

JOURNAL OF ALLIED HEALTH CLINICAL RESEARCH AND INNOVATION

Volume 1 | Issue 3 | September (2026)
www.jahcri.com

Review Article

Open Access

Imaging-Guided Respiratory Care: The Role of Chest Radiography, Computed Tomography, and Lung Ultrasound in Respiratory Therapy Practice

Eldhos Jacob^{1*}, Ajay Chand P², Antonio M. Esquinas³

¹Department of Respiratory Medicine, Father Muller Medical College Hospital, Mangalore, India.

²Department of Medical Imaging Technology, Father Muller College of Allied Health Sciences, Mangalore, India.

³Intensive Care Unit, Hospital Morales Meseguer, NIV-ICU Group, Biomedical Research Institute Pascual Parrilla-IMIB, Murcia, Spain.

Received: 26 August 2026, Revised: 10 Sep 2026, Accepted: 20 Sep 2026

***Correspondence:** Eldhos Jacob,
Department of Respiratory Medicine, Father
Muller Medical College Hospital, Mangaluru,
India. Email: eldhos.jacob2@gmail.com

Copyrights: © The Author(s). Published by
MedWise Spectrum Academy. This is an open-access
article under the CC BY 4.0 licence, permitting use,
distribution, and reproduction in any medium,
provided the original work is properly cited.

ABSTRACT

Imaging is an integral component of contemporary respiratory and critical care, providing structural and increasingly functional information that complements clinical examination, respiratory physiology, and monitoring. Respiratory therapists (RTs) participate in the assessment and management of patients receiving oxygen therapy, non-invasive respiratory support, invasive mechanical ventilation, airway clearance, and weaning. Understanding clinically relevant thoracic imaging can therefore support timely recognition of respiratory deterioration and communication within multidisciplinary teams. This narrative review examines the roles of chest radiography, computed tomography (CT), and lung ultrasound (LUS) in respiratory therapy (RT) practice and considers how imaging can be integrated with bedside physiological assessment. Chest radiography remains important for evaluating pulmonary opacities, atelectasis, pulmonary edema, pneumothorax, pleural abnormalities, and respiratory-device position. CT provides high-resolution anatomical information and can quantify regional lung aeration and structural disease, particularly in heterogeneous acute respiratory distress syndrome (ARDS). LUS provides radiation-free, repeatable bedside assessment of pleural and peripheral pulmonary abnormalities and has increasing evidence in acute respiratory failure, lung aeration assessment, and weaning. Emerging evidence also supports structured LUS education for RTs, although competency standards and longitudinal outcome data remain limited. Imaging should complement, rather than replace, clinical assessment and respiratory physiology. The most useful model is an integrated pathway in which imaging findings are interpreted alongside gas exchange, respiratory mechanics, ventilator waveforms, work of breathing, and treatment response. Quantitative CT, artificial intelligence, dynamic chest radiography, and electrical impedance tomography may further expand personalised imaging-guided respiratory care. Implementation should occur within local scope-of-practice, credentialing, and multidisciplinary governance frameworks.

Keywords: Chest Radiography, Computed Tomography, Lung Aeration, Lung Ultrasound, Mechanical Ventilation, Point-Of-Care Ultrasound, Respiratory Care, Respiratory Therapy.

INTRODUCTION

Respiratory assessment integrates clinical examination, gas exchange, respiratory mechanics, ventilator parameters, and imaging findings.

Thoracic imaging provides structural information and, with newer modalities, additional regional information about lung aeration, pleural abnormalities, and diaphragmatic function.^[1,2,3] This

complementary information is particularly relevant when respiratory status changes rapidly, or conventional examination is limited.

Respiratory therapists contribute to oxygen therapy, airway management, non-invasive and invasive

ventilatory support, airway clearance, pulmonary function assessment, and monitoring of patients with respiratory failure.^[1-3] As respiratory care becomes increasingly physiology-driven, imaging literacy may help RTs connect anatomical abnormalities with bedside physiological findings and communicate more effectively with pulmonologists, intensivists, radiologists, nurses, and other clinicians.

The role of point-of-care ultrasound (POCUS), particularly LUS, is evolving within respiratory therapy. A 2022 scoping review identified seven studies evaluating POCUS education for RTs and concluded that training was feasible while standardised curricula and patient-centred outcome research were still needed.^[1] A 2024 international survey of 514 RTs from 22 countries found substantial interest in incorporating LUS into respiratory therapy practice and emphasised structured education and curricular integration.^[2] A 2025 updated scoping review identified 133 studies involving physiotherapists, physical therapists, and RTs using diaphragm and/or lung ultrasound, with a marked increase in studies addressing education and implementation.^[3] These developments support a broader discussion of imaging-guided respiratory care rather than a review limited to one imaging modality.

The central concept of this review is that imaging should be linked to a clinical pathway: imaging finding → physiological interpretation → respiratory assessment → targeted intervention → reassessment. The purpose is not to redefine the diagnostic role of radiologists or physicians, but to

describe how imaging can complement respiratory therapy assessment and decision-making within an appropriately governed multidisciplinary model.

METHODS

Literature search

A narrative literature review was undertaken using PubMed/MEDLINE and peer-reviewed literature identified through targeted searches. Search concepts included respiratory therapy, respiratory therapists, chest radiography, computed tomography, quantitative computed tomography, lung ultrasound, point-of-care ultrasound, mechanical ventilation, non-invasive ventilation, acute respiratory failure, acute respiratory distress syndrome, weaning, diaphragm ultrasound, electrical impedance tomography, dynamic chest radiography, and artificial intelligence. Priority was given to literature published from 2020 through 2026, while earlier landmark studies and consensus recommendations were retained when necessary. Relevant reference lists were also examined. Because this article is a narrative review rather than a systematic review or meta-analysis, no formal risk-of-bias synthesis or pooled effect estimate was performed.

Chest radiography in respiratory care

Chest radiography remains a widely available and rapidly deployable imaging modality in acute respiratory and critical care. Portable radiography is particularly valuable when a patient cannot safely leave the intensive care unit. In addition to lung parenchymal abnormalities, chest radiographs can assess the position and complications of devices such as endotracheal tubes, tracheostomy tubes, central venous catheters, chest tubes, and nasogastric tubes.^[4]

For respiratory therapists, clinically relevant radiographic findings include atelectasis, consolidation, pulmonary oedema, pleural effusion,

pneumothorax, and diffuse pulmonary opacities. A new lobar or dependent opacity may prompt assessment for secretion retention, mucus plugging, impaired lung expansion, positioning, or other causes of regional hypoventilation. Increasing bilateral opacities may raise concern for pulmonary oedema, infection, diffuse alveolar injury, or other processes. None of these findings should be interpreted in isolation. Oxygen requirement, work of breathing, breath sounds, respiratory mechanics, ventilator pressures, secretion burden, and blood gas results remain essential for determining physiological significance.

The role of routine daily chest radiography has also changed. Contemporary practice increasingly favours clinically indicated imaging rather than automatic daily radiographs in stable mechanically ventilated patients. Large observational data have shown persistent use of daily chest radiography despite recommendations against routine daily imaging, while the evidence base has not demonstrated patient-centred benefit from indiscriminate daily imaging.^[5] For respiratory care, the relevant question is therefore not whether a patient is mechanically ventilated, but whether the radiograph is being obtained to answer a specific clinical question.

Computed tomography in respiratory care

CT provides substantially greater anatomical resolution than conventional radiography and is useful for evaluating complex parenchymal, airway, pleural, vascular, and structural disease. In respiratory practice, CT is particularly relevant to bronchiectasis, emphysema, interstitial lung disease, complicated infection, pulmonary embolism, and heterogeneous acute lung injury.^[6,7]

The major advantage of CT for respiratory physiology is its ability to demonstrate regional heterogeneity. In ARDS, CT has helped characterise

gravity-dependent collapse, non-aerated and poorly aerated lung, normally aerated regions, and hyperinflated regions. Quantitative CT uses attenuation values expressed in Hounsfield units to estimate the relative distribution of lung aeration. Commonly used thresholds classify tissue as hyperinflated, normally aerated, poorly aerated, or non-aerated.^[6,7] These measurements can provide information that cannot be obtained from global oxygenation alone.

Recent literature has moved CT from qualitative description toward quantitative and multimodal analysis. A 2026 narrative review describes progression from conventional morphological assessment toward quantitative CT, CT-based phenotyping, and artificial-intelligence-assisted analysis of ARDS.^[8] Another 2026 review emphasises that CT provides regional three-dimensional information on aeration, density, lung weight, and perfusion abnormalities and may complement bedside physiology when characterising ARDS heterogeneity.^[9] These developments are relevant to respiratory therapists because two patients with similar oxygenation impairment may have different regional patterns of collapse, consolidation, or hyperinflation and may therefore require different clinical approaches.

Despite its advantages, CT has important limitations. It exposes patients to ionising radiation, is generally intermittent rather than continuous, and often requires transport of unstable patients. CT should therefore not be considered a routine bedside tool for repeated ventilator titration; rather, it is most useful when the anatomical or physiological question cannot be adequately answered by clinical examination, radiography, ultrasound, or other bedside methods.^[6,7]

Lung ultrasound in respiratory care

LUS is portable, radiation-free, repeatable, and capable of real-time assessment at the bedside. These characteristics make it particularly attractive for patients with acute respiratory failure and for serial monitoring during respiratory support. Contemporary evidence-based recommendations have expanded the clinical framework for point-of-care LUS, addressing technical performance, ultrasound signs, monitoring, lung aeration, and clinical applications.^[10]

A-lines generally indicate preserved air-filled lung at the pleural interface, whereas multiple B-lines indicate increased density of the subpleural lung and may occur with interstitial or alveolar processes. Pleural sliding, lung point, consolidation, pleural effusion, and other signs can provide additional information. Interpretation requires attention to scanning technique and clinical context because individual ultrasound signs are not disease-specific.^[10,11,12]

In acute respiratory failure, LUS can help evaluate pulmonary oedema, pneumonia-related consolidation, pleural effusion, pneumothorax, and changes in lung aeration. A 2025 review described LUS as a rapid bedside tool with increasing value in acute respiratory failure and noted that it can outperform chest radiography for several peripheral thoracic abnormalities when performed by experienced clinicians.^[11] A 2021 systematic review and meta-analysis of lung ultrasound in critically ill patients with acute respiratory failure reported pooled sensitivity of 92% and specificity of 98%, with high diagnostic performance across several major thoracic pathological categories; however, most included studies were considered to be of low quality.^[12]

The most recent evidence is particularly relevant to ARDS. A 2026 systematic review and meta-analysis included 16 studies and 5,888 patients and reported

pooled sensitivity of 0.75, specificity of 0.87, and an area under the receiver operating characteristic curve of 0.91 for LUS-based ARDS diagnosis.^[13] These results support LUS as a useful adjunct, but they also reinforce that performance depends on protocol, operator experience, reference standards, and disease phenotype.

Lung ultrasound and respiratory therapists

The expansion of LUS into respiratory therapy is supported by a growing education and implementation literature. The initial RT-specific scoping review found only seven eligible studies, indicating that formal education standards were underdeveloped.^[1] A subsequent prospective curriculum study trained 10 RTs and reported that participants could independently acquire and interpret LUS examinations with accuracy above 85% after training; the study provided early evidence that structured curricula can establish and sustain competency.^[14]

The 2024 international survey of 514 RTs further demonstrated interest in LUS adoption and highlighted the need for structured education.^[2] In 2025, Luo et al. evaluated a dedicated LUS training program for RTs. Twenty-three RTs completed initial training, and seven completed both initial and refresher assessments. Knowledge improved significantly after initial training, declined over six to nine months without reinforcement, and improved again after refresher training.^[15] These findings suggest that competency should be maintained through repeated clinical exposure and periodic reassessment rather than a single introductory course.

The 2025 updated scoping review provides the broadest picture to date, identifying 133 studies involving therapists using diaphragm and/or lung ultrasound across 26 countries. Eighteen studies specifically involved respiratory therapists, while

many additional studies included other therapy professions. The authors noted rapid growth in education and implementation research but emphasised that direct evidence of patient-centred outcome benefit remains limited.^[3]

Accordingly, RT use of LUS should be framed as a competency-based extension of respiratory assessment rather than independent replacement of formal radiological diagnosis. Training should include ultrasound physics, thoracic anatomy, standardised scanning, recognition of common findings, image documentation, clinical correlation, limitations, escalation pathways, and supervised competency assessment. The precise scope should follow institutional policy, professional regulation, credentialing, and multidisciplinary governance.

Imaging-guided mechanical ventilation

Mechanical ventilation should be individualised according to disease process, respiratory mechanics, gas exchange, patient response, and risk of ventilator-induced lung injury. Imaging can add regional information to otherwise global measurements such as oxygen saturation, $\text{PaO}_2/\text{FiO}_2$ ratio, respiratory system compliance, and airway pressure.^[6,7]

Radiography may identify new atelectasis, pneumothorax, worsening infiltrates, or device complications. CT can characterise the extent and distribution of collapse, consolidation, and hyperinflation. LUS can provide repeated bedside information about peripheral lung aeration and pleural abnormalities. The most useful approach is to integrate these findings with ventilator waveforms, tidal volume, plateau pressure, driving pressure, compliance, work of breathing, and clinical trajectory.^[6,7]

Imaging should not be treated as a direct prescription for ventilator settings. CT-based recruitability or aeration measurements may identify potentially

recruitable lung, but recruitment does not automatically translate into improved outcomes. Similarly, an increase in LUS aeration does not by itself establish that a particular intervention is beneficial. Imaging is best used as one component of a physiology-guided decision rather than as a stand-alone determinant of PEEP or recruitment.^[6,7]

Imaging-guided non-invasive respiratory support

Patients receiving high-flow nasal oxygen, continuous positive airway pressure, or bilevel non-invasive ventilation may deteriorate because of pulmonary oedema, pneumonia, atelectasis, pneumothorax, pulmonary embolism, or other causes. Imaging can help identify the underlying process and monitor response when used with clinical assessment.^[10,11,12]

LUS is particularly attractive for serial assessment because it can be repeated at the bedside without radiation or transport. Changes in B-lines, consolidation, pleural effusion, or aeration patterns may complement changes in oxygen requirement, respiratory rate, work of breathing, and gas exchange.

CT remains important when a more definitive anatomical or vascular assessment is required. Chest radiography remains useful when portable imaging is sufficient to answer the clinical question.^[10,11,12]

Imaging for airway clearance and atelectasis

Airway secretion retention and mucus plugging can contribute to lobar or segmental atelectasis, particularly in mechanically ventilated, postoperative, neurologically impaired, and debilitated patients. Radiography may demonstrate volume loss or new focal opacity, while CT can show airway obstruction and the anatomical distribution of mucus plugging. LUS may identify peripheral atelectatic or consolidated regions and

can be used serially when the abnormality is accessible to ultrasound.^[4,6,10,11,12]

Imaging should not replace bedside assessment of secretion burden, cough effectiveness, airway patency, or patient-ventilator interaction. Instead, it can provide anatomical context and, when

appropriate, objective evidence of change after airway-clearance interventions. This creates an opportunity for respiratory therapists to connect treatment delivery with measurable physiological and imaging outcomes, as illustrated in the imaging finding-to-respiratory-care framework in Table 1.

Table 1. Imaging Finding-to-Respiratory-Care Framework

Imaging finding	Possible physiological implication	Bedside assessment	Potential respiratory-care response	Reassessment
Dependent atelectasis	Reduced regional aeration	SpO ₂ , work of breathing, breath sounds, compliance, secretion burden	Positioning, airway clearance, lung-expansion strategy when clinically appropriate	Clinical response; repeat imaging when indicated
Diffuse B-lines	Increased subpleural/interstitial density	Oxygen requirement, work of breathing, fluid/cardiac context	Optimise respiratory support and coordinate treatment of underlying cause	Serial LUS and clinical parameters
Peripheral consolidation	Focal loss of aeration	Oxygenation, fever/infection context, secretion burden	Supportive care and airway-clearance strategy when appropriate	Clinical and imaging response
Pneumothorax	Loss of ventilated lung volume	Acute change in oxygenation/work of breathing; ventilator changes	Urgent escalation according to institutional pathway	Follow-up imaging as clinically indicated
Diffuse CT heterogeneity	Regional collapse, normal aeration, or hyperinflation	Compliance, pressures, gas exchange, ventilator waveforms	Individualised ventilatory strategy led by treating team	Physiology and selected repeat imaging

Abbreviations: CT, computed tomography; LUS, lung ultrasound; SpO₂, peripheral oxygen saturation.

Note: Imaging findings are nonspecific and should be interpreted in conjunction with clinical examination, respiratory physiology, and the overall clinical context. Respiratory-care interventions should follow institutional protocols and the treating team's clinical assessment.

Source: Constructed framework based on the literature cited in references.^[4,6,10,11,12,13]

Imaging and weaning from mechanical ventilation

Liberation from mechanical ventilation depends on respiratory muscle function, pulmonary mechanics, gas exchange, cardiovascular stability, neurological status, airway protection, and secretion management. LUS and diaphragm ultrasound have

therefore been investigated as adjuncts to conventional spontaneous breathing trial assessment.

A 2024 systematic review and meta-analysis included 14 studies, with 13 studies and 988 patients contributing to the quantitative analysis. LUS predicted extubation failure with pooled sensitivity of 0.86, specificity of 0.75, and an area under the curve of 0.87.^[16] These findings suggest useful predictive information, but heterogeneity in LUS thresholds, definitions of extubation failure, and

study design limits direct translation into a single clinical cutoff.

For respiratory therapists, LUS and diaphragm ultrasound may therefore be most useful as complementary tools. They should be interpreted alongside spontaneous breathing trial tolerance, respiratory rate, tidal volume, work of breathing, cough strength, secretion burden, gas exchange, and clinical readiness for extubation, with key imaging considerations during respiratory support summarised in Table 2.

Table 2. Imaging Considerations During Respiratory Support

Clinical situation	Preferred imaging contribution	Key physiological variables	Important caution
Invasive ventilation	CXR for devices/major changes; LUS for serial bedside assessment; CT for complex questions	Compliance, airway pressures, tidal volume, oxygenation	Do not use imaging alone to prescribe ventilator settings
NIV/HFNC	LUS for serial peripheral findings; CXR/CT when diagnostic clarification is needed	Work of breathing, oxygen requirement, respiratory rate, gas exchange	Clinical deterioration requires escalation regardless of imaging
Suspected atelectasis	CXR/LUS; CT when cause is unclear or obstruction suspected	Secretion burden, breath sounds, oxygenation, mechanics	Imaging does not replace airway assessment
Weaning/extubation	LUS and diaphragm ultrasound as adjuncts	SBT tolerance, respiratory rate, tidal volume, cough, secretions	No single ultrasound cutoff should replace clinical readiness assessment

Abbreviations: CXR, chest radiography; CT, computed tomography; HFNC, high-flow nasal cannula; LUS, lung ultrasound; NIV, non-invasive ventilation; SBT, spontaneous breathing trial.

Note: Imaging should complement rather than replace clinical assessment, respiratory physiology,

ventilator parameters, and readiness criteria. No single imaging finding should independently determine ventilator settings or extubation decisions.

Source: Constructed framework based on the literature cited in references.^[4,10,11,12,13,16]

Multidisciplinary radiology-respiratory therapy practice

Imaging-guided respiratory care requires clearly defined professional boundaries and effective

communication. Radiologists provide formal interpretation of diagnostic imaging, while respiratory

therapists contribute detailed knowledge of respiratory physiology, ventilatory support, airway

management, and response to interventions.

Pulmonologists and intensivists integrate these data into diagnostic and therapeutic decisions.^[1,2,3,10]

A practical multidisciplinary model is to ask four questions: What does the imaging show? What physiological problem could explain the finding? Does the bedside assessment support that interpretation? Has the patient changed after the intervention? This approach reduces the risk of treating an image without considering the patient and promotes shared clinical reasoning.

Emerging imaging technologies

Quantitative CT is increasingly supported by automated segmentation and computational analysis. Recent reviews describe the transition from qualitative CT interpretation toward quantitative assessment of aeration, perfusion, lung density, and imaging-based ARDS subphenotyping.^[8,9] Artificial intelligence may assist with segmentation, pattern recognition, longitudinal comparison, and multimodal data integration. However, algorithmic outputs should remain decision-support tools

because performance can vary by population, acquisition protocol, disease prevalence, and software.

Dynamic chest radiography is another emerging technology. It produces sequential thoracic radiographs during respiration and can provide information about diaphragm and chest-wall motion, ventilation-related changes, perfusion-related information, and airway narrowing. A 2023 systematic review identified 29 human publications but emphasised that most studies were small and heterogeneous and that the clinical niche of the technology remains under development.^[17]

Electrical impedance tomography (EIT) provides radiation-free, continuous bedside information about regional changes in thoracic impedance and therefore regional ventilation. A 2024 systematic review and meta-analysis of EIT-guided PEEP titration in ARDS included 13 studies and 623 patients and reported improvements in compliance, mechanical power, and driving pressure, although the evidence base contained substantial non-randomised data.^[18] A 2026 meta-analysis found improved oxygenation and respiratory system compliance with EIT-guided PEEP but no significant mortality difference, emphasising the need for further evidence on patient-centred outcomes.^[19] EIT is therefore promising but should not yet be considered a universal replacement for established ventilator management strategies. The principal characteristics, applications, limitations, and potential respiratory therapy relevance of the major imaging modalities are summarised in Table 3.

Table 3. Comparison of Major Imaging Modalities Used in Respiratory Care

Modality	Main strengths	Key respiratory applications	Important limitations	RT relevance
Chest radiography	Portable, rapid, widely available	Atelectasis, oedema, consolidation, pneumothorax, device position	Projectional limitations; lower sensitivity for some abnormalities	Correlate findings with oxygenation, mechanics, devices, and treatment response
Chest CT	High spatial resolution; regional and quantitative information	ARDS heterogeneity, emphysema, bronchiectasis, ILD, PE, complex infection	Radiation; transport; intermittent assessment	Interpret regional disease in relation to respiratory mechanics and clinical phenotype
Lung ultrasound	Bedside, repeatable, radiation-free, real-time	Oedema, consolidation, pleural effusion, pneumothorax, aeration, weaning	Operator dependence; limited deep-lung visualisation	Potential bedside imaging competency with training and governance
Dynamic chest radiography	Functional information during respiration with low-dose X-ray	Diaphragm/chest-wall motion, ventilation/perfusion-related assessment	Emerging technology; limited evidence and availability	Potential future assessment of respiratory mechanics and diaphragm function
Electrical impedance tomography	Continuous, radiation-free regional ventilation monitoring	Ventilation distribution and PEEP titration	Specialised equipment and training; outcome evidence evolving	Potential integration with ventilator management

Abbreviations: ARDS, acute respiratory distress syndrome; CT, computed tomography; EIT, electrical impedance tomography; ILD, interstitial lung disease; LUS, lung ultrasound; PE, pulmonary embolism; PEEP, positive end-expiratory pressure; RT, respiratory therapist.

Source: Compiled from the literature cited in references.^[4,5,6,7,8,9,10,11,12,13,17,18,19]

Training, governance, and competency

A safe imaging competency pathway for RTs should include foundational ultrasound physics, thoracic anatomy, standardised scanning protocols, common lung and pleural findings, image optimisation, documentation, clinical integration, limitations, and escalation. Practical assessment should include supervised image acquisition and interpretation,

with periodic reassessment. The observed decline in knowledge after six to nine months without refresher education supports longitudinal competency maintenance.^[15]

Institutional governance is equally important. The authority to acquire, document, interpret, and act on imaging findings varies among jurisdictions and institutions. RT programs should therefore define credentialing requirements, supervision, quality assurance, image archiving, documentation standards, and communication pathways with radiology and medical teams. Adoption should be based on demonstrated competence rather than professional title alone. A proposed competency framework for respiratory therapists using lung ultrasound is presented in Table 4.

Table 4. Proposed Competency Framework for Respiratory Therapists Using Lung Ultrasound

Domain	Minimum competency focus	Quality-assurance approach
Foundations	Ultrasound physics, controls, artefacts, thoracic anatomy	Written/oral assessment
Image acquisition	Standardised lung/pleural zones, image optimisation, documentation	Observed practical assessment
Pattern recognition	A-lines, B-lines, consolidation, pleural effusion, pneumothorax	Image-based assessment and expert review
Clinical integration	Link imaging to oxygenation, mechanics, work of breathing, and treatment response	Case-based assessment
Safety and escalation	Recognise limitations and findings requiring immediate medical review	Simulation and supervised clinical practice
Maintenance	Ongoing scanning, audit, feedback, refresher education	Periodic competency reassessment

Abbreviations: LUS, lung ultrasound; RT, respiratory therapist.

Note: The proposed framework is intended as a conceptual educational and quality-assurance framework. Specific credentialing, scope of practice, supervision, and competency requirements should follow applicable institutional, regulatory, and professional standards.

Source: Constructed framework informed by the literature cited in references.^[1,3,14,15]

Limitations and evidence gaps

The evidence base for imaging-guided respiratory therapy remains uneven. Much of the RT-specific LUS literature consists of educational, observational, survey, or feasibility studies. The 2025 scoping review found substantial growth in the field but also emphasised the limited evidence linking therapist-performed LUS directly to patient outcomes.^[3] LUS performance is operator- and protocol-dependent, CT requires transport and radiation exposure, and chest radiography may have

limited sensitivity for some peripheral or early abnormalities.

Another limitation is that imaging abnormalities are often nonspecific. B-lines can reflect pulmonary oedema, interstitial disease, or other conditions; bilateral radiographic opacities have a broad differential; and CT findings may not correlate perfectly with oxygenation or treatment response. These limitations reinforce the need for integrated clinical interpretation.

Future directions

Future research should move beyond demonstrating that RTs can acquire images toward determining whether imaging-guided respiratory care improves patient-centred outcomes. Multicentre trials should evaluate standardised RT LUS curricula, competency retention, diagnostic agreement, time to clinical intervention, duration of respiratory support, ICU length of stay, and safety outcomes. Studies should also compare different LUS protocols and determine how imaging should be integrated with

ventilator waveforms, respiratory mechanics, gas exchange, and clinical scoring systems.

Multimodal imaging is likely to be particularly important. Quantitative CT can provide detailed regional structure, LUS can provide repeated bedside assessment, and EIT can provide continuous regional ventilation monitoring. Dynamic chest radiography and artificial intelligence may further bridge the gap between static anatomical imaging and functional respiratory assessment. The future model is therefore unlikely to depend on one modality; instead, it will combine complementary information according to the clinical question and the patient's stability.

CONCLUSIONS

Chest radiography, computed tomography, and lung ultrasound provide complementary information that can strengthen respiratory assessment. Chest radiography remains valuable for rapid evaluation of pulmonary abnormalities and thoracic devices, CT provides detailed structural and quantitative information about heterogeneous lung disease, and LUS offers portable, radiation-free, repeatable bedside assessment. The growing literature on RT-performed LUS indicates that structured education and competency assessment are feasible, but evidence linking imaging-guided RT practice to patient-centred outcomes remains limited.

The most clinically useful approach is to integrate imaging findings with respiratory physiology, ventilator parameters, gas exchange, clinical examination, and treatment response. Respiratory therapists can contribute meaningfully to this process within defined scope-of-practice and multidisciplinary governance frameworks. Further research should determine whether standardised imaging competencies and multimodal imaging pathways can improve the safety, efficiency, and personalisation of respiratory care.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Eldhos Jacob, Ajay Chand P, Antonio M. Esquinas

Acquisition, analysis, or interpretation of data: Eldhos Jacob, Ajay Chand P, Antonio M. Esquinas

Drafting of the manuscript: Eldhos Jacob, Ajay Chand P, Antonio M. Esquinas

Critical review of the manuscript for important intellectual content: Eldhos Jacob, Ajay Chand P, Antonio M. Esquinas

Supervision: Eldhos Jacob, Ajay Chand P, Antonio M. Esquinas

Ethics approval: Not Applicable

Conflicts of interest: The authors declare no competing financial or personal interests related to this work.

Funding: Nil

Acknowledgements

The authors acknowledge the use of OpenAI's ChatGPT solely for language refinement and editorial improvement of the manuscript. All scientific content was reviewed and approved by the authors, who take full responsibility for the accuracy and integrity of the final manuscript.

REFERENCES

1. Kappel C, Chaudhuri D, Hassall K, et al. Point-of-care ultrasound training for respiratory therapists: a scoping review. *Can J Respir Ther*. 2022;58:28-33. doi:10.29390/cjrt-2021-065.
2. Mathew CS, Dias E, Kalathikudiyil Sreedharan J, et al. Lung ultrasound in respiratory therapy: a global reflective survey. *Multidiscip Respir Med*. 2024;19:980. doi:10.5826/mrm.2024.980.
3. Hayward S, Cardinael C, Tait C, et al. Exploring

- the adoption of diaphragm and lung ultrasound (DLUS) by physiotherapists, physical therapists, and respiratory therapists: an updated scoping review. *Ultrasound J.* 2025;17:9. doi:10.1186/s13089-025-00412-w.
4. Baratella E, Marrocchio C, Bozzato AM, et al. Chest X-ray in intensive care unit patients: what there is to know about thoracic devices. *Diagn Interv Radiol.* 2021;27:633-638. doi:10.5152/dir.2021.20497.
 5. Gershengorn HB, Wunsch H, Scales DC, et al. Trends in use of daily chest radiographs among US adults receiving mechanical ventilation. *JAMA Netw Open.* 2018;1(4):e181119. doi:10.1001/jamanetworkopen.2018.1119.
 6. Malbouisson LM, Muller JC, Constantin JM, et al. Computed tomography assessment of positive end-expiratory pressure-induced alveolar recruitment in patients with acute respiratory distress syndrome. *Am J Respir Crit Care Med.* 2001;163(6):1444-1450. doi:10.1164/ajrccm.163.6.2005001.
 7. Chiumello D, Marino A, Brioni M, et al. Visual anatomical lung CT scan assessment of lung recruitability. *Intensive Care Med.* 2013;39(1):66-73. doi:10.1007/s00134-012-2707-9.
 8. Xu Z, Wu Y, Wang A, et al. Computed tomography in ARDS, from morphological insights to AI-powered multi-modal analysis: a narrative review. *J Intensive Care.* 2026;14:45. doi:10.1186/s40560-026-00883-6.
 9. Garberi R, Jabaudon M, Bayat S, et al. Characterizing heterogeneity and subphenotyping acute respiratory distress syndrome with computed tomography. *Intensive Care Med Exp.* 2026;14:38. doi:10.1186/s40635-026-00880-x.
 10. Volpicelli G, Gargani L, Zieleskiewicz L, et al. International evidence-based recommendations for point-of-care lung ultrasound: 2025 focused update of the 2012 recommendations. *Intensive Care Med.* 2026;52(7):1415-1446. doi:10.1007/s00134-026-08487-2.
 11. Flower L, Qawi I, Minami T. Lung ultrasound in acute respiratory failure. *Crit Care Clin.* 2025;41(3):443-453. doi:10.1016/j.ccc.2025.02.001.
 12. Yuan X, Liu L, Chang W, et al. Diagnosis accuracy of lung ultrasound for ARF in critically ill patients: a systematic review and meta-analysis. *Front Med (Lausanne).* 2021;8:705960. doi:10.3389/fmed.2021.705960.
 13. Sreedharan JK, Alqahtani AS, Albalawi IA, et al. Lung ultrasound for acute respiratory distress syndrome diagnosis: a systematic review and meta-analysis. *Respir Med.* 2026;256:108802. doi:10.1016/j.rmed.2026.108802.
 14. Young A, Wu D, Myslik F, et al. Acquisition and retention of lung ultrasound skills by respiratory therapists: a curriculum for respiratory therapists. *Can J Respir Ther.* 2023;59:26-32. doi:10.29390/cjrt-2021-077.
 15. Luo L, Weiss T, Zorce AD, et al. Lung ultrasound training for respiratory therapists. *Respir Care.* 2025;70(7):879-886. doi:10.1089/respcare.12291.
 16. Zhang Z, Guo L, Wang H, et al. Diagnostic accuracy of lung ultrasound to predict weaning outcome: a systematic review and meta-analysis. *Front Med (Lausanne).* 2024;11:1486636. doi:10.3389/fmed.2024.1486636.
 17. Fyles F, FitzMaurice TS, Robinson RE, et al. Dynamic chest radiography: a state-of-the-art review. *Insights Imaging.* 2023;14:107. doi:10.1186/s13244-023-01451-4.
 18. Songsangvorn N, Xu Y, Lu C, et al. Electrical impedance tomography-guided positive end-expiratory pressure titration in ARDS: a systematic review and meta-analysis. *Intensive Care Med.* 2024;50(5):617-631. doi:10.1007/s00134-024-07362-2.
 19. Rauseo M, Azzolina D, Scaramuzzo G, et al. Personalised positive-end expiratory pressure using electrical impedance tomography in ARDS patients: a systematic review and meta-analysis. *Ann Intensive Care.* 2026;16:100049. doi:10.1016/j.aicj.2026.100049.

Cite this article as: Eldhos J, Ajay Chand P, Esquinas AM. Imaging-Guided Respiratory Care: The Role of Chest Radiography, Computed Tomography, and Lung Ultrasound in Respiratory Therapy Practice. *J Allied Health Clin Res Innov.* 2026;1(3): 81-92. DOI:10.67920/jahcri.2026.15