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Economic Value Analysis and Waste Burden of Household Unused Medicines in Four Districts of Garut Regency

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ABSTRACT

Medicines are substances or products including biological products, that play an important role in prevention, treatment, rehabilitation, and health promotion. Leftover medicines are unused medicines resulting from discontinued treatment or expired dates. Purpose: This study aims to analyze the burden of household medicine waste and its economic losses in Garut Regency. Method: the study employs a quantitative survey method with a cross-sectional design, using quota sampling for sample selection, along with specific inclusion and exclusion criteria. Data were collected through a ReDiUM validated questionnaire. The analysis was conducted using descriptive quantitative methods. Result: the results showed that the economic value of unused drugs amounted to Rp6,410,500 or an average of Rp16,026/ household, with a total household pharmaceutical waste burden of 2.6 kg. Drug classification was dominated by prescription drug at 48%. Implications: these findings indicate that improper management of drug waste can result in economic losses and health and environmental risks. Conclusion: Economic loss and environmental risk could be possibly emerged in the nearest future caused by this losses.

Keywords: *Household Pharmaceutical Waste, Medicine Management, Economic Burden*

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INTRODUCTION

Medicines are substances or products, such as biological products, that are essential for prevention, treatment, rehabilitation, and promotion in the field of health (M. K. R. Indonesia 2016). During this year, as much as 50% of medicines across worldwide were being misdirected, misadministered, or misused (Geremew et al. 2024). Leftover medicine is unused medicine caused by either treatment has been discontinued or it has been expired (Rezqi 2020). Pharmaceutical waste falls under the category of household medical waste, which is often not managed properly. In Indonesia, it is estimated to reach 290 tons per day, originating from thousands of hospitals and community health centers (Mada 2019).

In addition to posing a health hazard, this residual drug waste could also causing antimicrobial resistance, treatment failure, and wasteful healthcare spending. Common causes of this waste include dosage changes, patient non-compliance, discontinuation of treatment, or expiration (Ulfa 2023). People often dispose their medicines through waterways, toilets, or regular trash bins, which contributes to environmental pollution and microbial resistance (Ugoeze et al. 2024). A survey in Yogyakarta showed that 85% of households store unused medicines, and only 3% return them to pharmacies. The results also show that unused medicine waste accounts for 18% of total waste (Ridwan, Kristina, and Wiedyaningsih 2019). A study in Vienna showed that some of the medicines thrown away in household waste were still unused, with 14.5% of the packaging still containing contents (Kristina et al. 2018). Garut Regency has a number of health care facilities that contribute to medical waste. One hospital in this region produces approximately 300–600 kg of solid medical waste per day, or around 14 tons per month (Rezqi 2020). While this could be a problem, this pose a chance to proof pharmacists responsibility as one of the potential agent of change (Syamsudin 2025).

It can be stated that the management of unused medicines remains suboptimal, both in terms of regulatory frameworks and public education. Drug waste contributes to economic losses and poses risks to public health and the environment. Therefore, the aim of this research is to determine the economic value, waste burden, and categories of unused medicine waste in four districts: Karangpawitan, Garut City, Banyuresmi, and Tarogong Kaler in Garut Regency. This research is also anticipated to supply a clear example for decision-makers and serve as a basis for public education to raise awareness of the proper use and management of medicines in order to reduce clinical risks, economic losses, and environmental pollution.

METHODS

This study used quantitative survey analysis utilizing a cross-sectional design during 2024. The populace was at the household level in four subdistricts of Garut (Karangpawitan (-7.205779,107.946784), Garut Kota (-7.214184,107.902206), Banyuresmi (-7.160502,107.951307), and Tarogong Kaler (-7.205779,107.946784)) in West Java Province, Indonesia with a total population of 457,729 (Garut 2022). The size of the sample was calculated with a 5% margin of error using the

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Slovin formula. Based on the minimum sample size of 399.65, this study used a sample of 440 respondents using quota sampling.

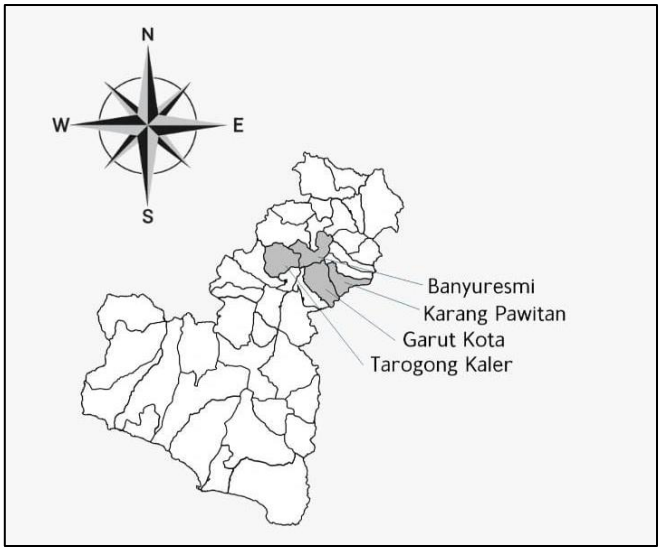

Figure 1. location Setting

Respondents were chosen using preset inclusion and exclusion standards. The requirements for inclusion were residents aged 18–65 years living in the subdistrict where the study was conducted, individuals who were currently taking medication, had medication at home, or were responsible for managing medication for family members at home, ready to take part in the research and fully completed the questionnaire. The exclusion criteria are as follows: individuals working as healthcare professionals (such as doctors, nurses, pharmacists, or other healthcare workers), individuals in severe ill health or with mental health conditions that may impair their ability to communicate, and individuals who have not had medication supplies at home in the past six months.

Data collection was conducted using a questionnaire developed based on previous literature (Sim et al. 2018). To assess content validity, the questionnaire was evaluated by two experts in the field of pharmacy. Reliability testing was conducted by distributing the questionnaire to thirty respondents from households not included in the study sample. The data obtained was then descriptive analysis to determine frequency and percentage.

RESULTS

1. Respondent Characteristics

This research offers a summary of the economic value of unused medicines, which has not received much attention in the context of household economic evaluation. During the three months of research, with a sample size of 440 respondents, the majority of whom were 277 (63.0%) women. The majority of respondents were under 25 years old, totaling 187 (42.5%). The majority of respondents who filled out the survey were housewives/unemployed, totaling 127 (28.9%) respondents, with the majority earning less than 1.5 million rupiah, totaling 232 (52.7%).

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Table 1. Respondent Characteristics

Sociodemographic Characteristics		n	%
Gender	Women	277	63
	Man	163	37
Age	< 25 Year	187	42,5
	25-34 Year	93	21,1
	35-44 Year	87	19,8
	45-54 Year	50	11,4
	55-64 Year	18	4,1
	> 65 Year	5	1,1
Education	< Elementary school	8	1,8
	Elementary school	51	11,6
	Junior high school	95	21,6
	High school	203	46,1
	Bachelor's/Diploma	80	18,2
	Master's degree	3	0,7
Occupation	Students/University Students	115	26,1
	Private Employee	112	25,5
	Civil servant	9	2
	Entrepreneur/Trader	56	12,7
	Housewife/Not Working	127	28,9
	Casual Daily Workers	21	4,8
Income	< 1.5 million	232	52,7
	1.5 million	85	19,3
	2.5 juta-3.5 million	86	19,5
	> 3.5 million	37	8,4
Travel time to the pharmacy	< 5 minute	255	58
	10-20 minute	167	38
	> 30 minute	18	4
Medication manager at home	Father	25	5,6

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	Mother	95	21,6
	Others	50	11,4
Having immediate family members who work as healthcare workers	Yes	111	25,2
	No	329	74,4
Health insurance	BPJS	323	73,4
	Private insurance	46	10,4
	Not having insurance	71	16,2

Several elements that affect the habit of storing medications in homes include education level, number of family members, and income. The presence of chronic disease sufferers, higher education background, and health insurance coverage also increase the tendency to store medicines (Kristina et al. 2018).

2. Economic Value

Respondents who stored leftover medicines at home numbered 235 (58.75%) with a total value of Rp6,410,500. This price estimate is adjusted based on the e-catalog of the Maximum Retail Price (MRP) from the decision of the Minister of Health of the Republic of Indonesia No. 436/MENKES/SK/XI/2013 and the e-catalog of online pharmacy services. Estimated weight of leftover medication waste ~ 2.6 kilogram (M. kesehatan Indonesia 2013).

Table 2. Economic Value of Pharmaceutical Waste

Drug Status	Amount/Details	Total Price (Rp)	Total Weight
Leftover Medicine	3.447,5 tablet 11 bottle 10 pot 6 capsule	6.410.500	~ 2,6 Kilogram

Based on Table 2 above, it can be concluded that the total estimated value of unused medicines from 400 household respondents reached Rp6,410,500, with an average value of medicine waste of Rp16,026 per household. If this figure is estimated based on the number of households in Garut Regency according to 2020 data, which is 928,917 households, the potential economic value of household medication waste could reach approximately Rp14,887,056,229 or equivalent to ±Rp14.89 billion. This value indicates that if leftover medications continue to accumulate in households without proper management, they have the potential to cause significant economic losses (Kusuma et al. 2023).

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3. Categories of Medicine

The categories of medicines found as leftovers in households are classified according to type and class, as shown in the table below:

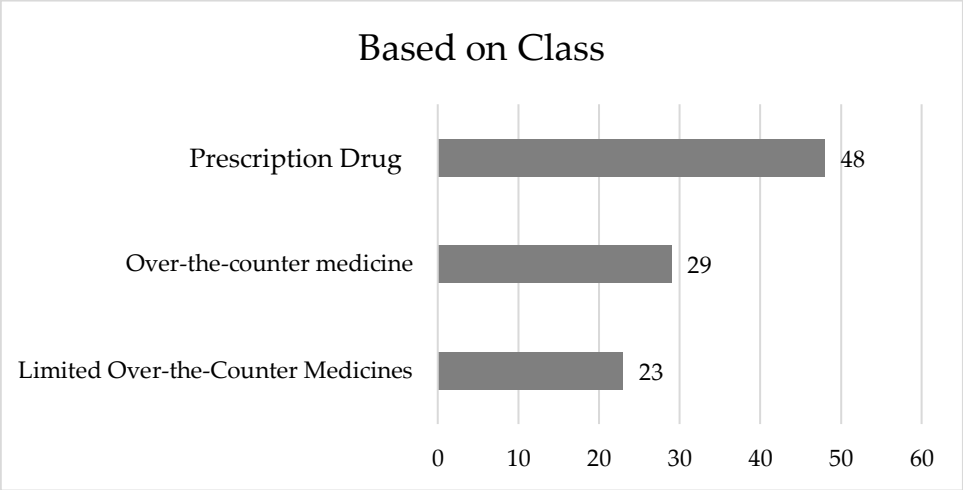

Figure 2. Percentage of Drug Classification Based on Class

The figure shows that prescription drugs account for based on the data obtained, leftover medicines found in households were classified into three main categories. The group with the highest percentage was strong medicines (48%), indicating that many patients did not finish the medicines obtained from their doctors' prescriptions, either because they felt they had recovered quickly, experienced side effects, or did not adhere to the treatment schedule. Over-the-counter medicines accounted for 29% of the leftovers, suggesting that easily accessible medications are also frequently not consumed completely. Meanwhile, limited over-the-counter medicines made up 23%, indicating that even medicines requiring stricter usage guidelines were still left unused by some households (Ika Nurvitasari, et al., 2025).

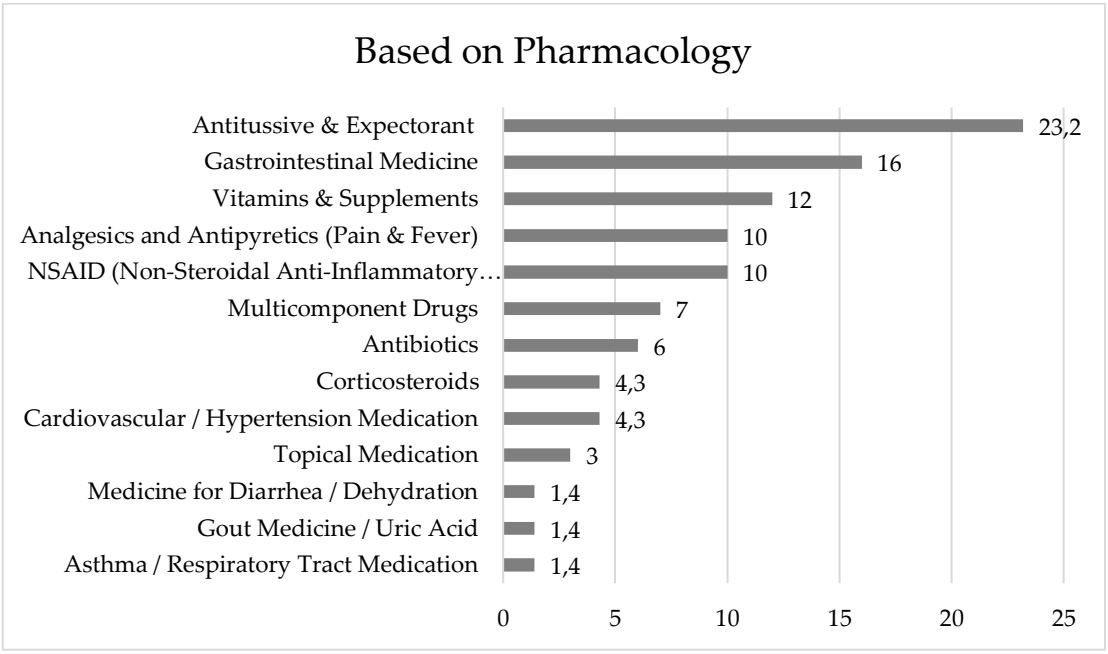

Figure 3. Percentage of Drug Grouping Based on Pharmacological Classification

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The figure shows that the most common leftover medicines were antitussives and expectorants (23.2%), likely because symptoms improved quickly and these products are easily purchased without a prescription. Antibiotics accounted for 6%, indicating non-adherence and the potential risk of antimicrobial resistance. This finding aligns with Avrilya I. Susilo et al. (2024), who reported that 54% of respondents stored antibiotics, reflecting persistent misuse and storage of prescription-only medicines in community self-medication practices (Mariles, Susilo, and Muslim 2025).

4. Waste Load

According to information from the Ministry of Environment and Forestry (KLHK), Indonesia produces approximately ±242 tons of medical waste per day from 2,813 hospitals, but only a portion of this waste is managed optimally (Kehutanan 2018). We used AI-based calculation with certain prompts to help calculate estimated weight based on our local survey of 440 households in four subdistricts in Garut Regency showed that the total amount of unused medicine waste reached 2.6 kg, or an average of 6.5 grams per household. Assuming that there are 928,917 households in Garut Regency (Garut 2022). The potential burden of household drug waste can reach around 6.03 tons. This amount is equivalent to around 2.49% of the total daily national medical waste, indicating that household drug waste is a component that cannot be ignored in comprehensive medical waste management efforts (Development 2022).

Table 3. Estimated Weight of Waste Medicines

Drug Groups by Category	Price	Weight
Prescription Drugs	3.852.500	1,24Kg
Over-the-counter medicine	466.000	0,44Kg
Limited Over-the-Counter Medicines	2.092.000	0,925Kg

Based on the table, the total weight of household drug waste reached 2.6 kg, with the majority coming from prescription drugs.

DISCUSSION

Our study find similar pattern with another. Research by Ridwan et al. (2019) in Yogyakarta City shows that of the total estimated value of household medicines of Rp7,082,556, Rp1,273,921 (18%) came from unused medicines. The average value of unused medications per respondent was Rp13,698.9. Furthermore, based on the findings of Naufal et al. (2022), the amount of leftover medications stored per person was Rp3,348, resulting in a potential economic value that could be saved amounting to Rp163,429,272 (Naufal, Muhammad, Melviani 2021). Then, based on studies carried out by Sulistyaningrum et al. (2023), the total value of unused drugs reached Rp2,609,388 (Sulistyaningrum et al. 2023). Similar findings were reported in Mushoffa's (2022) study, which noted that unused medicines stored in households in Semarang City had a total value of Rp2,948,412, with an average of Rp10,880 per family (Mushoffa 2022). These results support the findings of this study, that unused accumulated medicines stored at home can be a source of

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pharmaceutical waste that has a significant impact (Rahimah et al., 2022). Along with economic losses, the existence of unutilized drugs also opens up medical risks such as incorrect consumption, double use, and abuse (Tegegne et al. 2024). These losses in our study also find at higher amount compared to other study.

Another study found that people tend to save leftover medication to use again when similar symptoms appear, rather than throwing it away. This potentially increases the risk of misuse, especially if the medication is classified as a controlled substance (Wondimu et al. 2015). Research shows that antitussives and expectorants dominate (23.2%) leftover medicines, as they are often purchased for self-medication and stored as a reserve. This finding is supported by Kristina et al. (2018), who reported that many households in Yogyakarta store self-medication and rarely use it up (Kristina et al. 2018). Gastrointestinal medications are the second most common type of leftover medication in households (16%). This result aligns with a research in Addis Ababa (27.1%) and globally, as these medications are easily accessible, often used for self-medication, and their use is situational, resulting in frequent leftovers (Geremew et al. 2024). This study found that 12% of leftover medicines stored in households were vitamins and supplements. This finding is consistent with the research by Putri et al. (2020), which stated that vitamins and supplements are often not used because they are easily obtained without a prescription, consumed independently, and often discontinued without being finished (Geremew et al. 2024). Furthermore, leftover analgesics and antipyretics account for approximately 10% of total leftover medicines stored in households. Data from Ethiopia, where analgesics are the most common type of leftover medication found in households (32.2% in Dessie; 29% in Tigray), indicate that pain relievers and fever reducers are often stored as reserves and are not always fully used (Wondimu et al. 2015).

Residual antibiotics (6%) and corticosteroids (4.3%) are of particular concern because both groups have systemic effects and require close medical supervision (Ambarwati, 2018). Incomplete use of antibiotics can contribute to increased antimicrobial resistance, according to the WHO's Global Action Plan on Antimicrobial Resistance (2022). Meanwhile, the use of corticosteroids without medical supervision can cause metabolic disorders, immunity problems, and other systemic effects that are harmful to patients (Health 2015). According to a study by Ajekiigbe et al. (2025), poorly disposed pharmaceutical waste is among the main sources of antibiotic contamination and global resistance (Ajekiigbe et al. 2025).

The findings of this investigation show that household pharmaceutical waste in Garut Regency contributes to economic losses and poses potential health and environmental risks. Therefore, improving medicine management practices, increasing public awareness, and implementing medicine take-back programs are essential strategies to minimize pharmaceutical waste and its negative impacts. The accumulation of household drug waste poses a serious potential risk (Yohannes et al. 2025). Losw public awareness of the dangers of pharmaceutical waste poses a particular challenge in its management (Insani et al. 2020). To date, there are no national regulations specifically governing the management of household pharmaceutical waste, even though the amount and risks associated with it are increasing (Azzahra Luthfia 2021). Theres is need of health

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worker to be more involved to lower risk in community health through educational and preventive approach (Syamsudin 2025).

CONCLUSIONS

This study successfully analyzed the burden of household medicine waste and its associated economic losses in Garut Regency. The findings reveal that the economic value of unused medicines reached Rp6,410,500, with an average loss of Rp16,026 per household. The total estimated pharmaceutical waste amounted to 2.6 kg, dominated by prescription medicines (48%). These results demonstrate that household pharmaceutical waste contributes to measurable economic losses and may pose health and environmental risks if not managed properly. Therefore, the study highlights the importance of strengthening household-level awareness, improving disposal practices, and implementing clearer regulations to reduce the accumulation of unused medicines.

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