



## A review of screening tools used for the assessment of appropriateness of prescription's among elderly patients

Mandavi Kashyap\*, Muhammad Zahid Iqbal

AIMST University, Malaysia.

Received on 13 June 2014, Accepted on 25 July 2014, Available online from 04 September 2014

### Abstract

Inappropriate medication use in elderly population has long been an issue of healthcare quality along with over and under use of medication. Several factors like increasing age, availability of new classes of drugs, and changes in physicians' prescribing habits contributed to changes in the drug use patterns among elderly. The assessment of the appropriateness of prescription in elderly is an essentially complex task and the health researchers have identified various cases of inappropriate drug use in the elderly in several countries. Different screening tools were prepared for the assessment of appropriateness of prescription and some of them are being used for assessment of appropriateness of prescription. In this perspective, the Beer's Criteria is one of the most commonly used tools. None of the tools in its original contour is applicable to any country as there are differences in the pharmaceutical market of different countries, their prescribing patterns, diseases characteristics, physician areas and most of all, the patient's characteristics. This review explains advantages and limitations of all available different screening tools that can significantly improve elderly pharmacotherapy. The author believes that this review will highlight the requirement of modification of tools with respect to real time practice in terms of country specific prescribing behavior to avoid inappropriate prescription.

*Keywords:* Elderly, Beers criteria, Inappropriateness, Screening tools

### Introduction

Globally, the geriatric population is increasing in number with faster rate than any other age group, as a result of increased life expectancy and decreased fertility [1]. The increase in number of elderly population has also increased more hospital admissions, longer duration of hospital stays and more extended medical treatment. Increase of worldwide burden of oldness associated chronic conditions such as heart disease, neurological disease etc, emphasis health care providers' to use their scientific knowledge and promote appropriate use of medicines to protect elderly patient from adverse effects of inappropriate medications.

Appropriateness in healthcare has been defined as "the outcomes of process of decision making that maximizes net health gains within society's available resources". Appropriate prescribing also associated with reduction of over-use, under-use and misuse of treatment [2].

Appropriate geriatric pharmacotherapy is an intensive approach to preservation and restoration of physical and physiological functioning in elderly. The assessment of geriatric pharmacotherapy intends to modify the existing geriatric care practice. In this context of medicine the

prescribing of medications is an elementary component of elderly health-care, and the optimization of medication prescription has become an important public health concern. Inappropriate prescribing in elderly is widespread problem that has received much attention in recent years. Inappropriate prescribing in the elderly population is now considered as major public health issue, given its direct linkage to substantial morbidity, mortality and wastage of health resources that result from adverse drug reactions [3]. Improving prescribing quality for elderly patient means reducing irrational and inappropriate prescribing, thereby resulting in better healthcare of elderly. Therefore, assessment tools for appropriateness of elderly pharmacotherapy are the important fundamentals in defining whether an improvement in prescribing has happened. These screening tools should have desirable qualities such as easy availability, user friendliness and aiming to assist medication selection based on evidence based information, and, is helpful in reducing inappropriate prescribing. Different screening tools prepared for the assessment of appropriateness of prescription and some of them are being used for assessment of appropriateness of prescription. Using different tools inappropriate

\*Corresponding author E - mail: [avi\\_mandu@yahoo.co.in](mailto:avi_mandu@yahoo.co.in)

prescribing among elderly was assessed and prevalence of inappropriate prescribing was reported from different countries in range between 7.8% [4] to over 50% [5]. All the tools are different from one another and have specific characteristic features. Moreover, each of them has its own advantages and disadvantages. None of the tools in its original contour is applicable to any country as there are differences in the pharmaceutical market among countries, prescribing patterns, diseases characteristics, physician specialities and most of all, the patient's characteristics.

Therefore, the aim of this review is to explain all available different screening tools for assessment of appropriateness of prescribing in elderly that can significantly improve elderly pharmacotherapy. The author believes that this review insight into the necessity of modification of tools with respect to real time practice in terms of country specific prescribing behavior to avoid inappropriate drug use.

### Literature Search Methodology

The following electronic databases were used for search: PubMed, Science direct, MEDLINE and Medscape. These databases were searched using synonyms of the keywords such as elderly, IDU, PIM, inappropriate prescribing, criteria. All studies published in English with average patient age of 65 years or above were included. Databases also searched for studies identified inappropriate drug use in elderly using different screening tools like Beer's criteria 2003 [6], Screening Tool of Older People's potentially inappropriate Prescriptions (STOPP) criteria [7], Improved Prescribing in the Elderly Tool (IPET) [8], Health Plan Employer Data and Information Set (HEDIS) [9] criteria and Zhan criteria [10].

### Findings and Discussion

The prevalence of inappropriate medication use necessitates the evaluation and assessment of healthcare quality in elderly population. The commonest methods for assessing appropriate or inappropriate prescribing are implicit professional judgement and explicit criteria. In implicit approaches, a clinician employs patient-specific information and published evidence to form judgements about appropriateness. Implicit judgements are subject to reviewer variations. Implicit judgements take account of the context of individual patients and easily incorporate

newer evidences into assessment. They may have greater validity but they are time-consuming, depend on the users' knowledge and attitudes, and can have poorer reliability than explicit criteria.

On the other hand, explicit criterion [11-12] uses a consensus panel to prepare a set of standards from the literature. They are dependent not only upon available evidence but also upon the author's ability to routinely include newer evidences. Explicit indicators require each prescription to be compared with a set of published standards. These measures are usually drug or disease oriented and can be applied with little or no clinical judgement. Unfortunately, explicit criteria may not take into account all quality indicators of health care as defined by national guidelines for an individual patient and their preferences, nor do they address the burden of co-morbid conditions.

There are different explicit criteria for the assessment of appropriateness of prescription in elderly. Some of them are now modified or merged with other. Currently, five tools are being used to evaluate inappropriate prescription in elderly. The Beer's Criteria 2003, IPET, HEDIS and STOPP criteria are explicit approaches, while the Medication Appropriateness Index (MAI) [13] is an implicit approach. The following criteria are arranged in their chronological order of establishment:

1. Beer's criteria 1991 [14]
2. Medication Appropriateness Index (MAI) 1992 (Implicit)
3. Beer's criteria 1997 [15]
4. McLeod criteria 1997 [16]
5. Improved prescribing in elderly tool (IPET) 20008
6. Zhan criteria, 2001 [10]
7. Beer's criteria 2003
8. Rancourt criteria 2004 [17]
9. Health Plan Employer Data and Information Set (HEDIS) in 2006 [9]
10. STOPP Criteria 2006 [7]
11. START Criteria 2006 [7]
12. Winit-Watjana criteria 2008 [18]
13. AGS Beer's criteria 2012 [19]

All criteria named above have specific characteristic features and are different from each other. Each of them has its own positive characteristics and limitations. In order to understand the issue of appropriateness assessment process, it is crucial that healthcare providers of particular nation should have an understanding of all available tools, their advantages and limitations, so that,

they can modify the tool according to their setting and real time practice to restrain the problem associated with tool and ultimately leads to improvement of elderly pharmacotherapy. The explicit criteria are discussed below:

### 1. Beer's criteria

The Beer's criteria are based on expert consensus developed through an extensive literature review with a bibliography and questionnaire. It is evaluated by nationally recognized experts in geriatric care, clinical pharmacology, and psychopharmacology using a modified Delphi technique. It is explicit in nature, being derived from published reviews, expert opinions and consensus techniques without clinical judgement about the presenting patient. Beer's et al, published this criteria in the United States in 1991 to determine potentially inappropriate prescribing of medication in elderly [6,14,15].

According to this, drugs were classified as inappropriate in three categories: (1) drugs that generally should be avoided in older adults; (2) drugs that exceed a maximum recommended daily dose; and (3) drugs to be avoided in combination with specific co morbidity. Broadly, the Beer's Criteria is divided into two lists, first list contains the list of drugs which should be avoided in elderly patients regardless of diagnoses. And the second list consists of drugs that should be avoided in specific disease conditions.

Beer's Criteria were updated in 2003, again validated by a consensus technique. The revised version (2003) listed 48 medicines or drug classes that should generally be avoided in elderly patients. Medications added in revised version of general list of inappropriate medications were Nitrofurantoin, Doxazosin and Amiodarone. Fifteen medications and medication classes were removed from the 1997 list, e.g. the use of beta-blockers (with exception of Propranolol) in those with COPD, asthma, peripheral vascular disease and syncope or falls. However, the updated criteria do not identify all important causes of potentially inappropriate prescribing (e.g. drug interactions are not included). Controversy exists over some of the medications that are considered to be potentially inappropriate by Beer's criteria, e.g. Amitriptyline, Amiodarone [6].

Using Beer's Criteria, rates of inappropriate prescribing range from 7.9%<sup>20</sup> to 50% [21,22] among elderly patients of different country. The most commonly identified

inappropriate drugs in these studies were long-acting Benzodiazepines, Dipyrindamole, Propoxyphene and Amitriptyline. Research group from Orland<sup>23</sup> and Finland<sup>24</sup> have reported 25% and 14.7% of inappropriate drug use in elderly using Beer's criteria 2003, respectively. In year 2011, the modification and update of criteria was accomplished by American Geriatric Society along with multidisciplinary panel of experts in geriatric medicine, nursing, and pharmacotherapy to develop 2012 AGS Beer's criteria [19]. Firstly, in addition to using a modified Delphi process for building consensus, the expert panel followed the evidence-based approach. Secondly, criteria has identified and grouped medications that may be inappropriate for older adults into three different categories instead of two, as previously. The first category includes medications that are potentially inappropriate for older people because they either pose high risks of adverse effects or appear to have limited effectiveness in older patients, and because there are alternatives to these medications. The second category includes medications that are potentially inappropriate for older people who have certain diseases or disorders because these drugs may exacerbate the specified health problems. The third category includes medications to be used with caution in older adults. While these medications may be associated with more risks than benefits in general, they may be the best choice for a particular individual if administered with caution. Addition of third category is important because it highlights that medications need to be personalized to the unique needs of each patient [19].

Using AGS Beer's criteria 2012, the study has shown increased prevalence of inappropriate drug use (58.4%) as compared to previous criteria [25]. Inclusion of more drugs and third category could be possible explanation for this. Other research group has demonstrated immense difference in prevalence rate according to 2003 (28.57%) and 2012 (40%) criteria [26].

### 2. Medication Appropriateness Index (MAI)

The Medication Appropriateness Index (MAI) as implicit criteria developed by Hanlon et al [13] in 1992 and modified in 1997 is intended to be a reliable<sup>27</sup>, standardized method of addressing multiple elements of drug therapy prescribing, applicable to a variety of medications, clinical conditions and settings.

Medication Appropriateness Index is a comprehensive validated instrument for evaluating drug therapy. The

MAI consists of ten criteria for which each medication is rated according to a specified protocol. These ten criteria address the indication, effectiveness, dosage, accuracy, practicality of directions for administration, drug interactions, relative expenses and duration of treatment. The assessor rates each medication against each criterion to assign a judgement on scale of A-C, where A indicates "appropriate". Each Criterion is weighted 1-3 according to the standard protocol, resulting in a score of 0-18 (where 0 stands for maximum appropriateness per medication). An overall score per patient is derived by summing the MAI scores for each medicine used by a particular patient. Studies conducted using MAI as a screening tool showed range of 23.7% to 92% inappropriate prescription in elderly. The most common drug classes with appropriateness problems were gastric (50.6%), cardiovascular (47.6%), and central nervous system (23.9%) [28, 29].

Excellent intra-rater and inter-rater reliability associated with this tool which was tested in both the inpatient and ambulatory settings. It has reported numerous components to check appropriateness of prescription and could be applied to all type of medication in the context of patient-specific characteristics. Conversely, this is more time-consuming to complete as it take 10 minutes to assess on drug. This also does not assess under-prescribing e.g. untreated indications [30].

### 3. IPET Criteria

IPET is revised version of Canadian McLeod criteria which was developed in 1997. The McLeod, canadian criteria developed a list of medications considered to be inappropriate by the method similar to that of Beer's criteria, using a Delphi consensus approach. They identified 38 agents as contraindicated or likely to cause drug-drug or drug-disease interactions based on risk benefit ratio. As with the Beer's criteria, the McLeod criteria have been criticized for their limited applicability to geriatric clinical practice.<sup>31</sup> This list subsequently became the basis IPET, which was validated and published by Naugher et al [8]. This screening tool includes 14 instances of inappropriate prescribing and is a combination of explicit contraindications, adverse drug-drug interactions and adverse drug-disease interactions. IPET is deficient and is not based on physiological systems. This criteria is not comprehensive enough; there are only 14 cited situations to be avoided. IPET is heavily weighted towards cardiovascular, psychotropic and non-steroidal

anti-inflammatory drug use. Also many drug categories are under-represented.

A prospective, consecutive observational cohort study<sup>32</sup> was carried out over a 4-month period in acutely ill hospitalized patients to measure the incidence of inappropriate prescribing among older community-dwelling individuals presenting to an acute hospital in the Republic of Ireland and also to compare the efficacy of Beer's Criteria and the IPET. Results of this study reflected that Beer's criteria 2003 identified more inappropriate prescriptions than the IPET in this study population of elderly.

### 4. Zhan criteria

In 2000, to address nuances regarding prescribing of the medications included in the Beer's criteria, Zhan criteria was developed using Delphi method. Based on the 1997 version of the Beer's criteria, the Zhan criteria has focused only on those drugs which should be avoided in elderly patients without any concern of drug dosages form, drug-disease interactions, or drug-drug combinations. The Zhan criteria categorized 33 drugs into one of three categories: drugs that should always be avoided (e.g., meperidine), drugs that are rarely appropriate (e.g., diazepam), and drugs that are sometimes appropriate but often misused (e.g., amitriptyline) [10].

Studies have shown 29%<sup>33</sup> and 28%<sup>34</sup> of inappropriate drug use in elderly patient using Zhan-criteria in two different settings. Study had shown lower prevalence of inappropriateness as their formulary excluded 12 drugs from Zhan criteria [33].

Study has shown that this criterion has utility for identifying prescribing problems in retrospective review of elders' medication lists. But this has reflected weak ability to distinguish between patients with and without prescribing problems identified on expert review. This criterion has been criticized for its limited applicability to geriatric clinical practice as it has low levels of inter-rater reliability [34].

### 5. Rancourt criteria

This list was an explicit criteria mainly based on Beer's and McLeod criteria and that was updated and validated using modified Delphi method by local experts of long-term care setting of Quebec city, Canada. The list developed by Rancourt et al., [17] included all important causes of potentially inappropriate prescribing like potentially inappropriate medication, potentially inappropriate

duration, potentially inappropriate dosage and potentially inappropriate drug-drug interaction. Also, this list arranged according to drug classes along with their ATC code for ease of its use and matches the data on international level.

A study on 2,481 elderly patients showed 51.5% inappropriate drug use according to this criteria. The most commonly identified inappropriate drug classes were Analgesics & Antipyretic, Anxylitics and Antipsychotics. Limitations do exist with this criteria also. This criteria was developed on the basis of observation from one clinical setting of one region i.e. long term care setting of Quebec city. Also, this criteria was more oriented towards assessment of psycholeptic drugs and lack of information with respect to its inter-rater reliability. In addition to this, conduct of more robust studies required to establish these criteria [17].

#### **6. Health Plan Employer Data and Information Set (HEDIS) Criteria 2006**

The National Committee on Quality Assurance convened an expert consensus panel and, using a modified Delphi process, developed a quality measure to identify rates of inappropriate prescribing in the elderly based on the most commonly used measure of inappropriate prescribing, the Beer's criteria. This measure includes drugs that should always be avoided in the elderly and is currently being used in the 2006 Health Plan Employer Data and Information Set (HEDIS) in 2006 to assess quality of care for older Americans [29, 35].

A cross-sectional study<sup>29</sup> was conducted using HEDIS 2006 criteria to determine the rate of potentially inappropriate prescribing in the elderly showed 19.6% of older were exposed to HEDIS 2006 drugs, The most commonly prescribed drugs were antihistamines, opioid analgesics and skeletal muscle relax. The lower prevalence of inappropriate prescribing in this case was due to lesser number of drugs being enlisted in HEDIS Criteria.

HEDIS Criteria is a list of drug which should always be avoided in elderly. Certain drugs like Amiodarone, Amitriptyline, Indomethacin, Doxepin, Ticlopidine, Naproxen, Oxaprozin, Piroxicam, Fluoxetine etc, though present in Beer's Criteria, are removed from HEDIS Criteria. Also HEDIS Criteria was not arranged in any particular order or structure. Moreover the drugs enlisted are not classified according to the severity. There is lack of

convincing evidence showing the benefits of using HEDIS Criteria.

#### **7. STOPP criteria**

It is a validated new screening tool of older patients' medicines called STOPP (Screening Tool of Older People's potentially inappropriate Prescriptions). Eighteen experts in geriatric pharmacotherapy with recognized credentials in their specialist areas were recruited to establish the content validity of STOPP by a Delphi consensus method. STOPP incorporates commonly encountered instances of potentially inappropriate prescribing in older people including drug-drug and drug-disease interactions, drugs which adversely affect older patients at risk of falls and duplicate drug class prescriptions. STOPP criteria are easy to use as it is based on physiological systems similar to the pattern of most drug formularies. Each criterion is accompanied by a concise explanation as to why the prescription is potentially inappropriate [36].

In a prospective study [37], conducted in Ireland, STOPP identified 336 potentially inappropriate medications (PIMs) affecting 247 patients (35%), of whom one-third presented with an associated ADE. Whereas Beer's criteria identified 226 PIMs affecting 177 patients (25%), of whom 43 presented with an associated ADE. STOPP-related PIMs contributed to 11.5% of all admissions. Beer's criteria-related PIMs contributed to significantly fewer admissions (6%). STOPP criteria identified a significantly higher proportion of patients requiring hospitalization as a result of PIM-related adverse events than Beer's criteria.

One published study has shown significant improvements in appropriate prescribing in randomized controlled trial using STOPP/START Criteria. Unnecessary polypharmacy, the use of drugs at incorrect doses, potential drug-drug, drug-disease interactions and underutilization of clinically indicated medications were significantly lower in the intervention group at discharge [38].

The advantages of the STOPP consist of good inter-rater reliability (kappa co-efficient of 0.75), inclusion of both American and European medications, organization and structure based physiological systems, and short time to complete (~3 minutes). However, evaluation of this tool requires additional studies from different settings of different countries.

#### **8. START criteria**

START is a screening tool (screening tool to alert doctors to the right treatment), devised from evidence-based prescribing indicators and arranged according to physiological systems. It was prepared and validated for identifying prescribing omissions in older adults. START was designed, validated and used for the first time in Ireland by a team of healthcare professionals [39]. The START list found one or more prescribing omissions in 57.9% of patients. In order of prevalence, the most common prescribing omissions were: statins in atherosclerotic disease (26%), warfarin in chronic atrial fibrillation (9.5%), anti-platelet therapy in arterial disease (7.3%) and calcium/vitamin D supplementation in symptomatic osteoporosis (6%).

Although, STOPP and START are a valid, reliable and comprehensive screening tools that enables the prescribing physician to appraise an older patient's prescription drugs in the context of his/her concurrent diagnoses, the international applicability of these two criteria (STOPP and START) has not been established [40].

### 9. Winit-Watjana criteria

In Thailand, Winit-Watjana et al [18] developed a list of high-risk medication use in elderly using a Delphi technique with the three-round survey. These explicit criteria included use of high-risk medications with potential adverse reactions, drug-disease interactions and drug-drug interactions. According to this list drugs acting on central nervous system, musculoskeletal system and cardiovascular system were high-risk medications in elderly.

Chang et al [41], compared the explicit criteria for assessment of inappropriate prescribing and found that most of identified inappropriate medications were similar among the different explicit criteria. Benzodiazepines and falls as drug-disease interactions and warfarin and NSAIDs as drug-drug interactions were most commonly identified in all criteria. Although, this list has addressed different issue of inappropriate prescribing, this tool is not experienced in different clinical settings and also lack of inter-rater reliability.

### Conclusions

Despite challenges in using explicit criteria for assessing inappropriate medications for elderly patients, such criteria can be applied to population-based surveys to

identify opportunities to improve quality of care and patient safety.

While different inappropriate prescribing screening tools are available, several fundamental issues still unobserved with respect to different clinical setting of each nation. There is no single, universally-accepted tool for defining inappropriate prescribing problems among elderly in all type of clinical setting of any country; hence it is not wise to conclude that any criteria is perfectly suitable in its original contour. Therefore, author suggests that there is need of modification of established screening tool and also match with real time practice for proper assessment of level of inappropriate prescribing in perspective of any country.

### References

1. United Nations, Department of Economic and Social Affairs. World Population Ageing 2013. Retrieved on Mar 2014 : <http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeingReport2013.pdf>
2. Aronson, J.K., 2004. Rational Prescribing, Appropriate Prescribing. *Br J Clin Pharmacol.* 57, 229-230.
3. Schmadar, K.E., Hanlon, J.T., Landsman, P.B., Samsa, G.P., Lewis, I.K., Weinberger, M., 2006. Inappropriate prescribing and health outcomes in elderly veteran outpatients. *Ann Pharmacother.* 31(5), 529-533.
4. Goulding, M.R., 2004. Inappropriate medication prescribing for elderly ambulatory care patients. *Arch Intern Med.* 164, 305-312.
5. Laroche, M.L., Charmes, J.P., Bouthier, F., Merle, L., 2009. Inappropriate medications in the elderly. *Clin Pharmacol Ther.* 85(1), 94-97.
6. Fick, D.M., Cooper, J.W., Wade, W.E., 2003. Updating the Beer's criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med.* 163(22), 2716-2724.
7. Gallagher, P., Ryan, C., Byrne, S., 2008. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation. *Int J Clin Pharmacol Ther.* 46(2), 72-83.
8. Naugler, C.T., Brymer, C., Stolee, P., Arcese, Z.A., 2000. Development and validation of an improving prescribing in the elderly tool. *Can J Clin Pharmacol.*

- 7(2), 103–107.
9. National Committee on Quality Assurance. Drugs to be avoided in the elderly. Mar 2014. Available at: <http://www.ncqa.org/Programs/HEDIS>.
  10. Chunliu, Z., Judith, S., Arlene, S. B., 2001. Potentially Inappropriate Medication Use in the Community-Dwelling Elderly: Findings from the 1996 Medical Expenditure Panel Survey. *JAMA*. 286(22), 2823-2829.
  11. Tully, M.P., Cantrill, J.A., 2005. The validity of explicit indicators of prescribing appropriateness. *Int J Quality Health Care*. 18(2), 87-94.
  12. Gallagher, P.F., Barry, P., Ryan, C., Hartigan, I., O'Mahony, D., 2008. Inappropriate prescribing in an acutely ill population of elderly patients as determined by Beer's Criteria. *Age & Ageing*. 37, 96–10.
  13. Hanlon, J.T., Schmader, K.E., Samsa, G.P., 1992. A method for assessing drug therapy appropriateness. *J Clin Epidemiol*. 45(10), 1045-1051.
  14. Beer's, M.H., Ouslander, J.G., Rollinger, I., Reuben, D.B., Brooks, J., Beck, J.C., 1991. Explicit Criteria for Determining Inappropriate Medication Use in Nursing Home Residents. *Arch Inter Med*. 151, 1825-1832.
  15. Beer's, M.H., 1997. Explicit Criteria for Documenting Potentially Inappropriate Medication Use by the Elderly. *Arch Inter Med*. 157, 1531-1536.
  16. McLeod, P.J., Huang, A.R., Tamblyn, R.M., Gayton, D.C., 1997. Defining inappropriate practices in prescribing for elderly people: a national consensus panel. *Can Med Assoc J*. 156(3), 385-391.
  17. Rancourt, C., Moisan, J., Baillargeon, L., 2004. Potentially inappropriate prescriptions for older patients in long-term care. *BMC Geriatrics*. 4, 9.
  18. Winit-Watjana, W., Sakulrat, P., Kespichayawattana, J., 2008. Criteria for high-risk medication use in Thai older patients. *Arch Gerontol Geriatr*. 47(1), 35-51.
  19. American Geriatrics Society 2012 Beers Criteria Update Expert Panel., 2012. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 60(4), 16-31.
  20. Hanlon, J.T., Artz, M.B., Pieper, C.F., Lindblad, C.I., Sloane, R.J., Ruby, C.M., Schmader, K.E., 2004. Inappropriate Medications Use among Frail Elderly Inpatients. *Ann Pharmacother*. 38, 9-14.
  21. Rothberg, M.B., Pekow, P.S., Liu, F., 2008. Potentially Inappropriate Medication Use in Hospitalized Elders. *J Hosp Med*. 3(2), 91-102.
  22. Oster, G., Berger, A., Dukes, E., Eddsberg, J., McCarbery, B., 2004. Use of Potentially Inappropriate Pain- Related Medications in Older Adults with Painful Neuropathic Disorders. *Am J Geriatr Pharmacother*. 2, 163-70.
  23. Golden, A.G., Qiu, D., Roos, B.A., 2011. Medication assessments by care managers reveal potential safety issues in homebound older adults. *Ann Pharmacother*. 45(4), 492-8.
  24. Leikola, S., Dimitrow, M., Lyles, A., Pitkälä, K., Airaksinen, M., 2011. Potentially inappropriate medication use among Finnish non-institutionalized people aged  $\geq 65$  years: a register-based, cross-sectional, national study. *Drugs Aging*. 28(3), 227-36.
  25. Tosato, M., Landi, F., Martone, A.M., 2014. Potentially inappropriate drug use among hospitalized older adults: results from the CRIME study. *Age Ageing*. (online)
  26. Momin, T.G., Pandya, R.N., Rana, D.A., Patel, V.J., 2013. Use of potentially inappropriate medications in hospitalized elderly at a teaching hospital: a comparison between Beers 2003 and 2012 criteria. *Indian J Pharmacol*. 45(6), 603-7.
  27. Fitzgerald, L.S., Hanlon, J.T., Shelton, P.S., 1997. Reliability of a modified medication appropriateness index in ambulatory older persons. *Ann Pharmacother*. 31, 543–548.
  28. Stuijt, C.C.M., Franssen, E.J.F., Egberts, A.C.G., Hudson, S.A., 2008. Appropriateness of Prescribing among Elderly Patients in a Dutch Residential Home Observational Study of Outcomes after a Pharmacist-Led Medication Review. *Drugs & Aging*. 25(11), 947-954.
  29. Pugh, M.J., Hanlon, J.T., Zeber, J.E., Bierman, A., Cornell, J., Berlowitz, D.R., 2006. Assessing Potentially Inappropriate Prescribing in the Elderly Veterans Affairs Population Using the HEDIS 2006 Quality Measure. *J Manag Care Pharm*. 12 (7), 537-45.
  30. Samsa, G.P., Hanlon, J.T., Schmader, K.E., 1994. A summated score for the medication appropriateness index: development and assessment of clinimetric properties including content validity. *J Clin Epidemiol*. 47(8), 891–896.
  31. Laroche, M.L., Charnes, J.P., Nouaille, Y., 2007. Is inappropriate medication use a major cause of adverse drug reactions in the elderly? *Br J Clin Pharmacol*. 63(2), 177–186.
  32. Barry, P.J., O'Keefe, N., O'Connor, A., O'Mahony, D.,

2006. Inappropriate prescribing in the elderly: a comparison of Beer's criteria and the improved prescribing in the elderly tool (IPET) in acutely ill elderly hospitalized patients. *J Clin Pharm Ther.* 31, 617-626.
33. Barnett, M.J., Perry, P.J., Langstaff, J.D., Kaboli, P.J., 2006. Comparison of rates of potentially inappropriate medication use according to the Zhan criteria for VA versus private sector medicare HMOs. *J Manag Care Pharm.* 12(5), 362-70.
34. Michael, A.S., Gary, E. R., Landefeld, C.S., Bertenthal, D., Peter, J. K., 2009. Agreement between Drugs-to-Avoid Criteria and Expert Assessments of Problematic Prescribing. *Arch Intern Med.* 169(14), 1326–1332.
35. Crownover, B.K., 2006. Referral bias and other perspectives on the HEDIS measuring stick for quality of care in depression treatment. *J Manag Care Pharm.* 12(1), 76-77.
36. Gallagher, P., Ryan, C., Byrne, S., 2008. STOPP (Screening Tool of Older Person's Prescriptions) and START (Screening Tool to Alert doctors to Right Treatment). Consensus validation. *Int J Clin Pharmacol Ther.* 46(2), 72–83.
37. Gallagher, P., O'Mahony, D., 2008. STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions): application to acutely ill elderly patients and comparison with Beer's criteria. *Age Ageing.* 37(6), 673–679.
38. Gallagher, P.F., O'Connor, M.N., O'Mahony, D., 2011. Prevention of Potentially Inappropriate Prescribing for Elderly Patients: A Randomized Controlled Trial Using STOPP/START Criteria. *Clin Pharmacol Ther.* 89(6), 845-54.
39. Barry, P.J., Gallagher, P., Ryan, C., O'Mahony, D., 2007. START (screening tool to alert doctors to the right treatment)-an evidence-based screening tool to detect prescribing omissions in elderly patients. *Age & Ageing.* 36(6), 632-8.
40. Laroche, M.L., Charmes, J.P., Bouthier, F., Merle, L., 2009. Inappropriate medications in the elderly. *Clin Pharmacol Ther.* 85(1), 94-97.
41. Chang, C.B., Chan, D.C., 2010. Comparison of published explicit criteria for potentially inappropriate medications in older adults. *Drugs Aging.* 27(12), 947-57.

**Corresponding author:**

Mandavi kashyap, Ph.D, PDF  
 AIMST University,  
 Semeling, Malaysia, 08100  
 Email: avi\_mandu@yahoo.co.in  
 Telephone no: 04-4298151  
 Fax no: 04-4298009