RESEARCH ARTICLE

Prevalence of potentially inappropriate medications among geriatric residents in nursing care homes in Malaysia: a cross-sectional study

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Abstract

Background Polypharmacy has been associated with an increased risk of morbidity and mortality among older adults especially those living in nursing homes. Explicit criteria to evaluate the appropriateness of medications have recently been updated. *Objective* To estimate and compare the prevalence of potentially inappropriate medications (PIMs) among older adults in nursing homes using screening tool for older people's prescription (STOPP-2) and the 2015 Beers criteria. *Setting* Nursing care homes in the Klang Valley, Malaysia. *Method* A cross-sectional survey of medications used among residents living in nursing homes was performed. The 2015 Beers criteria and STOPP-2 criteria were used to evaluate the use of PIMs among this population. These PIMs were subsequently classified using the Pharmaceutical Network Europe classification (PCNE). *Main outcome measure* Number of PIMs among residents using both criteria. *Results* A total of 155 residents were recruited into the study. The prevalence of PIMs was 9.7% using the STOPP-2 criteria, 17.6% using the 2015 Beers criteria and 21.3% when both tools were used in combination. The PCNE criteria identified a total of 198 drug related issues, with an average of 1.27 issue per resident. Factors associated with higher risk of having PIM include multiple medication use and history of psychiatric disorder. *Conclusion* The 2015 Beers criteria was able to identify more PIM's compared to STOPP-2 criteria. The findings also support the expansion of pharmacists' services in nursing homes in Malaysia.

Keywords Beers criteria · Nursing homes · Pharmacist service · Potentially inappropriate medication · STOPP

Impacts on practice

- Health care profession should call attention to polypharmacy and psychotic disorders as there is an association with higher risk of potentially inappropriate medications.
- The use of tools such as Beers criteria or the STOPP tool is useful in helping to identify potentially inappropriate medications in nursing home residents in Malaysia.
- Physicians and pharmacist should consider using both tools hand-in-hand during medication review to optimise the care of older adults.
- There is a role for pharmacist to offer medication review services to nursing homes in Malaysia.

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Introduction

Southeast Asia with a total population approaching 700 million, will have an aging population that will surpass that of North America and Europe by 2050 [1]. In Malaysia, it is

estimated that there will be more than 7 million or 17.6% of the population older than 65 by 2040 [2]. This increasing numbers of the elderly represents a challenge for medicine due to the many implications it brings, including comorbidities such as non-communicable diseases as well as their complications [3, 4]. Managing these multiple health problems creates a tension for many prescribers due to the need to treat the condition while avoiding the risk associated with multiple medication use or polypharmacy.

Polypharmacy (defined as 5 or more regular prescription drugs [5]) have been shown to result in negative health outcomes such as adverse drug events, drug-interactions, medication non-adherence, decreased functional status and geriatric syndromes [6–8]. In North America, epidemiological studies have documented widespread use of potentially inappropriate medications (PIM) among nursing home residents (up to 40%) and community-dwelling older adults (14–37%). The use of PIMs among older adults is estimated to be the fifth most common cause of mortality among hospitalised patients [9]. These results have been similarly reported in other countries. In Norway, more than 4 in every 5 nursing homes resident were found to have some drug-related problem (DRP) [10]. Another study among Australian nursing homes found a total of 1433 DRPs in 480 of the 500 residents [11].

In Malaysia, nursing homes are operated by either the government-led and funded public sector or the private sector. These nursing homes are not regulated, and therefore only very few nursing homes have a dedicated physician or pharmacist working to promote the quality use of medicine. Most of these facilities are staffed by nurses and residents often seek medical treatment either at the government hospitals or primary healthcare facilities. Due to this fragmented system, there is limited information available on the prevalence and incidence of PIM patterns in nursing homes in Malaysia. Only few studies have reported these issues in Malaysia. For example, in the study by Chen and colleagues, the authors found the prevalence of PIMs use among nursing home residents was 32.7% using the Beers criteria [12]. This has similarly been reported by Lee and colleagues in 2014 which found a mean of 6.1 medication related problem per resident [3]. Hasan et al. [13] also reported that nearly 36% of the nursing home residents were prescribed at least one PIM. However, all of these studies were conducted in private or NGO-based nursing homes, and no studies have reported the prevalence of PIM patterns especially from the government-funded residential homes.

Aim of the study

The current study aims to identify the number and types of PIMs among nursing care home residents (both private and government funded) in Malaysia. The current study also aimed to compare the efficiency of different instruments, namely the Beers tool and START/STOPP tool which has recently been updated in identifying PIMs.

Ethics approval

The study was approved by the Monash University Human Research Ethics Committee (CF13/2911-2013001564).

Methods

Study setting

This was a multi-centre, cross sectional study conducted between November to December 2016 in four nursing care homes in Malaysia. The four nursing homes had a capacity to cater for 297 residents (range 12–240; median 15), and comprise of 3 private and 1 government run nursing homes. These homes offered between two to five medical services, including long term care, palliative care, assisted living, day care as well as dementia care.

Inclusion/exclusion criteria

Individuals aged 60 years and older (the age limit for elderly as recommended by the World Health Organisation for developing countries) who were taking at least one medication were included in the current study. Written informed consent was obtained from the resident prior to study participation. If the resident was too ill or had no next-of kin who could provide consent, the resident was excluded from the study.

Data collection

In the first visit, biodata of residents, including their age, gender, race, medical and hospitalisation history, current medications and fall risk assessment were documented via semi-structured interviews with the residents, carer and medical record. During the second visit, the blood pressure, body weight, blood glucose and plasma cholesterol of all residents were measured to evaluate their current health status. All data collection were performed by four final year pharmacy students under the supervision of the two academics (with postgraduate degree in pharmacy practice).

Assessment of medication appropriateness

The English version of the following tools were used to classify the medication as potentially inappropriate: the 2015 American Geriatric Society Beers Criteria [14] and the STOPP (screening tool of older persons' prescription)/

START (screening tool to alert doctors to right treatment) version 2 [15]. These were then broadly classified using the problems domain of Pharmaceutical Care Network Europe classification V7.0 (PCNE V7.0) [16] by two independent reviewers. A brief description of each tool is given below.

Beers criteria

The Beers' criteria was a tool developed in 1991 to screen patients' drug list and identify drugs known to produce undesirable health effects among older adults [17]. The criteria were revised in 1997, and has been updated in 2003, 2012 and 2015. The updated 2015 version [14] which was used in this study includes a list of PIMs, drugs to avoid or where dose adjustment are required based upon renal function, and lists of selected drug–drug interactions known to result in harm in older adults.

STOPP/START criteria

The STOPP criteria were originally developed in 2008 after a review of evidence base of systematic reviews and randomised controlled studies in Ireland [18]. The criteria were updated in 2014 to enable a more comprehensive identification of PIMs. The updated version was used in this study [15]. This version have several new categories included into the STOPP list, namely antiplatelet/anticoagulant drugs, drugs affecting, or affected by, renal function and drugs that increase anticholinergic burden.

Data analysis

Descriptive statistics were generated for all variables and presented as mean with standard deviation or percentages. For categorical variables, these were compared using the Chi squared test or Fisher's exact test. As residents' demographics have been determined as a priori as to impact PIM, we examined the impact of gender, age, nursing home settings and number of medication on the use of PIMs using logistic regression analyses. The inter-rater reliability of classification for PIM was assessed using kappa statistics. This statistic compares the two raters' agreement on an indicator, and in this case the PIM classification. A Kappa statistic that is above 0.70 is considered excellent, 0.41 to 0.69 is considered acceptable, while a Kappa statistic of below 0.40 is considered unacceptable. For other variables, a p value of < 0.05 was considered significant. All statistical analyses were performed using IBM SPSS version 21.0 (IBM Co., Armonk, NY, USA).

Results

A total of 155 residents were recruited into this study. The residents had a mean age (standard deviation) of 75.01 (± 8.49) years. The residents had used an average of 3.52 (± 3.07) regular medications and 0.75 (± 1.67) supplements. The demographics and clinical characteristics of residents recruited in this study is summarized in Table 1. There were no significant differences in the participant demographics recruited from either private or government funded facilities.

During the study, a total of 503 medications and 85 supplements were reviewed. When using the Beers criteria and STOPP criteria in combination, we identified 94 PIMs, i.e., an average of 0.61 per patient. 33 (21.3%) residents had at least one or more PIMs. The prevalence of PIMs using the STOPP-2 criteria was 9.7% (n = 16) and 17.6% (n = 29) using the 2015 Beers criteria. The mean number of PIMs identified using STOPP-2 criteria was 1.23 (± 0.44) while 2.39 (± 1.86) PIMs were identified using the 2015 Beers criteria (Table 2). Kappa statistics suggest that there is a moderate concordance between both

Table 1 Demographics of nursing home facility and study participants

	Overall, N = 155 (%)
Mean age of residents (years)[a]	75.1 (8.5)
Gender	
Male	86 (55.5)
Female	69 (44.5)
Race	
Malay	92 (59.4)
Chinese	38 (24.5)
Indian	23 (14.8)
Others	2 (1.3)
Presence of multiple morbidities	
Cardiovascular disease	102 (65.8)
Endocrine/metabolic disorder	56 (36.1)
Respiratory tract disorder	17 (11.0)
Gastrointestinal disease	15 (9.7)
Psychiatric disorder	11 (7.1)
Haemopoeitic or infectious disease	9 (5.8)
Genitourinary disorder	3 (1.9)
Number of pharmacological agents/resident[a]	
Prescription medication	3.52 (3.07)
Chronic medications only	2.69 (2.49)
Nutritional supplements	0.75 (1.67)
Number of residents	
Small (< 50 beds) nursing home	28 (18.1)
Large nursing home	127 (81.9)

[a]Data represents mean (standard deviation)

Table 2 Potentially inappropriate medications identified based on Beers' Criteria in 29 residents in this study

Beers' criteria	Number of issues, n = 74 (%)
Potentially inappropriate medications—independent of diagnoses and diseases	32 (43.2)
Potentially inappropriate medications—considering disease and syndrome interaction	17 (23.0)
Drugs to be used in caution in elderly	16 (21.6)
Non anti-infective drug–drug interaction that should be avoided in older adults	4 (5.4)
Use of drugs with strong anticholinergic properties	4 (5.4)
Non anti-infective medications that should be avoided or dosage reduced in older adults	1 (1.4)

items (kappa = 0.46, $p < 0.001$). The most common identified PIMs with the STOPP criteria was the use of first generation sedating antihistamines (n = 4, 2.5%), concurrent use of beta-blockers with oral hypoglycaemic agents, long-term use of benzodiazepines as well as prolonged use of proton pump inhibitors for more than 8 weeks (n = 2; 1.3% each). In contrast, the Beers criteria identified that the inappropriate use loop diuretics which increases the risk of urinary incontinence in 8 residents (5.2%) as well as use of antipsychotics or antihistamines in 7 residents each (4.5%).

Using the PCNE classification, a total of 198 drug related problems (DRPs) were identified, with an average of 1.27 DRPs per resident (Table 3). The most common causes of DRPs among residents in this study were: untreated indications (n = 38; 19.2%), suboptimal drug treatment effects (n = 37; 18.7%) and occurrence of an adverse drug event (n = 35; 17.7%). These mainly arise from residents who had suboptimal use of anti-hypertensive (n = 9), were not treated for hyperlipidaemia (n = 7) or dementia (n = 5). Another commonly identified DRP was the use of prolonged use of benzodiazepines among residents who had a history of falls (n = 6). In the remaining cases of DRPs, these were mostly related to unknown reasons for use of nutritional supplements such as vitamin B complex, coconut oil as well as co-enzyme Q_{10} despite the lack of indication of efficacy (n = 15, 8.5%) as well as lack of patient information such as kidney function status as well as blood sugar (n = 24, 13.6%). Another common issue noted was the lack

of follow-up with the attending physicians for more than 6 months (n = 8, 4.5%).

Factors associated with PIM

The residents were stratified into different groups according to age, gender, nursing home setting and number of medication (Table 4) [19, 20]. Analyses suggest that the use of multiple medications (5 or more) were risk factors for use of inappropriate medication [Odds ratio (OR) 4.81; 95% confidence interval 2.31–10.0; $p < 0.001$]. This trend was similarly noted among those who were living in private nursing homes compared to government funded nursing homes (OR 2.80; 95% CI 1.56–5.00; $p = 0.003$). In addition, we also examined the association between higher PIMs and different co-morbidities and medications. We found that residents who had psychiatric disorders ($p = 0.047$) as well as those who are taking a higher number of chronic medications ($p = 0.039$) were associated with higher drug related problems (Table 5).

Discussion

In this study, we found that one in every 5 nursing home resident would be at risk of taking a potentially inappropriate medication according to the BEER and STOPP/START criteria used in combination. Some of the most common PIM identified include the use of first generation antihistamines,

Table 3 Potentially inappropriate medications identified based on STOPP-2 Criteria in 16 residents in this study

STOPP-2 criteria	Number of PIMs, n = 20 (%)
Inappropriate use of drugs related to central nervous system and psychotropic drug	8 (40.0)
Inappropriate use of drugs related to endocrine system	4 (20.0)
Inappropriate use of drugs related to gastrointestinal system	4 (20.0)
Inappropriate use of drugs which can result in constipation	2 (10.0)
Inappropriate use of analgesic drugs	1 (5.0)
Inappropriate use of antiplatelet/anticoagulant drugs	1 (5.0)

Table 4 Drug-related problems classified using PCNE classification v7.0

PCNE code	Detailed classification	Number of DRPs (%)
P1	Treatment effectiveness	
P1.1	No effect of drug treatment	1 (0.5)
P1.2	Effect of drug treatment not optimal	37 (18.7)
P1.3	Unnecessary drug-treatment	22 (11.1)
P1.4	Untreated indication	38 (19.2)
P2	Adverse event	
P2.1	Adverse drug event occurring	35 (17.7)
P3	Others	
P3.1	Patient dissatisfied with therapy despite optimal clinical and economic treatment outcomes	0 (0)
P3.2	Unclear problem/complain. Further clarification necessary	65 (32.8)

Table 5 Rate of potentially inappropriate medication among the 33 residents stratified by patient subgroups

Characteristics	Number of residents using potentially inappropriate medication (%)	Odds ratio (95% CI)	p value (χ^2 test)
Gender			
Female	18 (23.4)	Reference	0.335
Male	15 (17.0)	0.73 (0.40–1.35)	
Age group (years)			0.578
60–64	4 (22.2)		
65–69	7 (20.6)		
70–74	5 (20.0)		
75–79	6 (22.2)		
80–84	3 (10.7)		
85–89	5 (38.5)		
≥ 90	3 (30.0)		
Number of medications			< 0.001
0–4	8 (8.0)	Reference	
5–6	25 (38.5)	4.81 (2.31–10.0)	
Nursing home facility			
Government funded facility	21 (15.3)	Reference	0.003
Private facility	12 (42.9)	2.80 (1.56–5.00)	

Potentially inappropriate medications were identified based upon the Beers 2015 and STOPP-2 criteria

inappropriate use of loop diuretics as well as the use of benzodiazepines among residents. This study also noted that that adverse drug event was a common medication-use problem, with 4 cases of moderate or high risk drug–drug interaction between amlodipine and simvastatin, which could lead to myopathy and rhabdomyolysis. Other common issues identified were the prescribing omission on synergetic or preventive medication. Example included omission of prescribing of antiplatelet therapy in diabetic patient presented with at least one major cardiovascular risk factor.

Polypharmacy is now increasingly common among older adults as this population is at a higher risk of developing chronic diseases. As such several tools such as the STOPP and Beers criteria have been developed to guide clinicians to identify for PIMs [14, 15]. In this study, we noted that prevalence of PIM was between 9.7 and 17.6%, depending on the criteria used. Results of this study were comparable with several other studies in the Asian region (including Malaysia) which reported prevalence rates of DRP between 21.3% to as high as 70.0% [12, 13, 21, 22]. While these figures were relatively lower compared to the global trend of 43.2%, such differences can be attributable to the variation in prescribing and care provided [22]. For example, the Malaysian guidelines currently recommended a less intensified approach to manage blood pressure and blood glucose among older adults [23]. Additionally, as Malaysia does not have a national health insurance scheme, patients are usually not managed by a single medical health practitioner.

This often results in patients seeking treatment from multiple prescribers who may have initiated medications without being informed on other medications that the patients were already on, invariably leading to the issue of polypharmacy.

Some of the risk factors which were independently associated with higher prevalence of PIM included use of multiple medication (5 or more medication) and a history of psychiatric disorder. These finding are expected, since studies have consistently noted a higher prevalence of PIMs with polypharmacy [22]. In this study, benzodiazepines were regarded as potentially inappropriate in both the STOPP and Beers criteria. As these drugs are primarily used for psychiatric and sleep disorders, this may have led to an overestimation of PIM. Our study also noted an interesting observation as we found that there was higher rates of PIMs among private nursing homes residents, despite the smaller number of residents living within the homes. This could potentially be due to the structure of the government funded homes, which only admits healthier, homeless or destitute residents who often have fewer comorbidities [24]. In comparison, residents living in private nursing homes are usually more ill, require some form of nursing care which necessitates them to live in nursing homes rather than with their families.

Untreated medical condition accounted for 19.2% (n = 38) of the drug related problems and merits discussion. This study noted that there were residents who were diagnosed with osteoporosis, hypertension, and cataract but not treated. This could potentially be due to the structure of these nursing homes, which are usually for-profit and thus were rarely staffed by trained nurses. The study found that there was poor documentation of resident's history and information such as kidney function and blood glucose level, as information from 13.6% of residents were unavailable. In addition, there was also poor documentation on the potential reasons these residents were on supplements.

The appropriateness of prescribing can be assessed by process measures (that is, what providers do) or outcome measures (that is, patient outcomes). These measures can be either implicit (judgment based) or, more often, explicit (criterion based). Explicit measures have the advantage of being based on literature review and expert consensus, and they are reliable and have content validity, although they do periodically need revision to reflect new evidence. In this study, the Beers criteria was able to identify for more PIMs compared to the STOPP-2 criteria. This can be partly explained by the differences in drugs listed in each indicator, since the STOPP-2 criteria were prepared by an European group while the Beers criteria were developed by an American group. For example, the Beers criteria includes a larger number of sedative medication and the provision of list of medications which should be used with caution such as antipsychotics and benzodiazepines. Meanwhile, the STOPP criteria systematically organise and incorporate both inappropriate prescribing and prescribing omission. Despite these differences, we noted that there were minimal differences in the number of residents identified which were at risk of developing adverse events, highlighting the potential benefit of using these tools to identify for residents who may benefit from ongoing medication review and deprescribing [25].

Results of our study has potential ramification for clinical practice in Malaysia and perhaps the region. While medications can increase the survival and improve quality of life, medication related issues remain a significant issue in nursing homes in Malaysia, as evidenced by the high number of PIMs in the study. This study highlights a potential new role for pharmacists' to improve the quality of prescribing in nursing homes, through regular medication reviews as part of routine care for nursing home residents. Pharmacists could also be involved to help educate the nurses and physicians on pharmacotherapy related issues in nursing homes [26, 27]. For these initiatives to be effectively implemented, it is important that pharmacists in Malaysia undertake further training on geriatric therapeutics and medication reviews [28], as well as training on use of nutritional supplements due to the risk of adverse events [29–31]. Results of this study concur with similar studies which have been conducted elsewhere which similarly noted the high prevalence of PIMs [8, 22]. In a recent study among Brazilian homes, Lima and colleagues found that a very high prevalence of PIMs (82.6%), which was contributed by polypharmacy, psychiatric disorder, cerebrovascular diseases and dependency [32]. Pérez and colleagues [33] similarly noted that nearly half of older adults in Ireland are exposed to PIMs each year and that the risk of PIMs are increased after hospital admission. Taken together, results of this and other studies provides further impetus for the need of effective multidisciplinary care working together to identify for patients at risk and providing decision support.

This study had several limitations. Firstly, because of the cross sectional design of this study, only the association between the risk factors for polypharmacy can be inferred, and not the establishment of causality. In addition, we only had recruited a small number of participants from urban nursing homes in Peninsular Malaysia which may limit its generalizability. However, the similarities in terms of prevalence and reported PIMs in other studies suggested that there was very little reason to believe that the situation will vary in other settings [3, 12]. Due to the small sample size, results of our study especially those related to the logistic regression model need to be interpreted with caution. Finally, while we attempted to obtain as much details as possible through medical notes as well as semi-structured interview with residents, it was possible that some inherent information including laboratory values and past medical history were not obtained, leading to an underreporting of PIMs.

Conclusion

This cross-sectional study found that polypharmacy and drug related problems were a common issue which affected the elderly in nursing home setting. Although the use of 2015 Beers criteria was able to identify more PIMs than STOPP-2 criteria, both criteria can be used together to guide physicians during prescribing as they identified different issues. The findings also further supported the need for pharmacist to offer medication review services in this population.

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

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