

Analysis of Potentially Inappropriate Medication Use in 372 Old Adult Inpatients

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Research article

Keywords: The old adults, Potentially inappropriate medication, Rational drug use

Posted Date: January 15th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-146098/v1>

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Abstract

Background: In 2017, China published the "Criteria for Potentially Inappropriate Medications use for the old adults in China". There is no medical institution in Huainan that has conducted investigations on PIMs for the old adults until now. The survey investigated the PIMs for the old adults in our hospital, and also tested the applicability and practicability of the 72 drugs included in the "Criteria for Potentially Inappropriate Medications use for the old adults in China".

Methods: According to the Criteria for Potentially Inappropriate Medications use for the old adults in China (2017 Edition), a retrospective analysis of the medications in 372 old adult inpatients aged 65 years and above was performed to evaluate the occurrence of their PIMs use.

Results: The average age of the 372 inpatients was (74.67±6.95) years old, the average Inpatient days was (11.96±8.5) days, and the average number of illnesses per person was (4.92±2.55). Of 372 inpatients, 62.63% (233) inpatients had PIMs in the China-PIM list for the old adults , and 17.20% (64) inpatients had PIMs related to their diseases.

Conclusion: The proportion of PIMs among old adult inpatients in our hospital is relatively high. The hospital should pay attention to it and actively take measures to reduce the risk of PIMs for the old adults and ensure rational drug use in clinical medicine.

Background

Potentially inappropriate medications(PIMs) refer to that the potential adverse risks of using certain drugs which belong to the high-risk drug class [1] may exceed the predicted benefits. As old adults suffer from multiple diseases at the same time, they need to take a variety of drugs. There are potential risks in the interaction both between drugs and between drugs and the body. The use of scientific criteria to evaluate the PIMs in old adults patients can prevent adverse drug events(ADEs), and guide rational drug use in clinical medicine. In 1991, American geriatric expert Beers and others first published the PIM criteria for the old adults mainly for outpatients and long-term care patients, called the Beers Criteria [2], and is currently widely used internationally [3]. China has now entered an aging society. From 2014 to 2016, Xuanwu Hospital of Capital Medical University took the lead to initially develop the Preliminary Judgment Criteria for Potentially Inappropriate Use of Drugs in the Disease State of the old adults in China by referring to the medication data of a large number of old adult patients over 60 years old[4] And the China PIM List for old adults [5], and tested the applicability and practicality of the China PIM List for old adults, and jointly issued the Judgement criteria of PIM for old adults in China in Beijing in 2017. PIMs can increase the risk of adverse drug reactions/events and other risks in the old adults, leading to increased rehospitalization and increased case fatality rate. Therefore, for the drugs listed in the Judgement criteria of PIM for old adults in China, measures should be taken to avoid the drug use, reduce the dose or increase monitoring in the treatment of old adults patients or under certain disease states.

Materials And Methods

Use the HIS of our hospital to retrieve information and medication records of all patients checking into our hospital from June 2019 to June 2020. The inclusion criteria: ☐age ≥ 65 years old; ☐time of hospitalization ≥ 48 h. Exclusion criteria: ☐Age < 65 years; ☐time of hospitalization < 48 h; ☐Those who have been repeatedly hospitalized 2 times or more within a month; ☐No drugs were used during hospitalization; ☐Death during hospitalization; ☐Case data are incomplete. According to the average value of the index assignment of expert evaluation in the Judgement criteria of PIM for old adults in China, the risk intensities of the drugs are classified:

(1) High-risk drugs, the old adults should avoid using them; (2) Low-risk drugs, the old adult should use with caution. Class A warning drugs are recommended for drug adjustment and intervention; the rest are classified as Class B warning drugs. According to the Judgement criteria of PIM for old adults in China, based on the frequency of medication, they are classified into Class A and Class B warning drugs. Class A warning drugs are recommended to clinicians and clinical pharmacists for priority warning.

SPSS 22.0 statistical software was used to process the data. Count data is represented by the number of cases and percentage (%), and dose data is represented by $X \pm s$.

Result

2.1 Basic materials

Of the 372 inpatients, the average age is (74.67 ± 6.95) years old, average inpatient days are (11.96 ± 8.5) days, average number of disease per person is (4.92 ± 2.55) . Within them, the incidence rate of PIM among female patients is higher than that of male patients. The incidence rate of PIM among old adult patients ≥ 80 years old is higher than that of old adult patients aged 65 to 79. The incidence rate of PIM among patients with Inpatient days ≥ 10 is higher than that of the patients with inpatient days of 2–9 days. The incidence rate of PIM among patients with ≥ 4 disease is higher than that of the patients with 1 to 3 diseases. See Table 1 for details.

Table 1
Basic situation of the old adult inpatients

project		cases	PIM cases	PIM Incidence rate (%)
Gender	Male	218	129	59.17
	Female	154	104	67.53
Age(years)	65 ~ 79	280	166	59.29
	≥ 80	92	67	72.83
Inpatient days(days)	2 ~ 9	165	87	52.73
	≥ 10	207	146	70.53
Number of diseases (Cases)	1 ~ 3	118	64	54.24
	≥ 4	254	169	66.54

2.2 Occurrence of PIM

Among them, 233 (62.63%) patients used the drugs in the China-PIM list for the old adults. The top three drugs with higher incidence were spironolactone (15.21%), clopidogrel (11.22%) and insulin (11.22%). Among them, 219 (54.29%) cases used A-level warning drugs, but did not use high-risk-intensity drugs; 182 (45.71%) cases used B-level warning drugs, and 93 (23.19%) cases used drugs of high risk intensity. See Table 2 for details. Among them, 64 (17.20%) patients have 90 PIMs related to the disease state, all of which are A-level warning drugs. The highest incidence took place when taking clopidogrel or non-steroidal anti-inflammatory drugs during coagulation disorders or anticoagulation treatment. See Table 3 for details.

Table 2
Occurrence of PIM among old adult inpatients(n = 401)

Drug name	Drug risks/ Recommendation	Risk level	Incidence rate (case)
Drugs of A-class caution			
Nervous system medication			
Esmolol alprazolam	(1) Nervous system adverse reactions (prolonged sedation time, lethargy); (2) risk of falls	low	5
Nigeria ergot Lin	(1) The curative effect is inaccurate; (2) The risk of medication is greater than the benefit; (3) Orthostatic hypotension; (4) risk of falls	low	17
Psychotropic drugs			
Risperidone	(1) Avoid the treatment of abnormal behavior in patients with dementia, and only apply when non-drug treatment fails or the patient poses a threat to themselves and others; (2) Increase the risk of cerebrovascular accidents and death in patients with dementia	low	1
Olanzapine	(1) Nervous system adverse reactions (prolonged sedation time, cognitive dysfunction); (2) Extravertebral system and anticholinergic adverse reactions (Parkinson's disease, hypotonia); (3) Falls; (4) Increasing the mortality rate of patients with mental illness	low	2
Cardiovascular system medication			
Digoxin(> 0.125 mg/d)	(1) Severe arrhythmia (prolonged QT interval and torsade de pointes arrhythmia)	low	25
Amiodarone	(1) Severe arrhythmia (prolonged QT interval and torsade de pointes arrhythmia)	low	5
Endocrine system medication			
insulin	Risk of hypoglycemia (increase dose carefully)	low	45
Blood system medication			
Warfarin	(1) Individual differences are large, protein binding rate is high, overdose is likely to cause hemorrhage; (2) Old adults take more drugs, and their physiological state changes, possible interactions and risk of adverse reactions caused by single drugs are increased; (3) Routine monitoring of Coagulation index	low	7

Drug name	Drug risks/ Recommendation	Risk level	Incidence rate (case)
Clopidogrel	(1) Hematological adverse reactions (thrombocytopenia, neutropenia, gastrointestinal bleeding, purpura, epistaxis, eye bleeding, hematuria, intracranial hemorrhage); (2) Nervous system adverse reactions (headache, dizziness, confusion of consciousness, hallucinations)	low	45
Urinary system medication			
Spironolactone(> 25 mg/d)	(1) Patients with heart failure have an increased risk of hyperkalemia, especially when the dose > 25 mg/d, combined with non-steroidal drugs, angiotensin converting enzyme inhibitors, angiotensin receptor antagonists or potassium supplements; (2) Avoid use in patients with heart failure or endogenous creatinine clearance < 30 ml/min	low	61
Respiratory system medication			
Theophylline	(1) Cardiac adverse reactions (atrial fibrosis, atrial flutter and tachycardia, etc.); (2) Nervous system adverse reactions (epilepsy, insomnia, irritability); (3) Nausea and diarrhea (dose correlation)	low	6
Class B warning drugs			
Nervous system medication			
Barbiturates (except phenobarbital)	(1) It is easier to cause drug dependence dependence, tolerance and withdrawal reactions than most sedative hypnotics; (2) Nervous system adverse reactions (unconsciousness); (3) Falls and fractures	high	14
Phenobarbital	(1) Nervous system adverse reactions (prolonged sedation, reversal excitability, drowsiness, memory loss, abnormal reactions, agitation); (2) dyskinesia, ataxia; (3) respiratory depression	high	29
Diazepam	(1) Prolonged half-life in old adults; (2) Nervous system adverse reactions (prolonged sedation, lethargy, forgetfulness, ataxia, cognitive dysfunction, agitation, restlessness, hallucinations, confusion, depression); (3) Falls and fractures; (4) hypotension; (5) respiratory depression	high	2
Psychotropic drugs			

Drug name	Drug risks/ Recommendation	Risk level	Incidence rate (case)
Chlorpromazine	(1) Orthostatic hypotension, palpitations or changes in electrocardiogram; (2) Extravertebral system adverse reactions (tremor, stiffness, salivation, bradykinesia, akathisia, acute dystonia), long-term large amounts of medication can cause tardive dyskinesia; (3) secondary drugs	high	1
Antipyretic, analgesic, anti-inflammatory and antirheumatic drugs			
≥Combination of 2 non-steroidal anti-inflammatory drugs	No improvement in therapeutic effect, but increased risk of adverse reactions	high	15
Cardiovascular system medication			
Nifedipine	(1) Increased risk of myocardial infarction or stroke; (2) Hypotension; (3) Constipation	low	13
Anti-infective drugs			
Aminoglycoside antibiotics	(1) Kidney damage; (2) Ototoxicity	low	14
Clindamycin	(1) Allergic reactions (anaphylactic shock, high fever, chills, throat edema, dyspnea); (2) Urinary system adverse reactions (hematuria, acute kidney injury)	low	2
Anti-allergic drugs			
Promethazine	(1) Anticholinergic adverse reactions (dry mouth, blurred vision, gastrointestinal reactions); (2) Nervous system adverse reactions (sedation, lethargy, disturbance of consciousness); (3) Non-anticholinergic antihistamines are preferred for allergic reactions in old adults	low	16
Endocrine system medication			
Megestrol	(1) Increase the risk of thrombosis; (2) Increase the risk of death in old adult patients	low	1

Drug name	Drug risks/ Recommendation	Risk level	Incidence rate (case)
Digestive system medication			
Hyoscyamines	(1) The curative effect is dubious; (2) Strong anticholinergic effect; (3) Avoid use (especially long-term use)	high	15
Belladonna alkaloids	(1) The curative effect is dubious; (2) Strong anticholinergic effect; (3) Avoid use (especially long-term use)	high	16
Cimetidine	(1) Nervous system adverse reactions (disorders of consciousness, delirium); (2) More interactions than other H2-receptor blockers	low	31
Anesthetics and anesthesia auxiliary medication			
Pethidine	(1) Nervous system adverse reactions (unconsciousness, delirium, seizures, sedation); (2) respiratory depression; (3) falls	high	1
Morphine, morphine sustained-release tablets	(1) Excessive use is prone to respiratory depression; (2) Once respiratory depression occurs, the duration is long	low	3
Tramadol	(1) Nervous system adverse reactions (seizures, delirium, dizziness); (2) Vomiting; (3) Constipation	low	9

Table 3
Old adult patients and PIM relating to disease status (n = 90)

Disease or Syndrome	PIMs	Medication risks	use suggestion	Incidence rate(cases)
A-level judgment standard				
cardiovascular system				
hypertension	non-steroidal anti-inflammatory drugs	retention of water and sodium, leading to high blood pressure	Switch to acetaminophen or aspirin and monitoring blood pressure closely	34
Blood coagulation disorder or receiving anticoagulant therapy	Clopidogrel, non-steroidal anti-inflammatory drugs	Increase the risk of bleeding Prolong clotting time or inhibit platelet aggregation, increase the potential risk of bleeding	Use with caution, Adopt non-drug therapy, switch to paracetamol, and combine with gastric mucosal protective agent	39
urinary system				
Renal insufficiency	Non-steroidal anti-inflammatory drugs	retention of water and sodium, aggravating or causing kidney failure	Avoid using	7
Endocrine System				
Osteoporosis	glucocorticoids	Accelerate bone loss	Use with caution	2
diabetes	Glucocorticoids (long-term use)	Exacerbate diabetes	Take inhaled corticosteroids and closely monitor blood sugar	8

Discussion

3.1 Analysis of PIM in old adult inpatients in our hospital

Among the 372 inpatients, 62.63%(233)inpatients used the drugs in China PIM List for old adults. The incidence rate of PIM was slightly higher than the retrospective analysis result (61.15%) of PIM conducted by Liu Yulong et al. [6] on 317 old adults inpatients. In the statistics of the PIM situation of old adult inpatients in our hospital, the barbiturate compound amidobarbital injection was included. This medicine is a compound preparation, and its components are aminopyrine, antipyrine and barbital. ;

Ophthalmic drugs in aminoglycoside antibiotics are not included such as tobramycin dexamethasone ointment and the eye drops.

The incidence rate of PIM among female inpatients in our hospital is higher than that of female inpatients, which may be related to the sample size. The incidence rate of PIM in old adult inpatients ≥ 80 years old is higher than that of old adult inpatients aged from 65 to 79, the incidence rate of PIM in patients with inpatient days ≥ 10 is higher than that inpatients with inpatient days of 2–9, and the incidence rate of PIM in inpatients with diseases ≥ 4 is higher than that of inpatients with 1 ~ 3 diseases, it may be because that old adult inpatients have more complications, more severe illness condition, and different degrees of cognitive impairment [7], and it may also be related to the adverse drug reactions and drug interactions caused by taking a variety of drugs by old adult inpatients^[8-10].

62.63%(233) patients in our hospital used the drugs in the China PIM List for old adults. The top three drugs with high incidence rate are spironolactone (15.21%), clopidogrel (11.22%) and insulin (11.22%). Spironolactone increases the risk of hyperkalemia in patients with heart failure. For old adult patients, blood potassium and electrocardiogram should be closely monitored, and using spironolactone with potassium-containing drugs such as penicillin, non-steroidal anti-inflammatory drugs, angiotensin converting enzyme inhibitor and angiotensin receptor inhibitor should better be avoided in treating old adult patients. When using clopidogrel, attention should be paid to bleeding and hematological abnormalities; If a patient is treated with aspirin, non-steroidal anti-inflammatory drugs, heparin or thrombolytic drugs, clopidogrel should be used with caution, and the patient should be monitored closely. There are many types of insulin in our hospital, including short-acting insulin, intermediate-acting insulin, long-acting insulin and premixed insulin. The appropriate insulin should be selected according to the blood glucose monitoring of the old adults, and the blood glucose of the patient should be closely monitored.

3.2 Personal advice on the China PIM List for old adults

The problem of rational use of drugs for old adult has become increasingly prominent. Now most clinical research and drug treatment guidelines focus on specific diseases, rather than the age or physical condition of special populations. Therefore, it is necessary to develop a list of PIMs for old adult. which provides a certain guarantee for the rational use of drugs. I have some doubts and questions on calculating the PIMs of old adult inpatients in our hospital based on the China PIM List for old adults. ☒In the disease state of peptic ulcer, the use of non-steroidal anti-inflammatory drugs will exacerbate the primary ulcer and cause new ulcers. It is recommended to add the disease state of gastrointestinal bleeding; in the disease state of gout, the use of thiazide diuretics will exacerbate or cause gout, it is recommended to add the disease state of hyperuricemia. ☒It is recommended to add tramadol sustained-release tablets in the anesthetics and anesthetic adjuvants. There are more patients using tramadol sustained-release tablets in our hospital, while fewer patients use tramadol tablets and tramadol injection. ☒In the China PIM List for old adults Chinese patent medicines can be added according to the

national conditions. For example, Xiaoke Pills containing glibenclamide can also cause hypoglycemia in old adult patients; ¶ In the basic state of diabetes, long-term use of glucocorticoids will aggravate diabetes. The specific length of long-term use is recommended to be standardized; ¶ In the case of a history of falls or fractures, the list of PIMs is dexzopiclone and zopiclone can be added. Ezopiclone is the dextrorotatory form of zopiclone, and the risk points of the two drugs are relatively similar.

Conclusion

There are no medical institutions in Huainan that have conducted investigations on PIMs in old adult, and only a few domestic medical institutions have conducted investigations and analysis based on the Judgement criteria of PIM in old adults in China. Thoroughly investigate the situation of PIMs in the old adults in our hospital, and providing suggestions for the next measures the hospital should take to improve the rational use of drugs for old adult patients in our hospital. At the same time, the applicability and practicability of 72 drugs included in the China PIM List for old adults were tested for the actual use of drugs in our hospital.

Abbreviations

PIMs: Potentially Inappropriate Medications; HIS: Hospital Information System;

Declarations

Acknowledgements

Thanks to the pharmacists performing the medication reviews (WANG Xiao-juan, TIAN Jing-jing, ZHU Xi-ling, YUAN Jun, HUANG Qing, ZHANG Hua, FANG Hui-hui, CAO Le-le¹, TANG Bo, CHEN Xu).

We are indebted to WANG Zhen for expertise and valuable advice in editing the manuscript.

Funding

This study is supported by funding provided by the Humanities and Social Sciences Key Project of Bengbu Medical College ¶BYKY2019326skZD¶

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request and subject to appropriate ethics approvals.

Authors' contributions

ZHANG Xian and WANG Xiao-juan conceived and designed the study and obtained the funding. TIAN Jing-jing and ZHU Xi-ling analyzed the data. ZHANG Xian drafted the manuscript. All authors commented

on earlier drafts of the manuscript and read and approved the final manuscript.

Ethics approval and consent to participate

The study was approved by the Medical Ethics Committee of Huainan First People's Hospital. Written informed consent was obtained from all patients.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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