INPLASY

Diagnostic accuracy of culture plate image analysis for identification of organisms: A systematic Review

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ADMINISTRATIVE INFORMATION

Support - Personal.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 March 2026 and was last updated on 13 March 2026.

INTRODUCTION

Review question / Objective 1. What is the diagnostic accuracy of culture plate image analysis for identification of organisms with standard microbiological identification methods?
2. How sensitive and specific is culture plate image analysis in identifying bacterial organism from culture or agar plates?
3. How does diagnostic performance vary by organism group (e.g., Gram-negative, Gram-positive, culture medium, imaging system, and analytical approach (classical computer vision vs deep learning)?
4. What are the reported advantage and limitations of use of culture plate image analysis for organism identification?

Rationale Microbiological culture remains the gold standard for organism diagnosis despite modern diagnostic advancements. It offers definitive identification and antimicrobial susceptibility testing. In the realm of automated plate reading, different studies are carried out with different methods. Parallel progresses in deep learning and computer vision have generated remarkable results in automated analysis of culture plates, with applications spanning colony detection, segmentation, classification, and enumeration. These computational approaches have achieved performance metrics that challenging or surpass human expert interpretation across multiple studies and imaging modalities.

A comprehensive analysis of diagnostic accuracy of culture plate image for organism identification is urgently needed. No systematic review assessed the feasibility and accuracy of image based identification of organism from culture plates. This systematic review will address this gap by synthesizing available data on diagnostic accuracy of image analysis , thereby providing insights to support laboratory and public health strategies for improving microorganism identification.

Condition being studied Our study will include original diagnostic accuracy studies that evaluate culture plate image analysis for microorganism identification. Eligible study designs include

prospective or retrospective cohort studies, cross-sectional studies, and case-control studies that compare the image analysis with a recognized reference standard.

METHODS

Search strategy Our search strategy will consist of a comprehensive three-stage process: First, we will develop comprehensive search terms based on the Population, Index test, Comparator, and Outcome (PICO) criteria. Standard terminologies such as Medical Subject Headings (MeSH) terms along with relevant keywords will be used to capture studies addressing culture plate image analysis for organism identification. Finally, we will perform a thorough search across four electronic databases: MEDLINE (OVID), PubMed, Scopus and Web of Science (WoS) to identify peer-reviewed articles related to our topic. Additionally, we will utilize Google Scholar to access grey literature, ensuring a comprehensive overview of available evidence. To enhance the effectiveness of our search strategy, we will seek assistance from institutional librarian for expert guidance to craft and refine the search terms and methodology.

Participant or population Eligible studies for this review will meet the following criteria: (i) investigations conducted on clinical or laboratory culture plate or agar plate containing microbial growth; (ii) studies that included culture plate image analysis for bacteria or other clinically relevant microorganisms. There will be no restrictions based on patient age, sex or clinical setting or biological samples. Studies will be included if culture plate image is analyzed for microorganism identification. Studies will be excluded if they do not involve image based analysis, lack of appropriate reference standard, non-original research.

Intervention NA.

Comparator NA.

Study designs to be included Prospective or retrospective cohort studies, cross-sectional studies, and case-control studies or RCTs.

Eligibility criteria 1. Original diagnostic accuracy studies that evaluate culture plate image analysis for microorganism identification
2. Studies must be assessed image analysis as standalone or integrated diagnostic approach an compare it with reference standard.
3. Studies published in English language.

Information sources We will perform a thorough search across four electronic databases: MEDLINE (OVID), PubMed, Scopus and Web of Science (WoS).

Main outcome(s) The primary outcome of this systematic review is accuracy of culture plate image analysis. Sensitivity, specificity, positive predictive value, Negative predictive value and AUC-ROC. These outcomes must be measured by comparing the image analysis to a recognized reference standard.

Data management In this review, all documents retrieved from the search databases will initially be exported to Covidence for screening, full-text review, and extraction. Two reviewers, Sharika Nuzhat and Ferdous Rahman will independently screen titles and abstracts based on predefined inclusion and exclusion criteria. Articles that meet the initial screening will undergo a full-text review, during which both reviewers will assess the eligibility according to the established criteria. Studies not meeting these criteria will be excluded, with reasons for exclusion documented and reported. Data extraction will be conducted independently by Sharika Nuzhat and Ferdous Rahman, who will cross verify each other's work to ensure accuracy. The extracted data will include the following information: trial authors, study year, location, design, population details, intervention and comparator specifics, duration, setting, participant numbers, age demographics, and outcomes. Any discrepancies between reviewers will be resolved by involving a third reviewer.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included studies will be assessed using the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool. This tool evaluates four key domains:1. Sample selection-whether the specimen selection was unbiased, 2. Image analysis (index test)- whether culture plate image analysis was interpreted without reference standard, 3. Reference standard: whether the comparator accurately identifies microorganisms is applied consistently, 4. Flow ad timing: whether all samples received both image analysis and reference tests and whether timing affects outcome.
Each domain will be rated as low, high, or unclear risk of bias, and concerns regarding applicability to real-world diagnostic practice will also be noted.

Strategy of data synthesis Data from eligible studies will be summarized descriptively focusing on organism, culture media, image analysis

method, performance matrices etc. When there is sufficient and comparable data are available a meta-analysis of diagnostic accuracy will be conducted. Pooled estimates of sensitivity and specificity, AUC etc will be included.

Meta-analysis will not be performed when data are insufficient or too heterogenous, in such cases, results will be presented as a narrative synthesis. Analysis will be performed using STATA and R.

Subgroup analysis Based on availability of sufficient data, subgroup analysis will be conducted to explore potential sources of heterogeneity in the diagnostic accuracy of culture plate image analysis. If data are insufficient there will be no subgroup analysis and findings will be reported narratively.

Sensitivity analysis Based on availability of sufficient data.

Language restriction English.

Country(ies) involved Bangladesh , Australia.

Keywords Image analysis; artificial intelligence; Deep learning, Microorganism.

Dissemination plans Publication.

Contributions of each author
Author 1 - Sharika Nuzhat - Conceived the study idea, developed the research question, designed the systematic review protocol, prepared the search strategy, and drafted the manuscript. Will oversee literature screening, data extraction, and overall project coordination.
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Author 2 - Md Ferdous Rahman - Will assist with literature search, title and abstract screening, full-text review, and data extraction. Contributed to methodological development and will assist in manuscript revision.
Author 3 - Monjur Rahman - Will support study selection, quality assessment of included studies, resolution of conflict and contribute to interpretation of results and critical revision of the manuscript.
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