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Artificial Intelligence in Medicine: Chances & Challenges

OP0190

A MACHINE LEARNING MODEL THAT PREDICTS RA PROGRESSION FROM UNDIFFERENTIATED ARTHRITIS -KURAMA AND ANSWER COHORT STUDY-

Keywords: Rheumatoid arthritis, Undifferentiated connective tissue disease, Real-world evidence

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Background: Early diagnosis and treatment of rheumatoid arthritis (RA) improve clinical outcomes. Undifferentiated arthritis (UA) is arthritis that does not fit a specific diagnosis. Half of the UA undergo spontaneous remission, while 30% of cases develop RA. Therefore, in UA, identifying patients at high risk for developing RA and providing close monitoring for those patients is required for early diagnosis and treatment [1]. However, predicting the evolution of UA to RA is still difficult.
Objectives: Machine learning, including deep learning, which is comparable to and in some cases surpasses the performance of human experts, is broadening its application in medicine. This study aims to build a machine-learning model that predicts the development of UA to RA.
Methods: For model training, a total of 322 UA patients in KURAMA cohort were analyzed (Table 1). For variables to train models, we chose 24 clinical features, which are easy to obtain in daily clinical practice. The target variable was the final diagnosis. We built models using Random forest (RF), XGBoost (XGB), Logistic regression (LR), and Deep neural network (DNN) and compared their performances. For model validation, we used data of 88 UA cases in ANSWER cohort (Table 1).
Results: We trained models using 24 clinical parameters at the first clinical visit, performed 10-fold cross-validation, and evaluated model performance by averaging accuracy and AUC. The performance of the models was 73.5%, 74.2%, 74.5%, and 85.1% in precision and 0.760, 0.734, 0.748, and 0.895 in AUC for RF, XGB, LR, and DNN, respectively. DNN showed the highest performance. We then applied the DNN model to external validation data from ANSWER cohort and found that the prediction accuracy was 80.0%.
Conclusion: Using parameters available in clinical practice, we developed a DNN model that effectively predicted RA development in internal and external UA datasets. Applying a machine learning approach might enable identifying patients at high risk of RA progression and improve the clinical management of UA patients.

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Table 1. Baseline patients' characteristics

	KURAMA		ANSWER	
Variables	RA (n=94)	Non-RA (n=228)	RA (n=14)	Non-RA (n=74)
age (median, yr)	60 [46.5-69]	53.5 [44-64]	44 [37.75-53.5]	63 [53.3-69.8]
sex (female%)	72.34%	78.07%	71.43%	64.86%
BMI (median, kg/m^2)	22.03 [20.09-24.29]	21.23 [19.22-23.90]	22.60 [20.85-28.37]	21.55 [19.68-23.44]
Family history of RA (positive %)	31.91%	27.19%	14.29%	17.57%
Smoking (current or past %)	35.11%	30.70%	57.14%	63.51%
CRP (median, mg/dL)	0.3 [0.1-1.1]	0.1 [0-0.1]	0.23 [0.078-0.63]	0.12 [0.04-1.09]
ESR_1h (median, mm)	19 [9-41]	12 [6-19.25]	11 [8-36.75]	13 [7.5-37.5]
RF (median, IU/mL)	8 [8-22.7]	8 [8-18.53]	6 [5-36.75]	7 [5-19]
ACPA (median, U/mL)	0.6 [0.6-0.7]	0.6 [0.6-0.6]	5.6 [0.675-263]	0.7 [0.5-3.05]
MMP-3 (median, ng/mL)	65.85 [43.15-137.58]	46.7 [31.9-62.13]	81.4 [49.03-98.78]	55.35 [39.16-128.15]
Dr_VAS (median, mm)	20 [9.25-33]	7 [2-17.25]	20 [10.5-32.25]	18 [10-33]
Pt_VAS (median, mm)	49.5 [22.25-67.75]	44 [15-55.25]	48.5 [31.5-64.5]	47 [21-68]
DAS28_CRP (median,)	3.22 [2.36-4.08]	2.38 [1.78-2.94]	3.27 [2.38-4.02]	3.09 [2.27-4.20]
HAQ (median)	0.5 [0.125-1]	0.25 [0-0.5]	0.313 [0-0.594]	0.375 [0.125-0.969]
ACR2010_points (median)	4 [3-5]	3 [2-4]	1 [0.25-2.75]	1 [0-2] [Q1-Q3]

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