

Prevalence of Polypharmacy and Potentially Inappropriate Prescribing (PIP) among Older Adults Aged 65 Years and above in Brunei Darussalam

Sebastian Eng Chong KOH^{1*}, Maggie SIM¹, Lina Maziyyah PG METUSSIN¹, Pey Siaw LIM¹, Su Ying YEO¹, Yung Shin YEO¹, Wai See WONG¹, Shyh Poh TEO^{2,3}, Li Ling CHAW³

Abstract

Introduction: Polypharmacy and potentially inappropriate prescribing (PIP) are increasingly recognised as important contributors to medication-related harm among older adults. However, published national data on the prevalence of polypharmacy and PIP in Brunei Darussalam are unavailable. The objectives of this study was to determine the prevalence of polypharmacy and PIP among adults aged 65 years and above in Brunei Darussalam using Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) version 2 criteria. **Materials and Methods:** A retrospective cross-sectional study was conducted using data from the Brunei Healthcare Information Management System (Bru-HIMS). A stratified proportional random sample of 2,000 older adults with documented medical encounters in 2016 was selected. Polypharmacy was defined as the concurrent use of five or more medications. PIP was assessed using STOPP version 2 criteria. Descriptive statistics were used to summarise prescribing patterns. **Results:** Of the 2000 older adults included (mean age 73.0 ± 6.6 years), 1,181 (59.1%) had polypharmacy. Among those with polypharmacy, 1,057 (89.5%) could be assessed using STOPP criteria, and 206 (19.5%) had at least one PIP. The most frequently identified PIPs involved prolonged use of proton pump inhibitors for uncomplicated peptic ulcer disease at full therapeutic dosage for more than eight weeks, where dose reduction, discontinuation, or transition to maintenance therapy (e.g. H2 receptor antagonists) is indicated, prescribing without evidence-based indication, duplication of drug classes, use of ACE inhibitors or angiotensin receptor blockers in patients with hyperkalaemia, and use of first-generation antihistamines. **Conclusion:** Polypharmacy and PIP are common among older adults in Brunei Darussalam. The findings highlight the need for systematic medication review and deprescribing strategies to optimise pharmacotherapy and improve medication safety in older populations.

Keywords: Aged; Electronic health records; Medication review; Polypharmacy; Inappropriate prescribing

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Author Details:

1 Hospital Pharmacy Services, RIPAS Hospital, Brunei Darussalam

2 Geriatrics and Palliative Medicine, RIPAS Hospital, Brunei Darussalam

3 PAPRSB Institute of Health Sciences, Universiti Brunei Darussalam, Brunei Darussalam

***Correspondence:**

Sebastian Eng Chong KOH

sebastian.koh@moh.gov.bn

INTRODUCTION

The advancement of healthcare medical practices and medication development led to people worldwide living longer.¹ The World Health Organisation (WHO) estimated that between 2015 and 2050, the proportion of global population aged 60 years and above will nearly double from 12% to 22%.² Similarly, national statistics indicate a significantly increasing proportion of older people in Brunei Darussalam.³ Ageing is associated with multimorbidity, such as hypertension, diabetes mellitus, arthritis, chronic heart disease and renal disease, resulting in the concomitant use of multiple medications to manage chronic conditions, which is termed polypharmacy.⁴

Polypharmacy has been variably defined in the literature, and its interpretation has evolved over time. It has previously been used to describe the use of many drugs in one prescription, or the use of more medications than are clinically indicated.⁵ Polypharmacy is associated with a higher risk of adverse drug reactions (ADRs) and drug interactions, especially in older adults.⁶ While there is no universal definition, polypharmacy is regarded as an important and growing public health concern. In this study, polypharmacy is defined as the concurrent use of five or more medications.⁵

The risks associated with polypharmacy are relevant in older adults, who are more susceptible to medication-related harm. This is due to age-related physiological conditions and chronic conditions resulting in metabolic changes and reduced renal clearance.^{4,6} Polypharmacy is also associated with important clinical outcomes, such as increased hospitalisation, quality of life and healthcare costs.^{1,7} These risks provide a strong rationale for examining prescribing patterns and medication burden in older people.

The safety and appropriateness of prescribing in older adults are not related to medication count only. Potentially inappropriate prescribing (PIP) refers to prescribing medications where the potential risks outweigh anticipated benefits, especially when safer alternatives exist or when medications are continued without clear ongoing indications.⁸ As PIP in older adults are potentially preventable, screening tools such as the

Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) criteria has been developed and refined to support identification of PIP in clinical practice.^{9,10} This study aimed to determine the national prevalence of polypharmacy and incidence of PIP among older adults aged 65 years and older in Brunei Darussalam across the four districts: Brunei-Muara, Belait, Tutong and Temburong.

MATERIALS AND METHODS

Study design and population: This was a retrospective cross-sectional study using data from the Brunei Darussalam Health Information and Management System (Bru-HIMS). Inclusion criteria were adults aged 65 years and older with at least one medical encounter within the public healthcare system (including primary care, hospital inpatients and outpatient clinics), between 1st January 2016 and 31st December 2016. Exclusion criteria were duplicate records, deceased individuals, and patients without documented medical encounters during the study period. For PIP assessment, patients with incomplete prescribing data, including those receiving concurrent care in private healthcare settings were excluded.

Sampling: A stratified proportional sampling approach was used to ensure representation across all four districts in Brunei Darussalam. The initial data extract identified 25,221 individuals aged 65 years and older within Bru-HIMS. After duplicate records and deceased individuals were removed (n = 2,514), a total of 22,707 active records of older adults remained in the system and formed the sampling frame. This figure is consistent with national population estimates from the Population and Housing Census Update 2016, which reported 21,599 individuals aged 65 years and older in Brunei Darussalam.³ From this population, a stratified random sample was selected. Of the 2,684 individuals identified, 684 were excluded due to the absence of documented medical encounters during the study period, resulting in a final study sample of 2,000 participants.

The sample size of 2,000 was calculated to estimate the prevalence of polypharmacy with a precision of ±

0.021 at a 95% confidence level, assuming a prevalence of 50%. This sample represented approximately 9% of the total population aged 65 years and above in Brunei Darussalam during the study period.

Data Collection: Demographic and clinical data, including age, gender, district of residence, diagnoses and medication information were extracted from Bru-HIMS. Medication history was accessed securely via pharmacist clinician access within Bru-HIMS, and included the generic name of drugs prescribed, dosage, quantity and duration prescribed. Diagnoses were coded using ICD-10 classification. Laboratory data extracted included serum potassium level for assessment of hyperkalaemia.

Definitions and outcomes: Polypharmacy was defined as the concurrent use of five or more medications.⁵ The primary outcome was the prevalence of polypharmacy. Secondary outcomes included the prevalence and patterns of PIP.

Assessment of potentially inappropriate prescribing: PIP was assessed using the Screening Tool of Older Persons' potentially inappropriate Prescriptions (STOPP) version 2 (v2). STOPP v2 comprises 81 criteria covering commonly encountered instances of inappropriate prescribing in older adults, including drug–drug and drug–disease interactions, inappropriate drug choice, excessive dose or duration of treatment, duplicate drug class prescriptions, and medications associated with increased risk of falls.^{11,12} The full list of the 81 criteria from STOPP v2 is available in the original publication.¹²

Electronic medical records, including diagnostic codes, laboratory results, and documented medical interventions, were reviewed to identify clinical conditions required for application of STOPP criteria.

Assessment of PIP was restricted to patients with polypharmacy. Patients without chronic medications or those receiving concurrent care in private clinics or hospitals were excluded from the PIP assessment due to incomplete prescribing data. In cases where ambiguity arose during application of STOPP criteria, medication histories were reviewed by a medical clinician within the research team to ensure consistency and validity.

Statistical analysis: Descriptive statistics were used to summarise patient characteristics and prescribing patterns. Categorical variables were reported as frequencies and percentages, and continuous variables as means with standard deviations. The prevalence of polypharmacy was calculated as the proportion of patients prescribed five or more medications among the total study population (n=2,000). The prevalence of PIP was calculated as the proportion of patients with at least one PIP among those assessed using STOPP criteria (n=1,057). Data analysis was performed using Microsoft Excel 2019 MSO (Version 2508).

Ethical Considerations: Ethical approval was obtained from the Medical and Health Research Ethics Committee (MHREC), Ministry of Health, Brunei Darussalam Reference: MHREC/MOH/2017/4/4(1). The requirement for individual informed consent was waived, as this study involved secondary analysis of routinely collected clinical data that were deidentified prior to analysis, and posed minimal risk to participants.

RESULTS

There was a total of 2,684 patients screened for polypharmacy, of whom 684 (25.5%) had no medical encounters during the study period and were excluded. The population characteristics of the remaining 2,000 in the study population are summarised in **Table I**.

Table I: Characteristics of study population.

Population Characteristics (n=2000)	Overall	Brunei Muara, n (%)	Belait, n (%)	Tutong, n (%)	Temburong, n (%)
Number of patients, n (%) [†]	2,000 (100%)	1,274 (63.7%)	399 (19.9%)	273 (13.7%)	54 (2.7%)
Mean age (years) ± SD	73.0 ± 6.6	72.8 ± 6.4	73.4 ± 6.6	73.6 ± 7.6	74.1 ± 7.1
Age Range	65-103	65-100	65-94	65-103	66-93
Male	925 (46.3%)	599 (47.0%)	184 (46.1%)	112 (41.0%)	30 (55.6%)
Female	1,075 (53.8%)	675 (53.1%)	215 (53.9%)	161 (59.0%)	24 (44.4%)
Polypharmacy present	1,181 (59.1%)	738 (57.9%)	246 (61.7%)	163 (59.7%)	34 (63.0%)
Median number of drugs prescribed (IQR)	5 (3-8)	5 (3-8)	6 (4-9)	5 (3-7)	5 (3-6)
Assessed using STOPP criteria	1,057 (89.5%)	668 (90.5%)	225 (91.5%)	134 (82.2%)	30 (88.2%)
PIP identified [‡]	206 (19.5%)	112 (16.8%)	55 (24.4%)	33 (26.6%)	6 (20.0%)

SD - standard deviation; IQR - interquartile range; STOPP - Screening Tool of Older Persons' potentially inappropriate Prescriptions ; PIP - potentially inappropriate prescribing

[†]Based on the Population and Housing Census Update 2016, the distribution of older adults (≥65 years) across districts was 62.3% (Brunei-Muara), 20.9% (Belait), 13.6% (Tutong), and 3.1% (Temburong).³

[‡]PIP calculated among patients assessed using STOPP criteria (n=1057)

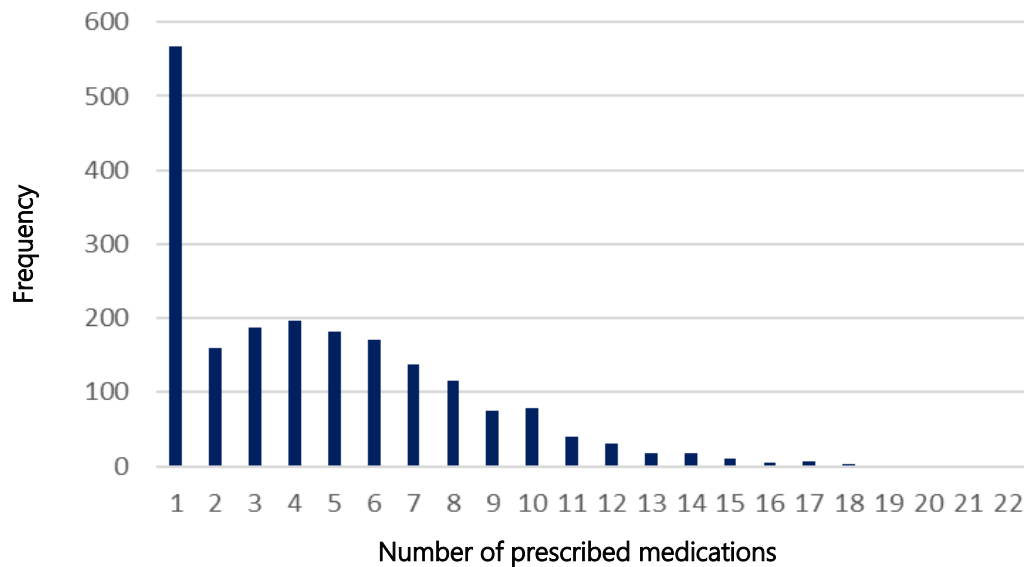


Fig. 1: Distribution of number of drugs prescribed.

The overall mean age is 73.0 ± 6.6 years, with a slight predominance of females (53.8%). There were 1,181 (59.1%) of patients with polypharmacy, varying from 57.9% in the Brunei-Muara district to 63.0% in the Temburong district. The median number of drugs prescribed was 5 (IQR 3-8), with a range of 1 to 22. **Figure 1** shows the distribution of the number of regular prescribed medications, which was right-skewed, with the majority of patients receiving between 3 and 7 medications.

Among the 1,181 patients with polypharmacy, 1,057 (89.5%) had sufficient data for assessment using the STOPP criteria. The remaining 124 patients were excluded from PIP assessment due to incomplete prescribing data, mainly due to concurrent care in private healthcare settings. Among those assessed, 206 (19.5%) had PIPs. The prevalence of PIPs varies by districts, ranging from 16.8% in the Brunei-Muara district to 26.6% in the Tutong district.

The top five most common PIPs based on the STOPP criteria were:

1. any drug prescribed without an evidence-based clinical indication (1a),
2. any duplicate drug class prescription e.g. two concurrent non-steroidal anti-inflammatory drugs (NSAIDs), selective serotonin reuptake inhibitors (SSRIs), loop diuretics, angiotensin converting enzyme (ACE) inhibitors, anticoagulants (1c),
3. ACE inhibitors or Angiotensin Receptor Blockers in patients with hyperkalaemia (2k),

4. first-generation antihistamines, as safer, less toxic antihistamines are now widely available (4n), and
5. proton pump inhibitors (PPIs) for uncomplicated peptic ulcer disease or erosive peptic oesophagitis at full therapeutic dosage for more than eight weeks, as dose reduction or earlier discontinuation was indicated (6b).

These five categories accounted for 117 of the 206 identified PIPs (56.8%), with the remaining 89 cases corresponding to other STOPP criteria.

Across the four districts, the most prevalent PIP overall was prolonged use of proton pump inhibitors at full therapeutic dosage beyond eight weeks, identified in 48 cases (23.3% of all PIPs). The Brunei-Muara district had the highest percentage of drugs prescribed without evidence-based clinical indications ($n=12$ out of 13, 93%), while the Tutong district had the highest proportion of duplicate drug class prescriptions ($n=6$ out of 15, 40.0%). The Brunei-Muara district had the highest proportion of patients with hyperkalaemia who were prescribed ACE inhibitors or angiotensin receptor blockers ($n=7$ out of 16, 43.8%), and patients on prolonged proton pump inhibitors which should have dose reductions or discontinuation ($n=22$ out of 48, 45.8%). The Belait district had the largest prevalence of first-generation antihistamine prescribing for older adults ($n=20$ out of 25, 80.0%)

Figure 2 shows the variation in prescribing patterns for the five most common PIPs across the districts.

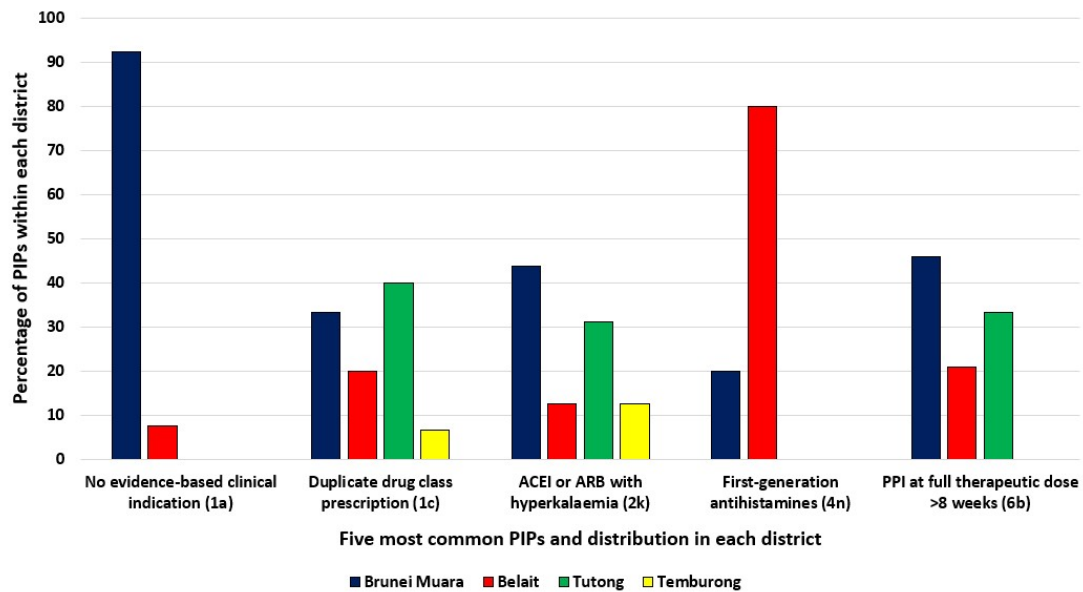


Figure 2: Distribution of the five most common PIPs in each district.

DISCUSSION

This study provides national baseline data on the prevalence of polypharmacy and PIP among older adults aged 65 years and above in Brunei Darussalam using routinely collected electronic health record data. Nearly six in ten older adults were prescribed five or more medications from the public healthcare system. Among those with polypharmacy, approximately one in five had at least one PIP identified using STOPP version 2 criteria. This identified a burden of complex prescribing in older adults and the potential for medication-related harm in this population.

The prevalence of polypharmacy observed in this study was 59.1%, which is comparable to findings from international studies, where estimates range between 40% and 70% among community-dwelling older adults.^{13,14} Differences in reported prevalence across studies may reflect variation in healthcare systems, population age structures, and access to medications. Regardless, the consistently high prevalence across the studies suggests that polypharmacy is increasingly common with ageing populations and poses a challenge for healthcare systems.

Among older adults with polypharmacy, 19.5% were found to have at least one PIP detected using the STOPP criteria. In this study, 56.8% of the PIPs fell within five main categories: prescribing PPIs at full therapeutic dosage for more than eight weeks for uncomplicated peptic ulcer disease or erosive peptic

oesophagitis; prescribing medications without an evidence-based clinical indication; duplication of drug classes (for example, concurrent use of two NSAIDs, SSRIs, loop diuretics, ACE inhibitors or anticoagulants); use of ACE inhibitors or angiotensin receptor blockers in patients with hyperkalaemia; and use of first-generation antihistamines, despite the availability of safe alternatives.

The prolonged use of PPI at full therapeutic dosage for more than eight weeks was the most common PIP identified, accounting for 23% of all detected PIPs. Similar findings have been reported in other studies, where inappropriate long-term PPI use is a frequent PIP in older adults in both primary care and hospital settings.^{15,16} Long-term use of PPIs in older adults has been associated with adverse outcomes, including accelerated osteoporosis, *Clostridium difficile* infections and increased healthcare expenditure.¹⁷⁻¹⁹ The persistence of prolonged PPI use may reflect continuation of therapy without regular review, prophylactic prescribing practices, and the perception that PPIs are relatively safe medications. In the absence of structured deprescribing processes, long-term use may continue beyond the recommended duration despite resolution of the initial indication.^{18,19} There is evidence to suggest that dose reduction or cessation of long-term PPI therapy does not result in significant worsening of dyspepsia symptoms or quality of life.^{20,21} Therefore, withdrawal of PPI with monitoring for symptom recurrence, or dose reduction where appropriate, is recommended to reduce the preva-

lence of PIPs.¹⁹

The use of first-generation antihistamines among older adults was also identified as a concern in this study. These medications are known to cause sedation and have anticholinergic effects, which may increase the risk of falls in older people.²² Studies from Asian countries have also reported that first-generation antihistamines contribute significantly to the burden of PIP.^{23,24} In this study, first-generation antihistamines accounted for 12% of PIPs, making them the second most common category of inappropriate prescribing. This pattern was observed more frequently in the Belait district, and may warrant targeted feedback and education for prescribers. This may be explained by several factors: these agents are inexpensive and widely available, and their sedative properties may be intentionally utilised for symptomatic relief of nocturnal symptoms or sleep disturbances. Prescribing inertia and familiarity with older medications may also contribute to ongoing use, as well as limited awareness of anticholinergic effects and risks in older adults.²⁵ Safer, non-sedating antihistamines are now increasingly available and should be considered as first-line agents, taking into account their cost-effectiveness and potential to improve quality of life.²⁵ Thus, where antihistamine therapy is required, substitution of first-generation antihistamines with safer alternatives should be considered in older adults.

Another important finding of this study was the presence of duplicate drug class prescriptions across all districts, which may lead to adverse events and increase healthcare costs.¹⁹ Thus, improved medication reconciliation practices may play a role in reducing PIP in Brunei.

Clinical and policy implications: The overall prevalence of polypharmacy and PIP identified in this study was 59.1% and 19.5% respectively. Given the high prevalence of polypharmacy and PIP, healthcare professionals should aim to reduce both through targeted interventions. This study identified commonly prescribed medications and prescribing patterns that contribute to PIPs and may inform the evaluation or development of clinical guidelines to improve prescribing practices.

Deprescribing interventions using STOPP criteria have been shown to reduce the incidence of polypharmacy and PIPs among older adults,²⁶ and may be integrated into routine practice to improve patient outcomes.²⁷ Pharmacist-led interventions, including services such as the local Medication Appropriateness

Review (MAR) in inpatient settings and Medicine Use Review (MUR) may assist in identifying and addressing PIPs. Further evaluation of the economic impact of PIP is also warranted to better understand its cost burden.

Strengths and limitations: This is the first study to assess the prevalence of polypharmacy and PIP among older adults in Brunei Darussalam. It provides a comprehensive overview of prescribing practices within the public healthcare system and offers an opportunity to inform future medication optimisation initiatives. The study population from Bru-HIMS identified a total of 22,707 older adults, which is approximately the estimated population aged 65 years and older in Brunei in 2016 (21,599), which supported representativeness of the sampling frame.³ The use of Bru-HIMS also enabled access to comprehensive medication histories, laboratory results, vital signs, and prescriber documentation, facilitating efficient data collection.

However, this study has several limitations. Only public healthcare data were available, and prescribing details from private clinics and hospitals could not be assessed. The STOPP criteria were applied by six pharmacists, and some degree of inter-observer variability may have occurred. While the STOPP criteria were explicit, differences in interpretations may influence PIP identification. For example, in this study, low-dose aspirin used for secondary prevention of cardiovascular disease was not classified as an NSAID when screening for PIPs. Fall risk was also not consistently documented in medical records, which may further underestimate PIPs. It was also not possible to attribute PIPs to specific medical specialties, as prescriptions may have been continued or extended by different prescribers during routine reviews.

An important limitation is that the data were derived from prescribing records in 2016. While prescribing practices may have evolved over time, these findings remain highly relevant as baseline national data, particularly in the absence of other published studies in Brunei. It is also plausible that similar prescribing patterns persist, although future studies using more recent data are needed to confirm trends and evaluate improvements in prescribing practices.

CONCLUSION

The study provides baseline national data on the prevalence of polypharmacy and PIPs among older adults in Brunei. The findings demonstrate a substantial burden of complex prescribing, with implications for medica-

tion safety and healthcare utilisation. Raising awareness of polypharmacy and consequences of PIP alongside pharmacist-led interventions and structured deprescribing strategies, may help improve therapeutic outcomes for older adults.

Take Home Message

- Polypharmacy is highly prevalent (59.1%) among older adults in Brunei Darussalam.
- One in five older adults with polypharmacy has at least one potentially inappropriate prescription.
- Prolonged proton pump inhibitor use beyond the recommended duration and first-generation antihistamines are common contributors.
- Structured medication review and deprescribing may improve prescribing safety in older adults.

Abbreviations

PIP	Potentially inappropriate prescribing
STOPP	Screening Tool of Older Persons' potentially inappropriate Prescriptions
NSAIDs	Non-steroidal anti-inflammatory drugs
SSRIs	Selective serotonin reuptake inhibitors
ACE	Angiotensin converting enzyme

Declarations

The authors declare no conflicts of interest, and no external funding was received for this study.

Ethical Consideration

Ethical approval was obtained from the Medical and Health Research Ethics Committee (MHREC), Ministry of Health, Brunei Darussalam Reference: MHREC/MOH/2017/4/4(1)

Author Contributions

Conceptualisation: SECK, MS, LMPM, PSL, SYY, YSY, WSW, SPT, LLC; **Methodology:** SECK, WSW, SPT, LLC; **Software:** LLC; **Validation:** SECK, LLC; **Formal analysis:** SECK, MS, LMPM, PSL, SYY, YSY, SPT, LLC; **Investigation:** SECK, MS, LMPM, PSL, SYY, YSY; **Resources:** SECK; **Data curation:** SECK, LLC; **Writing – Original Draft:** SECK, MS, LMPM, PSL, SYY, YSY, SPT, LLC; **Writing – Review & Editing:** SECK, SPT; **Visualisation:** SECK, SPT; **Supervision:** SECK, WSW, SPT, LLC; **Project administration:** SECK.

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