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# Extent and causes of unused medications among patients in rural Ethiopia: a prospective multicenter cohort study

Dawit T. Gebregeorgise<sup>1\*</sup>, Teferi Gedif Fenta<sup>1</sup>, Bart J. F. Van den Bemt<sup>2,3</sup> and Charlotte L. Bekker<sup>3</sup>

## Abstract

**Background** Medication waste poses health, economic, and environmental challenges. However, the extent among patients living in rural areas is underexplored. This study assessed the proportion of prescribed medications remaining unused by patients living in rural areas of Ethiopia, and identify the causes thereof and disposal practices.

**Methods** A prospective multicenter cohort study was conducted in 5 rural health centers in Ethiopia. Patients ( $\geq 18$  years), who received a prescription for acute or chronic medication for pick up from the outpatient pharmacy were included. After 3 months, participants received a house visit by a health employee during which a questionnaire was verbally administered to assess the quantity of unused medication, reason thereof, and disposal practices used. Data were analyzed using descriptive statistics and multivariate logistic regression to identify factors associated with presence of unused medications.

**Results** In total, 178 patients participated. Up to 136 out of 601 (22.6%) dispensed medications ended up unused, mainly antibiotics and analgesics, with an average economic value of \$0.37. Of 178 patients, 72 (40.4%) ended up with unused medication, and 15 (8.4%) did not use 80% or more of the prescribed quantity. Early discontinuation of therapy was the main reason (61.8%) for patients' ending with unused medication. Patients reported to primarily dispose of unused medication either through the toilet (43.6%), household garbage (22.7%), burning (13.6%), or returning it to the pharmacy (2.7%). Medications dispensed to be administered with two or more-unit doses at a time were more likely to remain unused (adjusted OR 1.6 [1.0–3.4]) compared to medications dispensed to be administered one-unit dose.

**Conclusion** A substantial amount of prescribed medications remains unused by patients in rural areas, frequently not properly disposed. Interventions are needed to ensure medications are not wasted and reduce the unwanted consequences.

**Keywords** Unused medication, Medication waste, Disposal, Medication beliefs, Sustainability

\*Correspondence:

Dawit T. Gebregeorgise  
dawit.teshome@aau.edu.et

<sup>1</sup>Department of Pharmaceutics and Social Pharmacy, School of Pharmacy, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

<sup>2</sup>Department of Pharmacy, Sint Maartenskliniek, Nijmegen, The Netherlands

<sup>3</sup>Department of Pharmacy, Radboud University Medical Center, Nijmegen, The Netherlands



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## Introduction

Medication waste is a growing problem, affecting public health, healthcare expenditures and the environment negatively [1–3]. Lost therapeutic benefit, waste of money and environmental contamination as a result of waste might cause additional burden for the attainment of sustainable development goals and universal health coverage particularly in low- and middle-income countries if left neglected [1].

Medication waste is defined as expired or unused medications throughout the whole pharmaceutical supply chain [4]. Studies show that medications that are prescribed for and dispensed to patients are not fully used at home [5–7]. This is due to, for instance, early discontinuation of treatment resulting from improved health condition, intolerable side effects, or a switch in treatment [8–12]. When medications remain unused, most patients do not dispose of them properly, not always by returning them during drug take-back program or following through household disposal steps [13, 14]. They would rather throw it away, put it into the household garbage, or flush it in the toilet, or sink [9, 15].

Accumulation of unused medications at patients' homes could lead to health [16], economic [17] environmental challenges [18]. For instance, in the US, more than 36,000 children (aged 0–4) get poisoned every year [19], mainly due to ingestions of medications kept at home [16]. Also, various countries report on the financial value of unused medications and its associated loss [7]. Furthermore, unsafe disposal of unused medications poses risks to environment (i.e., in water, on land, and in the air) potentially affecting the ecosystem [18].

From an ecological perspective, around 25% of wastewater streams worldwide are contaminated with excessive high levels of pharmaceuticals. Among these countries, Ethiopia was ranked as top three of highest polluters [20]. While this is primarily due to a lack of enforceable regulatory oversight for proper medication sales [10], resulting in excessive medication use, the impact of improper disposal of unused medications might contribute as well.

Although the risks of pharmaceuticals polluting the environment are more significant in lower-middle income countries (LMICs) [20, 21], studies indicate that most LMICs are less concerned about environmental, health and social impact of unused medications [21]. According to the Sustainable Development Goals (SDGs) of the United Nation [22], increasing access to medications, achieving environmentally sound management of medications, other chemicals and waste throughout their life cycle and reducing the number of deaths and illnesses associated with these are the targets to be achieved.

There is health service coverage inequalities, including medication use, between urban and rural areas [23–25]. The concurrent health, social, economic, humanitarian

and human rights crises in rural areas affect primary health care service negatively [25]. Unused medication and its associated risks assumed to be imbalanced in rural areas, making attaining universal health coverage and ensuring equal access to healthcare too far. In Ethiopia, studies have quantified the extent of unused medications (i.e., 50–66%) [26–29] among households, described the reasons for accumulation of unused medications and the commonly used disposal practices [26–32]. However, most of these studies were conducted in urban areas, whereas the majority of the population lives in rural areas where the socio- economy, health seeking behavior and health literacy level are relatively low. In addition, previous studies used cross-sectional designs and lacked numbers of the actual extent of medications ending up unused. Therefore, this study aimed to prospectively assess the proportion of prescribed medications remaining unused by patients living in rural area of Ethiopia, and identify the causes thereof and disposal practices. Furthermore, patients' beliefs about medications and pharmaceutical literacy levels were assessed.

## Methods

### Study design and setting

A prospective multicenter cohort study was conducted in five health centers in rural areas of North Shoa Zone, Amhara Regional State, Ethiopia between April – September 2022. This zone consists of 472 health facilities (i.e., 1 referral hospital, 3 general hospitals, 8 primary hospitals, 97 health centers, and 372 health posts) and 354 health workforces (i.e., 115 general practitioners, 356 health officers, 1,064 nurse, 435 midwifery, 293 laboratory, 395 pharmacy, and 882 health extension workers) serving a total of 2,231,205 people. Acute and chronic diseases are the major health burden of the zone [33].

### Study population

Adult patients ( $\geq 18$  years), who filled at least one prescription for common acute and chronic indications (i.e., infection, hypertension, diabetes, asthma, or arthritis), were able to speak the local language (Amharic), and collected medications from the pharmacy of the health facility during the study period, were eligible for inclusion. Patients who were terminally ill or receiving non-orally administered medication were excluded. A consecutive sample of pharmacy visitors receiving a prescription were approached for participation. Eligible patients received information about the study from a health facility employee and were asked to provide verbal consent.

### Sample size

The number of medications included in the study were determined using a single population proportion formula;

$$n = \frac{(z_{\alpha/2})^2 \times p(1-p)}{d^2}$$

where:

- Z is confidence level at 95% (standard value of 1.96).
- p is the proportion of patients with unused medications.
- d is margin of error.

Previous study shows that 13.8% [30] of the households in the Awi zone, Amhara regional have unused medication. This was assumed to be the same in North Shoa too, which is found in Amhara regional states. Taking this, and a margin of error (d) of 5% and the z (1 -  $\alpha$ /2) value at 95% confidence interval (CI) i.e., 1.96, the sample size was found to be 183. Considering a non-response rate of 10%, the final sample size was determined to be 201.3 ~ 202 patients. So, 202 patients were followed for three months.

### Study instruments and variables

#### *Unused medications record*

Unused Medications Record form was adapted and modified from previous study [5] to fit the local context and collect patient related information including demographics, disease and medication related characteristics (see Supplementary materials). Demographics related information included were age, gender, religion, living situation (alone/with family members), and educational level of patients. Similarly, disease related information included were acute vs. chronic of the diagnosed disease and patient-reported perceived seriousness of the illness. Moreover, name, strength, quantity of the prescribed medications and quantity remaining unused (in units i.e., tablets or capsules and packages (unopened) were recorded as medication characteristics.

#### *Beliefs about medications questionnaire*

The Beliefs About Medicines Questionnaire (BMQ) is a validated tool for evaluating people's perception about medications [34]. It has an 18 (i.e., 8 general and 10 specific) item Likert scale ranging from 1 [strongly disagree] to 5 [strongly agree]. BMQ tool was used in this study to evaluate patients' belief about necessity and concerns of the prescribed medication and their general perception about medication overuse and harm (see Supplementary materials).

#### *Recognizing and addressing limited pharmaceutical literacy (RALPH) interview guide*

RALPH interview guide is prepared to support pharmacists in identifying patients with limited pharmaceutical literacy during dispensing and provide tailored medication information to their needs to use their medications safely [35]. In this study, this tool was used to assess

patients' understanding regarding the purpose, frequency and timing of the prescribed medication. The tool was also used to assess patients' ability to ask questions/express concerns about the prescribed medications to their healthcare providers, and find understandable (medication) information (see Supplementary materials).

Questionnaires were translated to the local language by two researchers independently and compared. The full questionnaire was pilot tested with two patients on the comprehensiveness, and understandability and the time it takes to complete the questionnaire. Accordingly, modifications such removing an item from RALPH question, including detailed information about locality, administering questions in two (i.e. at the time of dispensing and during the house visits) were done. This study follows the 'Strengthening the Reporting of Observational Studies in Epidemiology' (STROBE) statement [18].

### Study procedure

Patients agreeing to participate were asked demographic information. They were also counselled about the prescribed medication and supplied with a paper bag and received instructions to store the dispensed medication in the bag, including any medicine that was unused following completion or premature discontinuation of treatment regimen. If patients collected new prescriptions within three months, they were instructed to store these in the bag as well. Before leaving the pharmacy, they were asked the purpose, frequency and timing of the prescribed medication to assess their level of understanding. Moreover, their ability to ask healthcare provider questions, express concerns about their medication, and find understandable (medication) information were assessed. Based on patients' response, the dispensing pharmacists categorized the answers into "correct" and "incorrect", seek information from a reliable source, or not. Patients, were followed for three months and received a house visit after three months follow-up by a trained data collector. During this house visit, a questionnaire was verbally administered on quantity remaining unused (in units i.e., tablets or capsules and packages [unopened]) and reason for having unused medication (adverse effects, condition resolved, therapy changed, insufficient effect, early discontinuation and pharmacy supplied too much, and other) and disposal practice. The estimated monetary value of dispensed and unused medication were converted to dollars using weighted average exchange rate of the data collection period [36].

### Study outcomes

The primary outcome is the proportion of prescribed medications remain unused. This was assessed by asking the patient whether the unused medication was no longer used. If patients reported that the unused medication

would be used in the future, this was not considered as unused.

Secondary outcomes included economic value of unused medication, proportion of patients having unused medication, reasons for having unused medication, and frequently used disposal practices. Patients' beliefs about medications and pharmaceutical literacy, which have direct implication on for sensible use of medication were used.

For the Beliefs about Medicine Questionnaire, the sum for the-sub scale score for necessity (range:5–25), concern (range:5–25), overuse (range:4–20), and harm (range:4–20) of using medication were calculated. The higher the score refers to the stronger belief about medications. The sum scale score for necessity beliefs was subtracted from the sum scale score for concern beliefs to yield the necessity–concerns differential (NCD) score (range: -20–20). A positive NCD score indicates that the necessity domain dominates the concern domain.

For pharmaceutical literacy, two items of the RALPH, which contain correct or incorrect answers regarding the purpose, frequency and timing of the prescribed medication were graded as response and three items which asks how easy/difficult for patients to ask questions and concerns about their medications to the healthcare professionals were evaluated by a pharmacist. Literacy scores were derived by summing the item scores and dividing by the number of items.

### Data analysis

Descriptive statistics consisting of median and interquartile range (IQR) for non-normal distributions and mean with standard deviation (SD) for normal distribution, and proportions expressed as percentages were calculated using SPSS version 25 software. Uni- and multivariate logistic regression were used to identify factors associated with unused medication (dependent variable). Independent variables were age, gender, religion, educational level, unit dose, treatment duration, living situation, disease condition and perceived seriousness of the illness. Variables that had a *p*-value of less than 0.25 in bivariate analysis were retained.

## Results

### Characteristics of participants

202 patients were approached and included, of which 8 were lost-to follow up due to no longer available. In total, 194 patients were followed for three months and received a house visit. Of these, 178 were included in the analysis and 16 (i.e., seven patients were dispensed dosage forms such as eye drop/injection difficult to measure the leftover objectively; six patients with no recorded of unused medication and three patients with incompletely recorded forms [i.e., more than 50% of the item were not

answered] were excluded (Fig. 1). On average, patients were followed for 93.1 days (range 80–114).

Participants had a median age of 46 years (IQR:33.5–60), and 117 (65.71%) were female (Table 1). Most participants 134 (75.2%) had no formal education and lived with family 151 (84.8%).

### Proportion of medications remaining unused

In total, 601 medications were prescribed to 178 patients, of which 136 (22.6%) remained unused. Of 14,317 capsules and tables dispensed, 1,558 (11%) remain unused. Antibacterial for systemic use 49 (36%) and analgesics 29 (21.3%) were the most commonly unused therapeutic class of medications (Table 2). A total of 72 (40.4%) patients ended up with at least one unused medication. 15 (8.4%) patients ended up with at least 80% of the prescribed medication. Of the total (\$428.8) value of the dispensed medication, medications worth \$51.1 (11.9%) remained unused (Table 2).

### Causes of unused medications

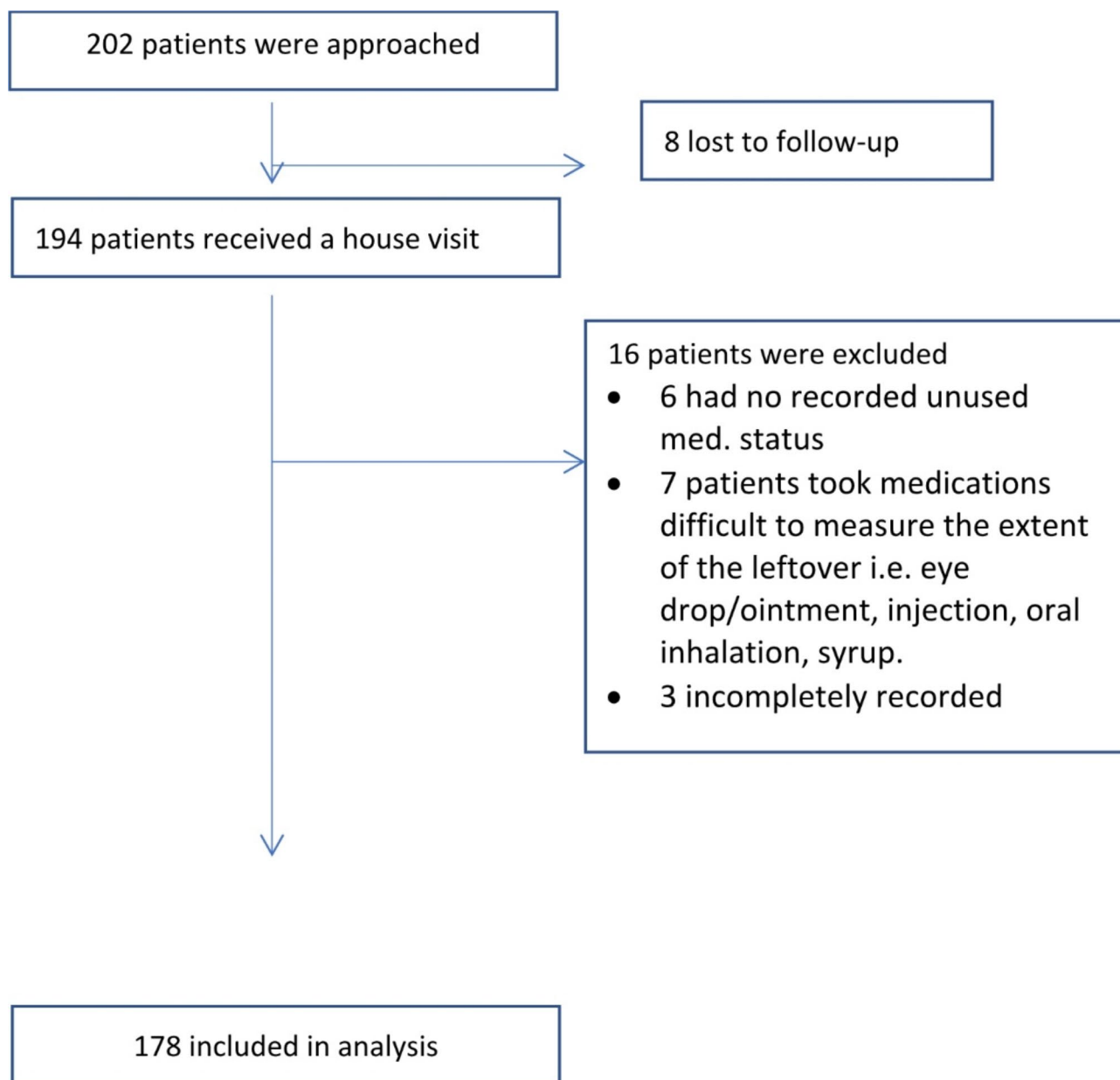
Of the 136 unused medications, 84 (61.8%) medications, mainly antibiotics for systemic use 46 (33.8%), analgesics 11 (8.0%), and medications prescribed for acid related disorders 11 (8.0%), were discontinued early. In addition, 13 (9.6%) medications dispensed in excess by the pharmacy and 37 (27.2%) medications prescribed “when needed” (e.g., for pain control) were found unused. Medications were discontinued mainly as the patients' disease condition resolved 61 (44.8%). Adverse effects 14 (10.2%) and change in therapy 15 (11.0%) and insufficient therapeutic effect 8 (5.8%) were also the reasons for the discontinuation of medications.

### Medication disposal practice

When patients were asked what they normally do with unused medication, 110 (61.7%) respondents said they dispose of it, 26 (14.6%) patients keep it at home for potential future use and 20 (11%) patients keep it for no purpose. Patients reported to primarily dispose of unused medication either through the toilet 48 (43.6%), household garbage 25 (22.7%), burning 15 (13.6%), or return it to the pharmacy (2.7%).

### Beliefs about medications

BMQ scores were analyzed for 106 respondents. Patients' mean scores regarding the necessity and concern subscales were 16.7 (SD 4.1) and 10.9 (SD 3.0), respectively. The findings revealed a positive necessity-concerns differential (NCD) score of 5.8 (range: -20–20), indicating a dominant belief on the need for using the prescribed medications. Similarly, patients rated mean scores 12 (SD 1.5) for general overuse and 7.5 (SD 2.0) for general harm sub scales. Respondents did not agree with the



**Fig. 1** Schematic overview of inclusion of participants

perception that there is harm associated with medication in general. In contrast, they were uncertain about whether healthcare professionals overprescribe medication to patients or not (Table 3).

#### Pharmaceutical literacy of respondents

Regarding pharmaceutical literacy, 149 (83.7%) participants correctly answered the purpose for which the prescribed medication issued during study entry was indicated. Also, 157 (88.2%) patients correctly answered the frequency and timing of the prescribed medication. If there was discrepancy in the information given by the healthcare professionals (e.g., between the pharmacist

and the physician) about the prescribed medication, 87(48.8%) participants said they would seek information from a reliable source, 31 (15.9%) would do so but not necessarily from a reliable source, and 32 (17.4%) would do nothing. In general, if patients had a question about their prescribed medication, 154 (86.5%) found it easy to ask a healthcare professional.

#### Factors associated with unused medications

Medications ending up unused were significantly more often administered with two or more unit of doses (i.e., tablets/capsules) (Adjusted OR 1.6 [1.0-2.5]) compared to



**Table 1** Demographic characteristics of study participants ( $n = 178$ )

Characteristic	$n = 178$ (%)
<b>Age</b> (median, IQR)	46 (IQR 33.5–60)
<b>Gender*</b>	
Female	117 (65.7)
Male	60 (33.7)
<b>Religion*</b>	
Orthodox Christian	177 (99.4)
Muslim	1 (0.2)
<b>Educational level*</b>	
No education	134 (75.2)
Primary School (Grade 1–8)	23 (12.9)
Secondary School (Grade 9–12) and above	15 (8.4)
<b>Living situation*</b>	
Living alone	23 (12.9)
Living together with family	151 (84.8)
<b>Disease condition</b>	
Acute	129 (72.5)
Chronic	49 (27.5)
<b>Perceived seriousness of the illness*</b>	
Mild	19 (10.7)
Moderate	75 (42.1)
Severe	84 (47.2)

\*missing data

**Table 2** Therapeutic class of frequently unused prescribed medication remaining unused ( $n = 136$ )

Therapeutic Class	Unused medication $n = 136$ (%)
Antibacterial for systemic use	49 (36.0)
Analgesics	29 (21.3)
Calcium channel blockers	14 (10.3)
Corticosteroids for systemic use	14(10.3)
Drugs for acid related disorders	13(9.6)
Anti-inflammatory and antirheumatic products	9(6.6)
Others	8(5.8)

medication administered with one unit of dose at a time (Table 4).

## Discussion

This study quantified the extent of unused medications prescribed to patients living in rural areas in Ethiopia. One-fifth of the dispensed medication remained (partially) unused, and even 40% of patients ended up with unused medication.

This study demonstrated that a substantial number of prescribed medications remained unused within 3 months. When comparing the proportion of patients ending up with unused medication, this is lower than previous research conducted in Ethiopia with ranges of 50–66% of patients [26–29]. This could be explained by the fact that this study consisted of active follow-up over

**Table 3** Participants' score for the general and specific BMQ items ( $n = 106$ )

	Mean (SD)	Sub-category Mean score (SD)	Sub-category sum score, mean (SD)
<b>Specific necessity</b>			
My health at present depends on my medicines	3.0 (1.1)	3.3 (0.8)	16.7 (4.1)
My life would be impossible without my medicines	2.8 (1.2)		
Without my medicines I would be very ill	3.4 (1.2)		
My health in the future will depend on my medicines	2.8 (1.2)		
My medicines protect me from becoming worse	4.4 (0.6)		
<b>Specific concern</b>			
Having to take medicines worries me	2.1 (0.8)	2.2 (0.6)	10.9 (3.0)
I sometimes worry about long-term effects of my medicine	2.6 (2.0)		
My medicines are a mystery to me	1.9 (0.9)		
My medicines disrupt my life	1.8 (0.9)		
I sometimes worry about becoming too dependent on medicines	2.3 (1.0)		
<b>General overuse</b>			
Doctors use too many medicines	2.9 (1.1)	3.0 (0.3)	12.0 (1.6)
Natural remedies are safer than medicines	1.6 (0.7)		
Doctors place too much trust in medicines	4.2 (0.5)		
If doctors had more time with patients, they would prescribe fewer medicines	3.1 (0.8)		
<b>General harm</b>			
People who take medicines should stop their treatment for a while every now and again	1.5 (0.6)	1.8(0.4)	7.5 (2.0)
Most medicines are addictive	2.1 (0.9)		
Medicines do more harm than good	1.7 (0.7)		
All medicines are poisons	2.0 (0.7)		

3-month period, while previous studies included a cross-sectional survey design and asked whether participants experienced any unused medication during any time of treatment. A systematic review done reported 90–99.6% in middle East countries, 38–94.8 in Asia, 35.0–97.7% in Africa [8]. In Europe, estimates of the share of household medication becoming waste vary from 3% to as high as 50% [37]. Previous research used cross-sectional surveys, visited households and checked availability of any unused

**Table 4** Factors associated with unused medications

Factor	Unused medication n = 132 n (%)	Used medication n = 463 n (%)	Crude OR	Adjusted OR
<b>Age</b>				
18–64	96 (72.7)	376 (81.2)	Ref	Ref
65+	36 (27.2)	87 (18.7)	1.6 (1.0–2.5)	1.5 (0.9–2.4)
<b>Gender*</b>				
Female	99 (75.0)	313 (67.6)	1.4 (0.9–2.2)	1.4 (0.9–2.2)
Male	33 (25.0)	150 (32.4)	Ref	Ref
<b>Education</b>				
No education	109 (82.5)	355 (76.7)	Ref	Ref
Had education	23 (19.4)	108 (23.3)	0.6 (0.4–1.1)	0.7 (0.4–1.3)
<b>Unit dose administered (tab/caps)</b>				
1	91 (68.9)	347 (74.9)	Ref	<b>Ref</b>
2 or more	41 (31.0)	116 (25.1)	1.3 (0.8–2.0)	<b>1.6</b> <b>(1.0–2.5)</b>
<b>Treatment duration</b>				
1–14 days	67 (50.7)	232 (50.1)	Ref	Ref
15 days or more	39 (29.5)	113 (24.4)	1.1 (0.7–1.8)	1.1 (0.6–2.5)
Un-specified duration	26 (19.6)	118 (25.5)	0.7 (0.4–1.2)	0.6 (0.3–1.1)

Significant associations are shown in bold; \*shows missing sociodemographic data

medication from all family members and computed unused medications per household, whereas this study used a prospective observational design to objectively measure medication waste.

In terms of economic value, 11.9% of the total value of dispensed medication was wasted. Although these were mainly low-cost medications, the wasted proportion is substantial given the fact that patients in rural areas of low- to middle income countries have difficulties with access to medicines, unnecessary waste should be avoided.

In this study, BMQ scores with respect to the necessity and concern of prescribed medications, as well as perceptions regarding overuse and harm from medication usage was positive. Patients reported a general high belief in the necessity of the medications and in positive effects of the medication. The positive necessity-concern differential indicates that patients' belief that the advantages of taking medication outweigh than the disadvantages. Research showed that patient beliefs are significantly associated with waste, indicating that patient beliefs could be taken into account when aiming to minimize medication waste [38].

Factors significantly associated with unused medications were unit dose administered and dosage forms. A

study conducted in Switzerland showed that patient preference for medication is driven by the appearance (format, shape, size, and color – 44%), number of units per administration (39%), and number of administrations per day (17%). More than half of the patients (67%) in this study preferred tablet formulation. As this finding shows, medications that not preferred by patients might remain unused [39]. In this study, capsules were found more likely to end up unused compared to tablets. Medications administered two or more units at a time were also found more likely to remain unused. When aiming to reduce unused medications, patient's preference needs to be considered this will increase their adherence medication and safe disposal practices. Medication waste prevention strategies therefore target all patients. Currently, little is known regarding perspectives of patients on waste-minimizing measures of LMICs.

Patients and health professionals support is required for interventions to be fully uptaken and work at best. Hence, exploring how unused medication could be recycled and reused need to be explored since it avoids costs of producing another resources and reduces costs of disposing expired medication [40].

Early discontinuation of medication, particularly antibiotics, and their metabolites in the environment could lead to increased antimicrobial resistant microorganisms, increasing the risk of potential transmission of resistant antimicrobials to humans [41, 42]. Air pollution, water contamination and exposure to hazardous compounds are linked to 24% of the global deaths (WHO, 2018). Moreover, these factors pose threats to the health of animals, plants and ecosystems. In order to tackle or prevent wastage throughout the medication supply chain, amongst others, creating awareness and education about proper medication use, and safe disposal is crucial.

The majority of patients reported undesirable disposal practice through, for instance, the toilet or household garbage. This can result in significant environmental and public health risks since some medications are designed to be slowly degradable or resist degradation during passage through a human or animal body and persist in the environment [43]. In rural areas, where agriculture is the main source of income, unsafe disposal may introduce medications into the soil, water and air; and be retained in various plant parts. According to Gworek reviews, vegetative plant, particularly those which have roots and leaves, were found to have the highest accumulation of active substances of pharmaceuticals and their metabolites [44]. Building and operating waste treatment systems in developing countries, particularly in rural areas is too expensive. It is therefore actions are needed to reduce or curb the risks associated with unsafe disposal of unused medications. This may include introducing safe

medication disposal services and promoting safe medication disposal by involving pharmacists [45].

The findings of this study will have practical implications for regulatory, health facilities, healthcare providers, manufacturers and educational institutions, striving to prevent medication wastage, ensure sustainable and green supply chain. It also helps patients with high tendency of ending up with unused medication to get tailored counselling, enjoy therapeutic benefit, prevent resource from being wasted and environment from being contaminated.

Major strength of this study is the prospective follow-up design to accurately assess the proportion of unused medications. Some limitations should be acknowledged. Questionnaires were administered verbally at home that may have led to participants giving socially desirable answers. However, patients living in rural areas have difficulties with reading and writing and therefore this was the most feasible approach. Patients were selected from health facilities in rural areas and this population may not be comparable with those living in urban areas or other settings.

## Conclusion

Sizable amount of medications remains unused by patients living in rural setting at home. Also, almost all medications are being disposed of unsafely. Educational interventions aimed at proper use of prescribed medications and safe disposal of leftovers are needed to tackle this waste to ensure adequate prevention and waste management at patient level to minimize unwanted consequences for public health, healthcare expenditures and environment risks associated with this unsafe disposal practice.

## Abbreviations

AMR	Antimicrobial resistance
BMQ	Beliefs about Medicine Questionnaire
LMICs	Lower-middle income countries
NCD	Necessity–concerns differential
OR	Odds Ratio
RALPH	Recognize and Address Limited PHarmaceutical literacy
SDGs	Sustainable Development Goals

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-024-20021-x>

Supplementary Material 1

Supplementary Material 2

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## Author contributions

All authors participated in the article preparation. DTG was involved in study conceptualization and design, data collection, analysis and interpretation, and

drafting the manuscript. CB was involved in study conceptualization, protocol preparation, data interpretation, and reviewing the manuscript. TGF reviewed the manuscript and provided feedback for finalization. BB was involved in study conceptualization and design, data interpretation and reviewing the manuscript. All authors read and approved the final manuscript.

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## Data availability

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

This study was approved by the Ethics Committee of the School of Pharmacy, Addis Ababa University [ERB/SOP/369/2021]. Permission to conduct the study was also secured from North Shoa Zonal Health bureau, selected Woredas health bureaus and health centers. After explaining the study's purpose and anonymity of reporting the results, verbal informed consent was obtained from all voluntary patients prior to participation.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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