CASE STUDY: July 2023

Operose Health study shows AI effective in identifying risks and preventing harm for patients prescribed multiple medicines

The following case study is a summary of 'Automated Detection of Patients at High Risk of Polypharmacy including Anticholinergic and Sedative Medications' which was published in the leading *International Journal of Environmental Research and Public Health* in June 2023. The paper was authored by Dr Amirali Shirazibeheshti, Dr Alireza Ettefaghian and Dr Tarek Radwan from Operose Health with colleagues from Aston Business School and Anglia Ruskin University.

Overview of project

Ensuring that medicines are prescribed safely is fundamental to the role of healthcare professionals who need to be vigilant about the risks associated with drugs and their interactions with other medicines (polypharmacy). One aspect of preventative healthcare is to use artificial intelligence to identify patients at risk using big data analytics. This will improve patient outcomes by driving pre-emptive structured medication reviews for the identified cohort before adverse effects present.

The project

The project, run by Operose Health's clinicians, technology, and data experts, used artificial intelligence to identify patients at risk due to polypharmacy – the regular use of over five prescription drugs. AI was added to our in-house population health management platform EZA Analytics and during the study over 300,000 patient records were analysed to identify patients at risk from polypharmacy and high anticholinergic burdens.

The project's AI learning algorithm used a mean-shift clustering technique to identify groups of patients at the highest risk of polypharmacy. This produced an anticholinergic risk score and a weighted drug interaction risk score for over 300,000 patients.

The two measures were introduced to the mean-shift clustering algorithm which then grouped patients into clusters reflecting different levels of polypharmacy risk.

The results showed that, for most of the data, the average risk scores are not correlated within patient groups (clusters) and, secondly, the high-risk outliers have high scores for one measure but not for both. These suggest that any systematic recognition of high-risk groups should consider both anticholinergic and drug–drug interaction risks to avoid missing high-risk patients. Implementing this through our EZ Analytics healthcare management system automatically identifies groups at risk far more quickly than the manual inspection of patient records.

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Polypharmacy and the effects

Polypharmacy can give rise to adverse drug reactions (ADRs) where the effect of one drug is changed in the presence of other drugs, potentially resulting in increased toxicity. Approximately 10% of consultations in primary healthcare are related to ADRs and 60-70% of serious ADRs are preventable but are often inadvertently overlooked due to the complexity of the issue, availability of data and clinical knowledge.

Research estimates the prevalence of polypharmacy ranges from one-third to two-thirds with older patients and is also common for those with multiple long-term conditions. With ageing, the risk of developing chronic diseases and ADRs related to multiple drug prescriptions increases. Prolonged use of anticholinergic and sedative medications is highly correlated with worsening cognition and decline in physical functions among the elderly.

Key findings/outcomes from the study

- Using AI with large data sets improved patient outcomes by identifying high drug burdens in identified patient groups before any symptoms presented or harm occurred.

- AI was highly effective in its ability to self-identify clusters of patients at the highest risk of polypharmacy using real-world data analysis of over 300,000 patients and calculating a weighted drug interaction risk score for each individual.

- Integrating AI with our population health management platform automatically identified groups at risk far more quickly than through manual inspection of patient records.

- This AI-driven approach was considerably less labour-intensive, freeing up clinical time to assess and support the higher-risk patients, rather than spending time identifying them.

'Outstanding' work continues

This latest study builds on our work to explore how AI and machine learning can improve the way we extract patient data to drive better patient safety and outcomes. The original project in 2015 was funded as a Knowledge Transfer Partnership (KTP) by Innovate UK leading to the development of our in-house data-management tool EZ Analytics.

This second project, also funded as a KTP added an AI element to EZ Analytics, focusing on a target group of patients, in this case older people prescribed anticholinergic drugs. This module optimised the identification of patients in this group with significant risk-factors, supporting our clinical teams to de-prescribe where appropriate. Extracting the data in a way that individuals or existing searches could not do, this new AI-driven approach will reduce the risk of serious illness or death. The outcome of this work has been published in the *International Journal of Environmental Research and Public Health*. Both of these projects were rated as 'Outstanding' by Innovate UK.

Next steps

The next stage of integrating AI with EZ Analytics will focus on identifying patients at risk of developing multiple long-term conditions, with the aim of prevention through earlier interventions to improve patient outcomes. For more information contact: hello@operosehealth.co.uk

Views from our team

Dr Tarek Radwan
GP Director

"The impact of this study should not be under-estimated, as it clearly demonstrates the benefits of integrating AI with large scale data for patients, clinicians and the NHS. It is vitally important that we recognise when harm could be caused by the interaction of a person's different medicines. The findings of our study show we that can use data and AI to quickly identify potential risks across large groups of people and take action before their health is impacted."

Yvette Agyako
Lead Pharmacist

"The use of artificial intelligence in the management of complex polypharmacy medication reviews, particularly when managing those with an increased anticholinergic burden, has been amazing. Without AI, the process of identifying the cumulative score for our patients would have been difficult and time consuming. However, now within EZ Analytics we can easily identify all patients at risk and systematically review them, prioritising those with the greatest risk."

Dr Alireza Ettefaghian
Study Lead and Head of Business Intelligence

"Here at the Operose Health business intelligence team, we are pro-actively innovating and championing AI-aided health analytics for primary care. This latest study achievement confirms that our approach and investment will deliver better patient care and more effective use of clinical time and resources. This is a potentially game-changing study for patients and the NHS, and we will now look at how future studies will incorporate other measures such as age, gender, and location to enhance outcomes."

Dr Amirali Shirazibeheshti
Clinical Data Scientist

"Operose Health is at the forefront of technology and innovation within the UK healthcare sector. This has propelled us to develop AI algorithms to unlock valuable insights and data-driven decision-support mechanisms. With artificial intelligence leading the way, we envision a future where healthcare management is revolutionised, enabling precise diagnostics, tailored treatments, and improved patient outcomes."