

Original Article

A descriptive observational study on ‘medication-related injurious fall’ amongst elderly patients admitted to a tertiary care teaching hospital

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ABSTRACT

Introduction: There is a scarcity of information on the impact of fall-risk-increasing drugs (FRIDs) amongst the elderly in the Indian population. Accidental falls and associated injuries in the elderly population contribute to substantial morbidity, mortality and rising healthcare expenditures.

Objectives: There is a scarcity of information on the impact of Fall-risk-increasing drugs (FRIDs) amongst the elderly in the Indian population. Accidental falls and associated injuries in the elderly population contribute to substantial morbidity, mortality and rising health care expenditures. The study was carried out with the aim to evaluate the pharmacotherapeutic aspects of injurious falls in elderly patients and also identifies probable risk factors for falls.

Materials and Methods: A descriptive observational study for a 1-year duration included >65 years of patients, admitted to a tertiary care hospital, with major injuries (fractures and head injuries) due to a fall. The clinical and demographic details, including the consumption of FRIDs, comorbidities, cognitive function and fall-related injuries, were recorded. The literature was reviewed to compile a list of FRIDs, which encompassed cardiovascular medications, psychotropic drugs and other categories such as non-steroidal anti-inflammatory drugs (NSAIDs), opioids and antiepileptics.

Results: Amongst the study participants, the mean age was 74.9 ± 7.0 years, with 74.1% females. The femur fractures were 86 (76.78%), the most common consequence of the fall. The probable causes of falls were hypotension (45.5%), diminished vision (37.5%), cognitive impairment (17.0%) and sedation (11.6%). The most common FRIDs consumed were antihypertensives (calcium channel blockers – 28.6% and angiotensin-converting enzyme-I – 15.2%), the other FRIDs received before falls were NSAIDs (8.9%), benzodiazepines (6, 5.4%), antidepressants (17%) and antidiabetic drugs (8.0%). The FRIDs per patient were 0.79 ± 1.02 , with at least one FRID consumed by 42% of patients.

Conclusion: Femur fracture was the consequence of falls in 76% of elderly people over the age of 70 years. In significant numbers, the consumption of at least 1 FRID was reported. Antihypertensives, analgesics and benzodiazepines were the most common FRID classes, with the probable cause of orthostatic hypotension and drowsiness. The study emphasises the need for a careful pharmacotherapeutic review of the elderly prone to injurious falls.

Keywords: Elderly, Fall-risk-increasing drugs, Risk factors

INTRODUCTION

Elderly individuals are an essential part of our society, and the ageing process presents both opportunities and challenges. According to the ‘Elderly in India 2021’ report by the Ministry

of Statistics and Programme Implementation, India had approximately 138 million senior citizens aged 60 and above in 2021, representing 10.1% of the total population. Falls are a leading cause of injury amongst the elderly. About 28–35% of the elderly experience falls annually; for those over 70, this rises to 32–42%.^[1] The World Health Organisation (2016) reports that falls constitute the second most prevalent cause of accidental or unintentional mortality on a global scale.^[2] The consequences of falls include physical consequences such as fractures and prolonged immobility, social consequences such as financial costs and loss of independence and psychological consequences such as frustration and fear.^[3,4]

The majority of falls in the elderly have a multifactorial origin. The Institute for Healthcare Improvement broadly categorises the risk factors for recurrent falls into two main groups: Intrinsic and extrinsic. Intrinsic factors include reduced flexibility, unsteady gait, impaired postural control, visual and hearing impairments and coexisting chronic conditions such as cardiovascular disease, diabetes mellitus and osteoporosis. In addition, cognitive and emotional decline, behavioural changes linked to a sedentary lifestyle, contribute significantly. Extrinsic factors are mainly related to environmental hazards, particularly within the home setting, such as slippery floors, uneven surfaces and door thresholds that can precipitate falls.

Notably, medications are considered modifiable risk factors that can increase the likelihood of falls and related injuries. While some risk factors remain beyond an individual's control, many are preventable or manageable with appropriate interventions. Polypharmacy, often arising from multiple comorbidities, significantly increases the risk of medication-related falls, especially when the patient's daily regimen includes one or more drugs known to elevate fall risk.^[5] There are many prescribing guidance tools available to assess drug-related fall risk, some of which include fall-risk-increasing drugs (FRIDs) prescribing guidelines, the Beers list, STOPP/START criteria, etc.^[6]

Despite awareness of the potential risks, the prescription of FRIDs remains widespread. Various interventions have been shown to decrease the risk and the rate of falls. Providing education to physicians on fall risks and implementing modifications in clinical practices can help mitigate the occurrence of serious fall-related injuries. A Dutch prospective cohort study involving 139 geriatric outpatients revealed that the complete cessation or, at a minimum, a reduction in the dosage of FRIDs appears to be the most effective intervention for fall prevention. Other strategies to address preventable medication errors include using digital technologies, e.g. computerised systems for drug dosing guidance, along with alerts to detect drug treatment duplication, contraindications and drug interaction errors, which have been proposed to enable better decision-making

when prescribing for the elderly.^[7] There is a scarcity of comprehensive studies elucidating the ramifications of FRIDs on the Indian populace. Against this background, this study was planned to assess the profile of regular medications consumed by older (≥ 65 years) persons at the time of fall-related admission and to identify the probable drug as a risk factor for that fall episode.

MATERIALS AND METHODS

This descriptive observational study was conducted over one calendar year at the trauma centre of a tertiary care hospital in Western India. The study received approval from the Institutional Ethics Committee (Approval No. 354/MC/EC/2023, dated 12 April 2023) and adhered to the ethical principles outlined in the Declaration of Helsinki.

Study population

The study included older adults aged ≥ 65 years who were admitted to the trauma centre due to a fall. Patients admitted for other reasons, such as road traffic accidents or non-fall-related injuries, were excluded. Written informed consent was obtained from all participants before enrolment.

Data collection

Data were collected using a combination of hospital medical records and direct interviews with patients and their attendants. The following variables were recorded: Demographic details – age, sex, education, income and self-reported general health; medical history – existing comorbidities and physical function; fall-related information – description of the fall event and its probable causes; medication history – names, dosages and duration of all regular medications; clinical data at admission – vital parameters (e.g. blood pressure and heart rate) and relevant laboratory investigations

Operational definitions

Regular medication was defined as a drug taken for at least 30 consecutive days.

Polypharmacy was defined as the concurrent use of five or more regular medications.

Cognitive function was assessed using the mini-mental state examination (MMSE). The MMSE evaluates cognitive functions across five domains, with scores ≤ 23 indicating cognitive impairment

The sample size calculation

The sample size was calculated, a total of 112 elderly patients who presented with a fall at 95% confidence and 4% absolute

error, ensuring sufficient power to verify a minimum 4.7% use of antipsychotics during falls.^[8]

Statistical analysis

The investigator entered the data into Microsoft Excel sheets on the same day to minimise potential data entry bias. For descriptive analysis, mean and standard deviation (SD) were used to summarise quantitative/continuous data and qualitative discrete data were summarised using frequencies/proportions. Data were analysed using Microsoft Office 365.

RESULTS

Among the 112 studied older persons with injurious falls, the mean age was 74.9 ± 7.0 years, and 74.1% were females. The study found that 30.3% of elderly patients were using an assistive device for walking, and 31.6% reported a history of previous falls within a year before the present episode. The most common comorbidity found was hypertension (35.7%), followed by coronary artery disease (14.3%). In contrast, 37.5% of persons were devoid of any comorbid condition. Vision and hearing impairment were found in 34.8% and 26.8%, respectively. Cognitive impairment was found amongst 17% of study participants according to the MMSE.

The injurious consequences of the falls were fracture of the femur (76.78%), fracture of the humerus (6.3%), radius (4.5%), ulna (4.5%) and fracture of the metacarpals (0.92%). A few cases of head injury (5.34%), wounds requiring stitches (13.39%) and fracture of the clavicle, ribs and pneumothorax (6.25%) were also reported in the study. At the time of the fall, the mean (\pm SD) number of routinely prescribed medications was recorded as 1.41 ± 1.74 .

Polypharmacy was found in 17.1% of patients, and the mean number of FRIDs was 0.79 ± 1.02 in our study. Amongst the persons with injurious falls, 6.3% received 3 or more FRIDs, 42.9% received 1–2 FRIDs, and 50.89% received no FRIDs [Table 1].

In our study, the most widely used FRIDs in patients of falls were calcium channel blockers (32, 28.6%), pharmacological agents targeting the renin-angiotensin system (17, 15.2%), diuretics (9, 8%) and beta-blockers (9.8%). Apart from antihypertensive medications, the other most common FRIDs received before falls were non-steroidal anti-inflammatory drugs (NSAIDs) (8.9%), benzodiazepines (6, 5.4%), antidepressants (17%) and antidiabetic drugs (8.0%). The FRID amongst antidiabetic drugs (9, 8%) were mainly insulin or sulfonylurea [Figure 1].

Based on the history received from the patients/attendants and hospital records at the time of admission, the probable causes of falls amongst the study participants were orthostatic hypotension (51, 45.5%), impaired cognition

Table 1: Characteristics of Study Participants

Variable	Patients presented with Falls % (number)
Age (Mean \pm SD*)	74.9 \pm 7.0 years
Gender	
Male	25.9%
Female	74.1%
Live with someone	75% (84)
Education (College or more)	20.7%
Income (Sufficient for daily living)	80%
Fall in previous year	31.6% (35)
Use of assistance device	30.3% (34)
Comorbidities	
Hypertension	35.7%
Vision impairment	34.8%
Hearing impairment	18.8%
Coronary Arterial Disease	14.3%
Bilateral Knee Pain	12.5%
Type 2 Diabetes Mellitus	9.8%
Bronchial asthma	4.5%
Cognitive impairment (**MMSE <23)	17%
Without any co-morbidity	37.5%
Injurious consequences of the fall	
Fracture femur	76.8% (86)
Fracture of lower limb bones	15.2% (17)
Wound requiring stitches	13.39% (15)
Fracture wrist	8.92% (10)
Fracture upper arm	6.25% (7)
Head injury	5.34% (6)
Others	6.25% (7)
Regular Medications	
Mean \pm SD	1.41 \pm 1.74
0	33.8%
1-4	49.10%
>5	17.10%
Number of Fall Risk Increasing Drugs (FRIDs)	
Mean \pm SD	0.79 \pm 1.02
0	50.90%
1-2	42.9%
>3	6.3%
*SD- Standard Deviation	
**MMSE- Mini-Mental State Examination	

(19, 17%), drowsiness (13, 11.6%) and hypoglycaemia (11, 9.8%) [Figure 2].

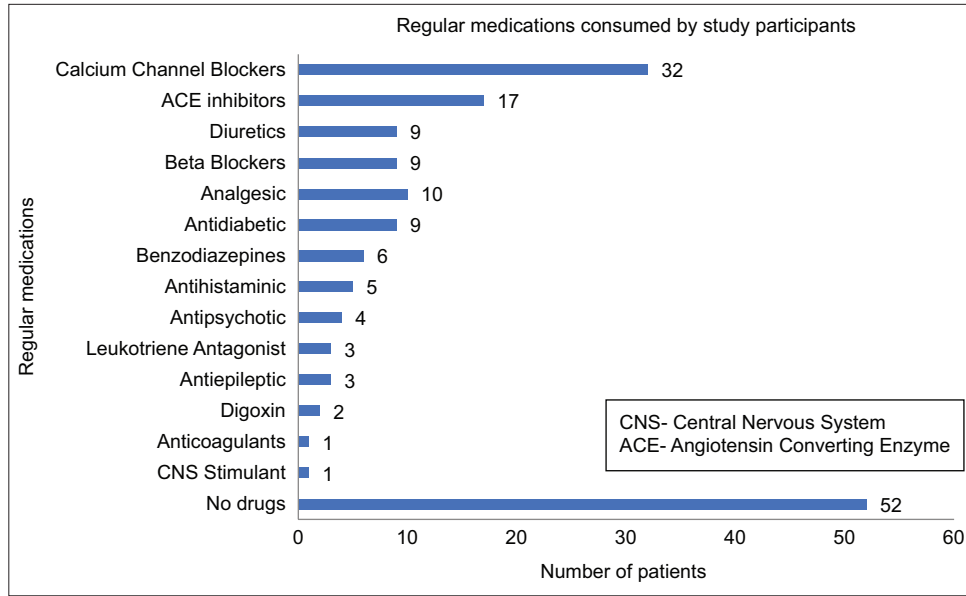


Figure 1: Regular medications consumed by the study participants.

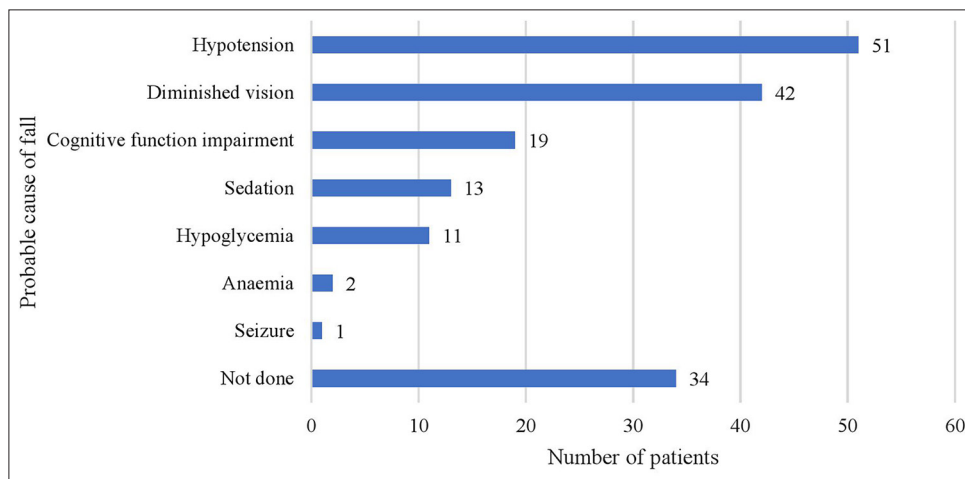


Figure 2: Probable cause of fall amongst the study participants.

DISCUSSION

With the global population ageing rapidly, falls amongst older adults have become a significant public health issue. Falls represent a major cause of injury and subsequent disabilities, impacting daily functional activities and diminishing quality of life.

In our study, the mean age of the participants was 74.9 ± 7.0 years. The mean age of participants was 87.4 ± 5.7 years in a study done by Milos *et al.*^[8] and 83.2 ± 7.2 years in a study done by Morin *et al.*^[9] In our study, the gender distribution included 83 females (74.1%) and 29 males (25.9%); most of the studies also found female predominance. The results indicate that women aged 70 and above are more prone to experiencing falls than men, primarily due to the hormonal

changes that occur post-menopause. In our study, the most frequently observed injury was a femur fracture, affecting 86 patients (76.8%), followed by fractures of the elbow and forearm, and head injury. Similarly, Beunza-Sola *et al.*^[10] reported hip fractures as the most common injury (63%), followed by ankle fractures (7.1%) and pelvic fractures (5.9%). Morin *et al.*^[9] found that the most prevalent severe injuries were those involving the hip and thigh (28.7%, including 15.5% hip fractures). In our study, the most common comorbidity was hypertension (35.7%), and others were 14.3% coronary artery disease, 9.8% diabetes, 26.8% diminished hearing and 34.8% diminished vision. Interestingly, 37.5% of participants in our study had no existing health conditions. Consistent with our findings, Sharma *et al.*^[11] found that 56.3% of fallers had hypertension, 18.3% had diabetes, and

12.7% had a history of stroke. Hypertension was observed in 55.3% and diabetes in 56.8% of individuals in a study done by Sharif *et al.*^[7] Apart from chronic respiratory disorders, anaemia, vertigo or balancing disorders and dementia.

In our study, the assessment of consumption of FRIDs revealed that 42.9% were on 1–2 FRIDs, 6.3% were on >3 FRIDs, and 50.9% were not taking any FRIDs. The mean (\pm SD) number of FRIDs consumed per patient was 0.79 ± 1.02 . Polypharmacy was found in 17.1% of participants, with the mean number of regular medications being 2.61 ± 1.63 . These figures are much lower than the study results reported by Beunza-Sola *et al.*,^[10] which found that over 90% of patients of accidental falls admitted after a bone fracture were taking at least 1 FRID (mean 3.1 ± 1.9 FRIDs/patient with a mean of 7.2 ± 3.6 regular drugs) and De Andrés *et al.*^[12] where 96% received at least one FRID (3.4 ± 1.8 FRIDs/patient). These high percentages might reflect specific prescribing habits (e.g. some countries prescribe more central nervous system-active or cardiovascular medications), healthcare policies and systems (e.g. drug reimbursement and guidelines vary by locale), and population characteristics (e.g. age distribution, multimorbidity rates or polypharmacy levels differ geographically).

In our study, the most widely used FRIDs in patients of falls were calcium channel blockers (28.6%), drugs acting on the renin-angiotensin system (15.2%), diuretics (8%) and beta-blockers (8%). Beunza-Sola *et al.*^[10] and two other studies done by Butt *et al.*^[13] and Solomon *et al.*^[4] also reported quite similar results while Sharif *et al.*^[7] found the prevalence of these drug usage much higher (diuretics 65.4% and beta-blockers 61.8%). These categories of medications are commonly prescribed for hypertension and may exacerbate the risk of falls by increasing susceptibility to orthostatic hypotension. The study suggests that adjusting anti-hypertensive medications may reduce syncope and falls. Apart from antihypertensive medications, the other most common FRIDs received before falls in our study participants were NSAIDs (8.9%), benzodiazepines (5.4%), antidepressants (17%) and antidiabetic drugs (8.0%). These findings align with those reported in previous studies on FRIDs. A study by Sharif *et al.*^[7] found that the prescription of several of the medications classified as FRIDs was hypnotics, sedatives (71.4%), NSAIDs (63%), antidepressants (72.7%) and antipsychotics (66.7%). Similarly, in a study by De Andrés *et al.*^[12] 80% of patients received a psychotropic drug (mainly benzodiazepines [15.2%] or quetiapine) before the fall. Psychotropic medications can elevate fall risk through side effects such as drowsiness, dizziness and slow reaction time. The use of beta-blockers and insulin may significantly contribute to the risk of falls in the elderly due to postural hypotension and hypoglycaemic effects.

An effective fall injury prevention approach^[15] involving medication includes the following key steps:

Detailed clinical and drug history

A thorough assessment should begin with collecting a comprehensive medical and drug history to identify risk factors and medications that may contribute to falls.

Accurate diagnosis and individualised treatment goals

Establishing a clear diagnosis helps define the therapeutic objectives. Pharmacologic therapy should begin with the lowest effective dose, followed by slow titration as needed.

Rational prescribing and minimising polypharmacy

Only essential and evidence-based medications should be prescribed. Unnecessary or duplicate medications must be avoided to reduce the risk of adverse drug reactions (ADRs) and interactions.

Simplification of drug regimen

Regimens should be simplified using appropriate dosage forms, fixed-dose combinations and scheduling medications to improve adherence.

High index of suspicion for ADRs

Clinicians should maintain vigilance for potential ADRs and drug interactions, especially in elderly patients who may present with atypical symptoms.

Discouraging over-the-counter (OTC) medication use

Patients and caregivers should be advised against unsupervised use of OTC medications, which may contain agents that increase fall risk.

Patient and caregiver counselling

Proper education on the risks of certain medications, expected side effects and the importance of adherence to the prescribed regimen is essential.

Regular monitoring and regimen modification

Medication regimens should be reviewed periodically and adjusted based on the patient's clinical condition, laboratory values and response to therapy. For regimen modification, certain FRIDs – including antidepressants, benzodiazepines and cardiovascular agents – necessitate a gradual and closely monitored tapering process to minimise the risk of withdrawal symptoms, ADRs and clinical destabilisation, at the same time fulfilling the same therapeutic objectives without compromising treatment efficacy. When considering benzodiazepine use and fall risks, prevention would be the best management, i.e. avoiding long-term therapy.

Vitamin D supplements and calcium

Combined vitamin D supplementation is the only intervention proven to decrease the rate of falls in long-term care.^[16]

Limitation of the study

The utilisation of FRIDs constitutes merely one of numerous risk factors for falls, and consequently, reducing FRID use forms only a part of a multifaceted and comprehensive strategy to mitigate fall risk. The study has not evaluated the potential influence of FRID–FRID interactions on falls. Another limitation of the study worth noting is that this was a descriptive type of study and did not include a control group. The relatively small sample size and single-centre nature are other limitations. A multi-centre study with a larger sample size is crucial to ensure the broader applicability and generalisability of the results

Strength of the study

There is a paucity of data regarding falls and related drugs in India. This study provides initial evidence on the medications related to falls in elderly patients that may be useful for healthcare professionals in the care of older persons.

CONCLUSION

The world's elderly population is growing dramatically. Pharmacotherapeutic management in geriatric patients presents a significant challenge due to polypharmacy arising from multimorbidity, particularly when multiple FRIDs are prescribed, which is an independent risk factor for falls. Our study results show that more than 76% of femur fractures occur as a result of falls, with most of these fractures occurring in persons over 70 years of age. Consumption of at least 1 FRID was reported by 42% of the participants. Antihypertensives, analgesics and benzodiazepines were the most commonly prescribed FRID classes, with the probable cause of orthostatic hypotension and drowsiness. Polypharmacy in the form of a regular number of medications >5 was in 17.5% of the study population. As per the analysis of MMSE scoring, patients with cognitive impairment were fewer in comparison to other studies. A significant number of patients were found with diminished hearing and vision. Interventions to reduce falls in the elderly include frequently reviewing all FRIDs for their continued appropriate use. Nevertheless, the reduction of FRIDs constitutes a single element within a broader, multifactorial strategy designed to mitigate fall risk in the elderly.

Ethical approval: The research/study was approved by the Institutional Review Board at SMS Medical College, Jaipur, approval number 354/MC/EC/2023, dated 12th April 2023.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

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Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Rural India Online. Elderly in India. Available from: <https://ruralindiaonline.org/hi/library/resource/elderly-in-india-2021> [Last accessed on 2024 Dec 19].
2. Blake AJ, Morgan K, Bendall MJ, Dallosso H, Ebrahim SB, Arie TH, *et al.* Falls by elderly people at home: Prevalence and associated factors. *Age Ageing* 1988;17:365-72.
3. Oliver D, Healey F, Haines TP. Preventing falls and fall-related injuries in hospitals. *Clin Geriatr Med* 2010;26:645-92.
4. WHO Global report on falls prevention in older age. Available from: <https://iris.who.int/handle/10665/43811> [Last accessed on 2024 Dec 19].
5. De Jong MR, Van der Elst M, Hartholt KA. Drug-related falls in older patients: Implicated drugs, consequences, and possible prevention strategies. *Ther Adv Drug Saf* 2013;4:147-54.
6. Seppala LJ, Petrovic M, Ryg J, Bahat G, Topinkova E, Szczerbińska K, *et al.* STOPPFall (screening tool of older persons prescriptions in older adults with high fall risk): A Delphi study by the EuGMS task and finish group on fall-risk-increasing drugs. *Age Ageing* 2020;50:1189-99.
7. Sharif SI, Harbi AB, Shihabi AM, Daour DS, Sharif RS. Falls in the elderly: Assessment of prevalence and risk factors. *Pharm Pract (Granada)* 2018;16:1206.
8. Milos V, Bondesson Å, Magnusson M, Jakobsson U, Westerlund T, Midlöv P. Fall risk-increasing drugs and falls: A cross-sectional study among elderly patients in primary care. *BMC Geriatr* 2014;14:40.
9. Morin L, Larrañaga AC, Welmer AK, Rizzuto D, Wastesson JW, Johnell K. Polypharmacy and injurious falls in older adults: A nationwide nested case-control study. *Clin Epidemiol* 2019;11:483-93.
10. Beunza-Sola M, Hidalgo-Ovejero AM, Martí-Ayerdi J, Sánchez-Hernández JG, Menéndez-García M, García-Mata S. Study of fall risk-increasing drugs in elderly patients before and after a bone fracture. *Postgrad Med J* 2018;94:76-80.
11. Sharma PK, Bunker CH, Singh T, Ganguly E, Reddy PS, Newman AB, *et al.* Burden and correlates of falls among rural elders of South India: Mobility and independent living in elders study. *Curr Gerontol Geriatr Res* 2017;2017:1290936.
12. De Andrés A, Romano E, García-Salmónes M, Pérez LM, Inzitari M. 4CPS-216 Prescription of fall-risk-increasing drugs in patients suffering a fall with major lesions during admission at an intermediate care center. *Eur J Hosp Pharm* 2019;26:A170.
13. Butt DA, Mamdani M, Austin PC, Tu K, Gomes T, Glazier RH. The risk of hip fracture after initiating antihypertensive drugs in the elderly. *Arch Intern Med* 2012;172:1739-44.
14. Solomon DH, Mogun H, Garneau K, Fischer MA. Risk of fractures in older adults using antihypertensive medications. *J Bone Miner Res* 2011;26:1561-7.

15. Guideline for the Prevention of falls in older persons. American geriatrics society, British geriatrics society, and American academy of orthopaedic surgeons panel on falls prevention. J Am Geriatr Soc 2001;49:664-72.
16. Kalyani RR, Stein B, Valiyil R, Manno R, Maynard JW, Crews DC. Vitamin D treatment for the prevention of falls

in older adults: Systematic review and meta-analysis. J Am Geriatr Soc 2010;58:1299-310.

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