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ECONOMIC BURDEN OF POLYPHARMACY ON GERIATRIC PATIENTS

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Abstract:

Polypharmacy is increasingly prevalent among older adults due to population aging and rising multimorbidity, affecting nearly 39% of geriatric individuals and over 59% of frail elderly populations. This review of studies published between 2015 and 2025, identified through major databases including PubMed, MEDLINE, Scopus, and Cochrane Library, evaluates the multidimensional economic burden of polypharmacy among adults aged 65 years and older. Evidence consistently indicates that polypharmacy is associated with nearly a twofold increase in total healthcare expenditure and a substantial rise in pharmacy-related costs. In the United States, older adults exposed to polypharmacy incur significantly higher annual healthcare expenses compared with those without it, and mismanaged polypharmacy contributes billions of dollars in avoidable healthcare spending each year. The economic impact extends beyond direct medication costs to include hospitalizations resulting from adverse drug reactions, emergency department visits, increased outpatient consultations, prolonged hospital stays, caregiver burden, and diminished quality of life. Collectively, these findings underscore the urgent need for evidence-based interventions, such as medication therapy management, structured deprescribing protocols, regular medication review, and interprofessional collaboration, to optimize pharmacotherapy, reduce unnecessary expenditures, and improve clinical outcomes in the geriatric population.

Keywords: *Polypharmacy, Geriatric, Economic Burden, Deprescribing, Adverse Drug Reactions, Healthcare Expenditure, Multimorbidity.*

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1. INTRODUCTION:

The global population is aging at an unprecedented rate. According to the World Health Organization, by 2030, one in six people globally will be aged 60 years or older, and the proportion of the population aged 60 and over is projected to nearly double by 2050. [17] This demographic shift brings with it an increasing prevalence of chronic diseases, multimorbidity, and the consequent escalation in medication use among older adults. Polypharmacy, most commonly defined as the concurrent use of five or more medications, [18] has emerged as one of the most critical and yet underestimated public health challenges facing geriatric medicine today. [13]

The relationship between aging, multimorbidity, and polypharmacy forms a self-reinforcing cascade. As older adults develop multiple chronic conditions such as hypertension, diabetes, cardiovascular disease, arthritis, and depression, clinical guidelines often recommend combining multiple pharmacological agents to manage each condition individually. [19,24] While each medication may be individually justified, the cumulative effect of taking numerous drugs simultaneously exposes patients to a significantly elevated risk of adverse drug reactions (ADRs), drug-drug interactions, medication non-adherence, and prescribing cascades wherein the side effects of one drug are treated with additional medications. [6,12,25]

Beyond the well-documented clinical consequences, polypharmacy exerts a substantial economic burden that affects patients, caregivers, insurers, and society. [3,4,5] This burden encompasses direct costs including medication expenditure, hospitalizations due to adverse drug events, and increased outpatient utilization, as well as indirect costs such as lost productivity, caregiver burden, and diminished quality of life. [9,10] Despite the magnitude of this problem, few comprehensive reviews have systematically examined the economic dimensions of polypharmacy in geriatric populations. [10,11]

This review aims to provide a thorough synthesis of the current evidence on the economic burden of polypharmacy among geriatric patients, drawing upon global epidemiological data, national healthcare expenditure analyses, and economic evaluations of interventions designed to optimize medication use. [17] Furthermore, it presents evidence-based strategies and deprescribing frameworks that have demonstrated potential in mitigating both the clinical and financial consequences of polypharmacy. [6,16]

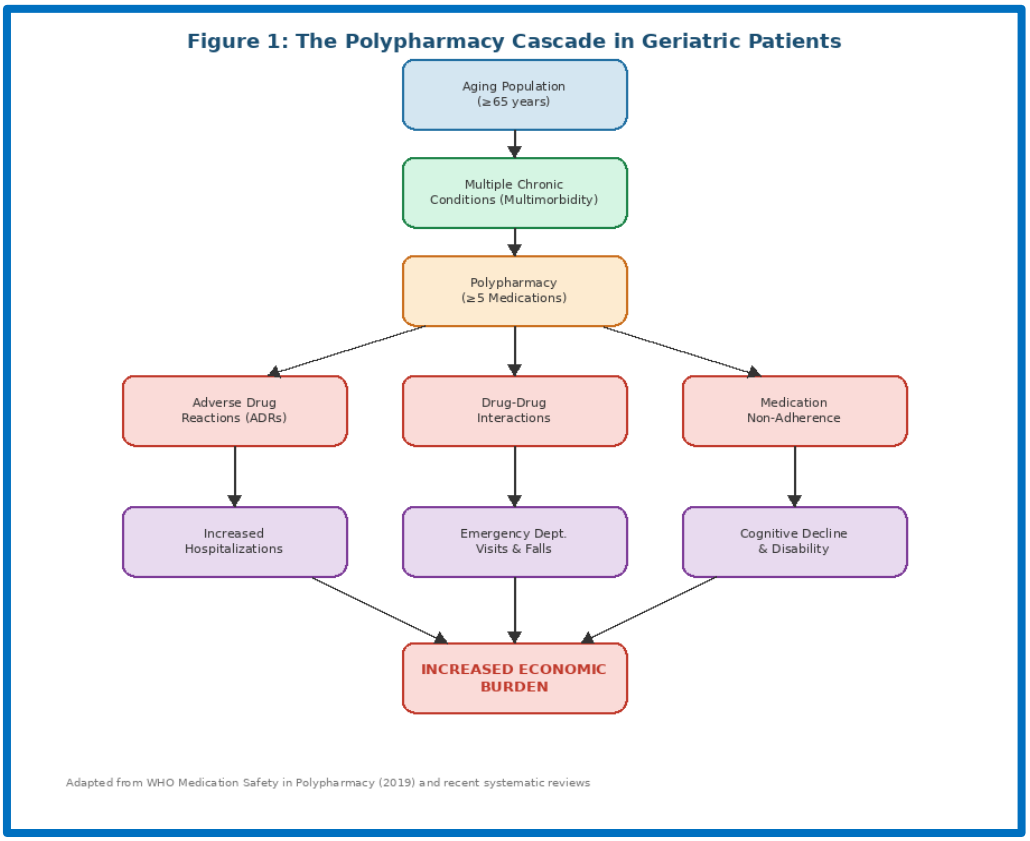

Figure 1: The Polypharmacy Cascade in Geriatric Patients — From Aging to Economic Burden

2. GLOBAL EPIDEMIOLOGY OF POLYPHARMACY IN THE ELDERLY

2.1 Worldwide Prevalence

A landmark systematic review and meta-analysis by Wang et al. (2024), encompassing 122 observational studies with over 57 million individuals, established that the overall global prevalence of polypharmacy among elderly populations stands at 39.1% (95% CI: 35.5–42.7%). [1] Hyperpolypharmacy, defined as the concurrent use of ten or more medications, was observed in 13.3% of the elderly population worldwide. [1] These figures represent a significant and growing public health concern with direct implications for healthcare resource allocation. Regional variations in polypharmacy prevalence are notable and reflect differences in healthcare systems, prescribing practices, and disease burden. The highest prevalence was observed in Europe at 45.8%, followed by Oceania at 45.5%, North America at 40.8%, Asia at 29.0%, and South America at 28.4%. [1] A comprehensive umbrella review by Kim et al. (2024), analyzing data from 295 studies across 41 countries, corroborated these findings and additionally highlighted that North America demonstrated a higher prevalence of 52% when broader inclusion criteria were applied. [2]

2.2 High-Risk Populations

Polypharmacy prevalence is markedly higher in certain subpopulations of older adults. Among frail elderly individuals, the prevalence reaches 59%, with rates as high as 68% in Europe and 71% in hospital settings. [2] Nursing home residents represent another high-risk group, with polypharmacy rates consistently exceeding 50% across studies. [1,2] In South Korea, an analysis of 319,185 adults aged 65 and older revealed a staggering 86.4% prevalence of polypharmacy when defined as six or more medications, with 44.9% classified as having excessive polypharmacy of eleven or more drugs. [24]. Age within the geriatric population is itself a significant determinant, with individuals aged 70 years and older exhibiting substantially higher polypharmacy rates. [1,24] The prevalence is also significantly influenced by socioeconomic deprivation, with the most deprived populations showing higher rates of excessive polypharmacy. [19] Gender differences have been observed, with some studies reporting higher rates in women due to greater healthcare utilization, though men showed a greater increase in medication numbers over longitudinal follow-up periods. [19,24]

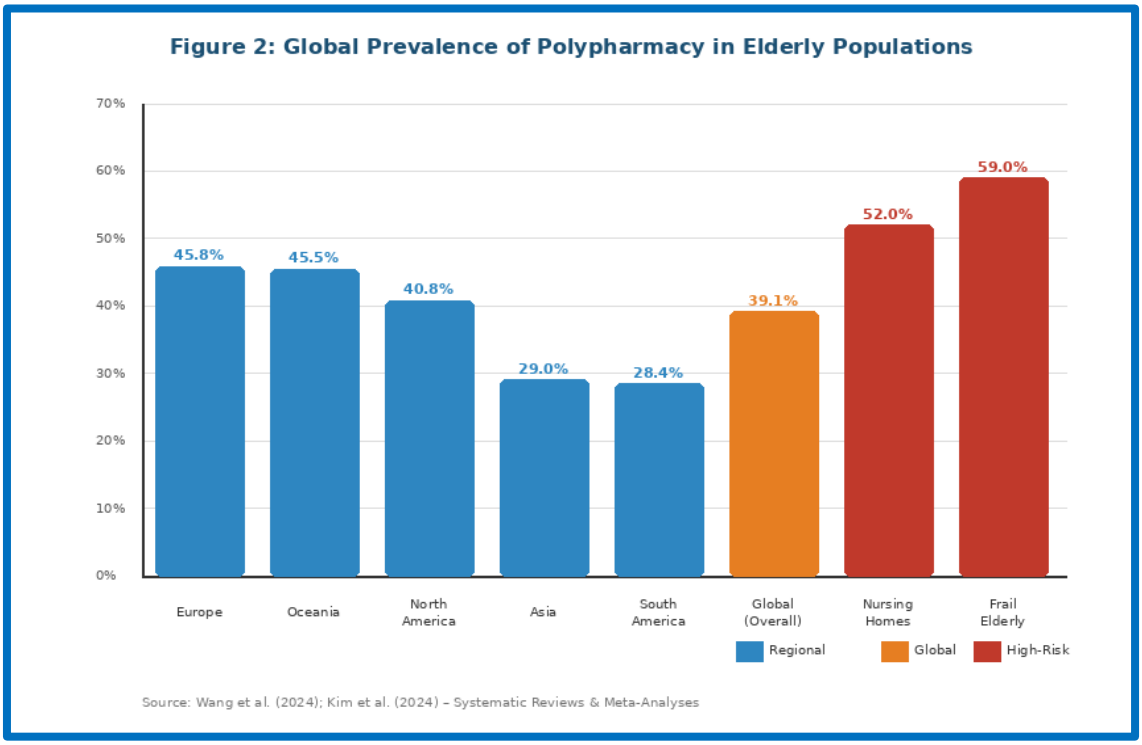

Figure 2: Global Prevalence of Polypharmacy in Elderly Populations by Region and Setting

3. ECONOMIC BURDEN: DIRECT COSTS

3.1 Total Healthcare Expenditure

The financial impact of polypharmacy on healthcare systems is substantial and multidimensional. A seminal cross-sectional study by Kwak et al. (2022) using the 2017 Medical Expenditure Panel Survey, analyzing data from 1,610 older adults with cardiovascular disease (weighted to represent 17.3 million individuals), provided compelling evidence of the economic burden. [3] After adjusting for demographic and clinical factors, polypharmacy was associated with a 198% increase in total healthcare expenditure. The expected average total healthcare expenditure for patients with polypharmacy was $19,068 (95% CI: $18,249–$19,887) compared with $8,815 (95% CI: $8,544–$9,086) for those without polypharmacy. [3]. Pharmacy-related expenditure showed an even more pronounced differential, with a 287% increase associated with polypharmacy. Patients with polypharmacy incurred average pharmacy costs of $1,286 annually, compared with $488 for those without polypharmacy. [3] Non-pharmacy-related expenditure, encompassing hospitalizations, outpatient visits, and diagnostic procedures, was $13,987 for polypharmacy patients versus $7,178 for non-polypharmacy patients, representing a 178% increase. [3] A more recent propensity score-matched study using MEPS data from 2018 to 2021, published in BMC Geriatrics (2025), included 23,300 participants aged 65 and older and further confirmed these findings using rigorous statistical methods to control for confounding. [4] The study demonstrated that the additional healthcare costs associated with polypharmacy impose a significant economic burden on patients, families, insurers, and society. [4]

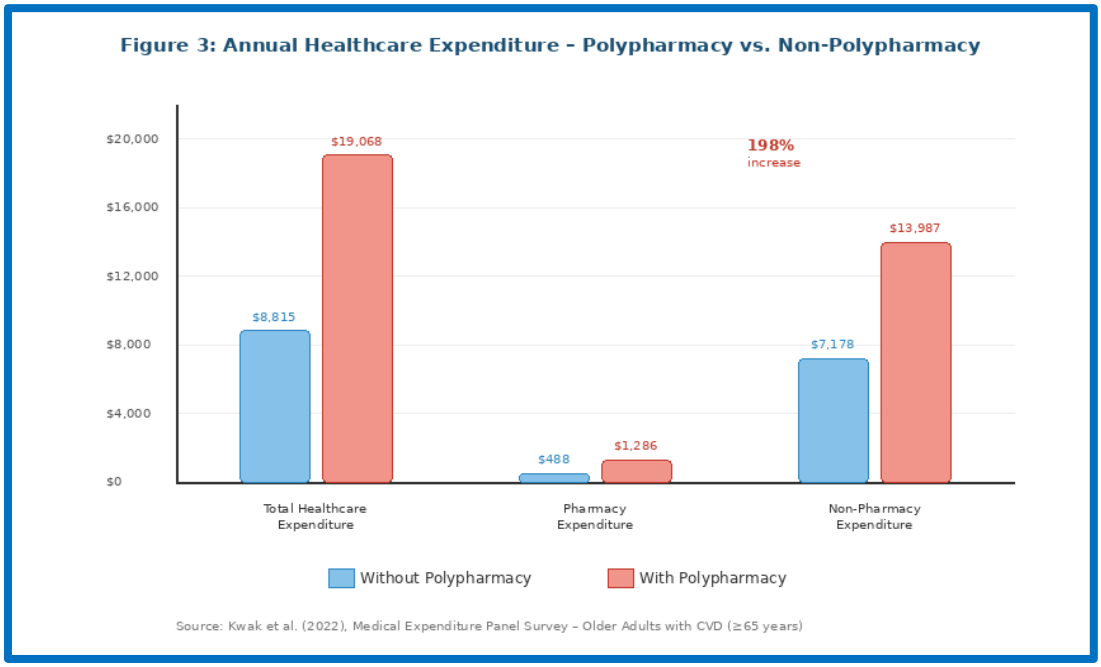

Figure 3: Annual Healthcare Expenditure — Polypharmacy vs. Non-Polypharmacy in Older Adults with CVD

3.2 Hospitalization and Emergency Department Costs

Adverse drug reactions constitute one of the most costly consequences of polypharmacy. A landmark study demonstrated that ADRs accounted for 16.5% of hospital admissions among older adults, with an associated increase in mortality and considerable cost to the health economy. [15] Each additional medication prescribed to an older adult has been shown to be independently associated with increased mortality risk. [15] The dose-response relationship between polypharmacy and hospitalization has been demonstrated across multiple healthcare systems. [7,24] In South Korea, older adults engaged in polypharmacy were found to incur annual healthcare expenses 872,018 Korean Won (approximately $650 USD) higher than their non-polypharmacy counterparts. [7] A prospective cohort study demonstrated that the number of medications was independently associated with all-cause hospital admission over 4.5 years of follow-up. [24] The Taiwan Longitudinal Health Insurance Database revealed a dose-response relationship between polypharmacy and both all-cause and fracture-specific hospital admissions. [24] Mismanaged polypharmacy among older adults is estimated to cost the United States healthcare system approximately $2 billion each year in avoidable costs. [9] More than half of older adults take at least one medication that is not clinically indicated, [13]

and the odds of incurring a medication-related problem increase by 10% with each additional chronic medication. [9] Patients taking 11 or more medications are approximately twice as likely to experience a medication-related problem compared with those on fewer drugs. [9]

3.3 Comparative Cost Analysis

Table 1 summarizes the key economic indicators associated with polypharmacy across different healthcare dimensions, drawn from major studies conducted in the United States, South Korea, Mexico, and multi-national analyses. [3,5,7,9,15,27]

Table 1: Summary of Economic Indicators Associated with Polypharmacy in Geriatric Patients

Cost Dimension	With Polypharmacy	Without Polypharmacy	Increase (%)
Total Healthcare Expenditure (annual) [3]	$19,068	$8,815	198%
Pharmacy Expenditure (annual) [3]	$1,286	$488	287%
Non-Pharmacy Expenditure (annual) [3]	$13,987	$7,178	178%
Annual System Cost (US mismanagement) [9]	~$2 billion	N/A	N/A
ADR-Related Hospital Admissions [15]	16.5% of admissions	Baseline	Significant
MRP Risk per Additional Drug [9]	+10% per drug	Baseline	Dose-response
Annual Cost per Patient (South Korea) [7]	+872,018 KRW	Baseline	Significant
Annual Cost (Mexico Primary Care) [27]	$2,201	N/A	N/A

ADR = Adverse Drug Reaction; MRP = Medication-Related Problem; KRW = Korean Won. Sources as indicated by reference numbers.

4. INDIRECT AND HIDDEN ECONOMIC COSTS

4.1 Caregiver Burden and Lost Productivity

The economic burden of polypharmacy extends well beyond direct healthcare expenditure. Managing complex medication regimens imposes a significant time and cognitive burden on both patients and their caregivers. [26] Older adults with polypharmacy require assistance with medication management, including understanding the purpose of multiple prescriptions written by multiple providers, obtaining and organizing refills, taking each medication at the correct time, and recognizing potential side effects. [26] For patients with cognitive impairment, which is itself exacerbated by polypharmacy, [25] this burden often falls entirely on family caregivers. The indirect costs include lost productivity among working-age caregivers, increased utilization of home healthcare services, and the opportunity costs associated with frequent outpatient visits and hospitalizations. [4,10] Though quantifying these costs is methodologically challenging, they represent a substantial yet frequently overlooked component of the total economic impact of polypharmacy. [10]

4.2 Quality of Life and Functional Decline

Polypharmacy is strongly associated with reduced health-related quality of life, functional decline, cognitive impairment, and increased frailty. [12,14] These outcomes carry economic implications through increased dependency on social services, accelerated need for institutional care, and reduced capacity for independent living. [5] Studies have demonstrated that the combined effect of frailty and polypharmacy significantly increases the risk of mortality, incident disability, hospitalization, and emergency department visits. [24] The anticholinergic burden associated with multiple medication use further compounds cognitive decline and functional impairment, leading to a cyclical relationship between medication burden, disability, and healthcare utilization. [25]

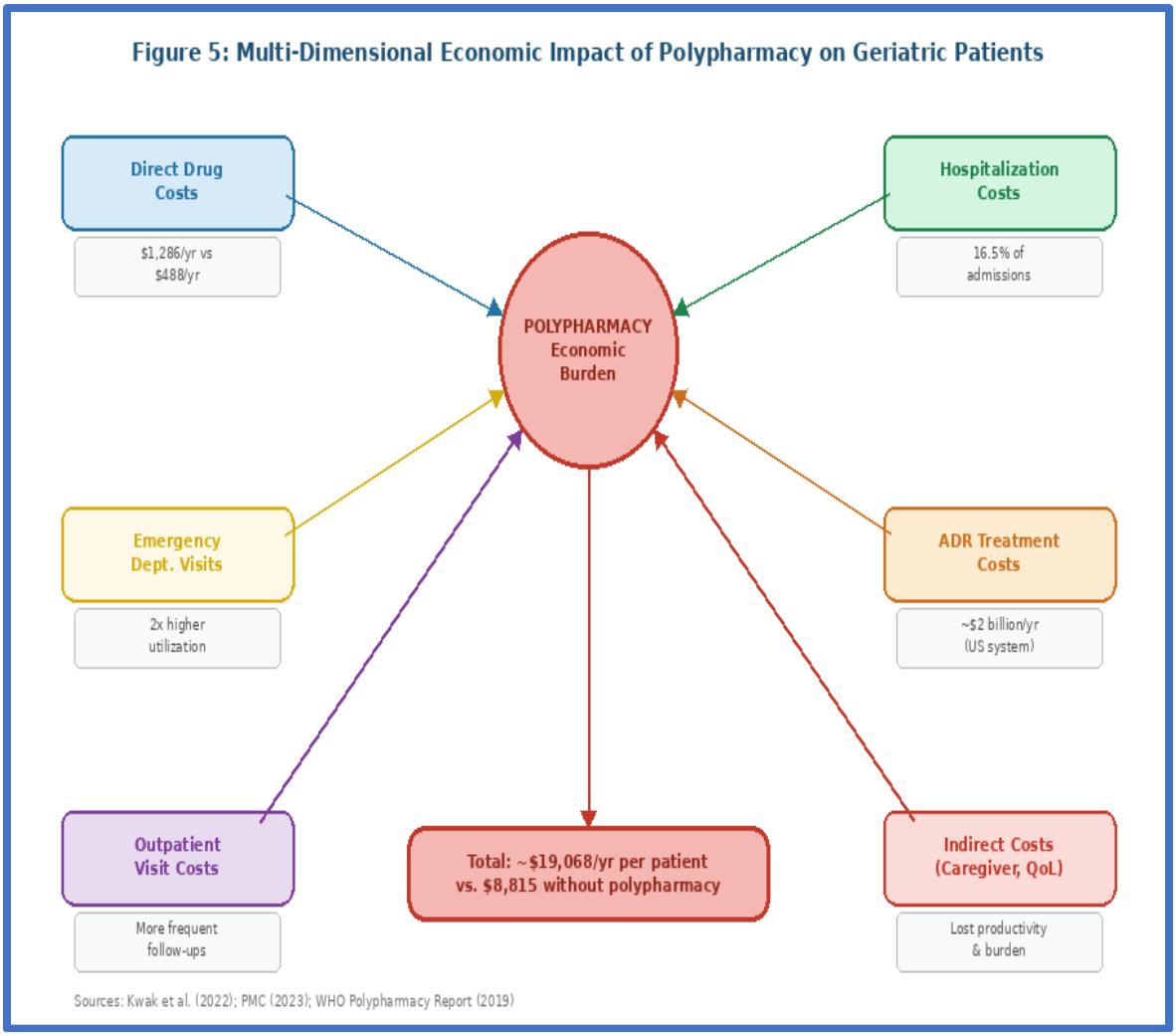

Figure 5: Multi-Dimensional Economic Impact of Polypharmacy on Geriatric Patients

4.3 Medication Non-Adherence Costs

As the number of prescribed medications increases, adherence to treatment regimens predictably decreases. [11,23] Medication non-adherence among older adults with polypharmacy leads to treatment failure, disease progression, and the prescribing of additional, potentially unnecessary, medications — creating a costly prescribing cascade. [6,8] The economic implications of non-adherence include wasted medication expenditure, increased emergency department visits due to uncontrolled disease states, and preventable hospitalizations. [9,11] Studies estimate that approximately 50% of older adults take at least one medication that is not clinically indicated, contributing to both direct waste and downstream healthcare costs. [13]

5. CLINICAL CONSEQUENCES WITH DIRECT ECONOMIC IMPLICATIONS

5.1 Adverse Drug Reactions

Adverse drug reactions represent the most clinically significant and economically costly consequence of polypharmacy. [6,21] The high rates of ADRs among older adults are primarily attributed to polypharmacy, compounded by age-related physiological changes including altered pharmacokinetics and pharmacodynamics, reduced hepatic and renal clearance, and changes in body composition. [22] Research has demonstrated that patients with a higher frailty index are twice as likely to experience ADRs during hospital stays and to receive potentially inappropriate prescriptions. [22] The single most important predictor of inappropriate prescribing and risk of ADRs in older patients is the number of prescribed drugs. [6] Each additional medication adds incrementally to the risk, creating a dose-response relationship between polypharmacy and adverse outcomes. [9] These events translate directly into emergency department presentations, hospital admissions, extended lengths of stay, and in severe cases, intensive care utilization — all of which carry significant financial costs. [3,7,15]

5.2 Falls, Fractures, and Associated Costs

Falls are among the most common and costly consequences of polypharmacy in older adults. [13,25] Medications with sedating properties, anticholinergic effects, and those affecting blood

pressure regulation are particularly implicated. [25] Fall-related injuries, especially hip fractures, represent a major source of healthcare expenditure among the elderly. The anticholinergic cognitive burden scale identifies 117 medications with anticholinergic effects that adversely impact cognition, functional activity, and fall risk, with associated liabilities including injurious falls, episodes of confusion or delirium, emergency department visits, and hospitalizations. [13,25]

5.3 Drug-Drug Interactions

The probability of drug-drug interactions increases exponentially with the number of co-prescribed medications. [19] These interactions can lead to therapeutic failure, enhanced toxicity, and unpredictable adverse effects that necessitate additional healthcare utilization. [12] In geriatric populations, where altered drug metabolism is prevalent, the clinical and economic consequences of drug-drug interactions are amplified. [21] The resulting need for monitoring, dose adjustments, and management of interaction-related complications contributes substantially to the overall cost of polypharmacy. [3,10]

Table 2: Clinical Consequences of Polypharmacy and Their Economic Implications

CONSEQUENCE	CLINICAL IMPACT	ECONOMIC IMPACT
Adverse Drug Reactions [15,22]	16.5% of hospital admissions; increased mortality	Extended hospital stays, ICU costs, increased readmissions
Falls & Fractures [13,25]	Sedation, cognitive impairment, orthostatic hypotension	Surgical costs, rehabilitation, long-term care needs
Drug-Drug Interactions [12,19]	Therapeutic failure, enhanced toxicity	Additional monitoring, dose adjustments, emergency visits
Non-Adherence [11,23]	Treatment failure, disease progression	Wasted medication costs, preventable hospitalizations
Cognitive Decline [22,25]	Anticholinergic burden, delirium, dementia risk	Institutional care costs, caregiver burden
Prescribing Cascade [6,8]	Side effects treated with additional drugs	Escalating medication costs, compounded ADR risk

6. INTERVENTIONS AND STRATEGIES TO MITIGATE ECONOMIC BURDEN

6.1 Deprescribing Protocols

Deprescribing represents the most direct and evidence-based approach to reducing the economic burden of polypharmacy. [6,16] Defined as the systematic process of identifying and discontinuing medications where existing or potential harms outweigh existing or potential benefits, [6] deprescribing has demonstrated promise in reducing both clinical adverse outcomes and associated healthcare costs. Scott et al. (2015) proposed a widely adopted five-step deprescribing protocol: ascertaining all current medications, assessing overall risk of drug-induced harm, evaluating each drug's benefit-harm ratio, prioritizing discontinuation candidates, and implementing a monitored discontinuation regimen. [6] Evidence from randomized controlled trials supports the safety and efficacy of deprescribing. [16,22] Studies have demonstrated that deprescribing interventions can effectively reduce polypharmacy and potentially inappropriate medications, lower drug burden, and decrease medication costs, with few reported adverse drug withdrawal events and generally no difference in mortality. [16] A systematic review of pharmaceutical services for polymedicated patients found that pharmacist-led interventions resulted in deprescription of unnecessary drugs and contributed to reduced healthcare costs.

Interprofessional models involving physicians, pharmacists, and nurses have been found to enhance implementation success and patient acceptance. Furthermore, integration of clinical decision-support systems (CDSS) and explicit screening tools such as STOPP/START criteria and Beers Criteria into routine practice facilitates identification of inappropriate prescriptions, thereby strengthening deprescribing efforts and improving cost containment. When combined with shared decision-making and patient education, deprescribing becomes not only a cost-reduction strategy but also a quality-improvement initiative. Overall, deprescribing represents a clinically safe, economically beneficial, and sustainable intervention for mitigating the growing financial burden associated with polypharmacy, particularly in aging populations with multimorbidity.[11]

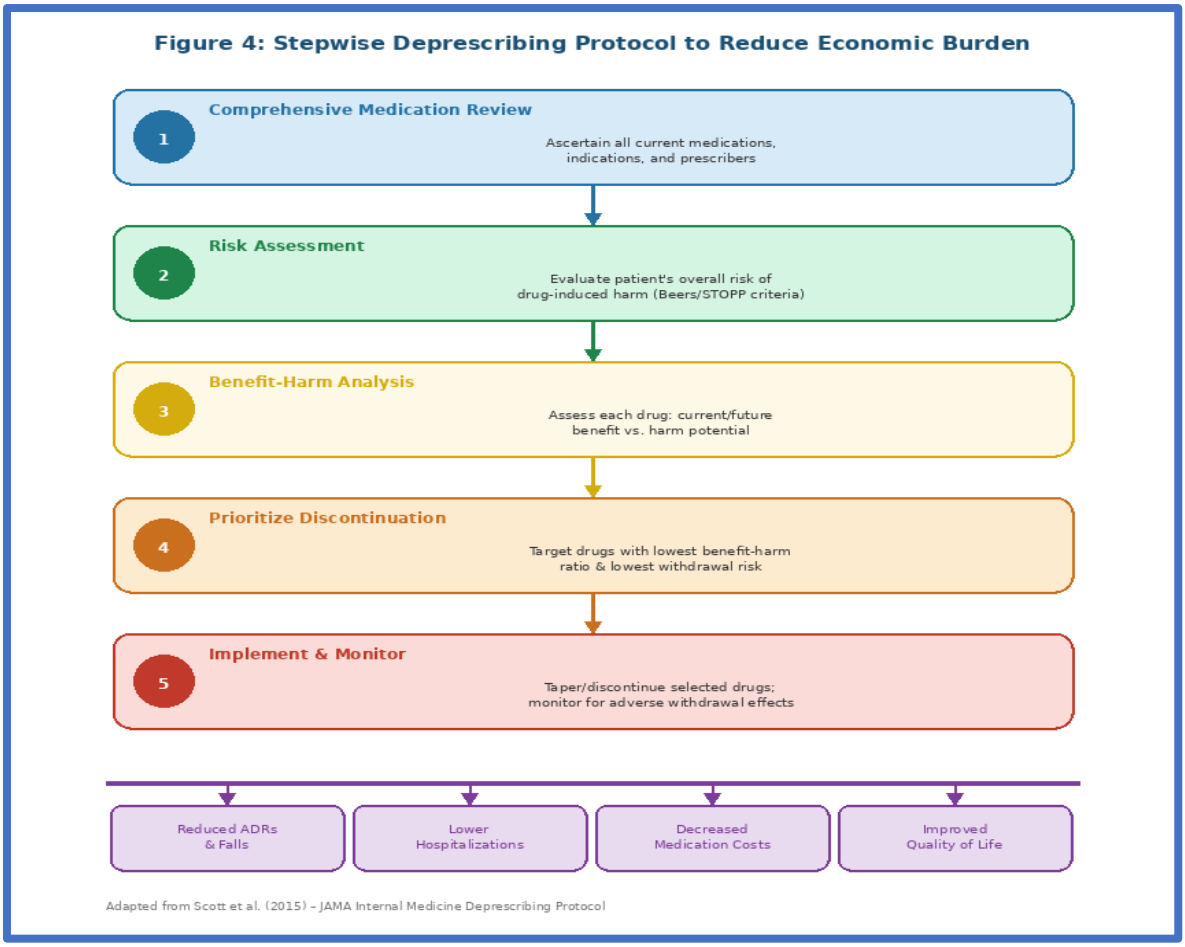

Figure 4: Stepwise Deprescribing Protocol to Reduce Economic Burden [6]

6.2 Medication Therapy Management

Medication Therapy Management (MTM) represents a structured, pharmacist-led service designed to optimize medication use, improve health outcomes, and reduce associated costs. [9] MTM is particularly relevant for Medicare beneficiaries with polypharmacy, who are eligible to receive comprehensive medication reviews. [9] Evidence from pharmacist intervention studies has demonstrated notable success: one study reported a 67% reduction in polypharmacy after the first intervention and a 39% reduction following a second intervention. [13] The pharmacist's role encompassed identification and management of high-risk drugs, education of physicians and patients regarding drug safety, and development of deprescribing strategies. [13] Cost-benefit analyses of medication optimization interventions have generally demonstrated net positive or neutral economic returns. [10] A systematic review of economic evaluations found that five studies conducting cost-benefit analyses reported either null or positive net benefits, while cost-utility and cost-effectiveness analyses yielded incremental cost-effectiveness ratios generally within acceptable willingness-to-pay thresholds. [10]

6.3 Clinical Decision Support Tools

Several validated tools exist to guide clinicians in identifying potentially inappropriate medications in older adults. [12] The Beers Criteria, updated by the American Geriatrics Society, the STOPP/START guidelines (Screening Tool of Older Persons' Prescriptions/Screening Tool to Alert Doctors to Right Treatment), the Anticholinergic Cognitive Burden (ACB) scale, and the Drug Burden Index (DBI) all serve as essential frameworks for rational prescribing. [12,13] Clinical Decision Support Systems (CDSS) integrating these tools into electronic health records can enhance prescribing safety by identifying drug-drug interactions and recommending safer therapeutic alternatives in real time. [12]

6.4 Interprofessional Collaboration and Patient Education

Addressing polypharmacy effectively requires coordinated effort among physicians, pharmacists, nurses, and other healthcare professionals. [14,23] Interprofessional medication reviews have demonstrated efficacy in reducing polypharmacy and identifying medication-related problems. [28] Barriers to effective deprescribing include

communication gaps between providers, patient reluctance to discontinue long-standing medications, and the complexity of managing multiple prescribers. [23] Strategies to overcome these barriers include education programs for both clinicians and patients, structured medication review frameworks, and patient-centered shared decision-making approaches. [14,23,26]

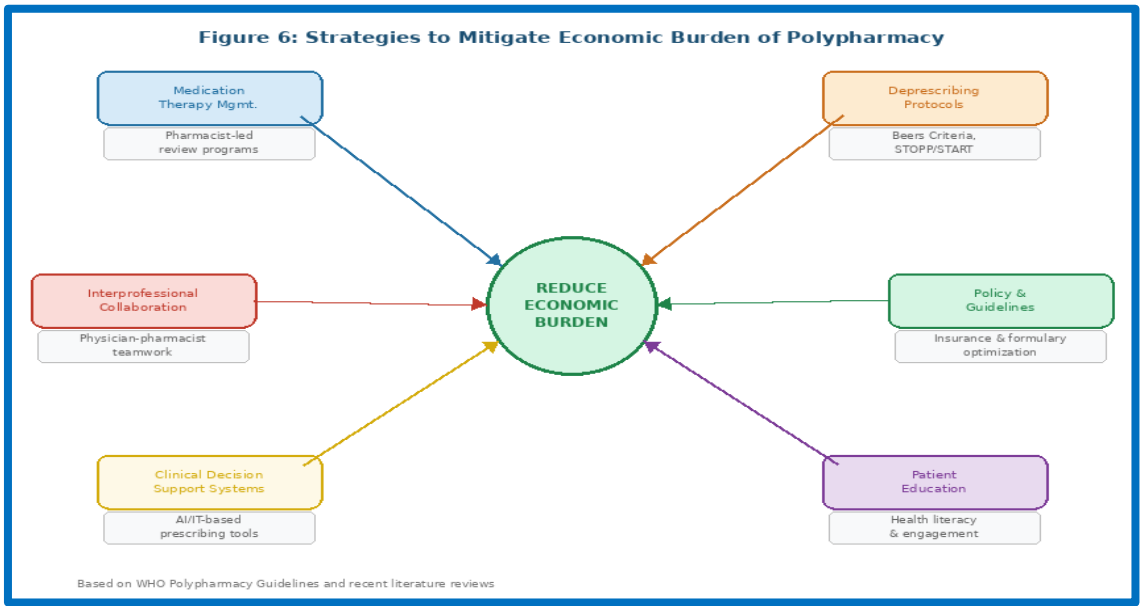

Figure 6: Framework of Strategies to Mitigate Economic Burden of Polypharmacy

7. GLOBAL PERSPECTIVES AND HEALTH POLICY IMPLICATIONS

The economic burden of polypharmacy is not confined to any single healthcare system but represents a global challenge that varies in magnitude across different economic and healthcare contexts. [1,2] In developed nations with extensive pharmaceutical coverage, such as the United States, European countries, and Australia, the direct costs of polypharmacy are amplified by higher drug prices and greater overall healthcare utilization. [3,4] In developing countries, while medication costs may be lower in absolute terms, the economic burden relative to household income can be disproportionately devastating, particularly for older adults without adequate insurance or social safety nets. [5,27] The World Health Organization has recognized polypharmacy as a key patient safety issue, publishing a comprehensive technical report on medication safety in polypharmacy that calls for systematic approaches to reduce inappropriate medication use. [17] Health policy implications include the need for insurance and formulary optimization, incentive structures that reward quality prescribing over volume, integration of pharmacists into primary care teams, and investment in clinical decision support infrastructure. [10,17] India, where a cross-sectional study in Odisha revealed significant economic burden from multimorbidity and polypharmacy among geriatric patients, [5] exemplifies the challenges faced by rapidly aging populations in low- and middle-income countries. South Korea's experience, with extremely high polypharmacy prevalence and demonstrable healthcare cost differentials, [7] has prompted national policy attention to geriatric pharmaceutical care. These examples underscore the universal relevance of polypharmacy management as a health economic priority. [2,17]

8. DISCUSSION:

This review demonstrates that polypharmacy imposes a substantial, multidimensional economic burden on geriatric patients and healthcare systems globally. [3,4,5,7] The evidence is consistent across study designs, geographic settings, and healthcare systems: the use of five or more concurrent medications in older adults is associated with significantly increased healthcare expenditure, ranging from a near doubling of total costs to a tripling of pharmacy-specific expenditure. [3] Several important themes emerge from the synthesized evidence. First, the economic burden of polypharmacy is not limited to direct medication costs but encompasses a broad spectrum of downstream expenditures including hospitalization for adverse drug reactions, emergency department utilization, extended outpatient care, and institutional placement. [3,7,9,15] Second, the indirect costs, while more difficult to quantify, are substantial and include caregiver burden, lost productivity, reduced quality of life, and accelerated functional decline. [4,5,10,26] Third, evidence-based interventions, particularly pharmacist-led medication reviews and structured deprescribing

protocols, have demonstrated potential to reduce both clinical and economic harm, though the evidence base for long-term outcomes remains limited. [10,11,16]

Several limitations of the current evidence should be acknowledged. Many studies rely on cross-sectional designs, which limit causal inference. [3,5] Economic evaluations often omit key cost elements, particularly intervention costs and the patient perspective. [10] Definitions of polypharmacy vary across studies, complicating direct comparisons. [18] Furthermore, randomized trials of deprescribing interventions have generally reported limited evidence for impact on distal clinical outcomes such as mortality and hospitalizations, though they consistently demonstrate safety and efficacy in reducing medication burden. [16,21] Future research should prioritize large-scale, longitudinal economic evaluations that incorporate comprehensive cost accounting, including patient-borne costs and quality-of-life metrics. [4,10] Pragmatic clinical trials evaluating deprescribing interventions in real-world settings are needed to bridge the gap between controlled trial evidence and clinical practice. [16,21] The integration of health economic outcomes as primary endpoints in polypharmacy intervention studies would substantially strengthen the evidence base for policy recommendations. [10,17]

9. CONCLUSION:

Polypharmacy represents one of the most significant yet modifiable contributors to the economic burden of healthcare among geriatric populations. [3,4] With nearly 40% of elderly individuals worldwide exposed to polypharmacy, and rates exceeding 59% among frail elderly, [1,2] the financial implications are vast and growing. The evidence reviewed herein demonstrates that polypharmacy nearly doubles total healthcare expenditure and triples pharmacy costs, [3] while mismanaged polypharmacy costs the healthcare system billions of dollars annually in avoidable complications. [9] Addressing this burden requires a multifaceted approach encompassing evidence-based deprescribing protocols, [6] pharmacist-led medication therapy management, [9,11] clinical decision support tools, [12] interprofessional collaboration, [14,23] patient education, [26] and supportive health policy. [17] The challenge lies not in the availability of effective interventions but in their systematic implementation at scale across diverse healthcare settings. [10,16] Investing in polypharmacy management is not merely a clinical imperative but an economic one, with the potential to simultaneously improve patient outcomes, enhance quality of life, and reduce healthcare expenditure in our rapidly aging global population. [17,28]

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