Jung Yin Tsang

Please describe the work that you wish to be considered for the Hildi Franke Award.

Development and validation of a Polypharmacy Assessment Score: Improving case finding in primary care using a machine learning approach

Please explain the relevance to primary care informatics of your submission (max 200 words).

Polypharmacy is characterised by the increasing use of multiple medicines. This is a growing global patient safety challenge for primary care, with its prevalence having quadrupled over the last 20 years. Currently, nearly half of all adults over 65 years old are already taking at least five medicines daily. As 90% of prescribing occurs in primary care and most of this is conducted electronically, there is great potential for informatics solutions to address inappropriate prescriptions in polypharmacy. However, identifying those with excessive or inappropriate prescriptions is challenging as people with more health needs often require more medicines, meaning that simple counts of medicines do not distinguish appropriate from problematic polypharmacy. As such, I developed a Polypharmacy Assessment Score to improve the identification of patients with inappropriate polypharmacy using routinely collected electronic health records (EHR) from 8.4 million adults within 1495 general practices from CPRD. This combined prediction modelling statistics with supervised machine learning techniques to highlight people that have unusually high or unusually low levels of prescribing, given their age, gender and long-term conditions. My approach is intentionally pragmatic using readily available covariates found in EHR data to optimise explainability and implementability in primary care electronic health systems (https://pubmed.ncbi.nlm.nih.gov/39010248/).

Please explain the originality or innovation of your submission (max 200 words).

This is original research developed within my PhD in Primary Care and Clinical Informatics at the University of Manchester, supported by the NIHR (https://fundingawards.nihr.ac.uk/award/NIHR302624). The development and validation of the Polypharmacy Assessment Score adopts state of the art techniques combining prediction modelling statistics and supervised machine learning. The optimal fitting model utilised a zero-inflated negative binomial model to predict the observed count of medications per patient. Age, gender, 37 long-term conditions and 20 negative interaction terms of long-term conditions were used as independent variables. Selection of terms in the optimal model then adopted supervised machine learning via the least absolute shrinkage and selection operator (LASSO) for adjustment of coefficients and regularisation. The resulting Polypharmacy Assessment Score represents a significant shift from existing measures and case-finding approaches for polypharmacy. It identifies groups of patients with unusual levels of prescribing, who are at higher risk of adverse drug reactions and potentially inappropriate prescribing. By expanding the focus beyond only the most unwell patients, it highlights opportunities for earlier intervention. It also enables risk stratification using a

population-based approach to optimise the people that would benefit most from medication optimisation interventions.

Please explain the impact or benefits of your submission (max 200 words).

The Polypharmacy Assessment Score has demonstrated validity, with unusually high (potential overprescribing) and unusually low (potential underprescribing) levels of prescribing being associated with the highest levels of adverse outcomes and potentially inappropriate prescribing. This effect has persisted even when applied to subpopulations of 10 or more medications or within severe frailty, allowing the score to further stratify a subgroup when combined with existing approaches. Overall, the Polypharmacy Assessment Score represents a different approach to existing measures, such as high medication counts or frailty measures. These are less specific, highlighting older adults that are generally more ill, severely frail, or are simply on lots of medications. In contrast, my tool highlights potentially problematic polypharmacy through identifying unusually high or unusually low levels of prescribing relative to their age, gender and long-term conditions. This identifies a different and more focussed proportion of the population. Designed as an implementable tool in routine primary care EHRs, the Polypharmacy Assessment Score carries potential for national roll-out. This would allow healthcare professionals to systematically prioritise and risk stratify polypharmacy patients. This would be a substantial improvement from current approaches to enable a systematic and higher acuity approach to case-finding in polypharmacy.