Improving knowledge on safe medicine disposal through e-flyer-based DAGUSIBU education

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Abstract. Improper disposal of unused and expired medications is a significant public health and environmental issue globally. In both high- and middle-income countries, including Australia and Indonesia, public awareness of safe pharmaceutical disposal remains low, increasing risks such as accidental ingestion, environmental pollution, and antimicrobial resistance. This community program aimed to evaluate the effectiveness of an e-flyer-based educational intervention, guided by the culturally relevant DAGUSIBU (Dapatkan, Gunakan, Simpan, Buang) framework, in improving knowledge about safe medicine disposal. A one-group pre-post design targeted 60 adult members of the Indonesian diaspora in Australia. Participants received a digital e-flyer covering medicine lifecycle, expiry recognition, return facility awareness, and environmental risks, and completed a structured questionnaire before and after the one-week intervention. Results showed a significant improvement in knowledge, with mean scores rising from 6.18 to 9.07 out of 10 ($p < 0.001$) and a large effect size (Cohen's $d = 1.52$). Gains were especially notable in proper disposal methods and environmental awareness. These findings indicate that culturally adapted, low-cost digital tools like e-flyers can effectively increase health literacy and promote safe medicine practices. The study supports integrating such interventions into community and public health strategies, particularly in under-resourced or diaspora settings.

1 Introduction

Improper disposal of unused or expired medicines remains a significant global public health and environmental challenge. Across many countries, including Australia and Indonesia, the accumulation of unwanted pharmaceuticals in households is common, yet the public often lacks awareness or access to proper disposal mechanisms [1-2]. When medicines are flushed down the toilet, thrown into household waste, or left unattended in cabinets, they pose serious risks. These include accidental ingestion by children or pets, the development of antimicrobial resistance due to persistent environmental exposure, and contamination of water systems that impacts both human health and ecological balance [3-4]. Despite efforts by health authorities to mitigate these dangers, studies consistently reveal low levels of public

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knowledge regarding correct disposal methods [5]. Compounding this issue is the absence of standardized return systems, particularly in communities without structured pharmaceutical take-back programs. As such, public education on medicine safety and disposal is urgently needed to reduce household risks and environmental harm.

Digital health patient education methods have expanded significantly, with low-tech solutions like electronic flyers (e-flyers) emerging as practical tools to disseminate health information efficiently. Unlike web-based platforms that require continuous internet access and interactivity, e-flyers offer a more accessible and flexible medium, particularly in community-based and low-resource settings. Delivered through social media, email, or messaging apps, e-flyers retain the core advantages of digital communication—broad reach, cost-effectiveness, and repeat exposure—while being easier to share and consume. Educational e-flyers, when designed with clear language, culturally relevant visuals, and focused messaging, have been shown to effectively raise awareness and improve health-related knowledge, behaviors [6-7], and quality of life as well [8].

Within this context, the DAGUSIBU offers a culturally grounded educational model to promote responsible medication practices. DAGUSIBU, an abbreviation of *Dapatkan*, *Gunakan*, *Simpan*, dan *Buang Obat* (Get, Use, Store, and Dispose) [9], was initiated by the Indonesian Ministry of Health to raise awareness about rational drug use and safe handling practices. It underlines the entire medicine lifecycle—from acquisition to final disposal—and encourages individuals to take an active role in ensuring medicine safety at the household level. Due to its simplicity, cultural resonance, and linguistic clarity, DAGUSIBU has gained recognition in community health campaigns across Indonesia and within diaspora populations.

In health promotion, e-flyers are particularly useful for reinforcing key messages and prompting action, especially when part of larger campaigns or community outreach programs. Their portability and shareability make them an ideal medium for populations with limited health literacy or digital infrastructure. Importantly, in culturally diverse communities, the ability to localize language and design can enhance both relevance and engagement. Of these reasons, this community program aims to assess the effectiveness of an e-flyer-based DAGUSIBU education program in improving public knowledge about the safe return and disposal of unused or expired medicines. By using a culturally tailored digital format, this intervention seeks to promote safer household medicine practices and support environmental health through increased awareness and behavioral change.

2 Methods

2.1 Design and participants

This study employed a one-group pre-post intervention design by using a quantitative approach to evaluate the effectiveness of the DAGUSIBU e-flyer educational campaign in improving participant's knowledge regarding the safe disposal of unwanted or expired medicines. The main outcome of interest was the change in knowledge scores measured before and after the dissemination of the educational e-flyer. This design was selected to assess the preliminary impact of a community-based educational intervention in a real-world setting, allowing for evaluation of knowledge acquisition over a short intervention period. The absence of a control group limits causal inference; however, this design is considered appropriate for exploratory educational interventions and is frequently used in public health education research [10].

Fig. 1. E-flyer of the DAGUSIBU

The study targeted adult members of the Indonesian diaspora in Australia, especially individuals affiliated with Pimpinan Cabang Istimewa 'Aisyiyah (PCIA) in Melbourne. Recruitment was also extended to the broader Indonesian-speaking public residing in Australia through online outreach. Eligible participants were adults aged 18 years or older, with the ability to read in Bahasa Indonesia or English, and possessing access to a digital device capable of receiving and reading PDF e-flyers (Figure 1). Participants were expected to have basic digital literacy to independently engage with the materials. The sample size was estimated at 60 people based on the feasibility of community outreach and resource availability. Recruitment was conducted using purposive sampling model, disseminating digital flyers and announcements via WhatsApp groups, Facebook community pages, and institutional mailing lists. Community leaders were enlisted to promote participation and provide logistical support throughout the study.

2.2 Intervention

The intervention consisted of an e-flyer based educational tool themed around the DAGUSIBU framework. The e-flyer included modules on the life cycle of medicines, proper storage practices, recognizing expiry dates, risks of improper disposal, existing medicine return programs in Australia, and the broader environmental and health consequences of pharmaceutical waste. The content was presented in Bahasa Indonesia, with an optional English version provided to ensure accessibility for bilingual users. The e-flyer used visual

aids, simplified language, and call-to-action messages. It also covered links to short videos and quizzes hosted on external platforms for deeper engagement. Participants were encouraged to study the material at their own pace over a week.

2.3 Data collection and procedure

To assess the impact of the intervention, a pre- and post-intervention questionnaire was administered. The instrument included 12 multiple-choice and true/false questions covering knowledge domains such as medicine storage, risks of improper disposal, return mechanisms, and environmental impacts. The questionnaire was adapted from existing tools utilized in pharmaceutical waste management studies [4-5] and was translated and validated in Bahasa Indonesia through expert panel review and pre-testing for clarity and relevance. An optional satisfaction survey was included post-intervention to gather user feedback on the clarity, usefulness, and perceived behavior influence of the e-flyer. A behavioral intention item—asking whether the participant would now seek out proper disposal services—was included to indicate practical uptake.

Upon expressing interest, participants received a study information sheet and digital consent form. Those who provided informed consent were asked to complete the baseline knowledge questionnaire via an online survey form. They were then sent the DAGUSIBU e-flyer via email or messaging apps, along with guidance to read the content over the next seven days. After this period, participants completed the same knowledge questionnaire as a post-test. All data were collected anonymously using coded identifiers and stored on password-protected digital systems.

2.4 Data analysis

Data were analyzed using SPSS ver. 26.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize participant demographic characteristics and baseline knowledge levels. For the main outcome analysis, a paired samples t-test was conducted to compare pre- and post-test knowledge scores among participants whose data met normal distribution assumptions. Where data deviated from normality, the non-parametric Wilcoxon signed-rank test was implemented. Statistical significance was set at $p < 0.05$ with 95% confidence intervals. To assess the magnitude of the intervention's effect, Cohen's d was calculated, with values of 0.2, 0.5, and 0.8 interpreted as small, medium, and large effect sizes respectively [11]. All tests were two-tailed.

3 Results and discussion

3.1 Results

3.1.1 Participant demographics

A total of 60 participants completed both the pre- and post-intervention knowledge assessments and were included in the final analysis. The gender distribution was fairly balanced, with 26 participants identifying as male (43.3%) and 34 as female (56.7%). Age distribution showed that the majority of respondents were within the 26–35 age group (33.3%), followed by 36–45 (26.7%), 18–25 (16.7%), 46–60 (16.7%), and over 60 years old (6.7%). This diverse age representation facilitated a more comprehensive understanding of knowledge disparities across generations.

Table 1. Demographic information of the study participants (n=60).

Demographic Information	Value (%)
Gender	
Male	26 (43.3)
Female	34 (56.7)
Age	
16 – 25	10 (16.7)
26 – 35	20 (33.3)
36 – 45	16 (26.7)
46 – 55	10 (16.7)
≥ 60	4 (6.7)
Education	
Senior high school	18 (30.0)
Diploma/Bachelor	27 (45.0)
Postgraduate	15 (25.0)
Prior Knowledge on Medicine Disposal	
Yes	22 (36.7)
No	38 (63.3)

As presented in Table 1, in terms of education, 18 participants (30.0%) had completed high school, 27 (45.0%) held a diploma or bachelor's degree, and 15 (25.0%) reported postgraduate qualifications. When asked about prior knowledge related to safe medicine disposal, only 22 participants (36.7%) indicated familiarity with proper practices, whereas 38 (63.3%) lacked formal exposure to this subject. These demographic patterns provided a broad foundation for assessing the effectiveness of the educational intervention across varying levels of literacy, age, and existing awareness.

3.1.2 Pre- and post-knowledge comparison

The primary outcome of this study was to measure changes in participants' knowledge regarding safe medicine disposal before and after exposure to the DAGUSIBU e-flyer-based educational content. As indicated in Table 2, the mean knowledge score prior to the intervention was 6.18 out of a possible 10 (SD = 1.92), reflecting moderate baseline knowledge. Post-intervention, the mean score increased significantly to 9.07 (SD = 1.38), showing an average improvement of 2.89 points (or 46.8). This increase signals a substantial gain in participant understanding over a short, one-week educational period. As shown in Table 2 below, when broken down by specific domains, the most significant improvement was observed in "Proper Disposal Methods," where correct responses rose from 42 pre-test to 82 post-test (+40). This domain included questions about safe ways to dispose of expired or unused medications, such as using return bins or take-back programs rather than flushing medicines or discarding them in household waste.

Table 2. Pre- and post-knowledge comparison of the study (n=60).

Assessment Item	Pre-Test	Post-Test	Improvement
Overall Score (Mean ± SD)	6.18 ± 1.92	9.07 ± 1.38	+2.89
Proper disposal methods	42	82	+40
Recognizing expiry signs	48	79	+31
Return facility awareness	36	71	+35
Environmental impact of improper disposal	40	75	+35

The second most notable improvement was in "Recognizing Expiry Signs," which showed a 31% increase (from 48 to 79). This domain assessed participants' ability to identify

common indicators of medication expiration such as changes in color, smell, or labeling. Awareness of "Return Facilities" also improved markedly, rising from 36% to 71%, suggesting that many participants initially lacked awareness of available pharmaceutical return programs. Similarly, the "Environmental Impact" domain saw scores increase from 40% to 75 (+35), indicating enhanced understanding of how improper disposal can contaminate water systems, contribute to antimicrobial resistance, and harm wildlife. These improvements suggest that the DAGUSIBU e-flyer succeeded in conveying both practical and ecological dimensions of proper medication handling and disposal.

3.1.3 Statistical analysis

To determine the statistical significance of the observed changes, both parametric and non-parametric analyses were conducted. A paired sample t-test revealed a significant difference between pre- and post-test scores ($t = 12.04$, $df = 59$, $p < 0.001$), indicating a highly reliable increase in knowledge following the intervention. Given the potential for non-normality in small samples, a Wilcoxon signed-rank test was also performed. The result ($Z = -6.49$, $p < 0.001$), as shown in Table 3, confirmed the t-test findings, ensuring robustness of interpretation across analytic models.

Table 3. Results of statistical analysis (n=60).

Test type	Value
Paired t-test	$t = 12.04$; $df=59$; $p < 0.001$
Wilcoxon signed-rank test	$Z = -6.49$, $p < 0.001$
Effect Size (Cohen's d)	$d = 1.52$ (Large effect)

The effect size, calculated using Cohen's d, was 1.52—qualifying as a large effect size and emphasizing the strong impact of the DAGUSIBU e-flyer-based educational materials on participant knowledge. Such a high effect size indicates not only statistical but practical significance in the intervention outcomes. These results affirm that even brief, well-structured educational interventions can meaningfully elevate public health literacy in key behavioral domains.

3.2 Discussion

The present study examined the effectiveness of an e-flyer-based DAGUSIBU educational intervention in enhancing public knowledge regarding the safe disposal of unused and expired medicines among the Indonesian diaspora in Australia. The DAGUSIBU framework, emphasizing the four stages of pharmaceutical use—Dapatkan (Get), Gunakan (Use), Simpan (Store), and Buang (Dispose)—served as a culturally resonant structure for delivering key health messages. The findings demonstrated a significant improvement in knowledge post-intervention, supporting the hypothesis that structured, culturally appropriate educational tools, even when delivered through a simple medium such as an e-flyer, can play a pivotal role in addressing knowledge gaps and promoting safer medicine disposal practices. Practically, all participants reported marked gains in understanding safe disposal routes, identifying expiry indicators, and recognizing the environmental consequences of improper drug waste management. Notably, domains such as disposal methods and environmental impact exhibited the most pronounced improvements. It suggests the intervention effectively engaged users in often-overlooked aspects of household pharmaceutical management. The self-paced, visually guided format of the e-flyer may have contributed to better retention of information by simplifying complex concepts into accessible formats.

The results align with the findings from earlier studies that evaluated the impact of educational initiatives on public awareness of medicine disposal. For instance, Lai et al. (2021) reported a significant improvement in knowledge following a poster-based intervention, although attitude and practice were less influenced [12]. Similarly, Mohammed and Al-Hamadani (2024) demonstrated that educational programs grounded in behavioral models could improve safe disposal practices and reduce health risks [13]. The inclusion of culturally tailored content, as done in this study, may explain the effectiveness of the intervention even in a relatively brief exposure. The cultural alignment of the DAGUSIBU model likely enhanced its relevance and reception among Indonesian participants. Prior studies have stressed the need for localization in public health education to ensure engagement and compliance. For example, Adhimoolam et al. (2019) highlighted the benefits of using culturally aligned educational frameworks in India, where participants showed improved knowledge after similar interventions [14].

This study also benefits from several strengths. First, it was community-driven, engaging actual users within the diaspora community and delivering education in a familiar language and culturally appropriate format. Second, the digital e-flyer format ensured accessibility, particularly important for populations with varied digital literacy levels. Lastly, the structured questionnaire enabled clear measurement of knowledge shifts, providing reliable outcome data. However, there are limitations to consider. The study lacked a control group, limiting the ability to infer causality with certainty. The follow-up period was short, preventing assessment of long-term knowledge retention or behavior change. Additionally, the reliance on self-reported data introduces the possibility of response bias, wherein participants might overstate their knowledge post-intervention.

Despite these constraints, the practical implications of the findings are promising. The low-cost, easily distributable nature of e-flyers makes them an ideal tool for scaling public health campaigns in both diaspora and home country contexts. Integration into community health centers, places of worship, and social organizations can foster a broader culture of safe medicine disposal. Similar strategies have been suggested in Saudi Arabia and India, where government-supported take-back programs and educational initiatives are still nascent [15]. Future research should explore longitudinal designs to track whether increased knowledge translates into actual behavior change, such as participation in drug take-back programs. Additionally, collaborations with pharmacies or local councils could facilitate integration of digital education with real-world disposal infrastructure. Investigating knowledge retention over several months and incorporating biometric or behavioral outcome measures (e.g., reduced household pharmaceutical waste) would strengthen the evidence base for such interventions.

4 Conclusion

The results of this study demonstrate that the DAGUSIBU e-flyer-based program was highly effective in enhancing participant knowledge across multiple facets of medicine safety and environmental health. These findings provide empirical support for expanding such digital educational tools within culturally relevant frameworks to address similar knowledge gaps in other communities.

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