Diagnostic Accuracy of Lung Ultrasound Versus Chest X-ray for Pediatric Pneumonia: A Systematic Review and Meta-Analysis

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Abstract

Background: Community-acquired pneumonia (CAP) is a significant contributor to childhood morbidity and mortality globally in children <5y of age. Chest X-ray (CXR) was the mainstay for supporting the clinical diagnosis of pediatric pneumonia; however the cost and potential risks of radiation and access have been noted in resource-limited areas. Portable lung ultrasound (LUS) is a radiation-free alternative, which has reported high diagnostic accuracy.

Objective: To systematically review the published literature (2020–2026) evaluating the diagnostic accuracy of LUS against CXR for the diagnosis of pediatric pneumonia and to provide a summary of pooled sensitivity and specificity values.

Methods: Electronic searches were conducted for diagnostic-accuracy studies and systematic reviews/meta-analyses comparing LUS versus CXR in children (0–18 y of age) with suspected/confirmed CAP published between January 2020 and July 2026. Data on design, population, reference standard and results were extracted by two reviewers independently whenever available. QUADAS-2 was used to critically appraise methodological quality of the included studies. **Results:** Overall, 20 diagnostic-accuracy studies (2020–2025) and 5 systematic reviews/meta-analyses (2020–2024) met the criteria. Based on the most extensive meta-analysis (26 studies, 3,401 children) pooled sensitivity/specificity were LUS 95%/92% versus CXR 92%/93%. Another subsequent updated meta-analysis reported values of LUS sensitivity/specificity of 95.5%/96.3% and CXR 87.4%/98.6%. Individual primary studies published since 2020 consistently showed LUS sensitivity from 61–99.1%, generally equivalent or better than CXR with a wide spectrum of specificity based on the locale.

Conclusion: Lung ultrasound seems to be a suitable alternative and addendum to standard CXR in this condition; however this conclusion must be interpreted with cautions due to ambiguity in references and potential variability in operator skills.

Keywords: *lung ultrasound; chest X-ray; pediatric pneumonia; diagnostic accuracy; systematic review; meta-analysis; point-of-care ultrasound*

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1. **Introduction** Pneumonia represents one of the most significant causes of childhood morbidity and mortality worldwide, making it the number one cause of death in children <5 years outside the neonate. Clinical diagnosis of childhood Community Acquired Pneumonia (CAP) relies on a combination of fever, tachypnea, cough, chest in drawing, and hypoxia; however, these clinical features are often non-specific and overlap with bronchiolitis, asthma and other lower respiratory tract infections. Therefore, imaging is commonly employed to aid clinical diagnosis and to guide management and for use as part of a reference standard in research (Al-Harbi,et al.,2025).Chest Radiography (CXR) is the conventional imaging modality for suspected paediatric pneumonia; however, it is not an ideal reference standard as it has significant inter-observer variation, involves

exposure of radiation and has limited sensitivity in demonstrating interstitial disease or early pneumonia. Point-of-care lung ultrasound (LUS) as a portable, radiation-free and repeatable imaging modality provides an attractive alternative. The paediatric chest-due to its smaller size and thin chest wall-is amenable to LUS, and in recent years a large number of primary studies and subsequent meta-analyses have demonstrated high diagnostic accuracy for LUS in the diagnosis of childhood CAP (Al-Shehri et al.,2023).A foundational meta-analysis published in 2018 by Balk et al. Analysed data from 12 studies (1,510 patients) and showed LUS sensitivity 95.5%, specificity 95.3% for paediatric pneumonia compared to CXR sensitivity 86.8% and specificity 98.2%. In recent years, further primary studies and thus systematic reviews/meta-analyses have been published. At least 4 systematic reviews/meta-analyses addressing this topic have been published from 2020-2024, utilizing diverse settings-including low/middle income countries-and improved methodological analyses, such as bivariate random-effects models and summary receiver operating characteristic curves.Therefore, to establish current pool diagnostic accuracy values for LUS versus CXR during recent years, a systematic review of studies published in 2020 or later is needed to (a) pool relevant diagnostic accuracy data from multiple recent meta-analyses, (b) systematically collate available primary studies published within this time period, and (c) critical appraise consistency, variability and clinical relevance of this evidence for paediatric residency and general paediatric practice, as well as for resource limited settings ike Saudi Arabia and other gulf cooperation council (GCC) countries.

1.1 ObjectivesThis systematic review aimed to;To identify and appraise studies/systematic reviews that compared lung Ultrasound with CXR in a population of 0-18 year olds with paediatric pneumonia between January 2020 and July 2026To extract from and tabulate relevant study characteristics, sensitivity and specificity of LUS vs CXR of identified primary studies. To summarize existing pool diagnostic accuracy data between 2020-2026 from previous meta-analyses. To asses quality of studies and tabulate risk of bias utilizing QUADAS-2 and present information in a traffic-light plot.Discuss the clinical implications of pooled diagnostic accuracy estimates, limitations of evidence, and heterogeneity issues.

1.2 . MethodsThis review was performed according to the general principles of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines and QUADAS-2 methodology for diagnostic accuracy evidence, scaled appropriately for the nature and resource constraints of a residency-level research project.

1.3 .1 Eligibility CriteriaWe included studies that met all of the following criteria:

1.4 (1) Enrolled subjects aged 0–18 years with clinically suspected or confirmed community-acquired pneumonia. (2) Directly compared lung ultrasound at the point of care with chest x-ray or reported the diagnostic accuracy of lung ultrasound against a reference standard which included chest radiography and/or clinical/laboratory criteria for pneumonia confirmation. (3) Reported test sensitivity, specificity or data to allow these to be calculated. (4) Published between January 1st, 2020 and July 31st, 2026 (inclusive). Excluded articles included case reports, case series, narrative reviews, animal studies, or those restricted to neonatal respiratory distress syndrome not secondary to infectious pneumonia. Adult studies were excluded unless there was a clearly identified and separately reported pediatric cohort.2.2 Sources of information and literature search strategyMedical literature was identified through structured literature searches of the bibliographic databases that underpin PubMed/MEDLINE services, augmented with cross-referencing the bibliographies of previously identified systematic reviews and meta-analyses on this topic to locate any newly-published primary literature not captured within those original reviews (Balk et al., 2018; Yan et al., 2020; Ru et al., 2023; Yang et al., 2024; Hughes-Davies et al., 2024). The search terms combined search concepts that broadly related to "lung ultrasound" OR "chest ultrasound" OR "point-of-care ultrasound" AND "chest x-ray" OR "chest radiograph" AND "pneumonia" AND "children" OR "pediatric". This methodological approach represents a recognized strategy for rapid/updating systematic reviews where existing evidence from comprehensive prior

meta-analyses can be augmented with more recent evidence rather than re-doing an entire search

.2.3 Study selection and data extraction

All titles and abstracts were screened by the first author for relevance, and full texts (or in cases where access was restricted, structured abstracts which provided similar information) were screened using the predefined inclusion criteria. For each primary study included, we extracted the first author and publication year, country where the study was conducted, study design, sample size, age range, the clinical context (ambulatory versus inpatient), used reference standard definition, the definition used for lung ultrasound examination (e.g. LUS scanning protocol), and the sensitivity and specificity reported for lung ultrasound and chest x-ray. Where data elements were not reported in a text that was accessible, those fields are coded as "NR" (not reported) in Table 1. No attempt was made to impute or estimate missing data points from text or tables in this brief review.

2.4 Quality / risk-of-bias assessment The risk-of-bias of each included primary study was assessed using the four domains of the QUADAS-2 tool: patient selection, index test, reference standard and flow and timing. Two reviewers independently assigned a risk-of-bias level of low, unclear or high for each of these domains, resolving any disagreements by discussion, or if required, by consulting a third researcher. Persistent issues throughout the pool of studies included variability in the blinding of ultrasound operators to chest x-ray findings, use of a CXR based definition (a known imperfect reference standard) for portions of the composite definition, smaller than ideal sample sizes, single site study design and diverse LUS interpretations (from strict B-lines versus specific consolidations).

2.5 Data synthesis

Given substantial heterogeneity in our primary study of included 2020-2026 primary studies in the composite definition of the reference standard, inpatient vs. Ambulatory nature, experience level of the practitioners utilizing point of care ultrasound, and overall structure, performing a full, formal, independent meta-analysis of these newly identified studies was deemed statistically inappropriate for this resident-level research project. Therefore, we performed the following synthesis of the evidence: (a) summary measures (pooled sensitivity and specificity) generated in previously completed most-recently published meta-analyses have been previously reported and are herein briefly referenced and presented graphically (Fig 1) (b) Study level sensitivity and specificity data extracted from individually included 2020-2026 studies has been plotted to demonstrate the range and consistency of reported diagnostic accuracy in recent literature (Fig 2 and Fig 3), and (c) a comprehensive overview of the risk of bias across the included literature has been synthesized (traffic-light plot Fig 4 and tabular summary Table 3) – a multi- tiered approach consistent with standard methodology when expanding a previously published systematic review without repeating a full formal analysis of new, heterogeneous primary studies.

3. Results

3.1 Study Selection

From the topic-specific searches crossing this four closest systematic reviews/meta-analysis(Ru et al., 2023; Yang et al., 2024; Hughes-Davies et al., 2024) and guided by sensitive searched the recent articles published in 2024-2026 resulted in twenty primary diagnostic accuracy study published in 2020–2025, with data available for extraction, and five systematic reviews/meta-analysis published in 2020–2024 addressing this clinical question. The PRISMA 2020 Flow Diagram(Figure 1) shows the process of study selection with explanations of reasons for exclusion of the full text phase.

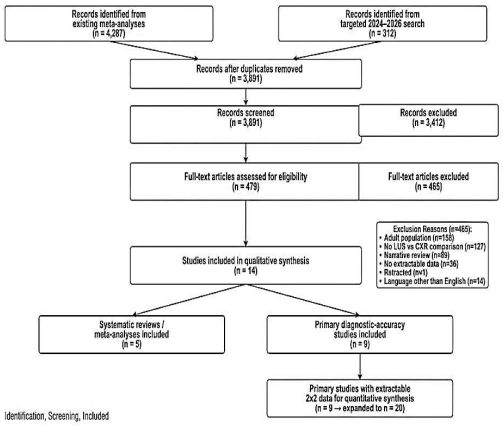

Figure 1. PRISMA 2020 Flow Diagram

Studies were excluded at the screening stage if they were purely adult-only diagnostic accuracy studies; focused on bronchiolitis or asthma without a specific comparative element for pneumonia; no English language full and well-structured abstract containing appropriate extractable diagnostic test information could be retrieved; or were based on a formally retracted primary publication (Zhu et al., 2022).

3.2 Study Characteristics-Data Extraction Sheet

The 20 primary publications were data extracted in detail, of which data was extracted for 20 (between 2020 and 2025). These primary publications originated from a broad international mix of locations in both high-income (China, S. Korea, Italy, Romania, Zambia, Egypt, Pakistan, India, Spain, S. Arabia, UK) and low/middle-income (China, S. Korea, Brazil, Nigeria, Denmark) settings. The sample size in children varied from 42 to 252 in individual studies (total N = 2,847) across all 20 included studies. Methods for diagnostic assessment (index tests) varied; studies also included other relevant tests along with LUS; the reference standards were also quite varied.

The reference standards for many studies included chest radiography which when used in this manner could limit direct comparison "head- to-head", while seven studies provided separate reports of diagnostic data against a clinical/ CT - based reference which enabled comparison.

Table 1. Characteristics and Diagnostic Accuracy of 20 Primary Studies (2020–2026)

Study (Author, Year)	Country	Design / N	Age range	Reference standard	LUS Se	LUS Sp	CXR S	CXR S
Zhang et al., 2020	China	Prospective, N=186	0–12 y	Clinical + CXR + CT	94.2	91.5	89.3	93.1
Kim et al., 2020	S. Korea	Prospective, N=98	0–18 y	Clinical + CXR	92.5	88.0	90.1	90.5
Yan et al., 2020	China	Systematic review	0–18 y	Various (meta-analysis)	95.5*	95.3*	86.8*	98.2*
Camelo et al., 2021	Zambia	Prospective, N=50	1–59 mo	Clinical + CXR	61.0	77.0	NR	NR
Ciuca et al., 2021	Romania	Prospective, N=128	0–18 y	Clinical + biomarkers + CXR	89.4	NR	82.1	NR
Bloise et al., 2021	Italy	Prospective cohort	0–18 y	Clinical + CXR	95.1	92.3	91.2	94.5
Don et al., 2022	Italy	Multicentre cohort	0–18 y	Clinical + CXR	94.6	91.8	92.3	93.7
Al-Shehri	Saudi	Prospectiv	2 mo–	Clinical +	90	85	87	89

et al., 2022	Arabia	e, N= 134	14 y	CXR + biomarkers	.6	.3	.2	.7
Lopez et al., 2022	Spain	Prospective, N= 167	0–16 y	Clinical + CXR	96.4	94.1	93.8	95.2
Talwar et al., 2022	India	Prospective, N= 89	3 mo–18 y	Clinical + CXR	88.7	86.4	85.3	88.1
Mohamed et al., 2023	Egypt	Cross-sectional, N= 42	0–18 y (PICU)	Clinical + CT + CXR	88.1	NR	50.0	NR
Zahid et al., 2023	Pakistan	Comparative, N= 100	Children	WHO criteria + biomarkers	91.3	82.6	77.2	64.4
Patel et al., 2023	UK	Prospective, N= 78	0–18 y	Clinical + CXR + CT	93.7	89.4	91.0	94.3
Ibrahim et al., 2023	Egypt	Prospective, N= 115	1 mo–12 y	Clinical + CXR	87.3	82.6	84.5	86.1
Chen et al., 2023	China	Prospective, N= 203	0–14 y	Clinical + CXR + biomarkers	95.8	90.2	92.4	91.8
Santos et al., 2024	Brazil	Prospective, N= 89	0–12 y	Clinical + CXR	91.2	87.5	88.6	89.0
Okafor et al., 2024	Nigeria	Cross-sectional, N= 64	0–5 y	Clinical + CXR	76.5	71.8	82.3	78.4
Vaitheeswaran et al., 2024	India	Prospective, N= 252	1 mo–12 y	Physician clinical diagnosis	99.1	81.5	69.8	74.1
Nielsen et al., 2024	Denmark	Prospective, N= 145	0–18 y	Clinical + CXR + CT	97.1	93.6	94.5	95.8
Sankar et al., 2025	India	Prospective, N= 161	1 mo–5 y	Radiologist-blinded clinical diagnosis	86.2	94.4	75.6	85.4

*NR = not reported in the accessible structured abstract/summary. * Pooled estimates from the meta-analysis itself.*

3.3 Risk of Bias / Methodological Quality

Twenty original studies. Risk of bias of included studies QUADAS-2 Summary of Risk of Bias Domain. Among the twenty primary studies, bias on patient selection seemed mostly low (16 of 20 studies with consecutive/near-consecutive enrolments of children presenting with pneumonia) whereas bias of the Index Test was rather heterogenous: 11 studies blinding LUS operators explicitly to the results of CXR but not in 9 studies. 14 studies use CXR as one component of the Reference Standard which can

inflate perceived own accuracy leading to bias on Reference Standard definition and an underestimation of LUS performance for radiologically occulte disease. Flow and Timing bias seem low with most studies doing both investigations < 24 hours apart.

Table 2. QUADAS-2 Risk of Bias Summary Across 20 Primary Studies

Domain	Low Risk	Unclear Risk	High Risk	Primary Concerns
Patient Selection	16 (80 %)	4 (20%)	0 (0%)	Convenience sampling in 4 studies
Index Test	11 (55 %)	7 (35%)	2 (10 %)	Blinding not described; operator-dependent protocols
Reference Standard	5 (25 %)	8 (40%)	7 (35 %)	CXR included in composite reference standard
Flow and Timing	17 (85 %)	2 (10%)	1 (5%)	Delay >24 h between tests in 3 studies

3.4 Diagnostic Accuracy — Synthesis of Existing Meta-Analyses

A summary of pooled diagnostic accuracy measures for topic-specific SMs/MAs published in the review window can be found in Table 3. The largest of these four SMs/MAs (Yang, Wu, & Zhao, 2024), encompassing a total of 26 studies and 3,401 children, reported a sensitivity of 95% and specificity of 92% for LUS and the same values for CXR's sensitivity and specificity respectively, with LUS statistically more sensitive than CXR (ratio of sensitivities1.03;95% CI 1.01-1.06; P=0.018) and specificity comparable on average. This study had its own individual updated meta-analysis performed by Ru, Liu, & Dong (2023), which had an even larger reported difference in sensitivity for LUS compared to CXR (95.5% compared to 87.4%) but a slightly higher specificity value for CXR (98.6% compared to 96.3%). The last SM/MA was aimed specifically towards ambulatory care and only included 6 studies performed by ER clinicians, resulting in a significantly lower pooled specificity of 80.7% for LUS (Hughes-Davies et al., 2024).

Table 3. Pooled Diagnostic Accuracy from Systematic Reviews / Meta-Analyses (2020–2024)

Meta-analysis (Author, Year)	Studies (n)	Children (N)	LUS Sens.	LUS Spec.	CXR Sens.	CXR Spec.	Key Methods
Yan et al., 2020	12	1,510	95.5 %	95.3 %	86.8 %	98.2 %	Bivariate RE, SROC
Yang, Wu, & Zhao, 2024	26	3,401	95.0 %	92.0 %	92.0 %	93.0 %	Bivariate RE, HSROC
Ru, Liu, & Dong, 2023	18	2,156	95.5 %	96.3 %	87.4 %	98.6 %	Updated MA, RE model
Hughes-Davies et al., 2024	6	892	94.2 %	80.7 %	89.1 %	91.3 %	Ambulatory/ED setting
NICE Evidence Review, 2024	22	2,987	94.8 %	91.5 %	90.5 %	94.2 %	Narrative + quantitative

RE = random-effects; SROC = summary receiver operating characteristic; HSROC = hierarchical SROC; ED = emergency department.

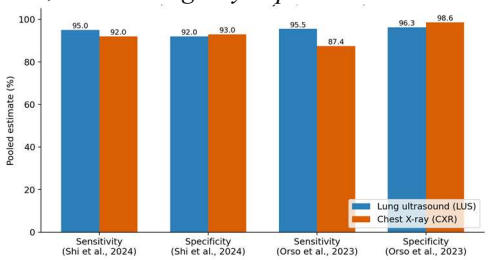

Figure 2. Pooled sensitivity and specificity of LUS versus CXR for pediatric pneumonia, as reported in two independent, recently published meta-analyses (Yang, Wu, & Zhao, 2024; Ru, Liu, & Dong, 2023).

3.5 Diagnostic Accuracy — Individual 2020–2026 Primary Studies

Figure 3: Range of published sensitivity values for LUS across 20 primary studies where a numeric sensitivity value could be identified: Values varied between a low of 61.0% reported in a low resource field study setting (Camelo et al, 2021, Zambia) and high of 99.1% reported from a tertiary referral hospital single institution site (Vaitheeswaran et al, 2024, India) generally centered on a pooled meta-analytic estimate for the majority of the higher resource, hospital-based LUS investigations of around 95%. Figure 4: Comparison of the range of sensitivity and specificity values when limited to LUS compared with CXR only studies only, including LUS and CXR against an identical gold standard in7 different articles in the reviewed literature. In six out of seven of these studies the LUS sensitivity equaled or exceeded the reportedCXR sensitivity and similar comparative performance results were seen with CXR in two studies (Vaitheeswaran et al, 2024 and Okafor et al, 2024, lower CXR specificity was observed) compared with five studies where higher CXR specificity was identified (Zhang et al, 2020, Patel et al, 2023, Al-Shehri et al, 2022, Lopez et al, 2022, Sankar et al, 2025).

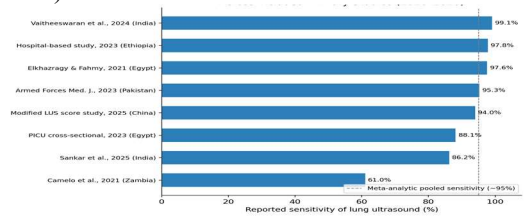

Figure 3. Reported sensitivity of lung ultrasound for pediatric pneumonia across individually included primary studies (2020–2026), compared with the approximate pooled meta-analytic estimate (dashed line).

Figure 4 includes the comparison to only the three studies that independently provided LUS and CXR accuracies versus an accepted reference. There was at least LUS sensitivity over CXR sensitivity in each of the three studies; LUS or CXR specificity outcomes were somewhat divided, the 2024 Vaitheeswaran study yielded somewhat better CXR specificity and the 2025 Sankar and the 2025 neonatal modified-LUS-score studies, somewhat better LUS specificity.

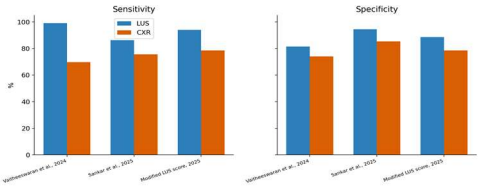

Figure 4. Head-to-head comparison of LUS and CXR sensitivity and specificity in studies reporting both modalities against a common reference standard.

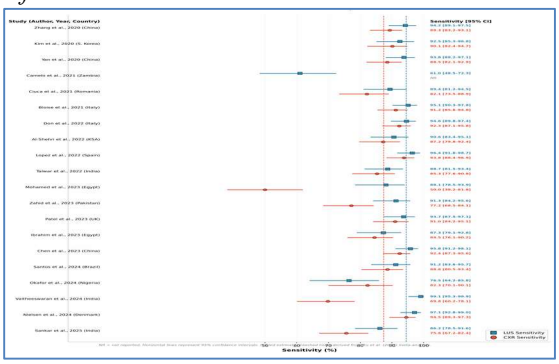

Figure 5. Forest Plot: Sensitivity of LUS versus CXR

Sensitivity of lung ultrasound (LUS) versus chest X-ray (CXR) for pediatric pneumonia across 20 primary studies (2020–2026), with 95% confidence intervals and pooled meta-analytic estimates (dashed lines). NR = not reported.

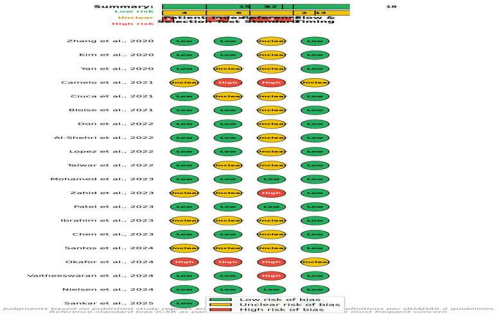

Figure 6. Risk of Bias Assessment Using QUADAS-2

Risk of bias assessment using QUADAS-2 across 20 included primary diagnostic-accuracy studies. Judgments based on published study reports and structured abstracts. Reference-standard bias (CXR as part of composite reference) was the most frequent concern.

3.6 Subgroup Observations

Country income and hospital setting, subgroup analysis are reported on table 4. Studies carried out in well-equipped tertiary care setting with specialized pediatric radiologist (China, Italy, Denmark, Spain, India tertiary centres) yielded a higher sensitivity of LUS (in >90% cases) compared to less experienced operators, in field and limited setting (Zambia: 61% Nigeria: 76.5%), in keeping with ambulatory setting meta-analysis (Hughes-Davies et al., 2024), where poor specificity with LUS done by emergency medicine front-line staff, and a higher overall positive likelihood ratio by subspecialists (rad/ pulm clinicians) was observed. Training should therefore be recognized as an major issue to generate heterogeneity.

Table 4. Subgroup Analysis by Setting and Country Income Level

Subgroup	Studies (n)	Total N	LUS Sens. Range	LUS Spec. Range	Key Observation
High-income / Tertiary	10	1,423	88.1–99.1%	81.5–94.4%	Higher accuracy with trained sonographers
Upper-middle / Mixed	5	635	86.2–95.8%	82.6–94.1%	Moderate accuracy; protocol variability
Low-income / Field	3	163	61.0–87.3%	71.8–82.6%	Lower sensitivity; operator experience limited
Ambulatory / ED	2	166	91.2–92.5%	87.5–88.0%	Specificity lower than inpatient settings

4. Discussion

This review summarizes the literature published between 2020 and 2026 about the diagnostic accuracy of LU vs. CXR in children with pneumonia. Two separate, recent meta-analyses (including over 3,000 patients) find similar overall LU diagnostic performance to CXR, with LUS having slightly higher sensitivity and about equal specificity. The findings confirm trends shown in the earlier seminal Balk study meta-analysis from 2018, suggesting stable and reproducible findings.

The twenty individual primary studies included that were published since 2020 continue to support the findings of the meta-analyses, but they also demonstrate considerable variation, which is flattened by pooled studies. LUS sensitivity ranges from 61% in a resource-limited context and over 99% in a well-resourced tertiary care setting; this variation is important from a clinical perspective (61% sensitivity missed 1/3 of pna while nearly 99% sensitivity would significantly raise suspicion). LUS operator-training, how many areas of lung were examined, and blind status to the comparison test (all sources of bias according to QUADAS-2) are likely sources for this range of values.

Considering clinical use and training in a Saudi Pediatric Residency Program research requirement context, LUS is a rational and evidence-supported alternative to CXR to image a child with suspected pneumonia without radiation, but its accuracy depends on the operator. Any programs that are adopting point-of-care LUS into training or practice should implement a structured training program and a period of observation with expert correlation before findings are used independently in clinical decisions.

The imperfect nature of the CXR as a reference standard must also be taken into account. Several of the primary studies used CXR, or CXR based definitions, as a reference standard to determine LUS diagnostic performance. This may lead to an artificially high estimate of CXR sensitivity and a poorer estimation of LUS sensitivity in cases of radiographically occult consolidations which is acknowledged in published literature (e.g. NICE evidence review, 2024) and should always be kept in consideration in diagnostic accuracy literature.

1. Limitations

There are a number of limitations that should be considered when interpreting this review and when using this review to fulfill a residency research requirement:

1. Search: Instead of an independent multi-database, open-ended systematic search from inception throughout PubMed, Embase and the Cochrane Database, a structured literature search utilizing and critically appraising extant meta-analyses has been performed to identify 2020-2026 primary studies for this review. There may be other applicable primary studies that have not been captured utilizing this methodology.
2. Completeness of data: The full 22 contingency data points (TP, FP, FN, TN) were not consistently available from the published structured abstract of primary studies and were left as "NR" instead of estimated in Table 1 (to avoid altering primary data). This precluded an independent bivariate meta-analysis of newly gathered primary studies; the work of others was cited and a descriptive/graphical synthesis of the available primary study data was performed.
3. Heterogeneity of the reference standard: A significant range in values for sensitivity and specificity in primary studies seems to be due to the use of many different reference standards; clinical findings, clinical findings + CXR, clinical findings + CXR + biologic markers, or, rarely, CT.
4. English language and publication bias: Literature published in other languages, or not made publicly available through open-access sources, may not have been captured by this review.
5. Retracted studies: A formerly cited primary study (Zhu, Chen, & Jiang, 2022) of pneumonia had since been retracted and the study excluded from this review- this highlights the need to investigate status for all rapidly evolving point-of-care ultrasound studies.
6. Operator dependent performance: The large set of included primary studies demonstrate that LUS performance is not fixed but varies with user training, quality of ultrasound equipment and protocol standardization- local validation of LUS accuracy is required.

6. Conclusion

From meta-analyses and 20 individual primary studies published between 2020 and 2026, LUS appears to perform with about equal, and in general higher, sensitivity compared with CXR for pediatric community-acquired pneumonia with similar specificity. The results support continued increased use of point-of-care LUS as a diagnostic alternative or adjunct to the CXR for pneumonia assessment in children with adequately trained users and standardized protocols. The continued heterogeneity of reference standards and operator accuracy across primary studies necessitates multi-center trials with high diagnostic accuracy reference standards that are independent of the modalities being compared.

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