

Predicting the treatment outcome of antidepressants using deep learning in patients with major depressive disorder

Pin Lin Tsai^{1,2}, Hui Hua Chang^{1,2,3,4,*}, Po See Chen^{5,6}

¹ Institute of Clinical Pharmacy and Pharmaceutical Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan

² School of Pharmacy, College of Medicine, National Cheng Kung University, Tainan, Taiwan

³ Department of Pharmacy, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

⁴ Department of Pharmacy, National Cheng Kung University Hospital, Dou-Liou Branch, Yunlin, Taiwan
Department of Psychiatry, Chung Shan Medical University Hospital, Taichung, Taiwan

⁵ Department of Psychiatry, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan

⁶ Institute of Behavioral Medicine, College of Medicine, National Cheng Kung University, Tainan, Taiwan

Background: Patients with major depressive disorder (MDD) are predominantly treated by antidepressant drugs (ADs), while the response to ADs differ greatly between each patient. To achieve the goal of precise medicine, our study applied deep neural network (DNN) model of deep learning to predict the treatment outcome of ADs.

Aims & Objectives: The aim of our study was to maximize prediction of treatment outcomes with antidepressants using a combination of clinical, demographic, and genetic data in Taiwanese MDD patients.

Methods: Our study collected clinical data, peripheral blood biochemistry data, score of questionnaire, cognitive function, and polymorphisms of genes in 70 MDD patients. These patients treated with fluoxetine or venlafaxine for six weeks were categorized as remission and non-remission. Our study used generalized linear model to extract predictors significantly related to treatment outcome. Then, multi-layer feedforward neural network containing two hidden layers was applied to build models with ten-fold cross-validation. The area under curve (AUC) of receiver-operating-characteristic curve (ROC curve) was used to evaluate the performance of models.

Results: Predictors extracted from four different types of variables were separately utilized to construct models, and the outcome indicated the AUC of ROC curve was 0.65 to 0.825. Furthermore, the best performing model was characterized by an AUC of 0.825 using cortisol level, oxytocin level, social support scale, World Health Organization Quality of Life, and polymorphisms of *OXTR*.

Discussion & Conclusion: DNN model was a promising way to predict the treatment outcome of fluoxetine or venlafaxine. Further validate model with external database is needed to confirm the results. In conclusion, application of deep learning in the field of medication show great potential to predict treatment outcome.