



OBSTETRIC TRAUMA GUIDELINE



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1. Key messages

The Victorian State Trauma System provides support and retrieval services for critically injured patients requiring definitive care, transfer and management. This obstetric trauma guideline provides evidence-based advice on the initial management and transfer of major trauma patients who present to Victorian health services with obstetric trauma. Changes in pregnancy presents a complex scenario for the health care professional.

This guideline is developed for all clinical staff involved in the care of trauma patients in Victoria. It is intended for use by frontline clinical staff that provide early care for major trauma patients; those working directly at the Major Trauma Service (MTS) as well as those working outside of a MTS.

These guidelines provide the user with accessible resources to effectively and confidently provide early care for critically injured patients. They provide up-to-date information for frontline healthcare clinicians. The guideline has followed the AGREE II methodology for guideline development and is under the auspice of the Victorian State Trauma Committee (VSTC).¹



OBSTETRIC TRAUMA GUIDELINE



Clinical emphasis points:

- An obstetric trauma patient presents a complex scenario that requires multidisciplinary care of both the mother and unborn child.
- Even minor trauma may lead to complications and require thorough investigation.
- The normal physiological changes of pregnancy affect the clinical assessment and management of obstetric trauma patients.
- Obstetric trauma patients require careful positioning to reduce the impact of aortocaval compression.
- Best fetal outcomes are the result of early maternal resuscitation.
- Early management in obstetric trauma aims to carefully manage fluid status, maintain oxygenation and prevent hypothermia.
- Adult Retrieval Victoria (ARV) is the first point of call to initiate retrieval and transfer for adults and Paediatric and Infant Perinatal Emergency Retrieval (PIPER) for paediatrics.
- Time-critical patients are retrieved to the Royal Melbourne Hospital, with other obstetric patients transferred to a hospital with obstetric and trauma capability.
- The main goal of early care is to ensure optimum resuscitation in the emergency setting as well as activation of the retrieval network, with timely transfer to an appropriate facility.



Make early contact with ARV for advice from the major trauma services and to initiate retrieval.

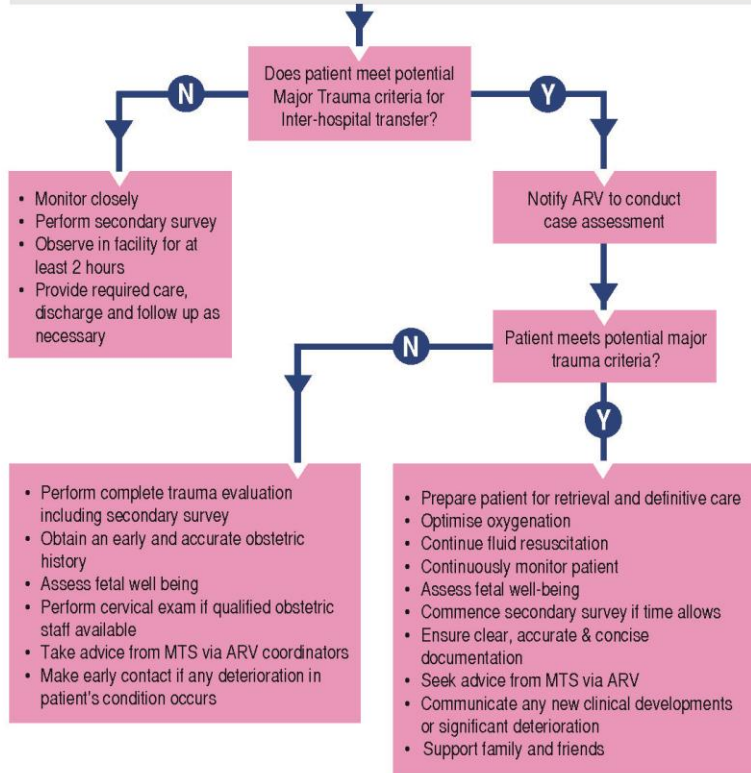
- Fetal survival depends on effective maternal resuscitation.
- Maternal position – 1 or 2 handed manual uterine displacement or left tilt 15-30°.
- Maternal hypovolaemia will significantly impact on fetal outcomes.

Early Activation

- Gather vital information
- Activate Trauma Team
- Designate roles
- Set up to receive patient
- Ensure safety using PPE

Primary Survey

AIRWAY / C-SPINE	BREATHING	CIRCULATION	DISABILITY	EXPOSURE / ENVIRONMENT	ADJUNCTS
<ul style="list-style-type: none"> • Protect Airway • Be prepared for difficult intubation • Maintain full spinal precautions if indicated 	<ul style="list-style-type: none"> • Identify and treat any life threats • Assess RR, work of breathing, SpO₂ & symmetry • Oxygen therapy to maintain SpO₂ 94% - 98% • ET/CO₂ monitoring if ventilated • Intercostal Catheter should be inserted 1-2 rib spaces higher 	<ul style="list-style-type: none"> • Position patient with manual left uterine displacement or tilt if > 20 weeks gestation • Insert x 2 large bore IV cannulas & commence fluid resuscitation if required • Assess HR/BP/Cap refill • Identify and control source of haemorrhage 	<ul style="list-style-type: none"> • Assess level of consciousness • Check pupils • Check BSL 	<ul style="list-style-type: none"> • Fully expose patient • Prevent heat loss • Log roll 	<ul style="list-style-type: none"> • Ultrasound / CTG monitoring • X rays: Chest, Pelvis • Take blood: Hb, Group & X-Match, coagulation studies • 12 lead ECG • Consider IDC • Orogastric tube if intubated



Key points

Maternal Resuscitation

- Fetal survival is improved by optimizing maternal resuscitation and avoidance of hypovolaemia. Haemorrhage control may be impossible without emergent surgical intervention.

Maternal oxygenation

- Maternal hypoxia is associated with poor fetal outcomes. Maintain oxygenation >94%. Apply supplemental oxygen as required.

Fluid resuscitation

- Initiate if hypovolaemia is suspected to maintain both maternal and fetoplacental perfusion. Note that a pregnant patient may not display signs of haemorrhage until as much as 30% of her blood volume is lost.
- *Crystalloid fluids:* Initial treatment with Normal Saline is recommended up to 20 - 30 mL/kg.
- *Blood products:* if minimal response to fluids, administration of Rhesus negative packed red blood cells should be given.

Patient positioning

- Patients greater than 20 weeks gestation should be deliberately positioned to protect blood flow and venous return. This can be achieved by using 1 or 2 handed manual left uterine displacement or with a left sided tilt of 15 - 30° to facilitate blood flow and venous return.



Obstetric Trauma Considerations

Pregnancy Related Complications

- Placental abruption.
- Premature labour.
- Uterine rupture.
- Feto-maternal haemorrhage.

Obstetric assessment is important to identify signs of labour, fetal well-being, perineal injury and concealed or contained haemorrhage.

Cervical examination should only be performed by qualified obstetric staff.

Fetal well-being: CTG monitoring is important to institute where possible to assess fetal status. If not available, auscultate fetal heart sounds and / or ask the mother when she last felt fetal movement.

PERIMORTEM CAESAREAN SECTION is indicated where the mother is in cardiac arrest with a fetus of > 20 weeks gestation. In these cases, caesarean section is performed to help restore circulating volume to the mother and fetal survival is not the primary indication. Rarely, where complications of trauma indicate that maternal survival is unlikely and the fetus is > 24 weeks gestation, a caesarean section may be performed to rescue the fetus.





3. Introduction

Trauma occurs in up to 6-7% of pregnancies². Mechanisms of injury in pregnant trauma patients leading to presentation at a health service vary considerably, but most commonly are the result of motor vehicle accidents, falls and domestic or intimate partner violence.³ A high suspicion for injury in a pregnant patient, even in minor trauma, is important. The risk of significant injury increases with the severity of trauma and stage of pregnancy.

Every female patient of child-bearing age should be asked if they are or could be pregnant, and all females of child-bearing age should have a pregnancy test as part of their secondary survey unless they are already known to be pregnant.⁴

Obstetric trauma patients present special challenges for the response team on arrival at a healthcare facility. The need for coordinated and synchronous assessment of both the mother and fetus with the potential need for urgent interventions for both may create significant stress for staff and for the health service.

Additionally, the many physiological changes of pregnancy predispose pregnant trauma patients to further risks and introduce new challenges, with modifications in positioning, resuscitative efforts and transfer arrangements required. Although management requires urgent assessment and treatment of both the mother and unborn child, it is important to emphasise that a clear focus on resuscitative measures to stabilise the mother is crucial to optimising the outcome for both.

Changes in pregnancy

Pregnancy causes physiological change in many body systems. As a result, normal models of trauma care must be modified for pregnant trauma patients. The adaptations of pregnancy that are important in trauma care include the following.⁵

Refer to Appendix 1: *Normal changes in pregnancy*.

Cardiovascular:

- Increased cardiac output (by up to 40% or 1.5 L/min).
- Increased baseline heart rate (10–15 bpm above normal).
- Increased plasma volume, resulting in a mild dilutional anaemia.
- 15–20% decrease in systolic blood pressure in the first half of the pregnancy (with the lowest blood pressures being recorded around 28 weeks' gestation) followed by a rise back to baseline at full term.

Changes in resting heart rate, blood pressure and cardiac output may mask signs of hypovolemia, and pregnant women can experience blood loss of up to 30% of their circulating volume without significant changes or visible clinical signs. The first sign of maternal shock may be fetal distress.

It is important to note that all pregnant women greater than 20 weeks gestation should be managed in a left lateral tilt position (15–30 degrees) to reduce the impact of aortocaval compression by the enlarged uterus. Alternatively/additionally, the uterus may be manually displaced.

Refer to Appendix 2: *Maternal positioning diagram*.



Respiratory

Pregnant women have reduced respiratory function and oxygen reserve as a result of:

- Increased oxygen consumption (up to 20% by the third trimester).
- Tidal volume and minute ventilation.
- Decreased residual volume and functional residual capacity.
- Increased airway oedema.
- Decreased chest wall compliance.

They are predisposed to rapid changes in oxygen saturation and so intubation and ventilation are often more difficult than in a non-pregnant trauma patient.

Uterine

Until the end of the first trimester, the uterus is relatively protected by its position within the pelvic structures and its thick-walled anatomy. By full term, the uterus has reached its maximum height (at the costal margins), is exposed within the abdominal cavity, is thin-walled and contains a large volume of blood. The blood flow to the uterus at term is 800–1,000 mL/min. Therefore there is significant risk for massive blood loss from an injury to the uterus or pelvic structures.

Gastrointestinal

Pregnant patients are susceptible to aspiration due to slowed gastric emptying and increased acidity of the gastric contents. A full stomach should be assumed during management of any pregnant trauma patient. A nasogastric tube (NGT) or orogastric tube (OGT) should be inserted for patients who are intubated.

Haematological

White cell count, clotting factor amount and plasma proteins are increased in pregnant patients, increasing the risk of thromboembolism. Low or borderline platelet levels (100–150 × 10⁹/L) are common in pregnancy. Measured reference ranges of clotting remain the same in pregnancy.

Renal

Glomerular filtration rate and renal blood flow increase during pregnancy, sometimes with a decrease in serum creatinine and urea. Glycosuria is a common finding on urinalysis. Haematuria is not normal in pregnancy and should be considered a significant finding in the trauma setting.

Complications associated with trauma

Trauma, whether minor or major, can have significant negative health effects on a mother and baby. It is estimated that 1-3% of minor trauma to a pregnant mother results in loss of the fetus, and there should be greater concern with increasing severity.^{6,7}

Pregnancy specific complications to be considered in trauma include the following:

Placental abruption	Preterm labour
Cardiorespiratory arrest	Spontaneous abortion
Labour and birth	Uterine rupture



Pelvic fractures

Haemorrhage and shock

4. Early activation

Emergency medical services responding to the scene will notify ARV and the receiving hospital that a trauma patient is on their way. This may be a major, metropolitan or regional trauma service or occasionally an urgent care centre, depending on distance, facilities available and the patient's condition. Notification information may be crucial to managing a severely injured patient and can allow for communication to vital members of the response team as well as time to prepare the department for the patient's arrival.

The following sequence of actions should take place upon initial notification:

1. Gather vital information from the notifier using the MIST mnemonic:
 - M** Mechanism of injury.
 - I** Injuries found or suspected.
 - S** Signs: respiratory rate, pulse, blood pressure, SpO₂, GCS or AVPU.
 - T** Treatment given.
2. Activate the trauma team and available support departments (medical imaging, pathology). In small health service settings this may only consist of a clinician and a nurse. Additional staff may be gathered from wards or on call. It may be necessary to utilise the skills of all available resources including emergency response personnel in the initial trauma management.
3. Set up the trauma bay to receive the patient, including equipment checks, documentation, medications and resuscitation equipment.
4. Designate roles and specific tasks to staff and maintain an approach based on teamwork. Ensure good communication between all parties involved in managing the trauma. Use closed-loop communication, which ensures accuracy in information shared between response staff. Repeat instructions, make eye contact and provide feedback. Misinterpreted information may lead to adverse events.
5. Ensure all staff involved in patient care are wearing gloves, aprons and eye protection. Personal protective equipment is vital in the care of trauma patients.

If there is no prior notification of the patient, then rapid activation of the trauma team request must take place and any additional resources notified. If it is anticipated that transfer to a MTS will be required, early retrieval activation is essential (phone ARV on 1300 368 661).

- Early retrieval activation ensures access to critical care advice and a more effective retrieval response.
- Early activation and timely critical care transfer improves clinical outcomes for the patient.

If you are undecided, call the ARV coordinator, who can provide expert guidance and advice over the phone or via tele- or videoconference, and link to a MTS as required.



5. Primary survey

Wherever possible, immediately from the time of commencing a primary survey, pregnant patients beyond 20 weeks gestation should be nursed in a manner which reduces compression of the great vessels by the pregnant uterus (aortocaval compression or supine hypotension syndrome). Supine positioning may result in significant compromise in both circulation and respiratory status.

Avoidance of aortocaval compression can be achieved either by manual left uterine displacement, or by positioning with a left lateral tilt of 15–30 degrees, using a wedge. Where a wedge is not available, similar effect can be achieved by placing a rolled up towel or bags of saline under the mother's right hip. Where the patient is immobilised on a spine board, this may mean positioning a wedge beneath the board if manual uterine displacement is not possible.

Increasingly, consensus opinion suggests that manual displacement of the uterus with either a one or two handed technique should be the method of choice, particularly in the haemodynamically unstable or critically injured pregnant patient. Manual left uterine displacement appears to result in less hypotension and less haemodynamic instability than tilting the patient, but does require an additional team member to execute. Manual left uterine displacement also facilitates more effective chest compressions in the event of cardiac arrest, and will facilitate easier access to the patient for the rest of the resuscitation team⁸.

Refer to Appendix 3: *Manual left uterine displacement 1 handed technique*

Refer to Appendix 4: *Manual left uterine displacement 2 handed technique*

Use a systematic approach based on the ABCDE⁹ survey to assess and treat an acutely injured patient. The goal is to manage any life-threatening conditions and identify any emergent concerns, especially in a pregnant patient who may present with other underlying polytrauma complications.

Airway with cervical spine protection

Assess for airway stability

Attempt to elicit a response from the patient.

Look for signs of airway obstruction (use of accessory muscles, paradoxical chest movements and see-saw respirations).

Listen for any upper airway noises and breath sounds. Are they absent, diminished or noisy?

Attempt simple airway manoeuvres if required

Open the airway using a chin lift, jaw thrust and neck tilt. **(Do not apply a neck tilt if a spinal injury suspected.)**

Suction the airway if excessive secretions are noted or if the patient is unable to clear it themselves.

Insert an oropharyngeal airway (OPA)/nasopharyngeal airway (NPA) if required.

If the airway is obstructed, simple airway opening manoeuvres should be performed, including suction, jaw thrust or chin lift. Care should be taken to not extend the cervical spine.



If the patient is already intubated, document the size and position of the endotracheal tube, including lip level, end-tidal carbon dioxide (ETCO₂) trace, cuff pressure, any intubation difficulty (or Mallampati grade).

Where possible, delegate ongoing airway management to an airway doctor/nurse and continue the initial assessment.

Maintain full spinal precautions if indicated.

Secure the airway if necessary (treat airway obstruction as a medical emergency)

Consider intubation early if there are any signs of decreased level of consciousness, unprotected airway or an uncooperative/combatative patient, leading to distress and further risk of injury.

Intubation should be considered earlier in pregnant patients compared with non-pregnant patients because pregnant women desaturate more rapidly and are more susceptible to irreversible hypoxic injury. Crucially, maternal hypoxia is associated with poor fetal outcomes.

However, the likelihood of failed intubation is higher in a pregnant patient, and intubation is increasingly difficult with advanced gestation. Intubation of a pregnant patient should be attempted by the most senior and experienced airway-skilled practitioner. In the event of a failed intubation, sustained cricoid pressure should be maintained to prevent aspiration in the unprotected airway.

Preparations for a difficult intubation should start early, with fibre-optic intubation equipment available for all pregnant women, but particularly for those with a known difficult airway or facial or cervical fractures. Correct airway placement should be confirmed with auscultation, capnography and direct visualisation if possible.

Breathing and ventilation

Oxygen administration

Administer oxygen to achieve oxygen saturations between 94-98% (Damiani, et al., 2014) (Panwar, et al., 2016)

Maternal hypoxia is associated with poor fetal outcomes.

Assess the chest:

- Count the respiration rate – high rates are markers of potential lung injury and a warning that the patient may deteriorate. Differential diagnosis to exclude metabolic/traumatic causes is important as patients in the later stages of pregnancy have a reduced functional reserve capacity with increased minute ventilation.
- Note the depth, pattern and equal rise and fall. Remember that underlying chest injuries may also be present.
- Listen to the chest and assess for any wheeze, stridor or decreased air entry.

Record the oxygen saturation (SpO₂)

Consider NGT placement if the patient is in an altered conscious state; insert if intubated. Note relative contraindications with suspected skull fractures.



If required, intercostal catheter(s) should be inserted **one or two rib spaces higher** (in the third or fourth intercostal space) due to the elevation of diaphragm in pregnancy and potential for inadvertent abdominal insertion.

Circulation with haemorrhage control

Assess circulation and perfusion:

- Note that a pregnant patient may not display signs of haemorrhage until as much as 30% of her blood volume is lost. Tachycardia with normotension may be considered an early sign of potentially significant blood loss. If fetal monitoring is immediately available, it may be used as part of the assessment of maternal volume status.
- Check the mother's heart rate, blood pressure and neck veins.
- Inspect for any signs of haemorrhage and apply direct pressure to any external wounds. Consider the potential for significant internal bleeding related to the mechanism of injury, which may or may not lead to signs of shock.

Insert two large-bore peripheral intravenous (IV) cannulas, preferably bilaterally. If access is difficult consider intraosseous insertion if the equipment/skills are available.

Fluid resuscitation should be initiated if hypovolemia is suspected to maintain both maternal and fetoplacental perfusion; however, haemorrhage control may be impossible without emergent surgical intervention. Commence resuscitation with up to 1–2 L of crystalloid solution. Blood or blood product transfusion should be considered in subsequent fluid administration.

Review the patient's skin colour and check her temperature and capillary refill.

Recheck the patient's position and ensure that manual uterine displacement or a 15–30-degree tilt remains in situ. This position is known to significantly improve blood pressure and is an important intervention in pregnant patients.

If possible, perform a FAST scan. FAST scan may be difficult in pregnancy where the enlarged uterus displaces other organs or obscures views of the retroperitoneum, but a positive FAST scan remains a significant finding in pregnant trauma patients.¹⁰ If the patient is haemodynamically **stable and there are no signs of significant internal bleeding** then the FAST scan may be delayed until the secondary survey.

Fluid resuscitation should be carefully monitored to achieve satisfactory blood pressure without contributing to ongoing blood loss from uncontrolled haemorrhage sites.

Disability: neurological status

Assess level of consciousness.

Perform an initial Glasgow Coma Scale (GCS) or AVPU assessment (Alert, responds to Voice, responds to Pain, Unresponsive); check the pupillary response.

Perform a blood sugar level test.

Ensure any alterations in level of consciousness are not related to a metabolic cause.

Exposure/environmental control

Remove the patient's clothing and any jewellery in order to fully assess all areas of the body.



A pregnant trauma patient may become hypothermic due to IV fluid administration and undressing for assessment, so it is important to monitor her temperature and keep her in a warm environment while administering warm IV fluids. Ideally, the patient's temperature should be kept above 36.5 °C.

6. Secondary survey

The secondary survey should only be started once the primary survey has been completed and any life-threatening injuries have been identified and treated. If during the examination any deterioration is detected, go back and reassess the primary survey.

Refer to Appendix 5: *Maternal Trauma Secondary Survey*.

History

Taking an adequate history from the patient, bystanders or emergency personnel of the events surrounding the injury can assist with understanding the extent of the injury and any other possible other injuries.

Use the AMPLE acronym to assist with gathering pertinent information:¹¹

- A** Allergies
- M** Medication
- P** Past medical history (including tetanus status)
- L** Last meal
- E** Events leading to injury

Note what first aid has already been given to the patient.

Head-to-toe examination

During this examination, any injuries detected should be accurately documented and any required treatment should occur, such as covering wounds, managing non-life threatening bleeding and splinting fractures.

Abdomen/obstetric examination

Obtaining an early and accurate history is important in identifying any information that may guide patient management and intervention.

Cornerstones include:

- The date of the last menstrual period or the estimated date of delivery, if known.
- Current gestation.
- Any conditions related to the pregnancy or any complications identified.
- Plurality of the pregnancy (singleton, twins or other multiple).

Where the gestational age is not known or unable to be determined, it may be estimated by the height of the fundus.

Refer to Appendix 6: *Fundal height palpation*

Assess uterine tone – firmness greater than expected associated with pain or uterine tenderness may indicate placental abruption.



Assess for uterine contractions.

Assess for uterine pain or tenderness, which may also indicate placental abruption.

Identify the fetal position including its orientation and head position.

Inspect the abdomen, palpate for areas of tenderness, especially over the liver, spleen, kidneys and bladder. Look for any bruising, lacerations or penetrating injuries. Auscultate for bowel sounds. Check the pelvis. Gently palpate for any tenderness. **Do not spring the pelvis** as any additional manipulation may exacerbate haemorrhaging.¹² Apply a binder if a pelvic fracture is suspected. Inspect the perineum and external genitalia and examine for externally visible blood or fluid loss.

A pelvic examination should only be undertaken by an appropriately experienced doctor or obstetrician. This examination may be used to:

- Look for vaginal blood loss.
- Assess for fetal cervical effacement and dilatation.

Fetal assessment

Electronic monitoring of the fetus is instituted where there is a viable fetus (greater than 24 weeks gestation) and the appropriate equipment is available (cardiotocography/CTG).

Fetal assessment in pregnancies less than 24 weeks is difficult without specialist equipment and personnel.

CTG allows monitoring of the fetal heart rate and uterine contractions. An experienced operator is required to manage this and interpret the results. CTG monitoring should be continued for a minimum of 4 hours after any maternal trauma, and admission for monitoring for 24 hours should be considered in well women with a significant mechanism of injury¹³.

If not available, the fetal heart rate should be measured by auscultation using a Pinard horn or a handheld Doppler. The fetal heart rate may also be assessed by ultrasound at the bedside by an operator with appropriate experience in the technique.

Normal fetal heart rate ranges from 120 to 160 bpm, with the average being 140 bpm, and varies according to gestation. Fetal heart rates generally decrease towards the lower ranges of normal closer to full term.

Head and face

Inspect the face and scalp. Look for any lacerations and bruising including mastoid or periorbital bruising, which is indicative of a base of skull fracture. Gently palpate for any depressions or irregularities in the skull.

Look in the eyes for any foreign body, subconjunctival haemorrhage, hyphaema, irregular iris, penetrating injury or contact lenses.

Assess the ears for any signs of a cerebrospinal fluid leak, bleeding or blood behind the tympanic membrane. Check the nose for any deformities, bleeding, nasal septal haematoma or cerebrospinal fluid leak.

Look in the mouth for any lacerations to the gums, lips, tongue or palate. Note any swelling, which may indicate an inhalation injury. Inspect the teeth, noting if any are loose, fractured or missing.



Test eye movements, pupillary reflexes, vision and hearing.

Palpate the bony margins of the orbit, maxilla, nose and jaw. Inspect the jaw for any pain or trismus.

Neck

To assist with adequate access, ensure another colleague maintains manual in-line stabilisation while the collar is removed and throughout the examination.

Gently palpate the cervical vertebrae. Note any cervical spine pain, tenderness or deformity. Check the soft tissues for bruising, pain and tenderness.

Complete the neck examination by observing the neck veins for distension and palpating the trachea and the carotid pulse; note any tracheal deviation or crepitus.

The patient will need to be log rolled to complete the full examination. This can be combined with the back examination.

Chest

Inspect the chest, observing movements. Look for any bruising, lacerations, penetrating injury or tenderness.

Palpate for clavicle or rib tenderness.

Auscultate the lung fields; note any percussion, lack of breath sounds, wheezing or crepitations.

Check the heart sounds: apex beat and presence and quality of heart sounds.

Limbs

Inspect all the limbs and joints. Palpate for bony and soft tissue tenderness and check joint movements, stability and muscular power. Note any bruising, lacerations, muscle, nerve or tendon damage. Look for any deformities, penetrating injuries or open fractures.

Examine sensory and motor function of any nerve roots or peripheral nerves that may have been injured.

Assess distal perfusion for capillary refill, pulse and warmth.

Back

Log roll the patient. Maintain in-line stabilisation throughout. Inspect the entire length of the back and buttocks noting any bruising and lacerations.

Palpate the spine for any tenderness or steps between the vertebrae. Include a cervical examination at this stage.

Digital examination should be performed only if a spinal injury is suspected. Note any loss of tone or sensation.

Buttocks and perineum

Look for any soft-tissue injury such as bruising or lacerations.

Genitalia

Inspect for soft-tissue injuries such as bruising or lacerations. Check the patient for visible vaginal bleeding or fluid loss.



7. Planning and communication.

All injured pregnant women should have an obstetric review as soon as possible.

Pre-hospital triage

Any pregnant trauma patient who meets the pre-hospital major trauma triage criteria should be transported to the Royal Melbourne Hospital. However, where the expected transport time to the Royal Melbourne is longer than 45 minutes, the patient is to be transported to the highest level of trauma service within 45 minutes (preferably with obstetric capability).

Any obstetric patient who is more than 20 weeks' gestation and sustains trauma not meeting the time-critical criteria still faces potential harm to the unborn child and should be transported to a hospital that has both obstetric and trauma capabilities.

For a trauma team to run effectively there must be an identifiable leader who will direct the resuscitation, assess the priorities and make critical decisions. Good communication between the trauma team members is vital, as is ensuring that local senior staff are aware and can provide additional support if required.

Once the initial assessment and resuscitation is underway, it is important to plan the next steps in immediate management. Priorities for care must be based on sound clinical judgement, patient presentation and response to therapies. Awareness of limitations in resources as well as training in the emergency field is vital. If escalation of care to senior staff is warranted, then do so early in the patient care episode. Do not wait until the patient deteriorates to ask for assistance.

Frontline clinical staff should initiate contact with ARV early in the patient care pathway or, more importantly, as soon as it is identified that the patient meets the inter-hospital trauma transfer criteria or may have sustained injuries beyond the clinical skill set of the emergency department or urgent care centre. ARV can be contacted at any time throughout the patient care episode to offer or coordinate clinical advice and consultation.

ARV coordinators can facilitate a three-way conversation between the referral health service, specialist obstetric resources and the ARV consultant to discuss the best, timely management of the patient.

The decision of when to transfer an unstable patient should ideally be made by the transferring and receiving clinicians in collaboration with the retrieval service. Clear communication is crucial: the transmission of vital information allows receiving clinicians to mobilise needed resources while the inadvertent omission of such information can delay definitive care. Information should be conveyed in both verbal and written (via the patient record) form and should include the patient's identifying information, relevant medical history, pre-hospital management and emergency department evaluation and treatment (including any procedures performed and imaging obtained).

It is important that additional communication with the ARV coordinator is initiated when there is:

1. Significant deterioration in:
 - conscious state
 - blood pressure



- heart rate
 - respiratory status
 - oxygenation
2. Major clinical developments such as significantly abnormal diagnostic tests or new clinical signs.
 3. The need for major interventions prior to the retrieval team arriving (for example, intubation or surgery). This will ensure the retrieval team is prepared, the patient receives the appropriate care en route and the patient is referred to the correct facility.

8. Early management

Early management continues the focus on assessment, management and intervention for the mother, as fetal viability and outcomes are directly related to maternal oxygenation and perfusion. Opportunities to assess fetal wellbeing should be sought, including obtaining necessary equipment.

Patient positioning	Wound care
Airway management	In-dwelling catheter
Radiology	Nasogastric tube
Pathology tests	Tetanus prophylaxis
Preventing hypothermia	Antibiotics
Analgesia and antiemetics	Cardiac arrest
Sedation	Blood matters
Monitoring	Reassess

Patient positioning

To reinforce: Pregnant patients should be positioned with manual left uterine displacement or a left sided tilt of 15–30 degrees to facilitate blood flow and venous return. This positioning reduces the aortocaval shunt caused by uterine pressure on the great vessels, and should be maintained while managing neutral spinal positioning on a spine board and while in transit.

Airway management

Intubation should occur if the patient is unable to maintain an adequate airway, has an oxygen saturation below 94 per cent or has a GCS under 9. Aim to keep the ETCO₂ reading around 30-35 mmHg in the absence of a head injury. This is normal physiology for a pregnant woman. Blood gas analysis should be used to assist setting ventilation parameters (if available). ETCO₂ monitoring (if available) should also be used to assess respiratory status and adequacy of ventilation.

Always have emergency airway equipment available by the bedside.



Radiology

Notify radiology staff if available of the arrival of a pregnant trauma patient. Remember that in an emergency situation the optimal resuscitation, imaging and treatment of the mother will ensure the optimal chance of fetal survival.

Most diagnostic procedures pose no substantial risk to the mother or fetus, and necessary investigations should not be delayed or avoided because of concerns for the pregnancy. Radiation risks are greatest in the early stages of pregnancy (less than eight weeks); however, it is highly unlikely that the fetal-effective dose from diagnostic or most interventional procedures will exceed 100 mSv, which is the dose range at which the possibility of fetal complications is more concerning.

X-ray

Plain x-ray imaging of the head, neck, chest, pelvis or extremities pose no substantial risk and should be undertaken as indicated for trauma patient management. Shielding of the abdomen or pelvis may be considered where appropriate.

CT scanning

CT scanning of the abdomen and pelvis may increase the total radiation dose to the fetus and therefore should be used only after a risk-benefit analysis. However, in a critically injured patient, fetal outcomes are directly related to maternal outcomes, and the best care for the mother is also the best care for the unborn child.

If it appears that the patient will require transfer to a MTS, the decision to conduct a CT prior to retrieval must be carefully considered.

FAST

Consider need for FAST if available and if staff trained in its use are present or available. In haemodynamically stable patients, FAST can be delayed until the secondary survey and is ideally performed by a second operator while the remainder of the secondary survey is completed.

Ultrasound

Ultrasound may be used to: assess a large organ injury; determine the presence of peritoneal fluid or blood; calculate gestational age and fetal heart rate; assess fetal wellbeing, fetal movement and placental location; and calculate amniotic fluid volume. However, ultrasound has a low sensitivity for placental abruption and should not be used to exclude this diagnosis.

Pathology tests

In a ventilated patient, arterial blood gases can have a significant impact on the ability to monitor and adjust the adequacy of ventilation and perfusion. Ventilation parameters should be based on blood gas analysis and adjusted accordingly; aim for a carbon dioxide of 30–35 mmHg and an oxygen saturation of 94–98%. (Damiani, et al., 2014) (Panwar, et al., 2016)

If the mother is Rh negative, perform a Kleihauer test (within 48–72 hours).

Lab tests should be taken for FBC (full blood count), UEC (urea electrolytes and creatinine) and glucose as a baseline. A group and hold should be taken for all major trauma patients;



consider requesting a cross-match as well if the patient is involved in a trauma presentation with a high index of suspicion for further injuries. Coagulation studies including fibrinogen should be done if accessible to establish baseline measurements in the pregnant trauma patient, and to assist in the management of haemorrhage. This is particularly important if the patient is on anticoagulation therapy.

Preventing hypothermia

Prevention of hypothermia is crucial in pregnant trauma patients. Warmed IV fluids should be administered if high volumes are required and external warming therapies should be commenced. An ideal patient temperature of 36.5 °C is the target for attending staff.

Analgesia and antiemetics

Use of antiemetic's should be considered early, to anticipate and prevent motion sickness and reduce the known risk of aspiration especially if transfer and retrieval is likely. All antiemetic's are safe after 8 weeks gestation, prior to this time or if gestation is unknown Ondansetron should be avoided (however evidence regarding any risk associated with Ondansetron use before 8 weeks gestation is incomplete). Effective management of vomiting, reflux and risk of aspiration is a clear priority in managing patients with trauma in early pregnancy.

Analgesia should be carefully considered for a pregnant patient suffering a traumatic injury. The drug of choice will be based on clinical signs, the need for analgesia and whether the drug crosses the placenta into the fetal circulation. Short-acting agents are generally preferred, avoiding continuous infusions.

Most opioids are considered safe for use in therapeutic doses for short periods of time during pregnancy, and many are used routinely for labour analgesia despite crossing the placenta. In most circumstances, opioids would be considered an appropriate choice for analgesia in a pregnant trauma patient. Non-steroidal anti-inflammatory drugs (NSAIDs) are contraindicated in pregnancy and should be avoided.

Advice should be sought from a pharmacist or pregnancy medication advice service where concerns exist.

Sedation

Appropriate sedation may lower intracranial pressure by reducing metabolic demand. Further beneficial effects of sedation include a reduction in hypertension and tachycardia as well as improved patient–ventilator synchrony. Propofol has become a widely used anaesthetic/sedative with pregnant patients because it has a rapid onset and short duration of action.¹⁴¹⁵

Monitoring

Monitoring the heart rate, respiration rate, blood pressure and oxygen saturation should take place at 15/60 intervals or less if indicated. All monitoring should be maintained until the retrieval team arrives.

A baseline ECG should be taken if time permits and facilities exist prior to transfer. Additionally, fetal monitoring should be commenced if capacity exists and gestation is 24 weeks or longer.



Wound care

Initial management of the wound in an emergency department is limited to controlling bleeding via external direct pressure.

If vaginal bleeding is unable to be controlled, this may represent severe pathology and discussion with an obstetric team and ARV should take place urgently to guide therapy. Vaginal packs **must not** be inserted.

In-dwelling catheter

A urinary catheter should be inserted in pregnant trauma patients and their urine output measured hourly. A urinalysis should be performed also to check for blood and protein. The desired urine output for adults is 0.5–1.0 mL/kg/hr.

Nasogastric tube

All patients should be kept nil orally in the initial post-resuscitation phase of injury.

If a base of skull fracture is suspected, and with any maxillofacial injuries, insertion should be avoided until the patient is transferred to the specialist centre. Alternatively, an OGT can be placed under careful direct visualisation. Care should be taken with inserting an NGT in pregnant patients due to mucosal congestion and the added risk of epistaxis.

Tetanus prophylaxis

Tetanus prophylaxis should be administered in any penetrating injury. Adult diphtheria tetanus vaccination (ADT) is a category A drug and is considered safe for use in pregnancy.

Antibiotics

Antibiotic prophylaxis should occur in all open and penetrating injuries as well as when there is suspicion of any base of skull fractures. The risk of local wound infections are particularly high in patients with a penetrating injury due to the presence of contaminated foreign objects such as skin, hair or bone fragments.

The routine prophylactic use of antibiotics remains controversial.

Cephalosporins, penicillins and metronidazole are category A or B medications and are usually considered safe for use where indicated in pregnancy. Tetracyclines and aminoglycosides are category D medications and their use should generally be avoided. Consultation with the ARV clinicians and obstetric specialists is indicated regarding the choice of antibiotics.

Cardiac arrest

A pregnant patient who has a cardiac arrest presents significant problems to the treating team outside a MTS.

Effective CPR is difficult to achieve in late pregnancy due to the effects of aortocaval shunting and compression of the great vessels by the enlarged uterus. **Maintenance of manual left uterine displacement or left lateral tilt is essential for effective resuscitation, and must be continued throughout.**

In cases where a trauma presentation results in a cardiorespiratory arrest in a pregnant woman, resuscitation should follow the standard basic and advanced life support guidelines with three important modifications:



- immediate positioning of the pregnant trauma patient in a left lateral tilt of 15–30 degrees
- consideration of early intubation by an experienced airway clinician
- performing a perimortem caesarean section if there is no response to resuscitation within four minutes.

An emergency (perimortem) caesarean section is considered part of the resuscitation protocol for cardiorespiratory arrest in a pregnant patient. CPR should be continued throughout. To provide any benefit, perimortem caesarean section should be commenced four minutes after the loss of maternal cardiac output, and delivery should be achieved by five minutes. This is a highly stressful and extremely rare situation.

The aim of delivery by caesarean section is to empty the uterus and therefore restore perfusion to vital maternal organs, improving the chances of maternal survival. Since the tolerance of the fetus to reduced blood flow and hypoxia is significantly less than that of the mother, this may also be the only chance for fetal survival. Emergency (perimortem) caesarean section therefore improves the chance of a successful resuscitation for both the mother and child. This is a decisive moment for responding teams and should be made in conjunction with appropriately qualified personnel with skilled support staff and appropriate equipment.

Blood matters

In the absence of cross matched blood, Rhesus negative blood and blood products should be administered. Where possible, for red cell and platelet transfusions the units should be CMV, Kell (K) and Duffy (Fya) negative. A blood group and antibody screen should also be performed to determine the maternal blood type and Rhesus antibody status, and to assess for the presence of any pre-formed anti-D antibody.

Rhesus isoimmunisation and the use of anti-D¹⁶

All Rhesus negative women should be given a dose of Anti-D appropriate for their gestation within 72 hours of a sensitising event. If a dose has been missed, some benefit may still be obtained up to 10 days post event and Anti-D should also be offered in these circumstances. Rhesus positive women do not require Anti-D. A small number of women will have pre-existing antibodies and have already been isoimmunised – these women also do not require Anti-D.

The recommended doses of anti-D are:

- 250 IU (50 mcg) for women 12 or fewer weeks' gestation
- 625 IU (125 mcg) for women at 12 or more weeks' gestation.

Any abdominal trauma may cause an injury which allows for exchange of maternal and fetal blood, and is considered to be a sensitising event. Ideally, a maternal blood sample should be taken prior to administration of Anti-D and sent for a Kleihauer test to measure the volume of fetal blood present in the maternal circulation. A Kleihauer test may still be useful in Rhesus positive women, as it can provide evidence of maternal-fetal haemorrhage where an abruption is suspected but cannot be seen on ultrasound or where bleeding is not revealed.

Anti-D is more effective the sooner it is given and administration of the first dose should not be delayed to await the results of the Kleihauer test, which can take some time. The



Kleihauer test results are most useful for determining whether more than one dose is subsequently required.

Reassess

The importance of frequent reassessment cannot be overemphasised. Deterioration in a pregnant patient can be rapid, leading to catastrophic haemorrhage, shock and other complications if not identified early. Patients should be re-evaluated at regular intervals as guided by the patient's condition.

If in doubt about any aspect of a patient's condition, repeat the primary survey and assessment.

9. Retrieval and transfer

Transfer and retrieval response will be managed according to patient need following clinical consultation.

It is important to note that an exhaustive clinical workup and interventions is not always necessary or appropriate prior to transfer. Stabilisation and ensuring life-threatening problems are addressed, as well as taking measures to prevent deterioration en route, are essential aspects of early care. Delaying transfer to obtain laboratory results or imaging studies may simply delay access to definitive treatment. Often such studies must be repeated at the receiving facility.

All health services should avoid a patient deteriorating during an inter-hospital transfer by transferring these patients to a major trauma centre quickly. Currently in Victoria, obstetric trauma specialists and facilities are located in metropolitan Melbourne, with patients transferred to the combined Royal Melbourne and Royal Women's site as a first-line destination. Obstetric patients who do not meet time-critical major trauma guidelines for transfer may be referred to the nearest hospital with trauma and obstetric capacity.

In liaison with ARV clinicians, contact Paediatric Infant Perinatal Emergency Retrieval (PIPER) if required and the receiving hospital. Confirm with both about the interventions to be used to stabilise the patient before retrieval personnel arrive. ARV will coordinate communications and retrieval and will evaluate the practicality and clinical needs involved in transferring the patient from the source hospital. Once retrieval staff arrive on scene, be prepared to give a thorough handover. Retrieval staff will assess the patient prior to transfer and may make changes to care to ensure the patient is safe during transfer.

Adult Retrieval Victoria recommends the IRMIST-AMBO method of handover for facilitating health professional communication and ensuring clarity and completeness.



10. Appendix 1: Normal Changes in pregnancy

Cardiovascular	
Blood pressure	Minimal change Slight ↓ in first and second trimester, normal in third
Heart rate	↑ 15–20% ↑
Cardiac output	↑ 30–40% 6–7 L/min during pregnancy
ECG	Non-specific ST changes, Q waves in leads III and AVF, atrial and ventricular ectopics
Systemic vascular resistance	↓ to 1,000–14,000 Due to progesterone and blood volume
Respiratory	
Respiratory rate	No change
Oxygen demand	↑ 15%
Functional residual capacity	↓ 25%
Minute ventilation	↑ 25–50% or 7–15 mL/min
Tidal volume	↑ 25–40% or 8–10 mL/kg
PaO ₂	↑ 10 mmHg or 104–108 mmHg
PaCO ₂	↓ 27–32 mmHg
Arterial pH	↑ 7.40–7.45
Bicarbonate	↓ 19–25 mmol/l
Haematological	
Blood volume (mL)	↑ 30–50% volume
White cell count (mm ³)	↑ to 5,000–14,000
Haemoglobin (g/dL)	↓ to 100–140
Haemocrit (%)	32–42
Plasma volume (mL)	↑ 30–50%
Red blood count volume (mL)	↑ to 1,900
Coagulation factors ↑ 30–50%	↑ factors VII, VIII, IX, XII
Platelet (mm ³)	200,000–350,000
Fibrinogen, plasma (mg/dL)	264–615
Renal	
Urea (mg/dL)	4–12
Sodium (mEq/L)	132–140
Potassium (mEq/L)	3.5–4.5
Chloride (mEq/L)	90–105
Calcium ionised (mEq/L)	4–5

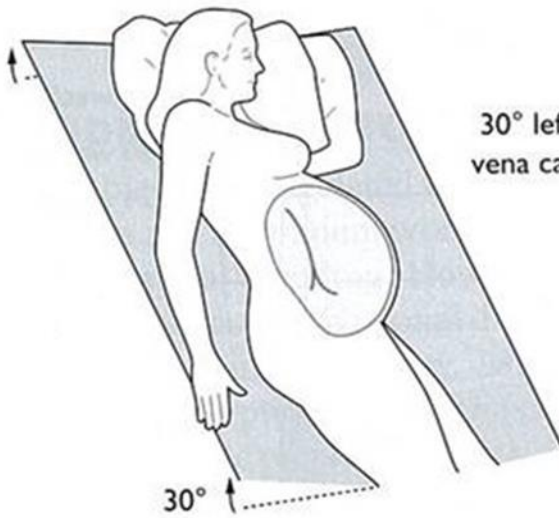
Used with permission from: The Royal Melbourne Hospital. Trauma Service. Emergency and Trauma Services. Pregnancy and trauma guideline. Melbourne: Advisory Committee on Trauma. 2009 Nov.



11. Appendix 2: Maternal Positioning Diagram



The gravid uterus compresses the vena cava in supine position



30° left lateral decubitus unloads vena cava



Alternative method: manual shift of uterus

Used with permission from Sally Pairman, Jan Pincombe, Carol Thorogood and Sally Tracy; Midwifery: Preparation for Practice © 2006 Sydney, Elsevier Australia.



12. Appendix 3: Manual left uterine displacement 1 handed technique





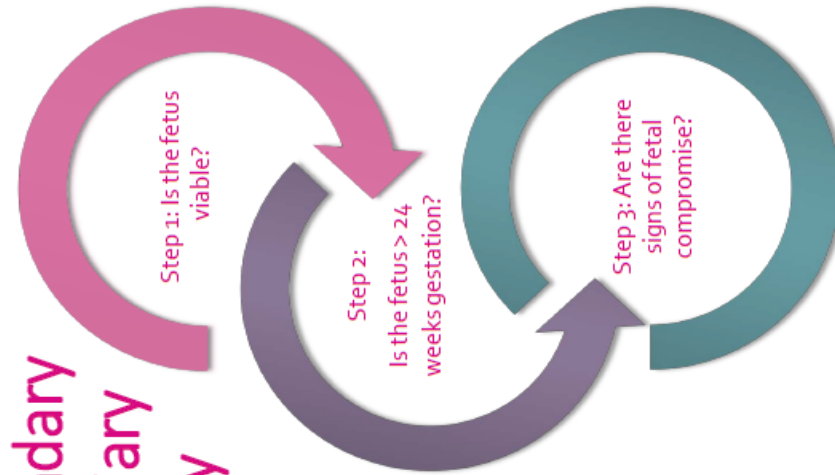
13. Appendix 4: Manual left uterine displacement 2 handed technique





14. Appendix 5: Maternal Secondary & Tertiary Survey

Secondary & Tertiary Survey



Is the fetus viable?

Measure fetal heart rate via handheld Doppler or ultrasound

- If present – proceed to step 2.
- If absent, provide maternal treatment only. No fetal treatment is required if fetal loss is confirmed. In consultation with obstetrics, plan timing of induction and delivery after maternal stabilization is complete.

Is the fetus > 24 weeks gestation?

Estimate gestational age and pregnancy history (calculate from pregnancy records, fundal height measurement or ultrasound)

- If yes – proceed to step 3.
- If no, provide maternal treatment first. In consultation with obstetrics, plan to optimize fetal well being after maternal stabilization is complete.

Are there signs of fetal compromise? Check for:

- Abnormal fetal heart rate patterns (fetal distress)
- Vaginal bleeding.
- Spontaneous rupture of membranes.
- Persistent uterine contractions.
- Uterine tenderness.
- Abdominal pain.
- Consider high risk mechanisms of injury and be wary of decreased maternal GCS.
- If yes, admit to hospital and manage in consultation with obstetrics team. Plan inpatient maternal and fetal monitoring for 24 hours, including at least 4 hours of continuous electronic fetal heart rate monitoring. Intervene as needed for fetal distress.
- If no, perform 4 hours of continuous electronic fetal heart rate monitoring and plan discharge home. Provide instructions to return to hospital for review if there is any vaginal bleeding, decreased fetal movement, fluid loss, uterine contractions, abdominal pain or tenderness.

Fetuses equal to or greater than 28 weeks gestation should have a minimum of 4 hours of continuous electronic fetal heart rate monitoring prior to discharge.



15. Appendix 6: Fundal palpation chart

Identifying the top of the fundus



Walk your fingers up the side of the belly.

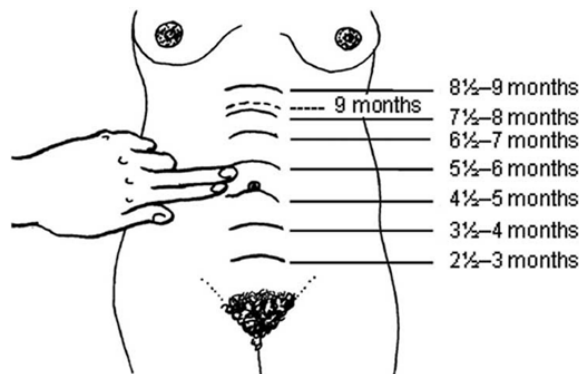


Find the top of the uterus (it feels like a hard ball under the skin).



You can feel the top by curving your fingers into the belly.

Measuring fundal height. Each increment is approximately two fingers' width.



Courtesy of: <http://www.open.edu/openlearnworks/mod/oucontent/view.php?id=40>



16. Appendix 7: AGREE II Score Sheet – Obstetric Trauma Guideline

AGREE II Score Sheet: Obstetric trauma guideline

Domain	Item	AGREE II Rating						
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>
Scope and purpose	1. The overall objective(s) of the guideline is (are) specifically described.							X
	2. The health question(s) covered by the guideline is (are) specifically described.							X
	3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.							X
Stakeholder involvement	4. The guideline development group includes individuals from all the relevant professional groups.						X	
	5. The views and preferences of the target population (patients, public, etc.) have been sought.							X
Rigor of development	6. The target users of the guideline are clearly defined.							X
	7. Systematic methods were used to search for evidence.					X		
	8. The criteria for selecting the evidence are clearly described.						X	
	9. The strengths and limitations of the body of evidence are clearly described.						X	
	10. The methods for formulating the recommendations are clearly described.						X	
	11. The health benefits, side effects and risks have been considered in formulating the recommendations.						X	
	12. There is an explicit link between the recommendations and the supporting evidence.							X
Clarity of presentation	13. The guideline has been externally reviewed by experts prior to its publication.							X
	14. A procedure for updating the guideline is provided.							X
	15. The recommendations are specific and unambiguous.						X	
	16. The different options for management of the condition or health issue are clearly presented.							X
	17. Key recommendations are easily identifiable.							X



Domain	Item	AGREE II Rating							
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>	
Applicability	18. The guideline describes facilitators and barriers to its application.							X	
	19. The guideline provides advice and/or tools on how the recommendations can be put into practice.							X	
	20. The potential resource implications of applying the recommendations have been considered.							X	
	21. The guideline presents monitoring and/ or auditing criteria.							X	
Editorial independence	22. The views of the funding body have not influenced the content of the guideline.							X	
	23. Competing interests of guideline development group members have been recorded and addressed.							X	
Overall Guideline Assessment	1. Rate the overall quality of this guideline.	1 <i>Lowest possible quality</i>	2	3	4	5	6	7 <i>Highest possible quality</i>	
Overall Guideline Assessment	2. I would recommend this guideline for use.	Yes	Yes, with modifications					No	
		X							



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