



Research article

Assessing the knowledge, attitude and perception about potentially inappropriate medications among community pharmacists in Kedah, Malaysia

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ABSTRACT

Potentially inappropriate medications (PIMs) among geriatric are detrimental to both clinical outcomes and health care costs. Knowledge of PIMs among community pharmacists plays vital role in minimizing the inappropriate prescribing. Beers Criteria is commonly used guidelines that lists specific PIMs, where community pharmacists would benefit from knowledge of Beers Criteria in detecting PIMs in primary care. This study therefore investigates the knowledge, attitude and perception of PIMs among community pharmacists in Kedah, Malaysia. This is a prospective, cross-sectional study. The knowledge of PIMs; perception regarding PIMs; awareness of Beers Criteria; and perception of educational needs to enhance community pharmacists' knowledge about PIMs was assessed by using 5-point Likert scale. Descriptive statistics and Chi-square tests were used to analyse the data. In this study a total of 107 community pharmacists participated. The respondents demonstrated a higher-level knowledge of PIMs. All of the respondents agreed inappropriate medications among geriatric will cause increased in healthcare utilization, health complications and hospitalization. The respondents demonstrated poor awareness of Beers Criteria. Majority respondents were uncertain that Omeprazole is the most common Beers medication prescribed in healthcare system. Majority of respondents agreed incorporation of geriatric pharmacotherapy education as a core subject or elective subject and postgraduate education in geriatric pharmacotherapy can help to enhance community pharmacists' knowledge about PIMs among elderly patients. The community pharmacists in Kedah demonstrated high knowledge level of PIMs but poor awareness of the Beers Criteria. Thus, there is a need to increase the awareness and use of Beers Criteria among community pharmacists.

Keywords: Potentially inappropriate medications, AGS-Beers criteria, Geriatrics, Community pharmacists.

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INTRODUCTION

As ageing is associated with an increase of chronic diseases, elderly population are more likely to be administered with multiple medications, thus, are exposed highly to Potentially Inappropriate Medications (PIMs). PIMs are medications that should be avoided in elderly population because it provides greater risk of harm than benefit, particularly when there are more effective or safer alternatives to treat the same condition ^[1]. Indeed, PIMs are closely related to adverse drug events which is avoidable ^[2] and negative health outcomes, such as hospitalizations, emergency department visits and mortality and high healthcare costs ^[3]. In order to prevent these negative outcomes as well as optimize medication prescribing among elderly population, several screening tools have been developed to detect and identify the prevalence of PIMs, such as the Beers criteria ^[4], STOPP and START. According to a published article, Beers criteria can be easily applied and patient records review is not needed ^[5].

In healthcare settings, physicians play a very vital role in complex therapy management in elderly population. Physicians often facing the issues of PIMs usage, as it is estimated that 1 in 5 regularly used drugs is seen to be inappropriate among the elderly ^[6]. Inappropriate prescribing practices can be minimized when well-trained clinicians and community pharmacists are available in healthcare setups. To improve any drug outcomes in elderly can be consistently determined by exposing to continuous geriatric pharmacotherapy education. A pharmacist is an important member of a healthcare team and all of them are equipped with medical and pharmaceutical knowledge where they will interpret and communicate their specialized knowledge to patients and healthcare professionals. On the other hand, community pharmacists are the health professionals most accessible to the public. They supply medicines with a prescription or without a prescription when legally permitted.

Pharmacists' role compromises of other professional activities which includes participation in health promotion and provision of drug information to health professionals, patients and to the public. With extensive training in pharmacotherapy and pharmacokinetics, pharmacists play an important role in geriatric care which often lies with management of chronic diseases; poly pharmacy use and preventing harmful consequences of both. Any medication related problems can be detected, resolved and prevented by the pharmacist and they are competent in appraising the medical literatures and adhering to the clinical practice guidelines to care any patients which includes geriatric patients also [7].

Elderly population is population aged above 65 years who is experiencing the infirmities of aging as manifested by advanced age or organic brain damage, or other physical, mental or emotional dysfunction, to the extent that the ability of the person to provide adequately for his own care or protection is impaired [8]. According to the statistics in 2019, it indicated that there was 6.7% of aging population in Malaysia. However, the amount of people aged 65 years and above is estimated to boost up in the future. As stated by a chief statistician in Malaysia, there will be 15% of aging population could be reached in 2030 [9]. According to the World Health Organization (WHO), "Potentially inappropriate medications (PIMs)" are defined as those medicine which provide greater risk of harm than benefit, and this often occurs particularly in older patients more than 65 years old [10]. The geriatric population with multi morbidity (≥ 2 chronic conditions) and poly pharmacy (≥ 5 long-term medications) is the biggest challenges facing by the healthcare organisations especially primary healthcare [11]. The increase in prevalence of poly pharmacy among the elderly population causes the prevalence of PIMs increase as well [10]. The primary most vital risk factor for PIMs use is the number of prescribed medications.

Generally, poly pharmacy is defined as the usage of multiple medications simultaneously. Poly pharmacy are one of the risk factors for adverse drug events and hospitalisations among the elderly population [12]. Those adverse drug events aroused can be misinterpreted as new symptoms and new medications have been prescribed to treat the condition. This prescribing cascade (negative spiral of prescribing to treat side effects or interactions) will increase the risk of PIMs. Furthermore, it also increases both with drug-drug and drug-disease interactions [13]. Nowadays, appropriate prescribing in the elderly population is very challenging. Firstly, elderly population have high potential risk of medication-related harm due to age-related changes in pharmacokinetics and pharmacodynamics, lower physiological reserve and drug-drug or drug-disease interactions [12]. Furthermore, geriatric patients are more prone to PIMs due to lack

of evidence regarding the advantages and side effects of medications on multi morbidity older adults [14]. The application of single disease evidence-based guidelines to geriatric patients with multi morbidity lead to complex poly pharmacy as they do not take into consideration about the potential drug-drug and drug-disease interactions [15].

According to Journal of the American Geriatrics Society, about 20-60 % of elderly patients take medicines that may be potentially inappropriate [16]. It depends on the healthcare setting or criteria used to define inappropriate prescribing. This may lead to increase of risk for being hospitalized, visiting to the emergency department (ED), experiencing poor quality of life, and/or harmful adverse drug reactions. As a result, certain drugs are categorized as potentially inappropriate medications (PIM) for the geriatric patients because they carry high potential risk of adverse drug reactions. However, the problem of PIMs may be reversed through de-prescription or replaced the drug regimen by another safer alternative [17].

Several studies have evaluated that when geriatric patients are hospitalized, they are often discharged on different drug regimens from those administered previously [18]. Any changes of patients' drug regimens may take place due to several reasons, including: new health conditions, ineffective pharmaceutical treatment or drugs adverse events. Hospitalization can provide an opportunity for the health care team to review and optimize the medication regimen of the patients with the potential to reduce PIMs problem at discharge [19]. However, some studies report indicates that environment may lead to development of new PIMs [20]. Although several clinical trials showed that in-hospital interventions provide opportunity to improve the medication appropriateness, no study has been conducted to study the development of new PIMs prescribed on subsequent drug adverse events in the post hospitalization period [21].

PIMs use among the elderly people is an important public health concern due to its high prevalence and complications. To provide optimal therapy physicians and community pharmacists should know which drugs should be avoided in the older people and which drugs to be optimally used. There are many validated tools available to screen for the presence of PIMs in the elderly patients of different settings. For example, Beer Criteria 2019 is one of the useful guidelines utilized by healthcare professionals to improve the safety of prescribing medications for older adults. Beer Criteria 2019 is divided into five categories i.e., PIMs use in older adults according to organ system, therapeutic category, drugs; PIMs use in older adults due to drug-disease or drug- syndrome interactions that may exacerbate the disease or syndrome; PIMs to be used with caution in older adults; potentially clinically important drug-drug interactions that should be

avoided in older adults; medications that should be avoided or have their dosage reduced with varying levels of kidney function in older adults [4].

Physicians may be busy and may not know appropriate prescribing to the patients and physicians should rely on pharmacists. In Malaysia, pharmacy practice is classified into various types according to pharmacist's services. They are classified into Hospital Pharmacy, Community Pharmacy, Education Pharmacy, regulatory control, drug management and so on. In the fields of pharmacy mentioned above, the ultimate goal is to ensure the optimal therapy of drugs both by contributing to the preparation, supply and control of medicines and associated products, as well as providing health advices to the general public. To improve better drug outcomes in the elderly, innovative education continuing programs needed to up-date the knowledge regarding PIMs among elderly.

MATERIALS AND METHODS

This prospective, cross-sectional study was conducted to assess the knowledge, attitude and perception of potentially inappropriate medications (PIMs) among community pharmacists in Kedah as well as to evaluate the awareness of Beers Criteria and educational needs to enhance community pharmacists' knowledge regarding PIMs among the geriatric patients. This research study was conducted on randomly selected respondents from community pharmacy in Kedah. Participants were distributed with validated online google form questionnaire for their response. This study was approved to conduct by the AIMST University Human Ethics Committee (Reference Number - AUHEC/FOP/2021/17) and informed consent was collected from all the study participants. Those who were not willing to participate in this study were not included in this study.

The questionnaire contains 4 different sections related to knowledge of potentially inappropriate medications (PIMs), perception of community pharmacists about PIMs, awareness of Beers Criteria and perception of educational needs to enhance community pharmacists' knowledge regarding potentially inappropriate medications (PIMs) among the geriatric patients. These questions were accessed by using Likert scale ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree". All data required was recorded and data collected was analysed prospectively. The analysis was performed using IBM SPSS Statistics for Windows (Version 26.0. Armonk, NY: IBM Corp.). Descriptive statistics was utilized for selected variables. Numerical data which is normally distributed was presented as mean and standard deviation while median and interquartile range was presented for numerical data which is not normally distributed. Descriptive statistics was used to analyse demographic data. Shapiro-wilk test was applied to check for normality of collected data. Chi

square test was used for dichotomous variables and to look for association between the independent variables. Statistical significance was set at p value less than 0.05. This study was performed in accordance to the principles of the Declaration of Helsinki, as revised in Washington in 2013.

RESULTS

Table 1: Demographic of respondents.

Variables	Frequency	% (n=107)	
Age	21-30	97	90.7
	31-40	6	5.6
	>40	4	3.7
Gender	Male	36	33.6
	Female	71	66.4
Race	Malay	8	7.5
	Chinese	94	87.9
	Indian	4	3.7
	Others	1	0.9
Years of Practice	<5	93	86.9
	5-10	11	10.3
	11-20	3	2.8

Table 2: Knowledge Assessment regarding PIMs

Survey statement	Agreement Mean \pm SD*
Community Pharmacists' knowledge about PIMs among geriatric.	
PIMs are defined as "medications that should be avoided due to their risk which outweighs their benefit and when there are equally or more effective but lower risk alternatives are available".	4.23 \pm 0.467
Inappropriate medication usage is an issue among older patients (aged \geq 65 years), particularly those who have concomitant morbidities.	4.03 \pm 0.574
Factors associated with inappropriate medications use are variable: Gender, older age, polypharmacy, having multiple prescribers' and having poor health status.	4.20 \pm 0.465
Unscheduled PIMs are closely related to adverse drug reactions and negative health outcomes, such as hospitalizations, visiting to the emergency department, mortality and high health costs.	4.13 \pm 0.414
Beers Criteria, STOPP and START criteria are validated screening tools that can be used to identify the presence of PIMs among geriatric.	3.83 \pm 0.541

A total of 107 respondents participated in the study, comprising 36 males and 71 females. Table 1 depict the demographic data based on age, gender, race and years of practice in community pharmacy.

The knowledge of respondents regarding the PIMs among geriatric was assessed based on the questions summarized in Table 2. The practicing pharmacists who understood the definition of PIMs had significantly higher mean score (4.23 \pm 0.467), followed by their understanding of factors associated with inappropriate medication

(4.20 ± 0.465) but lower mean score (3.83 ± 0.541) for their awareness of PIMs screening tools. This indicates high proportion of respondents are aware of the PIMs issues but some of them are not aware of the utilization of Beers Criteria, STOPP and START criteria in identifying the PIMs.

Table 3: Awareness on Beers Criteria

Survey statement	Agreement Mean ± SD*
Community Pharmacists' awareness of Beers Criteria.	
The Beers Criteria are lists of inappropriate or potentially inappropriate medications for patients age 65 and older.	3.92 ± 0.616
Anticholinergics, Benzodiazepines and NSAIDS are some medication classes included in the Beers Criteria.	3.82 ± 0.546
Omeprazole is the most common Beers medication prescribed within the system.	3.50 ± 0.556
Benzodiazepine use in elderly patients is associated with cognitive impairment, delirium, falls, fractures, and motor vehicle crashes.	3.56 ± 0.617
There is a gap between patient education and Beers medication prescriptions within the system.	3.87 ± 0.551

The awareness of Beers Criteria among respondents were tabulated in Table 3, which reveals an equivalent means and standard deviation for each of the questions but relatively lower as compared to other section. Based on the statistics, the respondents were aware that Beers Criteria is designed to assess PIMs for patients aged 65 and above have shown mean score of (3.92 ± 0.616). However, the respondents uncertain Omeprazole is the most common Beers medication prescribed shown mean score of (3.50 ± 0.556).

Table 4: Perception of Respondents about PIMs

Response of Community Pharmacists	Frequency	% Of respondents
Inappropriate medications for older adults have been linked to increased healthcare utilization, health complications, and hospitalization.	107	100
PIMs resulted in increased costs, inappropriate prescribing, and poor health outcomes.	105	98
The Emergency Department is an important site that can provide case findings for older adults at risk for inappropriate medication prescription use.	73	78
Community pharmacist play an important role in promoting rationale and safe medication use in geriatric patient.	106	99
Exposure to continuing education in geriatric pharmacotherapy in the workplace helps to improve drug outcomes in the elderly.	104	97

For assessment of perception regarding PIMs (Table 4), all the respondents agreed inappropriate medications among geriatric will cause increased in healthcare utilization, health complications and hospitalization, followed by 99% of them agreed community pharmacist play an important role in promoting rationale and safe medication use in geriatric patient. For assessment of educational

needs, 91% and 90% of respondents agreed incorporation of geriatric pharmacotherapy education as a core subject or elective subject as well as postgraduate education in geriatric pharmacotherapy can help to enhance knowledge about PIMs among geriatric respectively.

There is significant relationship between age and years of practice with knowledge of PIMs and awareness of Beers Criteria. Majority of the pharmacists within age 21 to 30 were aware of the PIMs screening tools (83.5%), agreed Anticholinergics, Benzodiazepines and NSAIDS are some medication classes included in the Beers Criteria (82.4%). However, all pharmacists age 31 and above were uncertain about Beers Criteria list and uncertain that Omeprazole is the most common Beers medication prescribed, Benzodiazepine use in geriatric is associated with cognitive impairment, delirium, falls, fractures, and motor vehicle crashes, there is a gap between patient education and Beers medication prescriptions within the system. Majority of respondents with less than 5 years of practice in community pharmacy aware of the screening tools of PIMs (81.7%), agreed that Beers criteria is specially designed for patients age 65 and older (82.8%). However, all pharmacists with years of practice within 11-20 uncertain about medication classes in the Beers Criteria, there is a gap between patient education and Beers medication prescriptions within the system.

DISCUSSION

Due to improving healthcare system, increasing life expectancies, and decreasing fertility rates, the ageing population worldwide as well as in Malaysia, is predicted to be increased at an unprecedented rate in future. Thus, it is vital that healthcare professionals are well-equipped to deal with the increased risk of PIMs among elderly due to their detrimental effects on both clinical outcomes and health care costs. Familiarity of specific geriatric guidelines such as the Beers, START and STOPP Criteria among community pharmacists can significantly aid with the detection of PIMs and ensure good quality pharmaceutical care to older adults.

The knowledge of PIMs is vital since inappropriate prescribing practices can be minimized when well-trained community pharmacists are available in healthcare setups. To determine the knowledge or ability of community pharmacists to provide better pharmaceutical care to older adults, the knowledge of PIMs and awareness of Beers Criteria among the respondents were measured. The respondents demonstrated a high-level knowledge of PIMs when observing higher mean score for each of the questions assessed. There was significant relationship between age and years of practice of community pharmacists with their knowledge of PIMs. Majority respondents with age range 21-30 demonstrated higher knowledge level about PIMs as compared to those aged beyond 30, perhaps aware

of the need to improve their skills in providing care to older customers, thus regularly referred to other resources and improved their knowledge through continuous professional development. Experience also improved knowledge of PIMs to a certain level but started to drop beyond 10 years of practice. For example, majority respondents with not more than 10 years of practice knew Beers, STOPP and START criteria are validated screening tools that can be used to identify the presence of PIMs among geriatric but respondents beyond 10 years of practice were uncertain about it. It could be due to less exposure of knowledge regarding PIMs among geriatric in older education system and hence further highlights the need for enhancing geriatric pharmacotherapy (GPT) education at pharmacy undergraduate level.

According to similar studies [Ryan T.K Foong et al., (2020)], it demonstrated an average knowledge of PIMs among the community pharmacists involved in the study [22]. The potential improvements may be resulted from increased dissemination of geriatric -specific guidelines with regard to the detection of PIMs in primary care. There was association between experience with the improved knowledge of PIMs to a certain level but the knowledge score dropped slightly beyond 20 years of practice [22]. This can be due to the knowledge of PIMs is not regularly given emphasis in older education system.

At the same time, the perception of community pharmacists about PIMs among geriatric was assessed. All of the respondents agreed inappropriate medications among geriatric will cause increased in healthcare utilization, health complications and hospitalization. The physiologic changes in pharmacokinetics and pharmacodynamics in old age go together with polypharmacy and PIM can contribute to a higher risk of ADEs. Consequently, it will lead to significant morbidity and mortality, as well as may increase the health care expenditures. Furthermore, majority of them think community pharmacist play an important role in promoting rationale and safe medication use in geriatric patient. Community pharmacists are described as “primary care pharmacists” due to their easy accessibility to the public, thus recognizing their contribution in delivering primary health care services. The involvement of pharmacist in primary health care services can help to reduce errors, improve prescribing practices, and enhance patient monitoring across settings.

The awareness of Beer Criteria is based on the understanding of community pharmacists regarding the guidelines. This will influence the community pharmacists’ dispensing pattern among geriatric patients. In this study, the respondents demonstrated poor awareness of Beers Criteria when considering lower mean score for individual questions in its section. Analysis of the individual questions revealed that the respondents actually felt uncertain in questions that

involved PIMs medications in Beers Criteria list. It could possibly be the result of assumptions on safety due to their frequency of use and thus further highlights the need for enhancing professional education regarding individual PIMs in specific older populations. For example, majority respondents were unaware that Omeprazole is the most common Beers medication prescribed within the system. Omeprazole is a proton-pump inhibitor (PPI) which is frequently prescribed to treat certain stomach conditions by decreasing levels of stomach acid. Many people also use omeprazole to protect the stomach when taking NSAIDS. However, the long-term use of PPI especially among geriatric will lead to certain side effects such as Clostridium difficile-associated colitis, community-acquired pneumonia, acute interstitial nephritis, vitamin B12 deficiency, and hip fracture risk [24]. Furthermore, majority respondents were uncertain that Benzodiazepine use in geriatric is associated with cognitive impairment, delirium, falls, fractures, and motor vehicle crashes. Benzodiazepines are belonged to the group of hypno-sedative medications. They are commonly prescribed for anxiety disorders and sleep problems and are widely used in younger adults as well as in the older population. However, their pharmacological profile can be influenced by age-related changes in pharmacokinetics and pharmacodynamics resulting in an increased potential to cause adverse effects such as daily sleepiness, fatigue, falls, cognitive impairment, and confusion [25]. Falls in older people are described as multifactorial adverse events, with use of particular medications being one of the potential risk factors. Therefore, risk/benefit ratios of particular active substances in the group of PPIs and benzodiazepines, their cautious indication for specific problems and rational selection, particularly in older adults with various multiple comorbidities, should be carefully evaluated in daily clinical practice. There was significant relationship between age and years of practice of community pharmacists with their awareness of Beers Criteria. Majority respondents aged 30 above with years of practice beyond 10 were unaware of Beers Criteria, perhaps indicating unfamiliarity with the latest recommendations.

Based on the similar studies [Ryan T.K Foong et al., (2020)], the awareness of Beers Criteria remained low among community pharmacists in Malaysia [22]. The result shown most respondents were unaware that low-dose aspirin should be used with caution when the indication is primary prevention of cardiovascular events in patients above 80 years of age. Furthermore, neither increased education nor experience were associated with increased awareness among the community pharmacists in the study, implying that Beers Criteria may not regularly given emphasis within community pharmacy practice in general. This further highlight the awareness of Beer Criteria should be given enough emphasis in both formal and continuing education.

Perception of community pharmacists regarding the educational tools needs to enhance the knowledge of PIMs among geriatric was evaluated. The educational needs regarding PIMs are evaluated based on the community pharmacists' opinion or perception on how to enhance knowledge of PIMs among future pharmacists. Majority of respondents agreed incorporation of geriatric pharmacotherapy education as a core subject or elective subject and postgraduate education in geriatric pharmacotherapy can help to enhance knowledge about PIMs among elderly patients. According to similar studies [Pradeep Battula et al., (2015)], all the respondents agree additional educational or continuing pharmacy education is necessary for improving knowledge of geriatric [23]. This further highlight knowledge is basic of everything in order to provide good quality healthcare services to the geriatric patients. The role of community pharmacists in detecting PIMs would be useful, but must be coupled with more formal initiatives aimed at both undergraduate education and continuous professional development for community pharmacists. Increased incorporation of Beers Criteria and other geriatric prescribing tools (STOPP and START Criteria) in undergraduate pharmacy education can be achieved by making it a mandatory component of the curriculum during the accreditation process. On the other hand, professional bodies can develop specific training modules that include these tools for community pharmacists to increase their familiarity with the latest recommendation. This can be supplemented with formal certification of pharmacists with an interest in geriatrics to encourage community pharmacists to proactively increase their knowledge in the subject area.

CONCLUSION

The risk and incidence of PIMs are set to increase as the ageing population worldwide and in Malaysia continues to expand, posing a substantial risk to the health care system in both the context of clinical outcomes and costs. Community pharmacists may aid significantly in the detection of PIMs in primary care therefore should be adequately trained and equipped to detect PIMs. As the Beers Criteria remains one of the most regularly updated guidelines on PIMs, awareness and application of Beers Criteria among community pharmacists in their practice would significantly aid such efforts. The study revealed that awareness of Beers Criteria was low among the community pharmacists and majority respondents feel uncertain in questions that involved PIMs medications which have been included in the Beers Criteria. Nevertheless, community pharmacists still demonstrate high knowledge level of PIMs, perhaps aware of the need to improve their skills in providing care to geriatric patients, thus regularly referred to other resources and improved their knowledge through continuous professional development. The study also revealed

that all the respondents agreed inappropriate medications among geriatric will cause increased in healthcare utilization, health complications and hospitalization. Therefore, efforts to ensure that healthcare professionals are adequately prepared to deal with PIMs through the application of geriatric-specific guidelines such as the Beers Criteria should therefore be given due attention. Majority of respondents agreed incorporation of geriatric pharmacotherapy education as a core subject or elective subject and postgraduate education in geriatric pharmacotherapy can help to enhance community pharmacists' knowledge about PIMs among elderly patients. Hence, a dual-pronged approach aimed at both undergraduate pharmacy education and continuous professional development for community pharmacists should be emphasised to provide good quality healthcare to geriatric.

Conflict of interest:

All the authors declare no conflicts of interest.

REFERENCES

1. Tommelein E, Els M, Mirko P, et al, 2015. Potentially inappropriate prescribing in community-dwelling older people across Europe: A systematic literature review. *European Journal of Clinical Pharmacology*, 71(12), Pages-1415-1427. doi: 10.1007/s00228-015-1954-4.
2. Hedna K, Katja MH, Hanna G, et al, 2015. Potentially inappropriate prescribing and adverse drug reactions in the elderly: A population-based study. *European Journal of Clinical Pharmacology*, 71(12), Pages-1525-1533. doi: 10.1007/s00228-015-1950-8.
3. Varga S, Matthew A, Scott WK, et al, 2017. Hospitalization rates during potentially inappropriate medication use in a large population-based cohort of older adults. *British Journal of Clinical Pharmacology*, 83, Pages-2572–2580. doi: 10.1111/bcp.13365.
4. American Geriatrics Society 2019 Beers Criteria Update Expert Panel. 2019. American Geriatrics Society 2019 updated beers criteria for potentially inappropriate medication use in older adults. *Journal of the American Geriatrics Society*. 67, Pages-674-694. doi: 10.1111/jgs.15767.
5. Michael AS, Judith LB, Catherine ED, et al, 2015. How to Use the American Geriatrics Society 2015 Beers Criteria—A Guide for Patients, Clinicians, Health Systems, and Payors. *Journal of the American Geriatrics Society*. 63, Pages-e1–e7. doi: 10.1111/jgs.13701.
6. Anderson K, Stowasser D, Freeman C, et al, 2014. Prescriber barriers and enablers to minimising potentially inappropriate medications in adults: a systematic review and thematic synthesis. *BMJ Open*, 4(12): Pages- e006544. doi: 10.1136/bmjopen-2014-006544.
7. Jeannie KL, Samah A, Hussam IK, et al, 2015. Optimizing pharmacotherapy in elderly patients: the role of pharmacists. *Integrated Pharmacy Research and Practice*, 4, Pages-101–111. doi: 10.2147/IPRP.S70404.

8. Amann U, Schmedt N, Garbe E, 2012. Prescribing of potentially inappropriate medications for the elderly: an analysis based on the PRISCUS list. *Deutsches Ärzteblatt International*, 109(5), Pages-69-75. doi: 10.3238/arztebl.2012.0069.
9. Keith M, Stewart WM, 2015. Challenges of managing people with multimorbidity in today's healthcare systems. *Moffat and Mercer BMC Family Practice*, 16, Page-129. doi: 10.1186/s12875-015-0344-4.
10. Aubert CE, Sven S, Bruno RDC, et al, 2016. Polypharmacy and specific comorbidities in university primary care settings. *European journal of internal medicine*, 35, Pages-35–42. doi: 10.1016/j.ejim.2016.05.022.
11. Fabrizia L, Irma L, Claudio P, et al, 2012. Geriatric Conditions and Adverse Drug Reactions in Elderly Hospitalized Patients. *Journal of the American Medical Directors Association*, 13(2), Pages-96-9. doi: 10.1016/j.jamda.2011.04.006.
12. Marjan VDA, Bert V, Geert G, et al, 2019. Trends in multimorbidity and polypharmacy in the Flemish-Belgian population between 2000 and 2015. *PLoS One*, 14(2), e0212046. doi: 10.1371/journal.pone.0212046.
13. Mangoni AA, Jackson SHD, 2014. Age-related changes in pharmacokinetics and pharmacodynamics: basic principles and practical applications. *British journal of clinical pharmacology*, 57(1), Pages-6–14. doi: 10.1046/j.1365-2125.2003.02007.x.
14. McCarthy LM, Visentin JD, Rochon PA, 2019. Assessing the Scope and Appropriateness of Prescribing Cascades. *Journal of the American Geriatrics Society*, 67(5), Pages-1023–1026. doi: 10.1111/jgs.15800.
15. Daniala LW, Todd CL, Emily GM, et al, 2020. Both New and Chronic Potentially Inappropriate Medications Continued at Hospital Discharge Are Associated with Increased Risk of Adverse Events. *Journal of the American Geriatrics Society*, 68, Pages-1184-1192. doi: 10.1111/jgs.16413.
16. Emma W, Chris S, Bruce G, et al, 2015. Managing patients with multimorbidity in primary care. *British Medical Journal*, Pages-350, h176. doi: 10.1136/bmj.h176.
17. Pérez T, Moriarty F, Wallace E, et al, 2018. Prevalence of potentially inappropriate prescribing in older people in primary care and its association with hospital admission: longitudinal study. *British Medical Journal*, Pages-363, k4524. doi: 10.1136/bmj.k4524.
18. Viktil KK, Blix HS, Eek AK, et al, 2012. How are drug regimen changes during hospitalisation handled after discharge: a cohort study. *BMJ Open*, 2(6): e001461. doi: 10.1136/bmjopen-2012-001461.
19. Forster AJ, Harvey JM, Josh FP, et al, 2005. Adverse drug events occurring following hospital discharge. *Journal of General Internal Medicine*, 20(4), Pages-317-323. doi: 10.1111/j.1525-1497.2005.30390.x.
20. Ryan TKF, Renukha S, Jason SEL, et al, 2020. Awareness of Beers Criteria and knowledge of potentially inappropriate medications among community pharmacists in the Klang Valley, Malaysia. *Journal of Evaluation in Clinical Practice*, 26(1), Pages-165-171. doi: 10.1111/jep.13180.
21. Pradeep B, Kali CS, Matam SA, et al, 2015. Pharmacy Student Knowledge, Educational Needs on Geriatrics Patients: A Cross-sectional Study. *Inventi Rapid: Pharmacy Practice*, 3, Pages-1-3.
22. Yoshikazu K, Norihisa I, Shunji I, et al, 2018. Advantages and Disadvantages of Long-term Proton Pump Inhibitor Use. *Journal of Neurogastroenterology and Motility*, 24(2), Pages-182–196. doi: 10.5056/jnm18001.
23. Anna LB, Daniela F, 2016. Benzodiazepines, Age-Related Pharmacological Changes, and Risk of Falls in Older Adults. *Neuropathology of Drug Addictions and Substance Misuse*, 3, Pages-334-344. Doi: 10.1016/B978-0-12-800634-4.00033-0.

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