Evaluation of the cost of unused medications in a hospital in Ethiopia: A cross-sectional study

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ABSTRACT

Background: In developing countries like Ethiopia one-third of health care expenditure is for medications. However, due to different reasons, patients may not use all the dispensed medications. Thus, the present study aimed to assess the Causes and cost of unused medications at the inpatient setting of the University of Gondar Compressive Specialized Hospital.

Methods: A hospital-based cross-sectional study was conducted over two months at University of Gondar Compressive Specialized Hospital. A survey of the Causes and cost of unused medicines was conducted through an interview-guided structured questionnaire in the inpatient setting. Those patients who had unused/leftover medications in the inpatient setting during the study period were the target population. All opened liquid preparations such as vials, ampoules, and bags were excluded from the study since it is tough to calculate the amount leftover/remaining. The collected data were entered with Epi Data version 3.1 and exported to SPSS version 21 for analysis. Descriptive statistics such as standard deviation, percentage, frequency, mean, and median were used for data presentation. Finally, the results were described using texts, tables, and figures.

Results: A total of 13 classes of medication were identified during the study period. Among these, antibiotics 74 (35.23%) were the most common leftover class of medications with the financial value of 143.48\$(25.10%) of total leftover/unused medication. The most common reasons for medication leftover or unused were because of condition resolved 51(24.28%) followed by treatment changed 50(23.8%). Most 86(40.95%) of leftover/unused medication with a monetary value of 5106.80 Ethiopian birr (127.65 USD) was discarded by the patient. About 66(31.43%) of the patients were taken their leftover medication to home for other programs or feature use, 13.80% of patients gave their leftover medications to other patients. More than half 160(76.19%) of unused medications were eligible for use with the monetary value of 17,992.85 (78.7%) Ethiopian birr.

Conclusions: Significant amounts of the hospitals' budget were wasted because of unused/leftover medications and have a serious cost impact. Antibiotics were most frequently class of medication leftover/unused and the condition resolved and treatment changed were the two main reasons for medication leftover/unused. Most of the leftover medications were discarded by the patient, only a very limited number of patients/caregivers plan to return their leftover medications to the pharmacy.

1. Introductions

In developing countries like Ethiopia one-third of health care expenditure is due to medications. However, due to different reasons, patients may not use all the dispensed medications that may contribute to financial waste, suboptimal treatment outcomes, and harm to the environment.^{1–3} Most of the time patients may not use all the dispensed

medications due to multi-dimensional reasons such as medication reaching the expiration date, patients dying due to life-ending morbidities patient/caregivers absentmindedness, intolerable side effects, treating condition has been relieved, and changes of the treatment.^{4–7}

Medication wastage is becoming a major concern in all health care systems both in developed and developing countries and it occurs in all stages of the medicines supply chain. It causes a substantial financial

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burden on the health care expenditures due to the wasted time for health care providers as well as for the clients and the cost of items being returned.⁸ To some extent, it is hard to estimate the actual value and extent of unused drugs precisely, since disposal occurs at several places and moments in time.^{2,9}

Globally, medication wastage is contributing to the big percentage of the inflating health care cost. A study conducted in the United States revealed that the predicted cost of wasted drugs is greater than \$ 1 billion annually.^{3,10,11} The economic value of drugs that are wasted or not used in the UK reaches up to £ 300 million yearly. likewise in Canada, drug wastage is becoming the common critical factor for the rising health care expenditures and consumption of pharmaceutical products, which has been projected to be nearly \$ 8 billion per year.^{1,3,12}

Several investigations have been done to address the medication wastage problem. Though, most of these investigations were conducted in outpatient settings. A study conducted in Gondar hospital on the disposal practice of unused medication revealed that about 89.1% of patients were having unused medications.¹³ But no more investigation was done on the estimation of the cost impact of unused medication in the inpatient setting. Thus, the present study aimed to assess the cost of unused medications at the inpatient setting of the University of Gondar compressive specialized hospital.

2. Methods

2.1. Study design, period, and area

A cross-sectional study design was employed over two months at the inpatient setting of the University of Gondar compressive specialized hospital Gondar, Ethiopia. This teaching hospital has been providing several services for more than five million people and has more than 1000-beds capacity. There are numerous inpatient and outpatient services in the hospital and currently, it offers service to more than 200,000 patients annually.

2.2. Population and sampling procedure

All patients visiting Gondar university compressive specialized hospital were the source population and those patients who had unused/leftover medications in the inpatient setting during the study period were the target population.

The single population formula was used to calculate the sample size of the current study since the study population size was more than 10,000.

$$n = Z^2 p(1 - p) / W^2$$

where n = sample size = 184, P = estimated population proportion 50%, Z = confidence interval level (95% = 1.96), w = margin of error (5%) and 10% non-response rate and 193 was calculated sample size. The participants were carefully chosen by means of systematic sampling method.

2.3. Inclusion and exclusion criteria

All preparations except opened liquid preparations and program drugs were included in the study. However, opened liquid preparations such as vials, ampoules, and bags were excluded from the study since it is tough to calculate the amount leftover/remaining and hence could not be precisely designate the actual cost of the unused/leftover drugs. In addition, program drugs like ART, Anti-TB, Antimalarial drug, drugs for child and maternal health, drugs for leprosy were excluded in the study as they were provided for free.

2.4. Operational definitions

Eligible for use – Redispensing of given leftover medicine can be suitable to treat the appropriate condition.

Unused/leftover/withdrawn -Medicine that remains after the consumer has quit using it.

Monetary value/financial value/economic value/worth - calculated by multiplying the actual number of pills/vials/ampoules/bags and other basic units of dispensing by the unit cost of the drugs.

3. Data collection procedures

During data gathering, two well-trained pharmacists and one nurse were recruited and supervised by two MSc graduate health professionals. During the study period and on a daily basis, the returned medications were collected and an interview-guided structured questionnaire was used after being modified to fit with the current study setup that allows collecting all the necessary information. The questionnaire has two parts such as demographic-related and drug-related parts. The monetary value of drugs was calculated by multiplying the actual number of pills/vials/ampoules/bags and other basic units of dispensing by the unit cost of the drugs. The monetary value of the drugs comprises only the price of the drugs that are directly spent by the patient or caregivers entirely for a given medication only, (that means the study excludes all direct and indirect costs spent by the patient other than direct expenditures for particular medications).

3.1. Data quality assurance

A two-day training was provided for the data collectors. Pretest of the data collection instrument was conducted on 5% of patients at the same hospital before the actual data collection to check the applicability of the instrument and make necessary adjustments. These samples were not included in the final analysis. The collected data were checked for completeness, consistency, and accuracy before entry to SPSS.

3.2. Data processing and analysis

Data validation and entry were conducted using EPI data 3.1 and transferred to Statistical Package Software for Social Sciences Version 20 for descriptive analysis like standard deviation, percentage, frequency, mean, and median. The collected data were checked and cleared every day for consistency and completeness before processing. Finally, the result was presented using texts, tables, and figures.

4. Results

A total of 210 patients with leftover medicines were identified for two months, among those 107(50.95%) were female, most 116(55.24%) of the participants were at age of 30 up to 65. More than half 113 (53.81%) of participants were living in the urban area, 89(42.38%) of participants were identified without formal education. Regarding occupational status, 74(35.24%) of participants were self-employed and 50(23.81%) were housewives. The majority 114(54.28%) of the participants were married (Table 1).

Unused/leftover medications collected in this survey were sorted by class of medications and a total of 13 classes of medication were founded during the study period. Among those, Antibiotics were most frequently 74(35.24%) class of medication leftover/unused followed by Angiotensin-Converting Enzyme Inhibitors (ACEI) 22(10.48%), and Steroid 20(9.52%) (Fig. 1).

Diagnosis of the conditions found in this inpatient survey was sorted based on disease classification criteria of Health System Management Information Systems (HMIS) of Ethiopia. A total of 13 classes of

Table 1

Characteristics of study participants at the University of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

S.N	Variables	Frequency	percentage
1	Sex		
	Male	103	49.05
	Female	107	50.95
2	Age		
	18–29	39	18.57
	30–65	116	55.24
	>65	55	26.19
3	Residence		
	Rural	97	46.19
	Urban	113	53.81
4	Occupational status		
	Self employed	74	35.23
	Governmental	42	20.00
	Employee	32	15.24
	Student	12	5.71
	House wife	50	23.81
5	Educational status		
	No formal education	89	42.38
	Elementary	53	25.24
	Secondary	40	19.05
	Collage and above	28	13.33
6	Marital status		
	Single	40	19.05
	Married	114	54.28
	Divorced	45	21.43
	Widowed	11	5.24

Fig. 1. Classes of medication leftover during data collection period at university of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

diagnosis were observed for patients with leftover medications. Among those, Bacterial infections were the most frequently 50(23.81%) observed cases, followed by Meningitis 31(14.76%), and Heart failure 28(13.33%). Chronic diseases, such as hypertension and diabetes were

Table 2

Classes of Diagnosis identified during the study period at University of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

S.N	Diagnosis	Frequency	Percentage
1.	Bacterial Infection	50	23.81
2.	Covid19 Suspected	9	4.28
3.	Diabetic Mellitus	10	4.76
4.	Dyspepsia	5	2.38
5.	Heart Failure	28	13.33
6.	Hypertension	23	10.95
7.	Meningitis	31	14.76
8.	Musculoskeletal Disorder	4	1.90
9.	Sepsis	6	2.85
10.	Stroke	25	11.90
11.	Thyroid Disease	2	0.95
12.	Thromboembolism	8	3.81
13.	Urinary Tract Infection	9	4.76
	Total	210	100

the most frequently reported chronic disease among the patients with leftover medications (Table 2).

The study also evaluates the monetary value (cost) of leftover medication from the patient perspective and revealed that a total of 13 classes of medication were leftover for two months which is worth 22,852.85 Ethiopian birr (ETB) or 571.33 USD. On average 108.82 ETB (2.72 USD) Per Patient was found unused/withdraw (Table 3).

The current study also investigates the reason for medication leftover or unused, 51(24.28%) of medication were leftover because of condition resolved followed by treatment changed 50(23.81%), and the diagnosis changed 29(13.81%) (Fig. 2).

The study also investigates the feat of leftover medicine, 86(40.95%) of the patients have discarded the leftover medicines even though 160 (76.19%) of unused medications were eligible for use with an economic value of 17,992.85(78.7%) ETB (Fig. 3).

5. Discussion

A total of 13 classes of medication were evaluated during the study period with a monetary value of 22, 852.85 ETB (571.33 USD). During the investigation two kinds of medicines leftover/unused were observed, which were eligible for use 160(76.20%) and not eligible for use 50(23.80%). Antibiotics were the most 74(35.23%) frequently class of medications leftover with the financial value of 143.48\$(25.10%) of total leftover/unused medication. Similar trends have been reported from the study conducted in Saud, antibiotics were the most frequently (47.11%) class of returned medication and had a financial value of 28.38% of the total returned items cost.³ Similar trends also have been reported from the study conducted in Dar Es Salaam Tanzania, on Medicines Wastage at Tertiary Hospital, the finding revealed that anti-infective medicines were the most wasted (18.9%) class of medicines. This implies that most infectious cases were treated empirically and the leading causes of morbidity and mortality in developing countries are mainly because of infectious disease.¹⁴

The current study also revealed that chronic disease such as stroke and heart failure were the most frequently observed cause of morbidity among patients with leftover medications, similar trends have been reported in other study conducted in Tanzania, cardiovascular disorders and diabetes mellitus were the major non-infectious diseases in medical wards.¹⁴ The current study also revealed that ACEI, BB, and CCB were commonly observed classes of leftover medications in the study area, similar trends have been reported in a study conducted on the frequency and reason for drugs returned to pharmacies such as ACEI, BB, diuretics, and CC Blockers were the most frequently returned to the pharmacies for varied reasons.¹⁵

Based on the findings of the current study, most 51(24.28%) of the reason for medication leftover or unused, were because of condition resolved followed by treatment changed 50(23.81%) and the diagnosis changed 29(13.81%). Similar trends have been reported in a study conducted on returned medicines in community pharmacies of Spain, most common reason for medication return was the treated condition had improved and there was no further need for the drug.¹⁶ Similar findings were reported in a study conducted on reasons for unused medications returned to pharmacies and showed that changing to other treatment was the major reason for the medicines being returned. Medications wastage because of treatment changes may not be prevented, but at least minimized through definitive diagnosis for definitive treatment approach.¹⁷

The current study also investigates that the second top cause of medication unused/leftover was because of the diagnosis changed 29 (13.81%), these types of leftover/wastage can be avoided or minimized through dispensing and prescribing based daily dose requirements. Particularly through encouraging definitive diagnosis for definitive treatment approach, creating efficiency into drug supply systems to avoid an oversupply of medications, enhancing patient adherence with their medications.

Table 3

Classes of medication leftover with their respective monetary value at University of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

S. N	Class of medications	Frequency	Proportion of Items	Total monetary value of items across a class in ETB	Total monetary value of items across a class in USD	% of Total monetary value across a class
1	ACEI	22	10.47%	159.70	4.00	0.70
2	Antibiotics	74	35.23%	5739.37	143.48	25.10
3	Anticoagulant	23	11.00%	11,486.20	287.16	50.26
4	Antidiabetics	9	4.28%	1621.60	40.54	7.10
5	Antiplatelet	10	4.76%	864.20	21.61	3.78
6	BB	11	5.23%	32.50	0.81	0.14
7	CCB	6	2.85%	42.40	1.06	0.19
8	Diuretics	9	4.28%	537.08	13.43	2.35
9	LLA	2	0.95%	85.00	2.12	0.372
10	ERP	10	4.76%	7380	18.45	3.23
11	NSAID	9	4.28%	59.80	1.50	0.26
12	PPI	5	2.38%	1136.00	28.40	4.97
13	Steroid	20	9.52%	351.00	8.77	1.56
Total		210	100%	22,852.85	571.33	100

Note, ACEI: Angiotensin-converting enzyme inhibitors; BB: Beta-blockers; CCB: Calcium channel blockers; ERP: Electrolyte replacement preparations; LLI: lipid-lowering agents; NSAID: Non-steroidal anti-inflammatory drugs; PPI: Proton pumps inhibitors.

Fig. 2. Reasons for having leftover/unused medication at University of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

Fig. 3. The feat of leftover medications with their economic value at University of Gondar compressive specialized hospital inpatient setting, Amhara regional state, Ethiopia, 2021.

Excess supply was one of the main reasons for medication leftover/unused, similar trends have been reported in a study conducted in Tanzania on factors contributing to medicine wastage were identified as excess supply, change treatment/diagnosis, and death.¹⁴ Excess supply can be occurred because of dispensing or prescribing error and it can be avoided or minimized through strict adherence with national standard treatment guidelines and creating efficiency into drug supply systems.

The current study also revealed that 10% of the reason for medication leftover were because of no effect/insufficient effect/unnecessary

treatment. This might be because of a lack of adherence to national standard treatment guidelines, lack of in-service training for health care professions, and poor regulatory measurement. Similar trends have been reported in a study conducted on the prevalence of inappropriate antibiotic prescriptions among the United States Ambulatory Care Visits, the finding revealed that nearly half of the antibiotics in the United States were prescribed unnecessarily.¹⁸

Most 86(40.95%) of left-over/unused medications with a monetary value of 5106.80 ETB (127.65 USD) were discarded by the patient. About 66(31.43%) of leftover medications were taken to a home for other program or feature use, 13.80% of patients gave their medications to other patients, even though 160(76.19%) of unused medications were eligible for use with an economic value of 17,992.85 (78.7%) Ethiopian birr. This finding was comparable with the study conducted on unused medications disposal practice in Ethiopia, the finding revealed that 163 (42.5%) of the respondents were discarding their unused medication through various methods, 82(21.4%) of respondents have kept their medication at home, only 5(1.3%) of respondents returned their medications into a nearby pharmacy.¹³ The finding of the current study was also comparable with the study conducted on knowledge, attitude, and practice of unused and expired medication disposal at Ayder comprehensive specialized hospital, Ethiopia, 297(77.3%) of respondents throw away their unused medication in household garbage, 43(11.2%) of respondents Keep at home, 11(2.9%) of respondents give to friends or relatives, 10(2.6%) of respondents return unused medication to the pharmacy.¹⁹ Similarly, trends have been reported from the study conducted in Zambia on Assessment of household knowledge, attitude, and practices on disposal methods of expired and unused medicines, 17(4%) of respondents throw their unused medication, 4(1%) and 364(95%) of respondents return to a nearby pharmacy and keep at home, respectively.²⁰ In this study, very small proportions of unused medications were returned to a nearby pharmacy; however, the major proportions of unused medications were discarded by the patient. This may be due to no means of returning the patient's unused medication to the pharmacy.

Based on the finding of the current study, approximately 160(76%) of unused medication was eligible for use with an economic value of 17,992.85(78.7%) ETB, if there are systems that encourage returning of unused medication back to the pharmacy, unfortunately, such amount of resource is wasted because of non-availability of such system. Also, a significant proportion of patients responded that they will keep their unused medication at home or give it to friends/relatives that may cause the danger of unintentional use or overdose, illegal abuse, and introduction of serious consequences to the environment and health.

6. Conclusions

Medication wastage is a serious problem in the inpatient setting and has a significant cost impact. Significant amounts of the hospitals' budget were wasted because of unused/leftover medications and have a serious cost impact. The current study also revealed that chronic disease such as stroke and heart failure were the most frequently observed cause of morbidity among patients with leftover medications. Antibiotics were most frequently class of medication leftover/unused followed by ACEI. A study has highlighted that the condition resolved and treatment change were the two main reasons for medication leftover/unused.

Recommendations

Most of the leftover medications were discarded by the patient, only a very limited number of patients/caregivers plan to return their leftover medications to the pharmacy, even though, there is no system to return unused medications to the pharmacy. Therefore, measures should be taken to minimize or prevent medication leftover through enhancing communication between health care professionals, training should be given to health care professionals, and regulatory measures should be taken to increase adherence to national standard treatment guidelines, especially with antibiotics could be the most vital strategies. The pharmaceutical supply chain agency of Ethiopia and all responsible stakeholders should design a system such as drug take-back programs aimed at collecting and safely disposing of unused medicines in the community and hospital; and placing drug collection sites at various areas in the community and educating the public to put unused medicines on the nearby collection site, with a disposal team conducting the collection, segregation, and steps related to disposal.

Authorship statement

Category 1

Conception and design of study: Alem Endeshaw Woldeyohanins, Chilot Abiyu Demeke, Diriba Feyisa Demu, Zemene Demelash Kifle. Acquisition of data: Alem Endeshaw Woldeyohanins and Zemene Demelash Kifle. Analysis and/or interpretation of data: Chilot Abiyu Demeke, Diriba Feyisa Demu.

Category 2

Drafting the manuscript: Alem Endeshaw Woldeyohanins and Zemene Demelash Kifle. Revising the manuscript critically for important intellectual content: Alem Endeshaw Woldeyohanins, Diriba Feyisa Demu.

Category 3

Approval of the version of the manuscript to be published (the names of all authors must be listed): Alem Endeshaw Woldeyohanins, Chilot Abiyu Demeke, Diriba Feyisa Demu, Zemene Demelash Kifle.

Limitation of the study

Evaluation of the cost of unused medication was done from the patient perceptive only, governmental or payer perspective can show better images of wastage.

Ethical considerations and consent to participate

The study protocol was approved by an ethical review committee of the School of Pharmacy, University of Gondar with approval number of UOG-SOP-11-2020. Written both written and verbal consent for data collection was obtained before conducting this study. Participants'

information gained was kept confidential.

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Availability of data and materials

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

Declaration of competing interest

The authors declare that they have no competing interests.

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Abbreviations

Angiotensin-converting enzyme inhibitors

ART	Antiretroviral Therapy
BB	beta-blockers
CCB	Calcium channel blockers
ERP	Electrolyte Replacement Preparations
HIV	Human Immune deficiency Virus
LLA	lipid-lowering agents
NSAID	Non-steroidal anti-inflammatory drugs
PPI	Proton pumps inhibitors
SPSS	Statistical Package Software for Social Sciences

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