Comparative Prevalence Analysis and Clinical Outcome of Potentially Inappropriate Medications in Elderly Population in Beers and START/STOPP Criteria

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Abstract: This review article provides a comparative prevalence analysis and clinical outcome of potentially inappropriate medications (PIMs) in the elderly population using the Beers and START/STOPP criteria. The Beers and START/STOPP criteria are two widely used tools to identify PIMs in the elderly population. The article evaluates their effectiveness in identifying PIMs. It also discusses the clinical outcomes of PIMs and the potential risks associated with their use in the elderly population. The findings suggest that both criteria are useful in identifying PIMs, but the START/STOPP criteria may be more sensitive in detecting potential drug-related problems. PIM is more common in IPD patients than in OPD patients. The extended hospital stay and poly-pharmacy are the reasons for this. Studies also suggest the prevalence of PIMs was more in Brazil than India. The reason for PIMs could be the content of the criteria lists, availability of medications in individual countries, whether the authors were able to apply all or only a subset of criteria, or differences in physician prescribing preferences. The article emphasizes the need for healthcare professionals to consider the use of these tools in their practice to reduce the incidence of adverse drug events and improve clinical outcomes in the elderly population.

Keywords: Drug Utilisation Evaluation, Potentially Inappropriate Medications, START/STOPP criteria, Beer's Criteria.

INTRODUCTION

The Beers criteria were among the first sets of formal PIP criteria to be devised, initially published in 1991; the American Geriatrics Society announced the most current modification in 2015. The 2015 Beers criteria include a list of medications or medication classes deemed potentially inappropriate in all older people, a list of medications deemed potentially inappropriate in older people with one of the specified health problems, and a list of medications/ medication classes deemed potentially inappropriate in all older people. [1] A comprehensive literature study preceded the Beers criteria, which were validated using a modified Delphi consensus process by an expert panel from the United States and Canada. Although the Beers criteria have been extremely influential and extensively utilised, they have been critiqued for their limited applicability outside of the United States due to disparities in drug availability and a lack of criteria measuring medication underuse. [2, 9]

Gallagher et al. created the Screening Tool of Older People's Prescriptions (STOPP) criteria and the Screening Tool to Alert to Right Treatment (START) criteria in Ireland in 2008, with an update published in 2014. The STOPP criteria include 80 situations in which particular drugs or medication categories are deemed possibly unsuitable in older people. The START criteria include 34 parameters for under-prescribing (i.e., possible under-prescribing of clinically useful medications/medication classes that should be administered in older adults with specific underlying medical problems, unless otherwise contraindicated). The STOPP and START criteria are both arranged by the physiological system to which each criterion is related (the cardiovascular, respiratory, central nervous, gastrointestinal, musculoskeletal and endocrine systems). Each criteria is followed by a brief description of why each PIM is seen possibly inappropriate or why a certain condition is under-prescribed. When the STOPP and START criteria are used together, they address issues such as drug-drug interactions, drug-disease interactions, potentially inappropriate treatment duration, medications that adversely affect older patients at risk of falls, duplicate medications from the same therapeutic class, potentially inappropriate medication dosages based on recent biochemical data, and potential under-prescribing of clinically beneficial medications.[3]

Strengths and weaknesses

Beers Criteria and START/STOPP Criteria are both widely used criteria to assess the appropriateness of medication use in older adults. Each of these criteria has its strengths and weaknesses, which are important to consider when using them in clinical practice. [4]

The strengths of Beers Criteria lie in its comprehensiveness and broad applicability. Beers Criteria include a list of potentially inappropriate medications in older adults, as well as medications that are potentially inappropriate in older adults with specific comorbidities. Moreover, it takes into account drug-drug interactions, drug-disease interactions, and potentially inappropriate treatment duration. The Beers Criteria have been widely used in clinical practice and have been updated regularly to reflect the most current evidence. [5]

However, a weakness of Beers Criteria is its limited applicability outside of the United States due to differences in drug availability and other healthcare-related issues. Additionally, it may not fully account for patient-specific factors, such as individual patient goals and preferences [6].

START/STOPP Criteria, on the other hand, have strengths in their specificity and focus on both over- and under-prescribing of medications. The STOPP criteria include specific situations in which particular medications or medication categories may be inappropriate in older adults. The START criteria, on the other hand, provide specific parameters for under-prescribing of clinically useful medications that should be administered in older adults with specific underlying medical problems. By addressing under-prescribing as well as over-prescribing, the START/STOPP criteria offer a more comprehensive approach to medication appropriateness. [7]

One potential weakness of START/STOPP Criteria is that they may not be as widely known or used as the Beers Criteria. Additionally, some healthcare providers may find the START/STOPP Criteria to be overly specific or difficult to implement in clinical practice. [8]

In conclusion, both the Beers Criteria and START/STOPP Criteria, have their strengths and weaknesses. While the Beers Criteria are comprehensive and widely used, they may not be applicable outside of the United States. The START/STOPP Criteria offer a more comprehensive approach to medication appropriateness by addressing both over- and under-prescribing, but may be more difficult to implement in clinical practice. Overall, healthcare providers should consider the strengths and weaknesses of each criterion when assessing the appropriateness of medication use in older adults.

FINDINGS OF THE STUDY

The percentage of patients that use unsuitable drugs is referred to as prevalence. In this review, several types of research were compared. Ten studies were chosen to determine the prevalence of Potentially Inappropriate Medicines (PIMs) using the Beers Criteria and the START/STOPP criterion. Three studies were chosen from the ten that used just Beers criteria to assess the PIMs. This review included two papers that looked at START/STOPP criteria. Similarly, six comparative studies that used both BEERs and START/STOPP Criteria to discover PIMs were compared.

According to Beers 2012 criteria, 37.76% patients of I.P.D. and 26.87% patients of O.P.D. got possibly inappropriate treatment, according to a study done in India by *Bhaveshaikh N et al.,* 2017. The gender distribution of PIM has been found to include 51.34% and 51.54% men in OPD and IPD, respectively. Females had a lower percentage of PIM, according to the research. In the OPD, the drugs that were inappropriate and should have been avoided were benzodiazepines and GI antispasmodics, which were found in 23 and 15 prescriptions out of 90 inappropriate prescriptions, respectively, while in the IPD, out of 91 inappropriate prescriptions, the drugs to avoid were insulin on a sliding scale (23 prescriptions) and prescribing paraffin (22 prescriptions). SNRIs/SSRIs/TCAs (16 prescriptions) were used with caution in OPD, as was aspirin for persons over the age of 80 for primary prevention (2 prescriptions).

Another research done in India by *Chandrappa et al.,* 2019 used Beers criteria 2015, and discovered that 86 (28.6%) of prescriptions contained one or more PIM. 48 medicines were selected as drugs that should be avoided in older persons in general that included prescriptions with Nitrofurantoin (14) and Hyoscine (12). The number of prescriptions containing the drugs to avoid in combination with certain comorbidities was ten, with five cases of heart failure receiving Nonsteroidal anti-inflammatory drugs (NSAIDs) and five cases of delirium receiving Lorazepam or ranitidine. The current study recommended that 76 drugs be taken with caution in the elderly. Diuretics

(52) were first, followed by vasodilators (17). There were 16 possible drug-drug interactions that may have been avoided in the elderly. 6 incidences with low creatinine received Raniditine.

Similarly, a research done in Tamil Nadu, India, by *Kumar Senthil et al*., 2020, found that 65.6% of prescriptions were inappropriate according to Beers Criteria 2019. Male patients (57.6%) outnumbered female patients. Digoxin (17 prescriptions) was shown to be the drug to avoid among the elderly, followed by Glimepiride (16 prescriptions). Diuretics (48 prescriptions) were the most cautiously used drugs, followed by Tramadol (23 prescriptions). PIM is more common in IPD patients than in OPD patients. The extended hospital stay and poly-pharmacy are the reasons for this. These studies also show that the higher version of the BEERs Criterion is more efficient than the previous versions in identifying PIMs.

Murthy MB et al., 2017 discovered that the prevalence of PIM according to STOPP criteria was 21.01% in Maharashtra, India. According to START criteria, 33.33% of patients had at least one potential prescribing omission (PPO). Overall, 46.37% of patients were exposed to potentially inappropriate medicine prescriptions (PIPs=PIMs +PPOs). According to STOPP criteria, the PIMs detected were long-term NSAIDs for pain relief in osteoarthritis as first-line therapy (8 prescriptions), followed by NSAIDs for long-term for a patient with severe hypertension (5 Prescriptions). START criteria identified PIMS as Statin treatment with a documented history of coronary, cerebral, or peripheral vascular disease, unless the patient's situation is end-of-life or the patient's age is greater than 85 years (11 prescriptions), followed by ACE inhibitor in Systolic heart failure (10 prescriptions).

A comparable research done in Brazil by *T F F Pereira et al.,* 2019 discovered that 93.5% of prescriptions contained at least one potential prescribing omission (PPO) indicated in the START criteria, whereas 95.4% utilised at least one drug from the STOPP criterion. According to the START criteria, the most commonly omitted potentially appropriate drugs from clinical practise were antihypertensive treatment if there was a history of systemic arterial hypertension (244 prescriptions), followed by laxatives in patients taking opioids on a regular basis (95 prescriptions). According to STOPP criteria, the most commonly prescribed potentially inappropriate drugs were Omeprazole (129 prescriptions) if there was no history of gastroesophageal reflux disease, peptic ulcer, or gastritis, and Furosemide (81 prescriptions) if it was first line for systemic arterial hypertension. These studies show potentially a large difference between the prevalence and nature of PIMs. There is more inappropriate prescribing in Brazil than in India.

A comparison research done in Brazil by *M.G. Oliveira et al.,* 2015 compared Beers Criteria 2012 with STOPP criteria and discovered that the prevalence of PIM was 33.8% using the STOPP criteria and 51.8% using the 2012 Beers criteria. According to the Beers criteria, the most common PIMs were short-acting nifedipine (17.4%), Glibenclamide (11.9%), as per STOPP criteria acetylsalicylic acid (32.9%), followed by clonazepam (10.1%) were the most prevalent PIMs. According to this study, Beers criteria are more successful in evaluating PIM than STOPP criteria, and there is a need to establish National Criteria.

Another study, done in Italy by *Giorgio Di et al.,* 2016, indicated that the number of potentially inappropriate medications used during hospitalisation rose internationally. An increase in inappropriate prescriptions was observed during the hospital stay. According to the Beers criteria, the percentage of patients with at least one PIM grew from 24% to 49%, whereas the STOPP criterion climbed from 21% to 27%. At the same period, according to START criteria, the percentage of patients having at least one potentially prescribed omission (PPO) climbed from 28% to 33%. During hospitalisation, the most prevalent PIM according to Beers criteria was Metoclopramide (38%), followed by Amiodarone (26%), but PIMs according to STOPP criteria were Diabetes mellitus (DM) and b-blockers (58%), followed by Benzodiazepines (26%).

In a study done in Kuwait by *Awad A et al.,* 2019, the prevalence of PIMs according to Beers and STOPP criteria were practically identical, with 53.1% according to Beers Criteria and 55.7% according to STOPP Criteria. According to Beers criteria, the therapeutic classes of PIMs were cardiovascular drugs (54.6%), followed by central nervous system medications (15.6%). According to STOPP criteria, the most common PIMs (52.6%) were associated with drugs administered without an evidence-based clinical indication, medications prescribed for longer than the recommended period, and duplication therapy. According to START criteria, the PPOs in patients

with established osteoporosis (39%) were bone anti-resorptive or anabolic treatment (e.g., bisphosphonate, teriparatide, denosumab), followed by vitamin D and/or calcium supplement in patients with recognised osteoporosis (36.1%). The proportion of patients with PIMs according to Beers and STOPP criteria did not differ significantly (p = 0.49).

A study done in Gujarat, India by *Mathur A et al.,* 2019 discovered a prevalence of PIM usage in the sample as 26.31% using the 2015 Beers criteria and 14.03% using the STOPP criteria. According to Beers criteria, the most common PIM was sliding scale insulin (17.54%), followed by long acting benzodiazepines (5.26%). According to the STOPP criteria, they were aspirin (5.26%) in heart failure, followed by chlorpheniramine (3.07%).

Another study done in Karnataka, India by *Nath S et al.,* 2021 discovered that the prevalence of PIM was 13.5% according to BEERs criterion 2015 and 4.2% and 19% according to START and STOPP criteria respectively. According to this study, the prevalence of PIMs was shown to be greater in males based on the Beers and STOPP criteria. The percentages were determined to be 9.9% and 11.3%, respectively. According to the START criteria, females have a higher prevalence of PIMs (2.3%) than males (1.8%). Moreover, the organ systems engaged in the STOPP criteria were cardiovascular (7.8%) followed by respiratory (4.9%) and vice versa was evident in the START criteria with 2.3% and 0.8% frequency of PIMs involved respiratory and cardiovascular, respectively. From this research we can conclude START/STOPP Ctriteria is more effective in finding PIMs compared to Beers Criteria.

DISCUSSION

In order to improve the prescribing patterns, current drug utilization should be understood. This review helps in understanding the inappropriate drug use among elderly patients using Beers criteria and START/STOPP Criteria. Issues examined in this review included prevalence, nature and extent of PIM use and factors associated with such usage, population affected and future scope. Ten research studies were included in this study, three studies utilized only Beers criteria, two studies analysed PIM by START/STOPP criteria and six studies were those in which both Beers criteria and START/STOPP criteria were utilized.

The prevalence of Potentially Inappropriate Medications (PIMs) is a significant issue worldwide. Several studies have been conducted to determine the prevalence of PIMs using different criteria, including Beers Criteria, START Criteria, and STOPP Criteria. The studies suggest that the prevalence of PIMs is higher in patients admitted to the hospital (IPD) compared to those in outpatient departments (OPD) due to longer hospital stays and poly-pharmacy. The range of prevalence of potentially inappropriate medications (PIMs) varies from 1.48% utilizing START/STOPP criteria [*Mathur A et al.,*] to 95.4% [*TFF Pereira et al.,*]. The prevalence range according to Beers Criteria mentioned in the above text varies from 3.66% to 65.6%. The study by *Mathur et al*., reported the lowest prevalence of PIMs at 3.66% using Beers Criteria, while the study by *Kumar Senthil et al*., reported the highest prevalence at 65.6%.

According to the *Bhaveshaikh N et al., Chandrappa et al.,* and *Kumar Senthil et al.,* studies, the Beers Criteria is more effective in finding PIMs than the STOPP Criteria. However, a study by *M.G. Oliveira et al*., found that the prevalence of PIMs was higher using Beers Criteria 2012 compared to STOPP Criteria, suggesting that regional differences may play a role in PIM prevalence. *Giorgio Di et al*., also found that the number of PIMs increased during hospitalization, with elderly patients being particularly vulnerable. Using different criteria such as Beers Criteria, Screening Tool of Older Person's Prescriptions criteria, and Screening Tool to Alert doctors to Right Treatment criteria, they found that the prevalence of PIMs increased from admission to hospitalization. Furthermore, *Awad A et al*., and *Mathur A et al*., found differing prevalence rates of PIMs using Beers Criteria and STOPP Criteria. *Nath S et al*., found that START/STOPP Criteria were more effective in finding PIMs compared to Beers Criteria.

According to this review, the prevalence of PIMs was higher in male patients [*Bhaveshaikh et al*., and *Kumar Senthil et al*.,] than female patients, the reason being large number of male population. While in other study, there was no significant difference between genders [*T F F Pereira et al*.,]. These studies also suggest the prevalence of PIMs was more in Brazil than India. The inappropriateness of medicines in Brazil can be attributed to the effectiveness of Beers criteria in Brazil as Beers criteria is widely used in America and Canada. In India, the Beers criteria are not so efficient in finding PIMs. The drugs that were inappropriate according to beers criteria and should have been avoided were Insulin on a sliding scale and prescribing paraffin [*Bhaveshaikh N et al.,],* Nitrofurantoin and

Hyoscine [*Chandrappa et al.*,], Digoxin and Glimepiride [*Kumar Senthil et al*.,], short-acting Nifedipine and Glibenclamide [*M.G. Oliveira et al*.,], Metoclopramide and Amiodarone [*Giorgio Di et al*.,], sliding scale Insulin and long acting Benzodiazepines [*Mathur A et al.,].*

CONCLUSION

This review revealed some consistent patterns across healthcare settings. Issues examined in this review included prevalence, nature and extent of PIM use and factors associated with the use of inappropriate medications. There is a significant difference in PIMs found by Beers Criteria and START/STOPP criteria. The reason could be the content of the criteria lists, availability of medications in individual countries, whether the authors were able to apply all or only a subset of criteria, or differences in physician prescribing preferences. All these factors need to be thoroughly studied in the future studies. These studies also suggest the need for standardized national criteria to evaluate PIMs effectively. Moreover, utilizing multiple criteria such as START Criteria along with STOPP Criteria may increase the detection rate of PIMs. The high prevalence rates of PIMs highlight the importance of appropriate prescribing practices and the need for regular medication reviews to ensure the safety of patients.

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