal neurological signs	**A. Isolation of group A Streptococcus from:** 1. Normally sterile site: blood, cerebrospinal fluid, peritoneal fluid, tissue biopsy 2. Non-sterile site: throat, vagina, sputum **B. Clinical case definition** Multi-organ involvement characterised by: 1. Hypotension and 2. Two or more of the following ○ Renal impairment – creatinine > 176 micromol/L ○ Coagulopathy – platelets < 100 x 109/L or disseminated intravascular coagulation ○ Liver involvement: alanine tranjsaminase or aspartame transaminase or bilirubin levels twice the normal upper limit for age ○ Acute respiratory distress syndrome ○ Generalised erythematous macular rash (present in 10 %): may desquamate ○ Soft tissue necrosis including necrotising fasciitis, myositis or gangrene
Case classification:	**Case classification:**
Probable: 4 of the 5 clinical findings positive **Confirmed:** case with all 5 clinical findings	**Probable:** meets clinical case definition plus isolation from non-sterile site **Definite:** meets clinical case definition plus isolation of group A Streptococcus from a normally sterile site

Intravenous immunoglobulin (IVIG)

- IVIG is recommended for severe invasive streptococcal or staphylococcal infection if other therapies have failed
- High dose IVIG has been used in pregnant and postpartum women and is effective in exotoxic shock (i.e. toxic shock attributable to streptococci and staphylococci)

Complications

- Acute respiratory distress syndrome (ARDS)
- Disseminated Intravascular coagulation
- Renal failure
- Hepatic failure

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- Surviving Sepsis Campaign at http://www.survivingsepsis.org

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