Abstract

Antibiotic-resistant bacteria have become a major global public health concern due to the increasing misuse of antibiotics and contributing to higher morbidity and mortality rates worldwide. The Kirby–Bauer disk diffusion method remains one of the most widely used techniques for Antibiotic Susceptibility Testing (AST) due to its simplicity and low cost; however, manual identification and measurement of inhibition zones can be time-consuming and susceptible to human error. This study aimed to develop a YOLO26-based computer vision algorithm for the automated detection and quantification of inhibition zones in Petri dish images obtained from Kirby–Bauer assays. A publicly available dataset consisting of 221 disk diffusion assay images was utilized, with 200 images used for model training, 20 images reserved for testing, and 1 image reserved to calculate the linear regression equation. Two YOLO26 model variants, YOLO26-n (nano) and YOLO26-l (large), were trained and evaluated using precision, recall, mAP50, and Mean Absolute Error (MAE) metrics. Model performance was further assessed using four image categories: clear images, blurry images, overlapping inhibition zones, and irregularly shaped inhibition zones. The results demonstrated excellent detection performance for both models, with mAP50 values exceeding 0.99. Although YOLO26-l achieved slightly higher precision and recall values, the performance improvement was negligible compared to YOLO26-n. The YOLO26-n model achieved an overall MAE of 1.636 mm, satisfying the proposed hypothesis of maintaining a measurement error below 2 mm. However, image quality was found to significantly influence measurement accuracy, with blurry images producing the largest errors. Overall, the findings indicate that YOLO26-based computer vision has strong potential to support the automation of inhibition zone analysis by reducing manual workload, improving measurement consistency, and minimizing subjective interpretation in laboratory settings.

Keywords: Antibiotic Susceptibility Testing, Kirby–Bauer Method, Computer Vision, YOLO26, Inhibition Zone Detection