# Potentially inappropriate medication among community-dwelling older adults : A public health issue in Burkina Faso

**HIEN H.[1,2*], SOMDA D.[1], TOUGOUMA J.-B. S.[3], MÉDA Z. C.[3,4],**
**BERTHÉ A.[1], DRABO K. A.[2], KONATÉ B.[1], MÉDA N.[1,5]**

## Abstract

PIM is defined as a lack of demonstrated indication, high risk of side effects, and a sub-optimal cost effectiveness and/or cost benefit. Little data on potentially inappropriate medications (PIM) in older adults with comorbidity are available in sub-Saharan Africa. The aim of this study was to assess the prevalence and the factors associated with the use of PIM in community-dwelling older adults in Burkina Faso. In 2012, we did a cross-sectional household survey which included 389 older adults in Bobo-Dioulasso. Updated 2012 Beers criteria were used to assess the PIM in older adults aged $\geq 60$ years. Medications from formal medical source (prescribing) and informal source (informal market, over-the counter and traditional medicines) were included. A multivariate analysis was performed to determine factors associated with the use of PIM. Proportion of older adults used at least one PIM was 59% (196/332). The most common PIM were traditional medicines 28.97% (62/214), diclofenac 21.03% (45/214) 17.5% (45/214), ibuprofen 7.76% (38/214), aspirin 7.01% (15/214), nifedipine  5.61% (12/214) and reserpine 5.61% (12/214). Polypharmacy ($\geq 3$ drugs), is the independent factor associated with PIM. Our findings highlight the need to think about integrated health care system in order to reduce the PIM among older adults with multiple comorbidities..

**Keywords:** potentially inappropriate medication, older adults, comorbidity

## Médicaments potentiellement inappropriés chez les personnes âgées vivant dans la communauté : un problème de santé publique au Burkina Faso

## Résumé

Les MPI sont définis comme un manque d'indication démontrée, un risque élevé d'effets secondaires et une efficacité et / ou un rapport coût / efficacité sous-optimal. Il existe peu de données sur les médicaments potentiellement inappropriés (MPI) chez les personnes âgées atteintes de comorbidité en Afrique sub-saharienne. Le but de cette étude était d'évaluer la prévalence et les facteurs associés à l'utilisation des MPI chez les personnes âgées vivant dans la communauté au Burkina Faso. En 2012, nous avons mené une enquête transversale dans les ménages auprès de 389 personnes âgées à Bobo-Dioulasso. Mis à jour en 2012, les critères de Beers ont été utilisés pour évaluer les MPI chez les adultes âgés de $\geq 60$ ans. Les médicaments de source médicale formelle (prescription) et informelle (marché informel, médicaments en vente libre et médicaments traditionnels) ont été inclus. Une analyse multivariée a été réalisée pour déterminer les facteurs associés à l'utilisation des MPI. La proportion d'adultes âgés ayant utilisé au moins un

[1] Département de Santé Publique, Centre MURAZ,  01 BP 390 Bobo-Dioulasso 01, Tél : +22670245554 , Burkina Faso

[2] Institut de recherche en science de la santé, 03 BP 7192, Ouagadougou 03, Burkina Faso.

[3] Département de Médecine, Centre Hospitalier Universitaire Sourô Sanou, Bobo-Dioulasso, Burkina Faso

[4] Institut supérieur des sciences de la santé, Université Nazi Boni 01 BP 1091 Bobo-Dioulasso 01, Burkina Faso.

[5] Unité de Formation et de la recherche des sciences de la santé, Université Ouaga I Pr Joseph Ki-Zerbo, Ouagadougou, Burkina Faso

[*] Corresponding author : Email : hien_herve@hotmail.com ; Tél : 00 226 70 24 55 54

MPI était de 59 % (196/332). Les MPI les plus courants étaient les médicaments traditionnels 28,97 % (62/214), le diclofénac 21,03% (45/214), l'ibuprofène 7,76 % (38/214), l'aspirine 7,01 % (15/214), la nifédipine 5,61% (12/214) et la réserpine 5,61 % (12/214). La polymédication (≥ 3 médicaments) est le facteur indépendant associé à la MPI. Nos résultats mettent en évidence la nécessité de réfléchir à un système de soins de santé intégré afin de réduire la MPI chez les personnes âgées présentant de multiples comorbidités.

**Mots-clés :** Médicaments potentiellement inappropriés, personnes âgées, comorbidité.

## Introduction

Potentially inappropriate medications (PIM) in older adults is an important public health issue that concern most health care systems in high incomes countries. PIM is defined as a lack of demonstrated indication, high risk of side effects, and a sub-optimal cost effectiveness and/or cost benefit (1-3). The prevalence of PIM is high, but varies across regions and settings. In USA and Canada, it ranges from 14% to 37% in community (4-6) and 50% in nursing homes (7). In Europe, prevalence ranges from 12% to 20% among older adults living in community (8, 9). It is 14% to 34% among hospitalized older adults (10,11), and 35% in nursing homes (12). PMI has been associated with adverse events (13,14), hospitalizations (15,16) and financial resources use (17). In Asia, the prevalence is 19.1% in Taiwan (18) and 24.6% in India (19). Most studies on PIM have been made in countries faced with demographic (i.e. aging population) and related epidemiologic challenge (comorbidity or chronic conditions) (20-24). In Sub-Saharan Africa (SSA) till recently, health care organization priorities have focused on acute care and infectious disease. Older people care and management of comorbidities have not been much considered. However, this region of the world starts to experience the ageing of its population. Currently, an estimated 62% of older adults live in low incomes countries. It is expected to increase to 80% in 2050 (25). In Burkina Faso, older adults aged ≥ 60 years increased from 490 344 in 1985 to 582 060 in 1996 and 712 573 in 2006, with an estimated total population of 14 017 262 in 2006 (26). So far, literature has addressed widely the issue of PIM by focusing on prescription in nursing homes (27-30), in health care institutions and hospitalization (31-35). The reality is different in SSA where access to drugs is also through the informal market, sale over-the-counter medications and traditional medications (36-38). The studies conducted in Africa come first from Kamuhabwa et al. in 2010. The authors worked about the drugs use among elderly patients in public and private hospitals in Dar-as Salaam. (39) and the second from Chetty et al. in 2004 (40). They worked about inappropriate prescribing in an elderly population in South African public sector. They only focused their studies on medical prescription in health care institutions. We therefore aim to fill a gap by assessing the prevalence and factors associated with the use of PIM among community-dwelling older adults in Burkina Faso.

## Methods

### Study Design

We conducted a cross-sectional study among older adults living at home in the second biggest city of Burkina Faso (Bobo-Dioulasso). According to the General Census of Population and Habitation (RGPH) in 2006 (41), Bobo-Dioulasso city had 489 967 inhabitants. This city had 94 947 households distributed in 25 geographical areas. It had 18 130 (3.7%) older adults aged ≥ 60 years.

Public care delivery system is provided at the primary level by 36 primary health care facilities and two urban health hospitals. The highest reference level is the University Hospital. Besides that, there are also private health care for-profit and non-profit providers. There are also a traditional health care providers and informal care providers (42). They provide care and medications in a fixed place or itinerant at homes, in markets or public spaces in the city.

## Study population and Sample size

Study population was older adults. Eligibility criteria were: i) being 60 years old or more, ii) living in a household in the city during the study period and iii) have consented to participate in the study. The level of 60 years has been defined according to the definition of older adult in Burkina Faso (26).

We conducted a random cluster sampling. We selected a sample random of 22 sectors from the three urban health districts. Then we selected a sample random of households according to the proportion to the size of the sectors. In each household, one older adult was interviewed. The sample size was calculated according to a proportion of 19.1% of potentially inappropriate prescription (18), a risk of error of 5%, a cluster effect of 1.5 and 10% of non-response rate. A total of 389 older adults were expected in the study.

## Data collection

From August to December 2012, data collection was conducted through older adult's interviews, review of heath documents and drugs review. Interviews with older adults were conducted to collect demographic data, symptoms and/or diseases. We used a questionnaire that was structured according to the organ system. Older adults had to answer the question: did a health professional diagnose you any of the following disorders?: Visual impairment, hearing impairment, gastrointestinal disease, cardiovascular, respiratory, urinary, muscular, neurological, osteo-articular, psychiatric, metabolic etc? Describe the symptoms. Three techniques of data collection were used: 1) interviews for seft reported diseases, 2) review of health documents (health booklet, medical prescription, biological and radiological results) and 3) drugs observations. Comorbidity was defined as the presence of ≥ 2 medical conditions (43).

All drugs were examined at home. Both regular and "as required", drugs from medical prescription or not (over-the-counter medication, informal market, traditional medication) were recorded. Traditional medication was defined as herbs, leaves, powders, barks of trees, or mixtures of these products. Medications data included name, dose, frequency, total number, and symptoms or disease indication. For this study polypharmacy was defined as the use of ≥ 3 drugs at the time of the study (44). Interviews, health documents and drugs review were conducted at home by two physician's researchers. When older adult was not able to answer questions, an assistance of a family member was requested. A pre-test of tools has been achieved before data collection.

## Potentially inappropriate medications

We used the updated 2012 Beers criteria (45) to evaluate PIM for multiples reasons.

Firstly, it was tested in low incomes countries and in Africa to assess potentially inappropriate medications (18, 24, 29, 34, 39, 40). Secondly, Beers criteria screen more PIM in these regions compared to other lists (19, 29), and thirdly, it seems easy to apply this for community survey because it can detect PMI independent of diagnosis. Finally it is also easy to use by non-experts

pharmacists (46). In this study, we considered drugs from traditional medicine as might be potentially inappropriate medication because of inadequate knowledge of their pharmacological properties. The 2012 updated Beers criteria (45) include three categories of drugs. The first describes 34 drugs or classes of drugs (independent of diagnosis or clinical conditions) that should be avoided in older adults in favor of a safer alternative. The second describes drugs to avoid in older adults with certain diseases and syndromes that the drugs listed can exacerbate (depend on diagnosis). The third category is a list of drugs to be used with caution. In our study each drug has screened according to the conditions (independent or dependent of diagnosis).

We hypothesize that traditional medications were PIM because of a lack of knowledge of their pharmacokinetics characteristics, lack of dose administration and precision of medical indication use during the survey. These can be potentially dangerous and interfere with other drugs and affect older adult's health already weakened by comorbidities.

In summary these Beers criteria have been modified to adapt to local context (inclusion of traditional drugs). The lists of Beers drugs were used to screen the PIM.

Two physician's researchers examined PMI. When there was a difference between them, a third more experienced researcher took a decision.

## Data Analysis

A first level of analysis consisted of describing i) characteristics of older adults: mean age (SD), age-group, gender, literacy, marital status, income, common habitat (more than one household), consultation in health facility in the past six months and comorbidity, ii) the proportion of older adults with polypharmacy ($\geq$ 3 drugs), iii) the total number of medications used by all older adults at home, iv) median number (IQR) of drugs used by older adults, v) the proportion (with CI 95%) of older adults using at least one PIM vi) the proportion (with CI 95%) of PIM among drugs used at home, vii) the proportion (CI95%) of PIM according to medical prescription or not.

A second level of analysis included univariate analysis and logistic regression. The univariate analysis was used to determine the association between PIM used and each of the following independent factors: age, sex, literacy, income, marital status, consultation in a health facility in the past six months, common habitat, medical prescription, polypharmacy, and comorbidity. The univariate analysis used chi 2 test. A logistic regression model was used to determine the independent factors associated with the PIM. The selection of independent variables for the logistic regression model was based on the literature data. Age, sex, illiteracy, medical prescription, number of comorbidity and polypharmacy showed associated with PIM (17, 32, 47-54). In addition, they had to be significantly associated with PMI in our univariate analysis (p <0.2) (31). Data entry were performed using Epi data and data analyses were performed using Stata version 11 software. For all tests, we used a significance level of 5%.

## Ethical approval

The research protocol was approved by Ethics Committee of Health Research in Burkina Faso. Agreements on health system and administrative authorities were obtained for data collection in households. Information notice and consent form were used to obtain the consent of the study participants. Participants signed a written informed consent to participate in the study.

## Results

### Participants characteristics

Our findings concerned 389 older adults at home. The median age (IQR) was 67 (64-74) years old. Among older adults, 55%(214/389) were men and 58.7% (225/383) were married. Forty two percent 42% (159/379) reported having a regular income (retirement benefits), 54.1% (205/379) were illiterate and 59.1% (230/389) had visited a health facility in the past six months. The proportion of older adults with a comorbidity was 85.6%. The median of comorbidity among older adults was 3 (IQR : 2-5). The most common comorbidities were: pain (62.2% (242/389), hypertension (42.2% (164/389)), constipation (41.4% (161/389)), insomnia (31.9% (124/389)), dizziness (36.2% (141/389)), visual impairment (29.7%(n)), peptic ulcer disease (20.8% (81/389)), symptoms of lower urinary tract (12.9% (50/389)).

Table I shows characteristics of older adults.

**Table I:** Characteristics of older adults ≥ 60 years at Bobo-Dioulasso

| Characteristics | n, % |
|---|---|
| Median age(IQR) | 67 (64-74) |
| Age-group (years), n=365 | |
| 60-69 | 212 (58.1) |
| ≥ 70 | 153 (41.9) |
| Sex, n=389 | |
| F | 175 (45.0) |
| M | 214 (55.0) |
| Literacy, n=379 | |
| No | 205 (54.1) |
| Yes | 174 (45.9) |
| marital status , n=383 | |
| Married | 225 (58.7) |
| unmarried | 158 (41.3) |
| Income, 379 | |
| No retirement benefits | 220 (58.0) |
| Retirement benefits | 159 (42.0) |
| Habitat, n=364 | |
| Common | 119 (32.7) |
| Unique | 245 (67.3) |
| Consultation, n=389* | |
| Yes | 230 (59.1) |
| Non | 159 (40.9) |
| Comorbidity, n=389 | |
| Yes | 333 (85.6) |
| No | 56(14.4) |

*in the past six months
IQR: Inter-Quartile Range; F: Female, M: Male

## Medications used by older adults

In total 839 medications were reported and they were used by 333 older adults living at home. The remain fifty six (56) older adults reported not using any medications during the survey. The median number of medications used by older adults was 2 IQR (1-3). The four main medications used were paracetamol (16.8% (141/839)), traditional medications (7.5% (63/839)), furosemide (5.8% (49/839)), diclofenac (5.5% (46/839)).

Table II shows the main medications used by older adults.

**Table II:** Most medications used by older adults at home

| Medicines (ICD*), N=839 | n (%) |
|---|---|
| Amlodipine | 13 (1.6) |
| Aspirin | 24 (2.9) |
| Captopril | 33 (3.9) |
| Traditional medicine | 63 (7.5) |
| Furosemide | 49 (5.8) |
| Ibuprofen/diclofenac | 83 (9.9) |
| Molsidomine | 13 (1.6) |
| Nifedipine | 27 (3.2) |
| Paracetamol | 141(16.8) |
| Quinine | 10 (1.2) |
| Reserpine+bendroflumethiazide | 11 (1.3) |
| Vitamin B complex | 19 (2.3) |
| Others | 353 (42.07) |

ICD*: international commercial denomination

The source of medications were at 69.1% (523/757) from medical prescription, 11.4% from fee over-the-counter, 8.5% (64/757) from informal market, 7.9% (60/757) from traditional healers, 2.5 % (19/757) from the neighborhood (friends, neighbors) and 0.7% (5/757) from family. The proportion of older adults with at least ≥ 3 drugs (polypharmacy) was 39% (130/333).

## Potentially inappropriate medication according to the 2012 Beers criteria

The proportion of older adults who used at least one PIM was 47.1%(145/308) according to the full 2012 Beers criteria and 59% (196/332) when we added traditional medications in the analysis. The median number of PIM by person was 1. Among the medical prescription, 65.3%(201/308) of the drugs were PIM. According to the 2012 Beers criteria adapted to the local context, we recorded 23.4% (196/839) of PIM among all medications used by older adults at home. The main PIM were traditional medications 28.97% (62/214) diclofenac (21.03% (45/214)), ibuprofen (7.76% (38/214)), aspirin (7.01% (15/214)), nifedipine (5.61% (12/214)), and reserpine (5.61% (12/214 n)).

Table III and IV shows the description of PIM.

**Table III:** potentially inappropriate medications among older adults ≥ 60 years

| PIM | Beers criteria N ( %) | Modified Beers criteria* N ( % ) |
|---|---|---|
| Proportion of older adults who used at least one PIM* | 145/308 (47.1) | 196/332 (59.0) |
| proportion of PIM among all medications used by older adults at home (n=839 ) | 145(17.3) | 196 (23.4) |
| Medical prescription, n=308 | | |
| Yes | - | 201( 65.3) |
| No | - | 107 (34.7 ) |

*including traditional medicine

**Table IV:** Most PMI according to modified Beers criteria

| Most PIM. N = 214 | N (%) |
|---|---|
| Aspirin > 325 mg /day | 15 (7.01) |
| chlorpheniramine | 10 (4.67) |
| ciproheptadine | 4 (1.87) |
| Traditional medicine | 62 (28.97) |
| Diclofenac | 45 (21.03) |
| Digoxin >0.125mg/day | 9 (4.21) |
| Ibuprofen | 38 (7.76) |
| Nifedipine | 12 (5.61) |
| Reserpine | 12 ( 5.61) |
| Spironolactone > 25 mg / day | 7 (3.27) |

N: number

PIM: potentially inappropriate medications

## Factors associated with potentially inappropriate medications

Polypharmacy was significantly associated with PIM ($p = 0.001$). The proportion of PIM was significantly higher among older adults who received a medical prescription than those with no formal prescription ($p<0001$). Also, PIM was higher among older adults living in a common habitat or when they were married, but the difference was not significant. Table V shows the results of factors associated with PIM.

**Table V:** Factors associated with the use of potentially inappropriate medications

| Factors | Potentially inappropriate medications | | | | |
|---|---|---|---|---|---|
| | N % | Yes (%) | No (%) | OR (95%CI) | p |
| Age ( years) | | | | | |
| 60-69 | 212 (58.1) | 59.0 | 41.0 | 1 | 0.8 |
| ≥ 70 | 153 (41.9) | 59.8 | 40.2 | 0.96 (0.6-1.5) | |
| Sex | | | | | |
| F | 175 (45.0) | 58.3 | 41.7 | 0.95 (0.6-1.4) | 0.8 |
| M | 214 (55.0) | 59.6 | 40.4 | 1 | |
| literacy | | | | | |
| No | 205 (54.1) | 60.2 | 39.8 | 1.1 (0.7-1.7) | 0.6 |
| Yes | 174 (45.9) | 57.6 | 42.4 | 1 | |
| marital status | | | | | |
| Married | 225 (58.7) | 60.9 | 39.1 | 1.2 (0.7-1.8) | 0.4 |
| unmarried | 158 (41.3) | 56.5 | 43.5 | 1 | |
| Income | | | | | |
| No | 220 (58.0) | 61.0 | 39.0 | 1.1 (0.7-1.8) | 0.4 |
| Yes | 159 (42.0) | 56.7 | 43.3 | 1 | |
| Habitat | | | | | |
| Common | 119 (32.7) | 63.2 | 36.8 | 1.3 (0.8-2.1) | 0.2 |
| Unique | 245 (67.3) | 56.7 | 43.3 | 1 | |
| Consultation* | | | | | |
| Yes | 230 (59.1) | 52.0 | 48.0 | 0.4 (0.3-0.7) | 0.001 |
| Non | 159 (40.9) | 69.4 | 30.6 | 1 | |
| Comorbidity | | | | | |
| Yes | 333 (85.6) | 58.2 | 41.8 | 0.7 (0.4-1.4) | 0.4 |
| No | 56 (14.4) | 64.0 | 36.0 | 1 | |
| polypharmacy | | | | | |
| 1-3 | 203 (61.0) | 52.2 | 47.8 | 1 | 0.001 |
| ≥3 | 130 (39.0) | 69.8 | 30.2 | 2.1 (1.3-3.4) | |
| Medical Prescription | | | | | |
| Yes | 201(65.3) | 50.2 | 49.8 | 0.3 (0.2-0.6) | <0.001 |
| No | 107 (34.7) | 73.6 | 26.4 | 1 | |

*: Consultation in the past six month in a health facility
ORa: Odds ratio
F:  Female, M: Male

In the logistic regression model, polypharmacy (≥ 3 drugs versus 1-3 drugs) is the independent factors significantly associated with the use of PIM (adjusted OR = 3.2; 95% CI (1.8-5.7)) .

# Discussion

The proportion of older adults who used at least one PIM was 59% according to the 2012 Beers criteria adapted to the local context. The most PIM were traditional medications (62%), diclofenac (17.5%), ibuprofen (14.8%), aspirin (5.8%), nifedipine (4.7%) and reserpine (4.7%). Polypharmacy is the independent factor associated with PIM. About two-thirds (65.3%) of PIM without the traditional medicines were from medical prescription.

Our finding showed more than half of older adults used at least one PIM. The proportion is higher than that observed by other authors who have used previous versions of Beers criteria using elderly populations: 18.3% by Ryan *et al.* in 2009 in Irland (55), 19.1% by Lai *et al.* in 2009 in Taiwan (18) , 34.5% by Oliveira *et al.* in 2012 in Brazil (32) 24.6% by Vischwas *et al.* in 2012 in India (19) 11.4% by Kamuhabwa e*t al.* in 2010 in Tanzania (39) , 30% by Chetty *et al.* in 2004 in Durban (40). This difference can be explained by our methodology, the context of health care and the conditions of access to drugs in Burkina Faso. In fact, various sources of medications have been included in this study. In our context, health services are not the only source to access to drugs for patients. It is recognized that drugs from the informal market (36), traditional medicine (26, 37, 38) are widely used by patients in sub-Saharan Africa. In our study 34.7% of PIM were informal source (traditional medicine and informal market). Among PIM, traditional medicine represented 62%. These traditional medicines consist of combination of leaves, powder, bark of trees whose pharmacokinetics characteristics are not always known during the study. The lack of these information's suggest these drugs could be potentially dangerous and interfere with other drugs and affect older adult's health already weakened by comorbidity. These traditional practices in additional of self-medication from informal market and free over-the-counter could be attributed to the lack of an effective policy control of medicines delivery in the pharmacies, the lack of regulatory policy of medicine sales in the informal market (56,57) and low care and medications access by older adults (26,58, 59).

The high proportion of the polypharmacy and the nature of PIM raise the need to urgently think about care delivery system for older adults and people with co-morbidities.

The characteristics of PIM were also found by other authors in Africa (39, 40) and in other low income country (18). Polypharmacy was significantly associated with PIM. Our finding is similar to those of other authors (27, 28, 60). We also showed that the medical prescription was significantly less likely to be associated with PIM. This result differs from those in the literature (28). However, most of the studies focused on the medical prescription, performed in nursing homes, during out-patient care or among hospitalized patients. This difference can also be explained by the broader source of medications considered in this study. However, even if the PIM were significantly associated with no- medical prescription, attention should be paid to the prescribers. The inappropriate medications such as reserpine, nifedipine, immediate release digoxin > 0.125 mg/day, spironolactone > 25 mg/day were from medical prescription source. As a reminder, 63.2% of older adults have used medication from the medical prescription. This would mean that the request for care and treatment is present among older adults. Therefore, to develop an approach for PIM reduction, older adults but also formal prescribers and informal actors care should be involved.

Our results may have some limitations. In our context, the multiplicity of sources of medications could lead to the use of drugs which are not on the "Beers" list. The fact that investigators were

physicians could lead to an information bias (i.e. people not willing to report the use of certain drugs). Additional, cross sectional design could lead to an underestimation some factors being associated of PIM such as memory bias in cases of morbidity record, medication use, the past six-month consultation in health facility. These all situations could lead to an underestimation of the proportion of people using at least one PIM and the mean number of PIM per person. Although, sample size estimated through probabilistic method give a representation of older adults in general population. Our finding can only be generalized to the all older adults of Bobo-Dioulasso.

## Conclusion

According to our knowledge, this is the first time that the new 2012 Beers criteria were used to assess the PIM in the community-dwelling older adults and particularly in Africa region. Our findings raise the need to think the process of diagnosis and prescription, particularly for older adults. This would need interventions at various level: i) at central level, the control of informal market and a strengthening of the regulation of sale over-the-counter medication, ii) at intermediate level, the development of a health care delivery system taking into account the older adults with comorbidities, iii) at peripheral level, the education of older adults by the medical staff at home. Further research is needed to better understand how the system provides care to the older adults and to study the effects of PIM on the health status of older adults.

What is already know on this topic
      - Potentially inappropriate medications are prevalent in older adults from high incomes countries.
      - Literature has addressed widely the issue of potentially inappropriate medications by focusing on prescription in nursing homes, in health care institutions and hospitalization.

What this study adds
      - Potentially inappropriate medications are prevalent among community-dwelling older adults in context of Africa, Burkina Faso.
      - The burden of potentially inappropriate medications was from traditional medications.

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