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Chest drain care bundle: Improving documentation and safety

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Abstract

Chest drain insertion is a common advanced procedure with a significant associated risk of pain, distress, and complications. Nationally, audit and recommendations from leading bodies have highlighted a number of safety concerns around chest drain insertion.

Audit work has demonstrated poor levels of documentation; particularly around use of premedication, use of ultrasound guidance and consent. This has obvious potential consequences for patient safety and thus is an important target for improvement work.

This project quantifies current standards of documentation and aims to improve this through a combination of accessible and easy to read guidelines, education, and the introduction of a chest drain insertion bundle. National best practice standards were identified through review of national guidance.

Drain insertion was prospectively analysed over a three month period to establish baseline standards of documentation. This initial work was presented and a bundle and clinical guidelines produced. Chest drain insertion was then reaudited and assessed for improvement.

Results demonstrated an improvement in many areas of documentation, pushing local results above the national average. However, only 40% of cases used the new bundle due to a mixture of staff rotation and an unexpectedly high proportion of drains inserted in non targeted areas including the emergency department, theatre, and intensive care. Despite this, the introduction of accessible guidance and bundle has significantly improved chest drain insertion documentation to the benefit of all.

Problem

The insertion of chest drains is a relatively common advanced procedure in hospital; especially in hospitals with busy acute medical takes and respiratory units. However, the insertion of chest drains can cause significant pain and distress in patients [1] and can cause significant complications [2]. Some of these complications can be potentially fatal [2]. As such, proper documentation of drain insertion and consent is paramount.

Prior to this work, insertion and documentation of chest drains in Gloucester NHS Trust, United Kingdom (UK) had not been examined. Similarly, no hospital approved guidance or insertion bundle existed for this important procedure. This may have contributed to inadequate documentation and potential patient safety incidents. In addition, chest drains are often inserted in areas of high staff turnover such as the emergency department or acute care unit. This can create difficulty for staff taking over patient care to find out details of the procedure and follow up outstanding requested investigations. There were also concerns that not all practitioners who were inserting drains were fully aware of the most current guidance from the British Thoracic Society on best practice in this area; particularly around the use of ultrasonography and premedication. These factors highlighted the documentation of chest drain insertion as an area for improvement important for patient safety.

Background

Chest drains are commonly inserted for the management and further investigation of chest pathology. Indications include pleural effusion, pneumothorax, haemothorax, and post-thoracic surgery. For medical chest drains, the Seldinger technique is typically used with the requisite equipment provided in prefabricated packs.

Concerns regarding correct chest drain insertion documentation and patient consent have been raised by both the National Patient Safety Agency and the British Thoracic Society [3]. Indeed, the national audit of chest drains [4] flagged up a number of safety concerns around the insertion of chest drains, particularly around access to ultrasonography and training for this vital skill. Other areas of concern included lack of documentation of informed consent in 42% of cases. It also highlighted that the majority of drains were inserted at the patient bedside despite active discouragement from current guidance [3]. Other problem areas included indication for chest drain, with many drains being inserted for undiagnosed pleural effusions, potentially delaying diagnosis in patients [4]. The BTS list in their guidance on pleural procedures the things that should be documented prior to chest drain insertion [5] and national audit is increasingly a priority.

Following the British Thoracic Society's guidance on chest drain insertion would allow minimisation of the risk of complications and has been demonstrated to reduce patient anxiety and pain [2].

Care bundles have been widely used in many other areas of medicine and surgery to improve documentation and practice [6]. These have been demonstrated to improve practice and patient

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outcomes in many areas of medicine; including intensive care and respiratory medicine [6-8]. Care bundles can improve patient survival rates, reduce length of stay, and reduce risk of some infections. As such, use of a similar bundle for chest drain insertion offers an appealing method of improving practice.

Care bundles also have several other functions in aiding best practice. They provide a prompt to the clinician by reminding them of specific steps advised in performing best practice. They also aid consistency in service delivery and enable ease of documentation. By using a uniform method of presentation and format designed to ensure all important points are recorded, they make it much easier for other team members to review the procedure, follow-up outstanding results, and ensure the best care possible is delivered.

Baseline measurement

A prospective audit of patients with newly inserted chest drains on the acute care unit, respiratory unit, and oncology was undertaken over a period of three months. Posters advertising the project and data collection forms were posted in these locations and staff working in these areas approached to identify potential cases.

Data was collected on various audit measures following review of the best practice advised by the British Thoracic Society [5]. A full list of these is included in the following section and data collection tool attached (Appendix 1). The gathered results were anonymised. Records of patient identifiable details were kept on a separate data collection tool and kept in a secure location. The standards for each of the audit measures would ideally be 100%. This data was analysed and areas for potential improvement highlighted.

The results showed that the date was recorded in 91.7% of cases, but that the time was only documented for 58.3%. The indication was reported in 100%. Only 16.7% of cases received premedication. In cases where patients did not receive premedication, in no cases was the rationale for not giving this medication given. Consent was only recorded in 66.7% of total patients. 68.8% of those who had consent recorded had formal written consent. Worryingly, only 50% of drains were undertaken with ultrasound guidance. The drain site was recorded in 41.7%. Local anaesthetic use was recorded in 66.7%. 54.2% recorded the volume of local anaesthetic used.

Vitals details of drain insertion such the length inserted to was recorded in 17%, the size of the drain in 58.3% and how the drain was secured in 41.7%. Post procedure advice was recorded in 66.7% of cases. Drain observation sheets were used in 79.2%. 87.5% of patients had the interpretation of post-drain insertion chest radiograph documented in their notes. There was a written record of pleural samples sent for testing in 54.2% of cases.

This initial work highlighted several key areas for improvement. Some of these were around simple measures that should be recorded in any clinical interaction. However, particular areas for improvement were demonstrated in the use of ultrasound guidance, pre-medication, patient consent, and specific details of the insertion and investigations requested.

See supplementary file: ds6007.pdf - “appendices”

Design

The initial audit was presented to the Respiratory department including the Trust lead for Pleural Procedures. It was concluded that documentation levels were largely poor and none of the recorded examples included all of the key points recommended by the BTS. This therefore raised a crucial need for improvement. Care bundles are widely used in medicine and thus the trial of a chest drain care bundle was agreed. Members of the respiratory team and the BTS guidance was used to inform which areas were important to include in documentation.

Strategy

A draft care bundle was created and reviewed by members of the respiratory team, the pleural procedures consultant, and the Trust’s documentation review committee. In addition to this, electronic written guidance for pleural procedures were produced and reviewed by the respiratory team and Trust’s Guidance Committee. The approved “Plan, Do, Study, Act” (PDSA) cycles were used to establish the appearance and content of the final care bundle, guidance, and educational interventions.

PDSA Cycle 1:

The initial results of the pre-intervention audit were used alongside BTS “best practice” recommendations to identify crucial areas needed on a care bundle. An initial draft of the bundle tool was produced using these factors.

PDSA Cycle 2:

The draft care bundle was introduced to the respiratory ward and used to record several drain insertions. Feedback was collected from acute medical registrars and respiratory team members. Reviewers were invited to provide feedback regarding several different areas including appearance, usability, organisation of information, and content. This highlighted areas of improvement from the main users. One user mentioned that the space for documenting rate of drainage from the drain was small and could be lost in the rest of the document. The form was updated to reflect these factors.

PDSA Cycle 3:

The second draft care bundle was then introduced and reviewed over a week by a mixture of medical registrars, junior doctors, and respiratory physicians. Further feedback was obtained about the contents, structure, and usability of the form. Another user mentioned that not every patient undergoing drain insertion required clotting and platelets checked. The form was updated and this process was repeated two further times.

PDSA Cycle 4:

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The care bundle was then reviewed by the Trust's documentation committee and respiratory specialist physicians. The documentation committee wished for a space on the bundle to be created for "non-verbal consent" so this was included to enable Trust wide use. The respiratory consultants also felt that a space for documenting any supervising physician would also be appropriate so this was included. This process was repeated over 15 times over a period of several months until all reviewers were satisfied with the overall content, layout, and appearance of the care bundle.

PDSA Cycle 5:

The finalised care bundle (Appendix 2) was introduced and publicised via brief presentations and posters in the acute care unit, respiratory, and oncology wards. Copies of the forms were kept in an easily accessible location on each of these wards and copies were also filed with the equipment for chest drain insertion. This was trialled over a further period of three months and prospectively audited using the same standardised data collection tool as before (Appendix 1). This data was analysed and the results compared to both the pre-intervention audit and results from the 2014 BTS National Pleural Procedures Audit [9].

PDSA Cycle 6:

It was noted that Gloucestershire Hospitals NHS Trust had no formal guidance or training programme for pleural procedures. Draft guidance for pleural procedures including guidance on training, indications, ultrasonography, location and timing of procedure, consent, asepsis, key points from aspiration and drain insertion techniques, and recognition and management of complications was produced. This aims to provide a more detailed reference for doctors to aid safety of pleural procedures and also provide the foundations for a more formal training programme.

PDSA Cycle 7:

The guidance was reviewed by respiratory consultants and specialist registrars. Feedback was invited on both content, organisation, and appearance. All users were happy with the organisation and presentation of material. Further material regarding the use of suction and management of complications was suggested.

PDSA Cycle 8:

The guidance underwent further review by respiratory physicians and the Trust's Guidance Committee. In total, over eight further subsequent drafts were reviewed before all members were satisfied with the content. A final version of the guidance was then produced (Appendix 3).

PDSA Cycle 9:

The results of the care bundle were presented to both the respiratory team and at the Trust's annual Quality Improvement Initiative in July 2015. The project won first prize due to the improvements it has helped to achieve locally in comparison with national standards. It is now officially in use across Cheltenham General and Gloucester Royal Hospitals. The supportive guidance was also publicised and uploaded to accessible locations on the Trust intranet and treatment guidelines pages. The respiratory team have also secured a chest drain mannequin for formal training of drain insertion and a standardised teaching programme included in Foundation Doctor Training is planned, to help sustain the positive changes which the chest drain bundle has initiated. Re-audit is planned for a further three month period in 2016.

Results

The data collected on the audit measures described previously was analysed for statistical significance using Fisher's exact test. The data set included 24 pre-intervention and 23 post-intervention (see Figure 1).

Prior to the intervention, documentation was found to be poor; especially in areas related to consent, use of ultrasonography, premedication, post-procedure advice, details regarding length and size of drain and investigations requested. Overall the results showed improvement in most areas of documentation. The results were also compared with the national figures from the most recent national pleural procedures audit [9].

After the introduction of the bundle, all cases had the date documented and 87% had the time recorded. This showed a significant improvement from pre-intervention levels (p=0.049). Again, 100% of indications were documented. Overall, there was no significant improvement in the proportion of patients given premedication. However, there was a significant improvement in documenting the rationale for not giving premedication when the bundle was used (p=0.033).

The number of cases where the consent obtained was recorded improved with the bundle but this did not achieve statistical significance. Similarly, there was a nonsignificant improvement in the documentation of ultrasonographic guidance. Both of these measures are better than the national average when the proforma is used. Where the bundle was used, there was a significant improvement in chest drain site documentation (p=0.0214). Documentation of local anaesthetic use was also significantly improved, being recorded in 95.7% (p=0.0226). Documentation of drain size or method of securing improved but this did not achieve statistical significance. However, there was a significant improvement in the documentation of drain length (p=0.0145).

The bundle did not lead to an improvement in post procedure advice documentation. The use of chest drain observation sheets was unchanged significantly, nor was the documentation of post insertion CXR interpretations, nor was the record of samples sent for investigation.

However only 9 of the 23 (39%) of drain insertions reviewed used the new bundle. The majority of those that did not use the bundle were performed in clinical areas not targeted by the improvement work; particularly in the emergency department, theatres, and intensive care. When the bundle was used it demonstrated

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improvement in documentation compared to the classical "freehand" documentation.

The percentage of patients who were cared for on a respiratory ward and had a chest drain observation chart post-intervention where much better than the national average (see graphs appendix).

See supplementary file: ds6008.pdf - "figures"

Lessons and limitations

Introduction of the documentation tool as part of the chest drain bundle has helped improve documentation of chest drain insertion in medicine. In addition to this, feedback from staff has been positive in enabling ease of documentation, reflecting on the procedure and prompting the check of pertinent factors prior to the procedure. This demonstrates the use of a valid insertion proforma to enable uniformity of documentation and protect patients.

However, one key limitation of this work was the patchy use of the bundle. There are likely several reasons for this intermittent use. Several of the physicians targeted by educational interventions rotated midway through the data collection period and their replacements were not updated regarding the bundle. Similarly, several of the clinical areas not targeted demonstrated to insert chest drains more frequently than expected. In the absence of the bundle and targeted education it is not unexpected that results from these areas have not improved in line with the other clinical areas where the bundle was used. This was likely exacerbated as the bundle and guidance was not included on the widely used treatment guidelines on the Trust intranet where many other similarly important documents can be found. There is also the possibility that some drains were missed from this data collection period if the practitioner failed to notify the data collection team.

In the future, the documentation tool will be distributed on a hospital wide basis by the Trust; both in physical form in all places where drains are inserted as well as in an easy to use location on the intranet as part of the care bundle. The comprehensive and easy to read pleural procedures guidance will also be made available to all clinical staff and features links to the insertion bundle. The use of the intranet and accessing guidance is included in departmental induction and so this will help ensure universal exposure to the bundle, education and awareness. The above, coupled with a training event integrated into foundation doctors induction will help ensure that the chest drain bundle leads to sustainable changes.

Education of trainees was not the primary focus of this work. However, given that the improvement procedure does include an educational component, it would be interesting for future work to examine the effect education has on learner satisfaction as well as behaviour.

Another limitation is that it has not been possible to directly observe clinicians inserting chest drains. In this case, ideal outcome measures would include numbers of patients receiving best-practice care (cared on respiratory ward, written informed consent, use of ultrasonography, reduction in inappropriate drains) as well as patient and user satisfaction and comparison of complication rates. Unfortunately, there are several barriers to this. These include the need for longer follow up to assess complication rates, investigator costs, and the requirement for validated questionnaires to fully examine patient and user satisfaction. These all feed in to the most significant barrier to formally observing all inserted chest drains for robust data gathering: that of time.

Due to these significant barriers, quality of documentation has been used as a surrogate marker for changes in behaviour. This was deemed a valid approach for several reasons. An old adage in medicolegal advice states that "if it isn't documented in the notes, it hasn't happened." Legally, failure to document relevant data can be considered a significant breach of and deviation from the standard of care. Record keeping is therefore paramount and thus was deemed a suitable source for data gathering. Critically, existing work suggests that quality of documentation is a valid marker for overall quality of care [10-12]. As such, this was used for this work as a real world measure of procedure quality.

Conclusion

When used, the chest drain insertion bundle helps improve the documentation of this important procedure. This is important to ensure uniformity in clinical "best" practice, aid communication, and protect patients. This is being implemented across the Trust and with the aid of greater publication and increasingly accessible guidance should help further improve practice.

References

1 Luketich JD, Kiss M, Hershey J, Urso GK, Wilson J, Bookbinder M, Ginsberg R. Chest tube insertion: a prospective evaluation of pain management. Clinical Journal of pain. 1998; 14(2): 152-154.

2 Harris A, O'Driscoll BR, Turkington PM. Survey of major complications of intercostal chest drain insertion in the UK. Journal of Postgraduate medicine. 2010; 86: 68-72.

3 Havelock T, Teoh R, Laws D. On behalf of the British Thoracic Society Pleural disease Group. British Thoracic Society Guideline for Pleural Procedures. Thorax 2010, 65(2): 61-76.

4 Hooper C, Bucknall C, Welham SA, Reid K, Routh C, Maskell NA. Pilot Pleural Procedures Audit. British Thoracic Society, 2009. Available at: https://www.brit-thoracic.org.uk/Portals/0/Audit%20Tools/pleural_audit_2009_results%20.pdf (accessed on 27/4/2014)

5 Laws D, Neville E, Duffy J. On behalf of the British Thoracic Society Pleural Disease Group. BTS guidelines for the insertion of a chest drain. Thorax, 2003; 58(2): 53-59.

6 Resar R, Griffin FA, Haraden C, Nolan TW. Using Care Bundles to Improve Health Care Quality. IHI Innovation Series white paper. Cambridge. Massachusetts: Institute for Healthcare Improvement,

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2012. (Available at: www.IHI.org.)

7 Calvert J, Shen Lim W, Rodrigo C, Turner A, Welham S. The British Thoracic Society Pilot Care Bundle Project: A Care Bundles-Based Approach to Improving Standards of Care in Chronic Obstructive Pulmonary Disease and Community Acquired Pneumonia. British Thoracic Society Reports, 2014; 6(4).

8 Robb E, Jarman B, Suntharalingam G, Higgens C, Tennant R, Elcock K. Using care bundles to reduce in-hospital mortality: quantitative survey. BMJ, 2010; 340: 1234.

9 Hooper C. British Thoracic Society National Pleural Procedures Audit Report, National Audit Period: 1 June – 31 July 2014. British Thoracic Society Audit Report June 2015 (unpublished).

10 Dunlay S, Alexander K, Melloni C, Kraschnewski J, Liang L, Gibler B, Roe M, Ohman E, Peterson E. Medical records and quality of care in acute coronary syndromes: results from CRUSADE. Archives of Internal Medicine, 2008; 168(15): 1692-1698.

11 Glavan B, Engelberg R, Downey L, Randall Curtis J. Using the medical record to evaluate the quality of end-of-life care in the intensive care unit. Critical care medicine, 2008; 36(4): 1138-1146.

12 Darling S, Sammer M, Chapman T, Parisi M. Physician documentation of fluoroscopy time in voiding cystourethrography reports correlates with lower fluoroscopy times: a surrogate marker of patient radiation exposure. Journal of Roentgenology, 2011; 196(6): 777-780.

Declaration of interests

None declared.

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Ethical approval

Not required according to local standards.

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Appendix 1. Standardised data collection tool used to assess documentation of chest drain insertion.

Case number:			
Pre-procedure			
Date recorded:	Yes		No
Time recorded:	Yes		No
Indication for drain recorded:	Yes		No
Specific indication for drain:			
Documented who made decision for drain insertion	Yes		N
Specialty of decision maker:	ACU	Respiratory	Other
Level of decision maker:	Consultant	SpR	SHO
Record of clotting checked:	Yes		No
Record of platelets checked:	Yes		No
Record of up to date / recent CXR:	Yes		No
Pre-medication recorded:	Yes		No
Nature of pre-medication:			
If no pre-medication, reason documented:	Yes		No
Nature of reason:			
Patient consent recorded:	Yes		No
Nature of consent:	Written		Verbal
Information leaflet given recorded:	Yes		No
Procedure			
Location of drain insertion:	Bedside Procedure room		Theatre Other
Bedside ultrasonography:	Yes		No
Ultrasonography + marked in radiology:	Yes		No
CT guided	Yes		No
Site of drain insertion recorded:	Yes		No
Site of drain insertion:			
2% chlorhexidine / antiseptic use recorded:	Yes		No
Mask use recorded:	Yes		No
Gown use recorded:	Yes		No
Sterile drapes use recorded:	Yes		No
Local anaesthetic use recorded:	Yes		No
Volume of local anaesthetic used recorded:	Yes	No	Volume:
Drain size recorded:	Yes	No	Size:
Length drain inserted to recorded:	Yes	No	Length:
Method drain secured recorded:	Yes	No	Method:
Post-procedure			
What drained recorded:	Yes		No
What drained:	Serous Blood stained Other		Turbid Purulent
Initial volume drained recorded:	Yes	No	Volume:
Complications recorded:	Yes		No
Nature of complications:			
Post-procedure advice recorded:	Yes		No
Nature of advice:			
Chest drain observation sheet:	Yes		No
Pain score during insertion recorded:	Yes	No	Pain:
Record of post-drain CXR request:	Yes		No
Record of post-drain CXR interpretation:	Yes		No
Results of post-drain CXR:			
Investigations any aspirated samples sent for recorded:	Yes		No
Investigations requested:	Microbiology Cytology		Biochemistry Other
Grade of practitioner recorded: Grade of practitioner:	Yes F1/F2 SpR		No SHO Consultant

Gloucestershire Hospitals NHS
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Name:	
Date of Birth:	DD / MM / YYYY
MRN Number:	
NHS Number:	
(OR AFFIX HOSPITAL LABEL HERE)	

Adult Chest Drain Insertion Record

Date DD / MM / YYYY		Time 00 : 00
Hospital		Location
PRE-PROCEDURE		
Indication	Coagulopathy or anticoagulation use - check clotting and platelets ❑	**Radiological Guidance**
	Up to date CXR ❑	Bedside USS ❑ (Ultrasonography results should be recorded in the patient's health record)
Consent verbal ❑ non-verbal ❑ written ❑		
Pre-medication (suggest opioid or midazolam)		
WHO CHECKLIST (PERFORM ALOUD WITH PATIENT AND ASSISTANTS)		
Ask patient to confirm their identity ❑		Procedure site marked ❑
Proposed procedure confirmed ❑		Consent for procedure given ❑
Confirm site of procedure (double-check with imaging) ❑		Specimens taken correctly labelled ❑
PROCEDURE		
Site		
Asepsis 2% chlorhexidine ❑ mask ❑ gown ❑ drapes ❑ sterile gloves ❑		
Local anaesthetic + volume		
Drain size (French)		
Length drain inserted to **Drain secured** non-absorbable suture (required) ❑ drain-fix dressing ❑		
Notes on procedure / complications		
POST-PROCEDURE		
Drained Serous ❑ Turbid ❑ Blood stained ❑ Purulent ❑ Frank blood ❑ Other (specify) ❑		
Initial volume drained (if calculable)		
POST-PROCEDURE ONGOING CARE		
Request bed on respiratory or other designated ward trained in caring for chest drain and start chest drain nursing observation sheet ❑		
Pain score during insertion None ❑ Mild ❑ Moderate ❑ Severe ❑		Additional analgesia given
Instructions for rate of drain and clamping		
Post-Drain CXR Requested		**Results**
Samples sent	Biochemistry ❑	Microbiology ❑
	Cytology ❑	Other (specify)
Inserted by		**Grade** F1/F2 SHO SpR Consultant
Assisted by		**Grade** F1/F2 SHO SpR Consultant
Signed		

Gloucestershire Hospitals NHS
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Pleural Procedures Guidelines

INDEX:

Guidance Overview

1. Introduction

Safe and appropriate use of pleural procedures by skilled and experienced operators remains a key recommendation of the British Thoracic Society (BTS)[1] following national work on significant concerns raised by the National Patient Safety Agency (NPSA)[2].

This guidance is primarily based British Thoracic Society for management of pleural diseases[1], which can be found at https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/pleural-disease-guideline/.

2. Policy Scope

This policy applies to all medical staff who perform pleural aspirations and chest drain insertion, and to all nursing staff who manage patients with chest drains.

3. Policy Aims

The aim of this policy is to ensure safe and effective pleural aspiration, chest drain insertion and appropriate management of patients who undergo these procedures.

4. Roles and Responsibilities

Consultants and senior members of the nursing staff team are responsible for ensuring this guidance is implanted within their individual departments. It is the duty and responsibility of all medical and nursing personnel to ensure they work within this guidance.

Training in Pleural Procedures

1. Achieving Competence for Trainees

For trainees who have not yet achieved the relevant competencies, pleural aspiration and chest drain insertion should be performed under the direct guidance of a doctor who has adequate training and experience with the relevant procedure and available equipment.

2. Competencies for Independent Pleural Aspiration or Drain Insertion

The number of procedures required to achieve competency will vary between individuals. However it is anticipated that most trainees would need to have performed at least 5-10 procedures to develop the skills needed to be signed off as independent practitioners. Competence in pleural procedures must be evidenced by DOPS stating independence.

Those who are already fully competent in pleural aspiration and chest drain insertion should be able to demonstrate that competence is being actively maintained.

The difficulty of pleural procedures depends on many factors such as effusion size or location and body habitus. It is paramount that all clinicians, whatever their level of experience, seek senior help whenever they are uncertain whether a pleural procedure is indicated or whether it can be performed safely.

3. Further Training

The respiratory team can be contacted by those who wish to obtain these competencies in pleural aspiration and / or chest drain insertion (GRH: henry.steer@glos.nhs.uk; CGH: Mark.Slade@glos.nhs.uk).

For trainees within the Emergency Department, the primary point of contact for those wishing to achieve these competencies should be an Emergency Department Consultant with adequate training and experience with the relevant procedure (helen.mansfield@glos.nhs.uk).

Indications for Pleural Procedures

1. Pleural Effusions

1a. Diagnostic Aspirations

Pleural aspiration of up to 50ml of fluid is utilised for diagnostic evaluation of unilateral pleural effusions.

1b. Therapeutic Aspirations

Therapeutic aspiration of up to 1.5L of fluid is usually sufficient to relieve acute breathlessness in patients with pleural effusions. It should be considered first line in patients who do not have suspected pleural infection and do not need a drain for other reasons – see below. Therapeutic pleural aspiration is also preferable out of hours when chest drain insertion is best avoided unless necessary.

1c. Chest Drain Insertion

Chest drain should be inserted in the following instances:

- Empyema and complicated parapneumonic effusions
- Traumatic haemo/pneumothorax
- During surgery in certain instances (VATS, thoracotomy, oesophagectomy, cardiac surgery)
- Malignant effusions for the purpose of talc pleurodesis

2. Pneumothorax

2a. Pleural Aspiration

Minimally symptomatic patients with small (<2cm at level of hilum) primary pneumothoraces can be initially managed with observation alone.

Aspiration should be considered first line in symptomatic patients with spontaneous primary pneumothorax of any size[1]. No more than 2.5L of air should be aspirated before reassessment with CXR.

2b. Chest Drain Insertion

Chest drains should be inserted for patients with pneumothorax in the following situations:

- In any ventilated patient

- In tension pneumothorax after initial needle decompression
- Persistent or recurrent pneumothorax after initial aspiration
- Secondary pneumothorax
- Traumatic pneumothorax
- Bilateral pneumothoraces

Some clinicians favour initial small bore (≥12F) chest drain insertion over aspiration in patients with a large/complete spontaneous primary pneumothorax.

A pneumothorax in a patient over 50 with a significant smoking history should be treated as a secondary pneumothorax.

Use of Ultrasonography

1. Bedside Ultrasonography

BTS guidelines strongly recommend that all chest drains and pleural aspirations for the purposes of draining fluid be carried out under bedside ultrasound guidance by a suitably trained practitioner. This has been demonstrated to give greater likelihood of success as well as minimising the risk of adverse events and complications[1]. Ultrasound is recommended especially in the case of "white out" to ensure that the opacified lung field is truly fluid and not consolidated/collapsed lung.

If no suitably trained US operator is immediately available pleural procedures should be delayed until an ultrasound can be performed. The occasions when pleural drainage cannot be deferred for a few hours to obtain an ultrasound are rare (eg trauma), and in all other circumstances ultrasound guidance should be considered mandatory.

Ultrasound is of no practical use in guiding pleural procedures for pneumothorax.

2. "X-marks-the-spot" Departmental Ultrasonography

If "X-marks-the-spot" ultrasound guidance is to be used, the person who is to perform the procedure should accompany the patient to the radiology department and perform the procedure there under the ultrasound guidance.

Reliance on a previously marked spot is not recommended as the technique has poor accuracy. The complication rate for "X-marks-the-spot" with later, separate insertion is equivalent to that of using no ultrasound guidance[1].

Location and Timing of Procedure

1. Location

1a. Generalities

Both pleural aspiration and chest drain insertion should be performed in a clean area using full aseptic technique[1]. Equipment for monitoring should be available. This includes pulse oximetry, blood pressure measurement and access to ECG.

1b. Designated Procedure Room

A designated clean procedure room is preferable for aspiration or drain insertion. This should be used whenever possible unless the clinical situation demands otherwise, or a suitable alternative area exists, eg ED resus.

1c. Patient Bedside

Bedside aspiration or drain insertion should only be performed where no procedure room is available. Adequate care must be taken to ensure there is sufficient space for both the procedure and appropriately sterile field.

2. Timing

Pleural aspiration and chest drain insertion should be avoided outside of normal working hours unless absolutely necessary[1]. This is because the complication rate has been demonstrated to be higher at these times, especially at night[1]. There may be occasions where the clinical situation requires an out-of-hours pleural procedure to be performed. Out of hours pleural aspiration is preferable to chest drain. The circumstances where this may be appropriate are detailed in Section 3: Indications for Pleural Procedures.

Patient Consent

1. Nature of Consent

Patients should be fully consented as to the risks and benefits of their pleural procedure. For pleural aspiration, documented verbal consent is adequate. For chest drain insertion, consent should be written consent except in a clinical emergency.

2. Risks of Pleural Procedures

2a. Risks of Pleural Aspirations

- Pain
- Failure of procedure
- Pneumothorax (about 3% with ultrasound guidance, 5-15% without ultrasound guidance)
- Visceral injury, haemothorax, pleural infection (rare)

2b. Risks of Chest Drain Insertion

- Pain
- Pneumothorax (5%)
- Bleeding / haemothorax (2%)
- Intrapleural infection (2%)
- Drain dislodgement or blockage (15%)
- Organ puncture (rare)
- Failure of procedure

Pre-medication and Anaesthesia

1. Pre-medication

1a. Pre-medication for Pleural Aspiration

Pre-medication is not routinely indicated for pleural aspiration.

1b. Pre-medication for Chest Drain Insertion

Chest drain insertion is a painful procedure[1,3]. As such, pre-medication with an opioid or anxiolytic agent should be strongly considered.

If sedation is given, this should be in line with current guidance for conscious sedation[4] with appropriate monitoring.

2. Use of Local Anaesthesia

1% lidocaine should be infiltrated into the skin, periosteum and pleura prior to carrying out therapeutic pleural aspiration or chest drain insertion. For diagnostic pleural aspiration the needle size used to infiltrate lignocaine to the pleura is the same size as the aspiration needle and therefore the use of lignocaine may not reduce discomfort.

It is thought that the volume of lidocaine given rather than the total dose is more important in achieving adequate analgesia as this helps achieve adequate spread of anaesthesia[1]. For this reason 1% lidocaine is preferred to stronger formulations.

Both lidocaine strength and volume given should be documented post-procedure.

Aseptic Technique

1. Aseptic Technique for Pleural Aspirations

Pleural aspiration should be carried out in a clean area using full aseptic technique. For full aseptic technique, this requires[1]:

- Sterile gloves/gown
- Sterile field
- Sterile dressing
- Skin sterilising preparations such as iodine or chlorhexidine in alcohol

2. Aseptic Technique for Chest Drain Insertion

Chest drains should likewise be inserted in a clean area using full aseptic technique. This clean area should ideally be separate from the main ward area. To achieve adequate aseptic technique, this requires[1]:

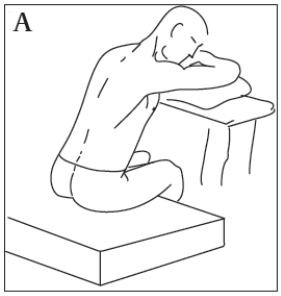
- Sterile gloves
- Sterile gown
- Sterile field
- Sterile drapes
- Mask
- Skin sterilising preparations such as chlorhexidine in alcohol
- Additional sterile equipment required: sterile gauze swabs, selection of syringes and needles, scalpel and blade, suture (0 or 1-0 silk), guide wire and dilators for Seldinger technique, chest tube, connecting tubing, closed drainage system including sterile water for underwater seal

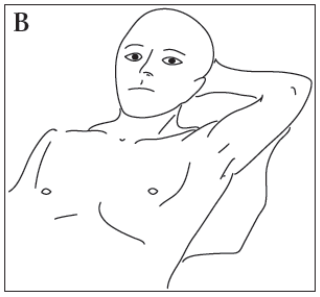
Patient Position

1. Patient Position

There are two usual positions for a patient to be sat for a pleural procedure.

- Upright position whilst leaning forwards with arms resting on a table or bed (image A)[1]
- Lying on the bed whilst slightly rotated with the arm on the side of the lesion behind the patient's head (image B)[1]





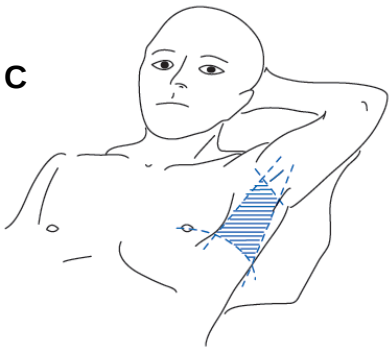
Providing there is sufficient depth of fluid visible on ultrasound, an alternative is with the patient lying flat in the lateral position with arms up in front of the face

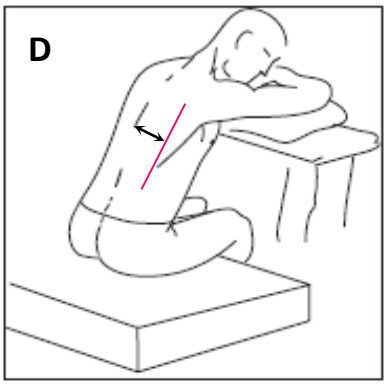
2. Site of Needle Insertion

The site of needle insertion should ideally be within the triangle of safety (image C)[1] to minimise the risk to underlying structures and reduce the risk of visible scarring. Alternatively, the 2nd intercostal space in the mid-clavicular line may be used in the case of pneumothorax.

The triangle of safety is bordered by the lateral edge of latissimus dorsi, the lateral border of pectoralis major and superior to the 5th intercostal space.

A posterior approach may be used for drainage of fluid under ultrasound guidance. However, inserting the needle more posteriorly gives greater risk of damage to the intercostal artery. For this reason it is important that the site is located lateral to the angle of the rib posteriorly (at least 10cm from spine) (figure D).





Pleural Aspiration

It is not the aim of this guidance to provide a step-by-step walkthrough guide to performing pleural aspiration but rather to cover the important safety points for the procedure. Therefore:

- Ultrasound guidance for all fluid aspirates is strongly advised
- Ensure adequate patient position
- Use small-bore needle to reduce risk of complications
- Insert needle above superior border of rib to avoid neurovascular bundle
- For diagnostic aspirations, 20-50ml of fluid is sufficient
- For therapeutic aspirations:
    - After confirming depth of the pleural space using initial needle aspiration the cannula should be advanced into the chest whilst aspirating continuously until the pleura is breached and air or fluid is withdrawn
    - Attach the cannula to a three-way tap to enable easy expulsion of fluid or air
    - Stop when no more air / fluid can be withdrawn or 1.5L has been withdrawn or until the patient develops symptoms of cough / chest discomfort

Post-procedure Care

After aspiration has been carried out, there are several steps to consider.

- A simple clean dressing should be immediately applied to the site of aspiration
- Follow-up chest radiograph is not indicated if the patient has had a simple, uncomplicated diagnostic tap.
- For diagnostic aspirates, the samples should be sent for:
    - Biochemistry (protein, lactate dehydrogenase, glucose)
    - Microbiology (M,C&S +/- acid-fast bacilli) in blood culture bottles
    - Cytology
    - pH if suspected pleural infection (into heparinised blood gas syringe. Must not be put through a gas machine if purulent)
    - Other tests may be indicated as discussed with respiratory team

Chest Drain Insertion

1. Size of Chest Drain

Small-bore chest drains (12-18 French) inserted with the Seldinger technique should be used as first line therapy for[1]:

- Pneumothoraces
- Pleural effusions
- Pleural infection / empyema

Large-bore chest drains inserted with blunt dissection require a different set of competencies. These should be considered for:

- Haemothorax / Trauma
- Where risk of lung perforation exists with Seldinger needle technique (e.g. lung edge close/tethered to chest wall)
- Where there is worsening surgical emphysema despite small bore drain.

2. Important Points from Procedure

It is not the aim of this guidance to provide a step-by-step walkthrough for inserting chest drains. Instead, it aims to cover the important safety points for the procedure. Therefore when inserting chest drains:

- Written consent for all chest drains should be obtained
- Direct ultrasound guidance is strongly recommended for pleural effusions
- Ensure adequate patient position and analgesia
- Should be carried out with full aseptic technique (including gown, sterile drapes, mask, sterile field, sterile gloves)
- Insert drain above superior border of rib to avoid neurovascular bundle
- Before fully inserting the drain, fluid (or air in the case of pneumothorax) from the site of drain insertion should be obtained. If no fluid can be drained, the procedure should be abandoned
- Drains should be inserted with the Seldinger technique
- It is imperative that the wire is not left inside the chest cavity

- Drains should never be inserted with substantial force

- The dilator should not be inserted further than 1cm beyond the depth from skin to pleural space. The marker on the dilator should be set to the correct depth needed to access the pleural space, as determined by the introducer needle.

3. Securing Chest Drains

A common complication of drain insertion is accidental removal due to insufficient securing methods. Chest drains should be secured with a combination of[1]:

- Stout non-absorbable (0 – 1.0 silk) suture that gathers adequate skin and subcutaneous tissue. A stitch under the skin 0.5cm from the drain exit site should be secured then the threads should be tied around the drain multiple times next to the skin to ensure that the drain can neither move forwards nor backwards.

- A clear dressing over the drain site

- It is good practice to secure the drainage tubing to the abdomen at a second point to take the direct weight off the chest drain fixing.

4. Post-procedure Care

After a chest-drain has been inserted, there are several aspects to post-procedure care that must be carried out, documented and communicated to the nursing staff and/or patient. These include:

- Keep the bucket below hip level

- Complete record for chest drain insertion (utilising Trust chest drain proforma)

- Post-procedure radiograph for all successful or failed chest drain attempts

- Rate of drainage for pleural effusions / empyema / haemothorax:

    - A maximum of 1.5L should be drained in the first hour after chest drain insertion to reduce the risk of re-expansion pulmonary oedema. Drainage should be ceased immediately if the patient begins to cough. It can be cautiously restarted 1 hour later if the coughing ceases with cessation of drainage.

    - A suitable regime for rate of drainage should be provided by the doctor inserting the drain – a recommended regime would be drain 1-1.5L, clamp for 4 hour, drain 1L, clamp for 4 hour then repeat

- Prophylactic Fragmin can be given after drain insertion, providing there are no bleeding complications or haemothorax.

- Clamping chest drains:

  - A bubbling chest drain should NEVER be clamped

  - Clamping drains in the case of pneumothorax, once bubbling has ceased and the lung is fully re-inflated on CXR, should be done under the direct guidance of respiratory registrar or consultant only.

- In the case of empyema, regular flushes (2-4 times per day) with 10-20ml of normal saline should be prescribed on the drug chart to reduce the likelihood of drain blockage.

- Suction may occasionally be used. This should be under the guidance of a respiratory registrar or consultant. This should be high volume low pressure thoracic suction

- Nursed on a ward familiar with the management and monitoring of chest drains (generally respiratory ward except in exceptional circumstances)

- Chest drains should be checked daily for signs of wound infection, drainage volumes, swinging & bubbling, and for loose connections which can allow air into the drain and produce bubbling even when the air leak from the lung has ceased.

Recognition and Management of Drain Complications

1. Bleeding

1a. Recognition

- It is not uncommon for a small amount of bleeding during drain insertion however this should quickly stop.
- Bruising/swelling around drain insertion site.
- Frank blood draining from the drain which quickly clots (unless known haemothorax). This can be difficult at times to distinguish from heavily blood stained effusion however these should not clot.
- Signs and symptoms of shock. This may develop several hours after the procedure.
- Increasing dyspnoea post drain insertion and CXR showing no change or increasing effusion size.
- Bleeding can rarely be a complication of drain removal. This occurs when a vessel is penetrated during drain insertion but is then tamponaded by the drain until it is removed.

1b. Management

- Check urgent haemoglobin, coagulation, cross match
- Obtain good intravenous access.
- Apply continuous pressure to the intercostal space at the site of pleural intervention. This can be very effective in compressing the bleeding vessel and slowing the rate of blood loss.
- Significant bleeds will require resuscitation of the patient and urgent discussion with the thoracic surgeons.

2. Surgical Emphysema

2a. Recognition

- Occurs when air is trapped under the skin, is usually associated with pneumothorax.
- Subcutaneous swelling, which in extreme circumstances can extend up to involve the face and neck. In this circumstance it has the potential to cause airway compromise and restrict drainage from the jugular veins.
- Crepitus on palpation
- CXR showing radiolucent streaks throughout the subcutaneous tissue and muscle.

2b. Management

- Ensure that any pneumothorax present is being appropriately managed with a functioning chest drain and the drain is not kinked. Check that proximal drainage holes are not in subcutaneous tissue.
- Management is usually conservative and the air should reabsorb on its own over time, however patients should be closely monitored especially if the emphysema is extending.
- If airway compromise is suspected urgent senior anaesthetic assistance is required.
- A blunt dissection, wide bore drain may be required if progressive surgical emphysema despite narrow bore drain or if pneumothorax is not large enough to insert Seldinger drain safely.
- In rare cases skin incision +/- subcutaneous drain to allow the release of air can be considered – only after discussion with a respiratory or ITU consultant.

3. Pneumothorax

3a. Recognition

- Small pneumothoraces are relatively common complication of chest drain insertion and will be noted on CXR.
- Consider if the patient is at risk of trapped lung, which is due to the lung being fixed and unable to expand once pleural fluid is drained. This is especially common in mesothelioma but can also occur in other malignant effusions and in empyema.

3b. Management

- Ensure that the drain is correctly positioned and swinging (fluid in drainage tubing moves with respiration) – a swinging drain means that it is functioning.
- Check the connections and underwater seal
- Discuss with respiratory team

4. Secondary Infection

4a. Recognition

- Risk of infection increases the longer the drain is in situ.
- Cloudy pleural fluid, pain, infection round drain exit site.
- Clinical signs of sepsis

4b. Management

- Aspirate some pleural fluid and send for MC&S and culture.
- Discuss with microbiology and respiratory.

5. Pain

5a. Recognition

- Pain is common post drain insertion and is managed with regular analgesia, including opiates if necessary.

- Chest pain and discomfort can also result from negative intrapleural pressure during fluid removal. This can indicate an underlying trapped lung and can be accompanied by vasovagal responses.

5b. Management

- Check for other complications, including haemorrhage.
- If pain due to rapid fluid drainage is suspected, turn the drain off and leave it off for 2 hours or until the pain has completely settled.
- Analgesia

6. Drain Blockage

- If the drain is no longer swinging or draining any fluid this can be an indication that it is blocked.
- Flushing the drain with 20mls of normal saline is usually sufficient to relieve any blockage.

7. Drain Dislodgement

- This occurs when a drain has not been adequately sutured in place.
- The drain should never be advanced again due to risk of infection but can be pulled back slightly and resutured if drain is in too far.
- Consider removing the drain.

References

(1) Pleural procedures and thoracic ultrasound; British Thoracic Society pleural disease guideline 2010. BTS Guidance. *Thorax* 2010; **65** (suppl 2); ii61-ii76.

(2) NPSA Alert. http://www.npsa.nhs.uk/nrls/alerts-and-directives/rapidrr/risks-of-chest-drain-insertion/

(3) Chest tube insertion: a prospective evaluation of pain management. Luketich JD, Kiss M, Hershey J, et al. *Clinical Journal of Pain* 1998(14): 152e4.

(4) Implementing and ensuring safe sedation practice for healthcare procedures in adults. *Academy of Medical Royal Colleges*. London: Academy of Medical Royal Colleges, 2001.

Audit Measure	Pre-intervention	Post-intervention	P value	Significance
Date recorded	91.7%	100.0%	0.489	Not significant
Time recorded	58.3%	87.0%	0.049	Significant
Indication recorded	100.0%	100.0%	1.000	Not significant
Pre-medication recorded	16.7%	26.7%	0.494	Not significant
Consent recorded	66.7%	87.0%	0.168	Not significant
Ultrasonography recorded	60.0%	86.7%	0.134	Not significant
LA use recorded	66.7%	95.7%	0.023	Significant
Drain site recorded	41.7%	69.6%	0.0798	Not significant
Drain size recorded	58.3%	78.3%	0.212	Not significant
Drain length recorded	16.7%	52.2%	0.0145	Significant
Method secured recorded	41.7%	52.2%	0.564	Not significant
Post-procedure advice	66.7%	43.5%	0.147	Not significant
Nursing observation sheet use	79.2%	87.0%	0.701	Not significant
Nursed on respiratory ward	37.5%	69.6%	0.025	Significant

Figure 1. Results of data points recorded when inserting chest drain pre and post-intervention

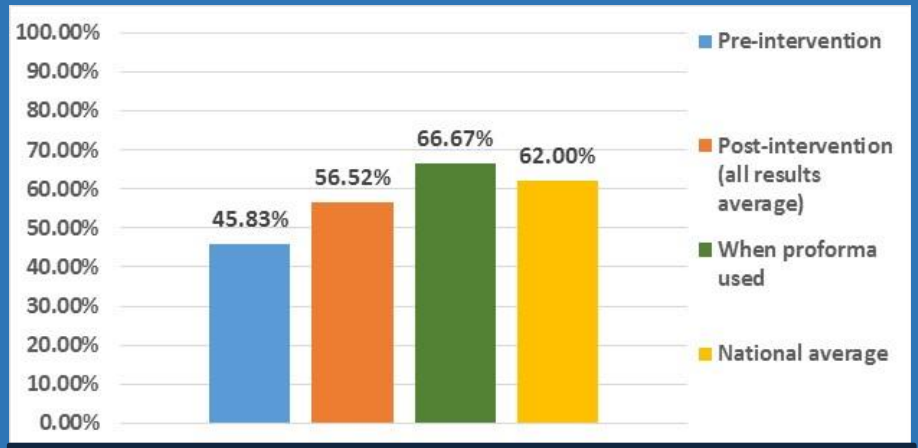


Figure 2. Comparison of written consent obtained pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 98%

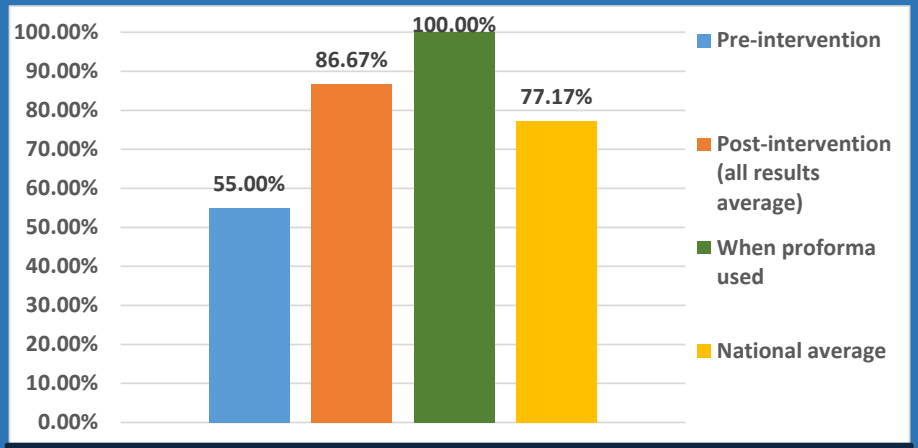


Figure 3. Comparison of use of bedside ultrasonography pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 100%

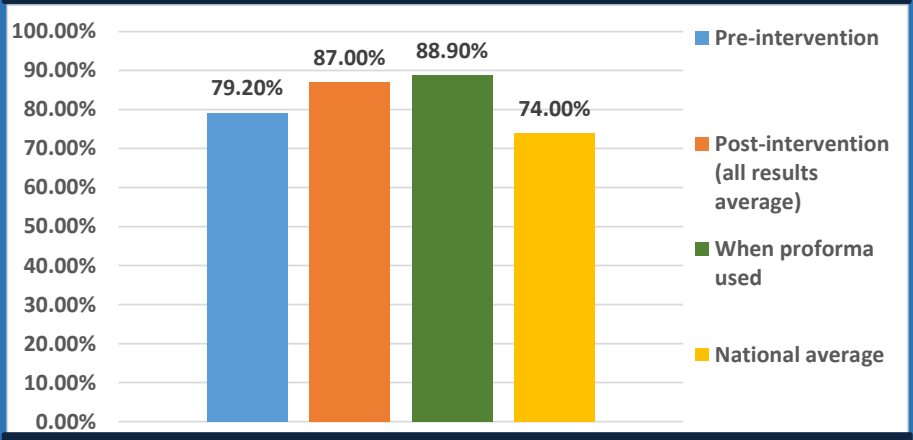


Figure 4. Comparison of use of nursing drain observation sheets pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 100%

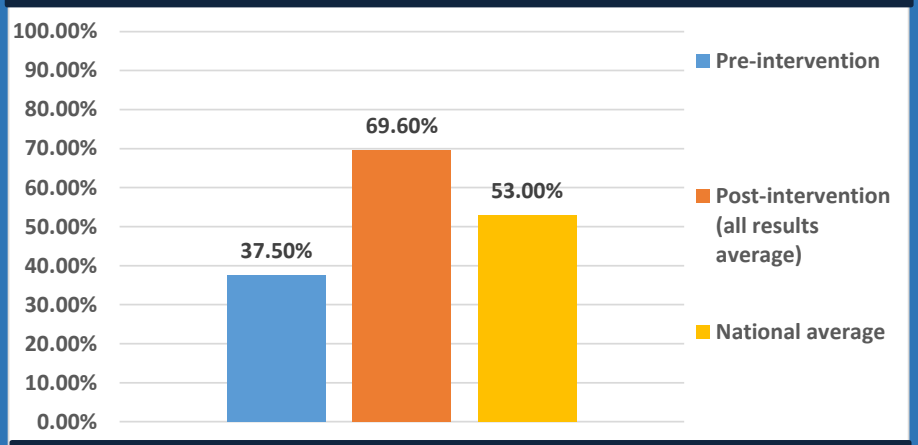


Figure 5. Comparison of care on respiratory ward pre-intervention, post-intervention and national average. Target = 100%

Appendix 1. Standardised data collection tool used to assess documentation of chest drain insertion.

Case number:			
Pre-procedure			
Date recorded:	Yes		No
Time recorded:	Yes		No
Indication for drain recorded:	Yes		No
Specific indication for drain:			
Documented who made decision for drain insertion	Yes		N
Specialty of decision maker:	ACU	Respiratory	Other
Level of decision maker:	Consultant	SpR	SHO
Record of clotting checked:	Yes		No
Record of platelets checked:	Yes		No
Record of up to date / recent CXR:	Yes		No
Pre-medication recorded:	Yes		No
Nature of pre-medication:			
If no pre-medication, reason documented:	Yes		No
Nature of reason:			
Patient consent recorded:	Yes		No
Nature of consent:	Written		Verbal
Information leaflet given recorded:	Yes		No
Procedure			
Location of drain insertion:	Bedside Procedure room		Theatre Other
Bedside ultrasonography:	Yes		No
Ultrasonography + marked in radiology:	Yes		No
CT guided	Yes		No
Site of drain insertion recorded:	Yes		No
Site of drain insertion:			
2% chlorhexidine / antiseptic use recorded:	Yes		No
Mask use recorded:	Yes		No
Gown use recorded:	Yes		No
Sterile drapes use recorded:	Yes		No
Local anaesthetic use recorded:	Yes		No
Volume of local anaesthetic used recorded:	Yes	No	Volume:
Drain size recorded:	Yes	No	Size:
Length drain inserted to recorded:	Yes	No	Length:
Method drain secured recorded:	Yes	No	Method:
Post-procedure			
What drained recorded:	Yes		No
What drained:	Serous Blood stained Other		Turbid Purulent
Initial volume drained recorded:	Yes	No	Volume:
Complications recorded:	Yes		No
Nature of complications:			
Post-procedure advice recorded:	Yes		No
Nature of advice:			
Chest drain observation sheet:	Yes		No
Pain score during insertion recorded:	Yes	No	Pain:
Record of post-drain CXR request:	Yes		No
Record of post-drain CXR interpretation:	Yes		No
Results of post-drain CXR:			
Investigations any aspirated samples sent for recorded:	Yes		No
Investigations requested:	Microbiology Cytology		Biochemistry Other
Grade of practitioner recorded: Grade of practitioner:	Yes F1/F2 SpR		No SHO Consultant

Gloucestershire Hospitals NHS
NHS Foundation Trust

Name:	
Date of Birth:	DD / MM / YYYY
MRN Number:	
NHS Number:	
(OR AFFIX HOSPITAL LABEL HERE)	

Adult Chest Drain Insertion Record

Date DD / MM / YYYY		Time 00 : 00
Hospital		Location
PRE-PROCEDURE		
Indication	Coagulopathy or anticoagulation use - check clotting and platelets ❑	**Radiological Guidance**
	Up to date CXR ❑	Bedside USS ❑ (Ultrasonography results should be recorded in the patient's health record)
Consent verbal ❑ non-verbal ❑ written ❑		
Pre-medication (suggest opioid or midazolam)		
WHO CHECKLIST (PERFORM ALOUD WITH PATIENT AND ASSISTANTS)		
Ask patient to confirm their identity ❑		Procedure site marked ❑
Proposed procedure confirmed ❑		Consent for procedure given ❑
Confirm site of procedure (double-check with imaging) ❑		Specimens taken correctly labelled ❑
PROCEDURE		
Site		
Asepsis 2% chlorhexidine ❑ mask ❑ gown ❑ drapes ❑ sterile gloves ❑		
Local anaesthetic + volume		
Drain size (French)		
Length drain inserted to **Drain secured** non-absorbable suture (required) ❑ drain-fix dressing ❑		
Notes on procedure / complications		
POST-PROCEDURE		
Drained Serous ❑ Turbid ❑ Blood stained ❑ Purulent ❑ Frank blood ❑ Other (specify) ❑		
Initial volume drained (if calculable)		
POST-PROCEDURE ONGOING CARE		
Request bed on respiratory or other designated ward trained in caring for chest drain and start chest drain nursing observation sheet ❑		
Pain score during insertion None ❑ Mild ❑ Moderate ❑ Severe ❑		Additional analgesia given
Instructions for rate of drain and clamping		
Post-Drain CXR Requested		**Results**
Samples sent	Biochemistry ❑	Microbiology ❑
	Cytology ❑	Other (specify)
Inserted by		**Grade** F1/F2 SHO SpR Consultant
Assisted by		**Grade** F1/F2 SHO SpR Consultant
Signed		

Gloucestershire Hospitals NHS
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Pleural Procedures Guidelines

INDEX:

Guidance Overview

1. Introduction

Safe and appropriate use of pleural procedures by skilled and experienced operators remains a key recommendation of the British Thoracic Society (BTS)[1] following national work on significant concerns raised by the National Patient Safety Agency (NPSA)[2].

This guidance is primarily based British Thoracic Society for management of pleural diseases[1], which can be found at https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/pleural-disease-guideline/.

2. Policy Scope

This policy applies to all medical staff who perform pleural aspirations and chest drain insertion, and to all nursing staff who manage patients with chest drains.

3. Policy Aims

The aim of this policy is to ensure safe and effective pleural aspiration, chest drain insertion and appropriate management of patients who undergo these procedures.

4. Roles and Responsibilities

Consultants and senior members of the nursing staff team are responsible for ensuring this guidance is implanted within their individual departments. It is the duty and responsibility of all medical and nursing personnel to ensure they work within this guidance.

Training in Pleural Procedures

1. Achieving Competence for Trainees

For trainees who have not yet achieved the relevant competencies, pleural aspiration and chest drain insertion should be performed under the direct guidance of a doctor who has adequate training and experience with the relevant procedure and available equipment.

2. Competencies for Independent Pleural Aspiration or Drain Insertion

The number of procedures required to achieve competency will vary between individuals. However it is anticipated that most trainees would need to have performed at least 5-10 procedures to develop the skills needed to be signed off as independent practitioners. Competence in pleural procedures must be evidenced by DOPS stating independence.

Those who are already fully competent in pleural aspiration and chest drain insertion should be able to demonstrate that competence is being actively maintained.

The difficulty of pleural procedures depends on many factors such as effusion size or location and body habitus. It is paramount that all clinicians, whatever their level of experience, seek senior help whenever they are uncertain whether a pleural procedure is indicated or whether it can be performed safely.

3. Further Training

The respiratory team can be contacted by those who wish to obtain these competencies in pleural aspiration and / or chest drain insertion (GRH: henry.steer@glos.nhs.uk; CGH: Mark.Slade@glos.nhs.uk).

For trainees within the Emergency Department, the primary point of contact for those wishing to achieve these competencies should be an Emergency Department Consultant with adequate training and experience with the relevant procedure (helen.mansfield@glos.nhs.uk).

Indications for Pleural Procedures

1. Pleural Effusions

1a. Diagnostic Aspirations

Pleural aspiration of up to 50ml of fluid is utilised for diagnostic evaluation of unilateral pleural effusions.

1b. Therapeutic Aspirations

Therapeutic aspiration of up to 1.5L of fluid is usually sufficient to relieve acute breathlessness in patients with pleural effusions. It should be considered first line in patients who do not have suspected pleural infection and do not need a drain for other reasons – see below. Therapeutic pleural aspiration is also preferable out of hours when chest drain insertion is best avoided unless necessary.

1c. Chest Drain Insertion

Chest drain should be inserted in the following instances:

- Empyema and complicated parapneumonic effusions
- Traumatic haemo/pneumothorax
- During surgery in certain instances (VATS, thoracotomy, oesophagectomy, cardiac surgery)
- Malignant effusions for the purpose of talc pleurodesis

2. Pneumothorax

2a. Pleural Aspiration

Minimally symptomatic patients with small (<2cm at level of hilum) primary pneumothoraces can be initially managed with observation alone.

Aspiration should be considered first line in symptomatic patients with spontaneous primary pneumothorax of any size[1]. No more than 2.5L of air should be aspirated before reassessment with CXR.

2b. Chest Drain Insertion

Chest drains should be inserted for patients with pneumothorax in the following situations:

- In any ventilated patient

- In tension pneumothorax after initial needle decompression
- Persistent or recurrent pneumothorax after initial aspiration
- Secondary pneumothorax
- Traumatic pneumothorax
- Bilateral pneumothoraces

Some clinicians favour initial small bore (≥12F) chest drain insertion over aspiration in patients with a large/complete spontaneous primary pneumothorax.

A pneumothorax in a patient over 50 with a significant smoking history should be treated as a secondary pneumothorax.

Use of Ultrasonography

1. Bedside Ultrasonography

BTS guidelines strongly recommend that all chest drains and pleural aspirations for the purposes of draining fluid be carried out under bedside ultrasound guidance by a suitably trained practitioner. This has been demonstrated to give greater likelihood of success as well as minimising the risk of adverse events and complications[1]. Ultrasound is recommended especially in the case of "white out" to ensure that the opacified lung field is truly fluid and not consolidated/collapsed lung.

If no suitably trained US operator is immediately available pleural procedures should be delayed until an ultrasound can be performed. The occasions when pleural drainage cannot be deferred for a few hours to obtain an ultrasound are rare (eg trauma), and in all other circumstances ultrasound guidance should be considered mandatory.

Ultrasound is of no practical use in guiding pleural procedures for pneumothorax.

2. "X-marks-the-spot" Departmental Ultrasonography

If "X-marks-the-spot" ultrasound guidance is to be used, the person who is to perform the procedure should accompany the patient to the radiology department and perform the procedure there under the ultrasound guidance.

Reliance on a previously marked spot is not recommended as the technique has poor accuracy. The complication rate for "X-marks-the-spot" with later, separate insertion is equivalent to that of using no ultrasound guidance[1].

Location and Timing of Procedure

1. Location

1a. Generalities

Both pleural aspiration and chest drain insertion should be performed in a clean area using full aseptic technique[1]. Equipment for monitoring should be available. This includes pulse oximetry, blood pressure measurement and access to ECG.

1b. Designated Procedure Room

A designated clean procedure room is preferable for aspiration or drain insertion. This should be used whenever possible unless the clinical situation demands otherwise, or a suitable alternative area exists, eg ED resus.

1c. Patient Bedside

Bedside aspiration or drain insertion should only be performed where no procedure room is available. Adequate care must be taken to ensure there is sufficient space for both the procedure and appropriately sterile field.

2. Timing

Pleural aspiration and chest drain insertion should be avoided outside of normal working hours unless absolutely necessary[1]. This is because the complication rate has been demonstrated to be higher at these times, especially at night[1]. There may be occasions where the clinical situation requires an out-of-hours pleural procedure to be performed. Out of hours pleural aspiration is preferable to chest drain. The circumstances where this may be appropriate are detailed in Section 3: Indications for Pleural Procedures.

Patient Consent

1. Nature of Consent

Patients should be fully consented as to the risks and benefits of their pleural procedure. For pleural aspiration, documented verbal consent is adequate. For chest drain insertion, consent should be written consent except in a clinical emergency.

2. Risks of Pleural Procedures

2a. Risks of Pleural Aspirations

- Pain
- Failure of procedure
- Pneumothorax (about 3% with ultrasound guidance, 5-15% without ultrasound guidance)
- Visceral injury, haemothorax, pleural infection (rare)

2b. Risks of Chest Drain Insertion

- Pain
- Pneumothorax (5%)
- Bleeding / haemothorax (2%)
- Intrapleural infection (2%)
- Drain dislodgement or blockage (15%)
- Organ puncture (rare)
- Failure of procedure

Pre-medication and Anaesthesia

1. Pre-medication

1a. Pre-medication for Pleural Aspiration

Pre-medication is not routinely indicated for pleural aspiration.

1b. Pre-medication for Chest Drain Insertion

Chest drain insertion is a painful procedure[1,3]. As such, pre-medication with an opioid or anxiolytic agent should be strongly considered.

If sedation is given, this should be in line with current guidance for conscious sedation[4] with appropriate monitoring.

2. Use of Local Anaesthesia

1% lidocaine should be infiltrated into the skin, periosteum and pleura prior to carrying out therapeutic pleural aspiration or chest drain insertion. For diagnostic pleural aspiration the needle size used to infiltrate lignocaine to the pleura is the same size as the aspiration needle and therefore the use of lignocaine may not reduce discomfort.

It is thought that the volume of lidocaine given rather than the total dose is more important in achieving adequate analgesia as this helps achieve adequate spread of anaesthesia[1]. For this reason 1% lidocaine is preferred to stronger formulations.

Both lidocaine strength and volume given should be documented post-procedure.

Aseptic Technique

1. Aseptic Technique for Pleural Aspirations

Pleural aspiration should be carried out in a clean area using full aseptic technique. For full aseptic technique, this requires[1]:

- Sterile gloves/gown
- Sterile field
- Sterile dressing
- Skin sterilising preparations such as iodine or chlorhexidine in alcohol

2. Aseptic Technique for Chest Drain Insertion

Chest drains should likewise be inserted in a clean area using full aseptic technique. This clean area should ideally be separate from the main ward area. To achieve adequate aseptic technique, this requires[1]:

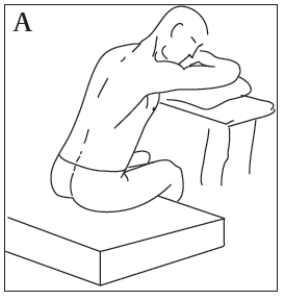
- Sterile gloves
- Sterile gown
- Sterile field
- Sterile drapes
- Mask
- Skin sterilising preparations such as chlorhexidine in alcohol
- Additional sterile equipment required: sterile gauze swabs, selection of syringes and needles, scalpel and blade, suture (0 or 1-0 silk), guide wire and dilators for Seldinger technique, chest tube, connecting tubing, closed drainage system including sterile water for underwater seal

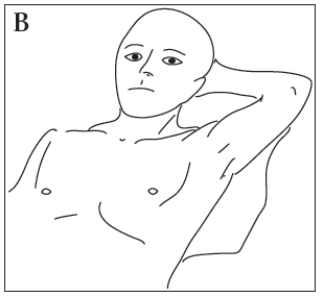
Patient Position

1. Patient Position

There are two usual positions for a patient to be sat for a pleural procedure.

- Upright position whilst leaning forwards with arms resting on a table or bed (image A)[1]
- Lying on the bed whilst slightly rotated with the arm on the side of the lesion behind the patient's head (image B)[1]





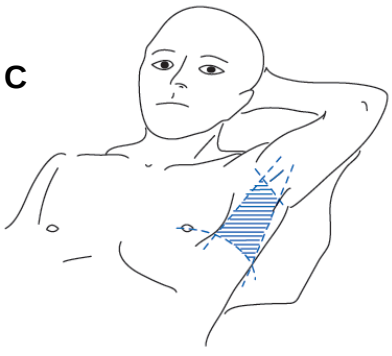
Providing there is sufficient depth of fluid visible on ultrasound, an alternative is with the patient lying flat in the lateral position with arms up in front of the face

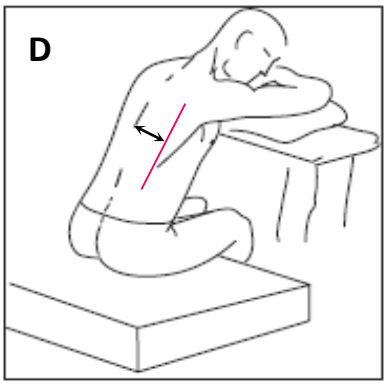
2. Site of Needle Insertion

The site of needle insertion should ideally be within the triangle of safety (image C)[1] to minimise the risk to underlying structures and reduce the risk of visible scarring. Alternatively, the 2nd intercostal space in the mid-clavicular line may be used in the case of pneumothorax.

The triangle of safety is bordered by the lateral edge of latissimus dorsi, the lateral border of pectoralis major and superior to the 5th intercostal space.

A posterior approach may be used for drainage of fluid under ultrasound guidance. However, inserting the needle more posteriorly gives greater risk of damage to the intercostal artery. For this reason it is important that the site is located lateral to the angle of the rib posteriorly (at least 10cm from spine) (figure D).





Pleural Aspiration

It is not the aim of this guidance to provide a step-by-step walkthrough guide to performing pleural aspiration but rather to cover the important safety points for the procedure. Therefore:

- Ultrasound guidance for all fluid aspirates is strongly advised
- Ensure adequate patient position
- Use small-bore needle to reduce risk of complications
- Insert needle above superior border of rib to avoid neurovascular bundle
- For diagnostic aspirations, 20-50ml of fluid is sufficient
- For therapeutic aspirations:
    - After confirming depth of the pleural space using initial needle aspiration the cannula should be advanced into the chest whilst aspirating continuously until the pleura is breached and air or fluid is withdrawn
    - Attach the cannula to a three-way tap to enable easy expulsion of fluid or air
    - Stop when no more air / fluid can be withdrawn or 1.5L has been withdrawn or until the patient develops symptoms of cough / chest discomfort

Post-procedure Care

After aspiration has been carried out, there are several steps to consider.

- A simple clean dressing should be immediately applied to the site of aspiration
- Follow-up chest radiograph is not indicated if the patient has had a simple, uncomplicated diagnostic tap.
- For diagnostic aspirates, the samples should be sent for:
    - Biochemistry (protein, lactate dehydrogenase, glucose)
    - Microbiology (M,C&S +/- acid-fast bacilli) in blood culture bottles
    - Cytology
    - pH if suspected pleural infection (into heparinised blood gas syringe. Must not be put through a gas machine if purulent)
    - Other tests may be indicated as discussed with respiratory team

Chest Drain Insertion

1. Size of Chest Drain

Small-bore chest drains (12-18 French) inserted with the Seldinger technique should be used as first line therapy for[1]:

- Pneumothoraces
- Pleural effusions
- Pleural infection / empyema

Large-bore chest drains inserted with blunt dissection require a different set of competencies. These should be considered for:

- Haemothorax / Trauma
- Where risk of lung perforation exists with Seldinger needle technique (e.g. lung edge close/tethered to chest wall)
- Where there is worsening surgical emphysema despite small bore drain.

2. Important Points from Procedure

It is not the aim of this guidance to provide a step-by-step walkthrough for inserting chest drains. Instead, it aims to cover the important safety points for the procedure. Therefore when inserting chest drains:

- Written consent for all chest drains should be obtained
- Direct ultrasound guidance is strongly recommended for pleural effusions
- Ensure adequate patient position and analgesia
- Should be carried out with full aseptic technique (including gown, sterile drapes, mask, sterile field, sterile gloves)
- Insert drain above superior border of rib to avoid neurovascular bundle
- Before fully inserting the drain, fluid (or air in the case of pneumothorax) from the site of drain insertion should be obtained. If no fluid can be drained, the procedure should be abandoned
- Drains should be inserted with the Seldinger technique
- It is imperative that the wire is not left inside the chest cavity

- Drains should never be inserted with substantial force

- The dilator should not be inserted further than 1cm beyond the depth from skin to pleural space. The marker on the dilator should be set to the correct depth needed to access the pleural space, as determined by the introducer needle.

3. Securing Chest Drains

A common complication of drain insertion is accidental removal due to insufficient securing methods. Chest drains should be secured with a combination of[1]:

- Stout non-absorbable (0 – 1.0 silk) suture that gathers adequate skin and subcutaneous tissue. A stitch under the skin 0.5cm from the drain exit site should be secured then the threads should be tied around the drain multiple times next to the skin to ensure that the drain can neither move forwards nor backwards.

- A clear dressing over the drain site

- It is good practice to secure the drainage tubing to the abdomen at a second point to take the direct weight off the chest drain fixing.

4. Post-procedure Care

After a chest-drain has been inserted, there are several aspects to post-procedure care that must be carried out, documented and communicated to the nursing staff and/or patient. These include:

- Keep the bucket below hip level

- Complete record for chest drain insertion (utilising Trust chest drain proforma)

- Post-procedure radiograph for all successful or failed chest drain attempts

- Rate of drainage for pleural effusions / empyema / haemothorax:

    - A maximum of 1.5L should be drained in the first hour after chest drain insertion to reduce the risk of re-expansion pulmonary oedema. Drainage should be ceased immediately if the patient begins to cough. It can be cautiously restarted 1 hour later if the coughing ceases with cessation of drainage.

    - A suitable regime for rate of drainage should be provided by the doctor inserting the drain – a recommended regime would be drain 1-1.5L, clamp for 4 hour, drain 1L, clamp for 4 hour then repeat

- Prophylactic Fragmin can be given after drain insertion, providing there are no bleeding complications or haemothorax.

- Clamping chest drains:

  - A bubbling chest drain should NEVER be clamped

  - Clamping drains in the case of pneumothorax, once bubbling has ceased and the lung is fully re-inflated on CXR, should be done under the direct guidance of respiratory registrar or consultant only.

- In the case of empyema, regular flushes (2-4 times per day) with 10-20ml of normal saline should be prescribed on the drug chart to reduce the likelihood of drain blockage.

- Suction may occasionally be used. This should be under the guidance of a respiratory registrar or consultant. This should be high volume low pressure thoracic suction

- Nursed on a ward familiar with the management and monitoring of chest drains (generally respiratory ward except in exceptional circumstances)

- Chest drains should be checked daily for signs of wound infection, drainage volumes, swinging & bubbling, and for loose connections which can allow air into the drain and produce bubbling even when the air leak from the lung has ceased.

Recognition and Management of Drain Complications

1. Bleeding

1a. Recognition

- It is not uncommon for a small amount of bleeding during drain insertion however this should quickly stop.
- Bruising/swelling around drain insertion site.
- Frank blood draining from the drain which quickly clots (unless known haemothorax). This can be difficult at times to distinguish from heavily blood stained effusion however these should not clot.
- Signs and symptoms of shock. This may develop several hours after the procedure.
- Increasing dyspnoea post drain insertion and CXR showing no change or increasing effusion size.
- Bleeding can rarely be a complication of drain removal. This occurs when a vessel is penetrated during drain insertion but is then tamponaded by the drain until it is removed.

1b. Management

- Check urgent haemoglobin, coagulation, cross match
- Obtain good intravenous access.
- Apply continuous pressure to the intercostal space at the site of pleural intervention. This can be very effective in compressing the bleeding vessel and slowing the rate of blood loss.
- Significant bleeds will require resuscitation of the patient and urgent discussion with the thoracic surgeons.

2. Surgical Emphysema

2a. Recognition

- Occurs when air is trapped under the skin, is usually associated with pneumothorax.
- Subcutaneous swelling, which in extreme circumstances can extend up to involve the face and neck. In this circumstance it has the potential to cause airway compromise and restrict drainage from the jugular veins.
- Crepitus on palpation
- CXR showing radiolucent streaks throughout the subcutaneous tissue and muscle.

2b. Management

- Ensure that any pneumothorax present is being appropriately managed with a functioning chest drain and the drain is not kinked. Check that proximal drainage holes are not in subcutaneous tissue.
- Management is usually conservative and the air should reabsorb on its own over time, however patients should be closely monitored especially if the emphysema is extending.
- If airway compromise is suspected urgent senior anaesthetic assistance is required.
- A blunt dissection, wide bore drain may be required if progressive surgical emphysema despite narrow bore drain or if pneumothorax is not large enough to insert Seldinger drain safely.
- In rare cases skin incision +/- subcutaneous drain to allow the release of air can be considered – only after discussion with a respiratory or ITU consultant.

3. Pneumothorax

3a. Recognition

- Small pneumothoraces are relatively common complication of chest drain insertion and will be noted on CXR.
- Consider if the patient is at risk of trapped lung, which is due to the lung being fixed and unable to expand once pleural fluid is drained. This is especially common in mesothelioma but can also occur in other malignant effusions and in empyema.

3b. Management

- Ensure that the drain is correctly positioned and swinging (fluid in drainage tubing moves with respiration) – a swinging drain means that it is functioning.
- Check the connections and underwater seal
- Discuss with respiratory team

4. Secondary Infection

4a. Recognition

- Risk of infection increases the longer the drain is in situ.
- Cloudy pleural fluid, pain, infection round drain exit site.
- Clinical signs of sepsis

4b. Management

- Aspirate some pleural fluid and send for MC&S and culture.
- Discuss with microbiology and respiratory.

5. Pain

5a. Recognition

- Pain is common post drain insertion and is managed with regular analgesia, including opiates if necessary.

- Chest pain and discomfort can also result from negative intrapleural pressure during fluid removal. This can indicate an underlying trapped lung and can be accompanied by vasovagal responses.

5b. Management

- Check for other complications, including haemorrhage.
- If pain due to rapid fluid drainage is suspected, turn the drain off and leave it off for 2 hours or until the pain has completely settled.
- Analgesia

6. Drain Blockage

- If the drain is no longer swinging or draining any fluid this can be an indication that it is blocked.
- Flushing the drain with 20mls of normal saline is usually sufficient to relieve any blockage.

7. Drain Dislodgement

- This occurs when a drain has not been adequately sutured in place.
- The drain should never be advanced again due to risk of infection but can be pulled back slightly and resutured if drain is in too far.
- Consider removing the drain.

References

(1) Pleural procedures and thoracic ultrasound; British Thoracic Society pleural disease guideline 2010. BTS Guidance. *Thorax* 2010; **65** (suppl 2); ii61-ii76.

(2) NPSA Alert. http://www.npsa.nhs.uk/nrls/alerts-and-directives/rapidrr/risks-of-chest-drain-insertion/

(3) Chest tube insertion: a prospective evaluation of pain management. Luketich JD, Kiss M, Hershey J, et al. *Clinical Journal of Pain* 1998(14): 152e4.

(4) Implementing and ensuring safe sedation practice for healthcare procedures in adults. *Academy of Medical Royal Colleges*. London: Academy of Medical Royal Colleges, 2001.

Audit Measure	Pre-intervention	Post-intervention	P value	Significance
Date recorded	91.7%	100.0%	0.489	Not significant
Time recorded	58.3%	87.0%	0.049	Significant
Indication recorded	100.0%	100.0%	1.000	Not significant
Pre-medication recorded	16.7%	26.7%	0.494	Not significant
Consent recorded	66.7%	87.0%	0.168	Not significant
Ultrasonography recorded	60.0%	86.7%	0.134	Not significant
LA use recorded	66.7%	95.7%	0.023	Significant
Drain site recorded	41.7%	69.6%	0.0798	Not significant
Drain size recorded	58.3%	78.3%	0.212	Not significant
Drain length recorded	16.7%	52.2%	0.0145	Significant
Method secured recorded	41.7%	52.2%	0.564	Not significant
Post-procedure advice	66.7%	43.5%	0.147	Not significant
Nursing observation sheet use	79.2%	87.0%	0.701	Not significant
Nursed on respiratory ward	37.5%	69.6%	0.025	Significant

Figure 1. Results of data points recorded when inserting chest drain pre and post-intervention

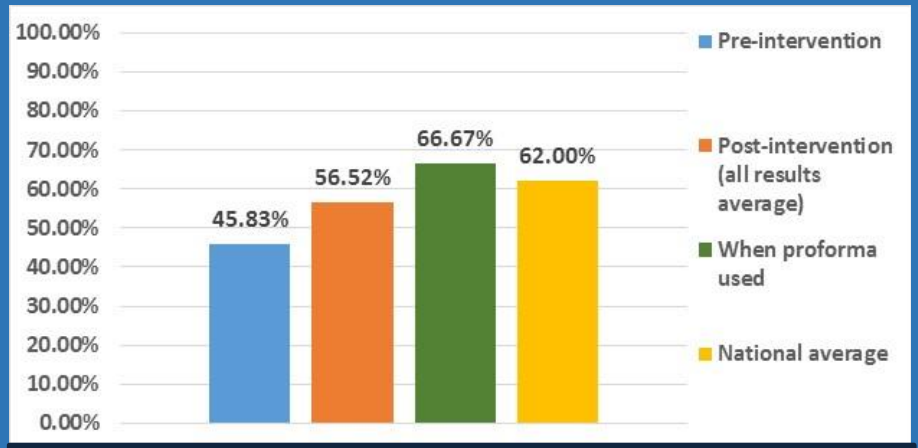


Figure 2. Comparison of written consent obtained pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 98%

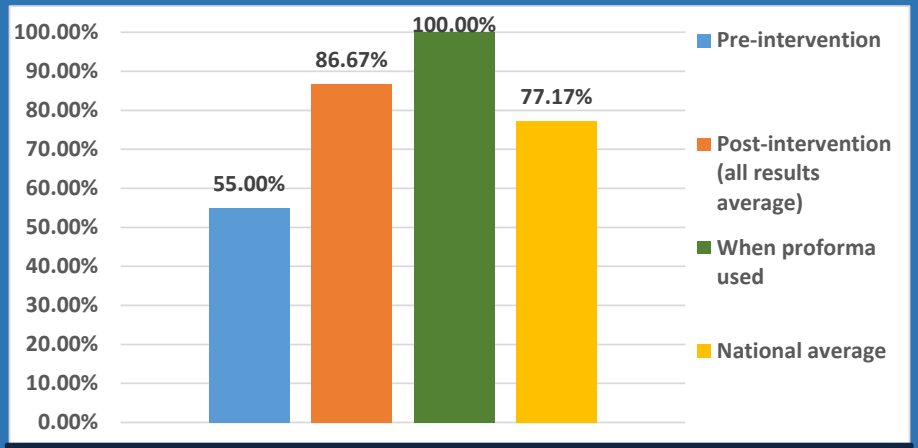


Figure 3. Comparison of use of bedside ultrasonography pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 100%

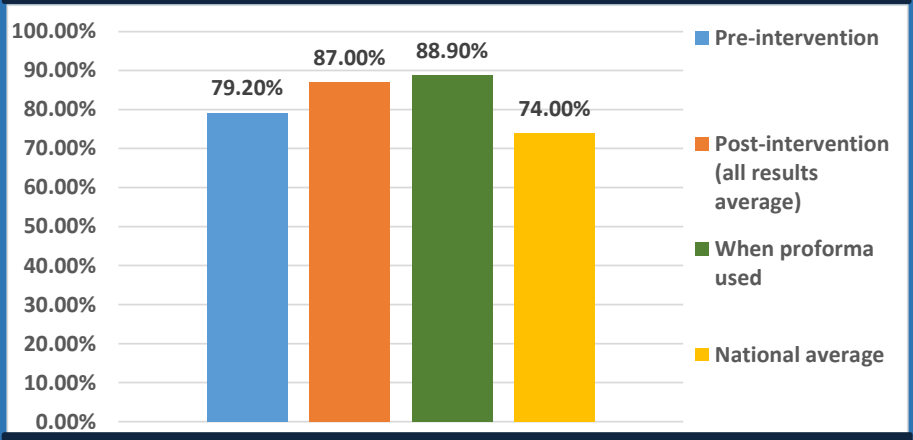


Figure 4. Comparison of use of nursing drain observation sheets pre-intervention, post-intervention, when proforma exclusively used and national average. Target = 100%

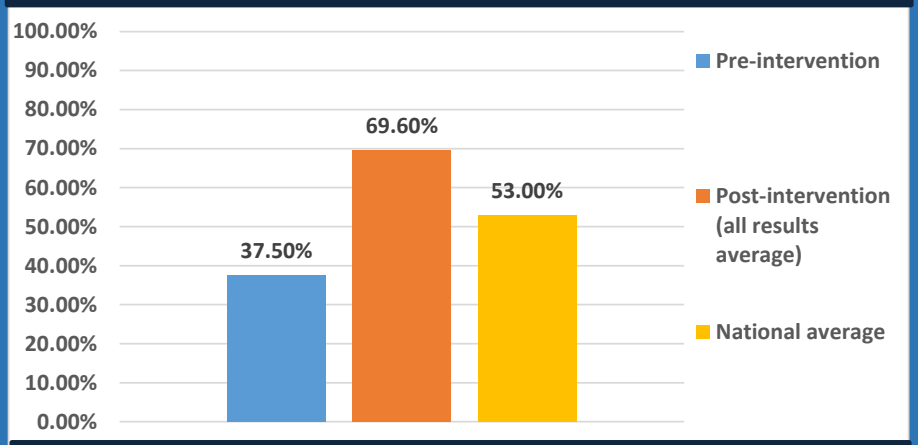


Figure 5. Comparison of care on respiratory ward pre-intervention, post-intervention and national average. Target = 100%