e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(9); 160-166

Original Research Article

Comparison of Chest X-Ray and Bedside Ultrasound in the Detection of Pleural Effusion

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Received: 02-07-2026 / Revised: 01-08-2026 / Accepted: 02-09-2026

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Conflict of interest: Nil

Abstract:

Background: Pleural effusion is a common clinical finding that requires timely and accurate diagnosis. Conventional chest radiography may have limited sensitivity, particularly for small effusions. This study compared the diagnostic performance of chest X-ray and bedside ultrasound in detecting pleural effusion.

Material and Methods: A prospective comparative diagnostic-accuracy study was conducted among 150 adults with clinical suspicion of pleural effusion. All participants underwent conventional chest radiography and bedside thoracic ultrasonography. Findings were compared with a reference standard based on computed tomography and/or final clinical-radiological assessment. Sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratios, and diagnostic accuracy were calculated. Paired diagnostic results were compared using the McNemar test.

Results: Pleural effusion was confirmed in 80 (53.3%) patients. Bedside ultrasound correctly identified 76 cases, compared with 48 cases detected by chest radiography. Ultrasound demonstrated higher sensitivity (95.0% vs. 60.0%), specificity (98.6% vs. 90.0%), positive predictive value (98.7% vs. 87.3%), negative predictive value (94.5% vs. 66.3%), and overall diagnostic accuracy (96.7% vs. 74.0%). Ultrasound produced fewer false-negative results than chest radiography (4 vs. 32). Paired analysis demonstrated a statistically significant difference between the modalities (χ^2=19.24, p<0.001).

Conclusion: Bedside ultrasound demonstrated substantially superior diagnostic performance compared with chest radiography for detecting pleural effusion. Its high sensitivity and accuracy support its use as a rapid and accessible first-line imaging modality in patients with suspected pleural effusion.

Keywords: Pleural effusion; Chest radiography; Bedside ultrasound; Thoracic ultrasonography; Diagnostic accuracy; Point-of-care ultrasound.

DOI: 10.25258/ijcpr.18.9.25

Introduction

Pleural effusion is a frequent manifestation of several cardiopulmonary and systemic disorders, including heart failure, infection, malignancy, and thromboembolic disease. Because its clinical manifestations may overlap with other causes of respiratory symptoms, imaging plays an important role in establishing the presence of pleural fluid and guiding subsequent management. Conventional chest radiography remains widely used because it is readily available and familiar in routine clinical practice; however, its ability to identify small or clinically occult pleural effusions may be limited, particularly in patients who undergo portable anteroposterior examinations [1,2].

Thoracic ultrasonography has emerged as an increasingly important bedside imaging technique for evaluating pleural abnormalities. Unlike chest radiography, ultrasound permits direct visualization of the pleural space and can identify small fluid collections that may be difficult to appreciate radiographically. It can also be performed at the patient's bedside without ionizing radiation, which is particularly advantageous in critically ill patients, those with limited mobility, and individuals requiring rapid assessment [1,3]. In addition to identifying pleural fluid, ultrasonography can provide information regarding the morphology of an effusion, including internal echoes, septations, and associated pleural abnormalities, thereby contributing additional information beyond simple detection [4].

Evidence accumulated in recent years supports the diagnostic value of lung and thoracic ultrasound for pleural effusion. A systematic review and meta-analysis by Hansell et al. reported substantially greater sensitivity of lung ultrasound than chest radiography for identifying pleural effusion in critically ill adults, while maintaining comparable specificity [1]. More recently, Zaki et al., in a systematic review and meta-analysis of 18 studies, reported pooled sensitivity and specificity of 97.88% and 85.30%, respectively, for point-of-care ultrasound and 67.68% and 94.54%, respectively, for chest radiography, supporting the superior overall diagnostic performance of point-of-care ultrasound for pleural effusion [5].

The clinical utility of thoracic ultrasound is also being evaluated increasingly in contemporary respiratory and emergency-care pathways. Prospective investigations have demonstrated that systematic thoracic ultrasound can provide additional diagnostic information in patients with suspected pleural disease, while its bedside application facilitates rapid assessment without transporting potentially unstable patients to the radiology department [3,6]. Recent clinical studies have further highlighted the expanding role of portable and bedside thoracic ultrasound in the assessment and management of patients with pleural effusion [4,6].

Despite the growing evidence supporting ultrasonography, chest radiography continues to be routinely used as an initial imaging investigation in many clinical settings. Direct comparison of the two modalities within the same patient population is therefore clinically relevant, particularly in resource-constrained and acute-care environments where rapid bedside decision-making is required. The present study was undertaken to compare the diagnostic performance of chest radiography and bedside ultrasound in detecting pleural effusion, with particular emphasis on their sensitivity, specificity, predictive values, and overall diagnostic accuracy.

Materials and Methods

Study Design and Setting: A prospective, hospital-based comparative diagnostic-accuracy study was conducted to compare the performance of bedside ultrasonography and conventional chest radiography in the detection of pleural effusion. The study was carried out at a tertiary-care teaching hospital.

Study Population: The study population comprised adult patients presenting to the outpatient department, emergency department, medical wards, or intensive care unit with clinical suspicion of pleural effusion and for whom chest imaging was considered clinically indicated.

A total of 150 consecutive patients fulfilling the eligibility criteria were enrolled. Consecutive recruitment was used to reduce selection bias and to obtain a study population representative of patients encountered in routine clinical practice.

Sample Size: The sample size was determined with consideration of the diagnostic performance of bedside ultrasonography reported in previous comparative studies. Considering an expected sensitivity of approximately 95% for bedside ultrasonography, an allowable absolute precision of 4%, and a 95% confidence level, the minimum sample size required for estimating sensitivity was approximately 114 participants. To compensate for potentially non-evaluable examinations, incomplete imaging, and protocol deviations, the sample size was increased to 150 patients.

Inclusion Criteria: Patients were eligible for inclusion if they

1. were aged **18 years or older**;
2. had clinical suspicion of pleural effusion based on symptoms, physical examination, or preliminary clinical assessment;
3. were referred for chest radiography as part of their clinical evaluation;
4. were able to undergo bedside thoracic ultrasonography; and
5. provided informed consent for participation.

Exclusion Criteria: Patients were excluded if they

1. had previously established pleural effusion for which imaging was being performed solely for follow-up;
2. had undergone thoracic surgery or pleural intervention immediately before enrollment that could substantially alter the imaging appearance;
3. had extensive chest wall wounds, dressings, or conditions preventing adequate ultrasonographic examination;
4. were unable to undergo either of the study imaging examinations;
5. had technically inadequate or incomplete radiographic or ultrasonographic examinations; or
6. declined participation.

Study Procedure: After enrollment, relevant demographic and clinical information was recorded using a structured study proforma. This included age, sex, presenting symptoms, relevant clinical findings, and major underlying clinical diagnoses.

Each patient underwent bedside thoracic ultrasonography and conventional chest radiography as part of the study protocol. Wherever clinically feasible, both examinations were performed within a short redefined interval to minimize the possibility of changes in the amount of pleural fluid between examinations.

The ultrasound examination was performed by a trained physician/radiologist using a portable ultrasound system equipped with a low-frequency curvilinear or phased-array transducer and, when required, a higher-frequency linear transducer. Patients were examined in the sitting, semirecumbent, or supine position depending on their clinical condition.

The posterolateral and lateral thoracic regions were systematically examined bilaterally. Pleural fluid was identified by visualization of an anechoic or hypoechoic fluid collection between the parietal and visceral pleural surfaces, with assessment of associated features such as the movement of the lung within the fluid and displacement of adjacent structures. Internal septations, echoes, debris, or other sonographic characteristics were additionally documented whenever present.

A study examination was considered positive for pleural effusion when a discrete fluid collection was visualized in the pleural space. The presence or absence of effusion was recorded independently for the right and left hemithorax, together with the overall patient-level interpretation.

Chest Radiography: Conventional chest radiography was performed using the institution's standard radiographic protocol. Posteroanterior chest radiographs were obtained in ambulatory patients whenever possible, whereas anteroposterior portable radiographs were obtained in patients who were unable to stand or cooperate adequately.

Radiographs were assessed for features suggestive of pleural effusion, including blunting of the costophrenic angle, homogeneous basal opacity, meniscus formation, and other signs compatible with pleural fluid. The radiographic examination was categorized as positive or negative for pleural effusion.

The radiographs were interpreted independently by a radiologist who was blinded to the bedside ultrasonography findings.

Reference Standard: To minimize incorporation bias, the final diagnosis of pleural effusion was established using the best available reference standard, based on thoracic computed tomography and/or an unequivocal clinical-radiological diagnosis, depending on the investigations performed as part of routine patient care.

When thoracic CT was clinically available, the CT examination was considered the reference imaging modality because of its high sensitivity for detecting pleural fluid. Published diagnostic studies have commonly used CT as the reference standard when evaluating lung ultrasound for pleural pathology.

In patients who did not undergo CT because it was not clinically indicated, the final diagnosis was determined from the available clinical course and follow-up imaging, including repeat chest radiography or ultrasonography where appropriate. The reference-standard assessment was performed independently of the index-test result wherever feasible.

Blinding: To reduce observer and interpretation bias, the operators interpreting the two index investigations were blinded to the findings of the other imaging modality. The radiologist interpreting chest radiographs did not have access to the bedside ultrasound findings, while the ultrasound examiner was not provided with the radiographic interpretation before completing the ultrasound assessment.

Outcome Measures: The primary outcome was the diagnostic accuracy of bedside ultrasonography compared with conventional chest radiography for detecting pleural effusion.

The following diagnostic parameters were calculated for each modality:

- sensitivity;
- specificity;
- positive predictive value;
- negative predictive value;
- positive likelihood ratio;
- negative likelihood ratio; and
- overall diagnostic accuracy.

Sensitivity was defined as the proportion of patients with pleural effusion according to the reference standard who were correctly identified by the respective imaging modality. Specificity was defined as the proportion of patients without pleural effusion according to the reference standard who were correctly classified as negative.

Statistical Analysis: Data were entered into a Microsoft Excel spreadsheet and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on data distribution. Categorical variables were summarized using frequencies and percentages.

The diagnostic performance of bedside ultrasonography and chest radiography was evaluated by constructing 2 × 2 contingency tables against the reference standard. Sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratios, and diagnostic accuracy were calculated with corresponding 95% confidence intervals.

Because both imaging modalities were performed on the same patients, their paired diagnostic results were compared using the McNemar test for discordant paired observations. Differences in sensitivity and specificity between the two modalities were assessed using appropriate paired-data methods. A two-sided p-value <0.05 was considered statistically significant.

Results

A total of 150 patients with clinical suspicion of pleural effusion were included in the study. The mean age of the study population was 56.8 ± 16.4 years, with an age range of 19–89 years. Males constituted the majority of the study population, accounting for 91 (60.7%) patients, while 59 (39.3%) were females. Dyspnea was the most frequently reported presenting symptom, observed in 112 (74.7%) patients, followed by cough in 83 (55.3%) and chest pain in 67 (44.7%) patients. Reduced air entry on clinical examination was present in 104 (69.3%) patients, whereas dullness to percussion was documented in 86 (57.3%) patients (Table 1).

According to the reference standard, pleural effusion was confirmed in 80 (53.3%) patients, while 70 (46.7%) patients had no evidence of pleural effusion (Table 2). Bedside ultrasound identified pleural effusion in 76 of the 80 confirmed cases, whereas chest radiography detected effusion in 48 patients. Among patients without pleural effusion, chest radiography correctly classified 63 of 70 patients as negative, while bedside ultrasound correctly classified 69 patients (Table 3).

The diagnostic performance of the two imaging modalities demonstrated a clear difference. Bedside ultrasound showed a sensitivity of 95.0% and specificity of 98.6%, whereas chest radiography demonstrated a sensitivity of 60.0% and specificity of 90.0%. The positive predictive value of ultrasound was 98.7%, compared with 87.3% for chest radiography, while the corresponding negative predictive values were 94.5% and 66.3%, respectively. Overall diagnostic accuracy was substantially higher with bedside ultrasound than with chest radiography (96.7% vs. 74.0%). The positive likelihood ratio was 66.50 for ultrasound compared with 6.00 for chest radiography, whereas the negative likelihood ratio was 0.05 and 0.44, respectively (Table 4).

When the individual classifications were compared, bedside ultrasound correctly identified 145 of the 150 patients, whereas chest radiography correctly classified 111 patients. Ultrasound therefore resulted in fewer false-negative examinations (4 vs. 32) and fewer false-positive examinations (1 vs. 7) than chest radiography (Table 5). The paired comparison further demonstrated that 24 patients who had a negative chest radiograph were subsequently identified as having pleural effusion by bedside ultrasound, whereas only 2 patients were positive on chest radiography but negative on ultrasound (Table 6).

The difference between the two diagnostic approaches was statistically significant on paired analysis, with the McNemar test demonstrating $\chi^2 = 19.24$ and $p < 0.001$. Thus, bedside ultrasound demonstrated significantly superior detection of pleural effusion compared with conventional chest radiography in the studied population (Table 6). The comparison of true-positive, true-negative, false-positive, and false-negative classifications against the reference standard is summarized in Table 7.

Table 1: Demographic and Clinical Characteristics of the Study Population (n=150)

Variable	**Value**
Age, years, mean ± SD	56.8 ± 16.4
Age range, years	19–89
Male sex, n (%)	91 (60.7)
Female sex, n (%)	59 (39.3)
Dyspnea, n (%)	112 (74.7)
Chest pain, n (%)	67 (44.7)
Cough, n (%)	83 (55.3)
Fever, n (%)	58 (38.7)
Reduced air entry on examination, n (%)	104 (69.3)
Dullness to percussion, n (%)	86 (57.3)

Table 2: Final Diagnosis According to the Reference Standard (n=150)

Reference-standard finding	**n (%)**
Pleural effusion present	80 (53.3)
No pleural effusion	70 (46.7)
Total	**150 (100)**

Table 3: Detection of Pleural Effusion by Chest X-Ray and Bedside Ultrasound

Imaging modality	Pleural effusion present	Pleural effusion absent	Total
Chest X-ray positive	48	7	55
Chest X-ray negative	32	63	95
Total	**80**	**70**	**150**
Bedside ultrasound positive	76	1	77
Bedside ultrasound negative	4	69	73
Total	**80**	**70**	**150**

Table 4: Diagnostic Performance of Chest X-Ray and Bedside Ultrasound

Diagnostic parameter	Chest X-ray	Bedside ultrasound
Sensitivity	60.0%	95.0%
Specificity	90.0%	98.6%
Positive predictive value	87.3%	98.7%
Negative predictive value	66.3%	94.5%
Diagnostic accuracy	74.0%	96.7%
Positive likelihood ratio	6.00	66.50
Negative likelihood ratio	0.44	0.05

Table 5: Comparison of Diagnostic Accuracy Between Chest X-Ray and Bedside Ultrasound

Parameter	Chest X-ray	Bedside ultrasound	Difference
True positive, n	48	76	+28
True negative, n	63	69	+6
False positive, n	7	1	−6
False negative, n	32	4	−28
Correctly classified patients, n (%)	111 (74.0)	145 (96.7)	+34 (22.7%)

Table 6: Paired Comparison of Chest X-Ray and Bedside Ultrasound Findings

Chest X-ray / Ultrasound	Ultrasound positive	Ultrasound negative	Total
Chest X-ray positive	53	2	55
Chest X-ray negative	24	71	95
Total	**77**	**73**	**150**

McNemar test: $\chi^2 = 19.24$, $p < 0.001$

Table 7: Comparison of Imaging Findings with the Reference Standard

Modality	TP	TN	FP	FN	Sensitivity (%)	Specificity (%)
Chest X-ray	48	63	7	32	60.0	90.0
Bedside ultrasound	76	69	1	4	95.0	98.6

Discussion

The high sensitivity observed for bedside ultrasound in the present study is consistent with contemporary evidence supporting thoracic ultrasonography as an accurate modality for pleural fluid detection. A 2024 systematic review and meta-analysis demonstrated significantly greater pooled sensitivity and overall diagnostic accuracy for point-of-care ultrasound than for chest radiography. Although the pooled estimates in that analysis differed from the present study, the direction of effect was similar, with ultrasound outperforming radiography in the identification of pleural effusion [7]. The relatively high sensitivity in our cohort may reflect the systematic examination of the dependent thoracic regions and the ability of ultrasound to directly visualize even relatively small fluid collections.

The comparatively lower sensitivity of chest radiography in our study is also clinically plausible. Radiographic detection of pleural fluid depends on the amount and distribution of fluid, patient positioning, and the radiographic technique used. In particular, portable anteroposterior examinations in patients who cannot stand may be less sensitive for small or posteriorly distributed effusions. A recent study demonstrated that the diagnostic performance of chest radiography varies considerably according to patient position, with lateral decubitus radiography providing greater sensitivity than conventional radiographic approaches [7]. Thus, the 60.0% sensitivity observed for chest radiography in our study may partly reflect the practical conditions under which radiographs are commonly obtained in hospitalized and acutely ill patients.

The specificity of bedside ultrasound was also high in the present study (98.6%), with only one false-positive examination. This finding is clinically relevant because high specificity indicates that a sonographically identified pleural fluid collection is unlikely to represent a false-positive finding when the examination is systematically performed. Recent evidence indicates that the accuracy of lung ultrasound can remain high even when examinations are performed outside highly specialized radiology environments. Halata et al. reported high specificity for the detection of pleural effusion when point-of-care lung ultrasound was performed by general practitioners following structured training, supporting the feasibility of extending ultrasound-based assessment beyond specialist imaging departments [8]. Nevertheless, operator training and adherence to standardized scanning protocols remain important determinants of diagnostic reliability.

The paired analysis in our study further strengthens the comparison between the two modalities. Twenty-four patients with negative chest radiographs were identified as having pleural effusion on bedside ultrasound, whereas only two patients were positive on chest radiography but negative on ultrasound. The statistically significant McNemar test result (χ^2=19.24, $p<0.001$) indicates that the difference was unlikely to be attributable to random variation. This paired design is particularly useful because both modalities were assessed in the same individuals, thereby reducing the influence of between-patient differences. Recent prospective work has similarly demonstrated the clinical utility of thoracic ultrasound in patients with pleural disease and has supported its incorporation into diagnostic pathways when additional bedside information is required [9].

An important advantage of bedside ultrasound is that its value extends beyond the binary detection of pleural fluid. Sonographic examination can characterize the pleural collection and identify features such as internal echoes, septations, and pleural abnormalities. A recent meta-analysis examining the ability of thoracic ultrasound to distinguish transudative from exudative effusions found that echogenic sonographic patterns had moderate sensitivity and high specificity for exudative fluid, although substantial heterogeneity existed between studies [10]. Thus, while ultrasound should not be regarded as a replacement for pleural fluid analysis when etiological classification is required, its ability to provide additional morphological information can complement the initial detection of an effusion.

The practical implications of these findings are particularly relevant in emergency and acute-care settings. Bedside ultrasound can be performed without transporting the patient to the radiology department and does not expose the patient to ionizing radiation. A recent study of patients presenting with acute dyspnea reported that point-of-care ultrasound substantially reduced the time required to establish a diagnosis compared with radiographic evaluation, while maintaining high diagnostic performance [11]. These characteristics may be especially valuable for patients who are hemodynamically unstable, mechanically ventilated, or unable to maintain an upright position for conventional radiography.

The present findings should nevertheless be interpreted within the context of several limitations. First, the study was conducted at a single tertiary-care institution, which may limit generalizability to other clinical environments. Second, ultrasound performance is dependent on operator experience, patient positioning, body habitus, and the presence of pleural adhesions or complex loculated collections. Third, although the reference standard incorporated CT when clinically available, not every patient necessarily underwent CT, introducing potential variability in reference-standard assessment. Finally, the study evaluated detection of pleural effusion rather than its underlying etiology; therefore, the results should not be interpreted as demonstrating that ultrasound can independently establish the cause of an effusion. Current pleural-disease guidance continues to emphasize appropriate integration of imaging findings with clinical assessment and, when indicated, pleural fluid investigation [12].

Conclusion

Bedside ultrasound demonstrated superior diagnostic performance compared with conventional chest radiography for the detection of pleural effusion, with markedly higher sensitivity, specificity, and overall diagnostic accuracy. Its ability to identify effusions missed on chest radiography supports its use as a rapid, non-invasive, and readily accessible bedside imaging modality, particularly in patients who are critically ill or unable to undergo standard radiographic positioning. These findings suggest that bedside ultrasound can serve as a valuable first-line imaging tool for suspected pleural effusion and may complement or, in selected clinical settings, reduce reliance on conventional chest radiography.

References

1. Hansell L, Milross M, Delaney A, Tian DH, Ntoumenopoulos G. Lung ultrasound has greater accuracy than conventional respiratory assessment tools for the diagnosis of pleural effusion, lung consolidation and collapse: a systematic review. J Physiother. 2021 Jan;67(1):41-48. doi: 10.1016/j.jphys.2020.12.002.
2. Ocel S, Kekec Z, Taskin O, Belli F, Tugcan MO. Diagnostic role of thoracic ultrasound in patients with acute respiratory failure at emergency service. Ir J Med Sci. 2024 Jun;193(3):1573-1579. doi: 10.1007/s11845-024-03618-4.
3. Fjaellegaard K, Petersen JK, Clementsen PF, Laursen CB, Bhatnagar R, Bodtger U.

Additional Up-Front Thoracic Ultrasound in the Workup of Patients with Unilateral Pleural Effusion: A Prospective Observational Pilot Study. Respiration. 2023;102(5):377-385. doi: 10.1159/000529871.
4. Shehata SM, Almalki YE, Basha MAA, Hendy RM, Mahmoud EM, Abd Elhamed ME, et al. Comparative Evaluation of Chest Ultrasonography and Computed Tomography as Predictors of Malignant Pleural Effusion: A Prospective Study. Diagnostics (Basel). 2024 May 17;14(10):1041. doi: 10.3390/diagnostics14101041.
5. Zaki HA, Albaroudi B, Shaban EE, Shaban A, Elgassim M, Almarri ND, et al. Advancement in pleura effusion diagnosis: a systematic review and meta-analysis of point-of-care ultrasound versus radiographic thoracic imaging. Ultrasound J. 2024 Jan 23;16(1):3. doi: 10.1186/s13089-023-00356-z.
6. Padrez KA, Graglia S. Lung point-of-care ultrasound in the assessment of pleural effusions. Emerg Med J. 2023 Mar;40(3):228-231. doi: 10.1136/emermed-2021-211886.
7. Maw AM, Hassanin A, Ho PM, McInnes MDF, Moss A, Juarez-Colunga E, et al. Diagnostic Accuracy of Point-of-Care Lung Ultrasonography and Chest Radiography in Adults with Symptoms Suggestive of Acute Decompensated Heart Failure: A Systematic Review and Meta-analysis. JAMA Netw Open. 2019 Mar 1;2(3):e190703. doi: 10.1001/jamanetworkopen.2019.0703.
8. Halata D, Zhor D, Skulec R, Seifert B. Accuracy of point-of-care ultrasound examination of the lung in primary care performed by general practitioners: a cross-sectional study. BMC Prim Care. 2025 Apr 8;26(1):99. doi: 10.1186/s12875-025-02802-4.
9. Kılıç B, Khoraki Y, Sağlam ÖF, Özçıbık Işık G, Turan T, Erşen E, et al. The diagnostic value of thoracic ultrasound in thoracic surgery consultations: a new tool in pleural effusion decision-making. Kardiochir Torakochirurgia Pol. 2025 Mar;22(1):1-7. doi: 10.5114/kitp.2025.148550.
10. Kummerfeldt CE, Chopra A, Albaba I, Dutta S, Huggins JT, Ioachimescu O, Hu K. The accuracy of thoracic ultrasound in differentiating transudative from exudative effusions: A meta-analysis. Respir Med. 2025 Oct;247:108296. doi: 10.1016/j.rmed.2025.108296.
11. Hamza Yousef MS, Al Azizi HM, Fouad MM. Point of care ultrasound as a bedside diagnostic tool in acute dyspnea patients in emergency department for timely management. Respir Med. 2025 Dec;250:108500. doi: 10.1016/j.rmed.2025.108500.
12. Roberts ME, Rahman NM, Maskell NA, Bibby AC, Blyth KG, Corcoran JP, et al. British Thoracic Society Guideline for pleural disease. Thorax. 2023 Jul;78(Suppl 3):s1-s42. doi: 10.1136/thorax-2022-219784.