



Original article

Do pharmacists counsel customers on the disposal of unused or expired household medications? A national survey among 1,596 pharmacists in Indonesia

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ARTICLE INFO

Keywords:

Community pharmacists
Household medications disposal
Unused medications
Expired medications
Indonesia

ABSTRACT

Introduction: Pharmacists play a vital role in counseling customers on proper medication disposal, yet their consistency in providing such information is often lacking. This study aimed to assess pharmacists' awareness of appropriate disposal practices for unused and expired household medications. Additional objectives included evaluating whether pharmacists offer disposal information during counseling, measuring their willingness to receive medication waste from the public, and identifying associated factors.

Methods: A national cross-sectional online survey employing convenience sampling was conducted among pharmacists working in hospitals, pharmacies, clinics, or community health centers (CHCs) in Indonesia, using a validated questionnaire to assess awareness, information provision, and willingness to receive medications for disposal. Binary logistic regression, with 95% confidence intervals (CI) and odds ratios (OR), explored potential associations between factors and outcomes.

Results: This study involved 1,596 pharmacists across 37 Indonesian provinces. Most pharmacists were women (80.4%), aged 31–40 years (49.3%), with a pharmacist professional background (93.8%), working in CHCs (41.2%), and practicing for 1–5 years (51.0%). More than half were unaware of guidelines for returning medications to health facilities. While 69.9% never counseled customers on disposal practices, 64.9% expressed willingness to receive unused and expired medication from the public. Pharmacists practicing for at least six years were more likely to provide disposal information during counseling (OR: 2.54; 95% CI: 1.44–4.47). Conversely, those in clinics (OR: 2.16; 95% CI: 1.29–3.62), CHCs (OR: 2.07; 95% CI: 1.45–2.95), or hospitals (OR: 2.00; 95% CI: 1.27–3.14) were more likely to be unwilling to receive expired and unused household medication.

Conclusions: The study reveals that most pharmacists, particularly those with limited practice duration, lacked awareness regarding the importance of proper medication disposal and did not provide counseling on appropriate medication disposal to patients. To address this issue, there is a pressing need for intensified education at the undergraduate level, continuous training for pharmacists, and a clear policy and practical guidelines, particularly targeting pharmacists in clinics, CHCs, and hospitals, to facilitate the acceptance of unused and expired household medications.

1. Introduction

Medication waste has become a significant environmental and public

health issue, which has increased exponentially since the late 1990s (Daughton, 2016). Most people in developing countries throw medication waste directly into the trash or flush it down the toilet or washbasin

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<https://doi.org/10.1016/j.jsps.2024.102020>

Received 14 November 2023; Accepted 3 March 2024

Available online 5 March 2024

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(Tong, Peake and Braund, 2011; Azmi Hassali and Shakeel, 2020; Kasahun and Tesfaye, 2020; Marwa et al., 2021). Similarly, in Indonesia, a study found that 82.1 % of expired and unused medications were immediately thrown into the trash (Insani et al., 2020). This situation is worsened by the fact that most people in Indonesia (85 %) keep expired and unused medications in their homes (Kristina et al., 2018), which could lead to an increase in the number of disposed medications (Makki et al., 2019).

Paracetamol residues have been found in the water of Muara Angke and Ancol Bays in Indonesia (Koagouw et al., 2021), and studies have reported that some bacteria have shown resistance to antibiotics present in drinking water (Fernando et al., 2016; Voigt et al., 2020). The presence of a pharmaceutical substance detectable at a nanogram/liter level in drinking water indicates that the water treatment plant is not able to remove it, thus posing a potentially serious health threat from antibiotic resistance (Massoud et al., 2016; Stoddard et al., 2017). Inappropriate unused or expired medication disposal could result in environmental poisoning due to the toxic effects of biologically active substances that enter the food chain and affect the human population (Cui et al., 2020).

Lack of awareness is one of the reasons for inappropriate medication disposal in Indonesia (Alfian et al., 2021). Of 497 respondents, 53.1 % did not know that inappropriate medication disposal could endanger the environment and health. Moreover, most respondents (79.5 %) had never received proper medication-disposal (Alfian et al., 2021).

Several countries have implemented systems to collect household medication waste, with pharmacists playing a key role. In Australia, the Returning Unwanted Medicines project encouraged the return of unused and expired medications to the nearest pharmacy (Wheeler et al., 2018). In France, pharmacists collaborating with the pharmaceutical industry initiated a display of medication management instruction leaflets advising on safe medication disposal by the public (Cyclamed, 2020). Moreover, Belgium, Italy, Greece, and Norway have enacted laws obliging citizens to responsibly dispose of unused and expired medications (Alnahas et al., 2020). In Indonesia, the 'Let's Dispose of Medication Waste Properly' program was first launched in 2019, with 1,000 pharmacies participating in community publicity on returning expired and unused medications to the pharmacy. However, the program's sustainability is unclear because the medication-disposal behavior among Indonesian citizens was not significantly impacted (The National Agency of Drug and Food Control, 2019). Furthermore, no explicit regulations exist regarding the appropriate disposal of unused and expired household medications in Indonesia.

Pharmacists play an important role in counseling customers regarding appropriate medication disposal (Varisco et al., 2019). However, most pharmacists in developed countries provide inconsistent information about the disposal of medications or only provide it occasionally (Jankie et al., 2022; Mahlaba et al., 2021; Tai et al., 2016). Evidence of pharmacists' awareness about unused and expired household medication disposal is also lacking. It underscores the urgent need to emphasize the pharmacist's role by educating customers about appropriate household medication-disposal practices, particularly where explicit regulations about appropriate disposal of unused and expired household medication are unavailable, such as in Indonesia. Therefore, the primary objective of this study was to assess pharmacists' awareness of appropriate unused and expired household medication-disposal practices. The secondary objectives were to assess whether pharmacists provide information about medication disposal during counseling, their willingness to receive medication from the public for disposal, and associated factors.

2. Methods

This study followed the Guideline for Reporting of Survey Studies guideline (Sharma et al., 2021) for its reporting (Table S1, Supplementary data).

2.1. Study design, setting, and participants

We conducted a cross-sectional study as an online survey of community pharmacists in 37 Indonesian provinces. Community pharmacists who had worked for at least a year at a pharmacy, clinic, community health center (CHC), or hospital were included in this study. Those who did not complete the questionnaire were excluded.

2.2. Ethical approval

The Health Research Ethics Committee of Universitas Padjadjaran, Indonesia, approved this study (No. 671/UN6.KEP/EC/2022). All participating pharmacists provided their written consent to participate by ticking a checkbox in the online survey. The pharmacists' privacy and anonymity were ensured during data collection and analysis.

2.3. Sample size calculation

A minimum of 439 participants was required to obtain a 95 % confidence level (5 % margin of error) using the Slovin formula with an unusable response rate of 10 % for a population size of 114,077 based on the total number of pharmacy staff in Indonesia (SISDMK, 2022). The minimum sample was also calculated for each of the 37 provinces based on the proportion of the total population within each region.

2.4. Study instrument

Pharmacists' counseling practices regarding disposing of unused and expired household medications were adapted from previous studies (Michelin et al., 2023). The questionnaire was adapted to the local context, reviewed by experts (two pharmacists and two pharmacoepidemiologists) experienced in survey studies, and validated on 30 respondents. Feedback from the pre-test group was evaluated, and minor phrasing modifications were made to some questionnaire items. The final version of the questionnaire was shown to be valid and reliable based on the content validity index and Cronbach's alpha coefficient of 0.8 and 0.7, respectively.

The validated questionnaire comprised four sections. The first section covered the pharmacists' demographic information, including age on completing the questionnaire, gender (male and female), highest educational level (registered pharmacists, master's, Ph.D.), and experience in clinical practice (years). The provided pharmacist ID numbers were used to exclude non-pharmacists and duplicate submissions. The second section consisted of four questions assessing pharmacists' awareness of household medication disposal in Indonesia (e.g., Are you aware of guidelines in Indonesia on the returning of unused and expired household medications to health facilities?). The third section assessed whether the pharmacists provided information about medication disposal during counseling. The fourth section assessed their willingness to receive unused and expired household medication disposal from the public.

2.5. Data collection

The link to the online survey was disseminated via a digital leaflet through the network of the Indonesian Pharmacists Association (Ikatan Apoteker Indonesia/IAI), formally or personally, to recruit a convenience sample of pharmacists working at a pharmacy, clinic, CHC, or hospital to ensure participation from various regions and all practice settings. Data were collected using Qualtrics® (Provo, USA). The survey was accessible from May 19 to June 19, 2023. Questionnaire completion was estimated to take 10 min. Participating pharmacists received two participation credit units from the IAI as a token of appreciation.

2.6. Data analysis

Before analysis, we conducted weighting by complex sample analysis techniques for the province variable. Weighting statistically corrected for the unequal proportions determined during sampling. Descriptive statistics were used to describe pharmacists' demographic characteristics and counseling practices regarding the disposal of unused and expired household medication. The variance inflation factor (VIF) was analyzed to eliminate multicollinearity among independent variables. Binary logistic regression analyses were used to assess bivariate associations of dichotomous or nominal independent variables with the binary outcomes. The potential factors found to be associated with the outcome at a significance level of $p < 0.05$ in the bivariate analysis were included in the initial multivariate models. Multivariable logistic regressions were performed to identify factors associated with the outcomes by using enter as variable selection methods. The results of the multivariate analysis were reported using the p -value, odds ratio (OR), and 95 % confidence interval (CI). Hosmer-Lemeshow test and pseudo-R-squared were performed to assess the goodness-of-fit of the models and to measure the amount of variance explained by the regression models, respectively. All analyses were two-tailed tests, and a value of $p < 0.05$ was taken as statistically significant. All statistical analyses were performed with IBM SPSS Statistics version 27.0 (IBM Corp., New York, USA).

3. Results

3.1. Pharmacists' characteristics

This study included 1,596 pharmacists from 37 provinces of Indonesia. Fig. 1 shows the pharmacists' distribution according to province. Most pharmacists lived in the province of West Java (>200 respondents), followed by Central Java (101–200 respondents), South

Kalimantan, and South Sumatra (61–80 respondents, respectively). Most pharmacists were women (80.4 %), aged 31–40 years (48.3 %), with a professional pharmacist background (94.2 %), working in CHCs (54.0 %), and with a length of practice of 1–5 years (52.1 %) (Table 1). Most pharmacists never counseled customers about medication-disposal practices (69.9 %) but were willing to receive unused and expired medication from the public (65.0 %).

3.2. Pharmacists' awareness about unused and expired household medication-disposal practices

Most pharmacists had a low level of awareness of Indonesian guidelines on returning unused and expired household medications to health facilities (59.6 %). Most also reported never receiving training on how to receive unused and expired household medications in health facilities (90.8 %) (Table 2); however, almost all respondents strongly agreed that pharmaceutical waste management at the household level needs to be included in the pharmacy curriculum (98.1 %). Most pharmacists rarely received questions regarding the disposal of unused and expired household medication from patients (55.8 %), and some of the pharmacists had never been asked (39.5 %) (Table 2).

3.3. Factors associated with how pharmacists counsel customers regarding household medication-disposal practices

No significant multicollinearity among independent variables was observed ($VIF < 10$). Among all investigated factors, pharmacists who had 6–10 years of practice (OR: 2.54; 95 % CI: 1.44–4.47; $p = 0.001$) and more than ten years of practice (OR: 2.79; 95 % CI: 1.52–5.12; $p = 0.001$) showed a significant association with giving counseling regarding medication disposal (Table 3). The goodness-of-fit p -value of the model was 0.926, with a pseudo-R-squared value of 2.19 %.

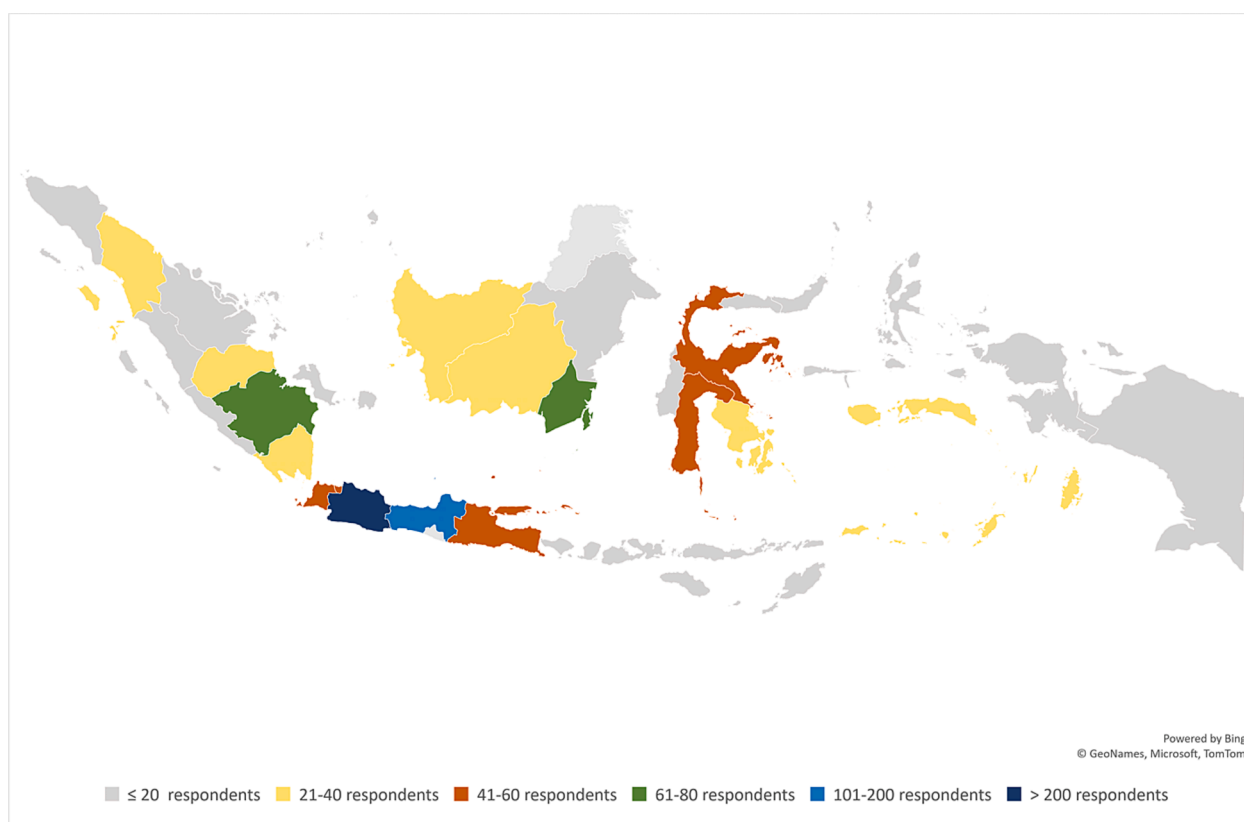


Fig. 1. Pharmacist distribution in Indonesia according to the province.

Table 1
Sociodemographic and pharmacist-related characteristics (n = 1,596).

Characteristics	Unweighted		Weighted
	n	%	% (95 % CI ¹)
Gender			
Men	315	19.7	19.1
Women	1,281	80.3	(16.0–22.8) 80.4 (77.2–84.0)
Age (years)			
21–30	713	44.7	42.6
31–40	718	45.0	(38.7–46.5)
41–50	139	8.7	48.3
> 50	26	1.6	(44.2–52.3) 8.1 (6.3–10.2) 1.1 (0.7–1.7)
Educational background			
Pharmacist professional	1,489	93.3	94.2
Master	104	6.5	(92.6–95.5)
Doctoral	3	0.2	6.1 (4.4–7.3) 0.1 (0.0–0.5)
Years of practice			
1–5	851	53.3	52.1
6–10	430	26.9	(48.6–55.7)
> 10	315	19.7	26.8 (23.2–30.7) 21.1 (17.7–24.9)
Practice Setting			
Pharmacy	548	34.3	26.6
Clinic	157	9.8	(23.7–29.7)
Community Health Center	658	41.2	7.7 (6.3–9.4)
Hospital	233	14.6	54.0 (50.7–57.3) 11.6 (9.9–13.6)
Counseling about medication disposal			
Yes	429	26.9	27.4
No	1,167	73.1	(23.9–31.3) 69.9 (68.7–76.2)
Willingness to receive medication waste from the public			
Yes	540	33.8	65.0
No	1,056	66.2	(61.5–68.2) 35.1 (31.8–38.5)

¹ CI: confidence interval.

3.4. Factors associated with the unwillingness of pharmacists to receive unused and expired household medications from the public

No significant multicollinearity among independent variables was observed (VIF < 10). Most pharmacists who worked at a clinic tended to be reluctant to receive unused and expired medications from the public (OR: 2.16; 95 % CI: 1.29–3.62; *p* = 0.003) (Table 4). Pharmacists who worked at community health centers (OR: 2.07; 95 % CI: 1.45–2.95; *p* = 0.000) and hospitals (OR: 2.00; 95 % CI: 1.27–3.14; *p* = 0.003) were also significantly associated with unwillingness to carry out the disposal of unused and expired medications from the public (Table 4). The goodness-of-fit *p*-value of the model was 0.735, with a pseudo-R-squared value of 3.36 %.

4. Discussion

Most pharmacists in our study were unaware of the importance of proper medication disposal. They never counseled customers about medication-disposal practices but were willing to receive unused and expired medication from the public. Furthermore, we explored factors that were associated with these outcomes.

Table 2
Pharmacists' awareness about unused and expired household medication-disposal practices.

Items	Unweighted		Weighted
	n	%	% (95 % CI)
Are you aware of guidelines in Indonesia on the return of unused and expired household medications to health facilities?			
Yes	670	42.0	40.4 (36.3–44.5)
No	926	58.0	59.6 (55.5–63.6)
Have you received training on the returning procedures for unused and expired household medications to health facilities?			
Yes	170	10.7	9.2 (7.6–11.1)
No	1426	89.4	90.8 (88.9–92.4)
Do you agree that material on pharmaceutical waste management at the household scale is included in the pharmacy curriculum?			
Yes	1565	98.1	98.1 (97.0–98.8)
No	31	1.9	1.9 (1.2–3.1)
Do patients ask you for guidance on household unused and expired medication disposal?			
Never	662	41.5	39.5 (36.1–43.1)
Rarely	855	53.6	55.8 (52.2–59.3)
Most of the time	66	4.1	3.4 (2.6–4.6)
Always	13	0.8	1.3 (0.6–2.6)

Table 3
Factors associated with pharmacists providing information about medication disposal during counseling.

Characteristics	Bivariate			Multivariate ³	
	Counseled patients (n = 429) n ¹ (% ²)	Did not counsel patients (n = 1167) n ¹ (% ²)	<i>p</i> -value	Odds ratio (95 % CI)	<i>p</i> -value
Gender					
Woman	333 (21.1)	948 (59.8)	0.158		
Man	96 (6.4)	219 (12.8)			
Age (years)					
21–30	182 (10.5)	531 (32.1)	0.493		
31–40	204 (14.3)	514 (34.0)			
41–50	36 (2.3)	103 (5.8)			
> 50	7 (0.4)	19 (0.7)			
Years of practice					
1–5	209 (11.8)	642 (40.4)	0.007	Ref	
6–10	124 (8.0)	306 (18.8)		2.54 (1.44–4.47)	0.001
> 10	96 (7.7)	219 (13.4)		2.79 (1.52–5.12)	0.001
Educational background					
Pharmacist professional	391 (25.3)	1098 (68.9)	0.140		
Master	37 (2.1)	67 (3.6)			
Doctoral	1 (0.0)	2 (0.0)			
Practice Setting					
Pharmacy	141 (7.0)	407 (19.7)	0.401		
Clinic	45 (2.5)	112 (5.3)			
Community Health Center	183 (15.5)	475 (38.6)			
Hospital	60 (2.5)	173 (9.1)			

¹Unweighted

²Weighted.

³Goodness-of-fit *p*-value: 0.926; pseudo-R-squared: 2.19%.

Table 4
Factors associated with the unwillingness of pharmacists to receive expired and unused household medication.

Characteristics	Bivariate			Multivariate ³	
	Willing (n = 1056) n ¹ (% ²)	Unwilling (n = 540) n ¹ (% ²)	p- value	Odds ratio (95 % CI)	p- value
Gender					
Woman	835 (51.2)	446 (29.7)	0.084		
Man	221 (13.8)	94 (5.4)			
Age (years)					
21–30	503 (29.6)	210 (13.0)	0.044	Ref	
31–40	466 (30.5)	252 (17.8)		1.01 (0.6–1.59)	0.966
41–50	71 (4.2)	68 (3.8)		1.67 (0.89–3.14)	0.108
> 50	16 (0.6)	10 (0.5)		1.25 (0.44–3.56)	0.676
Years of practice					
1–5	597 (35.4)	254 (16.8)	0.307		
6–10	278 (16.5)	152 (10.3)			
> 10	181 (13.1)	134 (8.0)			
Educational background					
Pharmacist professional	990 (61.3)	499 (32.9)	0.694		
Master	64 (3.5)	40 (2.1)			
Doctoral	2 (0.0)	1 (0.0)			
Practice Setting					
Pharmacy	398 (20.2)	150 (6.4)	0.000	Ref	
Clinic	99 (4.9)	58 (2.9)		2.16 (1.29–3.62)	0.003
Community Health Center	413 (32.7)	245 (21.4)		2.07 (1.45–2.95)	0.000
Hospital	146 (7.2)	87 (4.4)		2.00 (1.27–3.14)	0.003

¹Unweighted

²Weighted.

³Goodness-of-fit p-value: 0.735; pseudo-R-squared: 3.36%.

4.1. Pharmacists' awareness about unused and expired household medication-disposal practices

Notably, more than half of the pharmacists were unaware of guidelines in Indonesia on returning unused and expired household medications to medication take-back locations including healthcare facilities. It was supported by the fact that nearly all pharmacists stated that they had never received training on receiving unused and expired household medications in their health facilities, similar to a previous study (Jarvis et al., 2009). Therefore, pharmacists may lack the requisite knowledge and not consistently provide customer information.

It also suggests inadequacies in undergraduate pharmacy education and pharmacist professional study regarding medicines and the environment (Painter, He and Agyapong, 2018; Michelin et al., 2023). Educational intervention is reported to be effective in changing pharmacists' awareness of inappropriate and environmentally unsafe medication-disposal practices. It may lead to pharmacists recommending appropriate medication disposal methods to the public (Jarvis et al., 2009).

Furthermore, pharmacists' lack of awareness may also be associated with indifference to information on this subject or the inability to access it (Michelin et al., 2023). Therefore, pharmacy curriculums should be strengthened on environmentally friendly medication disposal, and

continuous professional education should keep pharmacists updated on regulations and increase their awareness regarding household medication disposal.

In addition, the fact that most customers rarely ask pharmacists for information regarding the proper disposal of household unused and expired medications may result from their lack of awareness of the risks associated with such improper disposal (Alfian et al., 2021; Coleman et al., 2023). Therefore, an individualized approach during pharmacists' counseling to raise customer awareness on proper medication disposal can be more effective than broad campaigns that pursue the same aim (Constantino et al., 2020).

4.2. Factors associated with how pharmacists counsel customers regarding household medication-disposal practices

Most pharmacists in our study confirmed never providing customers with information regarding the proper disposal of unused and expired household medications, a rate much higher than observed among pharmacists in Brazil (Michelin et al., 2023). The issue must be resolved, as customers who received relevant counseling from healthcare professionals, including pharmacists, were more likely to dispose of medications properly (Varisco et al., 2019). Thus, it is important that pharmacists, the frontline of dispensing medication, guide the disposal of unused or expired medications.

We further observed that the longer the duration of practice, the more likely pharmacists were to provide information about medication disposal during counseling. This finding aligns with a previous study (Michelin et al., 2023), showing that pharmacists who had worked for more than ten years confirmed they almost always guided household medication disposal. Pharmacists with greater experience may be more knowledgeable (Cheng et al., 2020) and aware of the importance of training in basic pharmacy and clinical knowledge (Reis et al., 2015). They also showed more concern for drug-related laws and regulations (Athiyah et al., 2019).

It has also been reported that the higher the educational background of pharmacists, the more frequently they counsel patients or consumers about household medication disposal (Michelin et al., 2023). However, we did not observe this association in our study.

4.3. Factors associated with the unwillingness of pharmacists to receive unused and expired household medications from the public

We observed that most of the pharmacists in our study were willing to receive unused and expired medications from the public. Returning these medications to health facilities is recommended since it can remove potential environmental contaminants from households (Bicket et al., 2017; Wheeler et al., 2018). The US Food and Drug Administration recommends that customers return unused or expired medications to support the Drug Take-Back programs so that they can be properly disposed of (FDA, 2020). Nonetheless, a third of the pharmacists in our study were still unwilling to receive unused or expired household medications from the public. Pharmacists who worked in clinics showed the highest propensity to refuse these medications, followed by pharmacists who worked at community health centers and hospitals, compared to those who worked at pharmacies.

The economic value may have influenced the willingness to receive unused and expired household medications, as observed in previous studies (El-Hamamsy, 2011; Perry, Shinn and Stanovich, 2014; Law et al., 2015; Moustarah, Desai and Blebea, 2020; Rahmadani and Kristina, 2021). Handling medication waste requires direct costs to properly dispose of the medication and avoid environmental issues (West et al., 2014; Rahmadani and Kristina, 2021; Romanelli and Lucente, 2022). Reportedly, healthcare facilities, particularly clinics and community health centers, often do not make specific budget allocations for handling unused or expired medications (Nurfitriya et al., 2022).

Additionally, health facilities that have a larger scope of services and dispose of larger amounts of medical waste, such as hospitals, usually have more advanced pharmaceutical waste handling systems than clinics and community health centers (Jovanović et al., 2016; Nurfitriya et al., 2022). However, whether they are also willing to receive returned unused and expired household medications from the public is unclear.

Moreover, frontline healthcare facilities (i.e., clinics and community healthcare centers) generally have limited human resources or expertise for handling medication disposal (Bruno et al., 2016; Nurfitriya et al., 2022). Some clinics in Indonesia also reported a lack of reliable third parties for handling medication disposal (Nurfitriya et al., 2022). At the same time, some community health centers had no policies regarding the proper management of expired medicines (Nuryeti and Ilyas, 2018).

4.4. Recommendations to policymakers and stakeholders

Governments as policymakers are encouraged to support the household medication disposal by providing clear policy and practical guidelines on household medication disposal, incorporating valid and relevant recommendations by compiling feedback and suggestions received from the public, and other stakeholders such as pharmaceutical industry, academia, and healthcare professionals in the policy-making process. Furthermore, sufficient budgetary allocations for the medication disposal facilities are needed to cover all administrative and technical costs (Ishaq Geer, 2023).

The role of the pharmaceutical industry in handling household unused or expired medications is needed by applying a reverse distribution system in which the public return their medications to the pharmaceutical industry. The pharmaceutical industry can be an initiator to open additional medication take-back locations including retails, hospitals, clinics, and pharmacies. A rewarding system for the pharmaceutical industry or determining the funding of end-to-end medication production from manufacturing to disposal may be a facilitator of such a program (Siler et al., no date).

The role of academia may address the actual needs and demands of the public by carrying out research to optimize the policy-making outcome and acceptability based on bottom-up approaches (Ishaq Geer, 2023). Furthermore, pharmacists associations may also play a role in establishing a continuous training on medication disposal for pharmacists.

5. Implications, study strengths and limitations

Our findings highlight the urgent need to emphasize the pharmacist's role as an information resource for proper medication disposal. In collaboration with medication-disposal programs and pharmaceutical collection events, they can be part of the solution to the medication waste problem. The awareness among pharmacists in Indonesia regarding the risks of improper disposal of expired and unused household medications, coupled with their acknowledgment of the responsibility to protect the environment, provides a promising opportunity to initiate collaborative efforts (Alfian et al., 2023). Furthermore, practical guidelines, professional training, and further education for pharmacists on pharmaceutical waste handling, particularly for household unused and expired medication, are essential to addressing the failure of pharmacists to manage medication waste properly (Painter, He and Agyapong, 2018; Kristina et al., 2021; Michelin et al., 2023). These efforts will pave the way for developing and implementing public policies to use and dispose of household medications properly. Additionally, a sustainable national program for returning and disposing of household medications within communities, facilitated through collaboration and coordination with all stakeholders, is imperative (Alhomoud, 2020; Michelin et al., 2023).

To the best of our knowledge, this is the first national-level study in Indonesia to assess whether pharmacists provide information about medication disposal during counseling and their willingness to receive

unused and expired household medications. Several limitations should be acknowledged. Social desirability bias may threaten the internal validity of self-reported survey, as it may result in an overestimation of positive behaviors or an underreporting of undesirable behaviors. However, we ensured the anonymity of the respondents in the beginning of the online questionnaire to mitigate the potential impact of this bias. Moreover, voluntary surveys may introduce self-selection bias, as pharmacists who voluntarily choose to complete the survey might differ in their responses compared to those who opt-out. It may raise concerns about the generalizability of the findings. Nonetheless, the widespread use of the internet and the standardized competence of pharmacists may mitigate this bias to some extent. Furthermore, as is common with online surveys, we could not calculate the response rate. Given the cross-sectional design, we could not infer a causal relationship among the factors associated with the outcomes. In addition, our models had a relatively low pseudo-R-squared. This implies that other unmeasured factors may be associated with outcomes to varying degrees, for example, health literacy among pharmacists (Cork and White, 2022), and awareness and beliefs of pharmacists on disposal of unused and expired household medications (Alfian et al., 2023). Finally, one main pitfall of convenience sampling is the risk of bias due to the lack of random selection. Certain groups within the population may be over-represented or underrepresented as we could not control the distribution of the link to the online questionnaire. This skew may lead to results that do not accurately represent the entire population. However, distributing the online questionnaire through Indonesian Pharmacists Association which consists of pharmacists working in community health centers, hospitals, clinics, and pharmacies may help to minimize this limitation. Furthermore, we conducted weighting by complex sample analysis techniques for the province variable which statistically corrected for the unequal proportions determined during sampling. In future investigations, combining multiple sampling techniques, such as random sampling, stratified sampling, or systematic sampling, may help improve the quality and representativeness of the convenience sample, which can lead to more accurate and reliable outcomes and enhance the generalizability of findings. Furthermore, future studies are needed to explore the facilitators and barriers (e.g., workload) of medication health facility to implement medication take-back programs on a national scale in Indonesia.

6. Conclusions

The study reveals that most pharmacists, particularly those with limited practice duration, lacked awareness regarding the importance of proper medication disposal and did not provide counseling on appropriate medication disposal to patients. To address this issue, there is a pressing need for intensified education at the undergraduate level, continuous training for pharmacists, and a clear policy and practical guidelines, particularly targeting pharmacists in clinics, community health centers, and hospitals, to facilitate the acceptance of unused and expired household medications.

CRediT authorship contribution statement

Sofa D. Alfian: Conceptualization, Funding acquisition, Data curation, Writing – review & editing, Writing – original draft, Investigation, Methodology. **Farida Rendrayani:** Conceptualization, Data curation, Writing – review & editing, Investigation, Methodology, Project administration. **Qisty A. Khoiry:** Conceptualization, Data curation, Writing – review & editing, Investigation, Methodology, Resources, Software. **Mochammad A.A. Pratama:** Data curation, Writing – review & editing, Visualization, Formal analysis, Resources, Software. **Meliana Griselda:** Conceptualization, Writing – review & editing, Visualization. **Ivan Surya Pradipta:** Funding acquisition, Writing – review & editing, Validation, Supervision. **Nursiswati Nursiswati:** Funding acquisition, Writing – review & editing, Validation, Supervision. **Rizky Abdulah:**

Writing – review & editing, Validation, Supervision.

Acknowledgment

This study was supported by a grant-in-aid from Universitas Padjadjaran, Indonesia (No. 1549/UN6.3.1/PT.00/2023). This funding body did not have any role in designing the study, writing this article, and deciding to submit it for publication.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsps.2024.102020>.

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