

LUNG ULTRASOUND FOR THE DIAGNOSIS OF PNEUMONIA IN CHILDREN: A META ANALYSIS

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1.INTRODUCTION:

❖ Pneumonia is the leading cause of illness & death of children (# a global annual incidence of 150 - 156 million cases in children <5 years of age, ~11 - 20 million of cases need hospitalization & 1.1 million die of this condition).

Pneumonia accounts for 18% of the total number of deaths in children <5 years worldwide, more than tuberculosis, AIDS, malaria combined.

❖ **Diagnostic tools include chest radiography CRs, still remains a challenge in resource-limited settings.**

❖ **The AAP recommends the use of CRs *cautiously*:**
- **potential late adverse effects of ionizing radiation**
- **the lack of findings on CR does not rule out the diagnosis.**

- **a chest CT scan almost never used for the diagnosis of pneumonia because of higher ionizing radiation exposure, difficulty in patient cooperation, cost.**

Other disadvantages: availability & portability, a considerable time delay & a final reading.

- ❖ **Advances in ultrasound technology have made lung ultrasound (LUS) an attractive option for the diagnosis of pneumonia. Moreover, ultrasound is safe, portable, inexpensive, and relatively easy to teach.**
- ❖ **We conducted a meta-analysis to summarize evidence on the diagnostic accuracy of LUS for childhood pneumonia.**

2.METHODS:

➤ 2.1. Search methods:

A systematic literature search was applied to:

- PubMed (1946 → present)
- Embase (1974 → now)
- The Cochrane Library (1898 → now)
- Scopus (1966 → now)
- Global Health (1973 → now)
- World Health Organization Global Health Regional libraries (1980 → now)
- Latin American and Caribbean Health Sciences Literature (1980 → now)

Key words: <18 years, pneumonia, ultrasound

❖ 2.2. Study Eligibility:

Children with clinical suspicion (signs and symptoms) of pneumonia and/or confirmation with CR or chest CT scan.

-The evaluation of pneumonia was based on a combination of clinical data, laboratory results, and chest imaging by CR or chest CT scan

❖ **2.2.Data Extraction:**

- Sample size,**
- gender proportion,**
- mean age,**
- LUS technique,**
- areas of the chest that were evaluated,**
- time lapse between CR and LUS, average time to perform LUS,**
- operator expertise,**
- blinding,**
- LUS pattern definitions,**
- and number of true-positives, true-negatives, false-positives, and false-negatives.**

2.3. Methodologic Quality Assessment and Biostatistical Methods:

- ❖ **Methodologic quality was assessed by using the QUADAS -2 criterion**
- ❖ **Biostatistical methods: The primary objective = estimate pooled measurements of diagnostic accuracy**
 - **Pooled sensitivity and specificity: Mantel-Haenszel method**
 - **Pooled positive and negative likelihood ratios (LRs): DerSimonian-Laird method**
 - **Heterogeneity: the Cochran Q-statistic and the inconsistency (I²) test**
 - **Statistical analyses: Meta-DiSc 1.4 and R**

3.RESULTS:

-In 1475 studies, we selected 8 studies for analysis (6 conducted in the general pediatric population & 2 conducted in neonates).

-5 studies conducted in Italy, 1 in USA, 1 in China & 1 in Egypt

-3 studies were conducted in emergency departments, 2 in hospital wards, 1 in the pediatric ICU, and 2 in the neonatal ICU.

-Overall, there were 765 children. The mean age: 5 years (range: 0–17 years) and 52% were boys.

-5 studies (63%): a highly skilled physician performed LUS,

3.1. Methodologic Heterogeneity:

The quality of most of the studies: high. 7 studies (88%) enrolled patients who would have had a CR as part of usual clinical practice. Only 1 (12%) study included controls who did not have CRs.

All studies conducted LUS immediately after chest imaging was obtained.

1 (12%) study used the same radiologist to read both the CR and LUS.

7 (88%) studies assessed LUS results independently and were blinded to CR results.

3.1. Methodologic Heterogeneity:

LUS sonographers were not blinded to clinical data.

Furthermore, 5 (63%) studies used clinical criteria and CR as a diagnosis standard and 3 included laboratory results as additional diagnostic tools.

3 studies (38%) used chest CT scan for clinical purposes.

All of the studies used a linear probe , with frequencies ranging from 6 to 12 MHz. In addition, a convex probe with frequencies ranging from 2 to 6.6 MHz was used in conjunction with the linear probe in 3 of the 8 studies.

3.2.Overall Meta-analysis:

- LUS had a sensitivity of 96% (95% confidence interval [CI]: 94%–97%) and specificity of 93% (95% CI: 90%–96%), and
- positive and negative likelihood ratios were 15.3 (95% CI: 6.6–35.3) and 0.06 (95% CI: 0.03–0.11), respectively.
- The area under the receiver operating characteristic curve was 0.98.

3.3.Subgroup Analyses:

- ❖ In the 6 studies (75%) (excluding neonates), LUS had a sensitivity of 96% (93%–98%) - a specificity of 92% (88%–95%); and in the 2 studies (only **neonates**), LUS had a sensitivity of 96% (90%–98.5%) - a specificity of 100% (92%–100%).
- ❖ 3 studies were conducted in **emergency departments**: sensitivity of 94% (88%–98%) and specificity of 90% (85%–94%). Studies conducted in hospital settings other than in an emergency department had a combined sensitivity of 96% (94%–98%) and a specificity of 97% (93%–99%)
- ❖ 4 studies that used emergency department physicians, general practitioners, residents, or **health care professionals otherwise not specified**, LUS had a pooled sensitivity of 95% (95% CI: 91%–97%) and a specificity of 91% (87%–95%).

4.Limitations:

- **The total number of studies was small, a low number of patients, there was significant heterogeneity between studies.**
- **Second, not all studies compared LUS results with a clinical diagnosis and, in some studies, the final diagnosis was based solely on CR findings without the influence of clinical data.**

5.CONCLUSION:

❖ Current evidence supports LUS as an imaging alternative for the diagnosis of childhood pneumonia.

Recommendations to train pediatricians on LUS for diagnosis of pneumonia may have important implications in different clinical settings.