T2-033 Will Robots Replace Doctors -- the performance of artificial intelligence in the Diagnosis of Breast Cancer
人工智慧在乳癌病理診斷的表現 醫生是否會被機器人取代

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Purpose

Artificial intelligence (AI) is an area of computer science where computers are designed to think and operate much like a human brain. Some of the AI news from Google are fascinating and close to our daily life. Google's Deepmind Computer Go program AlphaGo beats the long time World Go Champion Lee Sedol in March, 2016 (figure 1). Google's another well known AI product is the driverless cars. Google has been trialing driverless cars since 2009 (figure 2).

Figure 1 Lee Se-Dol, right, a legendary South Korean player of Go — an ancient board game developed in China that is more complex than chess — makes a move during the Google DeepMind Challenge Match in Seoul.   Adapted from Los Angeles Times. Retrieved May 11, 2016, from http://www.latimes.com/business/technology/la-fi-tn-google-ai-20160311-story.html Copyright © 2016

Figure 2, Police pull over Google's driverless car for driving too slowly. Adaptged from Telegraph.co.uk. Retrieved May 11, 2016, from http://www.telegraph.co.uk/ technology/google/11992795/Police-pull-over-Googles-driverless-carfor-driving-too-slowly.html c Copyright of Telegraph Media Group Limited 2016

This study evaluate the performance of AI in medicine, especially in the diagnosis of breast cancer. Fine-needle aspiration (FNA) of a breast mass is the early critical examination of breast cancer. The interpretation of FNA specimen depends solely upon a labor-intensive process that can be affected by human factors such as fatigue, reader variation and bias. We investigate the potential application of AI in the area of breast cancer diagnosis. The performance of 6 predictive models in the interpretation of fine-needle aspiration (FNA) in breast cancer are investigated.

Method

The Wisconsin Diagnostic Breast Cancer (WDBC) data consists cell nucleus features of FNA digital images from 569 instances. Ten real-valued features are computed for each cell nucleus: radius, texture, perimeter area, smoothness, compactness, concavity, concave points, symmetry, fractal dimension. The mean, standard error, and "worst" or largest (mean of the three largest values) of these features were computed for each image, resulting in 30 features. All feature values are recoded with four significant digits. Missing attribute values: none. Class distribution: 357 benign, 212 malignant. Total 6 predictive models are examined to predict pathologic results, either benign or malignant. The 6 models are: Back Propagation Network (BPN), Decision Tree (DT), Bayesian Network (BN), Support Vector Mathine (SVM), Logistic Regression (LR) and Discriminant Analysis (DA). The primary end points are accuracy, sensitivity and specificity. The WDBC database is public availabe at https://archive.ics.uci.edu/ml/datasets/Breast+Cancer+Wisconsin+(Diagnostic) (figure 3).
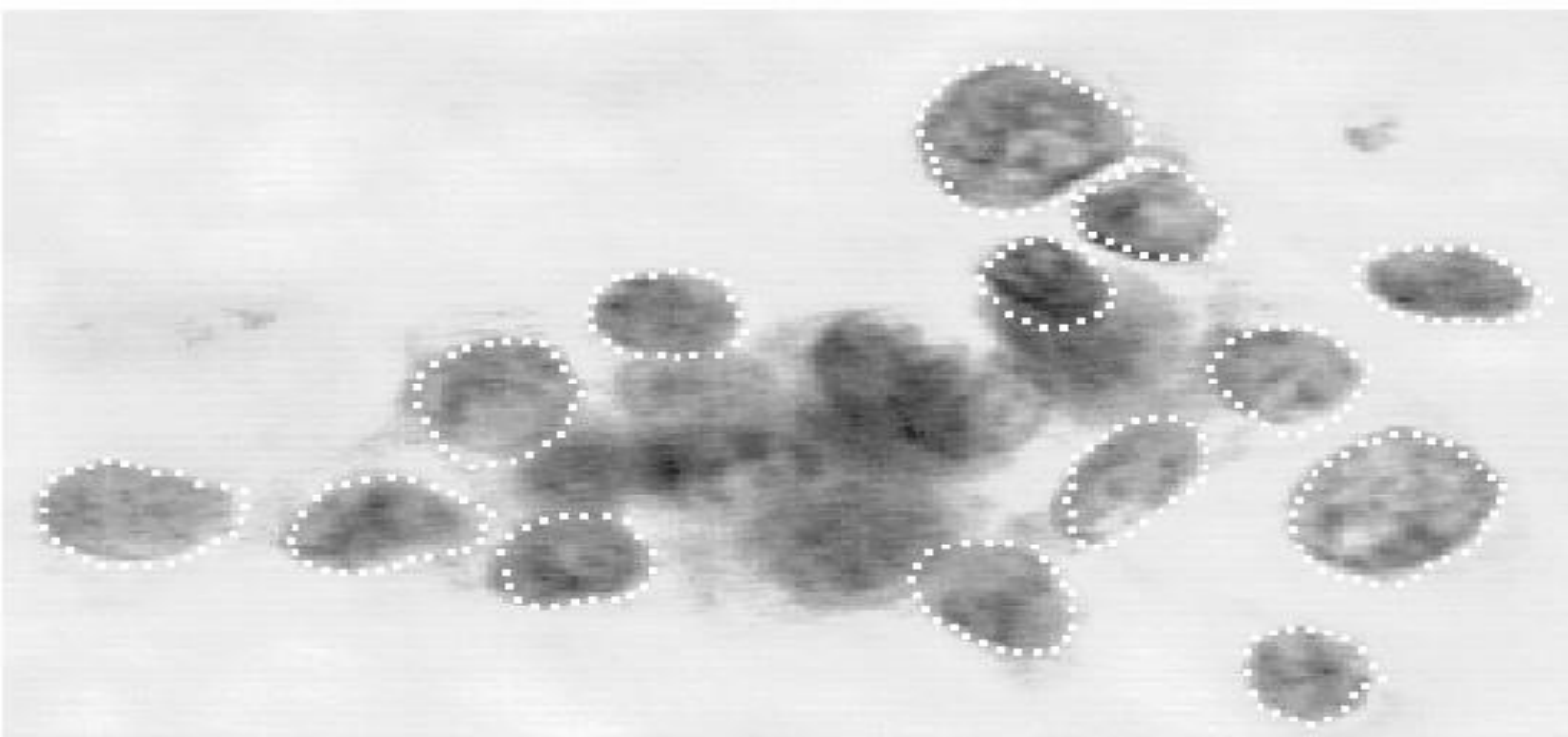

Figure 3, Initial approximate boundaries of cell nuclei. Adapted from "Nuclear feature extraction for breast tumor diagnosis." by Auther W.N. Street, W.H. Wolberg and O.L. Mangasarian , 1993 IS&T/SPIE 1993 International Symposium on Electronic Imaging: Science and Technology, volume 1905, pages 861-870, San Jose, CA.
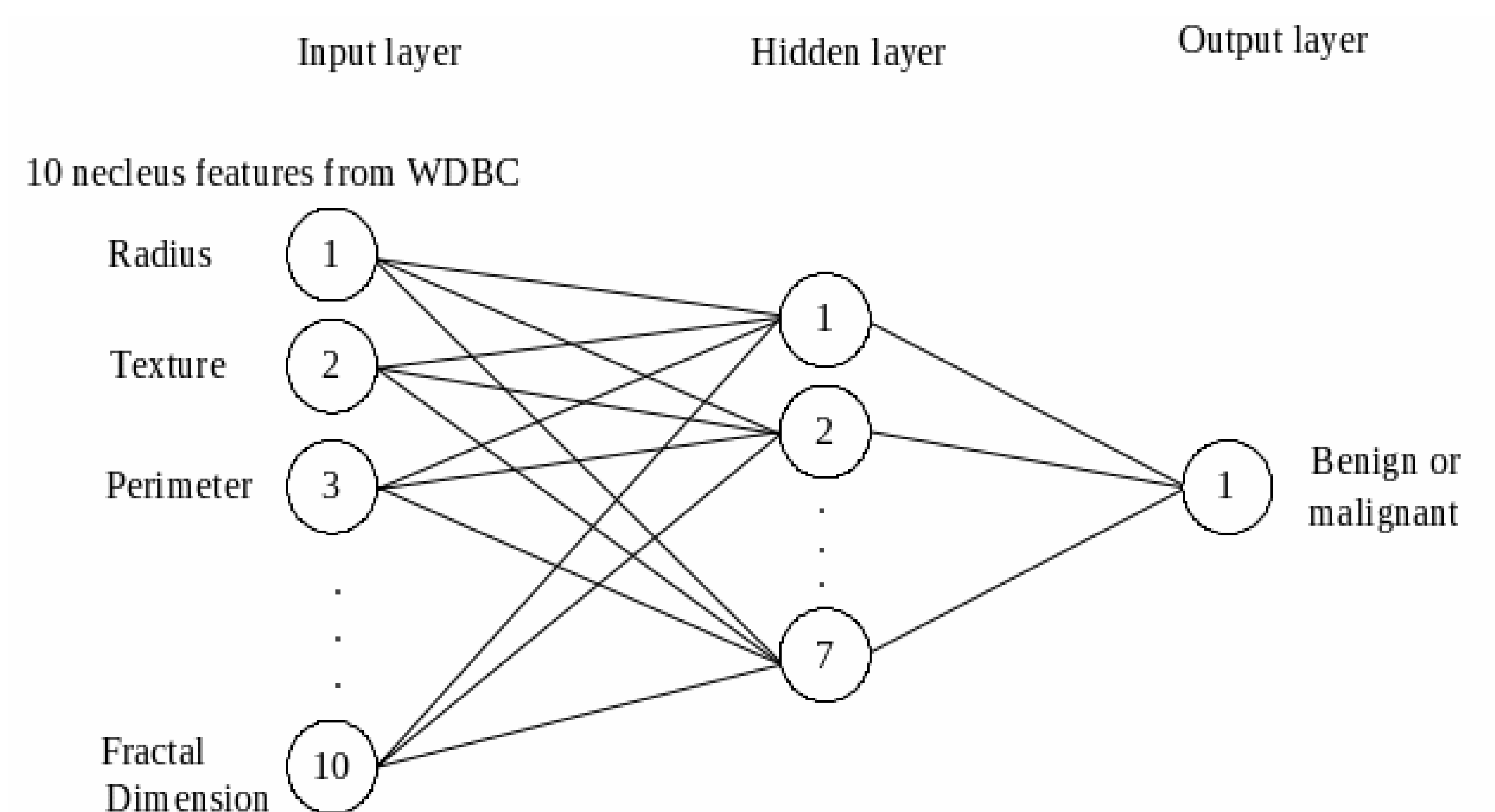

Figure 4, BPN, the input layer, hidden layer, output layer and WDBC.

Back Propagation Network (BPN) is the workhorse of learning in neural networks. This method calculates the difference between the targeted and actual output. Then use individual difference to update each weight-synapse. The ten features in WDBC are used as input laywer. The pathologic results, either benign or malignant, are used as the output layer (figure 4).

Results

The optimized ranges of accuracy, sensitivity and specificity of the 6 predictive models are (0.92 - 0.97), (0.83-0.95), and (0.93 - 0.99). The individual optimized (accuracy, sensitivity, specificity) are (BPN 0.97, 0.95, 0.98), (DT 0.92, 0.90, 0.94), (BN 0.94, 0.84, 0.99), (SVM 0.96, 0.90, 0.99), (LR 0.94, 0.92, 0.95), and (DA 0.93, 0.84, 0.98).

Conclusion

The accuracy, sensitivity and specificity of the 6 predictive models are encouraging. The clinical applications of AI in medicine may decrease human errors, fatigue, bias and escalate quality and efficiency