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Analysis of Polypharmacy in Elderly Patients: Current Status, Risks, and Intervention Strategies

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Abstract. China is experiencing rapid population aging, accompanied by a prevalence of more health problems and polypharmacy among older adults. Although multiple medications may be clinically necessary for chronic diseases, a situation that is common among older adults, it can increase the risks of inappropriate medication use, drug-drug interactions, and adverse drug reactions. This paper analyzes the current status and causes of polypharmacy among old patients in China, examines its major risks, and explores potential management strategies under the context of AI. This article uses literature analysis to synthesize evidence on polypharmacy, medication safety, pharmaceutical interventions, and AI-assisted management; uses a case study of an older Chinese patient with multimorbidity and polypharmacy to illustrate practical management challenges; and uses contrastive analysis of conventional and AI-assisted approaches. The analysis suggests that AI is able to identify drug-interaction and potentially inappropriate medication, medication-risk prediction, adherence support, and individualized medication optimization. However, AI should function as a decision-support tool rather than replace physicians or pharmacists. A human-AI collaborative model, supported by appropriate clinical oversight, may provide a more systematic, proactive, and individualized approach to polypharmacy management.

Keywords: older adults, polypharmacy, medication safety, artificial intelligence, medication management

1. Introduction

Population aging along with the increasing prevalence of chronic diseases have made polypharmacy a major challenge in healthcare for older adults. A systematic review and meta-analysis found that the pooled prevalence of polypharmacy among Chinese older patients was 48%, while potentially inappropriate medication (PIM) use reached 39% [1]. More recently, a meta-analysis focusing on community-dwelling older adults estimated the prevalence of polypharmacy at approximately 31%, indicating that the problem extends beyond hospital settings [2]. Another research found that PIM use was also common among older Chinese outpatients and was associated with multimorbidity and a greater number of medications [3]. These findings demonstrate that although prevalence varies according to population and healthcare setting, the phenomenon of polypharmacy is widely spreading in China, accompanied by some potential risks.

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Based on these findings, this paper examines three main aspects. The first topic is the current situation of polypharmacy among Chinese older adults, which is focused on the prevalence of multimorbidity and polypharmacy and how polypharmacy develops. The second aspect concerns the major medication-related risks and difficulties in existing management, addressing the risks that polypharmacy creates. Finally, the article will be talking about the potential of AI to support safer and more individualized medication management, discussing how AI may improve risk identification and medication optimization. This paper employs literature analysis, case analysis, and comparative analysis to connect existing evidence with practical management scenarios. By integrating these perspectives, this study aims to provide a theoretical framework for collaborative medication management between human and AI and to contribute to improving medication safety among older adults.

2. Current status and causes of polypharmacy among older adults in China

2.1. The prevalence of multimorbidity and polypharmacy

Polypharmacy is closely associated with multimorbidity, both of which are common among older adults, and this is because chronic conditions like hypertension, diabetes, cardiovascular disease, and other diseases require several medications to manage. Therefore, taking multiple medications is not necessarily inappropriate, but the key issue underlying this is whether the overall medication regimen remains necessary, effective, and safe for the individual patient.

Evidence from China demonstrates that polypharmacy is widespread. A study reported a pooled prevalence of 48% among older Chinese patients, with substantially higher prevalence among inpatients than outpatients [1]. Another research similarly found a pooled prevalence of approximately 31% among community-dwelling older adults [2]. The difference between these estimates illustrates how medication burden varies across populations and healthcare settings; however, both studies also indicate that polypharmacy represents an universal and persistent issue in China despite the differences.

2.2. Causes of polypharmacy

The development of polypharmacy results from multiple interacting factors. Multimorbidity is the most direct cause because older adults are more likely to suffer from a chronic disease, and each chronic disease may require varied kinds of long-term treatments. In addition, older patients may receive care from different departments or healthcare institutions, and the elderly themselves may sometimes have some communication issues with their doctors, increasing the possibility that physicians do not have access to their complete medication history. There may also be cases where timely physical examinations or regular medication reviews are not conducted, resulting in the continued use of the medication even after the original symptoms have changed.

Patient behavior can make the management further complicated. Older adults may use prescription medicines, over-the-counter medicines, or treatments obtained from some unknown providers online simultaneously. Therefore, polypharmacy should not simply be interpreted as "too many medications", but to should be distinguished between appropriate polypharmacy and unnecessary or potentially risky medication use. Effective management also requires assessment of the whole medication regimen history. Due to factors like multimorbidity, different departments and patients' bahaviors, the probability of drug interactions and adverse reactions have directly increased and crreating greater challenges to the current management.

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3. Major risks and management challenges of polypharmacy

3.1. Drug-drug interactions and adverse drug reactions

One major risk of polypharmacy is the increased possibility of drug-drug interactions (DDIs) and adverse drug reactions (ADRs). When several medications are used simultaneously, one drug may alter the absorption, metabolism, or effects of another. Older adults' particular age-related physiological changes may also affect their ability to absorb or process medications, causing them to be more vulnerable. An integrative review of 47 studies involving more than 14 million older adults found that polypharmacy and inappropriate prescribing were associated with DDIs, ADRs, and other negative medication-related outcomes [4].

PIMs is another important concern. Research found that polypharmacy was significantly associated with PIM use among older Chinese patients [1]; similarly, a study of 44,458 prescriptions from older Chinese outpatients found PIM prevalence of 30.05% according to the 2019 Beers criteria and 35.38% according to the Chinese criteria, and they also found that the prevalence of PIMs was associated with age, the number of diseases and the number of drugs [3]. These findings suggest that increasing medication complexity can make it more difficult to maintain safety.

3.2. Difficulties in existing management

Traditional medication management relies primarily on physicians, pharmacists, patients, and caregivers, and it remains essential and can be effective. A systematic review and meta-analysis of 14 randomized controlled trials found that pharmaceutical interventions significantly reduced PIMs and the number of medications used per person [5]. However, several practical challenges still exist.

First, medication information may be distributed across different hospitals, departments, and pharmacies. Second, manually checking numerous medications for DDIs and PIMs requires substantial professional time. Third, older patients may have difficulty understanding complex medication regimens or communicating effectively. A multicenter Chinese study of older adults with multimorbidity and polypharmacy found that 31.8% reported medication nonadherence and identified several factors associated with adherence, including PIM use and individual patient characteristics [6].

These challenges are demonstrated by a published case report of an 81-year-old man with diabetes, hypertension, non-valvular atrial fibrillation, chronic obstructive pulmonary disease, osteoarthritis, anxiety, and depression [7]. The patient was taking 11 medications daily, with a potential risk of 55 drug-drug interactions. After comprehensive evaluation, several potentially inappropriate medications were gradually discontinued, and the patient's cognitive function, mood, and mobility improved during the follow-up [7]. This case illustrates that for the management of polypharmacy of the old patients, not only should the treatment be based on the specific symptoms, but also the interrelationships between different treatments need to be considered, as well as the individual circumstances of the patients.

4. AI-assisted intervention strategies for polypharmacy management

4.1. AI-assisted risk identification

AI can potentially improve polypharmacy management due to its efficiency in processing large amounts of clinical and medication information compared with manual review. AI-assisted systems

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can integrate medication lists, diagnoses, laboratory results, previous medical records, and other available information to identify potential medication-related risks.

Another application of AI in health care is the automated screening for DDI and PIM. Instead of manually examining every possible combination of medications, an AI-assisted system can quickly compare the medications taken by a patient with drug interaction databases and medication safety criteria. The recently updated PIM-China criteria can serve as a good base for identifying the risks associated with the use of medications among older adults in China. The updated criteria include 154 items and incorporate considerations such as DDIs and renal-function-related medication risks [7]. Integrating such China-specific criteria into AI systems could improve the accuracy and applicability of automated medication risk screening, aligning with the actual situation in China.

AI could also help predict risks of complications. By analyzing multiple variables at the same time, machine learning systems may predict patients who are more likely to experience medication-related problems. For example, an older patient who suffers from several illnesses, takes too much medication, has previous adverse reactions, and has impaired renal function at the same time could be flagged for additional evaluation. This kind of automated process would allow medication professionals to have more time to focus their attention on more risky patients.

According to a case in a study, the patient was taking 11 medications and had a potential risk of 55 drug-drug interactions [7]. Such medication complexity makes it difficult to rely on the manual assessment process only. An AI assisted system could help support clinicians by integrating medication information, identifying possible DDIs and PIMs, and prioritizing patients requiring further medication review.

4.2. AI-assisted individualized medication optimization

Moreover, AI can also be effective in individualized medication optimization. Its goal is not simply to reduce the number of medications but to determine whether each medication remains necessary and appropriate according to the patient's current health status and treatment goals.

One specific application of AI in optimization is to provide deprescribing support. Based on the information from medication history, disease status, laboratory indicators, and potential medication risks, AI may help identify medications that require further assessment. It could then provide clinicians with appropriate suggestions based on evidence for consideration. However, an AI-generated recommendation should never be used directly as a judgment because clinical judgment and consideration of individual risks and benefits are important and are still required.

AI can also assist in monitoring people's daily medication behaviors. For example, AI reminder systems can provide individualized reminders according to a patient's medication schedule, to make sure they are keeping up with the treatments. When appropriately combined with monitoring systems, AI may also identify missed doses or unusual medication-taking actions and give alerts to caregivers, doctors or guardians. A 2026 systematic review of AI in medication management mentions smart reminders and automation, personalization and prediction, and improved adherence as key areas [8].

4.3. Conventional vs AI-assisted management: a human-AI collaborative model

Comparing conventional management and AI-assisted management can lead to a better understanding of their benefits and drawbacks. Conventional medication management depends heavily on the information available to healthcare professionals and the time available for manual review. AI-assisted management can process larger amounts of information in the same period of

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time, identify potential risks systematically, and provide continuous support. However, AI also introduces new challenges. A recent scoping review found that evidence on AI specifically for polypharmacy among older adults remains limited and emphasized the need for careful evaluation, oversight, and interdisciplinary collaboration [9].

Therefore, conventional and AI-assisted management should not be viewed as competing with each other. The more appropriate approach is a human-AI collaborative model. AI can perform information integration, preliminary risk screening, reminders, and decision-support functions, while physicians and pharmacists remain responsible for clinical interpretation and final decisions. Human professionals can also consider factors that AI systems cannot take into full account, including patient preferences, treatment goals, social circumstances, and the practical feasibility of the medication regimen.

However, attention to privacy, transparency, trust, usability, and digital literacy is all crucial for the implementation of such a collaboration model. The 2026 systematic review emphasized that AI-based medication management requires appropriate clinical workflow integration, inclusive design, and equity [8]. For older adults, the operation process needs to be simple and easy to understand, and the pace should be slow. AI should function as an additional layer of support within healthcare rather than become another barrier between patients and professional care.

Overall, AI has the ability to make polypharmacy management more proactive, systematic, and individualized. Its greatest value is not replacing healthcare professionals but reducing information-processing burdens and allowing physicians and pharmacists to devote greater attention to complex clinical decisions and the individual needs of older patients.

5. Conclusion

Polypharmacy is an increasingly important medication safety problem among older adults in China. Current existing evidence reveals that multiple medication use is common among older Chinese patients and is associated with potentially inappropriate medication use, DDI, adverse drug reactions, and adherence challenges. Factors causing such problems include multimorbidity and the complexity of healthcare delivery, while fragmented medication information and the limitations of manual review make comprehensive management more difficult.

This paper suggests that AI could provide additional support at several stages of medication management. AI-assisted systems can integrate medication and clinical information, screen for potential DDIs and PIMs, identify patients at higher risk, support adherence, and provide suggestions for individualized medication optimization. Updated PIM-China criteria may become an important knowledge base for such systems. However, current evidence related to AI-assisted polypharmacy management is rather insufficient, and there are a number of concerns that should be addressed before the implementation of such technologies.

However, there are several limitations of this paper. First, it focuses primarily on older adults in China, so its conclusions may not be directly generalizable to other populations. Second, although this paper includes a published case report, it represents an individual clinical scenario and cannot fully represent the broader population of older adults. Future research should therefore evaluate AI-assisted medication management through larger clinical studies, real-world applications, and long-term outcome assessment. Most importantly, future models should emphasize the collaboration between AI and human rather than substitution by technologies.

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