



Polypharmacy in the Elderly: The Need for Concern and Strategies for Its Control

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Authors' contributions

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ABSTRACT

In the last three decades, problems related to aging, multi-morbidity, and polypharmacy have become a prominent issue in global healthcare. In this study, Polypharmacy is defined as a concomitant use of five or more drugs simultaneously and/or the administration of more medications than are clinically indicated, representing unnecessary drug use. The purpose of this study was to describe and quantify the magnitude of polypharmacy, analyze the factors associated with this practice among elderly and suggest control measures for its reduction. Other objectives include creating awareness about the risks of multiple drug use in ageing population and propose practical recommendations/interventions regarding rational drug use for elderly age groups. Materials for this study were obtained from a search of the MEDLINE database and International Pharmaceutical Abstracts to identify articles in people aged 60 years and above. A combination of the search terms like polypharmacy, multiple medications, polymedicine, elderly, geriatric, and aged were used. This study found out that polypharmacy is a common problem and a known risk factor for important morbidity and mortality in the elderly. Many medications are associated with negative health outcomes, but more research is needed to delineate the consequences associated with unnecessary drug use in elderly patients. Health care professionals should be aware of the

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risks associated with polypharmacy and fully evaluate all medications at each patient visit in order to prevent polypharmacy from occurring.

Keywords: Polypharmacy; elderly; strategies; concern; control.

1. INTRODUCTION

The definition of health as proposed by the World Health Organization as status of complete physical, mental and social wellbeing and not merely the absence of illness or infirmity may not be adequate for describing health for the elderly [1]. An elderly individual is considered healthy when he/she is functionally capable, socially integrated and able to manage his/her own life in an independent fashion. In Nigeria, the segment of the population aged 60 years or older totaled 6,987,047 in 2006 and is expected to reach 15 million by 2025 [2]. The increase in life expectancy leads to an increase in the number of individuals with non-communicable chronic diseases (NCCDs), which require continuous care. Medications play an important role in this scenario, as a large percentage of elderly individuals use medications on a regular basis [3-5]. The treatment protocol for various NCCDs involves the combination of several medications and the combined prescriptions of an elderly individual with one or more NCCDs are likely to be classified as polypharmacy, which is the concomitant use of five or more medications [6,7]. More than 40% of individuals aged 65 years or older take five or more medications per week and 12% take ten different agents [7]. Elderly individuals take a disproportional number of prescription medicines; approximately one third purchase medications from more than one drugstore and half receive prescriptions from more than one prescriber [8]. Adverse drug events can compromise the functional capacity of elderly individuals exposed to polypharmacy and also constitute excess cost to the healthcare system [9]. Thus, medications can contribute to preserving functional capacity, but can also compromise it. Therefore, the risk-benefit of medications prescribed to elderly individuals must be evaluated adequately.

As elderly takes more medications, the risk for error increases. Also, as the body ages, it processes medications differently. Shepler and colleagues [10] describe the four processes most affected by medication use in aging bodies: medications remain in the system longer than they should because absorption rates are slower; medications are highly concentrated in discrete

parts of the body because of poor circulation; the liver shrinks and there is decreased cardiac output, which affects metabolism; and, finally, decreased renal function affects how the drug is excreted. Another concern for the elderly population is adverse drug reactions. The combination of age, multiple medications, and adverse drug reactions is cause for concern.

Poly pharmacy is on the increase. There are several explanations for this rise. Asymptomatic people are increasingly treated with preventive interventions to reduce their future risk of mortality and disease. This is seen particularly with cardiovascular disease and medicines to reduce stroke and acute myocardial infarction events. Many elderly have several comorbidities. If each one of these morbidities is treated according to national guidelines, patients may end up taking a complicated cocktail of drugs. Proportionally, the elderly use more drugs compared to other age groups. For many patients polypharmacy might be entirely appropriate. There are many conditions in which the combined use of two, three or more drugs is beneficial and can improve outcomes especially in older people with multiple co-morbidities (for example, type 2 diabetes complicated by coronary heart disease and hypertension). However, it is important to consider whether each drug has been prescribed appropriately or inappropriately, both individually and in the context of all the drugs being prescribed.

Under-prescribing in older people has also gained recognition as a concern. Paradoxically in some cases, drugs that are recommended for some conditions are actually not prescribed by doctors because of fears of causing polypharmacy-related problems in the patient. There can be a reluctance to prescribe additional drugs to patients with polypharmacy due to a perceived complexity of drug regimens, fear of adverse drug reactions, and concerns about drug-drug interactions or poor adherence. There are a multitude of definitions of polypharmacy in the literature. Many papers classify taking 5 or more drugs as polypharmacy [11]. There aren't just the side effects from the single medications or the adverse reactions of taking multiple medications, but also the stress of simply having

and needing multiple medications. Polypharmacy has been shown to be a strong predictor of "hospitalization, nursing home placement, death, hypoglycemia, fractures, impaired mobility, pneumonia and malnutrition" [12]. Over-the-counter availability of formerly prescribed drugs can lead to polypharmacy as individuals' self-treat [12].

The general objective of this study is to provide information on the need for the concern and strategies for the control of polypharmacy in the elderly, while the specific objectives are: 1. To define and describe the various types of polypharmacy in the elderly. 2. To quantify the magnitude of polypharmacy in the elderly. 3. To describe the risk factors and effects of polypharmacy in the elderly. 4. To create awareness about the risks of multiple drug use in the elderly. 5. To suggest/propose practical recommendations/interventions regarding control of poly pharmacy and rational drug use among the elderly.

2. LITERATURE REVEIEW

2.1 Pharmacokinetic and Pharmacodynamics Changes in the Elderly

Altered pharmacokinetics and pharmacodynamics in older clients are major factors to consider when discussing polypharmacy. Responses to medications differ with advancing age. The action system of drugs in an aged body is summarized as follows:

1. Drugs remain in the system for a long time due to low absorption rates,
2. Drugs become highly concentrated in different parts of the body due to impairment in the circulation system,
3. The metabolism changes due to the changes in liver and cardiac outputs,
4. Decreased renal functions affect drug excretion.

The pharmacokinetics of an orally administered drug refers to the rate at which it is absorbed, distributed, metabolized, and eliminated from the body. Aging has little effect on the absorption of most drugs, although there may be a change in the rate of absorption in older persons taking many medications. Absorption of many fluoroquinolones, for example, can be impaired if taken concomitantly with iron. Unlike absorption, drug distribution changes with age because of associated changes in body composition namely, an increase in fat stores and a decrease in total

body water. As such, drugs that are water soluble (or hydrophilic) such as ethanol or lithium have a lower volume of distribution, whereas fat-soluble drugs (or lipophilic drugs) such as diazepam and trazadone have a larger volume of distribution. Practically speaking, this means that in an older population, hydrophilic drugs reach steady state quicker and are eliminated more expeditiously compared with lipophilic medications that require more time to reach steady state and are eliminated at a slower rate. Moreover, drugs that are highly protein bound, such as digoxin, often have a higher proportion of unbound, pharmacologically active drug in older persons because of decreases in albumin that can occur in association with many of the chronic conditions prevalent in an older population. Ultimately, the changes in pharmacodynamics and pharmacokinetics support the adage of "start low and go slow." It is prudent to initiate drugs at a low dosage and to titrate slowly to achieve the desired therapeutic benefit. For some medications (eg, lithium, digoxin, and some anticonvulsants), dosages for the older adult will remain low and still prove effective because of the aforementioned changes in pharmacokinetics and pharmacodynamics, whereas for other medications (eg, angiotensin-converting enzyme inhibitors and some serotonin selective reuptake inhibitor antidepressants), slow titration to doses typically used in a younger population may be more appropriate.

2.2 Describing and Defining Polypharmacy

Polypharmacy is defined as the concomitant intake of five or more medications by patient simultaneously [13-15], or the use of clinically inappropriate medications [16] by the same patient. Topical and herbal medications are generally excluded of this definition as they are often not included in the traditional methods of assessing prescription quality. Vitamins and minerals taken on as-needed basis are also generally excluded in these assessments because of the inconsistent inclusion of these medications in polypharmacy. Polypharmacy, however, is more complex than just the number of drugs that a patient takes. Clinically, the criteria utilized for identifying polypharmacy involve the following:

- Taking medications that have no apparent indication
- Using therapeutic equivalents to treat the same illness

- Concurrent usage of interacting medications
- Using an inappropriate dosage
- Utilizing other medications to treat adverse drug reactions

2.3 Types of Polypharmacy

Polypharmacy can be categorized into 2 major classes [17].

2.3.1 Therapeutic polypharmacy

This type occurs when multiple drug regimens are carefully monitored by clinicians and are necessary for the treatment of conditions and for achieving a therapeutic goal. An example of therapeutic polypharmacy is the combination therapy of isoniazid, rifampin, ethambutol, pyrazinamide, and pyridoxine in the initial treatment of tuberculosis [18]. Another example of therapeutic polypharmacy is the multiple agents used in the management of congestive heart failure, such as digoxin, angiotensin-converting enzyme inhibitors, and a diuretic.

2.3.2 Contra-therapeutic polypharmacy

This type of polypharmacy occurs when an individual experiences unanticipated or unintentional adverse effects while he or she is on a drug regimen and is not monitored [18]. Therapeutic polypharmacy involves medications that are necessary for achieving an effective treatment and are prescribed by clinicians after a careful monitoring. Contra-therapeutic polypharmacy, on the other hand, involves use of long-term and often high-dose multiple agents, which cannot be monitored, which lead to undesired or unexpected side effects during drug intake, and depends on personal or professional preferences [19].

2.4 Why Elderly Patients Take So Many Medications

Several factors contribute to polypharmacy among patients over age 65. Compared to the general population, a patient over 65 is more likely to have several chronic disorders, each requiring at least one medication [20,21]. Elderly patients with more than one health condition are likely to receive care from several healthcare providers, each of whom may prescribe a different medication to treat the same symptoms [45]. Another factor in the equation is what's called the prescribing cascade: An elderly patient develops side effects from a medication he's

taking; however, his healthcare provider interprets the symptoms not as side effects of the drug but as symptoms of a disease. The healthcare provider then prescribes yet another drug, creating the potential for even more side effects [22,23].

2.5 Prevalence of Polypharmacy

Previous studies reported prevalence of polypharmacy as between 4% [49] and 34% [24] among people aged 65 years and above. Passarelli et al. [25] reported an average of between 9.9 and 13.6 drugs use in inpatients while the number of medications used in outpatient treatment was lower, ranging from 1.3 to 2.3 drug/patient [26]. A Brazilian study of 45 elderly found polypharmacy in 33.3%. In one of the few prospective studies on polypharmacy, Veehof et al. [27] followed up 1,544 elders for three years, and identified a 42% incidence rate of polypharmacy.

A number of studies investigated determinants of prescribed polypharmacy and reported relevant socio-demographic factors (age, gender, education, employment and socio-economic status) [28,29] influence of disease (multimorbidity, multiple complaints, well-being and chronic illness) [30,31] and health system factors (prescriber related, perceived patient pressure and free access to medications) [32,33]. These studies employed either limited numbers of health determinants or looked at overall health as an abstract concept when predicting polypharmacy. A 32% prevalence of polypharmacy was found for cardiovascular medications in another prospective study involving hospitalized or bedridden elderly patients [34]. As a predictor of polypharmacy, Loyola et al. [35] reported an association between the number of medical consultations and use of prescribed medications. Self-medication rate was lower among those who attended periodical medical consultations and high self-medication rates may be associated to lack of medical care. In contrast to studies conducted in developed countries, lower use of prescribed medications was found among elderly patients with lower socioeconomic condition was seen [36].

2.6 Aetiology (Predictors) and Risk Factors

The etiology of polypharmacy is multi-factorial. Chronic diseases and age-related changes in

organs are the primary reasons for multiple drug use in the elderly. Drug intake as personal preference and use of over-the-counter drugs can be cited as another factor. Approximately 75% of patients consulting a doctor are given prescriptions [28]. Since it is sometimes more difficult to provide training than to write a prescription, physicians choose the short-cut. Advertisements by pharmaceutical companies and television programs with insufficient educational content also encourage the elderly to use inappropriate drugs.

Reported risk factors involved in polypharmacy are [28,29].

1. Patients' going to different physicians and getting many prescriptions
2. Ease of getting non-prescription drugs
3. Physicians' inclination towards prescribing many medicines,
4. Patients' expectations for many different drugs,
5. Use of various medicines due to additional diseases,
6. Herbal preparations and over-the-counter medications,
7. Use of drugs without any knowledge of their side effects and interactions,
8. Consulting various physicians and receiving various prescriptions.
9. Inadequate communication and coordination,
10. Replacing medication due to drug side effects (prescription cascade),
11. Prescribing medication based on symptoms rather than diagnosis,
12. Tendency to quit the medication and start with a new one,
13. Automatic prescription of drugs that are known to the patient and the physician,
14. Presence of too many medications in the market,
15. Forgetfulness of the doctor to ask and of the patient to tell about the medication,
16. Tendency to use medications obtained from acquaintances.

Having been hospitalized in the last 6 months, being female, being in depression, low level of education, and consulting 5 or more physicians a year have also been reported to increase the risk of polypharmacy [30,31]. Polypharmacy was also found to be associated with advanced age, white race, education, poor health condition, use of >9 medicines, number of healthcare visits, additional insurance, and number of caregivers [32].

Veehof et al. [27], on the other hand, reported that the predictors of polypharmacy were age, cardiovascular diseases, diabetes mellitus, stomach disorders, use of drugs without full indication, and the number of medications at the start of the study [33]. It was also reported to be associated with depression, hypertension, asthma, anemia, angina, diverticulosis, osteoarthritis, gout, and diabetes mellitus [30,34]. Patients with cancer are also at risk today in terms of polypharmacy [35]. A study showed that 92% of cancer patients used an average of 5 medications before starting cancer treatment. Supportive and complementary therapies are also commonly used by cancer patients in general (25-91%) and this is usually overlooked in studies. Not only in studies but also in clinical practice, neither the patient tells about these to the doctor, nor does the doctor ask about them. In general, problems are also experienced in relation to the follow-up of the primary treatment [35].

2.7 Inappropriate Drug Prescription

In a medication appropriate index, indication, efficacy, dose, directions, drug-drug interaction, and drug-disease interaction must definitely be considered [36]. Polypharmacy and higher age were the main risk factors for potentially inappropriate drug use in the elderly [37]. The most commonly used tools for prescriptions for advanced ages are: the Inappropriate Prescribing in the Elderly Tool (IPET), the Beers Criteria, the Medication Appropriateness Index (MAI), the Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP), and the Screening Tool to alert Doctors to the Right Treatment (START) [38]. Among these, the most commonly used criteria in clinics seem to be the Beers Criteria. It aims to provide guidelines to the users about inappropriate drug names and their potential side effects. It makes distinctions such as "always inappropriate" and "potentially inappropriate". Medications are also rated according to high or low number of adverse events associated with them. The Beers Criteria was developed in 1991 and modified in 1997, in 2003 and 2012 [39-41]. Medications are also rated according to high or low number of adverse events associated with them. However, there are some points of doubt about the Beers Criteria. Some of these medications are not contraindicated; the criteria do not take into account polypharmacy, drug interactions, treatment period or different indications. Furthermore, some medications that cause

frequent visits to the emergency service or have frequent side effects (warfarin, insulin, digoxin etc.) are not included in the list [42]. Check lists may be helpful in detecting for discontinuing medication in elderly. The STOPP and START criteria that were developed to be used in Europe are viewed as being more comprehensive [38,39]. The STOPP criteria attempt to classify 65 potentially inappropriate drugs according to the systems and define them in terms of drug-drug, drug-disease, falls, and therapeutic duplications. STOPP criteria identified a significantly higher proportion of patients requiring hospitalization due to potentially inappropriate medication related adverse events than Beers' criteria. Inappropriate medications in elderly adults can lead to confusion, falls, cognitive impairment, poor health status, and mortality [40-44].

2.8 Adverse Drug Reactions

Adverse drug reactions (ADRs) may be defined as any response that is noxious and unintended and that occurs at doses normally used in man for diagnosis, prophylaxis or therapy, and excluding a failure to accomplish the intended purpose [45]. ADRs in older people are a common cause of admission to a Hospital and are an important cause of morbidity and death [46-48]. The incidence of ADRs in Europe was around twice that in the USA, exceeding 20% [49]. Whether advancing age is a cause of increased risk of ADRs is debatable, but the specific physiological changes associated with aging certainly play a critical role in ADRs. ADRs can be classified into 2 main types: type A or type B [50]. Type A refers to the ADRs that are expected from the pharmacological properties of a drug, such as hypotension when taking

enalapril, or heart block from beta-blocker therapy. These adverse effects often occur in patient who are unusually sensitive to the known pharmacological properties of the drug. They are largely dose-dependent and uncommon in normal doses. More than 80% of ADRs causing hospital admission or occurring in hospitals are type A in nature [51,52]. Antibiotics, anticoagulants, digoxin, diuretics, hypoglycemic agents, antineoplastic agents and non-steroidal anti-inflammatory drugs (NSAIDs) are responsible for 60% of ADRs leading to hospital admission, and 70% of ADRs occurring in hospital [49,53,54]. Most of these medications have a low therapeutic index and are more likely to be used in the elderly. Type B reactions are the unexpected responses that are not related to the drug's pharmacological effect. They are often immunologically mediated, such as anaphylactic reactions to penicillin or malignant hyperpyrexia when inhaling halothane. This type of ADRs is much less common than type A reactions, and are generally more serious in nature [54]. Apart from type A and B, type C and D reactions have also been described [51,52]. Type C refers to the adverse effects associated with long-term therapy, such as analgesic nephropathy; whereas type D is the delayed side effects, such as carcinogenicity or teratogenesis [51]. ADRs in the elderly are potentially preventable because majority of ADRs are type A and are dose-related. Several strategies have been recommended to minimize ADRs in the elderly (Table 1). It is important to note it is the integration of all these strategies that is likely to reduce the incidence of ADRs in the elderly, because so far there is no single solution for the problem. A good practice in prescribing medications is highlighted in Table 2.

Table 1. Strategies in preventing ADRs in the elderly

Better application of pharmacokinetic principles
Better instructions to patients
Physician education
More accurate and visible recording of adverse effect history
Enhancement of clinical and laboratory monitoring
Timely referral of patients to other community agencies after hospital discharge

Table 2. Good practice in drug prescription in the elderly

Accurate diagnosis of underlying disease and adequate clinical assessment of patients
Treat only the disorders that need to be treated
Keep drug regimens simple
Start with low dosage and increase slowly over time (often in weeks)
Keep the number of drugs to a minimum

Table 2 continued.....

Always consider drug-drug and food-drug interaction
Use newly marketed drugs with caution
Provide patients with clear instructions, both verbal and in writing
Regular medication reviews of patients and their medication their medications at clinics.
Regular medication review by qualified health professionals (e. g physicians, pharmacists or registered nurses) at patients' homes or aged care facilities

3. METHODOLOGY

A thorough literature search was conducted using PubMed and Google Scholar to select articles from 1999 till 2014 using key words like polypharmacy, geriatric patients, elderly care, Beer's criteria, inappropriate prescribing and adverse drug events. Key phrases like antihypertensive and "oral hypoglycaemic drugs as well as elderly" were also used to search articles for specific drugs. A literature search from Africa was also done through the Index Medicus. Thousands of citations were found during the initial literature search from which 125 most relevant articles were reviewed in detail. From African regional search, only a handful of articles were available. Some older articles which were historically relevant to polypharmacy and inappropriate prescribing were included in this review. Evidence-based non-drug interventions, and other interventions to minimise inappropriate prescribing were reviewed and included as well.

The MEDLINE database and International Pharmaceutical Abstracts (2007) were searched to identify articles on polypharmacy in the elderly. A combination of the following search terms was used: *polypharmacy, multiple medications, polymedicine, elderly, geriatric, and aged*. A manual search of the reference lists from identified articles and the authors' article files, book chapters, and recent reviews to identify additional articles was also conducted. Articles were included only if they were: (1) in English; (2) involved those aged >65 years; (3) not a review; or (4) observational or randomized trials that either quantified the multiple use of medicines and their consequences or described interventions to reduce or control polypharmacy.

4. FINDINGS AND DISCUSSION

From findings in this study, it is evident that more research in this area is needed. European countries appear to conduct more research regarding polypharmacy in the older population, while the focus in the United States appears to be inappropriate prescribing. For example, out of 12 studies that were conducted in the United

States, 2 addressed polypharmacy and 10 addressed inappropriate pre- scribing. In European studies, information regarding prescription drug use and utilization of health care is recorded in a computerized research register.

Clients may have several diagnoses and comorbidities (e.g., diabetes, hypertension), necessitating the use of multiple medications; therefore, a definition of polypharmacy dependent upon the number of medications may be inappropriate. A definition focusing on whether the medication is clinically indicated may be more appropriate. Nonprescription medications were included in some of the studies reviewed. Potential medication interactions and duplications can occur between prescription and nonprescription medications. In future studies, detailing the use of nonprescription medication is necessary when examining polypharmacy. Another consideration is that non-prescription medications are more common in European countries. Medications that are available by prescription only in the United States are available without a prescription in European countries; therefore, including nonprescription medications in polypharmacy research is important. Several gaps in the literature are noted. There is a lack of research related to the methods used when assessing polypharmacy; this indicates additional research and education are necessary to provide care for the older population. Based upon the non-empirical articles reviewed, multiple methods exist to assess polypharmacy in older individuals (e.g., utilizing the SAIL, TIDE, brown bag approach, or Beers' criteria for reviewing medications). The research articles found addressed the brown bag approach, chart review, home visits, and the utilization of computerized medication databases to assess polypharmacy. Using Beers' criteria to determine inappropriate medication prescribing is useful. The SAIL and TIDE criteria for reviewing medications may be useful, but limited research is available reporting the efficiency of each technique. Research related to the interventions utilize to decrease the incidence of medications that are not indicated was not addressed. There

is serious dearth of literature concerning polypharmacy in the elderly in Africa. Study on polypharmacy in Nigeria is still at infancy.

Regardless of the definition, the high prevalence of polypharmacy with aging may lead to an increased risk of inappropriate drug use, under-use of effective treatments, medication errors, poor adherence, drug–drug and drug–disease interactions and, most importantly, adverse drug reactions [55,56]. The latter are usually related to the established fact that elderly people are often frail and highly sensitive to pharmacotherapy, because of changes in pharmacokinetic and pharmacodynamic parameters [57,58]. Polypharmacy is an important risk factor for inappropriate medication prescribing [56,59], which is very frequent among elderly people [60]. Certain drugs are considered inappropriate or potentially inappropriate in older patients not only because of the higher risk of intolerance related to adverse pharmacokinetics or pharmacodynamics or drug–disease interactions but also because they are prescribed at too high dosages or for too long [61]. A European study involving 900 consecutive elderly patients admitted to university teaching hospitals in six countries found that potentially inappropriate prescribing ranged from 22 to 77%, depending on the criteria used [62]. However, an understated aspect of inappropriate prescribing in elderly people is also the omission of medications known to be effective in patients with an adequate life expectancy and good quality of life, because of lack of knowledge and fear of adverse drug reactions, in addition to other irrational reasons [63,64].

5. CONTROL STRATEGIES AND CLINICAL CORRELATES

1. Pharmacists should evaluate the aspects concerning the use of adequate medications; reduction of medication doses without affecting treatment efficiency; adjustment of doses beyond the drug safety margin; and correct use of the medication by elderly patients.
2. Avoid the use of inappropriate drugs.
3. The golden rules of prescribing must always be followed and these are:
 - *Think carefully before prescribing*
 - *Prescribe with maximum knowledge about your patient and the drugs*
 - *Monitor patient for efficacy and side effects*
4. Avoid conflicting information given by many different health professionals.
5. Practice safe prescription which is defined as the process that recommends an adequate medication for a given patient in ideal conditions, providing a balance between therapeutical activity and adverse effect. In this context, the balanced prescription considers the physiological changes of the elderly and the adverse effects of the drugs aiming at an adequate dose which should be possible with the individualization of the therapy.
6. Obtain a thorough medication history. This is very important before any new medication is prescribed. Both prescription and nonprescription medications need to be taken into account and should be brought with the patient to all health care provider visits. Once the prescriber has a complete medication history, he or she can then decide whether the addition of another medication is clinically indicated and if the benefits outweigh the risk of use.
7. Encourage non-pharmacologic therapy, such as diet modification or exercise. This may be appropriate instead of medication in some cases. If a medication is determined to be clinically necessary, the drug's pharmacokinetic, pharmacodynamics, and adverse-event profile, along with the patient's renal and hepatic function, must be taken into account for proper dosing.
8. Limit the prescribing of as-needed drugs.
9. Setting sensible therapeutic goals and assessing medication regimens periodically are also very important to ensure that polypharmacy is under control and does not lead to unnecessary medical problems.
10. Simplify the patient's regimen as much as possible by, for example, prescribing a single agent rather than multiple drugs to treat a condition or choosing a drug that can be given once or twice, rather than three times a day. Always write the purpose of the drug on the order.

11. Review the patient's medical record and eliminate duplicate medications—those prescribed by different healthcare providers for the same problem—and drugs with no therapeutic benefit or clinical indication. Substitute safer medications whenever possible.
12. Avoid treating an adverse reaction caused by one drug with a second drug; if possible, discontinue the drug that's causing the problem or reduce the dosage. Starting doses are often lower in the elderly and may be administered differently than in younger patients to prevent toxicity from occurring. Other concomitant disease states and medications should be evaluated to prevent any drug-disease or drug-drug interactions from occurring.
13. Educate both patients and their families verbally and in writing about their medications. This helps to improve adherence. Considering generic options, utilizing compliance aids (eg, pillboxes, medication calendars).
14. Trainings should be provided for patients, their families and healthcare professionals on drug management for older adult
15. Appropriate follow-ups should be carried out.

All these strategies allow the elderly to live a mentally and physically healthy and harmonic life, resulting in the reduction in medication use especially anti-depressive agents and sedatives.

6. CONCLUSION AND RECOMMENDATIONS

Pharmacotherapy mishaps among elderly patients are a major healthcare issue and a problem for all healthcare practitioners treating elderly patients. Physicians, nurses, pharmacists, nurse practitioners, physicians' assistants, and patients' families and caregivers are responsible for improving the care provided to elderly patients. The health personnel need to receive training with regard to their responsibilities towards the older persons. More effort is needed to decrease the use of drugs without control/prescription among older persons. Polypharmacy is common among the elderly. Many studies have found that various numbers of medications are associated with negative health outcomes, but more research is needed to further delineate the consequences associated with unnecessary drug use. Health care professionals should be aware of the risks and fully evaluate all

medications at each patient visit to prevent polypharmacy from occurring.

Network systems specific to the elderly should be encouraged. This makes easier to trace medication lists. Provision of product information (e.g., drug interactions) in hard-copies by companies, on-line access to patient information, alerts through special programs when inappropriate drugs are prescribed. Use of non-pharmacological treatment methods should be encouraged. A different dose and treatment calendar should be planned than those for younger age groups.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ramos LR. Fatores determinantes do envelhecimento saudável em idosos residentes em centro urbano: Projeto Epidoso, São Paulo. *Cad Saúde Pública* 2003;19:793-8.
2. United Nations. *The world ageing situation: Strategies and policies*. New York; 1985.
3. Coelho Filho JM, Marcopito LF, Castelo A. Medication use patterns among elderly people in urban area in Northeastern Brazil. *Rev Saude Publica*. 2004;38: 557-64.
4. Qato DM, Alexander GC, Conti RM, Johnson M, Schumm P, Lindau ST. Use of prescription and over-the-counter medications and dietary supplements among older adults in the United States. *JAMA*. 2008;300:2867-78.
5. Ribeiro AQ, Rozenfeld S, Klein CH, César CC, Acúrcio Fde A. Survey on medicine use by elderly retirees in Belo Horizonte, Southeastern Brazil. *Rev Saúde Pública*. 2008;42:724-32.
6. Flores LM, Mengue SS. Uso de medicamentos por idosos em região do sul do Brasil. *Rev Saúde Pública*. 2005;39: 924-9.

7. Kaufman DW, Kelly JP, Rosenberg L, Anderson TE, Michell AA. Recent patterns of medication use in the ambulatory adult population of the United States. *JAMA*. 2002;287:337-44.
8. Safran DG, Neuman P, Schoen C, Kitchman MS, Wilson IB, Cooper B, et al. Prescription drug coverage and seniors: findings from a 2003 national survey. *Health Aff (Millwood), Suppl Web Exclusives: W5-152-W5-166*; 2005.
9. Rozenfeld S, Fonseca MJM, Acurcio FA. Drug utilization and polypharmacy among the elderly: A survey in Rio de Janeiro City, Brazil. *Pan Am J Public Health*. 2008;23:34-43.
10. Shepler SA, Grogan TA, Pater KS. Keep your older patients out of medication trouble. *Nursing*. 2006;36(9):44-7. (PMID: 16951619).
11. Planton J, Edlund B. Strategies for reducing polypharmacy in older adults. *Journal of Gerontological Nursing*. 2010;36(1):8-12.
12. Frazier S. Health outcomes and polypharmacy in elderly individuals: an integrated literature review. *Journal of Gerontological Nursing*. 2005;31(9):4-11.
13. Brager R, Sloand E. The spectrum of polypharmacy. *Nurse Pract*. 2005;30:44-50.
14. Viktil KK, Blix SH, Moger AT, Reikvam A. Polypharmacy as commonly defined is an indicator of limited value in the assessment of drug-related problems. *Brit. Jou. Clin Pharmacol*. 2007;63(2):187-195.
15. Hilmer SN. The dilemma of polypharmacy; 2008. Retrieved 16/08/2014. Available:<http://www.australianprescriber.com/magazine/31/1/2/3.l.v>
16. Aparasu R, Mort J, Brandt H. Polypharmacy trends in office visits by the elderly in The United States, 1990 and 2000. *Research in Social and Administrative Pharmacy*. 2005;1:446-459.
17. Simon SR, Chan KA, et al. Potentially inappropriate medication use by elderly persons in U.S. health maintenance organizations, 2000 – 2001. *J Am Geriatr Soc*. 2005;53(2):227.
18. Lim WK, Woodward MC. Improving medication outcomes in older people. *Aust J Hosp Pharm*. 1999;29(2):103.
19. Fulton MM, Allen ER. Polypharmacy in the elderly: A literature review. *J Am Acad Nurse Pract*. 2005;17(4):123-32. (PMID: 15819637).
20. Corcoran ME. Polypharmacy in the older patient with cancer; 1997. Available:www.moffitt.usf.edu/pubs/ccj/v4n5/article5.html Retrieved 10th July 2014.
21. Lin P. Drug interactions: A method to the madness. *Perspectives in Cardiology*. 2004;20(10):20.
22. Fulton MM, Allen ER. Polypharmacy in the elderly: A literature review. *J Am Acad Nurse Pract*. 2005;17(4):123.
23. Beers MH, (Ed.). *The Merck manual of geriatrics (3rd ed.)*, Section 1, Basics of geriatric care. Chapter 6, Clinical pharmacology; 2005. Available:www.merck.com/mrkshared/mm/g/sec1/ch6/ch6a.jsp 4th August 2014.
24. Barat I, Andreassen F, Damsgaard E. The consumption of drugs by 75-year-old individuals living in their own homes. *Eur J Clin Pharmacol*. 2000;56:501–509.
25. Passarelli MC, Jacob-Filho W, Figueras A. Adverse drug reactions in an elderly hospitalised population: Inappropriate prescription is a leading cause. *Drugs Aging*. 2005;22(9):767-77.
26. Coelho Filho JM, Marcopito LF, Castelo A. Perfil de utilização de medicamentos por idosos em área urbana do Nordeste do Brasil. *Rev Saude Publica*. 2004;38(4):557-64.
27. Veehof LJG, Stewart RE, Haaijer-Ruskamp FM, Jong BM. The development of polypharmacy. A Longitudinal study. *Fam Pract*. 2000;17(3):261-7.
28. Odubanjo E, Bennett K, Feely J. Influence of socioeconomic status on the quality of prescribing in the elderly-a population based study. *Br J Clin Pharmacol*. 2004;58:496–502.
29. Perry B, Turner L. A prediction model for polypharmacy: Are older, educated women more susceptible to an adverse drug event? *J Women Aging*. 2001;13:39–51.
30. Linjakumpu T, Hartikainen S, Klaukka T, Veijola J, Kivela S, Isoaho R. Use of medications and polypharmacy are increasing among the elderly. *J Clin Epidemiol*. 2002;55:809–817.
31. Al-Windi A. Determinants of medicine use in a Swedish primary health care practice population. *Pharmacoepidemiol Drug Saf*. 2005;14:47–51.
32. Little P, Dorward M, Warner G, Stephens K, Senior J, Moore M. Importance of patient pressure and perceived pressure and perceived medical need for investigations, referral, and prescribing in

- primary care: Nested observational study. *Br Med J*. 2004;328:444–447.
33. Perkins A, Kroenke K, Unutzer J, et al. Common co-morbidity scales were similar in their ability to predict health care costs and mortality. *J Clin Epidemiol*. 2004;57:1040–1048.
 34. Blanski CRK, Lenardt MH. A compreensão da terapêutica medicamentosa pelo idoso. *Rev Gaucha Enferm*. 2005;26(2):180-8.
 35. Loyola Filho AI, Uchoa E, Firmo JOA, Lima-Costa MF. Estudo de base populacional sobre o consumo de medicamentos entre idosos: Projeto Bambuí. *Cad Saude Publica*. 2005;21(2):545-53.
 36. Lees J, Chan A. Polypharmacy in elderly patients with cancer: Clinical implications and management. *Lancet Oncol*. 2011;12(13):1249-57. (PMID: 21741307).
 37. Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. *Arch Intern Med*. 2003;163(22):2716-24. (PMID: 14662625).
 38. van der Hooft CS, Jong GW, Dieleman JP, et al. Inappropriate drug prescribing in older adults: The updated 2002 Beers criteria—a population-based cohort study. *Br J Clin Pharmacol*. 2005;60(2):137-44. (PMID: 16042666).
 39. Bao Y, Shao H, Bishop TF, Schackman BR, Bruce ML. Inappropriate medication in a national sample of US elderly patients receiving home health care. *J Gen Intern Med*. 2012;27(3):304-10. (PMID: 21975822).
 40. Fick DM, Mion LC, Beers MH et al. Health outcomes associated with potentially inappropriate medication use in older adults. *Res Nurs Health*. 2008;31:42–51.
 41. Hanlon JT, Schmadre KE, Samsa GP et al. A method for assessing drug therapy appropriateness. *J Clin Epidemiol*. 1992;45:1045–1051.
 42. Lau DT, Kasper JD, Potter DE et al. Hospitalization and death associated with potentially inappropriate medication prescriptions among elderly nursing home residents. *Arch Intern Med*. 2005;165:68–74.
 43. Wright RM, Roumani YF, Boudreau R, et al. Effect of central nervous system medication use on decline in cognition in community-dwelling older adults: Findings from the health, aging and body composition study. *J Am Geriatr Soc*. 2009;57:243–250.
 44. Fu AZ, Liu GG, Christensen DB. Inappropriate medication use and health outcomes in the elderly. *J Am Geriatr Soc*. 2004;52:1934–1939.
 45. Karch FE, Lasagna L. Adverse drug reactions: A critical review. *JAMA*. 1975;234:1236-41.
 46. Manness CK, Derkx FH, de Ridder MA, et al. Adverse drug reactions in elderly patients as contributing factor for hospital admission: Cross sectional study. *Br Med J*. 1997;315:1057-58
 47. Manness CK, Derkx FH, de Ridder MA, et al. Contribution of adverse drug reactions to hospital admission of older patients. *Age Ageing*. 2000;29:35-39.
 48. Lazarou J, Pomeroy BH, Corey PN. Incidence of adverse drug reactions in hospitalized patients: A meta-analysis of prospective studies. *JAMA*. 1998;279:1200-205
 49. Wiffen P, Gill M, Edwards J, et al. Adverse drug reactions in hospital patients. *Bandolier Extra*. 2002;1-15.
 50. Rawlins MD. Adverse drug reactions. *BMJ*. 1981;282:974-76.
 51. Rawlins MD, Thompson JP. Pathogenesis of adverse drug reactions. In *textbook of adverse drug reactions*, ed Davies DM. Oxford: Oxford University Press. 1977;44.
 52. Park BK, Coleman JW. The immunological basis of adverse drug reactions: A report on a symposium held in Liverpool on 6th April. *Br J Clinical Pharmacol*. 1988;26:491-95.
 53. Suh DC, Woodall BS, Shin SK, et al. Clinical and economic impact of adverse drug reactions in hospitalized patients. *Ann Pharmacother*. 2000;34:1373-79.
 54. Bowman L, Cadstcdt BC, Hancock EF, et al. Adverse drug reaction (ADR) occurrence and evaluation in the elderly inpatients. *Pharmacoepidmiol Drug Saf*. 1996;5:9-18.
 55. Steinman MA, Landefeld CS, Rosenthal GE, Berthenthal D, Sen S, Kaboli PJ. Polypharmacy and prescribing quality in older people. *J Am Geriatr Soc*. 2006;54(10):1516–23.
 56. Hilmer SN, Gnjdic D. The effects of polypharmacy in older adults. *Clin Pharmacol Ther*. 2009;85(1):86–98.
 57. Kuijpers MA, Van Marum RJ, Egberts AC, Jansen PA. Relationship between

- polypharmacy and under-prescribing. Br J Clin Pharmacol. 2008;65(1):130–3.
58. Simonson W, Feinberg JL. Medication-related problems in the elderly. Defining the issues and identifying solutions. Drug Aging. 2005;22(7):559–69.
59. Beer C, Hyde Z, Almeida OP, Norman P, Hankey GJ, Yeap BB, et al. Quality use of medicines and health outcomes among a cohort of community dwelling older men: An observation study. Br J Clin Pharmacol. 2011;71(4):592–9.
60. Linjakumpu T, Hartikainen S, Klaukka T, Veijola J, Kivela SL, Isoaho R. Use of medications and polypharmacy are increasing among the elderly. J Clin Epidemiol. 2002;55(8):809–17.
61. Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, et al. Appropriate prescribing in elderly people: How well can it be measured and optimised? Lancet. 2007;370(9582):173–84.
62. Gallagher G, Lang PO, Cherubini A, Topinková E, Cruz-Jentoft A, Errasquín BM, et al. Prevalence of potentially inappropriate prescribing in an acutely ill population of older patients admitted to six European hospitals. Eur J Clin Pharmacol. 2011;67(11):1175–88.
63. Lapi F, Pozzi C, Mazzaglia G, Ungar A, Fumagalli S, Marchionni N, et al. Epidemiology of suboptimal prescribing in older, communitydwellers: A two wave, population-based survey in Dicomano, Italy. Drugs Aging. 2009;26(12):1029–38.
64. Onder G, Landi F, Liperoti R, Fialova D, Gambassi G, Bernabei R. Impact of inappropriate drug use among hospitalized older adults. Eur J Clin Pharmacol. 2005; 61(5–6):1453–9.

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