SAMPLE SYSTEMATIC REVIEW AND META-ANALYSIS

Title: Diagnostic Accuracy of Artificial Intelligence for Detecting Pneumonia on Chest Radiographs: A Systematic Review and Meta-analysis

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Structured Abstract

Background: Artificial intelligence (AI) has become increasingly important in chest radiograph interpretation, particularly for detecting pneumonia. Several studies have evaluated AI algorithms, but reported diagnostic performance varies across different populations and study designs.

Objectives: To systematically review published studies and quantitatively evaluate the diagnostic accuracy of AI for detecting pneumonia on chest X-rays.

Data Sources: PubMed, Scopus, Web of Science, IEEE Xplore, and Embase were searched for studies published between January 2018 and December 2025.

Study Selection: Twenty-one studies involving 38,450 chest radiographs met the inclusion criteria according to the PRISMA 2020 guidelines. Two independent reviewers performed study selection, data extraction, and quality assessment.

Results: Meta-analysis demonstrated a pooled sensitivity of **91%** (95% CI: 88–93%), specificity of **89%** (95% CI: 86–91%), and an area under the summary ROC curve of **0.94**, indicating excellent diagnostic performance. Moderate heterogeneity was observed among the included studies.

Conclusion: AI-based chest X-ray interpretation demonstrates high diagnostic accuracy for pneumonia detection and may serve as an effective clinical decision-support tool. Further prospective multicentre studies are needed to validate these findings.

Keywords: Artificial Intelligence; Systematic Review; Meta-analysis; Chest X-ray; Pneumonia

1. Introduction

Artificial intelligence has rapidly transformed medical imaging by improving image interpretation and supporting radiologists in clinical decision-making. Numerous studies have investigated AI algorithms for pneumonia detection on chest radiographs; however, differences in study design, datasets, and evaluation methods have produced variable results. This systematic review and meta-analysis aims to synthesise current evidence and estimate the overall diagnostic accuracy of AI for detecting pneumonia.

2. Methods

Protocol and Registration

The review was conducted according to the **PRISMA 2020** guidelines and was prospectively registered in the PROSPERO database.

Search Strategy

A comprehensive literature search was performed in PubMed, Scopus, Web of Science, IEEE Xplore, and Embase using combinations of the keywords *artificial intelligence*, *deep learning*, *chest X-ray*, and *pneumonia*.

Eligibility Criteria

Original peer-reviewed studies evaluating AI models for pneumonia detection using chest radiographs were included. Reviews, editorials, conference abstracts, and non-English publications were excluded.

Study Selection

Two independent reviewers screened titles, abstracts, and full-text articles. Disagreements were resolved through discussion with a third reviewer.

Data Extraction

Information on study characteristics, sample size, AI algorithm, sensitivity, specificity, and diagnostic accuracy was extracted using a standardised data collection form.

Quality Assessment

The methodological quality of included studies was assessed using the **QUADAS-2** tool.

Statistical Analysis

Random-effects meta-analysis was performed to calculate pooled sensitivity, specificity, and summary receiver operating characteristic (SROC) curves. Statistical heterogeneity was evaluated using the I^2 statistic.

3. Results

The database search identified **1,245 records**, of which **21 studies** met the eligibility criteria after screening and full-text assessment.

PRISMA Flow Diagram: *(Insert PRISMA 2020 Flow Diagram here.)*

The pooled analysis demonstrated a **sensitivity of 91%**, **specificity of 89%**, and an **AUC of 0.94**, indicating excellent overall diagnostic performance. Moderate heterogeneity (I^2 = 48%) was observed across studies. Subgroup analysis showed slightly higher diagnostic accuracy in deep learning models trained on multicentre datasets.

4. Discussion

This systematic review indicates that AI algorithms consistently achieve high diagnostic performance for pneumonia detection on chest radiographs. The pooled

estimates are comparable to the performance reported by experienced radiologists, supporting the potential role of AI as a clinical decision-support system. However, variations in dataset quality, imaging protocols, and validation methods contributed to heterogeneity among studies. Future research should focus on prospective multicentre validation, explainable AI, and integration into routine clinical workflows.

5. Limitations

The review included only English-language publications, which may have introduced language bias. Considerable methodological variation among included studies and inconsistent reporting of external validation may also have influenced the pooled estimates.

6. Conclusion

Artificial intelligence demonstrates excellent diagnostic accuracy for pneumonia detection using chest radiographs. Although current evidence is encouraging, further high-quality prospective studies are required before widespread implementation in routine clinical practice.

7. Declarations

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Conflict of Interest: The authors declare no conflict of interest.
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Data Availability: All data analysed in this review were obtained from published studies.

8. References

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