

Medication Utilization And Polypharmacy Among Geriatric Patients In Saudi Arabia: A Rapid Review

Md. Mazharul Hoque MBBS, MD (Physiology)

Assistant Professor Emergency Medical Services Program/Department College of Nursing and Health Sciences Jazan University Saudi Arabia Official email: mazharulhaque@jazanu.edu.sa ORCID ID: 0009-0009-8153-6387

Key Words:	Abstract
Polypharmacy, Geriatric patients, Chronic diseases, Saudi Arabia, Medication management, Adverse drug reactions (ADRs)	<p>This rapid review examines polypharmacy in geriatric patients (≥ 65 years) with multiple chronic conditions in Saudi Arabia, focusing on its prevalence and implications. Polypharmacy—concurrent use of five or more medications—poses significant risks, including adverse drug reactions, interactions, and financial burdens. Studies highlight challenges like reduced adherence, poorer quality of life, and increased healthcare complexity. Managing polypharmacy in older adults with comorbidities requires careful coordination among providers. Proposed interventions include regular medication reviews, standardized assessment tools, and collaborative care models involving pharmacists and physicians. Enhancing provider communication and awareness can optimize medication management. The review emphasizes the need for comprehensive strategies to mitigate polypharmacy risks, improve patient safety, and enhance health outcomes. Addressing this issue is critical as Saudi Arabia's aging population grows. By implementing evidence-based approaches, healthcare systems can reduce polypharmacy-related harms and improve care quality for elderly patients with chronic diseases.</p>

Introduction

As global populations age, older adults increasingly face the complexities of managing multiple chronic health conditions, which poses significant challenges for healthcare systems, particularly in Saudi Arabia, where the prevalence of chronic diseases is rising. Polypharmacy, defined as the concurrent use of five or more medications, is becoming alarmingly common among the elderly, driven by the growing burden of conditions such as hypertension, diabetes, and hyperlipidemia [1]. This demographic shift necessitates a comprehensive approach to medication management, requiring careful consideration and coordination among healthcare providers to address the unique healthcare needs of older adults, who often present with multiple comorbidities that complicate treatment regimens.

A rapid review aimed to identify and summarize definitions of polypharmacy in the literature, following PRISMA guidelines. The review searched MEDLINE, EMBASE, Cochrane, and grey literature for English articles published between January 1, 2000, and May 30, 2016, yielding 1,156 articles, with 110 meeting the inclusion criteria. This resulted in 138 definitions categorized into three types: numerical only (111 definitions, 80.4%), numerical with a duration or healthcare setting (15 definitions, 10.9%), and descriptive (12 definitions, 8.7%). The most common definition was five or more medications daily (51 articles, 46.4%), with variations ranging from two to eleven or more medications [2]. Notably, only 6.4% distinguished between appropriate and inappropriate polypharmacy using descriptive definitions [3]. The review concluded that the definitions were inconsistent and primarily numerical, lacking consideration for specific comorbidities, thereby complicating the assessment of medication safety and appropriateness in clinical practice [4].

Polypharmacy poses various risks that can significantly impact patient health and well-being [5]. Adverse drug reactions (ADRs) are a major concern, as older adults are more susceptible to side effects due to age-related physiological changes that affect drug metabolism and clearance, increasing the likelihood of harmful interactions. Additionally, the financial burden associated with complex medication regimens can strain both patients and healthcare systems [6].

The challenges of polypharmacy extend beyond individual patients, affecting healthcare providers as well [7]. Clinicians must balance effectively managing chronic conditions while minimizing the risks associated with multiple medications [8]. This complexity necessitates a collaborative approach to care, where healthcare teams work together to ensure that medication regimens are appropriate, effective, and tailored to each patient's specific needs [9].

The issue of polypharmacy among older adults in Saudi Arabia is multifaceted and warrants serious attention [10]. As the prevalence of chronic diseases rises, comprehensive medication management strategies become increasingly vital [11]. By addressing the associated risks, healthcare providers can improve patient safety, enhance the quality of care, and ultimately contribute to better health outcomes for this vulnerable population [12].

Methodology

Study Design

This rapid review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to identify, evaluate, and synthesize existing literature on polypharmacy definitions and their implications for older adults in Saudi Arabia [13].

Eligibility Criteria

Inclusion Criteria

- **Population:** Studies focusing on older adults (typically aged ≥ 60 years) with polypharmacy (defined as concurrent use of multiple medications, often ≥ 5).
- **Intervention/Exposure:** Definitions, prevalence, risks, or management strategies related to polypharmacy.
- **Outcomes:** Definitions of polypharmacy, medication safety, adverse drug reactions (ADRs), and healthcare system challenges.
- **Study Types:** Original research articles, systematic reviews, meta-analyses, and grey literature (e.g., conference abstracts, reports).
- **Language:** English-language publications.
- **Time Frame:** Articles published between January 1, 2000, and May 30, 2016 (to align with prior systematic review findings).

Exclusion Criteria

- Studies not explicitly defining polypharmacy.
- Articles focusing on pediatric or non-geriatric populations.
- Non-English publications.
- Studies without full-text availability.
- Duplicate publications or overlapping datasets.

Search Strategy

A comprehensive search was conducted across the following databases:

- **MEDLINE (via PubMed)**
- **EMBASE**
- **Cochrane Library**
- **Grey literature** (e.g., governmental reports, conference proceedings)

Search Terms

Key terms included:

- Polypharmacy OR multiple medications OR medication burden
- Elderly OR older adults OR geriatric
- Saudi Arabia OR Middle East
- Definition OR prevalence OR adverse effects

Study Selection Process

1. **Initial Screening:** Titles and abstracts were screened for relevance.
2. **Full-Text Review:** Potentially eligible articles were assessed against inclusion/exclusion criteria.
3. **Data Extraction:** Relevant data (e.g., polypharmacy definitions, study characteristics) were extracted.

Polypharmacy Prevalence

The prevalence of polypharmacy among geriatric patients in Saudi Arabia has become a significant public health concern, particularly as the number of older adults managing multiple chronic health conditions continues to rise. A comprehensive retrospective cross-sectional analysis of 3,009 geriatric patients revealed that an alarming 55% were affected by polypharmacy, with an average of 6.4 medications prescribed for individuals aged 65 to 70 [14]. Notably, the study indicated that an increase in age does not necessarily correlate with a higher number of prescribed medications, highlighting the need for healthcare professionals to adopt a nuanced understanding of geriatric care management and to prioritize patient safety.

Another study focused on middle-aged and older patients at Qatif Central Hospital in 2021, where 66% of the 14,081 patients surveyed were identified with polypharmacy, including 31% of older adults [15] (Figure 1). The research found that polypharmacy was significantly associated with a higher Charlson comorbidity index (OR = 3.4), musculoskeletal diseases (OR = 4.2), and alimentary tract conditions (OR = 3.8), while it was negatively associated with age (OR = 0.9) and cardiovascular diseases (OR = 0.6). The study concluded that polypharmacy is especially concerning for patients with musculoskeletal or alimentary tract conditions and recommended regular medication reviews by pharmacists to mitigate the risks of adverse drug reactions.

A separate analysis at the Royal Adelaide Hospital assessed opioid prescribing among poly-medicated older patients from September 2015 to August 2016 [16]. Out of 15,000 geriatric admissions, 1,192 patients were included, with 283 (23.7%) prescribed opioids, predominantly oxycodone (56% of prescriptions). The study reported that opioid users had a higher average number of prescribed medications (11.2 vs. 9.0) and a greater Drug Burden Index (1.2 vs. 0.14) compared to non-users. Opioid prescribing was positively associated with the use of antiepileptics (OR = 1.7) but negatively associated with the Charlson Comorbidity Index (OR = 0.9), antipsychotics (OR = 0.5), and beta-blockers (OR = 0.4). The study concluded that strong opioids were prescribed more frequently than weak ones, with opioid users exhibiting characteristics that increase their risk of adverse drug effects.

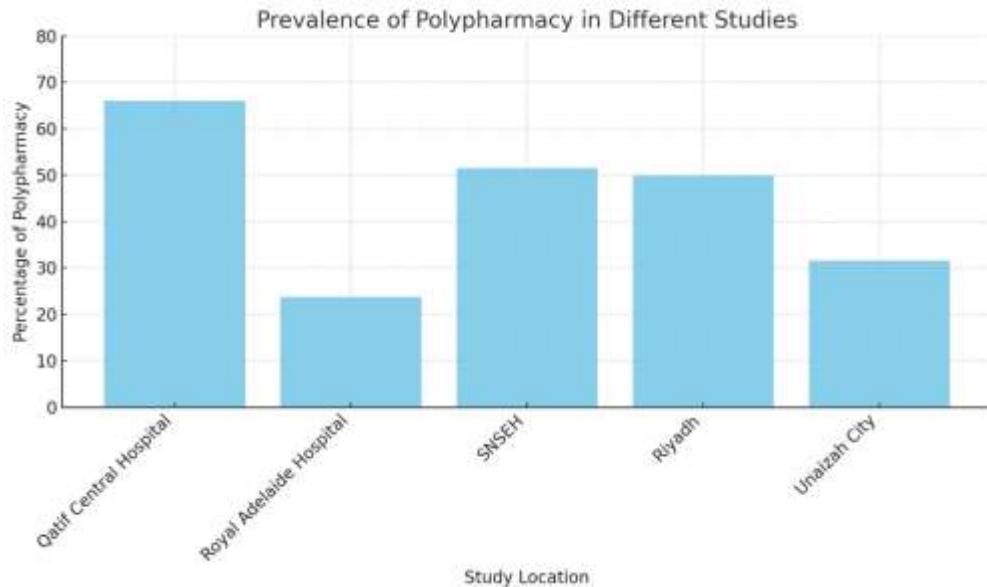


Figure 1: Bar Graph displaying the percentage of polypharmacy observed in different studies. Qatif Central Hospital shows the highest prevalence at 66%, with other notable rates at SNSEH, Riyadh, Unaizah City, and the Royal Adelaide Hospital.

Further research on analgesic prescribing patterns among older patients with polypharmacy at the Royal Adelaide Hospital found that of the 1,192 patients included, 824 (69%) were prescribed analgesics, primarily paracetamol (89% of users), followed by opioids (34%) and adjuvants (17%) [17]. Researchers found that analgesic users had a higher Drug Burden Index and were prescribed more medications, with no significant difference in the overall Charlson Comorbidity Index between users and non-users. However, analgesic users were more likely to have documented diagnoses of osteoarthritis, osteoporosis, and falls, indicating an increased risk of adverse drug reactions and falls among poly-medicated elderly patients [18].

In Riyadh, a study assessing the one-year prevalence of falls among older adults (aged 60 and over) revealed a prevalence of 49.9%, with 74% of those who fell sustaining injuries [19]. Significant risk factors included having no formal education (adjusted OR (aOR) 1.72), holding a middle school certification (aOR 1.81), living in rented accommodations, and having a caregiver (aOR 1.39). Conversely, not using medications was linked to a lower incidence of falls. The study concluded that nearly half of older Saudis experienced at least one fall in the past year, underscoring preventable risk factors that could be addressed through routine geriatric assessments.

Another study in Unaizah City identified a 31.6% prevalence of falls among elderly individuals, with polypharmacy (aOR: 2.40) and advanced age being significant risk factors [20]. Environmental hazards also contributed to the likelihood of falls, while higher education levels were associated with a lower risk [21]. Additional data from the Saudi National Survey for Elderly Health (SNSEH) indicated that approximately 51.5% of community-dwelling older adults aged 60 and above are currently experiencing polypharmacy, reflecting the widespread nature of this issue and the challenges healthcare systems face in managing the health of older individuals [22].

The SNSEH study, conducted from 2006 to 2007, included 2,946 Saudi older adults with a mean age of 70.1 years [23]. It revealed that about 70% were illiterate, and nearly 50% reported a monthly income of 2,500 Saudi Riyals. The most common health issues included hypertension, diabetes, and joint pain, with

over-the-counter drugs, antidiabetics, and antihypertensives being the most frequently reported medications. The study found that the nine-year age-adjusted death hazard was 42% higher for male participants compared to females, setting the stage for future research focused on the health of older adults in Saudi Arabia.

A retrospective analysis of home health care service users at the Armed Forces Hospital in Southern Saudi Arabia revealed that hypertension (59.1%) and diabetes mellitus (57.3%) were the most prevalent conditions, followed by stroke (34.9%) and dementia (28.5%). The study emphasized the need for preventive and rehabilitative programs to enhance healthcare services for the elderly population [24].

As multimorbidity—defined as having two or more chronic medical or psychiatric conditions—becomes more prevalent among older adults, it poses significant challenges for healthcare management [25]. A study in Alberta, Canada, found that 34% of adults over 65 had at least three chronic conditions, increasing to 50% over nine years. The rising prevalence of multimorbidity, especially among older adults, underscores the need for comprehensive healthcare strategies [26].

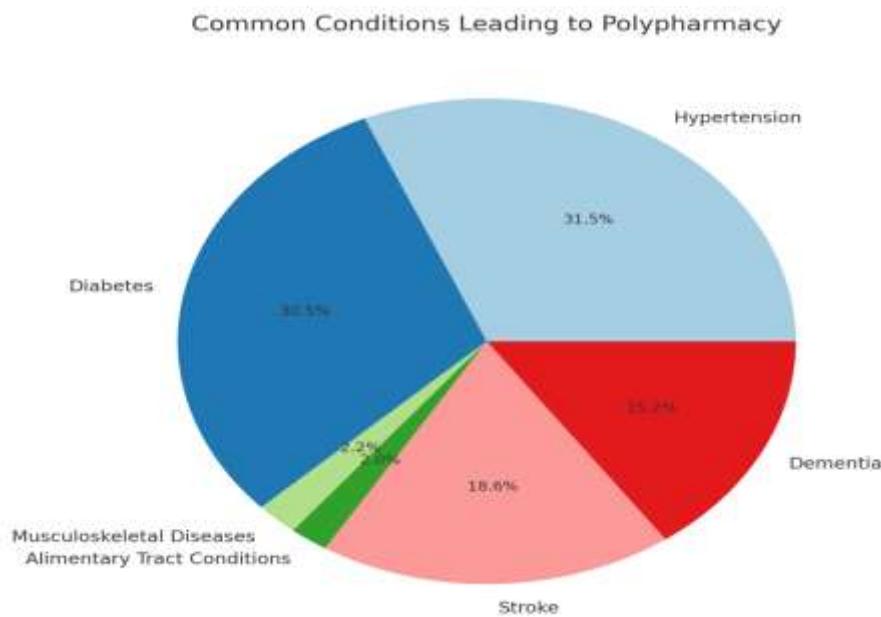


Figure 2: Pie Chart showing the common conditions associated with polypharmacy. Hypertension (31.5%) and diabetes (30.5%) are the leading contributors, followed by stroke (18.6%), dementia (15.2%), musculoskeletal diseases, and alimentary tract conditions.

The prevalence of polypharmacy among geriatric patients in Saudi Arabia is a pressing issue that demands immediate attention from healthcare providers [27]. The data from these studies not only highlight the extent of polypharmacy but also emphasize the critical need for comprehensive medication management strategies that consider the unique health profiles of older adults. By addressing the multifaceted nature of this issue, healthcare professionals can work towards improving health outcomes and enhancing the quality of care for this vulnerable population [28].

Challenges of Polypharmacy

Polypharmacy introduces numerous risks that can profoundly affect the health and well-being of older adults. Among the most pressing concerns are adverse drug reactions (ADRs), potential drug-drug interactions, and increased hospitalization rates. Research consistently demonstrates that elderly individuals prescribed multiple medications are at a significantly heightened risk for complications, including falls, which can lead to serious injuries and deteriorating health outcomes [29]. The cumulative effects of their pharmacological regimens often result in adverse effects that may not be immediately apparent, complicating diagnosis and treatment.

For instance, a recent study revealed a substantial association between polypharmacy and an elevated risk of falls among older adults, with over half of the participants classified as being at high risk for such incidents [30]. This finding underscores the critical need for healthcare providers to vigilantly monitor the medication regimens of geriatric patients. The interplay of multiple medications can amplify the likelihood of falls, as certain drugs may impair balance, coordination, or cognitive function, placing older adults in precarious situations.

The World Health Organization estimates that one in nine people globally is aged 60 or older, a figure projected to rise to one in five by 2050, predominantly in low- and middle-income countries [31]. This demographic shift poses challenges for health authorities, as older adults often face multiple chronic diseases, leading to polypharmacy, defined as the routine use of five or more medications daily [3]. Polypharmacy raises concerns due to the increased risk of ADRs and drug-drug interactions, higher risks of hip fractures, and the potential for "prescribing cascades," where ADR symptoms are mistaken for new health issues [32]. Symptoms associated with polypharmacy often overlap with normal aging signs, such as tiredness and confusion, leading to decreased medication compliance and increased healthcare costs [33]. Evaluating polypharmacy in elderly patients is crucial; comprehensive medication reviews by interdisciplinary teams can help mitigate adverse effects. Recommended strategies include monthly medication reviews, favoring single agents over multiple drugs, starting with lower dosages, and discontinuing non-beneficial medications. Regular reviews are essential to improve health outcomes and enhance the quality of life for older adults [34].

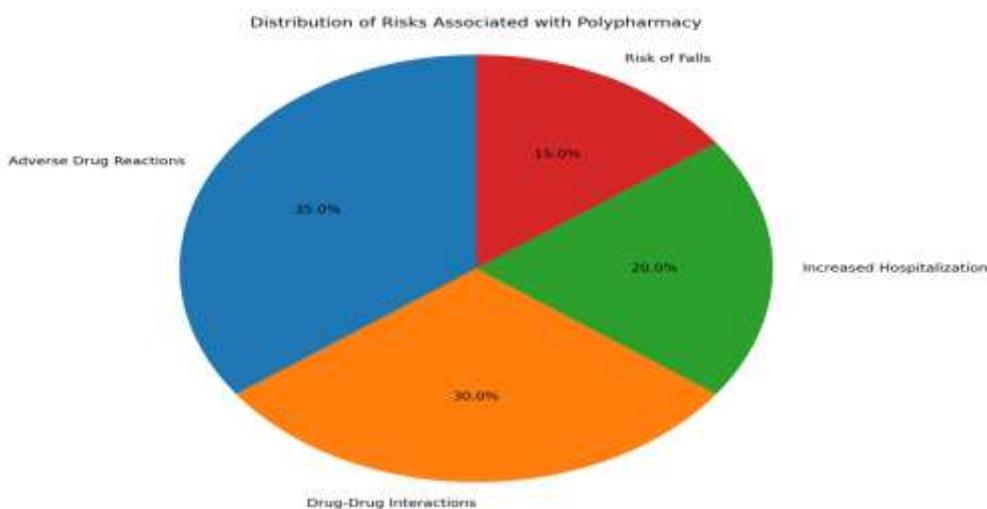


Figure 3: Pie chart illustrating the various risks associated with polypharmacy, including adverse drug reactions, drug-drug interactions, increased hospitalization rates, and the risk of falls.

A study aimed at identifying the optimal number of concomitant medications linked to geriatric syndromes, functional outcomes, and mortality among community-dwelling older men aged 70 and older analyzed 1,705 participants from the Concord Health and Aging in Men Project [35]. The findings highlighted that a cutoff of 6.5 medications was associated with frailty, 5.5 with disability, and 3.5 with cognitive impairment, while the optimal cutoff for mortality and incident falls was 4.5 medications. Each additional medication correlated significantly with increased adjusted odds ratios: 1.13 for frailty, 1.08 for disability, 1.09 for mortality, and 1.07 for falls; however, no association was found with cognitive impairment. The study concluded that using five or more medications aligns with the definition of polypharmacy and is useful for estimating medication-related adverse effects concerning frailty, disability, mortality, and falls in older adults [36].

Another study investigated changes in rates of polypharmacy and potentially serious drug-drug interactions (DDIs) within the Tayside region of Scotland from 1995 to 2010, utilizing a repeated cross-sectional analysis of prescribing data for 310,000 adults [37]. The findings revealed that the proportion of adults receiving five or more medications doubled to 20.8%, while those prescribed ten or more medications tripled to 5.8%. The likelihood of receiving ten or more medications was strongly associated with increasing age (from 0.3% in 20–29 years to 24.0% in those aged 80 and older) and was higher among individuals in deprived areas and care homes. Additionally, the proportion of adults experiencing potentially serious DDIs more than doubled to 13% in 2010, with the number of medications dispensed being the strongest predictor of these interactions, significantly rising from 10.9% with 2–4 drugs to 80.8% with 15 or more. The study concluded that drug regimens are becoming more complex and potentially harmful, highlighting the need for regular reviews and optimization of prescribing for individuals with polypharmacy, and called for further research on the implications of multiple interacting drugs and the effects of medication optimization on quality of life and mortality.

Inappropriate prescribing practices exacerbate the prevalence of polypharmacy. The Beers criteria, a well-established tool in geriatric medicine, identifies potentially inappropriate medications (PIMs) that should be avoided in older adults [38]. Alarmingly, recent analyses indicate high rates of PIMs being prescribed to the elderly population in Saudi Arabia [39]. These medications contribute to the adverse effects commonly associated with polypharmacy, including increased hospitalization rates and greater healthcare costs.

A retrospective cross-sectional study examined the association between multimorbidities and polypharmacy among elderly patients at King Fahad University Hospital and the Family & Community Medicine Center from January 1, 2019, to December 31, 2020 [40]. Of 76,216 patient records reviewed, 5,060 met the inclusion criteria, revealing a polypharmacy prevalence of 46% in 2019 and 44.6% in 2020, with an average of 5.17 medications in 2019 and 5.04 in 2020. Females had a higher average number of medications than males, and a significant positive association was found between comorbidities and the mean monthly medication count ($P < 0.01$). The study concluded that polypharmacy is highly prevalent among elderly patients and is positively correlated with multimorbidities, highlighting the need for measures to address this growing issue.

The implications of these findings are profound, emphasizing an urgent need for enhanced oversight and management strategies within the healthcare system. Healthcare professionals must engage in thorough medication reviews, utilizing established criteria such as the Beers criteria to assess the appropriateness of prescribed medications. Furthermore, fostering collaborative care models that involve pharmacists and physicians can provide a more comprehensive approach to managing polypharmacy.

The challenges posed by polypharmacy in older adults are multifaceted and require immediate attention from healthcare providers. Addressing the risks associated with ADRs, drug-drug interactions, and inappropriate prescribing practices can improve patient safety, enhance the quality of care, and ultimately contribute to better health outcomes for this vulnerable population. The urgency of implementing effective management strategies cannot be overstated, as the health of older adults facing polypharmacy is at stake.

Strategies for Managing Polypharmacy

Effectively managing polypharmacy among geriatric patients necessitates a comprehensive and systematic approach tailored to the unique health needs and goals of each individual. Given the complexities associated with aging and the management of multiple chronic conditions, healthcare providers must adopt a multifaceted strategy that emphasizes personalized care.

A cornerstone strategy in addressing polypharmacy is the implementation of regular and thorough medication reviews [33]. These reviews are crucial for reassessing the risks and benefits of current medications, allowing healthcare professionals to identify unnecessary or potentially harmful prescriptions. By systematically evaluating the effectiveness and necessity of each medication, clinicians can make informed decisions about whether to continue, adjust, or discontinue specific therapies. This proactive approach enhances patient safety and promotes better health outcomes.

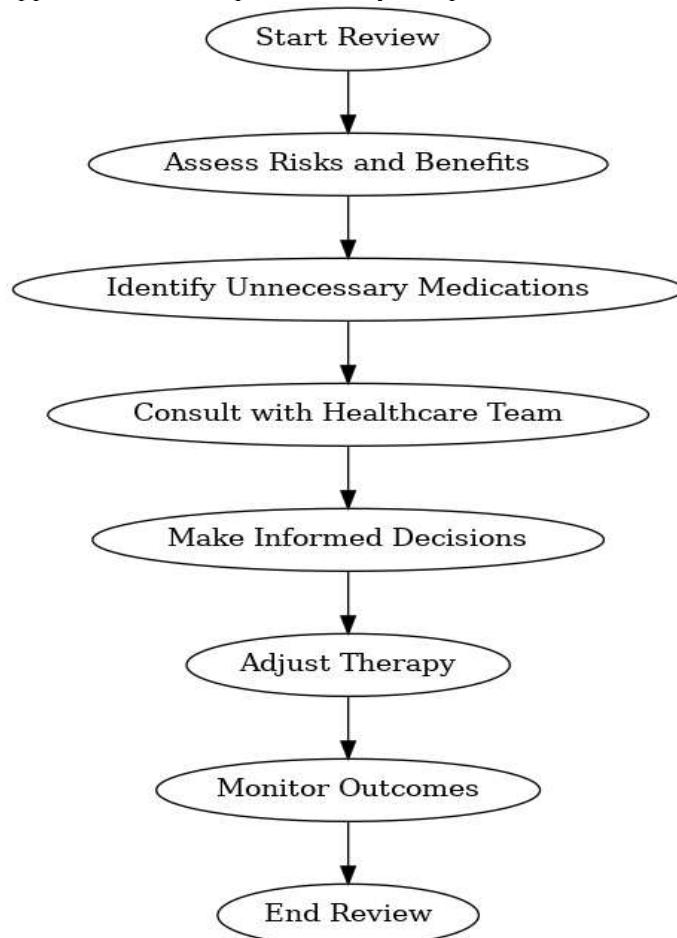


Figure 4: Flowchart illustrating the medication review process.

Managing medications for older adults is particularly important due to the prevalence of polypharmacy and its associated risks. A systematic approach tailored to the patient's specific goals is essential. Key considerations include the widespread prescription of statins, anticholinergics, benzodiazepines, antipsychotics, and proton pump inhibitors. Regular comprehensive medication reviews help reassess the risks and benefits of current medications based on care goals, life expectancy, and patient preferences. Tools like the Beers criteria and the Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP) can aid in safe prescribing [41]. Medications that were appropriate in middle age may require closer monitoring as patients age, as some may become unnecessary or hazardous due to declining functional and renal status and changing care goals [42].

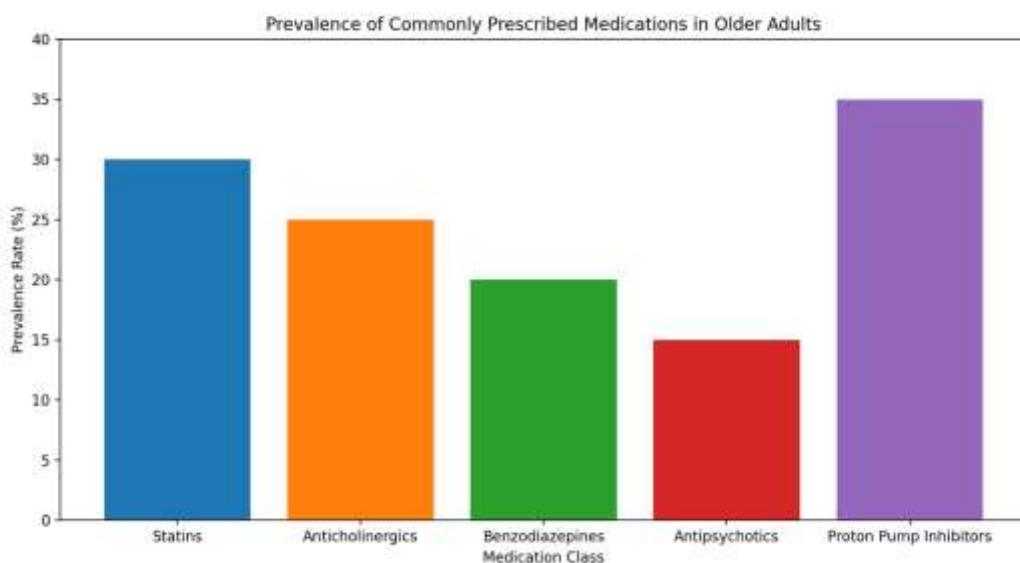


Figure 5: Bar chart visualizing the prevalence of commonly prescribed medications in older adults, highlighting the distribution across different medication classes.

In addition to routine medication reviews, utilizing established tools such as the Beers criteria and STOPP is essential. The Beers criteria is a widely recognized guideline that helps healthcare providers identify potentially inappropriate medications (PIMs) for older adults [43]. By applying these criteria, clinicians can significantly enhance prescribing practices, thereby reducing the risk of adverse drug reactions and improving the overall quality of care for geriatric patients.

It is also imperative for healthcare providers to prioritize medication therapy management services [44]. These services are designed to raise awareness of the risks associated with polypharmacy and educate patients and caregivers about the importance of medication adherence and safety. Such initiatives empower patients to actively engage in their own care, fostering a collaborative relationship between healthcare providers and patients.

The implementation of collaborative care models represents another vital strategy for effectively managing polypharmacy. Involving both pharmacists and physicians in the care team leads to improved medication management [45]. Pharmacists possess specialized knowledge regarding drug interactions and side effects, making them invaluable in assessing medication regimens. When pharmacists collaborate with physicians, they can provide critical insights and recommendations that enhance the overall treatment plan.

Furthermore, fostering open communication among all members of the healthcare team is essential in addressing the complexities of polypharmacy [46]. Regular interdisciplinary meetings can ensure that everyone involved in a patient's care is aware of changes in medication, treatment goals, and any emerging concerns. This collaborative framework enhances decision-making and promotes a unified approach to patient care.

Managing polypharmacy in geriatric patients requires a thorough, individualized, and collaborative approach [4]. By integrating regular medication reviews, utilizing established assessment tools, prioritizing medication therapy management services, and embracing collaborative care models, healthcare providers can significantly improve medication management and achieve better patient outcomes. Ongoing commitment to these strategies is critical in enhancing the quality of life for older adults facing the challenges of polypharmacy.

Conclusion

The prevalence of polypharmacy among geriatric patients in Saudi Arabia is a pressing public health concern that demands careful attention from healthcare professionals. Increasing awareness, conducting regular medication reviews, and employing standardized tools to evaluate the appropriateness of medications are crucial steps toward mitigating the risks associated with polypharmacy. Future research endeavors should continue to investigate the complexities of medication management in the elderly population and develop effective strategies aimed at promoting safer prescribing practices.

Ethical consent:

Not required.

Conflict of interest: There is no conflict of Interest

Acknowledgment: I would like to thank Editage (www.editage.com) for English language editing.

References:

1. Mukete, B. N., & Ferdinand, K. C. (2016). Polypharmacy in older adults with hypertension: a comprehensive review. *The Journal of Clinical Hypertension*, 18(1), 10-18. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jch.12624>
2. Laatikainen, O., Miettunen, J., Sneck, S., Lehtiniemi, H., Tenhunen, O., & Turpeinen, M. (2017). The prevalence of medication-related adverse events in inpatients—a systematic review and meta-analysis. *European journal of clinical pharmacology*, 73(12), 1539-1549. <https://link.springer.com/article/10.1007/s00228-017-2330-3>
3. Masnoon, N., Shakib, S., Kalisch-Ellett, L., & Caughey, G. E. (2017). What is polypharmacy? A systematic review of definitions. *BMC geriatrics*, 17(1), 230. <https://link.springer.com/article/10.1186/S12877-017-0621-2>
4. Muth, C., Blom, J. W., Smith, S. M., Johnell, K., Gonzalez-Gonzalez, A. I., Nguyen, T. S., ... & Valderas, J. M. (2019). Evidence supporting the best clinical management of patients with multimorbidity and polypharmacy: a systematic guideline review and expert consensus. *Journal of internal medicine*, 285(3), 272-288. <https://onlinelibrary.wiley.com/doi/abs/10.1111/joim.12842>
5. Van Wilder, L., Devleesschauwer, B., Clays, E., Pype, P., Vandepitte, S., & De Smedt, D. (2022). Polypharmacy and health-related quality of life/psychological distress among patients with chronic disease. *Preventing Chronic Disease*, 19, E50. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9390791/>

6. Masoudi, F. A., Baillie, C. A., Wang, Y., Bradford, W. D., Steiner, J. F., Havranek, E. P., ... & Krumholz, H. M. (2005). The complexity and cost of drug regimens of older patients hospitalized with heart failure in the United States, 1998-2001. *Archives of internal medicine*, 165(18), 2069-2076. <https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/486731>
7. Molokhia, M., & Majeed, A. (2017). Current and future perspectives on the management of polypharmacy. *BMC Family Practice*, 18(1), 70. <https://link.springer.com/article/10.1186/s12875-017-0642-0>
8. Gordon, K., Smith, F., & Dhillon, S. (2007). Effective chronic disease management: patients' perspectives on medication-related problems. *Patient education and counseling*, 65(3), 407-415. <https://www.sciencedirect.com/science/article/pii/S0738399106003284>
9. Chwastiak, L., Vanderlip, E., & Katon, W. (2014). Treating complexity: collaborative care for multiple chronic conditions. *International Review of Psychiatry*, 26(6), 638-647. <https://www.tandfonline.com/doi/abs/10.3109/09540261.2014.969689>
10. Alqurain, A. A., Albaharnah, M., Al Zayer, S., Ameer, L., Ghosn, S., Al-Shaibi, S., ... & Alomar, F. A. (2024). The prevalence of polypharmacy and hyper-polypharmacy among middle-aged vs. older patients in Saudi Arabia: A cross-sectional study. *Frontiers in Pharmacology*, 15, 1357171. <https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2024.1357171/full>
11. Vogeli, C., Shields, A. E., Lee, T. A., Gibson, T. B., Marder, W. D., Weiss, K. B., & Blumenthal, D. (2007). Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs. *Journal of general internal medicine*, 22(Suppl 3), 391-395. <https://link.springer.com/article/10.1007/s11606-007-0322-1>
12. Woolf, S. H. (2004). Patient safety is not enough: targeting quality improvements to optimize the health of the population. *Annals of Internal Medicine*, 140(1), 33-36. <https://www.acpjournals.org/doi/abs/10.7326/0003-4819-140-1-200401060-00009>
13. Parums, D. V. (2021). Review articles, systematic reviews, meta-analysis, and the updated preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines. *Medical science monitor: international medical journal of experimental and clinical research*, 27, e934475-1. <https://pmc.ncbi.nlm.nih.gov/articles/PMC8394590/>
14. Alhumaidi, R. M., Bamagous, G. A., Alsanosi, S. M., Alqashqari, H. S., Qadhi, R. S., Alhindi, Y. Z., ... & Falemban, A. H. (2023). Risk of polypharmacy and its outcome in terms of drug interaction in an elderly population: a retrospective cross-sectional study. *Journal of clinical medicine*, 12(12), 3960. <https://www.mdpi.com/2077-0383/12/12/3960>
15. Alqurain, A. A., Albaharnah, M., Al Zayer, S., Ameer, L., Ghosn, S., Al-Shaibi, S., ... & Alomar, F. A. (2024). The prevalence of polypharmacy and hyper-polypharmacy among middle-aged vs. older patients in Saudi Arabia: A cross-sectional study. *Frontiers in Pharmacology*, 15, 1357171. <https://www.frontiersin.org/journals/pharmacology/articles/10.3389/fphar.2024.1357171/full>
16. Al-Qurain, A. A., Gebremichael, L. G., Khan, M. S., Williams, D. B., Mackenzie, L., Phillips, C., ... & Wiese, M. D. (2020). Prevalence and factors associated with analgesic prescribing in poly-medicated elderly patients. *Drugs & Aging*, 37(4), 291-300. <https://link.springer.com/article/10.1007/s40266-019-00742-0>
17. Al-Qurain, A. A., Gebremichael, L. G., Khan, M. S., Williams, D. B., Mackenzie, L., Phillips, C., ... & Wiese, M. D. (2021). Opioid prescribing and risk of drug-opioid interactions in older discharged patients with polypharmacy in Australia. *International Journal of Clinical Pharmacy*, 43(2), 365-374. <https://link.springer.com/article/10.1007/s11096-020-01191-1>
18. Rolita, L., Spegman, A., Tang, X., & Cronstein, B. N. (2013). Greater number of narcotic analgesic prescriptions for osteoarthritis is associated with falls and fractures in elderly adults. *Journal of the American Geriatrics Society*, 61(3), 335-340. <https://agsjournals.onlinelibrary.wiley.com/doi/abs/10.1111/jgs.12148>

19. Al Saif, A., Waly, E., & Alsenany, S. (2012). The prediction of falls among older people in Saudi Arabia. *J Am Sci*, 8(6), 692-700. https://www.researchgate.net/profile/Ehab-Hafez/publication/255821846_The_Prediction_of_Falls_Among_older_people_in_Saudi_Arabia/links/00b49520bc23863f2f000000/The-Prediction-of-Falls-Among-older-people-in-Saudi-Arabia.pdf
20. Alabdullgader, A., & Rabbani, U. (2021). Prevalence and risk factors of falls among the elderly in Unaizah City, Saudi Arabia. *Sultan Qaboos University Medical Journal*, 21(1), e86. <https://pmc.ncbi.nlm.nih.gov/articles/PMC7968899/>
21. Gill, T. M., Williams, C. S., & Tinetti, M. E. (2000). Environmental hazards and the risk of nonsyncopal falls in the homes of community-living older persons. *Medical care*, 38(12), 1174-1183. https://journals.lww.com/lww-medicalcare/fulltext/2000/12000/environmental_hazards_and_the_risk_of_nonsyncopal.4.aspx
22. Khoja, A. T., Aljawadi, M. H., Al-Shammary, S. A., Mohamed, A. G., Al-Manaa, H. A., Morlock, L., ... & Khoja, T. A. (2018). The health of Saudi older adults; results from the Saudi National Survey for Elderly Health (SNSEH) 2006–2015. *Saudi Pharmaceutical Journal*, 26(2), 292-300. <https://www.sciencedirect.com/science/article/pii/S1319016417302037>
23. Aljawadi, M. H., Khoja, A. T., Alaboud, N. M., AlEnazi, M. E., Al-Shammary, S. A., Khoja, T. A., ... & Alwhaibi, M. (2022). Prevalence of polypharmacy and factors associated with it among Saudi older adults—results from the Saudi National Survey for Elderly Health (SNSEH). *Saudi Pharmaceutical Journal*, 30(3), 230-236. <https://www.sciencedirect.com/science/article/pii/S1319016422000032>
24. Al-Modeer, M. A., Hassanien, N. S., & Jabloun, C. M. (2013). Profile of morbidity among elderly at home health care service in Southern Saudi Arabia. *Journal of family and community medicine*, 20(1), 53-57. https://journals.lww.com/jfcm/fulltext/2013/20010/profile_of_morbidity_among_elderly_at_home_health.9.aspx
25. Castro-de-Araujo, L. F. S., Cortes, F., de Siqueira Filha, N. T., Rodrigues, E. D. S., Machado, D. B., Araujo, J. A. P. D., ... & Barreto, M. L. (2022). Patterns of multimorbidity and some psychiatric disorders: A systematic review of the literature. *Frontiers in psychology*, 13, 940978. <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.940978/full>
26. Lytvynak, E., Olstad, D. L., Schopflocher, D. P., Plotnikoff, R. C., Storey, K. E., Nykiforuk, C. I., & Raine, K. D. (2016). Impact of a 3-year multi-centre community-based intervention on risk factors for chronic disease and obesity among free-living adults: the Healthy Alberta Communities study. *BMC Public Health*, 16(1), 344. <https://link.springer.com/article/10.1186/s12889-016-3021-1>
27. Alsaif, M. M., Aldawsari, T. M., Alqutaym, A. S., Alqutaym, M. S., & Alanazi, A. M. (2024). A Systematic Review of Healthcare Providers Awareness of Medication Switching for Polypharmacy Patients in Saudi Arabia. *Saudi J Med Pharm Sci*, 10(6), 391-396. https://saudijournals.com/media/articles/SJMPs_106_391-396_FT.pdf
28. Dawson, A. J., Nkowane, A. M., & Whelan, A. (2015). Approaches to improving the contribution of the nursing and midwifery workforce to increasing universal access to primary health care for vulnerable populations: a systematic review. *Human resources for health*, 13(1), 97. <https://link.springer.com/article/10.1186/s12960-015-0096-1>
29. Zia, A., Kamaruzzaman, S. B., & Tan, M. P. (2015). Polypharmacy and falls in older people: Balancing evidence-based medicine against falls risk. *Postgraduate medicine*, 127(3), 330-337. <https://www.tandfonline.com/doi/abs/10.1080/00325481.2014.996112>
30. Dhalwani, N. N., Fahami, R., Sathanapally, H., Seidu, S., Davies, M. J., & Khunti, K. (2017). Association between polypharmacy and falls in older adults: a longitudinal study from England. *BMJ open*, 7(10), e016358. <https://bmjopen.bmjjournals.com/content/7/10/e016358.abstract>

31. Cohen, J. E. (2001, November). World population in 2050: assessing the projections. In Conference Series-Federal Reserve Bank of Boston (Vol. 46, pp. 83-113). Federal Reserve Bank of Boston; 1998. <https://core.ac.uk/download/pdf/6706944.pdf>
32. Sharifi, H., Hasanloei, M. A. V., & Mahmoudi, J. (2014). Polypharmacy-induced drug-drug interactions; threats to patient safety. *Drug research*, 64(12), 633-637. <https://www.thieme-connect.com/products/all/doi/10.1055/s-0033-1363965>
33. Hoel, R. W., Connolly, R. M. G., & Takahashi, P. Y. (2021, January). Polypharmacy management in older patients. In *Mayo Clinic Proceedings* (Vol. 96, No. 1, pp. 242-256). Elsevier. <https://www.sciencedirect.com/science/article/pii/S0025619620306169>
34. Sharkiya, S. H. (2023). Quality communication can improve patient-centred health outcomes among older patients: a rapid review. *BMC Health Services Research*, 23(1), 886. <https://link.springer.com/article/10.1186/s12913-023-09869-8>
35. Gnjidic, D., Bennett, A., Le Couteur, D. G., Blyth, F. M., Cumming, R. G., Waite, L., ... & Hilmel, S. N. (2015). Ischemic heart disease, prescription of optimal medical therapy and geriatric syndromes in community-dwelling older men: A population-based study. *International journal of cardiology*, 192, 49-55. <https://www.sciencedirect.com/science/article/pii/S0167527315010827>
36. Verma, A., Saha, S., Jarl, J., Conlon, E., McGuinness, B., & Trépel, D. (2023). An overview of systematic reviews and meta-analyses on the effect of medication interventions targeting polypharmacy for frail older adults. *Journal of Clinical Medicine*, 12(4), 1379. <https://www.mdpi.com/2077-0383/12/4/1379>
37. Guthrie, B., Makubate, B., Hernandez-Santiago, V., & Dreischulte, T. (2015). The rising tide of polypharmacy and drug-drug interactions: population database analysis 1995–2010. *BMC medicine*, 13(1), 74. <https://link.springer.com/article/10.1186/s12916-015-0322-7>
38. Skaar, D. D., & O'Connor, H. (2017). Using the Beers criteria to identify potentially inappropriate medication use by older adult dental patients. *The Journal of the American Dental Association*, 148(5), 298-307. <https://www.sciencedirect.com/science/article/pii/S0002817717300776>
39. Jabri, F. F., Liang, Y., Alhawassi, T. M., Johnell, K., & Möller, J. (2023, July). Potentially inappropriate medications in older adults—prevalence, trends and associated factors: a cross-sectional study in Saudi Arabia. In *Healthcare* (Vol. 11, No. 14, p. 2003). MDPI. <https://www.mdpi.com/2227-9032/11/14/2003>
40. Alsultan, M. M., Alamer, R., Alammar, F., Alzlaiq, W., Alahmari, A. K., Almalki, Z. S., ... & Almalki, B. A. (2023). Prevalence of polypharmacy in heart failure patients: A retrospective cross-sectional study in a tertiary hospital in Saudi Arabia. *Saudi Pharmaceutical Journal*, 31(12), 101875. <https://www.sciencedirect.com/science/article/pii/S1319016423003705>
41. Brown, J. D., Hutchison, L. C., Li, C., Painter, J. T., & Martin, B. C. (2016). Predictive validity of the beers and screening tool of older persons' potentially inappropriate prescriptions (STOPP) criteria to detect adverse drug events, hospitalizations, and emergency department visits in the United States. *Journal of the American Geriatrics Society*, 64(1), 22-30. <https://agsjournals.onlinelibrary.wiley.com/doi/abs/10.1111/jgs.13884>
42. Steinman, M. A., Handler, S. M., Gurwitz, J. H., Schiff, G. D., & Covinsky, K. E. (2011). Beyond the prescription: medication monitoring and adverse drug events in older adults. *Journal of the American Geriatrics Society*, 59(8), 1513-1520. <https://agsjournals.onlinelibrary.wiley.com/doi/abs/10.1111/j.1532-5415.2011.03500.x>
43. Sharma, R., Arora, M., Garg, R., & Bansal, P. (2020). A closer look at the 2019 Beers criteria. *Drugs & Therapy Perspectives*, 36(3), 116-122. <https://link.springer.com/article/10.1007/s40267-019-00704-x>
44. Hohmeier, K. C., Shelton, C., Havrda, D., & Gatwood, J. (2020). The need to prioritize “prioritization” in clinical pharmacy service practice and implementation. *Research in Social and*

Administrative Pharmacy, 16(12), 1785-1788.
<https://www.sciencedirect.com/science/article/pii/S1551741120303776>

45. Smith, M. (2009). Pharmacists' role in improving diabetes medication management. *Journal of diabetes science and technology*, 3(1), 175-179.
<https://journals.sagepub.com/doi/abs/10.1177/193229680900300120>

46. Umeano, A. (2024). Nursing leadership strategies for fostering interprofessional collaboration with pharmacists to improve medication safety and patient-centered healthcare outcomes.
https://www.researchgate.net/profile/Adanna-Umeano-2/publication/396400115_Nursing_leadership_strategies_for_fostering_interprofessional_collaboration_with_pharmacists_to_improve_medication_safety_and_patient-centered_healthcare_outcomes/links/68e93c517d9a4d4e870895f2/Nursing-leadership-strategies-for-fostering-interprofessional-collaboration-with-pharmacists-to-improve-medication-safety-and-patient-centered-healthcare-outcomes.pdf