# Artificial intelligence as an avenue for research and clinical work related to tic disorders

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**Background:**

In recent years there has been a growing number of methodologies aimed to apply new technologies for determination of clinical phenotypes and development of new treatment strategies for patients with tics. These include strategies such as machine learning and deep learning and other modalities of artificial intelligence (AI) used to analyze clinical variability of tics, neuroimaging phenotypes or treatment options.

**Methods:**

One reviewer (NS) searched the electronic database of PubMed on April, 2022 for relevant studies using the search terms: ('Tourette syndrome' [MeSH Terms] OR 'Gilles de la Tourette syndrome' [MeSH Terms] OR 'tic disorders' [MeSH Terms] OR 'tics' [MeSH Terms] OR 'tic disorders'[Title/Abstract]) AND ('artificial intelligence' [Title/Abstract] OR 'machine learning' [Title/Abstract] OR 'deep learning' [Title/Abstract], limit: 'humans'. These studies were further reviewed for additional relevant citations. The titles and abstracts of the studies obtained through this search were examined by the reviewer (NS) in order to determine article inclusion. Discrepancies were addressed by the reviewers through discussion and eventually conversation with the senior reviewers (TZ, PN, JP).

**Results and Conclusions:**

Our search strategy yield 10 studies which used AI methodology in studies dedicated to tics. All in all, these included the topics of clinical phenotypes, neuroimaging and response to treatment. In particular, in the area dedicated to clinical phenotypes, Paulus et al. developed a machine learning model helpful to differentiate between voluntary movements and tics. They used methodology of support vector machine (SVM) to evaluate the impact of each category of Modified Rush Videotape Rating Scale (MRVRS), the motor tic count per minute, age and gender on the classification of individuals into the groups “Tourette syndrome” and “no Tourette syndrome”. As a result, they demonstrated that severity of motor, but not vocal tics, is the best predictor to separate and classify patients with Tourette syndrome (TS) and healthy controls. Similar study was released by Wu et al. who attempted to find an automatic method for detecting tic movement to assist in diagnosis and evaluation based on real clinical data and deep learning architecture that combines both unsupervised and supervised learning methods. Further evaluation suggested its potential clinical application for auxiliary diagnoses and evaluations of treatment effects. As for neuroimaging studies, previous attempts were mainly focused on application of machine learning to analyze neuroimaging phenotypes that can distinguish healthy controls and TS individuals or using these techniques to develop more advanced neurostimulation via deep brain stimulation (DBS). It can therefore be concluded that all these avenues will serve to plan better, individualized treatment for patients with tics. These technologies enable better and personalized planning of treatment, which in the nearest future will be based on the combination of genetic information, neuroimaging findings and biological biomarkers.