

Development and performance evaluation of the Medicines Optimisation Assessment Tool: a prognostic model to target hospital pharmacists' input to prevent medication-related problems

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Background

- Medicines optimisation is a key role for hospital clinical pharmacists,¹ but with increasing demands on services there is a need to increase efficiency whilst maintaining patient safety.
- Clinical prioritisation has been proposed as a way to permit pharmacy services to focus on where need is greatest and where it has greatest impact.²

Objectives

- The aim was to use prognostic modelling to develop a prediction tool, the Medicines Optimisation Assessment Tool (MOATTM), to target patients most in need of pharmacists' input while in hospital.
- The objectives were to develop a decision aid to allocate patients to risk groups based on their risk of medication-related problems (MRPs), and to assess its predictive performance.

Methods

- Consecutive admissions (n=1,652) from adult medical wards at two UK hospitals were prospectively included into this cohort study between April and November 2016. Data on MRPs were collected by pharmacists as part of their routine daily clinical assessment of patients. Data on potential risk factors, such as polypharmacy and use of 'high-risk' medicines, were collected retrospectively.
- Multivariable logistic regression modelling was used to determine the relationship between potential risk factors and the study outcome, namely preventable MRPs that were at least moderate in severity, and a simplified electronic scoring system (the MOAT) developed (see image below). Three risk groups were created to guide general prioritisation decisions (categorising patients as high, medium or low-risk). The MOAT reports a patient's risk group in addition to their predicted probability of experiencing an outcome event; this permits some degree of prioritisation within each category (if required due to workload pressures).
- Discrimination (the ability of a prediction model to differentiate between those who do or do not experience the outcome event), was measured using the concordance index. Calibration (the agreement between observed outcomes and predictions from the model), was plotted graphically. Sensitivity and specificity were calculated, and clinical usefulness assessed using decision curve analysis, where 'net benefit' is plotted over a range of decision thresholds.

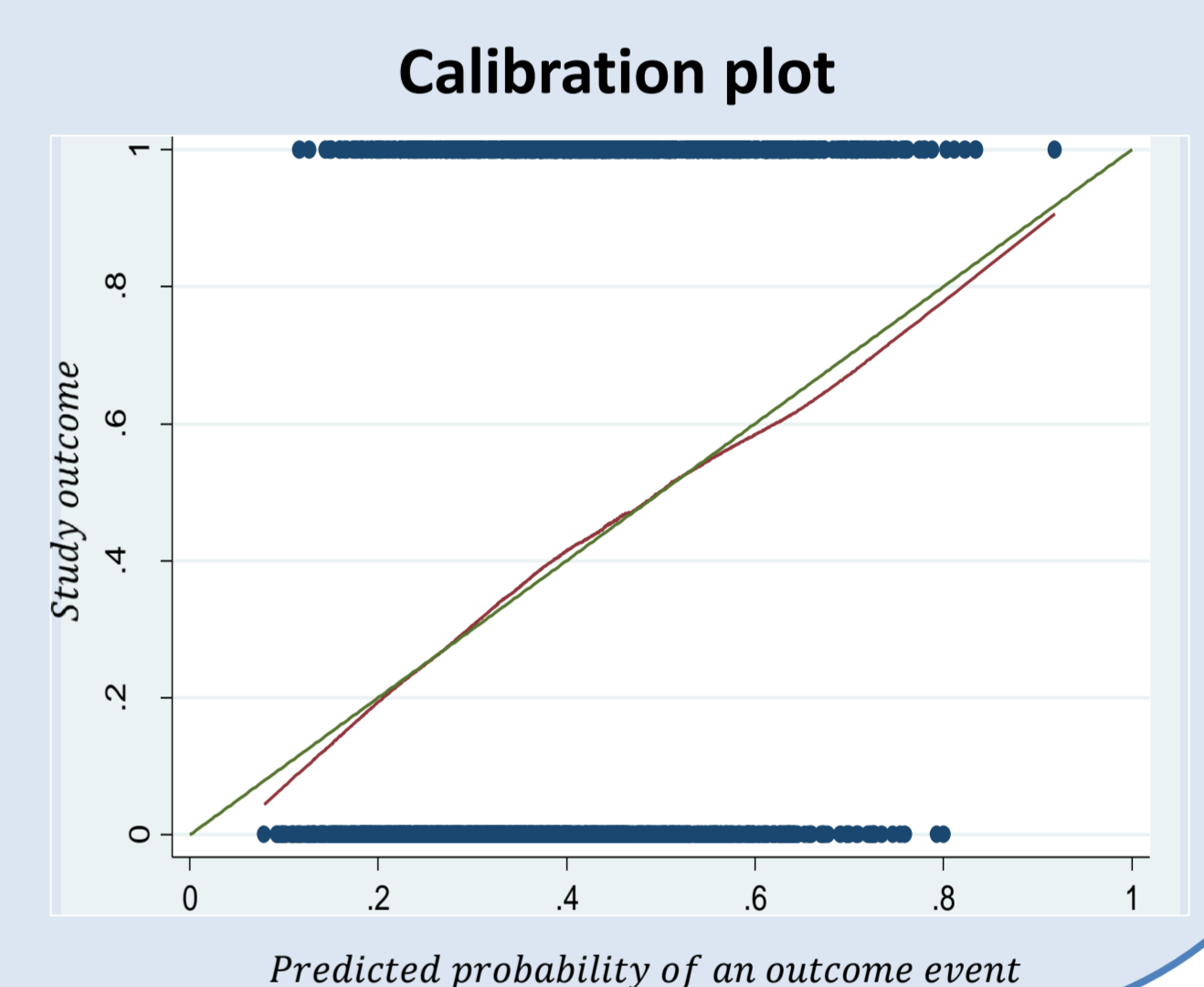
$$\text{Net benefit} = \frac{\text{true positive count}}{\text{total number of patients}} - \frac{\text{false positive count}}{\text{total number of patients}} \times \left(\frac{\text{threshold probability}}{1 - \text{threshold probability}} \right)$$



Results

- Among 1,503 eligible patient admissions, 610 (40.6%) experienced the study outcome. Eleven variables were retained in the final model: number of comorbidities, number of medicines, white cell count, renal function, previous allergy, aminoglycosides/glycopeptides, other systemic antimicrobials, epilepsy medicines, and 3 primary diagnoses (nervous system/mental disorders, respiratory system and gastrointestinal system).
- The MOAT demonstrated fair predictive performance (concordance index 0.66), and good calibration (see calibration plot below, which shows the predicted probability of an outcome event against the proportion of admissions that experienced an event). The decision threshold between 'low' and 'medium-risk' patients has a sensitivity of 90% (specificity 30%). The sensitivity for the threshold between 'medium' and 'high-risk' patients is 66% (specificity 61%).

- The MOAT has potential to increase the efficiency of hospital pharmacy services by identifying the 22% of patients least likely to experience a moderate or severe preventable MRP. Decision curve analysis suggests that the MOAT has potential to be clinically useful in guiding decision making (as both decision thresholds fall within the range shown to have 'net benefit').



Discussion and Conclusions

The MOAT is the first evidence-based clinical prioritisation tool to identify patients most in need of pharmacists' input in terms of their risk of moderate or severe preventable MRPs. Results suggest acceptable predictive accuracy, with decision curve analysis demonstrating potential clinical usefulness. The creation of three risk groups permits pharmacists to account for workload capacity when prioritising patients, as does the reporting of both the predicted probability and risk group for individual patients.

A strength of this research is adherence with recommendations of the PROgnosis REsearch Strategy (PROGRESS) partnership at all stages of MOAT development. Limitations include the observational nature of the study, meaning data collection was not carried out under strict trial conditions.

The aim of this research was to develop a decision aid with potential to be adopted widely into clinical practice; this will require clinical credibility, accuracy, generalisability and clinical effectiveness in improving decision making and the associated patient outcomes.³ The next step is to assess the MOAT's clinical credibility, which is dependent on content validity, ease of use, time taken and acceptability of the false negative rate. Extensive external validation, involving prospective validation in a new cohort, will also be required.

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