

Original Research Article

Assessing Public Awareness and Practices in Medicine Disposal: A Cross-Sectional Study on the Utilisation of the 'Return Your Medicines' Program in Terengganu, Malaysia

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ABSTRACT

Improper disposal of unused and expired medicines poses a significant risk to public health and the environment. While medication return programs have been established in various countries to mitigate this issue, data on their utilisation remain limited. The study aims to identify the disposal practices of unused and expired medicines; evaluate the public's awareness and utilisation of the "Return Your Medicines" (RYM) program; and investigate factors related to disposal practices, awareness, and RYM usage. A quantitative, cross-sectional survey was conducted in Terengganu, Malaysia, involving 290 adults recruited through convenience sampling. Data were analysed using SPSS, employing both descriptive and inferential analyses, including the chi-square test. The findings show that nearly 90% of participants improperly dispose of unused and expired medicines by discarding them in household trash and giving them to friends and relatives. Out of 290 participants, only 33.4% were aware of the RYM program, and only 23.7% had used it. There is a notable prevalence of improper medicine disposal practices, as well as a limited level of public awareness about the RYM program. These findings highlight the crucial role of healthcare practitioners, especially pharmacists, in continuously educating the public on safe disposal practices. Furthermore, the development and implementation of innovative strategies are imperative to increase public engagement with the RYM program and promote safer disposal methods.

Keywords: Unused medicines, Expired medicines, Disposal, Medicines take-back program

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1.0 Introduction

Unused and expired medicines present a multifaceted issue, impacting public health, environmental safety, healthcare costs, and economic loss. Expired drugs pose significant health risks due to their reduced potency, compromised safety, and the production of harmful by-products. Consuming expired drugs consequently leads to therapeutic failure, treatment resistance, or even death (1). Furthermore, the accumulation of unused and expired drugs at home, often due to a lack of awareness about proper disposal methods, poses significant risks, including child intoxication. Inappropriate disposal also raises concerns about the sharing of medicines and the increasing danger of psychoactive drug illicit use (2). Improperly discarded medications can be easily accessed by individuals such as family members, friends, or unauthorised persons, which heightens the risk of medication sharing. This practice is often driven by attempts to circumvent the costs associated with medical consultations and prescriptions. The 2023 National Survey on Drug Use and Health (NSDUH) reported that 39.1% of Americans who misused analgesic prescriptions obtained the medications from friends or families either for free or for money or took them without permission (3). Additionally, abuse and misuse of opioids secondary to inappropriate disposal of unwanted prescriptions has resulted in an opioid use disorder (OUD) epidemic in the United States (US), with almost 70000 opioid overdose deaths reported in 2020. Improper disposal of these medications, typically through household waste or wastewater systems, can result in environmental pollution, including the contamination of water bodies and aquifers, thereby posing risks to wildlife. Two anecdotal instances illustrate this detrimental impact. First, exposure to small amounts of

diclofenac nearly led to the extinction of vultures in Southeast Asia (4). Secondly, exposure to ethinylestradiol in European waters prevents fish from developing sexually and becoming female (5).

Multiple factors contribute to the accumulation of unused or expired medicines, including overprescribing, patients dying from terminal illnesses, forgetfulness by patients or caregivers, intolerable side effects, discontinuation or changes in treatment plans, highly subsidized medicines, and the absence of a proper drug disposal service (2, 6, 7). These factors collectively result in enormous medication wastage, increased economic burden and rising healthcare costs. The US estimates that wasted drugs cost over \$1 billion annually, while the UK's economic value has reached £300 million. Many developing countries, including Saudi Arabia and Malaysia, have observed similar patterns. For instance, families in Saudi Arabia and other Gulf countries collectively spent around 150 million USD on unused or expired medications (8). In Malaysia, the overall consumption of medicines in the public health sector has exhibited a consistent upward trend annually (9). However, over a two-year period from 2014 to 2016, reports indicated the disposal of approximately RM2 million worth of expired or spoilt medications (10).

Substantial evidence has demonstrated that, despite a positive attitude toward proper medication disposal, improper practices are still common in many countries (11). The dissonance could be attributed to a lack of easily available disposal facilities and information, compounded by insufficient guidance from healthcare practitioners. While several countries lack clear guidelines and have limited systems or processes for disposing of expired or unused medications (12), countries such as Sweden, Australia, and the United Kingdom (UK) have implemented systematic

disposal processes for these drugs through drug take-back or medication return programs (13). In Malaysia, the Ministry of Health has taken the initiative to implement the Return Your Medicines (RYM) program under the supervision of the Pharmaceutical Service Division. The primary aim of this program is to offer the public a proper location to dispose of unneeded medication, with the goals of safeguarding the environment from harmful pharmaceutical substances and preventing accidental consumption, misuse, and abuse of excess medication (14). The participation rate of the program varied across countries. Survey results indicate only one-third of participants adopted the medication return program in Malaysia (26%-27%) (14, 15). Meanwhile, the practice is adopted to a greater extent in European countries, such as Sweden at 43% and the Netherlands at 58% (16). Increased knowledge and awareness about safe disposal have led to generally growing support for take-back schemes designed for handling unused and expired pharmaceuticals (11). In view of the diverse and significant implications of improper medicine disposal—ranging from public health risks to environmental contamination—it is crucial to evaluate current disposal practices and public awareness of the 'Return Your Medicines' (RYM) program. Despite the introduction of medicine take-back programs several years ago, there remains a lack of data on their utilisation. The findings of this study will provide policymakers with insights into existing gaps and inform strategies to enhance the uptake of the RYM program.

2.0 Materials and methods

2.1 Study Design

A quantitative, cross-sectional study was conducted from April to June 2021 in Terengganu, Malaysia. The state, located on Malaysia's eastern coast, has approximately 1.2 million inhabitants. The state was chosen

because it offers a unique demographic profile, including urban and rural populations, which provides a comprehensive overview of medicine disposal practices across different community settings. This diversity allows for a more representative understanding of public awareness and utilisation of the RYM program in varying socio-economic contexts. Terengganu's proximity to significant water bodies, including the South China Sea, highlights the importance of proper medicine disposal practices to prevent environmental contamination (17). Studying this region will emphasise the environmental impact and the necessity of raising public awareness regarding safe disposal methods.

2.2 Study Sample

The sample size was calculated by using the prevalence sample size calculator described by Naing *et al.* (2006) (18) using an estimated prevalence of the utilisation of RYM from a similar study done by Yang *et al.* (2018) (14) to obtain a minimum sample size of 281 respondents. The analysis removed 86 incomplete responses from the 376 received, resulting in a sample size of 290. The study used convenience sampling to recruit participants. Participants included in this study are those aged 18 years and older, either male or female, residing in any part of Terengganu and those who are presently using or have previously used medicines. Meanwhile, survey forms with incomplete information were excluded.

2.3 Study Tool

A structured survey form was developed and adapted from previous published literature by Azmi Hassali *et al.* (2020) (19) and Yang *et al.* (2018) (14). The survey form consisted of an introductory section followed by three main sections. The introductory section provided participants with a brief overview of the study's purpose and an informed

consent form. The first main section collected demographic data, such as gender, age, education level, employment status, income, and the presence of family members with a medical-related background. The second section contained seven questions aimed at identifying participants' common disposal practices for unused and expired medications. The final section featured four questions designed to assess participants' awareness of and engagement with the RYM program.

Five experts, including two hospital pharmacists and three academicians, received the draft questionnaire in both English and Malay for content validation in the first phase of the development process. Following the content validity process, we conducted a pilot study with 20 participants to evaluate the transparency, feasibility, and clarity of the question items, a process known as face validity. The final study did not include the respondents who participated in the pilot testing. The validated survey form is transformed into a virtual format using the Google Form application, which is then distributed through different social media platforms such as WhatsApp, Facebook, and Instagram.

2.4 Data Analysis

All data was analysed using SPSS software version 26.0. Data were presented using descriptive statistics, where categorical variables are summarised in frequency and percentage. A chi-square test was employed to analyse the correlation between socio-demographic characteristics and the level of awareness of the RYM program, given the non-normal distribution of the data. A p-value of less than 0.05 indicates the statistical significance of the variable outcome.

2.5 Ethical Consideration

Ethical approval was obtained from the Universiti Teknologi MARA ethical

committee [REC/04/2021 (UG/MR/285)]. Prior to participating, each participant filled out an informed consent form, and the confidentiality of the acquired information is upheld by labelling the data with participant codes instead of their names.

3.0 Results

3.1 Participants' sociodemographic characteristics

Table 1 provides an overview of the sociodemographic characteristics of the 290 participants included in the study. Most of the participants are female, accounting for just over half of the sample, while males constitute 40.7%. The age group with the largest representation is 18–25 years old, followed by those aged 46 and above. Nearly half of the respondents reside in the Kemaman district, and a substantial 85.5% have completed tertiary education. More than half of the participants are employed, while 39.3% report having no source of income. Additionally, 65.5% have a family member in the medical field, and 77.6% regularly check the expiration date before purchasing medicines.

3.2 Participants' disposal practices of unused and expired medicines

Figure 1 presents the participants' disposal practices for unused and expired medicines. Many participants reported disposing of medicines by throwing them in the trash. Other methods, such as returning to healthcare facilities or giving to friends or relatives, were less frequently reported. A small proportion of participants disposed of medicines directly in the environment, such as rivers or soil, or used other methods, like storing them in closed cabinets or separate plastic bags at home.

Table 1: Participants' sociodemographic characteristics (n=290)

Participants' socio-demographic characteristics	N (%)
Gender	
Female	172 (59.3)
Male	118 (40.7)
Age (year)	
18 - 25	123 (42.4)
26 - 35	48 (16.6)
36 - 45	41 (14.1)
46 and above	78 (26.9)
Locality (district)	
Kemaman	144 (49.7)
Dungun	83 (28.6)
Kuala Terengganu	45 (15.5)
Others	18 (6.2)
Highest level of education	
Primary and below (e.g.: UPSR)	2 (0.7)
Secondary (e.g.: PMR/SPM)	40 (13.8)
Tertiary (e.g.: Diploma/Undergraduate/Postgraduate/Graduate certificates)	248 (85.5)
Employment status	
Employed	154 (53.1)
Unemployed	136 (46.9)
Monthly income	
No source of income	114 (39.3)
≤ RM4 849 (B40)	69 (23.8)
RM4 850 - RM10 959 (M40)	80 (27.6)
≥ RM10 960 (T20)	27 (9.3)
Do you have any family members in medical field?	
Yes	190 (65.5)
No	100 (34.5)
Do you check the expiry date before buying any medicines?	
Yes	225 (77.6)
No	65 (22.4)

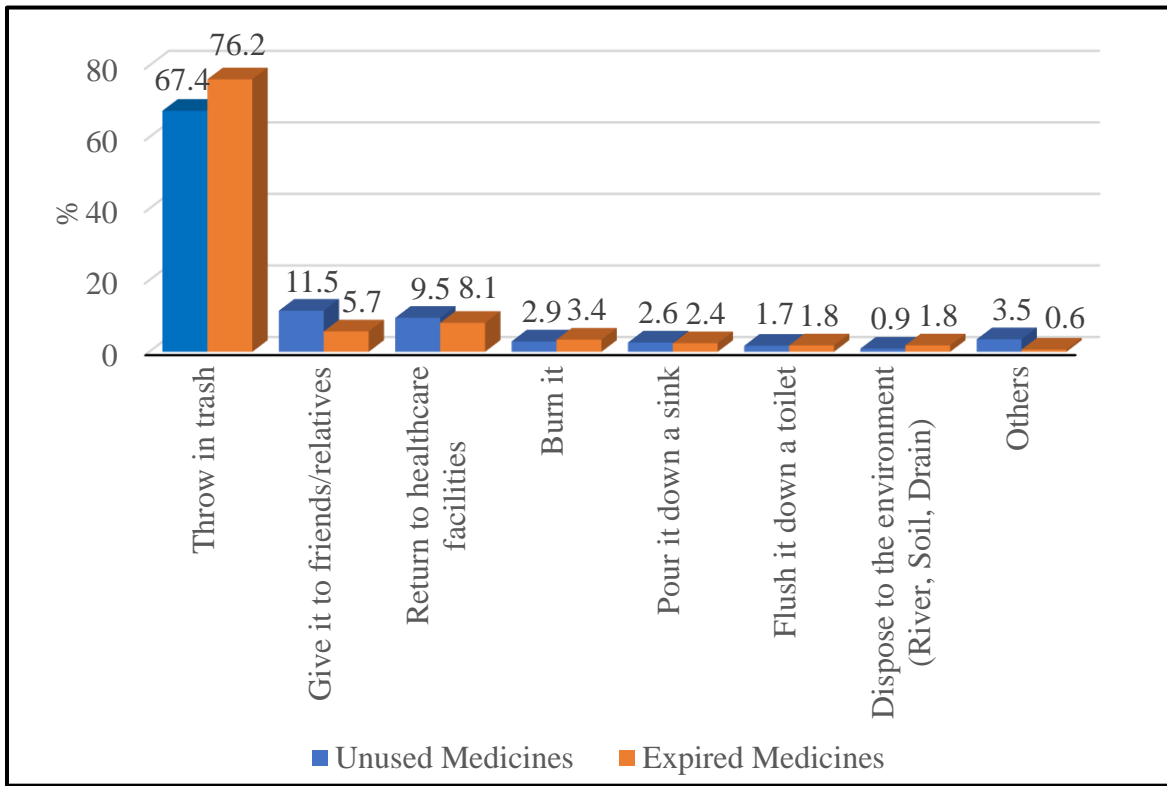


Figure 1: Participants’ disposal practices of unused and expired medicines

3.2 Participants’ awareness of the Return Your Medicine (RYM) program

An analysis of participants' awareness and utilisation of the RYM program reveals that approximately one-third of them are aware of it. Of those who were aware, only one out of five have actually participated in the program, ranging from one to three times over the past year (Figure 2). Respondents most commonly learn about the RYM program through social media. Online articles, news, and recommendations from friends and family were among the less frequently mentioned sources of information. Additionally, respondents reported receiving information about the program during clinic

or hospital appointments from doctors and pharmacists, as well as through posters displayed in waiting areas (Figure 3). Table 2 shows the factors associated with awareness of the RYM program among our study participants. Significant associations between respondents' gender, locality, and awareness of the program ($p < 0.001$) were observed. Females reported a higher level of awareness in comparison to males. Awareness was also higher among those residing in Kuala Terengganu and Kemaman compared to respondents from Dungun. Additionally, respondents who are aware of the medication product's expiry date had higher awareness of RYM ($p = 0.021$).

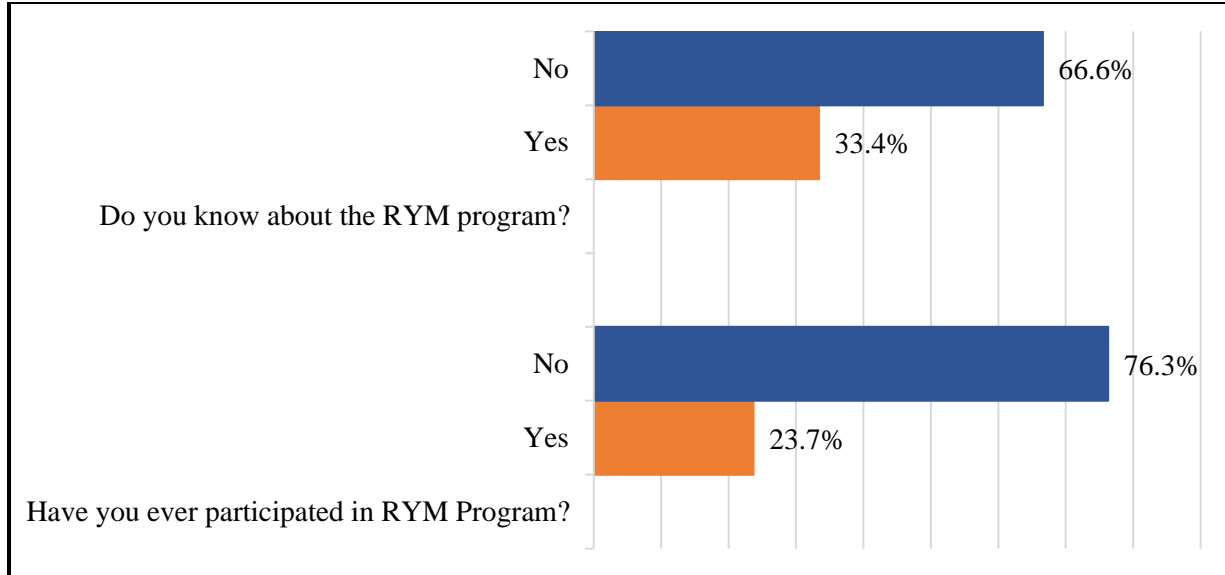


Figure 2: Participants' awareness and utilisation of the Return Your Medicine (RYM) program

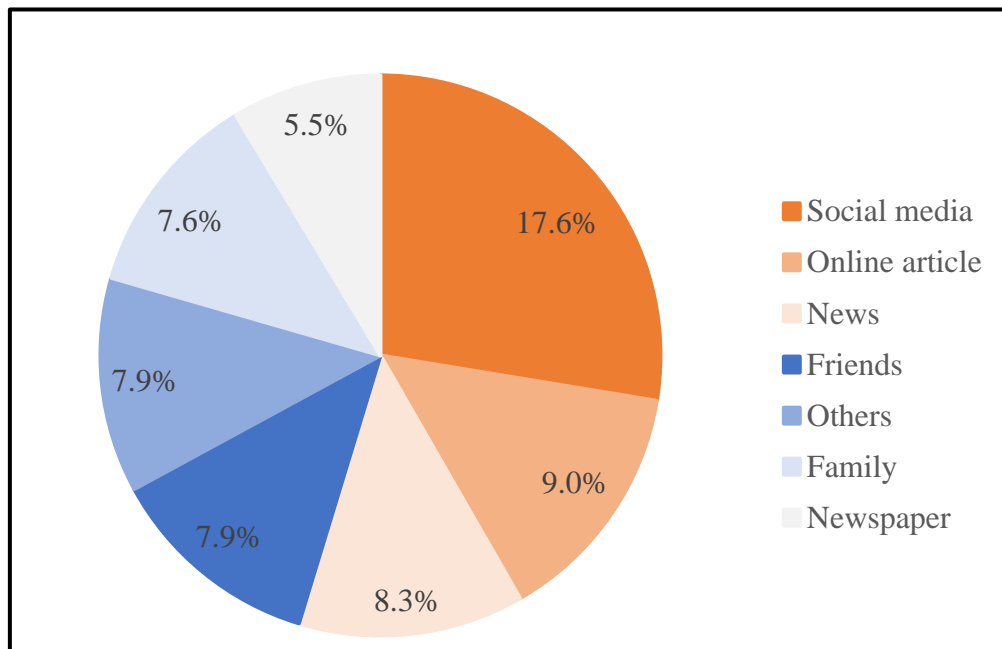


Figure 3: Sources of RYM program information

Table 1: Inferential analysis of participants characteristics on awareness of RYM program

Variable	n	Awareness on RYM program		p value
		Yes	No	
Gender				
Male	118	17 (14.4%)	101 (85.6%)	< 0.001
Female	172	80 (46.5%)	92 (53.5%)	
Age (year)				
18 - 25	123	47 (38.2%)	76 (61.8%)	0.423
26 - 35	48	16 (33.3%)	32 (66.7%)	
36 - 45	41	13 (31.7%)	28 (68.3%)	
46 and above	78	21 (26.9%)	57 (73.1%)	
Education Level				
Secondary and below	42	10 (23.8%)	32 (76.2%)	0.152
Tertiary	248	87 (35.1%)	161 (64.9%)	
Employment status				
Employed	154	47 (30.5%)	107 (69.5%)	0.261
Unemployed	136	50 (36.8%)	86 (63.2%)	
Monthly Income				
No source of income	114	43 (37.7%)	71 (62.3%)	0.052
≤ RM4 849 (B40)	69	26 (37.7%)	43 (62.3%)	
RM4 850 - RM10 959 (M40)	80	25 (31.3%)	55 (68.8%)	
≥ RM10 960 (T20)	27	3 (11.1%)	24 (88.9%)	
Locality				
Kuala Terengganu	45	19 (42.2%)	26 (57.8%)	< 0.001
Dungun	83	11 (13.3%)	72 (86.7%)	
Kemaman	144	60 (41.7%)	84 (58.3%)	
Others	18	7 (38.9%)	11 (61.1%)	
Any family members in the medical field?				
Yes	190	68 (35.8%)	122 (64.2%)	0.244
No	100	29 (29.0%)	71 (71.0%)	
Do you check your expiry date?				
Yes	225	83 (36.9%)	142 (63.1%)	0.021
No	65	14 (21.5%)	51 (78.5%)	

4.0 Discussion

The aim of this study is to identify the disposal practices of unused and expired medicines and to evaluate the awareness and utilisation of the Return Your Medicine (RYM) program in Terengganu, Malaysia. It is also to determine the association between participants' socio-demographic characteristics and these variables. Our study found that the

majority of participants disposed of their unused and expired medicines by throwing them into the dustbin. The finding agrees with studies conducted among various populations in several countries, including Tanzania, Serbia, Indonesia, and Mexico (12, 20-22). For instance, studies in urban areas in Mexico and Indonesia reported that over 80% of the population disposed of unused or expired medicines by throwing them into the

municipal dump (23, 24). Another study among nursing and pharmacy students in Saudi Arabia also showed similar findings to our study (21). This commonly adopted practice, while convenient for the public, raises concerns about environmental safety and the potential for unintended exposure to humans and animals (22, 23). Given its high prevalence, enhancing public education on the proper steps for disposing of medicines in households is essential to mitigate the associated risks.

Another unsafe disposal method noted in this study is giving unused or expired medicines to friends and relatives. This practice is similar to community practice in Afghanistan and Trinidad and Tobago, though at a lower percentage than our study (22, 25). The sharing practice associated with expired medicines raises considerable concern as it increases the risk of poisoning and toxicity from ingesting unsafe medicines with reduced potency due to a change in chemical composition or a decrease in strength (26). The accumulation of unused medications at home may suggest that patients are not following medical instructions and are likely to self-medicate. This behaviour increases the risk of an incomplete treatment regimen, which can lead to drug resistance and treatment failures (12). Furthermore, sharing leftover medicines among friends, household members, or neighbours may increase the risk of misuse and severe adverse events, particularly in countries like Malaysia, where self-medication and polypharmacy are prevalent (27).

The next most common methods for disposing of unused and expired medicines included burning them, flushing them down the sink or toilet—especially in the case of unused liquid formulations—and discarding them directly into rivers or onto the soil. These findings are consistent with numerous studies conducted in the United States, New Zealand, England, Bangladesh, and Saudi

Arabia (16, 20). Disposal through the sewage system was less prevalent in Sweden, Romania, and Oman (16, 28). This disposal practice is considered the least appropriate method and particularly unsuitable in Malaysia, where conventional sewage treatment plants are not equipped to remove pharmaceutical compounds from wastewater. As a result, undegraded and biologically active substances pose significant risks to aquatic life, public health, and the environment (16, 29). Therefore, collaborative efforts among stakeholders across various sectors, including environmental and regulatory authorities, are essential for monitoring pharmaceutical waste and implementing effective disposal strategies.

According to the current study's findings, only one-third (33.4%) of the participants were aware of how to properly dispose of expired and unused medication through the medicine take-back program, and only 7.9% of this group had participated in it. These findings are consistent with those from studies conducted in Tanzania, Indonesia, and Afghanistan, where disposal through this method is less prevalent in comparison to other practices (12, 22, 23). A previous local study in Sabah (14) revealed that while approximately half of the study populations knew about the medicine return program, only 26% of them had actually used it. In contrast, Sweden, Australia, and Germany have recorded high use of drug take-back or medication return programs (20, 30). Sweden's initiative began in 1971 when the monopoly pharmacy chain, Apoteket AB, introduced the program to improve security. Over time, as research and discourse on pharmaceutical chemicals in the environment grew, the program's focus expanded to include environmental concerns (31). Similarly, Australia established a nationally coordinated, free-to-consumer scheme in 1998, offering a safe and convenient way for the public to return unwanted and expired medicines to community pharmacies across the country

(32, 33). These long-standing initiatives have fostered cultural adaptations that encourage the responsible disposal of medicines.

Our study found a significant association between gender and awareness of the RYM program, with females demonstrating a higher level of awareness (46.5%) compared to males (14.4%). This disparity may be linked to societal norms, where women often take on caregiving roles that make them more attentive to health and safety practices, including proper medication disposal (34). Additionally, women generally exhibit more proactive health-seeking behaviours, as reflected by higher participation in health programs reported in other studies (19, 35). Next, our findings indicate that participants from Kuala Terengganu and Kemaman districts demonstrated greater awareness of the RYM program compared to those from other districts. These two districts, which serve as the primary urban centres in the state of Terengganu, benefit from well-developed infrastructure and an abundance of healthcare facilities, including health clinics and general hospitals. The accessibility of these resources likely contributes to increased exposure to healthcare initiatives and educational campaigns, thereby enhancing residents' knowledge and awareness of programs such as RYM (36). Living in these urban areas provides residents with more frequent interactions with healthcare professionals and greater access to information, both of which are critical factors in fostering an understanding of proper medication disposal practices (37).

Various studies (21, 38, 39) have observed growing support and the community's willingness to engage in the safe and effective disposal of medicines, despite the current poor awareness and low utilisation of the RYM program. Yang et al. (14) highlighted the need for a standard awareness-building strategy to promote the RYM program across all government and private healthcare facilities. This initiative

should extend beyond traditional methods such as posters, leaflets, and collection boxes. Innovative educational programs, such as the "Know Your Medicine" campaign, could be implemented to enhance awareness. Through such campaigns, pharmacists could play a crucial role in conveying information on the safe use of medicines and proper disposal practices for unused and expired medications directly to patients. Additionally, a reward system might be introduced to incentivise public participation in the program. Non-monetary incentives, such as access to a "rapid lane" for medication pickup, could be proposed. Moreover, collaboration with corporate entities as part of their corporate social responsibility (CSR) efforts could include providing food or shopping vouchers in exchange for public participation, further encouraging engagement in the program.

Visual education such as infographics and animations on the effects of unsafe medicine disposal practices as well as the public responsibilities in ensuring safe medicine disposal are recommended, as it can draw the interests of a wider population, from kids to the elderly, regarding the issue (40). It is believed that if the public understands the effect of medicine wastage on the environment and knows why they need to dispose of unused and expired medicines safely, they are most likely to be more careful when disposing of the medicines (14, 20, 31). This also highlighted the important role of pharmacists as experts in medicines management to be aware of medicines disposal practices in their communities. Educating and recommending appropriate medicine disposal practices to the community is one of the pharmacists' roles in tackling the issue of improper medicine disposal practices. Currently, Malaysia lacks an official public guideline for the disposal of unused and expired medicines. The current guideline primarily targets healthcare providers, such as pharmacists, to conduct medicine return programs (14). Thus, it is essential for the

public to consult with pharmacists and medical doctors when disposing of medications, as healthcare professionals are uniquely positioned to provide guidance and promote safe disposal practices. Their expertise can help individuals make informed decisions, ensuring that medications are disposed of in ways that protect both public health and the environment. Furthermore, developing comprehensive guidance for the public in the future will enhance awareness and encourage responsible disposal practices among community members.

While the current study provides valuable insights into disposal practices, public awareness, and RYM program usage, it is important to acknowledge certain limitations that may influence the interpretation and generalisability of the findings. The study's findings are based on self-reported data, which is dependent on the participants' reliability. In addition, as the study focuses solely on the Terengganu population, it may not accurately represent the overall Malaysian population, given the socio-economic differences, literacy levels, and public health infrastructure in Terengganu compared to more developed regions like the Klang Valley. Furthermore, the availability and accessibility of RYM facilities may be limited in the eastern coastal regions, potentially impacting public awareness and utilisation. Future research in other regions, including highly urbanised areas, would be valuable to provide a more comprehensive national perspective on medicine disposal practices.

5.0 Conclusion

This study provides valuable insights into the prevalent improper disposal of unused and expired medicines in Terengganu, as well as the low levels of public awareness and participation in the "Return Your Medicines" (RYM) program. These findings highlight the need for targeted public health initiatives to

enhance participation in the RYM program, such as expanding disposal sites to rural areas and leveraging social media and online platforms for broader outreach. Empowering the public with knowledge and providing accessible disposal facilities are essential steps toward transforming medicine disposal practices and achieving the RYM program's goal of protecting both public health and the environment.

Authorship contribution statement

NAS: Carried out data collection, performed data analysis and drafted the manuscript. **ZMN:** Directed and designed the project, supervised, participated in writing – review and editing **SMH:** Participated in the design of the study, helped to correct the draft manuscript. All authors discussed the results and contributed to the final manuscript.

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Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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