Penetrating Abdominal, Thoracoabdominal and Chest Trauma Management Clinical Guideline

Scope

Site	Department, division, or operational area	Applicable to:
Royal Perth Hospital (RPH) only	State Major Trauma Service (SMTU), Emergency Department (ED)	Medical and Nursing

Definition

Penetrating abdominal, thoracodominal and chest trauma	The surface anatomy of **the abdomen** extends from the nipples to the groin crease anteriorly, and the tips of the scapulae to the gluteal skin crease inferiorly. Any penetrating injury to this area, or that may have traversed this volume, should be considered as a potential abdominal injury.[1] Intraperitoneal abdominal organs include the solid organs (i.e., spleen, liver) and the hollow viscus organs (i.e., stomach, ileum, jejunum, transverse colon). Retroperitoneal organs include the duodenum, pancreas, kidneys, ureters, urinary bladder, ascending and descending colon, major abdominal vessels, and rectum. Traumatic injuries are not usually limited to single body areas. In particular, for gunshot injuries, trajectories can also extend across three or more anatomic regions (e.g., pelvis–abdomen–thorax–neck).[11] **The thoraco-abdominal region** is marked by the fourth intercostal space superiorly (nipple level) and the costal margin inferiorly around the entire torso. This region changes with each cycle of breathing given the continuous movement of the diaphragm. [11] The diaphragm is particularly vulnerable in this area. The chest is marked by the **right and left thoraces and the "cardiac box"**, which is restricted by the nipple lines laterally, sternal notch superiorly and xiphoid process inferiorly. Note that the concept of the "cardiac box" also applies for injuries in the projection of this area on the posterior aspect of the torso. Thoracic organs include the lungs, great vessels, and the mediastinum and its viscera.

General information/preamble

As a general approach, clinically, the mechanism and location of known injuries, the haemodynamic and neurological status of the patient, and associated injuries are critical in guiding the initial resuscitation, the diagnostics, and subsequent therapeutics.

Penetrating abdominal and/or chest trauma typically involves the violation of the abdominal and/or thoracic cavity by a gunshot wound or stab wound.[2] Other causes of penetrating injury include being impaled by objects as a result of industrial traumatic mechanisms, falls, collisions, blast injuries, and fragmenting military devices.

Gunshot wounds are associated with a high incidence of intra-abdominal injuries and nearly always mandate laparotomy. Stab wounds are associated with a significantly lower incidence of intra-peritoneal and retroperitoneal injuries; therefore, serial examination in association with selective non-operative management is suggested in certain patients[2].

The incidence of diaphragm injuries associated with penetrating trauma to the thoracoabdominal area is reported to be 11% - 19% [6,7,8]. This number increases to approximately 30% for stab wounds and 60% for gunshot wounds isolated to the left lower chest. Injuries to the diaphragm may be difficult to diagnose, as up to 31% of patients may demonstrate no abdominal tenderness and 40% may have normal chest radiographs. Among all asymptomatic patients with penetrating chest injuries, the risk of occult diaphragm injury is reported to be 7%[9]. If undiagnosed, diaphragm injury is associated with a high risk of bowel herniation and late complications.

Signs and symptoms[2]

Signs and symptoms of penetrating abdominal and/or thoracic trauma depends on patient, injury, and environmental factors.

Regarding mechanism, the type of penetrating weapon or object, the range and trajectory from which the injury occurred, which organs may be injured, and the location and number of wounds, are all crucial to consider.

Close-range injuries transfer more kinetic energy than those sustained at a distance, although range is often difficult to ascertain when assessing gunshot wounds. These wounds involve high-energy transfer and, consequently, can involve an unpredictable pattern of injuries, and an unpredictable trajectory. Secondary missiles, such as bullet and bone fragments, can inflict additional damage. Stab wounds are caused by penetration of the abdominal or chest wall by a sharp object. This type of wound generally has a more predictable pattern of organ injury. However, occult injuries can be overlooked, resulting in devastating complications.

Guideline

Diagnosis [2, 11]

In accord with Advanced Trauma Life Support (ATLS) guidelines.

- **Primary survey**
- **Secondary survey**

Immediate surgical exploration may be warranted where there is evidence of significant intra-abdominal/intra-pleural injury, especially vascular trauma, such as the following:

Abdominal	Thoracic[10]
Signs of shock	Hypotension, hypoxia or persistent tachycardia
Narrow pulse pressure	Narrow pulse pressure
Tachycardia	Persistent shortness of breath (SOB) or pleuritic chest pain
High or low respiratory rate	A foreign body sensation in the throat or change in voice
Signs of inadequate end organ perfusion	Unilateral/diminished breath sounds strongly suggestive of pneumothorax
Peritoneal signs (e.g., pain, guarding, rebound tenderness)	Jugular venous distension suggestive of pericardial effusion (may not be present in hypovolaemic patient with tamponade) or tension pneumothorax
Diffuse and poorly localized pain that fails to resolve	Subcutaneous air (crepitus) strongly suggestive of a tracheobronchial injury or a pneumothorax

Refer to Appendix I: Algorithm – Penetrating torso wound.

Laboratory testing

Patients with penetrating abdominal and/or thoracic trauma usually require the following laboratory investigations:

- Blood type and crossmatch
- Full Blood Picture (FBP)
- Urea and Electrolyte (U&Es) – consider Ca^{2+}, Mg^{2+}, PO_4^{3-}
- LFT and Lipase
- Coagulation profile (consider thromboelastography), ROTEM or TEG
- Blood gases
- Urinalysis
- Serum and urine toxicology screen
- Viral serology/nucleic acid studies.

Guideline – Diagnosis cont'd

Imaging studies

Numerous imaging modalities may assist in the diagnostics of thoracic and abdominal injuries. Their application is guided by patient physiology and comorbidities and tailored to the suspected injuries on the basis of mechanism, signs and symptoms, and situational realities (e.g., availability of diagnostics, etc.).

The following imaging studies may be used to evaluate patients with penetrating abdominal trauma (**Note:** Entry and exit wounds should be tagged with radio opaque markers prior to imaging to improve the interpretation of subsequent radiographs):

- Chest radiography: e.g.
  - To exclude pleural penetration (i.e., thoracic breach)
  - To assess for hollow viscus perforation (specificity > sensitivity)
  - Localisation of bullet fragments/other foreign bodies (FBs)
- Abdominal radiography of some use in the localisation of bullet fragments.
- Chest and abdominal ultrasonography, echocardiography and extended focused assessment with sonography for trauma.
- Abdominal Computed Tomography (CT):
  - In general, the most sensitive and specific study in identifying and assessing solid organ injury severity, for retroperitoneal organ injury, and the identification of free gas, suggestive of a hollow viscus perforation.
- Chest CT: e.g.
  - For the investigation of a trajectory of a penetrating object crosses the mediastinum or middle of the chest, symptoms or signs concerning for oesophageal or tracheobronchial or vascular injury are present, chest pain, SOB, or other symptoms consistent with injury are present that are not explained adequately by other investigation.
- Retrograde urethrogram/cystogram:
  - A technique useful in determining urethral and bladder rupture/perforation.
- Magnetic Imaging Resonance (MRI):
  - The modality is not usually included in the acute assessment given logistic constraints. However, certain specific indications are accepted: e.g., in pregnant patients (due to the absence of ionising radiation), and for acute neurological assessment of some central nervous system injuries.

Options for evaluation[1]

- All patients must be thoroughly and immediately inspected for other potential penetrating wounds (i.e., axilla, groin, perianal, and perineum). Missing wounds is a common source of preventable morbidity.[11]
- The investigations mentioned above, and diagnostic procedures mentioned below are no substitute for careful examination.
- Further evaluation requires the use of one or more of the following diagnostic modalities:

Guideline – Options for evaluation cont'd

Serial Physical Examination (SPE)

SPE has the best sensitivity and negative predictive value of all modalities for the evaluation of penetrating abdominal trauma.

The patient is admitted for observation for at least 24 hours. During this time the patient has regular (at least hourly, or continuous invasive) observation of their haemodynamic status. The abdomen is examined routinely for signs of developing peritonitis. Ideally the same surgeon should examine the patient each time. If this is not possible, during a handover period both surgeons should examine the patient at the same time, so they agree on the current status of the abdomen and whether there has been any progression in symptoms. The timing of examinations varies in the literature but should begin more frequently and then decrease over time. A suggested sequence of examination might be at one, four, 12 and 24 hours after the initial assessment. In practice, examination every four to six hours may be performed.

If the patient develops signs of haemodynamic instability or peritonitis during this period of observation, further diagnostics or an operative intervention should be performed. In the absence of this, the following day, the patient starts a normal diet and mobilises. The patient is discharged once diet is tolerated and they have completed the observation period.

A failure of improvement and resolution of symptoms should be treated as a failed examination, and prompt further investigation and/or surgical intervention.

The disadvantages of SPE are primarily the requirement to admit all patients with a penetrating injury, and the need for frequent haemodynamic and physical examinations.

Local Wound Exploration (LWE)

LWE is only to be performed under the direct tactile supervision of the Trauma Fellow or Consultant.

LWE requires a formal evaluation of a stab wound under local anaesthesia and with appropriate sterile technique. This procedure is ideally performed in the operating room but can be performed in the emergency department (ED). The wound is extended under local anaesthesia and the track followed through tissue layers.

In abdominal trauma, penetration of the deep fascia (anterior rectus sheath or the deep fascia of the external oblique muscle) is considered a positive LWE, as penetration of the peritoneum is difficult to identify.

The value in the LWE exists where a negative LWE result (i.e., no breach of the deep fascia), is demonstrated. Here, the clinician can exclude intra-abdominal injury, and the patient can be excluded from further investigation/intervention (and potentially discharged from inpatient care).

A positive LWE increases the likelihood of intra-abdominal injury and prompts further investigation/management.

Guideline – Options for evaluation cont'd

When LWE is used alone to determine laparotomy, there will be a high non-therapeutic laparotomy rate. Even if the penetration of the peritoneum is used as a cut-off, many of these patients will have no intra-peritoneal injury, or an injury that does not require surgical intervention - most commonly omental laceration, mesenteric laceration or liver tears that have stopped bleeding.

Diagnostic Peritoneal Lavage (DPL)

DPL involves passing a small catheter into the peritoneal cavity, usually at the umbilicus or just inferior to this. The suggested technical approach is identical to a Hasson cannulation of the infraumbilical linea alba (although blind or imaging guided needle-based techniques are also described). If blood can be aspirated through this catheter, this is referred to as a positive 'tap' or aspiration (this is a diagnostic peritoneal aspirate - DPA). If blood cannot be aspirated, a litre of warm crystalloid solution is run into the peritoneal cavity and then allowed to drain out. This lavage fluid is then sent to the laboratory for analysis of red cell count, white cell count, bilirubin and amylase level, and any bowel contents (faecal or food matter).

It is important to realise that the role of DPL in the haemodynamically stable patient is different from that in the unstable patient. In the unstable patient the problem is one of major haemorrhage, and DPL is a rapid way to identify intraperitoneal haemorrhage. This has been largely superseded by Focused Abdominal Sonography in Trauma (FAST), but DPL can be used as an alternative to identify intra-peritoneal haemorrhage, e.g., in situations where subcutaneous gas complicates the FAST ultrasound, or if ultrasound is unavailable. In the unstable patient one is searching for a lot of blood, so a positive DPL in this setting requires either a positive aspiration (DPA) or a high red-cell count (>100,000/mL).

The situation in penetrating abdominal trauma is very different. A haemodynamically unstable patient with an abdominal stab wound needs no further investigations and will proceed to laparotomy, as discussed above. However, the role of DPL in the haemodynamically stable patient with penetrating abdominal injury is to identify intraperitoneal hollow viscus injury (stomach, small bowel, colon) or diaphragmatic injury.

If faecal or food matter is seen on microscopy, this is diagnostic of a hollow viscus perforation. However, this is rarely the case - and a decision to proceed to laparotomy is usually based on the red cell count. By necessity this must be lower than that looking for gross haemorrhage, so the threshold for the red cell count is set somewhere between 5000/mL and 20,000/mL. The lower the threshold, the more sensitive the test, but the higher the non-therapeutic laparotomy rate. Contamination from the insertion site of the DPL can lead to false positive results, as can retroperitoneal blood in pelvic fractures. Some units also use a white cell count >500/mL as a positive result - this value is probably too low, and 3000/mL is probably a better threshold for gastrointestinal tract injury.

The primary disadvantages of DPL are that it is invasive, does not evaluate the retroperitoneum, and has a significant false positive rate. The varying thresholds for "positivity" trade sensitivity for specificity (and vice versa).

Guideline – Options for evaluation cont'd

Extended Focused Assessment with Sonography in Trauma (eFAST)

The role of eFAST in penetrating trauma has not been fully evaluated. Generally, eFAST accurately detects the presence of pericardial fluid, pneumothorax, haemothorax, and peritoneal fluid, thereby helping to determine management priorities. However, while eFAST is sensitive for pericardial fluid, it may have false negative results for intra-abdominal injury, including ruptured diaphragm. This may improve if serial eFAST scans are performed. eFAST may not detect the small amounts of fluid which may be associated with a hollow viscus injury alone. Usually, around 400mL of fluid is required for a positive abdominal view.

- A positive eFAST abdominal view indicates peritoneal breach or penetration but is poor at discriminating for injuries requiring intervention.
- A positive eFAST pericardial view indicates a likely cardiac injury but is poor at discriminating for injuries requiring intervention.
- A negative eFAST does not exclude significant injury in the abdomen but is good at excluding a cardiac injury (except in the situation of an associated pleural injury – where the pericardial sac may be decompressing into the pleura).

CT scan/CT angiography

CT imaging is a sensitive and specific investigation for abdominal and thoracic injuries, with a few important limitations (mentioned below). The accuracy of this investigation may be optimised by careful dialogue between Radiology and the Trauma Team, using appropriate contrast media, adjustment of phases or imaging, resolution of imaging, and other variables. The use of multidetector (multislice) scanners with the ability for multiphase imaging and 3D formatting, has improved this field of imaging greatly during recent years. CT gives the best assessment of retroperitoneal structures.

The CT features of penetrating abdominal injury are:

- Signs of peritoneal violation
- Free intra-peritoneal gas
- Free intra-peritoneal fluid
- Wound track extending through peritoneum
- Signs of bowel injury
- Wound track extending to bowel wall
- Bowel wall defect
- Bowel wall thickening
- Intra-luminal contrast leak
- Intravenous contrast extravasation
- Urine extravasation from genitourinary tract
- Diaphragmatic tear (especially on re-formats)

Guideline – Options for evaluation cont'd

In haemodynamically stable patients with penetrating chest trauma, Multi-detector computed tomography (MDCT), CT angiography and transoesophageal echocardiography (ECHO) offer several advantages over other diagnostic studies (such as supine chest x-ray, ultrasound), and CT angiography is rapidly developing into a primary method of determining vascular injuries.[12,13]

The CT features of penetrating chest injury are:

- Pericardial injury/tamponade
- Great vessel injury: aorta; arch (innominate, carotid, subclavian); pulmonary arteries
- Venous injury: superior and inferior vena cavae and main tributaries; pulmonary veins
- Pulmonary parenchymal lacerations/contusion
- Tracheobronchial/bronchopleural fistulae
- Oesophageal perforation – thickening oesophageal wall, pneumomediastinum, fluid collection
- Diaphragmatic tear
- Occult pneumothorax/haemothorax
- Cervical/Thoracic spine and cord injury

CT imaging has several notable pathology-based limitations:

- Hollow viscus perforation: CT is poorly sensitive at excluding intestinal perforation. A normal CT abdomen does not exclude this injury. If there is clinical suspicion, a period of clinical observation is necessary (and cannot be avoided by the CT)
- Diaphragm stab wounds: CT has poor sensitivity for this diagnosis. A laparoscopy, especially in situations for left sided injuries, is recommended.

Laparoscopy

Trauma laparoscopy has been suggested by many authors (usually based on case series publications). Although these case studies have shown feasibility, there is no direct comparison data such as in a randomised control trial. These studies confirm the feasibility of this, though no direct comparison data, such as in a Randomised Control Trial (RCT) is available. In most studies laparoscopy has a significant false negative rate, primarily from missed bowel injuries. Laparoscopy is also limited in the evaluation of retroperitoneal injury.

A full trauma laparoscopy for the evaluation of penetrating injury requires general anaesthesia and complete examination of intra-peritoneal contents, including visualisation of the whole small bowel and intra-peritoneal colon. This procedure is technically challenging, and the accuracy dependent on multiple factors such as: patient factors (e.g., obesity), and situational realities (e.g., surgeon and operating team ability, equipment, and time).

An important application of laparoscopy is in the evaluation for diaphragmatic injuries in stab wounds. Laparoscopy is the diagnostic method of choice for stable, asymptomatic patients, with injuries to the thoracoabdominal zone, to diagnosis occult or suspected diaphragmatic injury[4]. Diaphragmatic injury is present in ~ 40% of all penetrating thoracoabdominal trauma[5]. Many diaphragmatic lacerations can also be repaired via the laparoscope.

Guideline – Options for evaluation cont'd

Laparoscopy may also have a role in patients who have localised tenderness or develop a raised white cell count or fever without generalised peritonitis after a period of clinical observation. Laparoscopy may be useful to confirm that a wound is tangential and does not enter the peritoneal cavity - although many of the methods above have advantages over laparoscopy for this indication.

Laparotomy

Exploratory laparotomy remains the gold standard for the assessment of the peritoneal cavity. It remains indicated in the absence of other strategies; especially in resource-limited environments, or occasionally in cases of multi-cavity injuries. For most situations, however, the non-therapeutic laparotomy rate will be unacceptably high.

As a general rule, for patients with a single stab wound in the anterior abdominal wall:

- Half have a peritoneal breach:
  - Of these, approximately half have an intra-abdominal/retroperitoneal injury; and
  - Of these, approximately half have a need for operative intervention.

Therefore, if all patients with a single stab wound in the anterior abdominal wall underwent laparotomy, only approximately 1/8th of patients undergo a therapeutic laparotomy (with 3/4 having had a negative laparotomy, and another 1/8th having had a non-therapeutic laparotomy).

Thoracoscopy/Video-Assisted Thoracic Surgery (VATS)

Urgent thoracotomy remains the access of choice in patients with shock due to life-threatening thoracic injuries. However, a majority of hemodynamically stable thoracic injuries can be managed with tube thoracostomy initially or as a definitive care. In this group of patients, thoracoscopy or VATS has a definite role for timely assessment and treatment of intrathoracic injuries. As a minimal access procedure, it reduces the morbidity associated with a negative or non-therapeutic thoracotomy.[14]

If patients are managed expectantly, usually a chest drain is placed. This serves both diagnostic and therapeutic roles. The chest drain offers an ongoing assessment for active bleeding. Classic indications for failed expectant management (and need for operative intervention) include the development of haemodynamic instability, immediate drainage of approximately more than 1.5L of blood, or persistent drainage of more than 200mL of blood per hour. Patient factors, other injuries and the injury pattern, and situational realities all play a role in the final decisions surrounding operative indications.

Bronchoscopy

Bronchoscopy provides the single definitive diagnostic study in a patient with suspected airway injury. Laryngoscopy, which is performed by an anaesthetist, is a crucial part of endoscopic study in cervical trauma or suspected laryngeal injury. Careful examination of the tracheobronchial tree with the fibre-optic bronchoscopy provides information about the location and extent of injury. The advantages of fibre-optic bronchoscopy are that it can be applied easily and quickly even in the accompanying neck-head or cervical spine injuries.

Guideline – Options for evaluation cont'd

Oesophagoscopy/Gastroscopy

Endoscopic examination of the digestive tract offers an additional modality for consideration in situations where imaging may have been suboptimal, or concern remains. A clinical approach tailoring this investigation to the situation is critical.

Special situations

Wounds to thoraco-abdominal junction zone

Thoracoabdominal injuries need to be evaluated for diaphragmatic injury. Blunt trauma typically produces large radial tears measuring 5-15cm, most often at the postero-lateral aspect of the diaphragm. In contrast, penetrating trauma can create small linear incisions or holes, which are less than 2cm in size and may present late, after years of gradual herniation and enlargement.

The three clinical phases of diaphragmatic injuries were first described by Grimes[3]:

- The first, or acute, phase begins with the injury
- If not diagnosed early, the second, or latent, phase occurs. This phase is asymptomatic but may evolve into gradual herniation of abdominal contents. The diagnosis may be made later because of complications of herniation of abdominal contents into the pleural cavity
- The third, or obstructive phase, is characterized by bowel or visceral herniation, obstruction, incarceration, strangulation, and possible rupture of the stomach and colon. If herniation causes significant lung compression, it can lead to respiratory compromise. Cardiac tamponade has been described from herniation of abdominal contents into the pericardium. Diaphragmatic paralysis also may occur.

Where there is evidence of thoracic and abdominal injury by a single penetrating injury, there must, by definition, be an injury to the diaphragm, e.g., if there is a right pneumothorax and a liver laceration, the diaphragm must also be lacerated.

If the evidence for this is less clear, but diaphragm injury is still suspected, the options are CT, MRI, or laparoscopy/thoracoscopy. All radiological studies may miss small diaphragmatic tears, and so laparoscopy/thoracoscopy remains the investigation of choice. Laparoscopy is preferred for left sided injuries, while thoracoscopy or laparoscopy may be used for right sided injuries. Diaphragmatic lacerations may also be repaired through a laparoscopic or laparoscope-assisted approach.

Flank or back wound

Flank or back wounds may be associated with injuries to retroperitoneal organs such as the colon, kidney, and lumbar vessels - or more rarely the pancreas, aorta, and inferior vena cava. Injury to the colon is most often missed. Where colon injury is a possibility, the duration of serial physical examination may need to be extended to 72 hours, watching for fever or a rise in the white cell count. Dedicated rectal enema studies may be performed, though findings are incompletely sensitive. Where the wound track extends up to the colon, or there is evidence of abnormal bowel wall thickening, laparotomy should be considered.

Guideline – Special situations cont'd

Wound to buttock or perineum

The most dangerous missed injury in these cases is the occult rectal injury. Any penetrating injury to the gluteal region carries the risk of rectal injury. Digital rectal examination alone is inadequate to exclude rectal injuries, and may be supplemented with proctoscopy/sigmoidoscopy, and enema contrast studies. Occasionally, an empiric de-functioning colostomy may be required.

Pregnancy[17]

The evaluation of penetrating trauma in the pregnant patient needs to be a coordinated, multidisciplinary effort. Trauma in pregnancy is a leading cause of non-obstetric maternal death, and maternal death in turn is the most common cause of fetal death. However, while maternal death rate following penetrating abdominal trauma is 10%, fetal death rate nears 80%.

Anterior abdominal penetrating injury commonly results in injury to the uterus and fetus in the last half of pregnancy. Gunshot wounds have a higher mortality for both mother and fetus.

Resuscitation

Emergency Department thoracotomy

ED Thoracotomy (EDT) is an advanced resuscitative manoeuvre, which may assist resuscitation of the trauma patient, in physiological extremis. Recent maturation of trauma systems has resulted in increased numbers of such sick patients arriving at hospital. Most recently, REBOA (Resuscitative Endovascular Balloon Occlusion of the Aorta) has become a feasible alternative in select patients, where the goal of the EDT has been to clamp the descending thoracic aorta, for the control of non-compressible torso haemorrhage.

Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA)

REBOA is a feasible technique to assist the treatment of severe haemorrhagic shock due to non-compressible truncal haemorrhage (NCTH) in trauma, below the diaphragm.[16, 17] (NCTH is defined as haemorrhage arising from trauma to the torso vessels, pulmonary parenchyma, abdominal organs, or disruption of the bony pelvis). It provides the trauma team with a modern alternative in the situation where a left anterolateral thoracotomy would have historically been performed to cross-clamp the descending thoracic aorta.

Pharmacotherapy

- Analgesia[18] . Refer to relevant RPBG pain documents and protocols
- Antibiotic cover[19]
- Venous Thromboembolism (VTE) prophylaxis. [20] Refer to **Venous Thromboembolism (VTE) Risk Assessment and Prophylaxis for Adult Inpatients CPS**
- Tetanus prophylaxis

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Related policies, practice standards, clinical guidelines

RPBG Policy Hub

- STMU: Emergency Department Thoracotomy (EDT) Clinical Guideline
- Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) Clinical Guideline
- Venous Thromboembolism (VTE) Risk Assessment and Prophylaxis for Adult Inpatients CPS

Legislative requirements, the evidence, and the standard

For information relating to the legislative requirements and standards that RPBG policy documents must adhere to, and regarding the logos and levels of evidence used within RPBG policy documents, refer to Legislative Requirements, the Evidence and the Standard (live link) on the Policy Hub.

Related national standards

ACSQHC NSQHS Standards 2nd Edition (2021):

Standard 8: Recognising and Responding to Acute Deterioration

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Appendix I: Algorithm – Penetrating torso wound