



Consequences of ignoring patient diagnoses when using the 2015 Updated Beers Criteria

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Abstract

Background: Beers Criteria are one of the best known explicit criteria to identify inappropriate medication in elderly that can be used in medication review. The access to patients' medical records may be different among healthcare professionals and settings and, subsequently, the identification of patients' diagnoses may be compromised. **Objective:** To assess the consequences of ignoring patient diagnoses when applying 2015 Beers Criteria to identify potentially inappropriate medication (PIM). **Setting:** Three nursing homes in Central Portugal. **Method:** Medical records of nursing home residents over 65 years old were appraised to identify medication profile and medical conditions. 2015 Beers Criteria were used with and without considering patients' diagnoses. To compare the number of PIM and PIM-qualifying criteria complied in these two judgements, Wilcoxon signed-rank tests were performed. **Main outcome measure:** Number of PIMs and number of PIM-qualifying criteria. **Results:** A total of 185 patients with a mean age of 86.7 years (SD = 7.8) with a majority of female (70.3%) were studied. When assessing the patients with full access to the diagnoses, median number of PIMs was 4 (IQR 0–10) and number of PIM-qualifying criteria was 5 (IQR 0–15). When evaluating only patient current medication, median number of PIMs was 4 (IQR 0–10) and PIM-qualifying criteria was 4 (IQR 0–12). Statistical difference was found in the number of PIM-qualifying criteria identified ($p < 0.001$), but not in the number of PIMs per patient ($p = 0.090$). In 171 patients (92.4%) PIMs identified were identical when using or ignoring their medical diagnoses. However, in 80 patients (43.2%) the PIM-qualifying criteria complied were different with and without access to patient diagnoses. **Conclusion:** Although restricted access to patients' diagnoses may limit the judgement of Beers PIM-qualifying criteria, this limitation had no effect on the number of PIM identified.

Keywords Aged · Beers Criteria · Medical records · PIPs · Portugal · Potentially inappropriate medication

Impacts on practice

- Limited access to patient medical records should be considered when selecting potentially inappropriate medicines identification tools.
- The lack of access to patients' diagnoses does not seem to be relevant to identify potentially inappropriate medicines when using 2015 Beers Criteria.
- Studies using Beers Criteria should clearly state if their results are expressed in number of inappropriate medicines or number of PIM-qualifying criteria identified.

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Introduction

The proportion of people over 65 years old is steadily increasing. Older people tend to present multiple comorbidities resulting in the use of more medications, which, added to their physiological changes with impact in pharmacokinetic and pharmacodynamics, challenges older people prescribing [1].

Although the number of medicines used is always associated to an increase of potential medication adherence issues, no agreement exists about the definition of polypharmacy, and differentiating between appropriate and inappropriate polypharmacy has been recommended [2]. Potentially inappropriate medication (PIM) can be defined as the use of medicines whose adverse risks exceed their therapeutic benefits [3–5]. Guaraldo et al. showed in their systematic review that the prevalence of PIMs ranges from 11.5 to 62.5% in community-dwelling aged patients [6]. The use of PIMs is associated with negative outcomes like hospitalisations, morbidity, mortality and higher health expenditures [4, 7, 8]. Consequently, researchers committed in creating criteria to identify PIMs and to guide prescription for elderly patients [9, 10].

Beers Criteria are one of the best known criteria to identify PIMs in elderly that can be used as explicit criteria in medication review [11]. They were first introduced in 1991 [12] by Mark H. Beers, and then have been subject of several updates [13–15]. The most recent version of the Criteria was released in 2015 and corresponds to the second version of the Criteria released by the American Geriatric Society [16]. Beers Criteria are considered explicit criteria because their use implies little or no clinical judgement [10]. However, differently to other explicit tools, 2015 Beers Criteria are more complex than a simple list of medicines to avoid. Beers Criteria also include criteria related to drug-disease interactions, medications to use with caution in elderly, drug-drug interactions, and inappropriate drugs based on kidney function [16]. Thus, Beers Criteria belong to the group of 22 explicit PIM lists, identified in a recent systematic review, that include medications to be avoided in the presence of individual diseases/conditions. This review identified a total of 536 different drug-disease interactions involving 84 diseases/conditions included in these criteria [17].

Making more complex statements, with more conditionals, may produce PIM criteria with higher specificity. However, access to patients' medical records, including patients' diagnoses, is not equally granted for the different healthcare professionals, and may vary from country to country. In those situations with no access to diagnoses, information required to apply PIM criteria depends on patients' self-report, which may produce inaccuracies due

to patients' memory and health literacy [5]. Little research has been done to identify the usability of PIM criteria with limited access to patients' medical records.

Aim of the study

This study aimed to assess the consequences of ignoring patient diagnoses when applying 2015 Updated Beers Criteria to identify PIMs.

Ethics approval

This study was approved by the University of Coimbra Medical School Ethics Committee (105-CE-2015).

Method

A cross-sectional study was conducted in three nursing homes in Central Portugal that are part of the University of Coimbra practice-based research network. All the patients aged over 65 years, living in the nursing homes at the time of the study were included for the study.

Beers Criteria

The 2015 American Geriatric Society's Beers Criteria for PIM Use in Older Adults [16] were presented in six Tables:

- Table 2 “medications to avoid for many or most older adults”;
- Table 3 “medications for older adults with specific diseases or syndromes to avoid”;
- Table 4 “medications to be used with caution”;
- Table 5 “potentially important non-infective drug-drug interactions”;
- Table 6 “drugs for which dose adjustment is required based on individual's kidney function” and
- Table 7 “drugs with strong anticholinergic properties”.

A given drug can be included in more than one of these tables, resulting in one PIM but in more than one PIM-qualifying criteria complied. Thus, a careful interpretation of PIMs and number of PIM-qualifying criteria complied is needed [18].

Data collection

A pharmacist trained in the use of Beers Criteria collected the information from patients' medical records. The 2015 Updated Beers Criteria were applied to the study population

in a two-stage process. In the first stage, 2015 Beers Criteria were applied using only the information contained in the socio-demographic characterization (age and gender) and patients' current medication list (i.e., international non-proprietary names, dosages, pharmaceutical forms, and regime of each medicine). In the second stage, patients' medical records were fully considered to, in addition to that previous information, identify medical conditions diagnosed by the medical team. In both stages, two authors applied independently the Beers Criteria, with consensus meetings when discrepancies existed. Criteria were applied to both long-term systemic medication and PRN medication. Topical medication and eye drops were excluded. The information of 2015 Beers Criteria Table 6 was ignored because creatinine clearance data were not available in patients' medical records.

Statistical analysis

Central tendency and dispersion measures were reported for continuous and discrete variables, and frequencies (absolute and relative) were reported for categorical variables. To compare the number of PIMs and the number of PIM-qualifying criteria identified per patient, non-parametric paired tests (i.e. Wilcoxon signed-rank) were performed. p values lower than 0.05 were considered as significant.

Results

The study included 185 patients with a mean age of 86.7 years (SD = 7.8) ranging from 66 to 105 years and 70.3% were female. These patients had a total of 1557 medicines prescribed (median 8; IQR 0–20), being 1406 long-term medications (median = 8; IQR 0–18) and 151 medicines used as PRN. The most prevalent therapeutic classes used were the proton pump inhibitors (83 patients), antithrombotic agents (79 patients), benzodiazepines (74 patients), diuretics (73 patients) and antidepressants (71 patients).

In the first stage, when considering only patients' current medication profile, Beers Table 3 (drug-disease interactions) could not be evaluated (no information of patients' medical conditions existed). Consequently, with the application of Beers Tables 2, 4, 5 and 7, 718 PIMs that made part of 848 PIM-qualifying criteria were identified. In this analysis, the median number of PIMs per patient was 4 (IQR 0–10), and the median number of PIM-qualifying criteria was 4 (IQR 0–12). Using the complete patients' medical records, in the second stage, allowed judging Beers Tables 2, 3, 4, 5 and 7. A total of 711 PIM that made part of 976 PIM-qualifying criteria were identified. The median number of PIMs per patient was 4 (IQR 0–10) and the median number of PIM-qualifying criteria complied was 5 (IQR 0–15).

No significant difference was found in the number of PIMs per patient between the two assessments (Wilcoxon signed-rank $p = 0.090$) (Fig. 1). Only 7 patients did not present any PIM, whether considering or ignoring their medical diagnoses. In 171 patients (92.4%) PIMs identified presented no difference when using or ignoring their medical diagnoses. In 10 patients the number of PIMs identified was higher when diagnoses were ignored (8 proton pump inhibitors, 1 amiodarone, and 1 testosterone + desmopressin). Conversely, in the remaining 4 patients the number of PIMs was higher when having access to diagnoses (1 COX2 inhibitor, 1 anti-convulsant, 1 opioid, and 1 H₂-receptor antagonist). Differently to the number of PIMs, a significant difference was identified between the number of PIM-qualifying criteria complied when considering or ignoring patients' diagnoses (Wilcoxon signed-rank $p < 0.001$) (Fig. 2). In 105 patients (56.8%) PIM-qualifying criteria complied were identical when considering or ignoring medical diagnoses, while in 75 patients the number of PIM-qualifying criteria complied was greater when considering patients' diagnoses, and in 12 patients the number of PIM-qualifying criteria decreased when accessing patients' diagnoses, including 7 patients with both disappearing criteria and new criteria.

The 14 differences in the number of PIMs were caused by only 11 drugs. Proton pump inhibitors (i.e. 5 omeprazol, and 1 esomeprazol, lansoprazol, pantoprazol) were considered PIMs when diagnoses were ignored, but not when diagnoses were considered because patients presented any of the risk that justify the use of these drugs in elderly. Similarly, testosterone was considered as PIM when diagnoses were ignored, but not when diagnoses were considered because a patient presented hypogonadism. Amiodarone presented a similar situation in a patient with concomitant heart failure. Conversely, four drugs were considered as PIM only after accessing the complete diagnoses: phenytoin and tramadol in two patients with history of falls, etoricoxib with heart failure, and ranitidine with Alzheimer's disease.

The reason why 75 patients increased the number of PIM-qualifying criteria when considering their diagnoses, was because these patients were using antipsychotics and benzodiazepines with dementia or cognitive impairment and history of falls, and anticholinergics with cognitive impairment, all of them complying with PIM-qualifying criteria included in Beers Table 3.

Discussion

This study demonstrates that, when using 2015 Updated Beers Criteria, the access to patients' diagnoses was relevant in the number of PIM-qualifying criteria but not in the number of PIMs identified in a cohort of elderly patients.

Fig. 1 Number of PIMs with and without access to patients' diagnoses

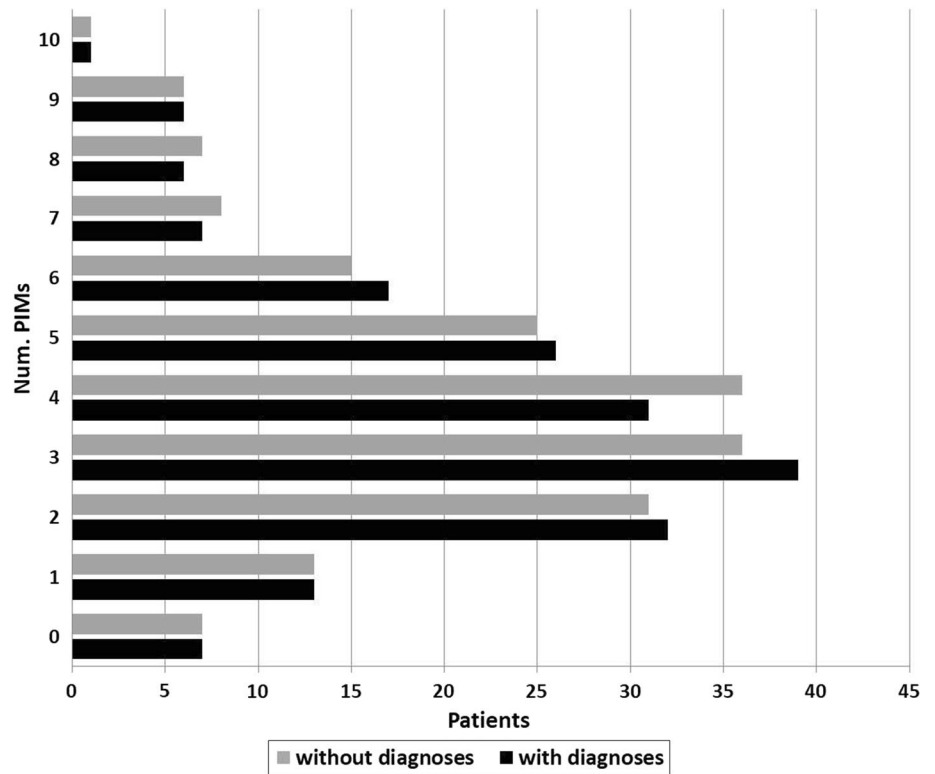
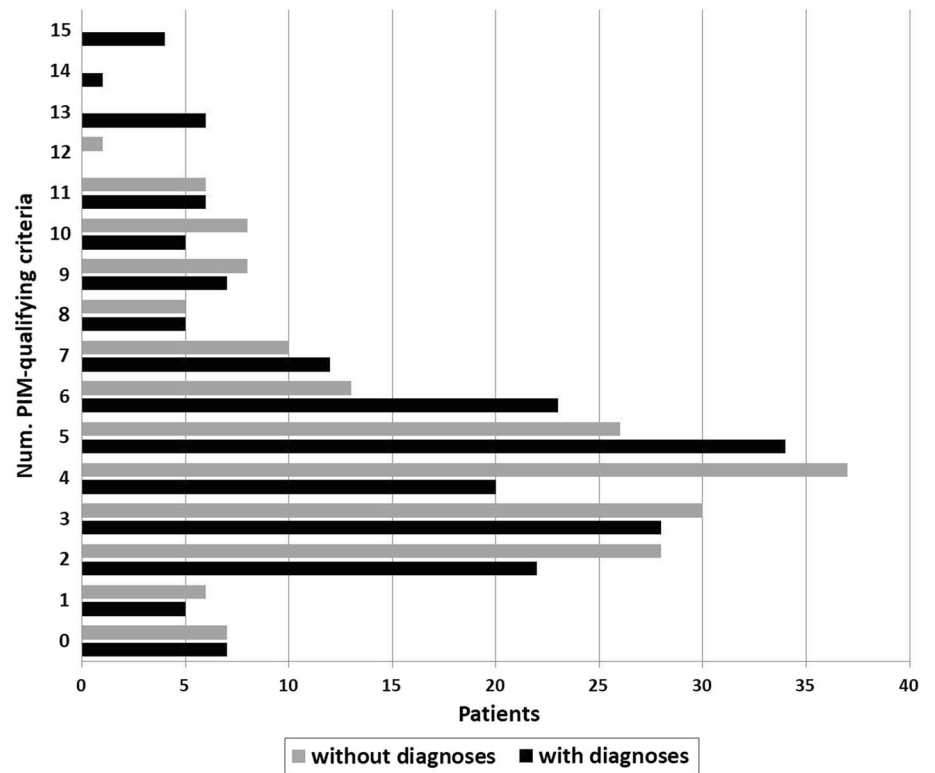


Fig. 2 Number of Beers PIM-qualifying criteria with and without access to patients' diagnoses



In fact, 92.4% of the patients had identical number of PIMs when considering or ignoring medical diagnoses.

The difference between PIMs and PIM-qualifying criteria has not been much explored in the literature. The number of PIMs refers to the number of different medicines that were classified as complying with one or more of the PIM-qualifying criteria presented in any of the six Beers Tables [4]. This means that one PIM can appear as part of more than one criterion. For example, anticholinergics, antipsychotics, benzodiazepines and non-benzodiazepine hypnotics appear in 2015 Beers Table 2 and, consequently, they can be classified as PIMs regardless the access to patient medical records. But these therapeutic classes are also listed in Beers Table 3—drug disease/drug syndrome criteria—specifically in cases of delirium, dementia or history of falls, situation where they should be avoided [15]. Thus, in a patient suffering one of these conditions, any of the aforementioned drugs would be considered as one PIM, but they would satisfy two PIM-qualifying criteria. Although the majority of the studies reported the number of PIMs [19–21], some reported only the number of PIM-qualifying criteria complied [18].

This difference between the number of PIM-qualifying criteria and the number of PIMs identified is also relevant when considering the necessity to access patients' diagnoses to judge the potential medication inappropriateness. In our population, we identified a significant increase in the number of PIM-qualifying criteria when accessing patients' diagnoses, compared to the judgement when ignoring this information. However, the vast majority of the PIM-qualifying criteria added with diagnoses included drugs that were already considered as PIMs, mainly based on Beers Table 2 (medications to avoid for many or most older adults) which does not require patients' diagnoses. These drugs include anticholinergics, benzodiazepines and antipsychotics, which are included in Beers Table 2, but also Beers Table 3 when associated a highly prevalent conditions in elderly. This redundancy between Beers Tables 2 and 3 may not add any value to this tool, and produces a false necessity of access to patients' diagnoses. In fact, the lack of diagnoses may overestimate the number of PIMs, mainly associated to the frequent use of proton pump inhibitors, which are also included in Beers Table 2, but this PIM-qualifying criteria accepts their use in "high risk patients (e.g. oral corticosteroids or chronic NSAID use), erosive esophagitis, Barrett's esophagitis, pathological hypersecretory condition, or demonstrated need for maintenance treatment" [15].

Subsequently, the chance of accessing patients' medical records has to be considered when selecting the tools that assess potentially inappropriate medicines. Some instruments cannot be used without patients' diagnoses, but others do not require that information. Our study demonstrates that in 2015 Updated Beers Criteria the access to patients' diagnoses was not relevant for the PIMs detected. PRISCUS List

[22] or EU(7)-PIM List [23], are other PIM-identification tools that do not require the access to patients' diagnoses, because they are lists of medicines to avoid. On the other hand, there are tools that cannot be used without access to patients' diagnoses. Examples of these are STOPP/START Criteria [24] and FORTA List [25] that are constituted by more complex criteria that require judgement with information of patients' diagnoses. Further studies comparing PIMs identifying tools in elderly should take into account the different settings where access to patients' medical records may be different.

Limitations

We characterised as PIMs all the situations where a PIM-qualifying criterion from Beers Table 4 was complied. Table 4 refers to medicines that should be "used with caution", which may invalidate the character of Beers Criteria as explicit criteria. The results obtained are limited to the residents of the three nursing homes studied, although there are no reasons to consider them as a particularly differentiated population, we cannot generalise these results. It is important to note that our aim was not depicting the PIMs in a population, but to assess the usability of 2015 Beers criteria with limited access to medical records by identifying the differences in the judgement when ignoring or considering patient diagnoses. To internationally validate these results, similar assessment should be repeated in other cohorts of elderly people.

Conclusion

Although restricted access to patients' diagnoses may limit the identification of some Beers PIM-qualifying criteria, this limitation was not relevant to identify PIMs in a cohort of elderly patients. The difference between the number of PIM-qualifying criteria and the number of actual PIMs should be considered when presenting results of Beers lists. The effect of the limited access to the complete information of patients' medical record should be evaluated for the different PIM identifying tools.

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Conflicts of interest The authors declare that they have no conflicts of interest.

References

- Hilmer SN, McLachlan AJ, Le Couteur DG. Clinical pharmacology in the geriatric patient. *Fundam Clin Pharmacol*. 2007;21(3):217–30. <https://doi.org/10.1111/j.1472-8206.2007.00473.x>.
- Mair A, Fernandez-Llimos F, Alonso A, Harrison C, Hurding S, Kempen T, et al. Polypharmacy Management by 2030: a patient safety challenge, 2nd ed. Coimbra: SIMPATHY; 2017. ISBN: 978-989-20-7674-4.
- Santos AP, Silva DT, Alves-Conceicao V, Antoniolli AR, Lyra DP Jr. Conceptualizing and measuring potentially inappropriate drug therapy. *J Clin Pharm Ther*. 2015;40(2):167–76. <https://doi.org/10.1111/jcpt.12246>.
- Lucchetti G, Lucchetti AL. Inappropriate prescribing in older persons: a systematic review of medications available in different criteria. *Arch Gerontol Geriatr*. 2017;68:55–61. <https://doi.org/10.1016/j.archger.2016.09.003>.
- Almeida TA, Reis EA, Pinto IVL, Ceccato M, Silveira MR, Lima MG, Reis AMM. Factors associated with the use of potentially inappropriate medications by older adults in primary health care: an analysis comparing AGS Beers, EU(7)-PIM List, and Brazilian Consensus PIM criteria. In: Research in social and administrative pharmacy: RSAP. 2018. <https://doi.org/10.1016/j.sapharm.2018.06.002>.
- Guaraldo L, Cano FG, Damasceno GS, Rozenfeld S. Inappropriate medication use among the elderly: a systematic review of administrative databases. *BMC Geriatr*. 2011;11:79. <https://doi.org/10.1186/1471-2318-11-79>.
- Hyttinen V, Jyrkka J, Valtonen H. A systematic review of the impact of potentially inappropriate medication on health care utilization and costs among older adults. *Med Care*. 2016;54(10):950–64. <https://doi.org/10.1097/MLR.0000000000000587>.
- Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, Hanlon JT. Appropriate prescribing in elderly people: How well can it be measured and optimised? *Lancet*. 2007;370(9582):173–84. [https://doi.org/10.1016/S0140-6736\(07\)61091-5](https://doi.org/10.1016/S0140-6736(07)61091-5).
- Kaufmann CP, Tremp R, Hersberger KE, Lampert ML. Inappropriate prescribing: a systematic overview of published assessment tools. *Eur J Clin Pharmacol*. 2014;70(1):1–11. <https://doi.org/10.1007/s00228-013-1575-8>.
- Chiappella LC, Menna JM, Mamprin ME. Potentially inappropriate medications in elderly ambulatory patients: a comparative study between a primary health care center and a community pharmacy. *Value Health Reg Issues*. 2018;17:119–25. <https://doi.org/10.1016/j.vhri.2017.12.009>.
- Beers MH, Ouslander JG, Rollinger I, Reuben DB, Brooks J, Beck JC. Explicit criteria for determining inappropriate medication use in nursing home residents. UCLA division of geriatric medicine. *Arch Intern Med*. 1991;151(9):1825–32.
- Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly. An update. *Arch Intern Med*. 1997;157(14):1531–6.
- Fick DM, Cooper JW, Wade WE, Waller JL, Maclean JR, Beers MH. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med*. 2003;163(22):2716–24. <https://doi.org/10.1001/archinte.163.22.2716>.
- American Geriatrics Society Beers Criteria Update Expert Panel. American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2012;60:616–31. <https://doi.org/10.1111/j.1532-5415.2012.03923.x>.
- American Geriatrics Society Beers Criteria Update Expert Panel. American Geriatrics Society 2015 Updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc*. 2015;63(11):2227–46. <https://doi.org/10.1111/jgs.13702>.
- Motter FR, Fritzen JS, Hilmer SN, Paniz EV, Paniz VMV. Potentially inappropriate medication in the elderly: a systematic review of validated explicit criteria. *Eur J Clin Pharmacol*. 2018;74(6):679–700. <https://doi.org/10.1007/s00228-018-2446-0>.
- Lavrador M, Fernandez-Llimos F, Caramona MM, Figueiredo IV, Castel-Branco MM. Impact of ignoring patient diagnoses when using 2015 Updated Beers Criteria. *Int J Clin Pharm*. 2018;40:222–3.
- Narvekar RS, Bhandare NN, Gouveia JJ, Bhandare PN. Utilization pattern of potentially inappropriate medications in geriatric patients in a tertiary care hospital: a retrospective observational study. *J Clin Diagn Res JCDR*. 2017;11(4):FC04–8. <https://doi.org/10.7860/jcdr/2017/21080.9731>.
- Zhang X, Zhou S, Pan K, Li X, Zhao X, Zhou Y, Cui Y, Liu X. Potentially inappropriate medications in hospitalized older patients: a cross-sectional study using the Beers 2015 criteria versus the 2012 criteria. *Clin Interv Aging*. 2017;12:1697–703. <https://doi.org/10.2147/CIA.S146009>.
- Bala SS, Narayan SW, Nishtala PS. Potentially inappropriate medications in community-dwelling older adults undertaken as a comprehensive geriatric risk assessment. *Eur J Clin Pharmacol*. 2018;74(5):645–53. <https://doi.org/10.1007/s00228-018-2412-x>.
- Bo M, Quaranta V, Fonte G, Falcone Y, Carignano G, Cappa G. Prevalence, predictors and clinical impact of potentially inappropriate prescriptions in hospital-discharged older patients: a prospective study. *Geriatr Gerontol Int*. 2018;18(4):561–8. <https://doi.org/10.1111/ggi.13216>.
- Holt S, Schmiedl S, Thurmann PA. Potentially inappropriate medications in the elderly: the PRISCUS list. *Deutsch Arzteblatt Int*. 2010;107(31–32):543–51. <https://doi.org/10.3238/arztebl.2010.0543>.
- Renom-Guiteras A, Meyer G, Thurmann PA. The EU(7)-PIM list: a list of potentially inappropriate medications for older people consented by experts from seven European countries. *Eur J Clin Pharmacol*. 2015;71(7):861–75. <https://doi.org/10.1007/s00228-015-1860-9>.
- O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age Ageing*. 2015;44(2):213–8. <https://doi.org/10.1093/ageing/afu145>.
- Kuhn-Thiel AM, Weiss C, Wehling M, members Faep. Consensus validation of the FORTA (Fit FOR The Aged) list: a clinical tool for increasing the appropriateness of pharmacotherapy in the elderly. *Drugs Aging*. 2014;31(2):131–40. <https://doi.org/10.1007/s40266-013-0146-0>.

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