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Advancements in Dengue Diagnosis Using Artificial Intelligence and Machine Learning Models

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Introduction

Dengue is a mosquito-borne viral infection impacting millions, particularly in tropical regions. Traditional diagnostics, like qRT-PCR and ELISA, can be slow and limited in resource-poor areas. AI and machine learning (ML) offer real-time data analysis, improving the speed and accuracy of dengue detection and prediction. This study highlights the potential of AI and ML models to enhance dengue diagnosis, predict severity, and improve early intervention, aiming for better disease management and quicker public health responses.

Methods

Database Search (2013-2025):

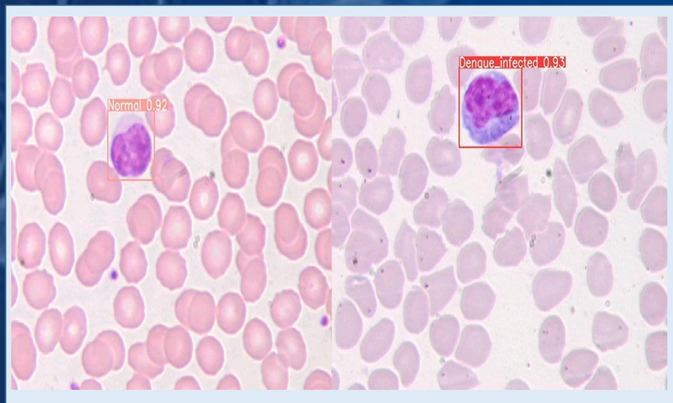
- Google Scholar
- PubMed (MeSH terms: AI, machine learning, and dengue detection)
- Scopus
- Embase
- Cochrane Library
- Web of Science

Inclusion criteria:
AI advancements in dengue diagnostic methods

Exclusion criteria:
prevention and treatment strategies

70 relevant articles out of 560

Results

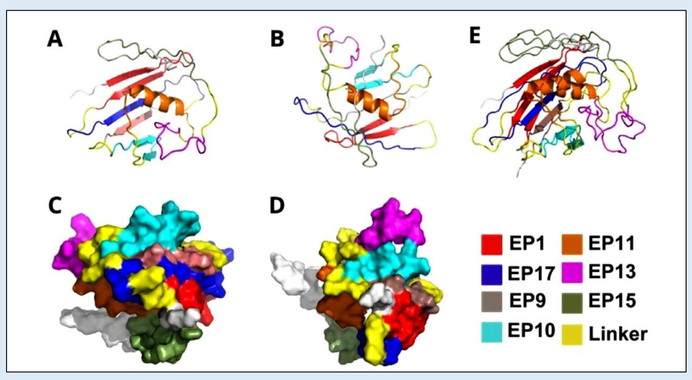


Model	Optimizer	Accuracy (%)	Recall (%)	Specificity (%)	F1 score (%)
YOLOv8n	Adam	98.1 ± 1.7	98.1 ± 2.6	98.6 ± 2.9	98.4 ± 1.4
YOLOv8n	SGD	97.5 ± 2.6	97.9 ± 4.7	97.3 ± 3.6	97.7 ± 2.3
YOLOv8s	Adam	99.3 ± 1.4	100.0 ± 0.0	98.6 ± 2.9	99.4 ± 1.3
YOLOv8s	SGD	96.2 ± 2.6	95.1 ± 4.7	98.6 ± 2.9	96.8 ± 2.0
YOLOv8m	Adam	98.7 ± 1.7	98.0 ± 2.6	100.0 ± 0.0	99.0 ± 1.3
YOLOv8m	SGD	96.2 ± 1.4	95.7 ± 4.8	97.1 ± 3.9	96.6 ± 1.6
YOLOv8l	Adam	99.3 ± 1.4	100.0 ± 0.0	98.6 ± 2.9	99.4 ± 1.3
YOLOv8l	SGD	96.8 ± 3.1	96.2 ± 5.2	98.6 ± 2.9	97.4 ± 2.5
YOLOv8x	Adam	98.1 ± 2.7	97.6 ± 5.3	98.6 ± 2.9	98.1 ± 2.7
YOLOv8x	SGD	96.8 ± 5.4	95.7 ± 9.4	98.6 ± 2.9	97.0 ± 5.1

- Model Used: Two YOLOv8 (You Only Look Once version 8) variants—object detection models

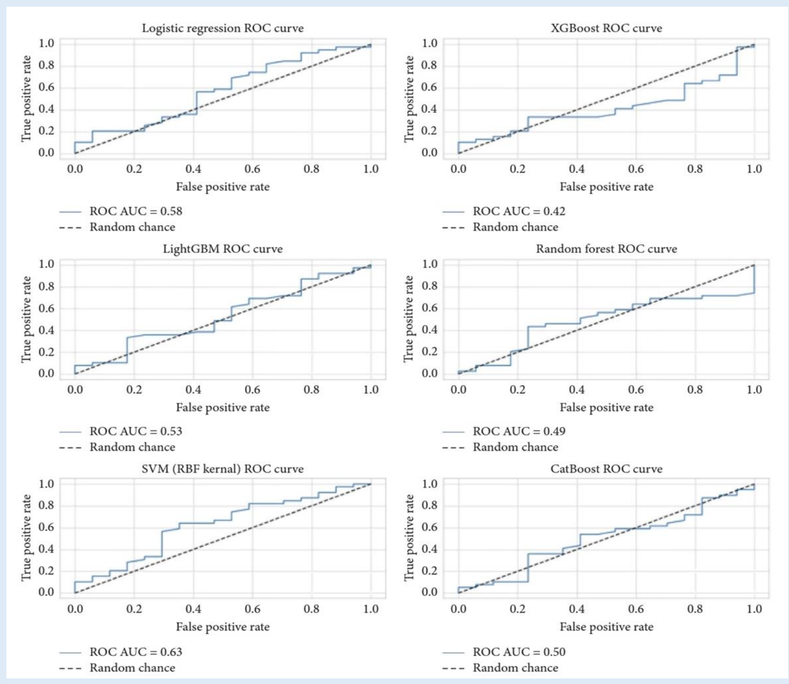
YOLOv8s (small) : Lightweight, more computationally efficient
YOLOv8 (large): Higher capacity, better at capturing complex patterns

- Application: Detecting dengue infection in PBS images
- Focus: Morphological changes in lymphocytes (e.g., enlarged size, irregular nucleus, bluer cytoplasm)
- Performance: Accuracy: 99.3%,Recall: 100%,Specificity:98.6% [1]

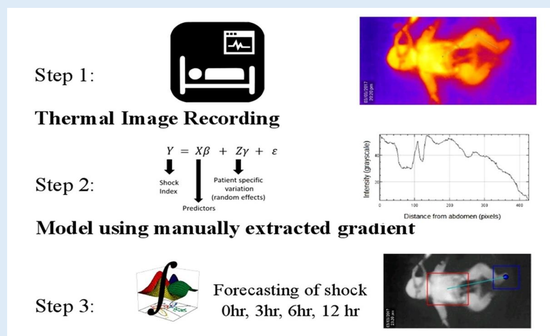


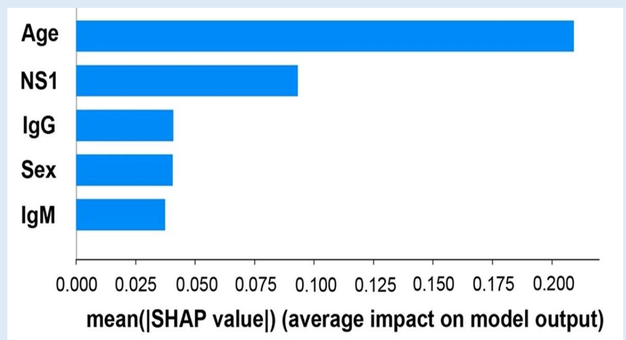
immuneML tool has been trained to:

- Design synthetic antigen
- Predicts high-specificity B-cell epitopes
- Minimizes cross-reactivity with other flaviviruses
- Models multiepitope protein structures for better antibody detection



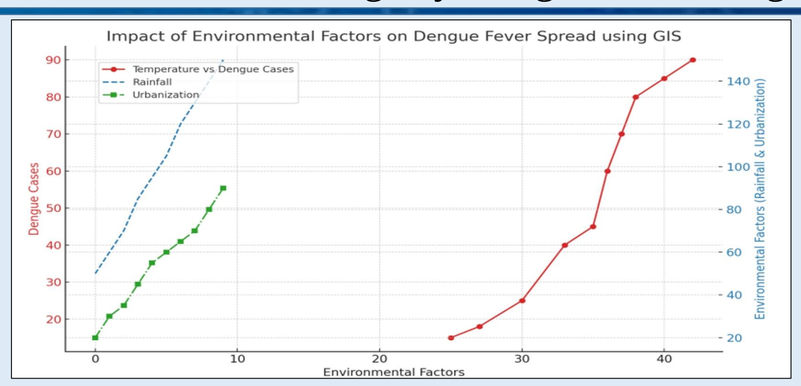
- Predicting RT-PCR results using ML models (e.g., SVM) on clinical and demographic data
- Identifying genes linked to severe dengue using models like XGBoost, aiding in patient prognosis
- Optimizing PCR primer design [2]





predicting :

- dengue severity by employing models like ANN and SVM, which utilize features including age, NS1 antigen, and antibody presence.
- Recurrent shock and Plasma leakage by using thermal imaging [3]



- Outbreak Prediction: by analyzing data like weather, mosquito populations, and previous cases to power early warning systems.
- Mosquito Classification: identifying mosquito species from images by deep learning models [4]

Conclusion

AI demonstrates strong potential in improving dengue diagnostics by significantly reducing diagnostic time, enhancing accuracy, and optimizing clinical workflows. These advancements support faster and more efficient disease detection, particularly in resource-limited settings.

References

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