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BactiFIND : An Offline-First Mobile Application Integrating Multiple Diagnostic and Laboratory Tools for Clinical Microbiology and Antimicrobial Stewardship

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Abstract:
BactiFIND is a powerful, offline-first mobile application for microbiology professionals and students. By consolidating the comprehensive data of clinical microbiology into a single platform, BactiFIND equips healthcare workers with critical data at their fingertips. From rapid organism identification to complex resistance decoding, the app streamlines clinical workflows, ensures data-backed decisions in seconds, and bridges the gap between laboratory data and patient care. The application unifies over 300 organisms database and 25 diagnostic, calculative, and educational features without requiring external internet dependencies. This paper details the technological framework, core diagnostic modules, laboratory utility calculators, and gamified educational paradigms that make BactiFIND a robust, all-in-one pocket tool for daily laboratory workflows.

Offline-First Functionality BactiFIND is engineered to operate with minimal internet dependency, ensuring that its full diagnostic and reference capabilities remain accessible even in resource-limited or signal-restricted laboratory settings. This offline-first design removes reliance on continuous connectivity, allowing microbiology professionals to use the application reliably at the bench regardless of network conditions.

Advanced Search & Diagnostics BactiFIND offers instant search and identification of over 300 clinically relevant organisms based on their morphology, biochemical reactions, diagnostic assays, and status as human commensal flora. The integrated search engine gives users immediate access to essential microbial profiles, streamlining organism confirmation and identification workflows in the laboratory.

Advanced Analytics To accelerate microbiological evaluation, BactiFIND combines comparative tools with machine learning intelligence. Its side-by-side comparison feature allows laboratory personnel to quickly differentiate between morphologically or biochemically similar organisms, while an AI-powered image analyzer provides rapid visual assessment of cellular morphology and culture characteristics, supporting faster and more confident diagnostic decisions.

Clinical Intelligence BactiFIND supports accurate therapeutic and diagnostic decision-making through a dedicated suite of clinical data tools. Users can access up-to-date antimicrobial susceptibility and

resistance breakpoints, interpret complex bacterial resistance phenotypes and detailed clinical case studies alongside infection profiles to guide differential diagnosis and appropriate treatment selection.

Lab Utilities & Operations Daily benchwork and laboratory management are optimized through a set of integrated administrative utilities. BactiFIND securely stores and retrieves critical lab and patient data locally, streamlines reagent and media preparation as well as specimen grading through built-in calculators, and tracks equipment performance, reagent status, and compliance standards via its Quality Control monitor.

App Settings & Distribution Features BactiFIND allows users to tailor their experience and manage software deployment through a range of built-in system tools. These include Dark Mode for low-light environments, Admin Mode for elevated controls, an Update utility that keeps reference data current, a dedicated Share section with QR-code-based distribution for offline sharing, and an integrated Feedback channel that supports ongoing improvement of the application.

Keywords: Clinical Microbiology, Offline Mobile Application, Integrated Diagnostic Toolkit, Antimicrobial Susceptibility, CLSI Breakpoints, Point-of-Care Diagnostics, Android WebView, Medical Education Software, Diagnostic Decision Support, Microbial Identification, Antimicrobial Stewardship, Antimicrobial Resistance

Introduction:

In fast-paced clinical laboratories, professionals frequently cross-reference multiple manuals, clinical guidelines, diagnostic algorithms, and standard operating procedures to accurately identify pathogens and determine antimicrobial susceptibility. BactiFIND was developed to consolidate these otherwise disparate diagnostic and laboratory tools into a single, intuitive mobile interface. Designed by clinical microbiologists, the application integrates 100+ organism profiles, CLSI-compliant antimicrobial breakpoints, 23+ biochemical tests, and a suite of laboratory calculators, decision trees, and quality-control utilities into one cohesive digital environment. By prioritizing offline accessibility, BactiFIND ensures uninterrupted utility even in resource-limited or signal-restricted laboratory settings.

Figure 1. BactiFIND logo and global search bar for organisms and infections search

2. Software Architecture and Technological Stack

BactiFIND employs a hybrid development model designed for maximum performance, data security, and offline reliability.

2.1 Single-File Architecture

The core application relies on a "Single-File Architecture." The entirety of the application's logic, user interface frameworks, data structures, and educational content is embedded within a single self-contained HTML/JS/CSS file.

2.2 Native Integration and Deployment

This web-based core is served via an Android WebViewAssetLoader, wrapping the application in a native Kotlin environment. This enables the application to utilize device hardware acceleration and specific Android features, such as local storage for persisting clinical isolate logs, while maintaining zero external Content Delivery Network (CDN) dependencies.

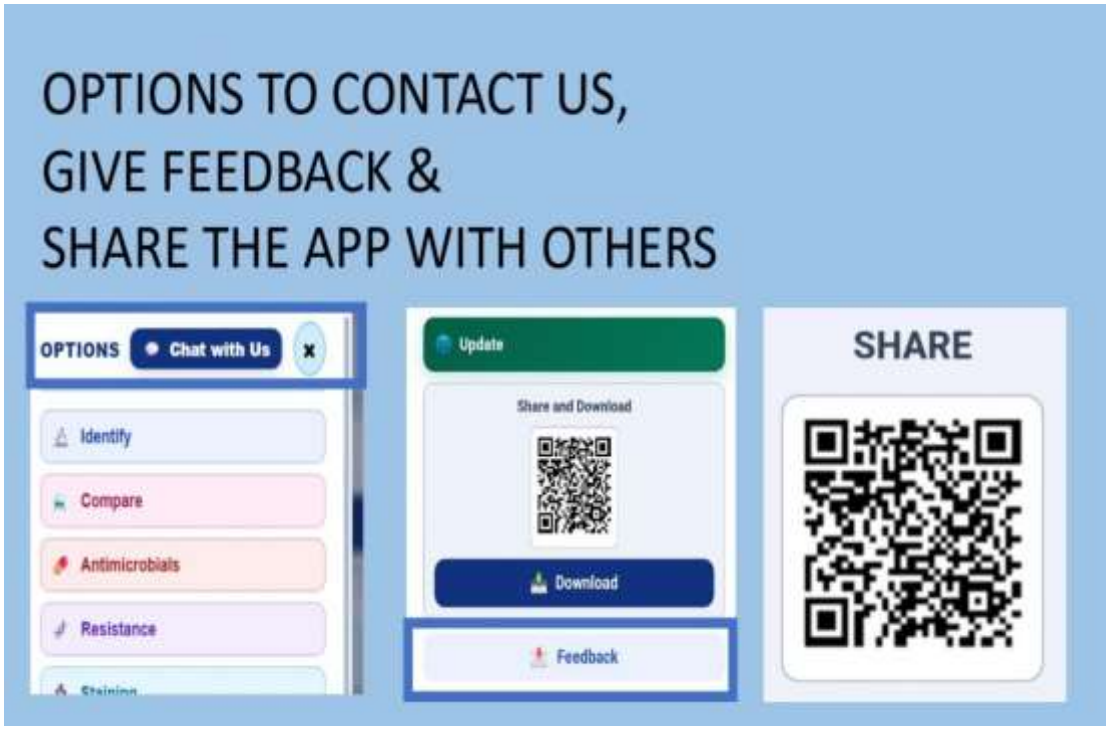
2.3 Peer-to-Peer Distribution

To facilitate deployment in environments lacking consistent internet access, BactiFIND includes an original QR-code-based peer-to-peer sharing model. Users can seamlessly share the application's APK directly with colleagues, bypassing traditional app store connectivity requirements.

2.4 Support, Feedback, and In-App Updates

An in-app Options panel gives users direct access to a chat-based support channel, a structured feedback submission form, and an update checker that surfaces new releases without requiring app-store connectivity. A dedicated Share screen regenerates the peer-to-peer QR code on demand, allowing users to distribute the current build to colleagues at any time.

Figure 2. In-App Options for Contacting Support, Submitting Feedback, Checking for Updates, and Generating a Share QR Code.



3. Core Diagnostic and Analytical Modules

The application is structured to mirror and assist the standard workflow of clinical sample processing, from initial staining to final organism identification.

3.1 Organism Search Engine and Comparison

Search Capabilities: The application features a robust search engine allowing users to find over 300 organisms by name or prefix instantly.

Resolved Matches: Search outputs provide immediate visual tags for Gram stain morphology, oxidase status, and motility.

Differential Engine: The "Compare Organisms" module allows simultaneous side-by-side comparison of multiple organisms across parameters like hemolysis, growth at 45°C, LAP, PYR, and Vancomycin susceptibility.

Figure 3. Organism Search Interface Showing Instantly Resolved Pseudomonas Matches with Gram Stain, Oxidase, and Motility Tags.

Figure 3.1. Side-by-Side Differential Comparison of Two Organisms Across Gram Stain, Hemolysis, and Biochemical Parameters.

3.2 LabD — Biochemical Decision Tree

The LabD module provides a step-by-step diagnostic trail. By inputting sequential observed results (e.g., Gram-negative rods → Oxidase negative → Glucose positive → Rapid Lactose Fermenter → Indole positive), the algorithmic framework guides the user to a resolved organism identity (e.g., Escherichia coli) while providing clinical context, such as its status as a leading UTI pathogen.

3.3 Biochemical Tests Library

A dedicated, searchable reference library indexes 23 biochemical assays, each entry detailing the underlying principle, required reagents, and result interpretation. Beyond the Catalase, Bile-Solubility, Slide and Tube Coagulase, Cytochrome Oxidase, Indole, and PYR tests used within the core identification workflow, the library also covers Complement Fixation, Hemagglutination Inhibition (HAI), ONPG, Nitrate Reduction, and Methyl Red assays, alongside twelve further procedures spanning bacterial and viral diagnostics [1].

Figure 3.2 The Biochemical Tests Library, Indexing 23 Searchable Diagnostic Assays with Principles and Reagent Details.

4. Clinical Reference and Treatment Support

BactiFIND serves as a comprehensive clinical reference for infection management and antimicrobial stewardship.

4.1 Infections Library

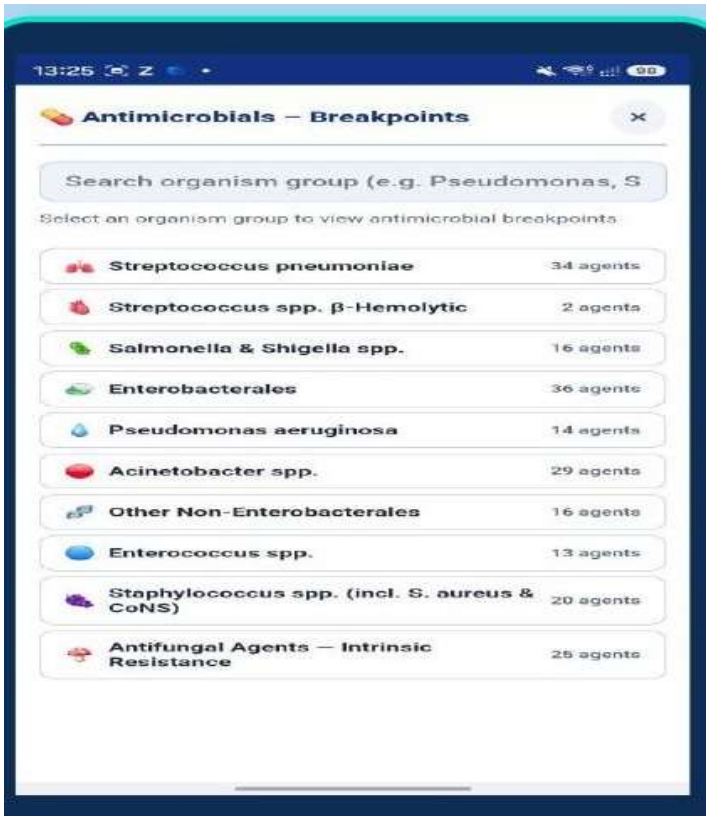
An authored library curates clinical infection protocols organized by disease category and severity, such as Community-Acquired Pneumonia and Acute Meningitis. Each protocol links directly to treatment guidance and pathogen profiles.

4.2 Antimicrobials and Breakpoints

CLSI Compliance: The application includes a structured database of antimicrobial agents organized by class, providing details on route of administration, potency, and solvent/diluent pairings [2].

Interpretation Calculator: Users can select organism groups (e.g., Enterobacterales) and specific agents (e.g., Amikacin) to input observed laboratory values (disk diffusion in mm or MIC). The calculator instantly interprets the result as Susceptible, Intermediate, or Resistant based on standard breakpoints.

Figure 4. CLSI 2026 complaint Antimicrobial Breakpoint Browser, Organized by Organism Group with Agent Counts.



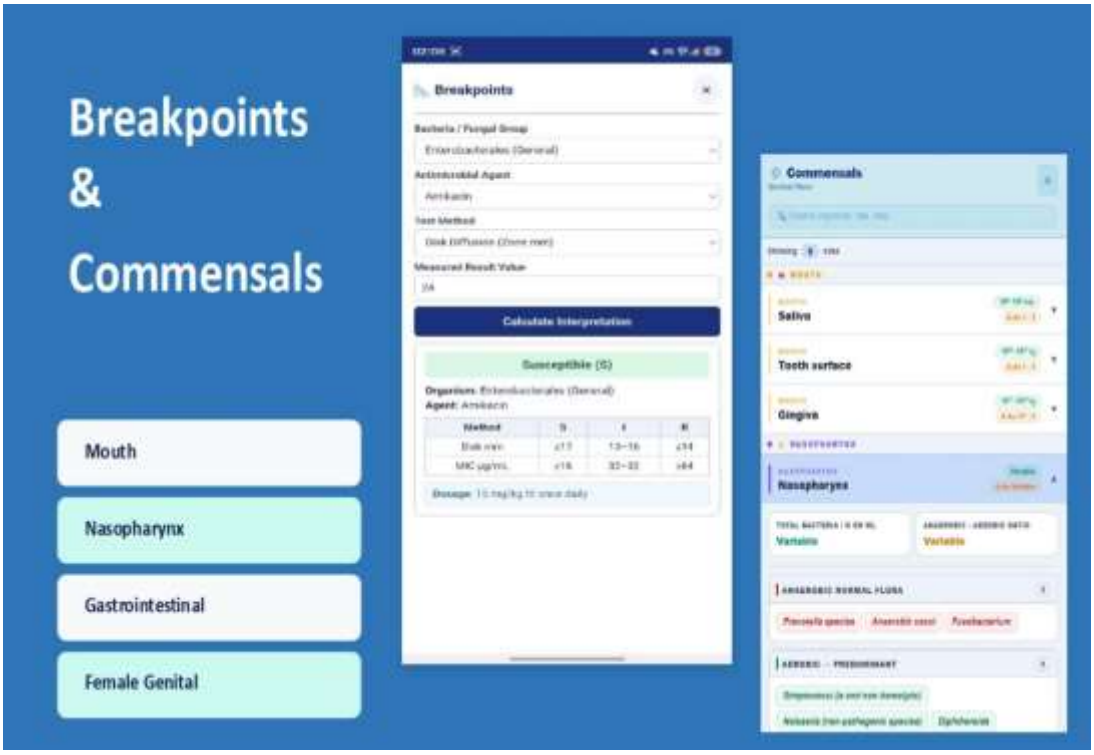
4.3 Resistance Decoder

An algorithmic decision framework designed to resolve complex phenotypic resistance patterns. By inputting observed zone differences and blunting patterns, the tool identifies mechanisms such as AmpC, ESBL, MBL, KPC, and OXA-48 [3].

4.4 Commensal Flora Reference

To help differentiate pathogenic isolates from normal flora, a Commensals module organizes reference data by anatomical site, including the mouth, nasopharynx, gastrointestinal tract, and female genital tract. Each site entry lists predominant aerobic and anaerobic organisms alongside typical total bacterial counts and aerobic-to-anaerobic ratios, giving users rapid context when interpreting culture results from mixed or commensal-heavy specimens.

Figure 4.1 The Breakpoints Interpretation Calculator (Left) Alongside the Commensals Reference, Showing Site-Specific Normal Flora and Aerobic-to-Anaerobic Ratios (Right).



5. Laboratory Utilities and Quality Control

To reduce manual mathematical errors and streamline benchwork, BactiFIND includes highly specialized laboratory utilities.

5.1 Smart Calculators and Timers

Stock Preparation: Auto-calculates the exact weight-to-volume ratio required to achieve target concentrations based on drug potency.

Dilution Solver: An integrated C1V1 = C2V2 calculator that automatically solves for any missing variable.

Grading Modules: Provides clinical grading systems including Bartlett's Scoring [4] and Murray-Washington Criteria [5] for sputum specimen quality, the Standard Gram Stain Scale and AFB Smear Grading [6] for microscopy reporting, and the Nugent Score [7] for bacterial vaginosis.

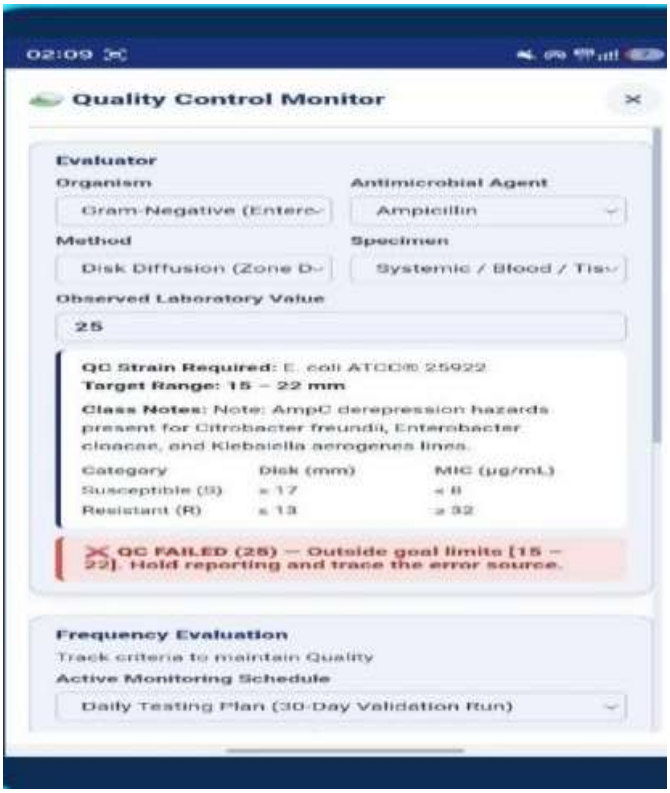
Multi-Timer: A parallel timer management system tailored for concurrent laboratory staining workflows and incubation periods.

5.2 Quality Control (QC) Monitor

This module acts as a real-time laboratory QA tool. Evaluators input the organism, antimicrobial agent, method, and observed value. The system cross-references this with required QC strain targets (e.g., E. coli ATCC 25922) and outputs a color-coded pass/fail evaluation, complete with actionable guidance if the results fall outside acceptable limits [2].

Figure 5. Complete Laboratory Toolkit — Lab Diagnosis (LabD), Media Preparation, Staining Timers, and Global Organism Search.

Figure 5.1 Real-Time QC Monitor Flagging an Out-of-Range Disk Diffusion Result Against ATCC 25922 Target Limits.



6. Educational Frameworks and Data Management

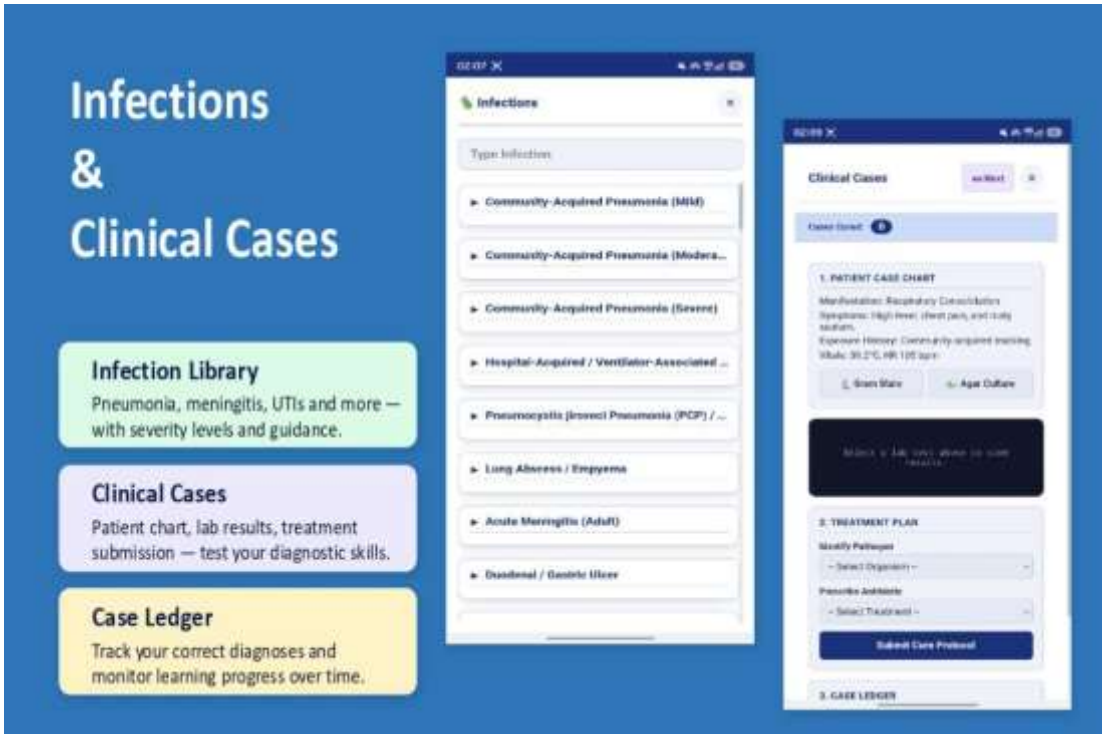
Beyond immediate bench support, the application includes features designed for continuous learning and clinical data tracking.

6.1 Clinical Cases and Gamification

Interactive Simulations: The Clinical Cases module presents interactive patient charts (manifestations, symptoms, vitals) alongside simulated laboratory test results. Users must accurately identify the pathogen and submit a cure protocol to progress.

Resistance Game: A gamified educational tool where users face descending "antibiotic threats" on a grid. Players must correctly identify the underlying resistance mechanism and neutralize the threat before time expires.

Figure 6. The Infections Library (Left) and the Clinical Cases Module, Showing a Patient Chart, Lab Results, and Treatment Submission with a Running Case Ledger (Right).



6.2 Isolate Data Logging and Publishing

Data Module: An isolate logging tool allows clinicians to capture patient details, specimen types, locations, and observed resistance patterns directly from the benchtop, storing the data securely.

PubliFIND: An integrated authoring tool enabling users to draft academic papers or case studies directly through the platform. Contributors enter their name, contact number, address, and paper title alongside the manuscript text, then submit it for review via in-app messaging or email.

Figure 6.1. Laboratory Grading Calculators, Including Bartlett's Scoring and Murray-Washington Criteria (Left), Alongside the PubliFIND Manuscript Submission Form (Right).

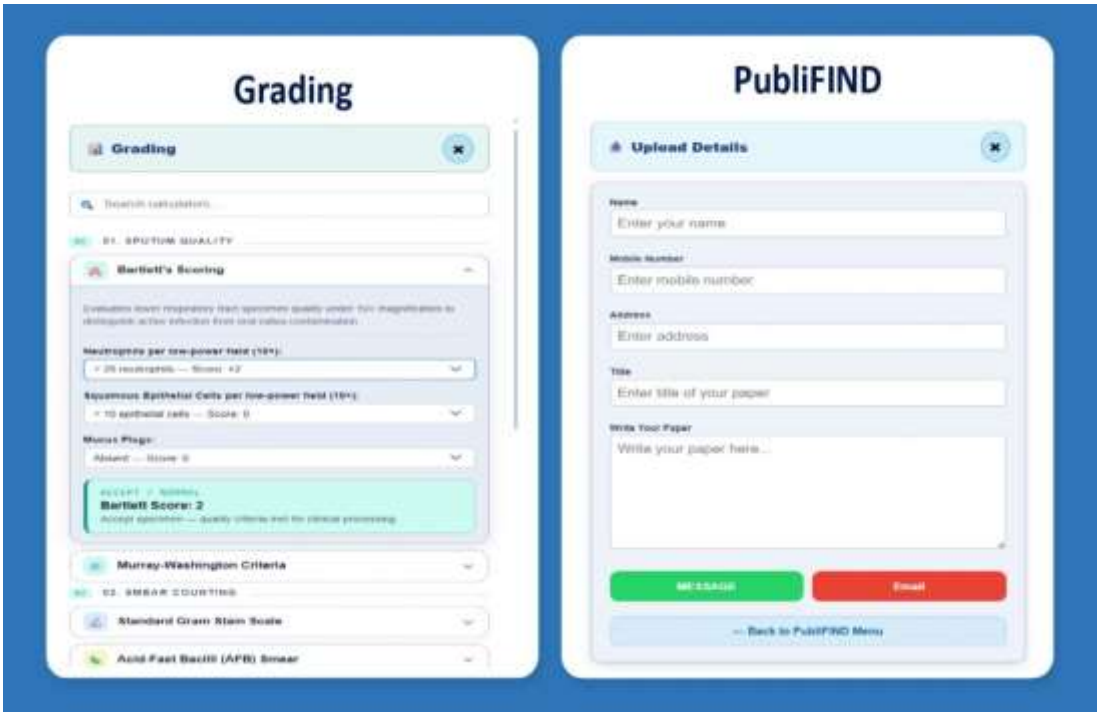
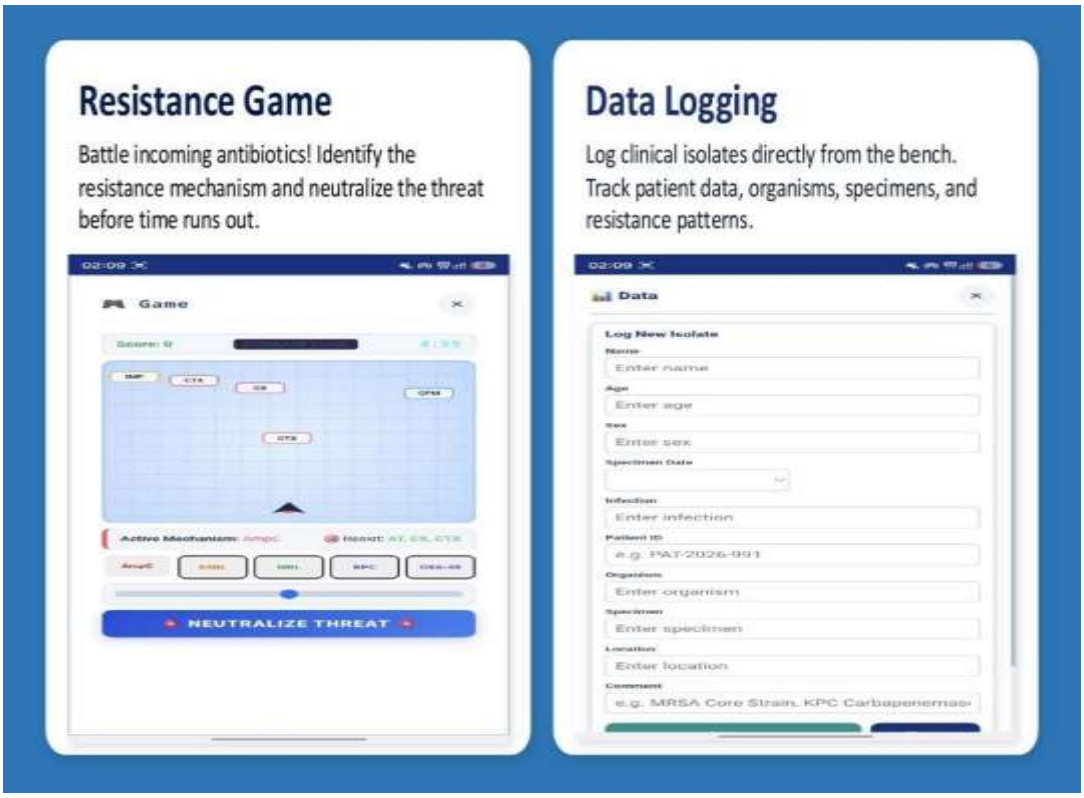


Figure 6.2 The Resistance Game (Left) Reinforces Resistance-Mechanism Recognition, While the Data Module (Right) Logs Clinical Isolates Directly from the Bench.



Conclusion

BactiFIND represents a significant step forward in the digitalization of clinical microbiology resources. By integrating over 300 organism profiles, complex diagnostic algorithms, laboratory calculators, rigorous quality control monitors, and interactive educational tools into a single, offline-capable mobile application, it provides an indispensable multi-tool resource for diagnostics and antimicrobial stewardship. The application not only empowers laboratory professionals to make faster, more accurate diagnostic decisions but also fosters continuous education in the critical domain of antimicrobial resistance.

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