Antibiogo: smartphone-based application to tackle antibiotic resistance challenges in low-to-middle income countries.

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Introduction

Timely and accurate identification of microorganisms and assessment of antimicrobial susceptibility in clinical specimens help clinicians in selecting the most appropriate treatment for their patients. In low-to-middle income countries (LMIC), bacteriological testing is generally not performed routinely due to technological challenges. This contributes treatment delays and consequent clinical complications, extended hospital stays, and the global spread of multidrug resistance (MDR). The MSF Foundation has developed Antibiogo, an offline smartphone-based application that allows non-microbiologists to carry out antimicrobial susceptibility testing (AST) and interpret the results. We are presenting the preliminary results of the Antibiogo performance evaluation.

Methods

Antibiogo comprises several components: the Image Analysis Program (IAP) that detects and measures inhibition zone diameters (IZDs); the Expert System (ES) that adjusts AST results based on the application of expert rules and identifies resistance mechanisms; and the Selective Reporting Program. For the evaluation of the IAP, we used collection isolates (n=8) and compared the automatic measurement of IZDs using Antibiogo with the readings made by eight laboratory technicians who inspected the plates manually. For evaluation of the ES, we used Antibiogo to assess 60 pathogens isolated from bone and tissues from patients admitted to MSF's Reconstructive Surgical Project in Amman, Jordan, between February and September 2020. In parallel, pictures of AST were shared with an external clinical microbiologist who performed an independent and blinded interpretation. Results of the two parallel interpretations were compared and the discordances categorised (minor, major, very major).

Results

Evaluation of the IAP showed good concordance of measurements between technicians and Antibiogo (Krippendorff's alpha value of 0.957, 95% confidence interval [CI] 0.94-0.97; p<0.001). These results indicate excellent inter-rater agreement between human raters and the Antibiogo platform for these pathogen-antibiotic pairs. For evaluation of the ES, 509 paired samples were read in parallel, and agreement of the measured diameters was excellent (R2=0.95). The ES correctly classified 474 (95.2%) of 498 interpretable samples (95% CI 92.9- 97.4), corresponding to a Krippendorff's alpha value of 90.6% (95% CI 87%-94%). This indicates excellent to near-perfect agreement. Further investigation of the samples showing non-agreement is underway.

Conclusions

Preliminary results suggest that Antibiogo is a very promising tool that can be used for the interpretation of antibiograms. This could improve access to microbiology diagnostic tests and the rational use of antibiotics in LMIC. The application currently undergoing further evaluation using a diverse set of pathogens isolated from multiple sites.

Ethics

This study was approved by the MSF Ethics Review Board and the Hospital Director of Al Mowasah Hospital, Amman, Jordan.

Nada Malou

Nada Malou holds a PhD in Microbiology. After several years spent in the field implementing microbiology laboratories in Mali, Jordan, and Yemen, she joined MSF's Operational Centre Paris medical department as a laboratory advisor and then as bacteriology and antibiotic resistance advisor. She has supervised the implementation of bacteriology laboratories in the Central African Republic, Liberia, Gaza, Yemen, Iraq, and Lebanon. She has collaborated with the antibiotic resistance task force where she led the microbiology intersectional group.In 2016, she joined the MSF Foundation in order to create Antibiogo, an open access, free, and offline smartphone-based application that enables reading and interpretation of antibiograms by non-expert laboratory technicians. She has continued her involvement in the development of Antibiogo with the MSF Foundation, while also joining the antimicrobial resistance team of Foundation for Innovative New Diagnostics in October 2020.