

Prevalence and Predictors of Potentially Inappropriate Medication Use Among Hospitalized Older Adults With COVID-19 in Malaysian Tertiary Hospitals

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Abstract

Geriatric populations represent one of the most susceptible demographics during the COVID-19 pandemic, accounting for a substantial percentage of mortality related to the virus. Although medication reviews and reconciliations conducted by pharmacists are effective in minimizing the occurrence of potentially inappropriate medications, these clinical services were suspended during the pandemic. To evaluate the prevalence of and the variables linked to the use of inappropriate medicines among older populations diagnosed with COVID-19. This study employed a retrospective, cross-sectional design to analyze medication regimens among hospitalized older adults with COVID-19. Instances of potentially inappropriate medication (PIM) use were classified in accordance with the Beers and STOPP criteria. Integrating both evaluation criteria revealed that 181 (32.7%) of the 553 included patients received at least one potentially inappropriate medication. The Beers 2019 criteria identified a slightly greater volume of inappropriate prescriptions (151 PIMs across 124 patients) relative to the STOPP criteria (133 PIMs across 104 patients). The prolonged administration of proton pump inhibitors ($n = 68$; 12.3%) and therapeutics that elevate the risk of postural hypotension ($n = 41$; 7.4%) constituted the most frequent PIMs observed. Furthermore, PIM utilization demonstrated a significant association with a history of hospital admission within the preceding 12 months (Odds ratio [OR]: 2.27; 95% CI: 1.29–3.99) alongside an increased quantity of medications prescribed at discharge. Approximately one-third of older individuals with COVID-19 were prescribed a PIM, and the subset of older adults experiencing polypharmacy expanded post-discharge. These findings underscore the critical need to involve clinical pharmacists in medication reviews, PIM identification, and the assessment of drug therapy appropriateness.

Keywords: Polypharmacy, Potentially inappropriate medications, Hospital, Older adults, COVID-19, Malaysia

Introduction

On a global scale, the population is aging. Life expectancy is rising worldwide, accompanied by a growing proportion and total number of older individuals in society. The aging process involves a progressive

decline in physical and psychological capacities, making individuals more prone to concurrent health disorders. Consequently, older adults frequently manage multiple daily prescriptions for various diseases, a state identified as polypharmacy [1]. Polypharmacy presents a major challenge for the elderly, given its established links to a higher likelihood of negative health outcomes, elevated rates of hospitalization, and considerable inflation of healthcare expenditures [2].

Epidemiological research indicates that polypharmacy is closely correlated with the administration of potentially inappropriate medications (PIMs), which are defined as therapies where the potential clinical risks surpass the expected therapeutic benefits [3]. To facilitate the detection of PIMs, researchers have established distinct

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screening instruments, with the most widely applied frameworks being the Beers criteria, the Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP), and the Potentially Inappropriate Medications in the Elderly (PRISCUS) list [4-6].

Prior investigations demonstrate that the documented prevalence of PIMs varies widely across clinical environments, assessment instruments, and specific cohorts. Within the Malaysian context, recorded PIM prevalence ranges from 13.6% in primary care settings [7] to 34.9% among hospitalized patients [8]. Conversely, a separate Malaysian study reported a prevalence rate of just 21.4% among nursing home residents [9]. These discrepancies stem from multiple factors, including differences in healthcare delivery standards, institutional contexts, and client characteristics.

The infrastructure of the Malaysian healthcare delivery system comprises a tax-supported public framework operating alongside an expanding private sector funded primarily via personal out-of-pocket spending [10]. The public network presently serves between 60% and 70% of the national population, while the remaining population uses private care options. In 2020, as part of the state's strategic initiatives to manage the COVID-19 crisis, the government mandated inpatient hospitalization for all individuals diagnosed with COVID-19 at public medical centers [11]. This policy created an exceptional baseline for analyzing the occurrence rates and specific categories of PIMs among elderly inpatients in Malaysia. Consequently, this investigation sought to appraise the prevalence, classifications, polypharmacy patterns, and corresponding predictors of PIM use among older adults hospitalized with COVID-19 in Malaysia.

Materials and Methods

This investigation comprised a retrospective, cross-sectional evaluation of medication regimens at hospital entry and exit for elderly patients with COVID-19. The dataset was gathered from five tertiary referral institutions distributed across the Malaysian states of Johor, Perak, Sabah, Selangor, and Penang. These specific facilities operated as primary centralized hubs where individuals with confirmed COVID-19 diagnoses were institutionalized under the state's strategic containment framework. At each participating site, clinical pharmacists identified elderly individuals aged 60 years or older who were hospitalized between October

2021 and July 2022. Individuals classified as moribund, those who self-discharged against medical guidance, or those who expired during institutionalization were omitted from the cohort. Patients experiencing a repeat hospitalization stemming from COVID-19 were likewise excluded. Based on statistical power calculations using Raosoft Seattle, a cohort of 311 individuals was deemed necessary, assuming a baseline point prevalence of 29%. Given that the protocol relied solely on secondary analysis of existing medical documentation, informed consent from individuals was not required. Authorization for this work was granted by the Malaysian Research and Ethics Committee (MREC: KKM/NIH/P21-1725 (3)).

Criteria for potentially inappropriate medication

To evaluate the utilization of potentially inappropriate medications, the authors implemented all established explicit indicators derived from the Beers and STOPP frameworks, assessing them both independently and as an integrated set. Agents were flagged as inappropriate, except in scenarios where such classification depended strictly on long-term use that could not be verified through available data. The analysis was restricted exclusively to systemic formulations. Investigators extracted all relevant baseline variables, including demographic metrics (such as gender and age), COVID-19 severity rankings, and pharmaceutical profiles captured at admission and discharge.

Data collection

Information was extracted from clinical records compiled at initial hospital entry, a stage at which comprehensive pharmaceutical tallies are routinely generated by pharmacy personnel as part of standard admission procedures. Details regarding exit therapies were derived from the formal discharge orders written by the managing physician, which documented all baseline maintenance pharmaceuticals and pro re nata (as-needed) prescriptions.

Statistical analyses

Analytical operations were performed via IBM SPSS Statistics for Windows version 27 (IBM Corporation, NY, USA). Predictors of PIM administration were evaluated through univariate logistic regression, with results presented as adjusted odds ratios alongside 95% confidence intervals. Subsequently, a multivariate logistic regression framework was constructed to identify specific patient features independently associated with

PIM exposure. A two-tailed $p < 0.05$ served as the threshold for establishing statistical significance. The architecture of this study complied with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting structures.

Results and Discussion

The final analytical sample comprised 553 individuals, with ages spanning from 60 to 98 years (median age: 67 [IQR 64–74] years). Females accounted for 300 of the participants (54.2%). The duration of institutionalization

ranged from 1 to 175 days (median, 8.00 [IQR 5.00–12.00]), and the study population used 0 to 19 concurrent therapeutic agents (median, 5.00 [IQR 3.00–7.00]). A substantial proportion of the cohort (67.5%) fell into COVID-19 Category 3 or 4 severity, with 43 individuals (7.8%) requiring critical care placement and 49 (8.9%) requiring mechanical ventilation support during their stay. Over half of the cohort met the criteria for polypharmacy—defined as managing 5 or more concurrent drugs—at the time of admission (280, 50.6%) as well as at discharge (346, 62.5%). Elaborated baseline profiles are presented in **Table 1**.

Table 1. Demographic characteristics, number of medications and PIMs detected among older adults studied (n = 553).

Patient characteristics	Count (%)
Age metrics, median (IQR) in years	67 (64–67)
60–70	363 (65.6)
71–80	139 (25.1)
81 and greater	51 (9.2)
Duration of hospital stay, median (IQR) in days	8 (5–12)
Sex	
Male	253 (45.8)
Female	300 (54.2)
Comorbid conditions present	
Absent	231 (41.8)
Present	322 (58.2)
Prior hospitalization within preceding 12 months	
No	487 (88.1)
Yes	67 (11.9)
COVID-19 clinical severity upon hospital entry	
Stage 1	58 (10.5)
Stage 2	82 (14.8)
Stage 3	133 (24.1)
Stage 4	240 (43.4)
Stage 5	25 (4.5)
Data unavailable	15 (2.7)
Intensive Care Unit (ICU) management	
No	510 (92.2)
Yes	43 (7.8)
Requirement for mechanical ventilatory support	
No	504 (91.1)
Yes	49 (8.9)
Total drugs managed at hospital entry, median (IQR)	5 (3–7)
Total drugs prescribed at hospital exit, median (IQR)	5 (4–8)
Overall pharmaceutical count upon admission	
0	8 (1.4)
1–4	265 (47.8)
5–10	252 (45.5)
11–15	26 (4.7)
16–20	2 (0.4)

Average (SD): 5.07 (3.09)	
Overall pharmaceutical count upon discharge	
1–4	207 (37.4)
5–10	309 (55.8)
11–15	36 (6.5)
16–20	0 (0.0)
Greater than 20	1 (0.2)
Average (SD): 5.79 (2.99)	
Volume of PIMs identified via STOPP criteria	
1	78
2	18
3	4
7	1
Aggregate PIM frequency	133
Average (SD): 0.25 (0.61)	
Volume of PIMs identified via Beers criteria	
1	102
2	18
3	3
4	1
Aggregate PIM frequency	151
Average (SD): 0.28 (0.57)	

Potentially inappropriate medications

When pooling both explicit classification frameworks, a total of 181 individuals were found to have received at least one potentially unsuitable therapeutic agent (32.7%). The Beers 2019 criteria flagged a slightly greater volume of inappropriate prescribing patterns (151 PIMs distributed among 124 patients) relative to the STOPP tool (133 PIMs distributed among 104 patients). **Table 2** highlights the 10 most frequent inappropriate prescription choices identified when combining the

explicit criteria systems. The extended administration of proton pump inhibitors ($n = 68$; 12.3%) and the use of therapies linked to elevated risks of orthostatic hypotension constituted the most prominent PIM categories observed ($n = 41$; 7.4%). Multiple logistic regression models indicated that undergoing a hospital admission within the prior 12 months, alongside managing a larger volume of discharge drugs, correlated significantly with an elevated likelihood of receiving inappropriate prescriptions (**Table 3**).

Table 2. Most common potentially inappropriate medication or prescribing identified in 553 older adults who were admitted due to COVID-19.

Clinical description	Frequency (%)
Proton pump inhibitors ordered for a duration of 8 weeks or longer, or absent an empirical clinical justification	68 (12.3)
Administration of ACE inhibitors, ARBs, or calcium channel blockers elevating the likelihood of orthostatic hypotension	41 (7.4)
Prazosin utilized for blood pressure management with the potential to induce orthostatic hypotension	16 (2.9)
Hydrochlorothiazide therapy carrying a secondary risk of inducing electrolyte imbalances	13 (2.4)
Chronic consumption of NSAIDs extending beyond 12 weeks	12 (2.2)
Selection of ticlopidine over better tolerated, more efficacious therapeutic substitutions	7 (1.3)
Beta-blocker usage potentially obscuring signs of hypoglycemia in elderly individuals managing diabetes	7 (1.3)
Oral elemental iron regimens exceeding 200 mg per day lacking justification of superior absorption kinetics	6 (1.1)
Benzodiazepine administration associated with an elevated liability for accidental falls	6 (1.1)

Loop diuretic therapy instituted in the absence of an explicit medical indication

5 (0.9)

Table 3. Binary logistic regressions assessing significant factors associated with the presence of potentially inappropriate medications either Beers or STOPP.

Variable	Univariate (Crude OR, 95% CI)	p value	Multivariate (Adjusted OR, 95% CI)	P-value
Age category				
60–70 years	Reference			
71–80 years	0.89 (0.58–1.36)	0.582		
≥ 81 years	1.32 (0.72–2.42)	0.363		
Sex				
Male	Reference			
Female	1.08 (0.65–1.81)	0.761		
COVID-19 severity level				
Category 1	Reference			
Category 2	0.87 (0.40–1.89)	0.715		
Category 3	1.57 (0.789–3.11)	0.200		
Category 4	1.38 (0.72–2.64)	0.329		
Category 5	1.61 (0.59–4.41)	0.352		
Hospital admission within previous 12 months				
No	Reference		Reference	
Yes	2.64 (1.57–4.44)	< 0.001	2.23 (1.29–3.99)	0.004
History of ICU admission				
No	Reference			
Yes	1.38 (0.73–2.61)	0.324		
Mechanical ventilation history				
No	Reference			
Yes	1.34 (0.73–2.45)	0.346		
Comorbidity status (≥1 comorbidity)				
No	Reference			
Yes	1.66 (1.14–2.40)	0.008		
Number of discharge medications				
1–4	Reference		Reference	
5–10	5.19 (3.25–8.30)	< 0.001	5.33 (3.20–8.58)	< 0.001
> 10	11.44 (5.24–24.98)	< 0.001	10.75 (4.79–24.16)	< 0.001

CI: confidence interval; OR: odds ratio

A backward stepwise multiple logistic regression procedure was applied. Assessment for multicollinearity and interaction variables revealed no confounding influences. Model fitness and explanatory capacity were validated using the Hosmer–Lemeshow test ($P = 0.927$), a classification performance overview (indicating an overall correct classification metric of 71.0%), and an area under the curve value of 70.4%.

To the best of our knowledge, this inquiry represents the first and most extensive study to evaluate the occurrence of PIMs in elderly individuals with COVID-19 by simultaneously applying the Beers and STOPP frameworks. In alignment with current literature, our

findings indicate that over 50% of the institutionalized cohort experienced polypharmacy (≥ 5 medications), while roughly 5% exhibited hyperpolypharmacy, defined as the consumption of 10 or more therapeutic agents. Furthermore, approximately one-third of the study population was prescribed one or more PIMs, with the protracted administration of proton pump inhibitors and the utilization of antihypertensive drugs that elevate orthostatic hypotension risks emerging as the most prevalent issues.

Due to the accelerating global demographic shift toward an aging population, investigations exploring polypharmacy and PIMs have been widely pursued in

recent years within geriatric cohorts. A meta-analysis examining polypharmacy rates across 189,870 individuals documented a combined prevalence of 34.6%, with the bulk of the included research originating from developed nations in Europe [12]. In contrast, an investigation conducted in India demonstrated that polypharmacy rates exceeded 80% among adults institutionalized in dedicated COVID-19 wards [13].

The present research addresses an essential gap in empirical knowledge by measuring the prevalence of polypharmacy and its linked inappropriate prescribing practices across several widespread medical conditions among geriatric COVID-19 patients in Malaysia. Although multiple publications have previously reported polypharmacy and PIM rates among older Malaysian adults [2], our work offers unique insights into these frequencies in the context of COVID-19, as prior regional investigations focused exclusively on uninfected cohorts [2]. This analysis also expands the broader body of COVID-19 evidence by evaluating the likelihood of patients encountering PIMs and their associated clinical ramifications. Consistent with our observations, Bhardwaj and Shoma [14] found that approximately one-third (34.3%) of individuals managing COVID-19 received at least one PIM when evaluated using the STOPP parameters.

We also detected a widespread, inappropriate administration of PPIs, which aligns with prior literature and runs counter to multiple professional guidelines regarding optimal prescribing practices, particularly within ambulatory environments [15]. In light of our observations, these outcomes signal a pressing need for key medical stakeholders to integrate systematic medication reviews that concentrate specifically on long-term PPI therapies. Nevertheless, this strategy must weigh individual patient preferences, as the cessation of PPI therapy can trigger a recurrence of gastrointestinal symptoms and lower patient satisfaction without offering transparent clinical advantages [16, 17].

Beyond traditional duties such as clinical ward rounds and structured medication reconciliations, the professional scope of pharmacists expanded significantly during the COVID-19 crisis. Globally, pharmacy professionals participated in designing preventive frameworks to address COVID-19 risks, coordinating pharmaceutical supplies, delivering direct clinical care and screening, conducting point-of-care antigen testing, and administering COVID-19 immunizations [18]. Within Asian nations, pharmacists provided

complimentary medical and pharmaceutical counseling, developed localized COVID-19 clinical protocols, managed home medication deliveries, and facilitated telehealth services [19]. In Malaysia, pharmacists functioned as a cornerstone of the medical workforce, overseeing experimental treatments, tracking medication safety parameters, restructuring delivery frameworks, performing remote supply monitoring, and utilizing digital communication platforms for patient counseling alongside their historical responsibilities [20-24]. Regarding the evaluation of prescription suitability for elderly patients with COVID-19, adopting these specialized strategies enhanced the availability and standards of pharmaceutical care.

This study contains certain limitations that must be acknowledged. The investigative design was retrospective, and there was no uniform protocol for documenting medication histories. Furthermore, the personal protective equipment used by medical staff varied across institutions, potentially affecting the consistency and precision of medication history retrieval during data collection. Additionally, this analysis did not track adverse drug reactions or clinical endpoints in patients exposed to PIMs, nor did it isolate alternative variables that might correlate with inappropriate medication use.

Subsequent investigations should evaluate larger patient samples and incorporate extended observation windows to thoroughly examine PIM-related adverse outcomes, hospital readmissions, fall incidence, and overall mortality.

Conclusion

Within the Malaysian context, the administration of potentially inappropriate medications appears widespread among older adults. This inquiry highlights the adverse implications of suboptimal prescribing patterns, and these insights are vital for medical decision-makers intending to establish routine medication utilization reviews, particularly within the geriatric population, to mitigate potential safety risks stemming from PIMs.

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