

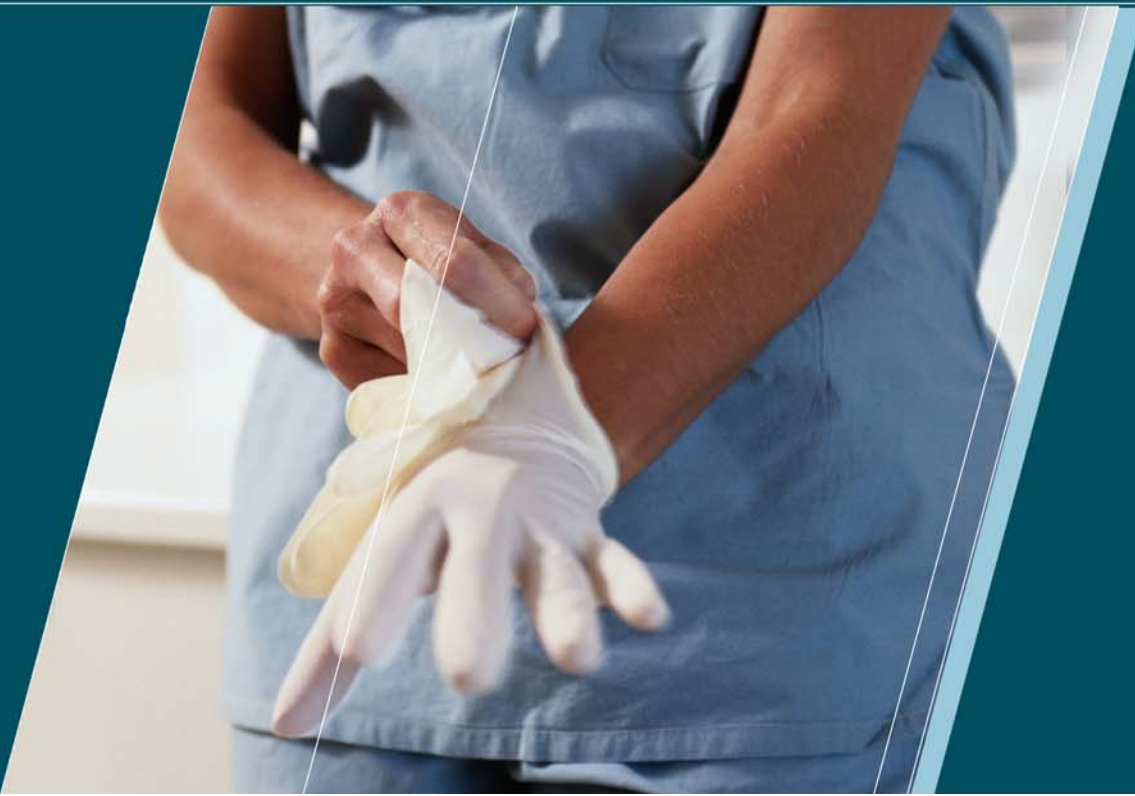


Queensland Government

Queensland Health

Procedural expert manual

Skills training program: Insertion of chest tubes in adults



Skills training program: Insertion of chest tubes in adults

Procedural Expert's manual

This manual is for Procedural Experts responsible for guiding and giving feedback to the participants, as they work through the simulation component of the chest tube insertion program for doctors.

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Overview of program

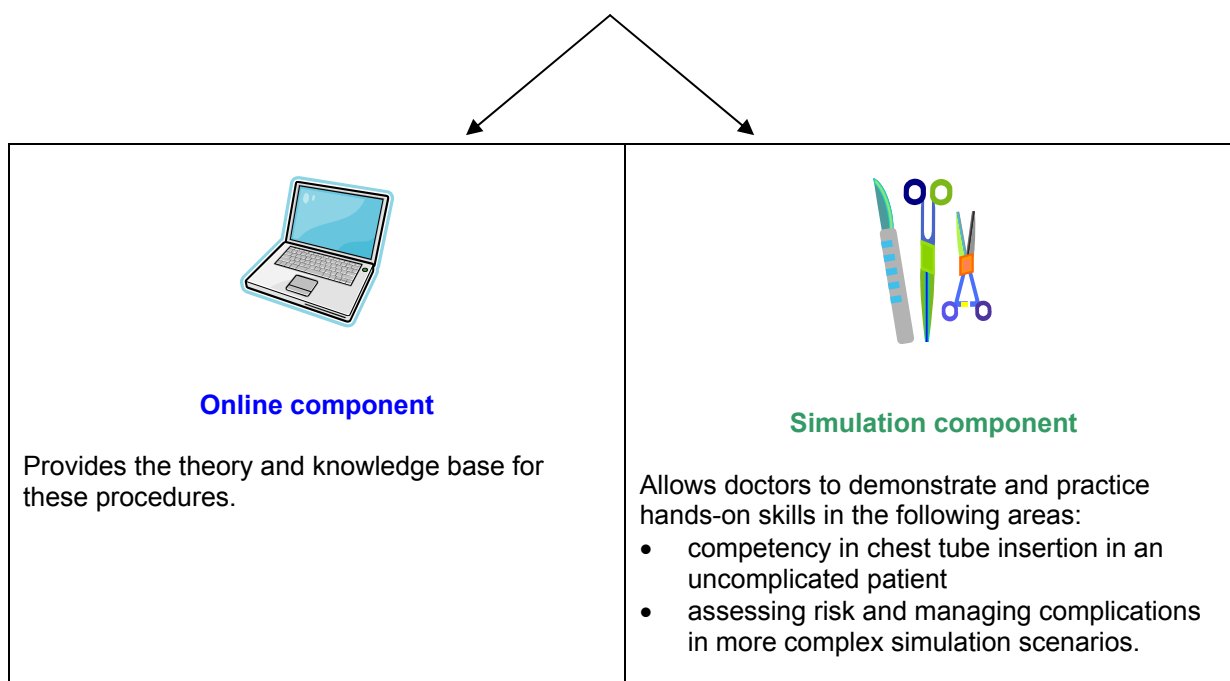
The insertion of a chest tube of any size and by any insertion method may result in significant iatrogenic injury. The objective of this program is to improve patient safety in clinical environments by advancing both the skills and clinical judgement of medical officers inserting chest tubes.

Online education and assessment tools for simulation training are available for:

- large bore chest tubes inserted by blunt dissection and
- small bore catheters inserted by Seldinger technique.

Doctors may wish to train in one or both techniques, depending on clinical practice at their institution.

The complete chest tube insertion program for doctors consists of two components:



Caution!

This program provides training in what is considered to be a safe approach to inserting chest tubes. It does not represent a 'gold standard' or standard of care. Substantial variations in practice occur in clinical practice, which are likely to be of comparable safety and efficacy.

On-line education and simulation training do not replace the need for supervision/observation of chest tube insertion in patients prior to independent practice.

Online component of program

This simulation skills training has been designed to integrate with, and run in collaboration with, the online course:

'Insertion of chest tubes and management of chest drains in adults'

This course is available for:

- Queensland Health staff, at: http://www.sdc.qld.edu.au/course_chest_drain.php
- Others–
 - <http://www.safetyandquality.gov.au/our-work/healthcare-associated-infection/building-clinician-capacity>

Prior to undertaking simulation skills training, participants should consider completing the relevant online learning.

- All participants:
 - **'Assessing risk and minimising complications in chest tube insertion'**
- Less experienced candidates or failure to achieve required mark in the online assessment quiz
 - **'Anatomy refresher'**
 - **'Insertion of small bore catheter by Seldinger technique in adults' and/or**
 - **'Insertion of large bore chest tube by blunt dissection in adults'**
- Completing the online assessment quiz and achieving a pass mark of % /% is **mandatory** and a prerequisite for attending simulation training. A copy of your online quiz with the result must be printed and taken to simulation training.

Simulation component of program

The simulation skills training has been designed in two parts. Doctors demonstrate and practice hands-on skills when:

- **Part 1.** inserting a chest tube in an uncomplicated patient
- **Part 2.** inserting a chest tube, assessing risk and managing complications in more complex simulation scenarios.

Prerequisites

1. Doctors attending the simulation component must tender proof of achieving a pass mark of 1(/1) in the online assessment quiz.
2. Demonstrating competency in the insertion of a chest tube in a mannequin is a prerequisite to proceeding to the more complex scenarios.

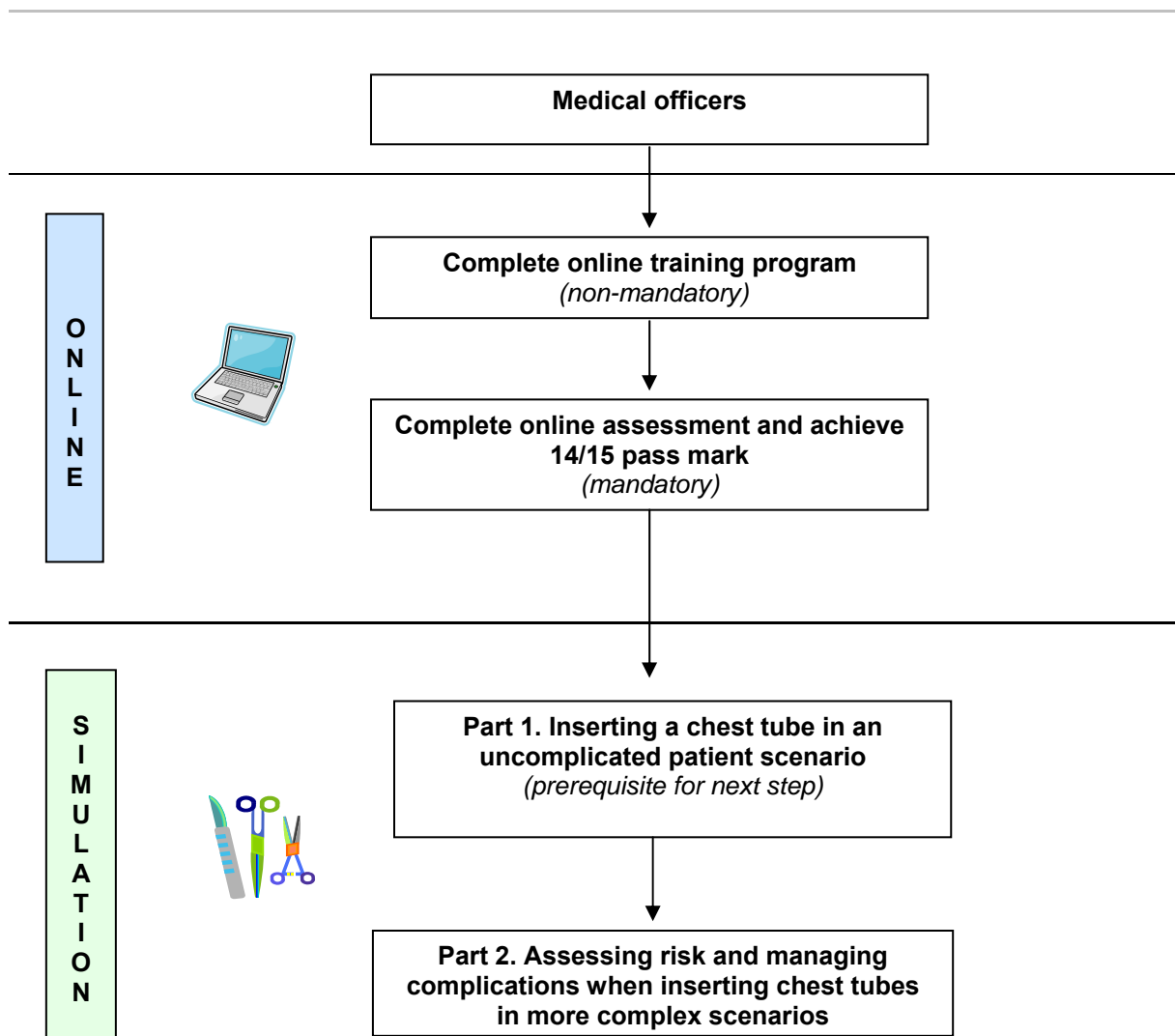


Golden Rule!

Completing the online assessment and achieving a pass mark of 14/15 is mandatory and a prerequisite to attending simulation training.

Flowchart of chest drain insertion program

Figure 1. Flowchart for chest drain insertion skills training for doctors



How to conduct the scenarios

Part 1. Inserting a chest tube in an uncomplicated patient scenario

Learning objective

- Be able to safely insert a chest tube in an uncomplicated patient

The **Procedural Expert** is responsible for:

- guiding the participant through one or more practice runs
- assessing and recording the participant's skill, on a final 'run', using the assessment tools
- providing feedback and reflecting with the participant on their performance.

The **Simulation Facilitator** is responsible for:

- set-up of the simulation room, equipment and mannequin in consultation with the Procedural Expert
- assisting the participant in the scenarios. (Ideally this role would be undertaken by a nurse who would be working with the training doctor).

Assessing part 1:

Use the following assessment tools:

For insertion of large bore chest tube by blunt dissection

- Assessment tool 1A: Assessment sheet for inserting a large bore chest tube by blunt dissection
- Criteria sheet for inserting large bore chest tube by blunt dissection

Complete Assessment tool 1A for each participant, using the criteria sheet for more detail where necessary.

For insertion of small bore catheter by Seldinger technique

- Assessment tool 1B: Assessment sheet for insertion of small bore catheter by Seldinger technique
- Criteria sheet for insertion of small bore catheter by Seldinger technique

Complete Assessment tool 1B for each participant, using the criteria sheet for more detail where necessary.

Part 2. Assessing risk and managing complications when inserting chest tubes in more complex scenarios

Before a participant can move on to Part 2 of the simulation skills training program, they must first demonstrate that they can safely insert a chest tube into the simulation mannequin.

Learning objective

- Demonstrate and practice hands-on skills in assessing risk and managing complications, when inserting a chest tube, in more complex simulation scenarios

The **Procedural Expert** is responsible for:

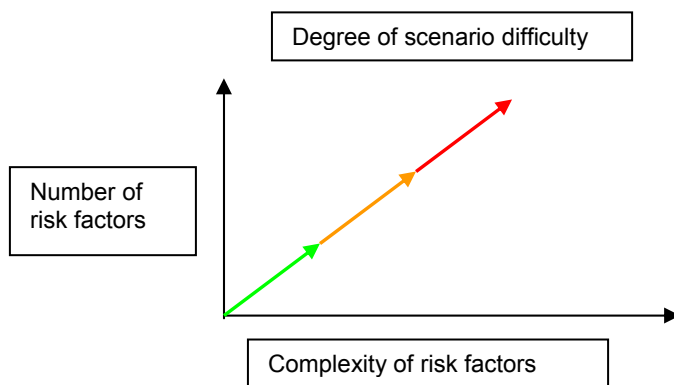
- selecting the simulation scenarios
- guiding the participant through the scenarios
- assessing and recording their skills, as they progress through the scenarios
- providing feedback and reflecting with the participant on their performance.

The **Simulation Facilitator** is responsible for:

- set-up of the simulation room, equipment and mannequin in consultation with the Procedural Expert
- assisting the participant in the scenarios.

Constructing the scenario

The degree of difficulty of the scenarios can be adjusted by varying the type and number of risk factors or confounders included in a specific scenario.



Use the following list of risk factors to construct scenarios for training. They have been organised according to a PEEP framework:

- **P**eople
- **E**quipment
- **E**nvironment
- **P**rocedures.



Practice tip!

For examples of scenarios constructed using the risk factor list, see the boxed examples in the page following the list.

Risk factors for an adverse outcome

People-related risk factors

Doctor-related (and assistant-related)

- Inexperience
- Fatigue
- No access to expertise
- Distraction
- Anxiety
- Time pressure

Patient-related

1. Haemodynamic instability

2. Coagulopathy

- Warfarin, heparin
- Antiplatelet agent, e.g. aspirin, clopidogrel
- DIC, other procoagulant conditions

3. Impaired respiratory function (e.g. COPD, hypoxia due to lung pathology or CNS depression)

4. Behaviour

- Agitation
 - Hypoxia, e.g. COPD
 - Anxiety
 - Hypovolaemia
 - Pain
 - Blood glucose levels
 - Mental Health, e.g. dementia
 - Intellectual impairment
- Decreased level of consciousness

5. Other comorbidities

- Increased risk of infection, e.g. diabetes, skin infections, immunosuppression
- Increased risk of death from other conditions
 - Unstable angina

6. Mobility (ability to position patient appropriately for the procedure)

- Elderly
- Heart failure (orthopnoea)
- Musculoskeletal abnormalities
- Women with pendulous breasts

7. Body habitus

- Overweight
- Obese, morbidly obese

8. Altered external anatomy

- Musculoskeletal abnormalities, e.g. scoliosis or other thoracic wall abnormality
- Previous surgery
- Flail chest
- Subcutaneous emphysema

9. Altered internal anatomy:

- Bullous disease
- Lung/ pleural surgery, e.g. pneumonectomy
- Elevated hemi-diaphragm due to phrenic nerve palsy
- Pleural adhesions
- Cardiac/aortic surgery
- Radiotherapy

Risk factors for an adverse outcome cont.

Equipment-related risk factors

- No assistant present
- Incorrect chest drain insertion equipment, and/or not adapted to patient, e.g. no long instruments and needles for obese or subcutaneous emphysema patients
- No access to resuscitation equipment
- No access to imaging or inadequate imaging
- No access to monitoring equipment

Environment-related risk factors

- Inadequate lighting
- Inappropriate and unsafe location, e.g. roadside
- Not enough room to manoeuvre
- Unclean environment
- Lack of privacy

Procedure-related risk factors

Risks related to difficulty in completing the steps of the insertion procedure:

- Step 1: Select and mark the insertion site
- Step 2: Choose tube and check equipment
- Step 3: Prepare the patient
- Step 4: Local anaesthetic
- Step 5: Incise the skin and dissect to the pleura (large bore chest tube)
- Step 6: Insert the tube
- Step 7: Anchor the tube - suturing
- Step 8: Connect the tube to a drain
- Step 9: Dress the site
- Step 10: Confirm tube placement

No access to supervision for inexperienced staff

Scenario examples



Examples!

Here are three different training scenarios constructed using confounders chosen from the risk factor list. These scenarios test the ability of a trainee to identify risks, take steps to mitigate them and perform the insertion procedure.

1. Insert a chest tube in a patient who is obese.

This scenario contains one patient-related risk factor that is operative at many steps throughout the insertion procedure. For this scenario, the trainee is given the patient's BMI as part of the patient history. The trainee should be able to identify the steps in the procedure impacted by the patient's obesity, and suggest or demonstrate actions to eliminate/minimise risk. For example:

- **risk identification:** recognise that standard equipment may not be suitable for special needs of obesity-
 - **action to address risk:** modify equipment before undertaking procedure, i.e. include spinal needles for injecting local anaesthetic, ensure artery forceps are long enough to dissect through to the pleural cavity.
- **risk identification:** recognise that inability to clearly identify the ribs and intercostal space by palpation increases the risk of insertion in wrong site and/or neurovascular damage-
 - **action to address risk:** bedside ultrasound guidance to ensure correct insertion site

2. Insert a chest tube in an uncomplicated patient where there is:

- **wrong equipment on the tray**
- **inadequate lighting**
- **no assistant.**

This scenario contains multiple equipment- and environment-related risk factors which, together, increase the chance of an adverse outcome for the patient. These risk factors are not disclosed to the trainee, but are built into the set-up of the scenario, e.g. the curved artery forceps for dissecting are absent from the equipment tray, the procedural room is set up with inadequate lighting, and part-way through the scenario, the assistant says they have to leave. The trainee must identify these risks and take steps to mitigate them.

3. Insert a chest tube in a patient who:

- **has a left-sided traumatic haemothorax**
- **has severe chest pain and shortness of breath and is agitated**
- **has a history of myocardial infarction**
- **develops 'crushing' chest pain radiating to his jaw and left shoulder during set-up for procedure.**

This scenario contains patient-related risk factors which are potentially life threatening. In this scenario, the trainee should investigate and address chest pain, prior to starting procedure.

Assessment part 2

Use the following assessment tools:

- Assessment tool 2: Global assessment for chest tube insertion in high risk / complex scenarios

Complete Assessment tool 2 for each participant, however, you may need to refer to Assessment tool 1A or 1B, to ensure the relevant procedure is being adhered to.

Appendices

Forms available:

- Assessment tool 1A: Assessment sheet for inserting a large bore chest tube by blunt dissection
- Criteria sheet for inserting large bore chest tube by blunt dissection
- Assessment tool 1B: Assessment sheet for insertion of small bore catheter by Seldinger technique
- Criteria sheet for insertion of small bore catheter by Seldinger technique
- Assessment tool 2 - Global assessment for chest tube insertion in risk / complex scenarios
- Evaluation sheet for simulation skills training

Assessment tool 1A

Date:

Participant Name:

Procedural expert:

Assessment sheet for inserting large bore chest tube by blunt dissection

NOTE: Not all details can be simulated; however the participant must be able to fully describe these aspects (e.g. aseptic technique).	Completes step		Comments
	Yes	No	
Step 1: Select and mark the insertion site			
Performs risk assessment			
Checks consent			
Positions patient appropriately for chest tube insertion *			
Determines the insertion site using appropriate anatomical markers *			
Marks site of insertion with indelible marker			
Considers ultrasound guidance for some scenarios e.g. loculated effusion			
Step 2: Choose the chest tube and check equipment			
Checks that appropriate equipment is available, sterile, and on hand			
Selects appropriate sized tube without a trocar *			
Step 3: Prepare the patient			
'Time out' including consent, ID, labeling of x-rays (displayed) and confirm side and site for insertion by reviewing clinical signs and radiological investigations			
Considers premedication			
Obtains reliable venous access			
Ensures continuous oximetry			
Uses an assistant			
Use strict aseptic technique *			
Step 4: Infiltrate local anaesthetic			
Uses adequate volume of local anaesthetic - 3 mg/kg (lignocaine 1% - 20 ml / 70 kg) *			
Infiltrates skin, subcutaneous tissue, muscle, periosteum and pleura along superior surface of rib margin *			
Once inside pleural space aspirates with LA syringe to confirm right location and diagnosis			
Waits 3- 5 minutes for the local anaesthetic to take effect			

**Refer to criteria sheet for additional information.*

Assessment tool 1A cont.

Assessment sheet for inserting large bore chest tube by blunt dissection			
	Completes step		
	Yes	No	Comments
Step 5: Incise the skin and dissect to the pleura			
Makes a horizontal incision along the superior surface of rib margin, and parallel to it			
Inserts wound closure suture (a mattress / interrupted suture(s)) loosely across middle of wound			
Uses blunt dissection utilising artery forceps (or similar), to spread subcutaneous fat, and muscle			
Punctures parietal pleura with tip of forceps			
Ensures track through the intercostal muscles is wide enough to allow easy passage of chest tube (forceps or finger)			
Digitally examines thoracic cavity to ensure no underlying organs are present			
Step 6: Insert the chest tube			
Inserts chest tube using artery forceps or guided by a finger			
Ensures all side holes of chest tube are inside the pleural cavity			
Attaches chest tube to chest drain or clamps the tube, while suturing and dressings are completed			
Operator asked how they would clinically confirm correct placement of chest tube, and correct answer given *			
Step 7: Anchor the tube – suturing			
Uses stout, non-absorbable suture material such as Mersilene 0 or silk 1 on cutting needle to suture tube			
Secures tube with stay or anchoring suture			
Ties the loose ends of wound closure suture together at distal end and winds around tube near skin			
Secures tubing to skin in manner to facilitate drainage and reduce tube dislodgment, e.g. using a mesenteric tag of tape			
Step 8: Connect the tube to a drain			
If not already connected, removes protective cap from end of drainage tube to chest drain and connects chest tube to chest drain. If used, removes clamp on chest tube			
Tapes junction of chest tube and drainage tube to prevent separation, and ensures connection remains visible			
Step 9: Dress the site			
Uses appropriate dressing			
Step 10: Confirm tube placement			
Confirms tube placement with an x-ray			
Step 11: Document the procedure			
Ensures procedure is documented in patient chart			

* Refer to criteria sheet for additional information.

Criteria sheet for inserting large bore chest tube by blunt dissection

Step 1: Select and mark the insertion site	
Positions patient appropriately for chest tube insertion – discuss alternative sites	<p>Axillary approach</p> <ul style="list-style-type: none"> Recline patient on bed at 30-60 degrees, slightly rotated with the arm on affected side abducted to expose axillary area (hand behind head, hand on hip or arm away from body) or Sitting upright leaning over adjacent table on pillow or lateral decubitus <p>OR Second intercostal space in mid-clavicular line - recline OR Posterior insertion – leaning over adjacent table on pillow</p>
Determines the insertion site using appropriate anatomical markers (requires live model)	<p>Preferred position is through 4th or 5th intercostal space, midaxillary or anterior axillary line, in a region bounded by:</p> <ul style="list-style-type: none"> lateral border of pectoralis major anterior border of latissimus dorsi 5th intercostal space, and apex in the axilla <p>Second intercostal space</p>
Step 2: Choose the chest tube and check equipment	
Selects appropriate sized tube without a trocar	<ul style="list-style-type: none"> Pneumothorax: 20 – 24 Fr (6.7- 8 mm) Effusion/pus: 20 – 28 Fr (8 – 9.3 mm) Blood/pus: 32 Fr (10.7 mm)
Step 3: Prepare the patient	
Use strict aseptic technique	<p>Dons personal protective equipment (PPE):</p> <ul style="list-style-type: none"> sterile gown and gloves, mask and protective eyewear <p>Cleans patient's skin with 2 applications of alcoholic chlorhexidine or povidone iodine 10% w/v solution Drapes site with sterile drapes</p>
Step 4: Infiltrate local anaesthetic	
Uses adequate volume of local anaesthetic – 3 mg/kg (Lignocaine 1%-20 ml/ 70 kg)	<p>Ask operator how they calculated dose of anaesthetic. Use of adrenaline (pre-mix vial) allows up to 5mg/kg lignocaine to be used</p>
Infiltrates skin, subcutaneous tissue, muscle, periosteum and pleura along superior surface of rib margin	<p>Ask operator to explain what anatomical structures they need to infiltrate</p>
Step 6: Insert the chest tube	
Clinically confirms correct placement of chest tube	<p>Correct placement of the chest tube can be clinically confirmed by observing:</p> <ul style="list-style-type: none"> fogging of chest tube with expiration movement of air/fluid through tube 'swinging', 'tidalling' or 'oscillating' of fluid level in water seal chamber

Assessment tool 1B

Date: _____ Participant Name: _____ Procedural Expert: _____

Assessment sheet for the inserting small bore catheter by Seldinger technique			
NOTE: Not all details will be simulated, however the participant must be able to fully describe these aspects. (e.g. aseptic technique)	Completes step		Comments
	Yes	No	
Step 1 – Risk assessment			
Performs risk assessment			
Checks consent			
Step 2 – Select and mark the insertion site			
Positions patient appropriately for chest tube insertion *			
Determines the insertion site using appropriate anatomical markers *			
Marks site of insertion with indelible marker			
Considers ultrasound guidance for some scenarios, e.g. loculated effusion			
Step 3 – Choose the chest tube and check equipment			
Checks that appropriate equipment is available, sterile, and on-hand.			
Uses an assistant			
Step 4 - Prepare the patient			
'Time out' including consent, ID, labelling of x-rays (displayed) and confirm side and site for insertion by reviewing clinical signs and radiological investigations			
Considers premedication			
Obtains reliable venous access			
Ensures continuous oximetry			
Uses strict aseptic technique *			
Step 5 – Infiltrate local anaesthetic			
Uses adequate volume of local anaesthetic (3mg/kg Lignocaine 1% - 20ml / 70kg). *			
Infiltrates skin, subcutaneous tissue, muscle, periosteum and pleura along superior surface of rib margin. *			
Aspirates with LA syringe to confirm right location and diagnosis			
Waits 3- 5 minutes for the local anaesthetic to take effect			

* Refer to criteria sheet for additional information

Assessment tool 1B cont.

Assessment sheet for the inserting small bore catheter by Seldinger technique			
	Completes step		Comments
	Yes	No	
Step 6 – Insert small bore catheter			
Confirms intrapleural placement of introducer needle			
Equipment all inserted in same plane			
Guide wire not kinked or contaminated			
Ensures all side holes of catheter in pleural space			
Attaches 3 way tap and turns 'off to patient'			
Attaches chest tube to chest drain or clamps the tube or 3 way tap 'off to patient', while suturing and dressings are completed			
Step 7 – Anchor the tube – suturing			
Secures tube with stay or anchoring suture			
Acknowledges that anchoring device does not replace need to suture catheter			
Step 8– Connect the tube to a drain			
Attaches adaptor to catheter / 3 way tap			
Removes protective cap from end of drainage tubing of under water seal drain			
Connects catheter to chest drain.			
If used, removes clamp on chest tube or turns 3 way tap to connect pleural space to UWSD			
Tapes junction of chest tube and drainage tube to prevent separation, and ensures connection remains visible			
Operator asked how they would clinically confirm correct placement of chest tube and correct answer given *			
Step 9– Dress the site			
Uses appropriate dressing			
Step 10 – Confirm catheter placement			
Confirms catheter placement with an x-ray			
Step 11– Document the procedure			
Ensures procedure is documented in patient chart			

**Refer to criteria sheet for additional information*

Criteria sheet for inserting small bore catheters by Seldinger technique

Step 2: Select and mark the insertion site	
Positions patient appropriately for chest tube insertion – discuss alternative sites	<p>Axillary approach</p> <ul style="list-style-type: none"> • Recline patient on bed at 30–60 degrees, slightly rotated with the arm on affected side abducted to expose axillary area (hand behind head, hand on hip or arm away from body) or • Sitting upright leaning over adjacent table on pillow or • Lateral decubitus <p>OR second intercostal space in mid-clavicular line – recline OR posterior – leaning over adjacent table on pillow</p>
Determines the insertion site using appropriate anatomical markers (requires live model)	<p>Preferred position is through 4th or 5th intercostal space, midaxillary or anterior axillary line, in a region bounded by:</p> <ul style="list-style-type: none"> • lateral border of pectoralis major • anterior border of latissimus dorsi • fifth intercostal space, and • apex in the axilla <p>Second intercostal space in mid-clavicular line</p>
Step 3: Prepare the patient	
Use strict aseptic technique	<p>1) Dons personal protective equipment (PPE):</p> <ul style="list-style-type: none"> • sterile gown and gloves • mask • protective eyewear <p>2) Cleans patient's skin with 2 applications of alcoholic chlorhexidine or povidone iodine 10% w/v solution</p> <p>3) Drapes site with sterile drapes</p>
Step 5: Infiltrate local anaesthetic	
Uses adequate volume of local anaesthetic—3 mg/kg (Lignocaine 1%-20 ml/ 70 kg)	<ul style="list-style-type: none"> • Ask operator how they calculated dose of anaesthetic • Use of adrenaline (premix vials) allows up to 5mg/kg lignocaine to be used
Infiltrates skin, subcutaneous tissue, muscle, periosteum and pleura along superior surface of rib margin	<ul style="list-style-type: none"> • Ask operator to explain what anatomical structures they need to infiltrate
Step 8: Insert the chest tube	
Clinically confirms correct placement of chest tube	<p>Correct placement of the chest tube can be clinically confirmed by observing:</p> <ul style="list-style-type: none"> • movement of air/fluid through tube • swinging, 'tidalling' or 'oscillating' of fluid level in water seal chamber

Assessment tool 2

Date: _____ Participant Name: _____ Procedural expert: _____

Global assessment for chest tube insertion in risk / complex scenarios

Only use this section with simulation scenarios containing risks.

	Identifies risk			Verbalises a plan to minimise/eliminate this risk			Demonstrates mitigation (if applicable)	Endangers patient	Comments
	Correct	Correct with prompts	Incorrect	Correct	Correct with prompts	Incorrect	Tick if yes	Tick if yes	
Scenario with low to moderate level of risk/complexity									
List risk(s) included in scenario:									
Scenario with moderate to high level of risk/complexity									
List risk(s) included in scenario:									