Beers Criteria versus Screening Tool of Older Persons’ Potentially Inappropriate Prescriptions in evaluation of drug-prescribing practice in an Indian hospital

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ABSTRACT

Purpose. To compare the Beers Criteria and Screening Tool of Older Persons’ Potentially Inappropriate Prescriptions (STOPP) in identifying potentially inappropriate medication (PIM) and adverse drug reaction (ADR) among Indian geriatric inpatients.

Methods. Patients aged ≥60 years who were admitted to the geriatric medicine ward of Bangalore Baptist Hospital between January 2016 and July 2016 were observed throughout the hospital stay. Medical records of patients were reviewed to determine PIM and ADR. The Beers Criteria and STOPP were used to identify PIM.

Results. 226 male and 124 female geriatric patients aged 60 to 92 (median, 68) years were included. The median number of medications was 12 (range, 0-26), the median number of comorbidities was 2 (range, 1-6), and the median length of hospital stay was 5 (range, 1-23) days. Respectively for the Beers Criteria and STOPP, 97 (27.7%) and 86 (24.6%) patients were identified to have 136 (38.9%) and 108 (30.9%) PIMs and 11 (3.1%) and 7 (2.0%) ADRs. Beers Criteria was more likely to identify PIM than STOPP (0.2 vs. 0.1 per patient, χ²=43.21, p<0.001). The Beers Criteria was more sensitive (0.59 vs. 0.52) but less specific (0.60 vs. 0.65) than STOPP in identifying PIMs.

Conclusion. The Beers Criteria was more sensitive but less specific than STOPP in identifying PIMs. The prevalence of PIMs was high among elderly patients in our geriatric medicine ward. The use of the Beers Criteria or STOPP may help reduce PIM and ADR.

INTRODUCTION

Potentially inappropriate medication (PIM) is a major health care concern in elderly patients. It increases the risk of adverse drug reaction (ADR), drug-drug interaction, hospital admission, and health care cost. Among hospitalised patients, ADR is the fifth most common cause of death.¹ Ageing results in changes in pharmacodynamics that alter body sensitivity to different classes of drugs (anticoagulants, psychotropic, and cardiovascular) and pharmacokinetics that prolong elimination half-life owing to reduced renal and hepatic clearance and increased volume distribution of lipid soluble drugs.²
PIM is assumed when the adverse effect outweighs the clinical outcome and a more effective and safer therapy is available for the same problem.\textsuperscript{3-5} There are various criteria to identify PIM in elderly patients.\textsuperscript{6} Although the Beers Criteria are commonly used in large-scale epidemiological studies, some of the Beers Criteria are controversial and almost half of PIMs in the Beers Criteria are unavailable in European formularies.\textsuperscript{7,8} The Screening Tool of Older Persons’ Potentially Inappropriate Prescriptions (STOPP) and the Screening Tool to Alert Doctors to Right Treatment (START) are evidence-based criteria. The STOPP comprises 65 criteria to systematically identify PIMs.

India’s geriatric population is expected to increase from 8.3% to 10.7% by 2021.\textsuperscript{9} This study aimed to compare the Beers Criteria and STOPP in identifying PIM and ADR among Indian geriatric inpatients. This may help health care professionals to make drug-prescribing decisions according to risk-benefit assessment.\textsuperscript{10}

**METHODS**

This prospective study was approved by the ethics committee of the Bangalore Baptist Hospital and conducted in compliance with the Declaration of Helsinki. Informed consent was obtained from each patient. Patients aged ≥60 years who were admitted to the geriatric medicine ward of Bangalore Baptist Hospital between January 2016 and July 2016 were observed throughout the hospital stay. Patients presenting to the outpatient, gynaecology, chemotherapy, or emergency department were excluded due to difficulty in follow-up.

Medical records of patients were reviewed to determine PIM and ADR. The Beers Criteria and STOPP were used to identify PIM. Causality of the ADR was assessed using the Naranjo algorithm\textsuperscript{11} and World Health Organization Adverse Drug Reaction Probability Scale.\textsuperscript{12} Severity of ADR was assessed using the Modified Hartwig and Siegel Scale. Causality, severity, and preventability of ADR were re-checked by a senior geriatric consultant.

Continuous variables of the Beers Criteria and STOPP were compared using the Mann-Whitney U test. The number of patients with PIM was the endpoint for assessment of sensitivity and specificity, using a 2x2 contingency table. Predictors of PIM were identified in the bivariate analysis using the Pearson Chi-squared test. Variables assessed in the bivariate analysis were age, number of comorbidities, number of medications, and length of hospital stay. A multivariate logistic regression model was used to evaluate the influence of predictors on PIM. A p value of <0.05 was considered statistically significant.

**RESULTS**

226 male and 124 female geriatric patients aged 60 to 92 (median, 68) years were included. The median number of medications was 12 (range, 0-26), the median number of comorbidities was 2 (range, 1-6), and the median length of hospital stay was 5 (range, 1-23) days (Table 1).

| Predictor          | Beers Criteria | STOPP |
|--------------------|----------------|-------|
| Number of medications | 12 (range, 0-26) | 12 (range, 0-26) |
| Number of comorbidities | 2 (range, 1-6) | 2 (range, 1-6) |
| Length of hospital stay | 5 (range, 1-23 days) | 5 (range, 1-23 days) |

Among patients with PIM, the Beers Criteria and STOPP were comparable in the percentage of male and female patients (58.8% male vs. 62.8% female, $\chi^2=0.31$, p = 0.575), the age of patients (70 vs. 68 years, Mann-Whitney Z=0.955, p = 0.328), the number of medications (12 vs. 12, Mann-Whitney Z= -0.09864, p = 0.928), the number of comorbidities (2 vs. 2, Mann-Whitney Z=0.60, p = 0.5485), and the length of hospital stay (6 vs. 6 days, Mann-Whitney Z= -0.1771, p = 0.8572).

The Beers Criteria was more likely to identify PIMs than STOPP (0.2 [0-3] vs. 0.1 [0-2] per patient,
χ²=43.21, p<0.001). The Beers Criteria was more sensitive (0.59 [95% confidence interval (CI)=0.50-0.67] vs. 0.52 [95% CI=0.42-0.62]) but less specific (0.60 [95% CI=0.55-0.64] vs. 0.65 [95% CI=0.62-0.68]) than STOPP in identifying PIMs.

In bivariate analysis, predictors of PIM identified by the Beers Criteria were the number of comorbidities of 1, length of hospital stay of ≥10 days, and patient age of 60-74 years. Whereas predictors of PIM identified by the STOPP were patient age of 65-69 years and length of hospital stay of 1-4 days (Table 3).

In the logistic regression model, predictors of PIM identified by the Beers Criteria (R2=0.05, Model χ²(8)=666, p<0.001) were the number of comorbidities of 1 (odds ratio [OR]=1.97, 95% CI=1.00-3.89, p=0.05), length of hospital stay of ≥10 days (OR=0.183, 95% CI=0.009-3.54, p=0.26), and patient age of 60-74 years (OR=0.52, 95% CI=0.276-0.967, p=0.04). Whereas predictors of PIM identified by the STOPP (R2=0.03, Model χ²(8)=11141, p<0.001) were patient age of 65-69 years (OR=0.43, 95% CI=0.23-0.83, p=0.01), patient age of 70-74 years (OR=0.43, 95% CI=0.21-0.87, p=0.02), and length of hospital stay of 1-4 days (OR=0.76, 95% CI=0.48-1.18, p=0.22).

**DISCUSSION**

In India, the age of retirement and senior citizenship
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is 60 years and life expectancy is 66 years, compared with life expectancy of 79 years in the United States and 81 years in the United Kingdom. In our study, there were more male than female patients (64.6% vs. 35.4%), which is consistent with one study, but is in contrast with another study reporting more female than male patients (61.9% vs. 38.1%). In our patients, an average of 10 drugs were prescribed, which is more than that reported in other studies with an average of 5 and 9 drugs per prescription.

Limiting the number of drugs per prescription is recommended because of the risk of drug-drug interaction, drug-food interaction, ADR, increased hospital cost, errors of prescribing, unwanted side effects, and prescribing and dispensing errors. Many elderly patients require polypharmacy for various co-morbidities; this is of concern as the chance of drug interactions increases.

In our study, the number of PIMs identified by

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**Table 2**

Potentially inappropriate medication (PIM) and adverse drug reaction (ADR) identified by Beers Criteria and Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP)

| Drug                  | Beers Criteria | STOPP |
|-----------------------|----------------|-------|
|                       | No. of PIMs    | No. of ADRs | | No. of PIMs    | No. of ADRs |
|                       | independent   | independent | |                       | independent   | independent |
|                       | of diagnosis | of diagnosis | |                       | of diagnosis | of diagnosis |
| Chlorpheniramine maleate | 9              | 1 (dry mouth) | | Chlorpheniramine maleate | 9              | 1 (dry mouth) |
| Aspirin               | 2              | 2 (gastrointestinal ulcer) | | Aspirin | 2              | 2 (gastrointestinal ulcer) |
| Chlordiazepoxide      | 4              | -           | | Chlordiazepoxide | 4              | -           |
| Digoxin               | 4              | -           | | Digoxin | 4              | -           |
| Promethazine          | 22             | 1 (confusion) | | Promethazine | 22             | 1 (confusion) |
| Amitriptyline         | 6              | 4 (2 confusion, 2 constipation) | | Amitriptyline | 6              | 4 (2 confusion, 2 constipation) |
| Clonazepam            | 1              | -           | | Clonazepam | 1              | -           |
| Amiodarone            | 5              | -           | | Amiodarone | 5              | -           |
| Clonidine             | 2              | -           | | Clonidine | 2              | -           |
| Dabigatran            | 1              | -           | | Dabigatran | 1              | -           |
| Spironolactone        | 13             | 1 (hyperkalaemia) | | Spironolactone | 13             | 1 (hyperkalaemia) |
| Hydroxyzine hydrochloride | 3             | 1 (constipation) | | Hydroxyzine hydrochloride | 3             | 1 (constipation) |
| Metoclopramide        | 19             | -           | | Metoclopramide | 19             | -           |
| Prazosin              | 4              | 1 (orthostatic hypotension) | | Prazosin | 4              | 1 (orthostatic hypotension) |
| Zolpidem              | 10             | -           | | Zolpidem | 10             | -           |
| Meperidine            | 8              | -           | | Meperidine | 8              | -           |
| Glyburide             | 2              | -           | | Glyburide | 2              | -           |
| Hyoscine butylbromide | 2              | -           | | Hyoscine butylbromide | 2              | -           |
| Diclofenac            | 8              | -           | | Diclofenac | 8              | -           |
| Diltiazem             | 8              | -           | | Diltiazem | 8              | -           |
| Ranitidine            | 1              | -           | | Ranitidine | 1              | -           |
| Tramadol              | 1              | -           | | Tramadol | 1              | -           |
| Lorazepam             | 1              | -           | | Lorazepam | 1              | -           |
| -                     | -              | -           | | - | - | - |
| Sertraline            | 4              | 1 (hypotension) | | Sertraline | 4              | 1 (hypotension) |
| Amlodipine            | 4              | -           | | Amlodipine | 4              | -           |
The Beers Criteria was more sensitive but less specific than STOPP in identifying PIMs. The prevalence of PIMs was high among elderly patients in our geriatric medicine ward. The use of the Beers Criteria or STOPP may help reduce PIM and ADR.

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| Predictor | Beers Criteria OR (95% CI) | p Value | STOPP OR (95% CI) | p Value |
|-----------|-------------------|--------|-----------------|--------|
| Sex       |                   |        |                 |        |
| Male      | 0.78 (0.52-1.17)  | 0.231  | 0.99 (0.65-1.52) | 0.98   |
| Female    | 1                 | -      | 1               | -      |
| Age (years) |                   |        |                 |        |
| 60-64     | 0.51 (0.27-0.96)  | 0.039  | 0.73 (0.40-1.33) | 0.316  |
| 65-69     | 0.33 (0.17-0.63)  | 0.009  | 0.43 (0.22-0.82) | 0.011  |
| 70-74     | 0.43 (0.22-0.87)  | 0.019  | 0.42 (0.21-0.86) | 0.018  |
| 75-79     | 0.49 (0.23-1.05)  | 0.069  | 0.44 (0.20-0.94) | 0.03   |
| ≥80       | 1                 | -      | 1               | -      |
| No. of comorbidities |                 |        |                 |        |
| 1         | 1.97 (1.0-3.88)   | 0.049  | 1.39 (0.69-2.81) | 0.34   |
| 2         | 0.83 (0.40-1.71)  | 0.621  | 0.86 (0.40-1.85) | 0.7    |
| 3         | 1.43 (0.67-3.05)  | 0.353  | 1.54 (0.70-3.38) | 0.27   |
| ≥4        | 1                 | -      | 1               | -      |
| No. of medications |                 |        |                 |        |
| 1-4       | -                 | -      | -               | -      |
| 5-9       | -                 | -      | -               | -      |
| 10-14     | 1.13 (0.71-1.80)  | 0.584  | 1.06 (0.65-1.71) | 0.81   |
| 15        | 1                 | -      | 1               | -      |
| Length of hospital stay (days) |               |        |                 |        |
| 1-4       | 0.97 (0.63-1.51)  | 0.919  | 0.75 (0.48-1.18) | 0.22   |
| 5-9       | 1                 | -      | 1               | -      |
| 10-14     | 0.18 (0.009-3.54) | 0.261  | -               | -      |
| ≥15       | 0.16 (0.008-2.89) | 0.215  | -               | -      |
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