AI-based decision support to optimize complex care for preventing medication-related falls

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Preventing and managing falls in older adults is a pressing global concern, especially in light of the world's aging population. Falls are the leading cause of injury-related mortality and hospitalization among older adults. Even without injury, falls can substantially affect a person's quality of life, by leading to reduced engagement in social and physical activities, physical decline, disability or institutionalization[1]. Moreover, falls lead to substantial healthcare costs, accounting for 0.85–1.5% of the total health care costs in high-income countries[1].

One of the key modifiable risk factors for falls is the use of some medications, commonly referred to fall-risk increasing drugs (FRIDs)[2]. There is strong evidence that these medications include all types of psychotropic, antiepileptic, anticholinergic and several classes of cardiovascular medication[2]. Medication review with appropriate deprescribing is one of the most effective components of falls prevention[1,2]. However, deprescribing is often not attempted or performed successfully in cases where it could be performed safely. Physicians cite several reasons for their reluctance towards deprescribing, including lack of knowledge, skills and time, and fear of negative consequences[3]. This is understandable, given that deprescribing requires a personalized and patient-centered approach owing to the heterogeneity of older adults. Moreover, effective deprescribing requires physicians to carefully weigh the potential benefits and risks of medications, which is often complicated by polypharmacy and multimorbidity.

A clinical decision support system (CDSS) or artificial intelligence (AI) system that leverages machine learning techniques and offers personalized deprescribing advice could help to optimize clinical care aimed at preventing medication-related falls. A CDSS is a computerized system that provides patient-specific recommendations or assessments to physicians[4].

As part of the AD*F*ICE_IT (Alerting on adverse drug reactions: Falls prevention improvement through developing a computerized clinical support system: Effectiveness of individualized medication withdrawal) research project, we developed a CDSS to personalize and optimize deprescribing in older adults. Based on the characteristics of a given patient, our CDSS generates guideline- and expert-based individualized deprescribing advice as well as a personalized estimation of the risk of falling. The system's algorithms for generating the deprescribing advice were based on over 30 clinical guidelines and the STOPPFall deprescribing tool[5]. Personalized deprescribing advice is given for each FRID the patient uses and the system's interface allows the physician to select options to discuss with the patient. The system provides references for all its recommendations and links to further information. The personalized estimation of fall risk is calculated by an embedded prediction model that was developed using a large harmonized cohort dataset and validated in two independent cohorts of older outpatients[6,7]. The personalized estimation of fall risk is presented as a gradient scale and helps the physician and patient to consider the treatment options based on the risk of falling.

An important aspect of a patient-centered deprescribing strategy is the use of shared-decision making, which has been shown to improve medication-related knowledge and adherence[2]. Our CDSS stimulates the physician to implement shared decision-making by mentioning consideration of the patient's values and goals in its advice, providing a patient-friendly view of the treatment plan for discussing the options with the patient, and allowing the user to easily switch between the clinician and patient-friendly view. The intervention under investigation also includes components to empower the patient to participate in the decision-making process. For patients in the intervention arm, the study invitation letter comes with a link to a patient portal that provides fall-related educational information. For these patients, the invitation also comes with a list of question prompts designed to encourage the patients to ask questions during their consultation.

We are currently evaluating the use of our CDSS as part of a multicomponent intervention in a cluster-randomized trial among ten hospitals in The Netherlands[8], in comparison with the usual care. The primary outcome is the time to first injurious fall, which is measured using fall calendars. Other measurements include quality of life, cost-effectiveness, feasibility and shared decision-making measures.

Only three other studies have investigated the use of a CDSS for deprescribing medications to reduce the risk of falling in an outpatient setting[8]. However, these studies were limited in scope as none of the CDSSs used in these studies provide both guideline-based deprescribing advice and a personalized risk estimate. The scarce uptake of CDSS-based interventions may be because the development process of such systems is highly complex, requiring expertise in user-centered design, data science and medicine. In this regard, our unique multidisciplinary collaboration with experts in geriatrics, epidemiology, communication science and medical informatics has been vital to the development of the AD*F*ICE_IT CDSS.

Another strength of the AD*F*ICE_IT CDSS is that its development was guided by the Medical Research Council (MRC) Framework for Complex Interventions[9] and followed a rigorous user-centered design process. Research indicates that involving physicians in the design process of CDSSs helps to optimize the system's use in the day-to-day workflow and prevent alert fatigue[10]. The system was conceptualized by a geriatrician and the design was based on an extensive literature review, surveys and semi-structured interviews with physicians. The user friendliness of the system was fine-tuned based on two usability testing rounds with physicians, which helped to improve the navigability of the system and its medical terminology. Compared with younger age groups, older adults adopt digital technologies at lower rates[11] and this may pose an additional challenge for the implementation of computerized interventions in this group. By involving older adults throughout the different phases of the project, we ensured the accessibility of our intervention's components for our target population.

Nevertheless, we found the implementation of our CDSS in the electronic patient record systems of participating intervention

hospitals to be challenging. IT departments were often short-staffed and had little or no experience with the state-of-the-art interoperability with the electronic health record that our CDSS uses. Because we wanted to offer specific user interface features to support shared decision-making, the AD*F*ICE_IT software had to be built as a separate application. This is not ideal in terms of user friendliness and introduces additional security and privacy requirements. The implementation process of our CDSS was further complicated by the requirements of the new European Medical Device Regulation, which came into force around the start of the project. Fortunately, the medical office of our academic hospital and the Dutch regulatory body (the CCMO) were both supportive in helping us to understand the new regulation and meet its criteria.

A CDSS may also support shared decision-making and thereby improve adherence to the treatment plan. We hope that the lessons learned from the development and implementation of our CDSS can help to improve similar digital interventions aimed at personalizing and optimizing complex medical decision making.

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Competing interests

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