Systematic AI Support for Psychiatry: A Framework on How to Implement Decision Support Systems

2023-09-28 12:03:30

Authors

Markus Bertl, Peeter Ross, Gunnar Piho, Dirk Draheim

Abstract

Diseases of the brain are, with an annual prevalence of 38%, not only very common, but they also account for more than ?461 billion in healthcare costs in Europe. These diseases are often diagnosed late or not at all. Artificial Intelligence (AI) could improve the diagnostic process. Two systematic literature reviews containing information from 80 research papers on Digital Decision Support Systems (DDSSs) in psychiatry show low adoption rates and generally low maturity. Research mostly focuses on pure algorithm development, and evaluation is performed on small datasets. This raises questions about the trustworthiness of the claimed high accuracy rates of algorithms. Additionally, the clinical component, such as the availability of data in the clinical workflow, the usefulness of the DDSS for clinicians or user acceptance, has been widely neglected. All this influences low adoption rates. This research proposes a systematic approach that takes into consideration both the clinical and the technical aspects. For this systematic AI support, a framework with dimension data, technology, user group, medical domain, decision, validation and maturity serves as a tool for more holistic DDSS development. The framework was derived based on (i) literature, (ii) data from a focus group interview with nine DDSS experts from various fields, and (iii) practical experience. A scenario-based evaluation and a focus group interview were used to evaluate the framework. To overcome the potential issue of insufficiently working decision technology, traditional machine learning algorithms, a rule-based approach and several deep learning methods, including our own novel attGRUdecay model, were benchmarked on real-world diagnostic data from 812,853 patients with a total of 26,973,943 diagnoses. Our attGRU-decay model outperformed the other methods and the current state of the art with an AUPRC of 0.974.

These results can be clustered into three main contributions: 1. Pointing out the shortcomings of current DDSS research, namely the lack of interdisciplinarity for DDSS design and development, resulting in a sole focus on the

algorithmic part of DDSSs, unreliable accuracy metrics because of low sample sizes for AI training and testing and low maturity and low clinical value of DDSSs. 2. Proposing and assessing systematic AI support based on our framework as a solution to raise DDSS adoption rates and increase their clinical benefit. 3. Evaluating the current decision technologies that can power DDSSs based on large amounts of real-world data; proposing a novel deep learning model that outperforms the current state of the art.

Keywords

Artificial Intelligence, Machine Learning, Deep Learning, Association Rule Mining, Digital Decision Support Systems, Clinical Decision Support, Psychiatry, Depression