

Original Research Article

Assessing the knowledge, attitude and perception about potentially inappropriate medications among a private university health-care students in Kedah, Malaysia

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Abstract

Purpose: To assess the knowledge, awareness and perceptive judgment towards potentially inappropriate medications (PIMs) among healthcare students in a Malaysian private university.

Methods: A cross-sectional study was conducted among healthcare students in a Malaysian private university ($n = 110$). A self-administered questionnaire was developed with questions framed in the knowledge, perception and awareness domains respectively, which were assessed using the 5-point Likert scale. Chi-square test and descriptive statistics were used to analyze the data, while all statistical analyses were performed using IBM SPSS Statistics 28.0.

Results: The mean scores obtained indicate positive outcomes across all domains: knowledge of PIMs (4.18, SD = 0.54), perceptions of PIMs (4.31, SD = 0.51), awareness of AGS Beers Criteria (3.91, SD = 0.67), and perceptions of educational needs (4.30, SD = 0.62). These findings suggest that healthcare students demonstrated acceptable knowledge, awareness, and perception of educational needs related to PIMs in geriatric care.

Conclusion: The knowledge, perception, awareness and educational needs perception of the respondents were acceptable; however, a structured educational intervention remains essential to equip future healthcare professionals with a strong foundation on PIMs and their implications on the geriatric population.

Keywords: Geriatrics, Potentially inappropriate medications, Polypharmacy, AGS Beers Criteria, Healthcare students

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INTRODUCTION

The global population is ageing rapidly and undergoing a momentous demographic change, with longer life expectancies and decreasing birth rates [1]. This demographic shift necessitates a holistic approach to address the evolving medical needs of the elderly population to ensure equitable and effective care, essentially by

identifying and grappling with the public health challenges they face. Older adults are typically more predisposed to disabilities, chronic illnesses, mental health conditions and physiological changes that require long-term medical care and support. Oftentimes, they present multimorbidity, wherein, for instance, an elderly diabetic patient may also suffer from other comorbid conditions like cardiovascular

diseases, hypertension, chronic respiratory diseases, or hyperlipidemia [2].

Treatment complications (both somatic and psychiatric), increased disability and mortality risk, as well as higher resource and medical expenditure, are all a result of multimorbidity [3]. Multiple medications are then prescribed to manage these coexisting conditions, resulting in polypharmacy, which is commonly observed in older populations. Polypharmacy is associated with negative outcomes among the elderly, including increased risk of falls, functional and cognitive impairment, disability, adverse drug reactions, drug interactions, hospitalizations and even mortality, which is often interrelated with the use of potentially inappropriate medications (PIMs) [4]. A systematic review and meta-analysis revealed the estimated overall prevalence of polypharmacy to be around 37 %, with strong associations to inpatient clinical settings and older age [5]. Similar trends have been observed in Malaysia, where polypharmacy prevalence ranges from 45.9 to 80.6 %, and nearly a third of the country's geriatric population is using PIMs [6]. Identification of polypharmacy is crucial to assess its appropriateness and to determine whether strategies such as utilization of screening tools, education and training, as well as collaborative medication review, should be implemented to mitigate inappropriate prescribing, which negatively impact older adults. PIMs are medications that cause more harm than benefit in elderly patients, yet they are still used as first-line treatments for numerous conditions despite growing evidence of negative outcomes stemming from their use in the geriatric population [7].

Studies suggest an increasing risk and prevalence of PIM use among older adults with global estimates ranging from 36.7 % in 2023 to 58.5 % in 2024 [8], with similar patterns observed in Malaysia, where the prevalence ranges from 37.0 to 89.1 % (reflecting differences in screening tools utilized) [9], which is undoubtedly concerning and necessitates prompt action from all pertinent stakeholders. Numerous screening tools have since been developed to assess medication appropriateness among older adults which include the American Geriatrics Society (AGS) Beers criteria (USA), Screening Tool to Alert to Right Treatment (START) criteria (Ireland), Screening Tool of Older People's Prescriptions (STOPP) criteria (Ireland), PIM-Check, PRISCUS List (Germany), the Australian PIMs list (Australia), EU(7)-PIM List (Europe), Medication Appropriateness Index (MAI), Fit for The Aged (FORTA) criteria (Europe), the Assess, Review, Minimize, Optimize, Reassess

(ARMOR) tool (USA), the Malaysian Potentially Inappropriate Prescribing (MALPIP) criteria (Malaysia) among others. These screening tools are categorized into three classes, namely, implicit (judgment-based), explicit (criterion-based), and mixed (utilizes both criterion and judgment), where examples of implicit tools include the MAI-drug compliance list; explicit tools include AGS-Beers criteria, STOPP/START Criteria, EU(7)-PIM List, PRISCUS list, and FORTA criteria, while the ARMOR criteria is an example of a mixed tool [10]. Among these screening tools, AGS-Beers criteria appear to be one of the most commonly used tools with established effectiveness in improving patient outcomes by abating hospitalizations, emergency visits and adverse drug events [4,7,11].

The first version of AGS Beers criteria was developed in 1991, and since then, numerous revisions have been made in 1994, 1997, 2003, 2012, 2015, 2019 and 2023, with the latter being the most up-to-date version. This screening tool was formulated using the modified Delphi technique, based on expert opinions and numerous trials, and consists of five classifications of medications that should be used with caution or completely avoided in older adults [12]. It is crucial to note that, despite the effectiveness of such screening tools as part of a comprehensive medication management strategy, they should ideally be supplemented with sound clinical judgement [4,10]. This reliance on professional judgment highlights the importance of ensuring that healthcare providers possess adequate knowledge and awareness of PIMs. Strengthening this competency is not only essential for current practitioners but should also be nurtured early among healthcare students to cultivate safe prescribing habits from the outset. However, the evidence to date reveals only a small number of studies evaluating these aspects among healthcare professionals, and there is a notable lack of focus on healthcare students, underscoring a critical gap in literature. This limited evidence base underscores the need to strengthen PIM-related education early in undergraduate curricula to support safe prescribing practices in the future.

Current literature primarily reports on healthcare students' knowledge, attitudes and perceptions towards geriatric care, geriatric health, geriatric curricula and geriatric pharmacotherapy education [13]. A thorough search identified a study that assessed the knowledge, attitudes and practices of postgraduate residents and medical interns regarding AGS Beers criteria [14], yet there remains a clear paucity of studies examining these parameters among

undergraduate healthcare students. Addressing this gap, the present study aims to evaluate healthcare students' knowledge, awareness, and perceptions of PIMs, providing much-needed insight into their preparedness for safe prescribing in older adults and informing future educational strategies.

METHODS

This cross-sectional study was conducted to assess the knowledge, awareness and perceptions of PIMs among pre-final and final-year healthcare students (Faculty of Medicine, Pharmacy and Dentistry) from AIMST University, a private university in Malaysia. Stratified random sampling of participants was utilized based on demographic characteristics, and participants were provided with a self-administered questionnaire that was developed, pretested and used for data collection in this study. The sample size was calculated using the Raosoft® calculator (population 3000; CI 90 %; margin of error 5 %; response distribution 50 %), with a total of 110 responses obtained from healthcare students on campus. The survey instrument consisted of questions on demographics, patterns of inappropriate medication use among healthcare students, and attitudes towards inappropriate medication use.

The 26-item survey questionnaire was divided into five sections and pilot-tested among 20 students (not part of the study sample) prior to the study. Section A comprised respondents' demographic data, Section B assessed knowledge of PIMs in geriatric patients, Section C explored perceptions of PIMs in geriatric care, Section D evaluated awareness of AGS Beers Criteria, and Section E examined perceptions of educational needs to enhance knowledge of PIMs in geriatrics. Items in Sections B to E were structured using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 strongly agree). The collected data were analyzed using IBM SPSS Statistics (Version 28.0, Armonk, NY: IBM Corp.).

Statistical analysis

Descriptive statistics were utilized for selected variables that focused on frequencies and percentages, while normally distributed numerical data were presented as mean and standard deviation. Associations between independent and dichotomous variables were examined using Chi-square test. Statistical significance was set at $p < 0.05$, unless otherwise specified. Correlation coefficients were

calculated to determine the strength of relationships between variables.

RESULTS

A total of 110 responses were obtained from healthcare students in the Faculties of Medicine, Pharmacy, and Dentistry. Of these, 72 (65.5 %) were pre-final year and 38 (34.5 %) were final year students. Majority of participants were female (82; 74.5 %), while 28 (25.5 %) were male. Most respondents were from the Faculty of Pharmacy (70.9 %) and of Chinese ethnicity (85.5 %). Table 1 presents participants' knowledge of PIMs in geriatric patients. Tables 2 and 3, respectively, show respondents' perceptions of PIMs in the elderly and their awareness of AGS Beers Criteria. Participants' perceptions of educational needs to enhance knowledge of PIMs in geriatric populations are presented in Table 4.

DISCUSSION

The knowledge of PIMs in geriatric patients among healthcare students was assessed, and the respective responses have been reported in this study. Majority of respondents demonstrated a good understanding of the definition of PIMs, with 45.5 % agreeing and 36.4 % strongly agreeing with the definition. An additional 17.3 % were neutral, while only one respondent (0.9 %) disagreed. A similar pattern was observed in responses to the second item, which stated that 'inappropriate medication use is a common concern among older adults (aged 65 and above), especially those with multiple comorbidities.' Half of the respondents agreed, 38.2 % strongly agreed, 10 % were neutral, while one participant (0.9 %) disagreed and another (0.9 %) strongly disagreed.

Most participants were able to identify factors linked to inappropriate medication use, with 52.7 % agreeing and 37.3 % strongly agreeing, while 10 % remained neutral. Regarding the fourth item, which examined the relationship between unscheduled PIMs, adverse drug reactions (ADRs), and deteriorating health outcomes, 42.7 % strongly agreed, 39.1 % agreed, 17.3 % were neutral, and one respondent (0.9 %) disagreed. The PIM screening tools are essential for detecting inappropriate medication use; however, previous studies have indicated that healthcare professionals themselves are often unaware of such tools [17,20].

Table 1: Knowledge of healthcare students about PIMs in geriatric patients

Questions (Section B)	Variables	Frequency (%)	P-value
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 available”.	Disagree	1 (0.9)	<0.001
	Neutral	19 (17.3)	
	Agree	50 (45.5)	
	Strongly agree	40 (36.4)	
Inappropriate medication use is a common concern among older adults (aged 65 and above), especially those with multiple comorbidities.	Strongly disagree	1 (0.9)	
	Disagree	1 (0.9)	
	Neutral	11 (10)	
	Agree	55 (50)	
	Strongly agree	42 (38.2)	
Factors linked to inappropriate medication use vary, which include gender, aging, polypharmacy, multiple prescribers and poor health status.	Neutral	11 (10)	
	Agree	58 (52.7)	
	Strongly agree	41 (37.3)	
Unscheduled PIMs are closely related to adverse drug reactions and deteriorating health outcomes, such as hospitalizations, emergency department visits, mortality, and high healthcare costs.	Disagree	1 (0.9)	
	Neutral	19 (17.3)	
	Agree	43 (39.1)	
	Strongly agree	47 (42.7)	
Beers Criteria, STOPP, and START criteria are validated screening tools that can be used to identify the presence of PIMs among geriatric patients.	Disagree	1 (0.9)	
	Neutral	31 (28.2)	
	Agree	45 (40.9)	
	Strongly agree	33 (30)	

Table 2: Perceptions of healthcare students about PIMs in geriatric patients

Questions (Section C)	Variables	Frequency (%)	P-value
The use of inappropriate medications among older adults is associated with increased healthcare utilization, a higher risk of adverse health outcomes, and elevated rates of hospitalization	Neutral	8 (7.3)	<0.001
	Agree	56 (50.9)	
	Strongly agree	46 (41.8)	
PIMs led to higher healthcare costs, suboptimal prescribing practices, and adverse health outcomes.	Neutral	15 (13.6)	
	Agree	45 (40.9)	
	Strongly agree	50 (45.5)	
The Emergency Department serves as a key setting for identifying older adults at risk of receiving inappropriate medication prescriptions.	Disagree	3 (2.7)	
	Neutral	30 (27.3)	
	Agree	41 (37.3)	
	Strongly agree	36 (32.7)	
Community pharmacists play an important role in promoting rational and safe medication use in geriatric patients	Disagree	1 (0.9)	
	Neutral	7 (6.4)	
	Agree	50 (45.5)	
	Strongly agree	52 (47.3)	
Participation in ongoing workplace education focused on geriatric pharmacotherapy helps to improve drug outcomes in the elderly.	Neutral	4 (3.6)	
	Agree	46 (41.8)	
	Strongly agree	60 (54.5)	

The fifth item assessed whether healthcare students recognized screening instruments such as AGS Beers Criteria, STOPP, and START criteria. Responses showed that 40.9 % of participants agreed that these were validated tools for detecting PIMs among the elderly, 30 % strongly agreed, 28.2 % were neutral, and one respondent (0.9 %) disagreed. The mean score for knowledge of PIMs in geriatric patients among healthcare students was 4.18 (SD = 0.54,

range 3 – 5), indicating a positive level of knowledge among the study participants.

The responses obtained for items in Section B revealed that the healthcare students demonstrated a basic understanding of PIMs, with only a minority lacking adequate knowledge of PIMs in geriatric patients. These findings highlight the importance of implementing educational interventions to improve awareness and equip future healthcare professionals with

essential competencies in PIMs. While majority of students demonstrated a basic understanding of PIMs, the limited recognition of validated screening tools highlights a critical educational gap. This reflects findings from previous studies reporting that practicing healthcare professionals often lack awareness of such screening tools, suggesting that the problem originates early in

training. The clinical importance of this gap is distinct as inappropriate prescribing remains a major contributor to adverse drug reactions, hospitalizations, and functional decline in older adults [15]. It is therefore vital that healthcare students develop a strong foundation in PIMs and the use of screening tools early in their undergraduate training.

Table 3: Awareness of healthcare students about AGS Beers criteria

Questions (Section D)	Variables	Frequency (%)	P-value
AGS Beers Criteria outlines the medications that are inappropriate or potentially inappropriate for individuals aged 65 and above.	Neutral	31 (28.2)	0.298
	Agree	44 (40.0)	
	Strongly agree	35 (31.8)	
Anticholinergics, Benzodiazepines and NSAIDs are some of the medication classes listed in the Beers Criteria.	Neutral	40 (36.4)	0.403
	Agree	40 (36.4)	
	Strongly agree	30 (27.3)	
Omeprazole is the most frequently prescribed medication listed in the Beers Criteria within the system.	Disagree	2 (1.8)	<0.001
	Neutral	48 (43.6)	
	Agree	36 (32.7)	
	Strongly agree	24 (21.8)	
Use of benzodiazepines in elderly patients is linked to cognitive decline, delirium, increased risk of falls, fractures, and motor vehicle accidents.	Disagree	1 (0.9)	<0.001
	Neutral	34 (30.9)	
	Agree	41 (37.3)	
	Strongly agree	34 (30.9)	
A disconnect exists between patient education and the prescribing of Beers Criteria medications within the healthcare system.	Neutral	46 (41.8)	0.151
	Agree	34 (30.9)	
	Strongly agree	30 (27.3)	

Table 4: Healthcare students' perceptions of educational needs for improving knowledge of PIMs in geriatric care

Questions (Section E)	Variables	Frequency	P-value
Undergraduate research project on potentially inappropriate medications (PIMs) among geriatric patients.	Disagree	1 (0.9)	
	Neutral	25 (22.7)	
	Agree	42 (38.2)	
	Strongly agree	42 (38.2)	
Pupillage or provisionally registered pharmacist (PRP) training.	Disagree	1 (0.9)	<0.001
	Neutral	19 (17.3)	
	Agree	41 (37.3)	
	Strongly agree	49 (44.5)	
Clinical attachment at a geriatric ward or unit with geriatricians.	Disagree	1 (0.9)	
	Neutral	11 (10)	
	Agree	21 (37.3)	
	Strongly agree	57 (51.8)	
Incorporation of geriatric pharmacotherapy education as a core subject or elective subject.	Disagree	2 (1.8)	
	Neutral	10 (9.1)	
	Agree	43 (39.1)	
	Strongly agree	55 (50)	
Postgraduate education in geriatric pharmacotherapy.	Neutral	16 (14.5)	
	Agree	43 (39.1)	
	Strongly agree	51 (46.4)	
Incorporate geriatric pharmacotherapy cases in integrated organ-based subjects, for example, cardiovascular system (CVS), endocrine system, pulmonary & renal system, etc.	Neutral	15 (13.6)	
	Agree	43 (39.1)	
	Strongly agree	52 (47.3)	

Developing this knowledge at an early stage not only prepares future healthcare professionals to recognize and prevent inappropriate prescribing but also helps to establish a culture of safe and evidence-based practice in geriatric pharmacotherapy [16]. Incorporation of these

tools into undergraduate curricula may help to address the observed clinical knowledge gap and improve patient outcomes among the elderly population.

The perceptions of PIMs in geriatric patients among the study participants are also reported in this study. Majority of the respondents agreed (50.9 %) that the use of inappropriate medications among the elderly led to increased healthcare utilization, higher risk of adverse health outcomes and higher rates of hospitalization, while 41.8 % strongly agreed and 7.3 % were neutral to this notion. On the other hand, 45.5 % of the study participants strongly agreed to the fact that PIMs led to higher healthcare costs, suboptimal prescribing practices and adverse health outcomes. 40.9 % of them agreed, while 13.6 % were neutral regarding the effects of PIMs. In terms of the third item in Section C, which was that the emergency department (ED) serves as a key setting for identifying older adults at risk of receiving inappropriate medication prescriptions, 37.3 % agreed and 32.7 % strongly agreed with this. However, it was noted that 27.3 % were neutral to this statement and 2.7 % of the respondents did not perceive the ED to be a key setting in identifying PIMs in older adults. It is well established that community pharmacists are in a critical position and play a vital role in ensuring medication safety, especially among geriatric patients [17]. This is due to the fact that patients are twice as likely to visit a community pharmacist as a primary care physician, which further highlights the intervention opportunities present for community pharmacists [18].

With regards to the fourth item in Section C, which states that community pharmacists play an important role in promoting rational and safe medication use in geriatric patients, majority of the healthcare students strongly agreed (47.3 %), 45.5 % agreed, 6.4 % were neutral and one participant disagreed with this (0.9 %). Participation in ongoing workplace education focused on geriatric pharmacotherapy helps to improve drug outcomes in the elderly as supported by various studies [19]. Responses for the fifth item in Section C revealed that more than half of the respondents (54.5 %) strongly agreed to this, 41.8 % agreed, while 3.6 % were neutral regarding ongoing workplace education participation in improving drug outcomes among the elderly. The overall mean perception score of PIMs in geriatric patients among healthcare students was 4.31 (SD = 0.51, range 3 - 5), indicating positive perception.

The PIMs screening tools, such as AGS Beers criteria, are effective in detecting and abating PIMs when used together with professional judgement. Healthcare professionals must be aware of the existence of such tools in order to effectively utilize them to improve medication

safety in geriatric patients. Numerous studies have revealed that healthcare professionals themselves have low awareness of such tools [14,16,17,20] and this worrying trend suggests that there may have been a lack of training in geriatric pharmacotherapy during their undergraduate years. With this in mind, the awareness of AGS Beers criteria among healthcare students was assessed and the respective responses were compiled. With regards to the first item in Section D, which states that AGS Beers criteria outline medications that are inappropriate or potentially inappropriate for individuals aged 65 and above, majority of respondents (40.0 %) agreed, 31.8 % strongly agreed, while 28.2 % were neutral regarding this. The p -value for this item was $p = 0.298$, which indicates that the responses obtained are not statistically significant. Equal proportions of participants agreed and were neutral (36.4 % respectively) to the second item, which was anticholinergics, benzodiazepines and NSAIDs are some of the medication classes listed in AGS Beers criteria. 27.3 % of the study participants strongly agreed with this item, and the p -value was 0.403, which suggests the data are not statistically significant. With regards to the third item, which specified omeprazole to be the most frequently prescribed medication listed in AGS Beers criteria, majority of the respondents were neutral (43.6 %), 32.7 % agreed, 21.8 % strongly agreed, while two respondents disagreed with this (1.8 %). In addition to omeprazole being a PIM, benzodiazepines also pose a great risk to the elderly population in terms of increased risk of falls, fractures and cognitive decline as supported by published evidence [20].

Responses to the fourth item in Section D showed that 37.3 % of the study respondents agreed with this, equal proportions of participants (30.9 % each) strongly agreed and were neutral, while one participant (0.9 %) disagreed with this. The p -values for the third and fourth items were both < 0.001 , indicating that the data for these items are statistically significant. A gap between patient education and prescribing of PIMs within the healthcare system is evident, which underscores the need for structured and individualized educational and deprescribing interventions for patients, caregivers and healthcare professionals alike, to prioritize patient safety [21]. Majority of the respondents were neutral regarding this (41.8 %), 30.9 % agreed, while 27.3 % strongly agreed. The p -value for this item was 0.151, suggesting the data obtained for this item is not statistically significant. The overall mean score for awareness of AGS Beers criteria among

healthcare students was 3.91 (SD = 0.67, range 3 - 5), indicating positive awareness.

In order to effectively address the significant risks associated with PIMs in the elderly and improve patient outcomes, strengthening educational interventions is essential to equip future healthcare professionals with the knowledge and skills required for safer prescribing. Without such structured education, gaps in knowledge and awareness are likely to persist in clinical practice; thus, integrating geriatric pharmacotherapy into undergraduate curricula provides a systematic approach in bridging the knowledge gap and promoting rational drug use across the healthcare system. In light of this, the respondents' perceptions of educational needs for improving knowledge of PIMs in geriatric care were assessed.

Equal proportions of respondents (38.2 %) strongly agreed and agreed with the incorporation of undergraduate research projects on PIMs among geriatric patients to enhance knowledge on PIMs, 22.7 % were neutral, while one respondent (0.9 %) disagreed with this. The implementation of undergraduate research projects on PIMs provides pharmacy students with deeper insight into evidence-based approaches to geriatric pharmacotherapy and helps them to identify and mitigate medication-related risks in older patients. While undergraduate projects enhance students' knowledge of PIMs, sustained reinforcement is equally important during professional training. In Malaysia, provisionally registered pharmacist (PRP) training is a requirement for pharmacy graduates to undergo a one-year internship in premises recognized and accredited by the Pharmacy Board of Malaysia in order to become a fully registered pharmacist (FRP). The rationale behind PRP training is to ensure pharmacy graduates are able to practice with sufficient competencies in terms of knowledge and skills [22]. A previous study showed that 94 % of pharmacy students perceived PRP training as a good approach to strengthening geriatric pharmacotherapy education. Although geriatric rotation is not compulsory during PRP training, recommendations have been made to provide continuous education on geriatric pharmacotherapy, which is delivered through various modes to young pharmacists in order to address this gap [23]. In line with this, 44.5 % of the study respondents strongly agreed, 37.3 % agreed, 17.3 % were neutral, while one participant disagreed on the role of PRP training in strengthening geriatric pharmacotherapy competencies among pharmacy graduates. In addition to PRP training, clinical attachment at a

geriatric ward with geriatricians is an effective approach to develop clinical judgment, communication skills, and confidence in prescribing for older adults. More than half of the respondents (51.8 %) strongly agreed, 37.3 % agreed, 10 % were neutral, while one participant (0.9 %) disagreed with this. However, because not all students may have access to such attachments, integrating geriatric pharmacotherapy education as a core or elective subject within the undergraduate curriculum would provide a systematic and equitable means of strengthening competencies in this area. Globally, undergraduate geriatric medicine education remains inadequate across several key areas, which necessitates urgent reforms in medical and pharmacy education to address the growing needs of aging populations as well as the integration of structured geriatric pharmacotherapy education into undergraduate curricula to better prepare future healthcare professionals [24].

Recognizing the urgent need for reform, these findings revealed that half of the respondents strongly agreed, 39.1 % agreed, 9.1 % were neutral, and 2 participants (1.8 %) disagreed. While strengthening undergraduate curricula is essential, continued emphasis through postgraduate education in geriatric pharmacotherapy is equally essential to ensure that pharmacists continue to develop advanced competencies in managing older adults. In view of this, 46.4 % of the study participants strongly perceived postgraduate education in geriatric pharmacotherapy as essential, 39.1 % agreed, while 14.5 % were neutral. Incorporating geriatric pharmacotherapy cases into organ-based subjects, such as cardiovascular, endocrine, pulmonary, and renal systems, is a highly effective educational strategy that is implemented through case-based learning (CBL) or problem-based learning (PBL), typically developed from detailed patient cases featuring older adults with multiple comorbidities and polypharmacy. This approach fosters critical thinking and clinical reasoning in realistic scenarios. This study shows that majority of respondents (47.3 %) perceived this as beneficial, 39.1 % agreed, while 13.6 % were neutral. The overall mean score for perceptions of educational needs to improve knowledge of PIMs in geriatric care was 4.30 (SD = 0.62, range 3-5), which signifies a positive perception of educational needs among the participants. The positive perceptions observed in this study reflect a growing recognition of the importance of geriatric education in addressing PIMs and deprescribing. As PIMs contribute substantially to medication-related harm in geriatric patients,

deprescribing plays a critical role in reducing medication burden and improving outcomes, thus reinforcing the need to integrate deprescribing education with PIMs in undergraduate healthcare curricula. Incorporation of deprescribing education into both undergraduate and postgraduate curricula, along with continuous professional development (CPD) initiatives, helps reinforce healthcare professionals' skills and confidence in medication optimization and improving safety in geriatric patients [25].

Translating these competencies into practice requires multidisciplinary team involvement, which facilitates comprehensive medication assessment and more effective deprescribing strategies [26]. Interprofessional learning for pharmacy and medical students comes into play, which enables deeper appreciation of each other's responsibilities and the importance of communication to prevent prescribing errors. When translated into patient-centered teamwork, these skills strengthen collaboration and enhance the quality of care in geriatric pharmacotherapy [16]. However, while didactic learning provides healthcare students with foundational knowledge on PIMs and geriatric pharmacotherapy, the complexity of deprescribing necessitates complementary approaches such as interprofessional and experiential learning to develop practical skills, communication, and patient-centered teamwork [27]. Importantly, the recent development of an undergraduate geriatric medicine curriculum in Malaysia represents a significant step forward in incorporating geriatric pharmacotherapy into formal training [28]. Within this context, this study underscores the need to integrate PIMs education and deprescribing principles into such curricula, ensuring that future healthcare professionals are not only equipped with theoretical knowledge but also with the collaborative skills required to optimize medication use and safeguard older adults from harm.

CONCLUSION

The PIMs represent a significant public health concern that must be assessed on a regular basis as pharmacotherapy continues to evolve. The findings of this study indicate that Malaysian healthcare students possess an acceptable level of knowledge, perception, and awareness of PIMS and AGS Beers criteria, as well as perception of education needs surrounding PIMs. A structured and comprehensive educational approach, as outlined in this study, is essential to equip future healthcare professionals with the competencies required to participate effectively

in the care of older adults. Strengthening this foundation will promote the rational use of medications and foster individualized, patient-centered care, ultimately contributing to safer and more effective geriatric pharmacotherapy.

DECLARATIONS

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Ethical approval and consent to participate

The study was approved by the Human Ethical Committee at AIMST University (approval no. AUHEC/FOP/2021/17)

Use of Artificial intelligence/Large language models

No AI tools were used to generate content, interpret data, or influence study design, results, or conclusions.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

No conflict of interest is associated with this work.

Contribution of authors

We declare that this work was done by the author(s) named in this article, and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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