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BMJ Open Respiratory Research

Providing safe and effective pleural medicine services in the UK: an aspirational statement from UK pleural physicians

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ABSTRACT

Physicians face considerable challenges in ensuring safe and effective care for patients admitted to hospital with pleural disease. While subspecialty development has driven up standards of care, this has been tempered by the resulting loss of procedural experience in general medical teams tasked with managing acute pleural disease.

This review aims to define a framework though which a minimum standard of care might be implemented. This review has been written by pleural clinicians from across the UK representing all types of secondary care hospital. Its content has been formed on the basis of literature review, national guidelines, National Health Service England policy and consensus opinion following a round table discussion. Recommendations have been provided in the broad themes of procedural training, out-of-hours management and pleural service specification. Procedural competences have been defined into descriptive categories: emergency, basic, intermediate and advanced. Provision of emergency level operators at all times in all trusts is the cornerstone of out-of-hours recommendations, alongside readily available escalation pathways. A proposal for minimum standards to ensure the safe delivery of pleural medicine have been described with the aim of driving local conversations and providing a framework for service development, review and risk assessment.

INTRODUCTION

The modern era of hospital medicine has seen a progressive change in how training and medical care are delivered and integrated. There has been a shift away from general medical physicians towards specialist and subspecialist groups caring for specific disease groups. Although this has many advantages in terms of providing optimal expertise specific to a patient's problem, it also presents challenges in providing safe and effective care at all times of the day and night, when subspecialist clinicians may not be available. In respiratory medicine, these challenges are felt acutely in the field of pleural medicine. The majority of pleural interventions are performed within working hours[1]; however, when emergency intervention is required outside these times, the responsibility often falls to increasingly inexperienced clinicians.

Pleural disease is extremely common and affects approximately 3000 people per million population per year in the UK.[2] Prior to the routine use of ultrasound to guide pleural interventions, doctors in training gained regular experience of pleural interventions on the wards and managing acute medical admissions. However, in 2008, a National Patient Safety Agency (NPSA) Alert, triggered by a significant number of deaths and other serious iatrogenic complications following chest drain insertion,[3] highlighted significant concerns about the training and supervision of these procedures and the limited availability of thoracic ultrasound (TUS), which may minimise these risks. The subsequent British Thoracic Society (BTS) Pleural Disease Guideline strongly advised that TUS should be used for all pleural procedures involving fluid and recommended local hospital policies and training be developed for pleural disease.[4] In view of this and the expanding range of advanced diagnostic and therapeutic interventions for pleural disease, specialist pleural services have developed in many UK hospitals. In general, this has led to vast improvements in the quality of care delivered to this patient group; however, there is growing concern that due to the diminishing experience of general medical staff in pleural disease that out-of-hours services may be compromised. Therefore, there is a drive to

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define a *minimum standard* of safe and effective pleural services available to all patients in all hospitals at all times to ensure the very best patient care. This should include appropriate out-of-hours clinical decision making and safe pleural intervention when necessary, incorporating bedside TUS in patients with pleural effusions.

The challenges in delivering a safe, out-of-hours pleural service are considerable. The clinical need exists in all UK acute hospitals, although the case load and existing local facilities available to manage this will vary. There is, therefore, no one solution for every hospital and this document does not attempt to define one. Instead, this document details a consensus statement from UK pleural clinicians to address many of these concerns, specifically around training and out-of-hours service provision within a defined framework. How these standards are implemented will vary between hospitals. However, we hope this document will facilitate and empower physicians to engage with colleagues and hospital administrators in designing deliverable pleural services that are safer for patients whenever they present.

TRAINING IN PLEURAL PROCEDURES AND TUS

Access to individuals with the appropriate level of training to provide emergency care in acute pleural disease is central to providing a safe and effective pleural service 24 hours a day. This will require access at all times to an individual able to confirm a large pleural effusion and select an appropriate site for intervention using TUS. It will also require access at all times to an individual with the appropriate training such that they are able to perform a large volume pleural aspiration or chest drain insertion in uncomplicated cases. How this is achieved will vary depending on the skill set and services available at individual hospitals. In this document, we have intentionally separated pleural procedural competency from TUS competency, as these skills may be provided by different individuals within the hospital, particularly in the out-of-hours environment.

For both ultrasound and pleural procedural skills, we have divided competency into four broad categories: emergency operator, basic operator, intermediate operator and advanced operator. We feel that a descriptive definition of the boundaries of an individual's competence is more meaningful than numerical labelling of operator levels and avoids confusion with other operator-level training systems. We have tried to minimise using specific numbers of procedures or scans needed before being deemed competent, as it is well established with other respiratory procedures (such as endobronchial ultrasound) that this number varies among operators and an individual's learning curve may continue even despite having performed a reasonable number of procedures.[5] One potential framework for confirming competence is through 'Entrustable Professional Activities' (EPAs). We have described a specific EPA framework for TUS, which is detailed in an accompanying manuscript. By adding a degree of granularity to the assessment of procedural and ultrasound competence, we hope it will facilitate practical design of rotas that can deliver safe practice at all times. This new entity of 'Emergency Operator' is designed to provide a realistic definition of a practitioner able to act in an emergency scenario to prevent the deterioration of an unwell patient with a primary pleural condition and which is achievable within the wide variation of hospital facilities and resources. Emergency operators should always practise within the confines of locally approved guidelines. It may be necessary to provide either 'in-house' or external training to create a core group of emergency operators in both ultrasound and pleural procedures. The benefit of in-house training is that it allows additional education on the local policies and pathways, as well as induction using the specific equipment available in that hospital. It also provides an opportunity for simulation of procedures and assessment of competency. The delivery of such a programme is likely to be organised by the nominated pleural lead(s) for the local hospital(s), which will require the appropriate allocation of time within their job plans.

Pleural procedure operators

We have defined the requirements for the pleural procedural competency levels based on our collective experience (table 1). It is important to recognise that the requirement for an out-of-hours pleural procedure will be rare, and in such scenarios, the vast majority can be managed effectively with a therapeutic pleural aspiration alone. We therefore advocate individual trusts or hospital sites undertake a considered risk assessment and robustly define what skills an emergency operator is likely to need out of hours in their setting. It is also important to state all medical trainees beginning their specialist training as a medical registrar (equivalent to junior residency) are required to have demonstrated their competency to perform a pleural aspiration independently in line with the national curriculum requirements. This represents an obvious source of procedural competency and skill in the out-of-hours setting for hospitals to consider when considering the recommendations discussed in this manuscript.

We envisage that core medical trainees and medical registrars (the equivalent of junior residents, senior residents and fellows) or, increasingly, advanced nurse practitioners with appropriate training could reasonably obtain emergency level competence in pleural procedures. Hence, it seems realistic that the majority of out-of-hours rotas could include someone with this level of competence. The majority of respiratory physicians (the equivalent of an attending physician), alongside appropriately trained specialist pleural nurses and physicians in relevant specialties (eg, intensive care, acute medicine and emergency medicine) are likely to be basic-level operators. The requirements for competency within this group is aligned to the Respiratory Medicine curriculum from

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Table 1 Pleural procedure competency levels

Emergency-level pleural operator	▶ Completed a training course in basic pleural procedures including therapeutic pleural aspiration and chest drain insertion (including didactic lectures and simulated practice). ▶ Completed a local induction programme (relevant to current trust) including education on out-of-hours pathways and equipment for pleural procedures relevant to the current hospital. ▶ Are entrusted to independently perform pleural aspiration/drainage for air or fluid in context of 'uncomplicated' cases where immediate 'out of hours' action is required. ▶ Documented satisfactory completion of a summative DOPS for therapeutic pleural aspiration and satisfactory completion of two summative DOPS by two separate assessors for chest drain insertion. ▶ A minimum of five basic pleural procedures (therapeutic pleural aspirations and/or chest drain insertions documented within a formal logbook.
Basic-level pleural operator	▶ A minimum of 10 therapeutic pleural aspiration and 20 chest drain insertion procedures documented within a logbook. ▶ At least emergency level thoracic ultrasound operator competence (see table 2).
Intermediate-level pleural operator	▶ A minimum of 2 years' experience as a basic level pleural operator with regular practice in basic pleural procedures evidenced within a formal logbook. ▶ Involved in the supervision and training of emergency and basic level pleural operators. ▶ Intermediate level pleural procedural skills including direct (real-time)-guided aspiration and chest drain insertion, and indwelling pleural catheter insertion and removal. ▶ At least basic level thoracic ultrasound operator competence (see table 2). ▶ Annual review and appraisal of practice including standardised outcome measures.
Advanced-level pleural operator	▶ Advanced level pleural procedures such as medical thoracoscopy and image-guided pleural biopsy. ▶ Advanced level thoracic ultrasound operator (see table 2). ▶ Annual review and appraisal of practice including standardised outcome measures.

DOPS, direct observation of procedural skills.

the Joint Royal College of Physicians Training Board[6]; these include competence in simple pleural procedures for fluid and air (aspiration and chest drain insertion). Intermediate-level operators will represent those respiratory physicians (and occasionally physicians in relevant specialties) with a subspecialty interest in pleural disease who wish to become pleural leads for centres providing category 1 or 2 services. They will have experience and/or competence in more advanced pleural procedures such as direct (real-time)-guided aspiration and chest drain insertion, and indwelling pleural catheter insertion and removal. Advanced-level operators will represent respiratory consultants with a subspecialty interest in pleural disease who lead centres providing category 3 services. This will require competence in more complex pleural procedures such as medical thoracoscopy and image-guided pleural biopsy.

TUS operators

Bedside TUS immediately prior to intervention for suspected pleural fluid is mandatory to minimise procedural complications, except in an exceptionally rare, imminently life-threatening situation where TUS is not available, and delaying the procedure would be catastrophic. There is robust data that either failure to use TUS prior to a pleural intervention for fluid, or an 'X marks the spot' approach in a different temporal or geographical locality results in a substantially increased risk of iatrogenic complications[7–12] and hence is medicolegally indefensible. Access to appropriately trained ultrasound operators and mobile ultrasound equipment is therefore a priority for all hospitals if they are to provide a safe pleural service. The on-call radiology service at individual hospitals is likely to be a common source of this ultrasound skill in the out-of-hours setting though additional sources of operators could include the accident and emergency department, the intensive care unit and the acute medical team.

The current training recommendations for TUS are set out in the Royal College of Radiology (RCR) documents for ultrasound training within medical specialties, which define criteria for 'Focused', 'Level 1' and 'Level 2' competence.[13 14] However, these criteria are frequently confused, as evidenced by the current JRCPTB Respiratory Curriculum,[6] which requires all respiratory trainees to achieve 'focused level 1' competency (a standard that does not strictly speaking exist within the RCR framework). There are data to show that the majority of TUS is now being performed by respiratory physicians (rather than radiologists),[15] and hence the RCR documents are challenging to deliver as they rely on attendance at ultrasound lists, which are not where the majority of TUSs are being performed. Therefore, there is an urgent need for the respiratory community, in collaboration with radiology, to redefine the training requirements for TUS by physicians, which meets their specific needs using all the available training opportunities. This could also provide a potential opportunity to

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Table 2 Thoracic ultrasound competency levels

Emergency-level TUS operator	▶ Completed an introductory thoracic ultrasound session and has a basic understanding of ultrasound machines and examinations. ▶ Logbook of five normal thoracic ultrasound and five large pleural effusions of more than 5 cm depth. ▶ Satisfactory summative DOPS* to identify thoracic and abdominal cavity structures (diaphragm, lung, heart, rib, liver, spleen and kidney). ▶ Satisfactory summative DOPS* to identify a large pleural effusion >5 cm depth and to guide intervention.
Basic-level TUS operator	▶ Completed a structured thoracic ultrasound course and has a basic understanding of ultrasound physics, modes of ultrasound, anatomy of thoracic cavity and simulated experience. ▶ Ability to identify small pleural effusions and complex/septated pleural effusions. ▶ Ability to identify gross malignant pleural nodularity, for example, diaphragmatic nodularity. ▶ Ability to identify consolidated and atelectatic lung. ▶ Ability to assess lung sliding. ▶ 2x satisfactory summative DOPS in a 'challenging USS case'. Examples of this include: small pleural effusion on CXR, consolidation versus collapse versus effusion on CXR and loculated effusion on CXR/CT. ▶ Logbook of procedures including more than 60 ultrasound procedures including normal scans, pleural effusions and identification of sites for intervention. ▶ The logbook should include minimum of 10 thoracic ultrasounds of small effusions <5 cm, complex/septated effusions, pleural nodularity or consolidated/atelectatic lung.
Intermediate-level TUS operator	▶ Minimum of 2 years' experience as a basic-level TUS operator. ▶ Ability to detect A-lines and B-Lines in lung ultrasound. ▶ Ability to identify and assess pleural thickening. ▶ Ability to assess diaphragm function on ultrasound. ▶ Ability to perform real-time pleural aspiration and chest drain insertion when required. ▶ Ability to use ultrasound help guide site for indwelling pleural catheter insertion (scanning patients in lateral decubitus position). ▶ Annual review and appraisal of practice including standardised outcome measures.
Advanced-level TUS operator	▶ Advanced thoracic ultrasound practitioners who performs minimum of 100 thoracic ultrasounds per year. ▶ Ability to perform real-time image-guided pleural biopsy. ▶ Ability to use M-Mode, colour and Doppler in appropriate setting. ▶ Annual review and appraisal of practice including standardised outcome measures.

CXR, chest X-ray; DOPS, direct observation of procedural skills; TUS, thoracic ultrasound.

integrate structured ultrasound training at the earliest possible stages of medical training, even within medical school curriculums. By so doing, it could help to provide sustainable provision of out-of-hours pleural ultrasound in the future. This group recommends a vertical integration of point-of-care ultrasound training, divided into four levels (in line with those for pleural procedure competence) (table 2). It is recommended that all hospitals consider the nomination of a 'Thoracic Ultrasound Mentor' (either a respiratory physician or a thoracic radiologist) to assist with training and supervision (box 1). Emergency-level TUS operators are required to provide only a basic level of ultrasound information, consisting of the confirmation of a large pleural effusion and identifying an appropriate site for intervention in an emergency scenario, within the confines of locally agreed guidelines. This could be provided by a suitably trained physician (eg, the medical registrar/senior resident), radiologist or other specialist (eg, intensive care, emergency medicine or acute medicine) depending on skills and availability.

Demonstrating continued competency

All practitioners, regardless of their grade, should be required to demonstrate maintained competence in TUS and/or pleural interventions. As a minimum, this should

Box 1 Role of a hospital thoracic ultrasound mentor

- Considering how bedside ultrasound-guidance for all pleural procedures in pleural effusions is delivered at all times within the local hospital framework and facilities.
- Considering what training opportunities for thoracic ultrasound are available within their hospital and how trainees may access those opportunities.
- Considering how a basic introductory session and formal structured thoracic ultrasound course can be accessed by the hospital's trainees—either through local course development or access to an external course.
- Providing a source of expertise and referral point for challenges cases.
- Audit and incident investigation for thoracic ultrasound.
- Supervising sign-off (with or without delegation) for trainees when appropriate competency and recommended training criteria have been met.

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include a logbook, including key procedural outcomes (eg, sonographic findings, diagnostic yield and complication rates). Ideally, a standardised, universal electronic logbook with predefined outcomes would be used, which could be independently reviewed as part of an individual's annual appraisal process. Trainees should be required to provide a logbook of evidence and completion of relevant bespoke assessment tools in either real-life or simulated settings.[16–19] Pleural leads could consider introducing a regular reassessment process for operators within their hospital, which if performed in an open and constructive manner, would help identify good practice and/or further training needs.

Other diagnostic uses of TUS

There is an increasing interest in the use of TUS as a point-of-care diagnostic tool in other clinical settings, most notably in the assessment of pneumothorax, the acutely breathless patient and diagnosis of lung parenchymal pathologies such as cardiogenic pulmonary oedema and pneumonia. There are data to suggest assessment of pleural apposition on ultrasound (by a loss of pleural 'sliding', associated A and B lines and identification of the lung point) may help detect pneumothoraces, although these findings are not specific and other pathologies may have similar appearances (eg, emphysema, bullous disease, shallow respiration, apnoea, pulmonary fibrosis, atelectasis or as a consequence of previous thoracic surgery or pleurodesis).[20] Although taught in many introductory courses and rapid assessment protocols, its application in routine practice remains contentious and, in our view, is much more operator dependent than fluid assessment. Furthermore, ultrasound is not able to give a reliable indication as to the size of a pneumothorax. We would argue that rapid CT imaging provides much more information about the extent, size and location of a pneumothorax, as well as affording an opportunity for safe image-guided drainage and parenchymal assessment. We therefore only recommend the use of ultrasound as a complementary technique in the assessment and management of pneumothoraces. Unlike the robust positive evidence base for the use of TUS for pleural pathology,[7–12 21] there is minimal data to support its use in identifying lung parenchymal pathologies in acute breathlessness even when performed by experienced operators.[22–25] There are no robust evidence-based criteria or curricula on TUS training and competence assessment for this indication. Therefore, robustly designed studies, evaluating hard clinical outcomes, are needed to define the precise role of TUS in the acutely breathless patient prior to its routine clinical use in these patients.

Provision of emergency out of hours pleural disease management

To ensure safe and effective out of hours pleural disease management, attention must be given to the standardisation of decision-making in the out-of-hours environment and the provision of appropriately trained procedural operators. An appreciation that most pleural procedures can and should be performed within working hours is important; however clinicians working outside these hours need sufficient guidance about the pathways and expertise available should a patient require an emergency pleural intervention. Local protocols should be readily accessible and specific and provide clear contact details for the designated thoracic ultrasound and/or pleural procedure operators. Provision of these designates (who may not be the same individual at any given time) is considered the basis of the minimum safe standard that all hospitals, regardless of size or configuration, should be able to deliver. Their skill level may vary depending on the complexity of the clinical problem and intervention required, and this granularity is key to the deliverability of these recommendations (see training in pleural procedures section for definitions).

Potential emergency pleural scenarios

A number of *potential* emergency pleural scenarios are discussed below, and it is envisaged that hospitals should have risk assessed the likelihood of each occurring and have a clear pathway for their management. However, it is appreciated that in a life-threatening situation, the attending doctor should remain empowered to intervene outside the hospital protocol, where inaction could be catastrophic.

Pneumothorax

A tension pneumothorax (TP) is a clear medical emergency requiring urgent intervention. Insertion of a wide-bore cannula into the anterior second intercostal space is considered a standard initial technique taught to all junior doctors through the Advanced Life Support programme.[26] All members of the cardiac arrest team should therefore already be trained in this skill. Following decompression, a chest drain should be inserted by an appropriately trained operator. Whether to intervene out of hours in a non-TP requires reasoned clinical decision making, taking into account the degree of acute respiratory compromise of the patient, whether breathlessness can be reversed by supportive management (eg, controlled oxygen dosing if appropriate) and the size and location of the pneumothorax. Pain should be managed with simple analgesia[27] and in itself is not an indication for intervention. The management of pneumothorax is described in detail within the British Thoracic Society Pleural Disease Guideline.[5] To provide the appropriate care to manage pneumothorax in the out of hours setting, all hospitals, should have an identified and accessible pleural operator, of at least emergency level competency, available at all times. This operator may not necessarily have to be on-site (although this is desirable) but must be easily identified and within close proximity to the hospital to provide emergency

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input within 20–30 min if required. Given the infrequent nature of this scenario, this may be best provided by an allied specialty such as accident and emergency, critical care, radiology or surgery (general or thoracic) to provide this level of trained operator. A clear escalation pathway is required to identify the designated emergency operators when required (an example is provided in online supplementary appendix 1) and further expert advice from a higher level if necessary (eg, in challenging pneumothorax cases such as those requiring positive pressure ventilation, extensive subcutaneous emphysema or pneumothorax in those with severe lung parenchymal disease). It is noted that weekends represent a prolonged and continuous period of 'out of hours' working for many hospitals and consideration might be given to providing a non-emergency procedure to prevent unjustifiable delays to patient treatment. In such scenarios, in the setting of appropriate training, competence±supervision, the intervention should be delayed until daytime hours where staffing levels and support are more optimal though it may not be necessary to wait until a week day. There may be occasions where experienced operators are immediately available with appropriate levels of support in an appropriate environment to allow an intervention in the out of hours setting where the wait until daytime hours is felt unjustifiable in that instance.

Pleural effusion

Pleural effusions are the most common pleural condition encountered on the acute medical take, and they rarely require emergency intervention out of hours. Symptoms can often be improved with appropriate supportive treatment (eg, controlled oxygen and management of the underlying condition). However, occasionally urgent intervention may be required, usually in the form of an ultrasound-guided, therapeutic pleural aspiration.[4] This has been shown to be as effective in relieving breathlessness as an intercostal chest drain.[28] In the context of an undiagnosed unilateral effusion, many centres advise against complete initial drainage of the fluid as it can prolong the diagnostic pathway by limiting future investigations (eg, local anaesthetic thoracoscopy). Hence, it is important that clear, local guidance is available to clinicians regarding the preferred management strategy and escalation pathway (see online supplementary appendix 2 for an example). To provide the minimum standard of appropriate care to manage pleural effusions out of hours, hospitals should have an identified and accessible TUS operator, of at least emergency operator-level competency and a pleural operator, of at least emergency-level competency, at all times (note: these might not be the same person). These operators may not necessarily have to be on-site (although this is desirable) but must be easily identified and within close proximity to the hospital to provide emergency input within 20–30 min of required. A potential solution might be to split the pleural operators into chest drain operators and pleural aspiration operators. Given that all medical registrars from ST3 level (junior residents) are required to have competency in pleural aspiration, one option would be use the on-call medical registrar in an emergency situation involving a pleural effusion requiring aspiration with an off-site radiology team available to perform bedside ultrasound.

Suspected pleural infection

It is rare for a case of suspected pleural infection/empyema to require immediate intervention in the out-of-hours setting. Supportive management, including early antibiotics and management of sepsis, will frequently allow pleural intervention to be deferred. However, a diagnostic pleural aspiration should be performed within 24 hours of pleural infection first being considered possible,[29] which may be challenging in some units during weekend working. Diagnostic aspiration in suspected empyema may also require a more skilled TUS operator since effusions are frequently complex and may be small in volume. Therefore, *consideration* should be given to having a asic-level TUS operator accessible in working hours 7 days a week including weekends, not necessarily on site. This could be a respiratory physician, intensivist or radiologist. A clear escalation pathway to contact this operator is required (an example of which is provided in online supplementary appendix 2). Confirmation of an empyema will mandate chest drain insertion that could be provided by the nominated emergency-level pleural operator described above. However, given the potential for more technically challenging drain insertion in empyema (complex fluid, viscous fluid and smaller collections), every effort should be made to facilitate an experienced operator to perform the insertion (basic-level or above) while not inducing an unacceptable delay (aiming not to exceed 24 hours from empyema diagnosis).

DEFINITION OF PLEURAL SERVICES AND SERVICE SPECIFICATION

All hospitals that manage acute medical, surgical, oncological or intensive care patients require the ability to diagnose and manage pleural disease to nationally accepted standards. We would recommend that all hospitals review their own services to clearly establish the extent of pleural service they require locally and how best it can be delivered. This may require innovation, investment and collaboration with other local or regional services to ensure a full range of pleural expertise is available in a timely manner for all patients. Central to this is concept is a requirement for all hospitals to have a nominated 'pleural lead', charged with coordinating education and training of pleural skills, defining appropriate pleural management pathways both in and out of hours, ensuring standardisation of available equipment and documentation for pleural interventions and investigating adverse events involving pleural procedures and implementing improvements. They will also be involved

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Table 3 Summary of pleural service categories

Category 1 pleural service	▶ Basic pleural interventions. ▶ Streamlined referral pathways for advanced diagnostics and therapeutics. ▶ Dedicated pleural lead with appropriate time allocated within job plan. ▶ Published hospital pathways for pleural disease management. ▶ Standardisation of equipment optimising safety of pleural intervention. ▶ Standardised procedural documentation and checklists. ▶ Implementation and compliance to National Safety Standards for Invasive Procedures and Local Safety Standards for Invasive Procedures standards. ▶ Unified process for Incident investigation in pleural medicine.
Category 2 pleural service	▶ At least one intermediate thoracic ultrasound and pleural procedure operator. ▶ Dedicated pleural clinic and ambulatory pathways. ▶ Dedicated pleural procedure area/room. ▶ Inpatient in-reach with physician led bedside ultrasound. ▶ Consideration to specialist pleural nurse and pleural administrator roles. ▶ Prospective data collection for performance monitoring. ▶ Audit trail for ultrasound images prior to pleural procedures.
Category 3 pleural service	▶ Lead consultants have a minimum 4× programmed activities for service delivery and development. ▶ Advanced diagnostics and therapeutics including medical thoracoscopy and IPC. ▶ Dedicated pathways and rapid access for IPC-related problems. ▶ Active engagement in pleural research trials. ▶ Consideration to developing a fellowship programme. ▶ Multidisciplinary team framework for pathway and list planning, trial screening, difficult cases.

IPC, Indwelling Pleural Catheter;

in the identification of a nominated TUS mentor. Pleural leads will help to ensure hospitals are compliant with National Safety Standards for Invasive Procedures recommendations[30] by ensuring standardised documentation is used including the necessary preprocedure and postprocedure checks (see online supplementary appendixs 3–6, for example, of Local Safety Standards for Invasive Procedures checklists for pleural aspiration, chest drain insertion, indwelling pleural catheter insertion and medical thoracoscopy). Accurate coding of pleural interventions is vital to allow hospitals to claim the best practice tariffs for pleural interventions, which may help provide future investment in local pleural services. The addition of pleural or lung cancer specialist nurses to a pleural clinic can attract an additional multiprofessional clinic tariff. Online supplementary appendix 7 shows an example coding form. To facilitate discussions and organisation of pleural services around the country, we feel a structured method of classifying services would be useful and hence is proposed here (table 3). It will also assist in developing networks of pleural services that can help provide specialist advice and expertise where they are not immediately available locally.

Category 1 pleural service

A category 1 pleural service has the ability to perform basic pleural diagnostics and initial management, including TUS, pleural aspiration and chest drain insertion and reflects the minimum standard for safe and effective care. Category 1 pleural services require reliable and timely access to category 2 or 3 pleural services and/or thoracic surgery with streamlined pathways for advanced diagnostics and specialist management and advice when required. The local category 2/3 may also help support the pleural lead in a category 1 centre, for example, through collaborative educational programmes.

Category 2 pleural service

A category 2 pleural service is led by a physician experienced in pleural medicine and includes at least one intermediate-level TUS and pleural operator. The service should have a dedicated pleural clinic able to facilitate rapid reviews (for acutely symptomatic patients or suspected pleural malignancy), an ambulatory pathway and the ability to provide an in-reach service for inpatient pleural disease. A category 2 service should have physician-led bedside TUS, with a clear audit trail (ideally with images saved on local radiology systems) and may also provide intermediate therapeutic procedures such as indwelling pleural catheter insertion. It requires a dedicated time and area for pleural procedures to minimise risk of infection.[31] Category 2 pleural services may consider a training framework for specialist nurses to enhance service provision and a dedicated pleural administrator to optimise the organisational elements of the service, including accurate coding to ensure appropriate funding and reinvestment in the service. Robust prospective data collection for pleural procedures performed within the service is recommended.

Category 3 pleural service

A category 3 pleural service is led by a physician with specific expertise in pleural medicine and with a

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significant proportion of their job plan allocated to the pleural service. The service takes a regional/national lead in pleural procedure training and competence assurance. A category 3 service provides advanced diagnostics and therapeutics such as local anaesthetic thoracoscopy and indwelling pleural catheter insertion and management and receives referrals for difficult cases. The service provides a rapid access pathway for patients in the community with IPC-related problems. Category 3 services may be actively engaged in pleural research and can offer patients access to relevant research studies. These services are likely to deliver specialist training for future pleural physicians. Robust prospective data collection is routine for category 3 services with a minimum dataset to include complication and performance metrics of local anaesthetic thoracoscopy and indwelling pleural catheters. In time, these services should be subject to external oversight in order to allow both the sharing of good practice and identification of areas needing improvement and/or additional support. Level 3 services are encouraged to drive a national agenda of collaborative data collection to allow comparison of key outcome measures. To maintain the level of competence required for a category 3 pleural service, it is recommended a minimum of 25 procedures per centre for local anaesthetic thoracoscopy. Category 3 pleural services require a multidisciplinary team (MDT) framework/team meeting in which to allow pathway planning, procedure list planning and identification of research trial candidates. Specialist thoracic radiology may input into this framework as may other allied pleural services that include thoracic surgery, pathology and cancer specialist nurses. Category 3 pleural services may have a role in the provision of a regional mesothelioma MDT.

Aspirational or achievable?

The minimum standards described within this manuscript are undoubtedly challenging to implement. These focus on having a standardised specification for all pleural services relevant to the individual hospital and patients' needs. This service is charged with delivering safe and effective pleural disease management within working hours. Standards of care are considered, implemented and monitored by pleural leads and TUS mentors, and this requires adequate time in their job plan to deliver these roles effectively. In the out-of-hours environment, dedicated patient management pathways guide medical teams in appropriate decision making for acute pleural disease and provide clear contact information for TUS and pleural operators if required. The minimum standard for out-of-hours care requires access at all times to a TUS operator that can confirm a large pleural effusion and an appropriate site for intervention as well as a pleural operator entrusted to undertake large volume pleural aspiration or chest drain insertion in uncomplicated cases. The definitions of emergency-level operators have been made simple and achievable in the hope of encouraging a broad range of clinicians to become trained to this level (eg, an emergency-level TUS operator requires a logbook of five normal ultrasounds and five large pleural effusions). The solutions to implementation will vary widely depending on individual hospital's infrastructure and needs. However, the on-call radiology team seems an obvious potential source of TUS expertise in the majority of institutions, likely to far exceed the requirements of emergency level operators. The critical element is the cross-departmental agreement on the responsibility of delivering out-of-hours TUS such that there are no misunderstandings at the time of an out-of-hours pleural emergency. This could provide a temporary solution while a dedicated programme of training occurs in other areas such as the acute medical team. Providing emergency-level pleural operators is equally challenging and will require robust training programmes delivered at individual hospitals (or at a regional level) on a regular basis, which once again highlights the need for dedicated time within the job plans for pleural leads to deliver this.

The authors acknowledge that this document and the recommendations within it are aspirational, but we also firmly believe that they can provide a platform for individual hospitals to consider their own challenges to implementation and drive a process of change where needed. At its heart, these recommendations are designed to enhance patient safety and address the very concerning number of critical incidents involving pleural procedures that has happened in the UK over recent years. The authors have undertaken an analysis of how compliant their own trusts are with these minimum standards and what the key challenges for implementation are; these are summarised and provided in online supplementary appendix 8 and represent a broad geography across the UK and a broad mix of hospital size and infrastructures. No single hospital is compliant with all the recommendations made in this manuscript, and there are common challenges and themes centred on: infrastructure to train a broad group of operators to deliver a 24 hours 7 days a week service, required time within job plans for leads and mentors to deliver this training and agreeing formal trust wide protocols and pathways for pleural medicine. Online supplementary appendix 8 also lists potential solutions relevant to the individual trusts such as the formation of cross-specialty pleural working groups to tackle the challenges.

Conclusion

In conclusion, we have set out a minimum standard for the delivery of safe pleural services, particularly in the out-of-hours setting, based on national guidance, the evidence base as well as collective experience. We have provided a framework for training and service provision as well as suggested pleural pathways and processes that we hope empowers physicians and managerial staff alike to review their local service provision and any necessary investments to meet the minimum standards set out in

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this document. Ultimately, service provision and development needs will be highly variable across different hospital trusts and the final decision making will rest with individual trusts.

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