



Identification of Potentially Inappropriate Medication Use in Geriatrics: A Prospective Study

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ABSTRACT

Geriatric individuals often present with higher prevalence of chronic illness, disability and dependency along with coexisting ailments, which requires the concurrent use of three or more drugs. This may sometimes lead to PIM (potentially inappropriate medication) use. The objectives were to identify the prevalence of PIMs use using the Beers Criteria, 2019 in geriatric population and to observe various factors associated with PIM use. This single center, prospective observational study was conducted at the in-patient departments of Gandhi Hospital, Hyderabad for 6 months in older adults aged equal to > 65 years. The research was initiated after approval from the Institutional Ethics Committee, CMR College of Pharmacy, Hyderabad. A descriptive analysis was performed. Results with a p-value lower than 0.05 were considered statistically significant to describe and identify potential predictors of PIMs use. SPSS version 22 was used for data analysis. Out of 134 collected cases, prevalence of PIMs use was reported in 75 cases, 55.97%. As per Beers Criteria, maximum number of PIMs of 75 cases, 64.1% belonged to category 3. PIMs use was observed more with pantoprazole 26 cases, 22.2%. In 88 cases, 65.6% of patients received more than 5 medications leading to polypharmacy. A $p < 0.00001$ showed polypharmacy association with PIMs use. The various disease conditions prevalent among geriatrics which led to PIMs were central nervous system illnesses, being the most typical cause for medical visits (39, 52%) followed by cardiovascular diseases (9, 12%) and respiratory diseases (7, 9.3%). A $p < 0.00001$ demonstrated co-morbidities associated with PIMs use. In order to preserve therapeutic efficacy, it is crucial to identify inappropriate drugs. Hence, it is important for the healthcare professionals to monitor and audit the prescription pattern and polypharmacy which would help in lowering the PIMs.

Keywords: Geriatrics, Beers Criteria, Polypharmacy, Potentially Inappropriate Medication.

INTRODUCTION

The geriatrics population is observed increasing in the world. As per WHO, the geriatrics age is considered 65 years and above. According to current data, 8.5% of the world's population is 65 and above and may increase to 17% by 2050.^[1, 2] Geriatric individuals are a heterogeneous group, which present with higher prevalence of chronic illness, disability and dependency compared to individuals less than 65 years of age. They mostly take many medications together than younger people^[3] as they frequently experience multi-morbidity (which is the coexistence of two or more chronic illnesses)^[4], which lead to polypharmacy. Polypharmacy is defined as prescribing 5 or more drugs together in a single prescription. However, in some cases polypharmacy that is the use of many prescription medications are common and justified due to the requirement in treatment of various chronic illnesses.^[2] Prescription cascade, a cycle of overprescribing to treat interactions or adverse effects, increases polypharmacy. Medications must be prescribed on risk-benefit ratio basis so when many medications are taken their use is justified.^[5] An ADR, drug-drug and drug-disease interaction, are seen to increase the therapy expenses caused due to polypharmacy.^[6] A potentially inappropriate medication (PIM) is when the prescribed medication shows the risk of a negative event out weighing the clinical benefit, especially if a safer or more effective alternative therapy exists for same condition.^[7] Studies have demonstrated inappropriate prescribing to be common in nursing homes, ambulatory setting and emergency wards to due being exposed to inappropriate medication frequently.^[8] PIM use is majorly observed related to females, older age, polypharmacy, having multiple prescribers or physicians and having poor health state which is having many disease conditions.^[9]

Possible factors causing PIMs are: Prescriber related factors, Patient related factors, Environment related factors, and Technology related factors.^[10]

A Geriatrician Mark H. Beers prepared **Beers Criteria** using the Delphi method. The latest Beers Criteria is given by American Geriatrics Society (AGS) in 2019.^[11, 12] The aim of Beers Criteria is to assist health care professionals improving the prescription pattern for geriatrics in reducing the risk associated with poly-pharmacy, drug interactions.^[4] The Beers List identifies drug to be avoided in persons 65 years or older because they are ineffective or pose an unnecessarily high risk or because safer medication alternatives are available.^[8]

The 2019 Beers Criteria as per AGS is categorized as follows:

1) Inappropriate drugs prescribed in geriatrics.

- 2) Inappropriate drugs not to be given in elders with certain conditions.
- 3) Drugs used with caution in elders.
- 4) Drug combinations that can cause harm in elders.
- 5) In renal complication patients, drugs not to be given or given at different doses.^[13]

The PIMs use has been studied in various setting such as out-patient, hospitalized patients and in care home setting. However, considering the feasibility of our study design and study site, this research work was specific to in-patient setting.

Materials and Methods: The study was aimed to assess the relevance of drugs prescribed in geriatric population. The research objectives were to find out the number of PIMs use in geriatric population. To observe various factors causing PIM use. The study was a single center, prospective- observational study done at Gandhi Hospital, Hyderabad during October 2022 to March 2023. The study duration was for 6 months. Selection of patients was based on the inclusion criteria which consisted of in-patient departments of Gandhi Hospital such as General Medicine, General Surgery, Gastroenterology, Gynaecology, Endocrinology and Orthopaedic wards. Patients who were 65 years or older, hospitalized during the study period, in the in-patient departments were considered for the study. Patients below 65 years of age, pregnant women and cancer patients were excluded from the study.

Study was initiated after being approved by the Institutional Ethics Committee, CMR College of Pharmacy, and Hyderabad (CMRCP/IEC/2022-23/05). Patient informed consent form was obtained from patients and permission was sort for publishing the data collected during the study. A sample size of 134 cases was collected.

Study Procedure:

A patient documentation form was prepared to collect demographic information and medications prescribed. The in-patient departments ward rounds were done on a regular basis. The cases collected according to inclusion and exclusion criteria were reviewed periodically for completeness of data. The PIMs in elderly were analyzed using AGS Beers criteria, 2019, to study the medication appropriateness. Various co-morbidities due to PIMs use were assessed. Further, prescriptions were checked for polypharmacy. The confidentiality of data was maintained. The results were interpreted by using descriptive statistics, chi- squared test. The level of statistical significance was set at $p < 0.05$. All data was analyzed using SPSS version 22.

RESULTS:

134 cases meeting the inclusion criteria were collected from the in-patient department of Gandhi hospital. The study shows 62 patients (46.26%) were male and 72 patients (53.73%) were female. The mean age of the total study population was found to be 71.45 ± 6.95 . Maximum cases were of age group between 65-74 years (102, 76.11%), followed by 23 patients (17.16%) of age group 75-84 years and only 9 patients (6.71%) of age 85+ years. It was also observed that maximum cases collected from general medicine ward of 110 cases (82.08%), from general surgery 10 cases (7.46%), 5 cases from endocrinology ward (3.73%), 4 cases from orthopedics ward (2.98%), 3 cases from gynecology ward (2.23%) and 2 cases from gastroenterology (1.49%). The total number of PIMs ranged from 0-4. Patients with 0 PIM were 59 (44.02%) making it the highest. 1 PIM was seen in 43 patients (32.08%), 2 PIMs noticed in 24 patients (17.91%), patients with 3 PIM's were 6 (4.47%) and with 4 and above PIMs were 2 patients making it 1.48%. In this study it was seen that, the patients with PIM comprised of 75 (55.97%) and the patients without PIM were 59 (44.02%).

The study revealed males having 46 (61.3%) PIMs and in females were 29 (38.6%) PIMs. Association of gender with incidence of PIM was evaluated with Chi square test. The test yielded p value > 0.05 thus establishing no significant association between gender and PIM incidence. In the (65-74) years range the number of PIMs were 53 (70.6%), 16 (21.3%) in the age range of (75-84) years and 6 (8%) PIMs in patients more than 85+ years. The chi-square statistic is 2.7327. P value was calculated as 0.255. The result was not significant at $p < 0.05$. Hence the statistic test did not prove any significant association between age group and PIM.

The number of PIMs listed as per Beers Criteria is as follows where Category 3 (75, 64.1%), followed by Category 1 (31, 26.4%); Category 5 were (5, 4.2%), after that Category 2 those having PIMs (4, 3.4%), and in last Category 4 the PIMs (2, 1.7%).

The drugs causing PIMs according to each Beers Criteria Category is further classified as follows:

Category 1: Pantoprazole, Glimepiride, Diclofenac, Digoxin, Amiodarone, Nifedipine, Chlorpheniramine, Dexchlorpheniramine, Lorazepam, Insulin.

Category 2: Tramadol, Ranitidine, Phenytoin

Category 3: Aspirin, Furosemide, Spironolactone, Tramadol

Category 4: Warfarin, NSAIDs (Non-steroidal anti-inflammatory drugs)

Category 5: Ranitidine, Tramadol, Spironolactone

The quality of evidence rating of PIM as per Beers Criteria showed that 27 patients (23.1%) have high severity; majority number of patients is with moderate severity that is 88 patients (75.2%) and 2 patients (1.7%) with low severity.

Figure 1: shows class of medications that are recognized to cause PIMs in patients. The medications of various classes are as follows: Aspirin (21, 17.9%), Diclofenac (4, 3.4%), Furosemide (18, 15.3%), Pantoprazole (26, 22.2%), Nifedipine (3, 2.5%), Spironolactone (16, 13.6%), Tramadol (11, 9.4%), Glimepiride (3, 2.5%), Amiodarone (1, 0.8%), Digoxin (3, 2.5%), Ranitidine (2, 1.7%), Chlorpheniramine (2, 1.7%), Dexbrompheniramine (1, 0.8%), Lorazepam (1, 0.8%), Insulin (3, 2.5%), Phenytoin (1, 0.8%), Warfarin (1, 0.8%).

In this study it was reported that 0-4 medications were prescribed to 46 patients (34.3%) and 5 or more medications were prescribed to 88 patients making it (65.6%). Further, **Table 1** showed the association of PIM and polypharmacy where the chi-square statistic is 47.204. The p value is < 0.00001. The result is significant at p less than 0.05.

Figure 2 depicts the prevalence of various disease conditions among geriatric patients in which Central nervous diseases were considered to be more and categorised as (CVA ischemic stroke 22, 29.35%; CVA CG bleed 4, 5.3%; altered sensorium 3, 4%; CVA IC bleed 3, 4%; parkinsonism 2, 2.6%; seizures 4, 5.3%; haemorrhagic stroke 1, 1.3%) followed by cardiovascular diseases (acute decompensate heart failure 5, 6.6%; thrombosis of jugular vein 1, 1.3%; hypertensive 2, 2.6%; acute fibrillation 1, 1.3%); respiratory diseases were (chronic obstructive pulmonary diseases 4, 5.3%; asthma 2, 2.6%; pneumonia 1, 1.3%); gastrointestinal diseases were found as (acute gastroenteritis 3, 4%; peptic ulcer disease 1, 1.3%) haemolytic diseases were (Pancytopenia 1, 1.3%; severe anaemia 3, 4%); endocrine diseases were (hypoglycaemic attack 1, 1.3%; dry gangrene 2, 2.6%) hepatic diseases were (Budd-Chiari syndrome 1, 1.3%; acute pancreatitis 2, 2.6%) renal disease was (acute kidney injury 2, 2.6%)

infectious disease was (sepsis 2, 2.6%) Musculoskeletal was found to be (polythralgia 1, 1.3%) and in last skin infection (lower limb cellulitis 1, 1.3%).

PIM incidence among various disease conditions was evaluated which yielded results as follows. Only co-morbidities which were presented with at least one PIM were used for test. Hence renal, hematological, musculoskeletal and hepatic disorders, infection diseases were excluded as PIM incidence found were nil among them. The distribution pattern is shown in **Table 2**. The chi-square statistic was 63.9998. The p value calculated was less than 0.00001. Hence, result was significant at p value less than 0.05.

DISCUSSION

This study aimed to find PIMs use among older patients using AGS Beers Criteria 2019. 134 cases were collected. The majority of research participants were women of 53.73% followed by males of 42.26%. This was similar to **Alhawassi et al.**, study which showed maximum population consisting of females.^[10] Maximum cases belonged to General Medicine ward of 110 cases, 82.08%. PIMs use in 134 patients consisted of (75 cases, 55.97%) to be in maximum, whereas (59 cases, 44.02%) comprised of no PIMs use which was regarded as appropriate drug use in in-patients. This was in contrary with **Zenney et al.**, study which showed maximum cases of appropriate drug use to be 54.8% and PIMs as 45.2% done in outpatient department of community pharmacy at a hospital in Lebanon.^[6] Majority of cases consisted of 59 patients (44.02%) having zero incidence of PIM followed by 43 patients (32.08%) having at least one PIM. This was slightly different from a study done by **Sharma et al.**, which showed one PIM to be in maximum cases of (44.7%) followed by zero PIM in (38%) cases. This was followed by two PIMs in (15.5%) cases, three PIMs in (4.5%) cases and more than four PIMs in (1.2%) cases.^[14]

Maximum cases with PIMs use belonged to age range of 65-74 years consisting of 53 cases, 70.6%. These results were seen to be slightly contrary in the study conducted by **Li Mo et al.**, which showed maximum cases with PIMs of 80 years and above. This contrary in results may because of number of patients being admitted in the hospital of 80 years and above of the geriatrics population, which was less at our study site.^[15]

As per the AGS Beers Criteria 2019 category listing the maximum number of PIMs in our study were found to be 75, (64.1%) belonging to category 3 followed by category 1 comprising of 31 PIMs (26.4%); category 5 comprising of 5 PIMs (4.2%) and category 2 and category 4 PIMs being the least observed as 4 PIMs, (3.4%) and 2 PIMs, (1.7%) respectively. These observations of our study were found to be similar to a study done by **Mariam Zahwe et al.**, which showed category 3 having majority PIMs (61.6%) followed by category 1 (70%) PIMs; category 5 (5%) PIMs and lowest PIMs in the category 2 and category 4 having 4% PIMs each respectively. ^[16]

India's biggest prospective research on PIM utilisation assessment among elderly in hospital patients was conducted by **Harugeri et al.**,^[17] at JSS medical college hospital, Mysore. According to their findings, 23.5% of the research participants received at least one PIM either at hospital admission or while they were there. These findings were in line with those of **H G Zaveri et al.**,^[18] who determined that 23.59% of the study population at Ahmedabad's municipal medical college had at least one PIM. However, our study site findings are somewhat higher than the outcomes of all other Indian investigations.

In our study the severity rated PIMs based on quality of evidence shows that majority of 88 PIMs, 75.2% came under the moderate severity followed by 27 PIMs, 23.1% of high severity and least PIMs use of 2, 1.7% of low severity. We may infer from this research that maximum medications prescribed were of moderate quality of evidence which means further research is probably required that would have an important effect on the estimation of therapeutic outcome and may also change the therapeutic estimation. Therefore, it is preferred to follow the medications under high quality evidence for safer patient care approach.

The maximum number of PIMs were found to be with the use of Pantoprazole (26 PIMs, 22.2%) followed by Aspirin (21 PIMs, 17.95); Furosemide (18 PIMs 15.3%); Spironolactone (16 PIMs, 13.6%) and Tramadol (11 PIMs, 9.4%). This was similar to a study done by **Sharma et al.**, which reported maximum PIMs of 51.3% for Proton pump inhibitors use. ^[14] On the other hand, the study of **Danisha et al** presents with a wider use of benzodiazepines 19.5%) followed by insulin sliding scale (15.5%) and prazosin at a rate of 11.5%. ^[19] The variations can be attributed to the differences in the patient and disease characteristics of the study sites.

Polypharmacy could be undoubtedly established as 65.6% of patients received more than 5 medications. Study done by **Alhawassi et al.**, showed 80% of the geriatric patients, be prescribed with equal to or higher than 5 medications. Polypharmacy demonstrated to be associated with PIMs and drug-drug interactions which also contribute to higher cost and prolonged duration of hospital stay causing a financial burden to the patient. ^[10] The chi-squared statistic proved a significant association between polypharmacy and PIM use as seen from **Table 3**.

The various disease conditions prevalent among geriatrics with PIMs are explained as follows. Central nervous system illnesses were the most typical cause for medical visits (39, 52%) followed by cardiovascular diseases (9, 12%) and respiratory diseases (7, 9.3%). This research differed somewhat from **Kanagasanthosh K et al.**, study which showed cardio vascular diseases to be most frequent reason for hospital visits (29.3%); followed by musculoskeletal conditions (27.65%) and endocrine disorders (13.3%). ^[3] Also, a significant association between comorbidities of patients including, cardiovascular diseases, gastro intestinal disorders, and CNS disorders, respiratory and endocrine disorders were proved with Chi –squared tests. However, PIM as the reason for hospital visits were not established. It is noted in this study that great majority of disease conditions were seen in the group of (65-74) years comprising of 59 cases, 78.6%, this was followed by (75-84) years of 11 cases, 14.6% and 85+ years comprising 5 cases 6.6% as very few patients of 85+ years were admitted in hospital.

Of prime importance is inappropriate medication use. More proper medication selection by doctors might be the goal of effective treatments. Due to the prevalence of illnesses in geriatrics and the fact that they receive prescriptions from several doctors, a large portion of the elderly population uses drugs. An unfavorable medication reaction can readily occur in older persons who are already predisposed to changed drug effects. Prior to filling prescriptions for vulnerable patient populations including the elderly, appropriate medication order review and clinical interventions must be used in all settings.

In conclusion, it can be said that prescribing for the elderly is discovered to be suboptimal, and it is time to get physicians' attention and express worry about the medication therapy for senior citizens. Drug use in special population like pediatrics, pregnancy, lactation and in elders is the area of specific concern in therapeutics. However, the inappropriateness of medicine and geriatric drug use are the subjects that receive the least attention in ordinary clinical practice. The

study's improper medicine usage findings, which were statistically significant, provide compelling support. Despite the growing elderly population and advances in medical field, geriatric pharmacy practice is still in its dark dormancy. The prevalence of PIM in older persons must be reduced by effective pharmacy interventions with practitioners. Considering the increase in elderly population, all the healthcare professionals must have awareness on the AGS Beers Criteria and PIMs use. To enhance management, lower unfavorable morbidity, and lower the use of health resources, advanced clinical education for practitioners is ideal, especially for drug-related issues and impacts. A multidisciplinary team of healthcare professionals involved in prescription analysis would be helpful to control the PIM use for providing better patient care.

The current study opens door for an extensive area of pharmacy practice called geriatric pharmacy practice. Though there are several studies in geriatrics, drug related problems and the possibility of use of a clinical tool is under-utilized. Hence the study puts forward the demand for further research in geriatric care. The study succeeded in proving the association of poly-pharmacy and co-morbidities of patients as significant factors in the incidence of PIM.

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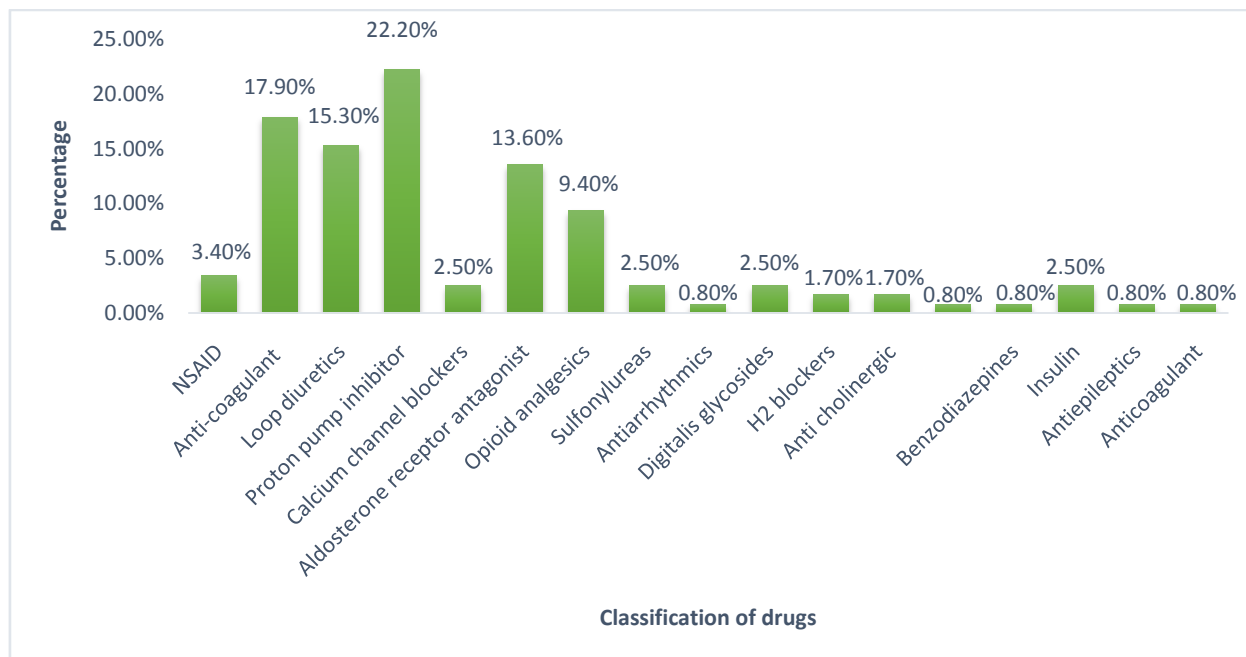


Figure 1: Classification of drugs causing PIMs.

Table 1: Association of PIM with Polypharmacy.

	With PIM	Without PIM	Total
0-4 drugs	37	92	129
Polypharmacy	94	38	132
Total	131	130	261

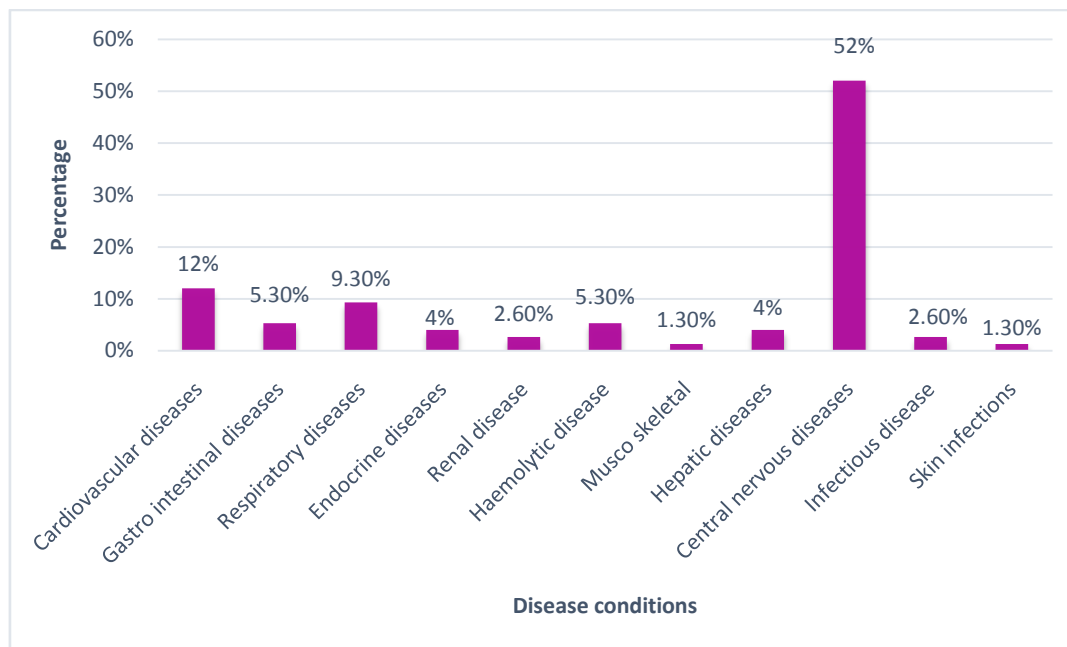


Figure 2: Prevalence of disease conditions in Geriatrics.

Table 2: Association of PIM with various disease conditions.

	With PIM	Without PIM	Total
Cardiovascular disorders	12	123	135
Gastrointestinal disorders	3	132	135
Respiratory disorders	8	127	135
Endocrine disorders	4	129	135
Central nervous system disorders	36	99	135
Total	63	610	675