ORIGINAL ARTICLE

Effectiveness of an intervention to increase the knowledge, attitude, and practice regarding the return and disposal of unused medications

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Abstract

This study aimed to evaluate the effectiveness of an educational intervention (Safe D.U.M.P) to improve the knowledge, attitude, and practice regarding the return and disposal of unused medications. Community-dwelling adults in Malaysia who could understand English were recruited from two healthcare events. Participants were asked to fill out the validated Return and Disposal of Unused Medications (ReDiUM) questionnaire (pre-intervention), view six educational intervention posters on how to dispose of unused medications (Safe D.U.M.P), then answer the ReDiUM questionnaire immediately after viewing the posters (post-intervention). A total of 390 out of 456 participants participated (response rate=85.5%). Most were female (71%) with a median age of 42 years. The overall knowledge of participants significantly increased from 60% to 80% ($p<0.001$). However, no improvement was seen regarding their overall attitude and practice. This outcome was as expected as it may be more difficult to improve attitude and practice (when compared to knowledge) with a single educational session.

Introduction

In 2010, the Pharmaceutical Services Division, Ministry of Health (MOH) Malaysia implemented the "Return Your Medicines Program."[1] This program aimed to encourage patients to return their unused or excess medications for safe disposal by the MOH. In 2016, a conservative estimate of medications returned to three MOH hospitals in Malaysia (based on their value) were US$6,670, US$12,854, and US$45,570, respectively.[2] These figures represent an underestimation of medication wastage, considering that a total of 144 hospitals and special medical institutions as well as 2881 health clinics are under the administration of MOH Malaysia.[3]

In 2017, approximately US$12.67 million was allocated for medications in a 1,643-bed, tertiary public teaching hospital serving a population of over 1.5 million.[4] An internal audit conducted from May 2016 to January 2017 found that US$36,216 worth of unused medications were returned to this hospital's outpatient pharmacy.[5] Common factors that led to excessive medications included a change or discontinuation of treatment regimen, non-compliance, adverse effects, or oversupply of medications.[2] Unused medications represent a significant waste of healthcare resources and economic wastage, and improper disposal of unused medications has adverse consequences for the environment and public health.[6]

Ideally, unused medications should be returned to authorized collectors for proper disposal to reduce releasing unwanted active pharmaceutical ingredients into the environment. One study reported that more than 50% of Malaysian patients disposed of unused medications by throwing them away with normal garbage or by burning them.[7] Another study found that 93% of university students in Malaysia were not aware of the "Return Your Medicines Program" and had flushed unused medications down the toilet or sink.[8] Disposal of unused medications as household garbage (which ends up in a landfill) or flushing them down the toilet or sink (where they end up in the sewerage system) may contaminate soil or surface water.[9] Management of active pharmaceutical ingredients in the environment is both challenging and potentially costly.[10]

To date, no study has investigated the knowledge, attitude, and practice (KAP) of community-dwelling adults in Malaysia regarding the return and disposal of unused medications. Hence, we decided to develop an educational intervention (Safe D.U.M.P) to assess the KAP of community-dwelling adults to determine if this educational program would increase their KAP regarding medication

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disposal. The aim of this study was to evaluate the effectiveness of this educational intervention (Safe D.U.M.P) to improve the KAP of community-dwelling adults toward the return and disposal of unused medications.

Methods

Recruitment was done during two events (at the World Pharmacist Day in September 2017 and Patient Safety Week in December 2017), considering that the safe D.U.M.P program consisted of 6 posters that could only be displayed using a poster board, usually only available at events. The aim of our study was to assess the KAP of community-dwelling adults. Hence, any adult ≥18 years of age who could speak English was recruited. It was not necessary to recruit only adults who had chronic illness, as any adult could have had an acute or chronic illness and could have unused medications at home. Individuals exhibiting intellectual disability, defined as a disability characterized by significant limitations in both intellectual functioning (reasoning, learning, problem-solving) and adaptive behavior and covering a range of everyday social and practical skills, were also excluded. We did not use any tool to assess intellectual disability. We excluded these participants by not approaching them.

A search of the published literature found that no study had previously assessed the effectiveness of an intervention to improve knowledge regarding the disposal of unused medications. Hence, for the purpose of calculating the sample size for this study, we hypothesized that knowledge levels would improve by 10% from pre- to post-intervention. Accordingly, the sample size required for this study with a confidence level of 95% and 80% power was 349 participants.[11]

The educational intervention (Safe D.U.M.P) provided

As no instrument had been developed previously for this purpose, an educational intervention program (called Safe D.U.M.P) was newly created by the research team (consisting of one physician, four pharmacists, and one pharmacologist) to assess the KAP of community-dwelling adults regarding discarding unused medications. Our research team developed six A1 size graphic posters, each with a key question, focus points, and a take-home message, based on a literature review (**Table 1**).

Table 1: The Safe D.U.M.P. posters

No.	Key questions	Focus points	Take-home message
1	Are you experiencing unwanted effects from your medications?	If so, seek medical attention as soon as possible and return the unused medications to a pharmacy.	Don't store medications "just in case."
2	What is the impact of unused medications?	Unused medications may cause: a) health hazard for people or animals, b) waste of public resources, and c) risk of global warming and contaminated water.	Return unused medications before they cause harm or become a waste of resources!
3	Why is safe disposal of unused medications important?	Water treatment does not remove medication residue in sewage; discarded medications may end up in landfills and appear in surface water.	Do not pour it down the drain, toss it in the toilet, or throw it in the garbage!
4	How to reduce unused medications?	Unused medications are a waste of resources and a risk to the environment.	Don't keep medications "just in case"; collect or buy medications only when you need them.
5	How to avoid medication wastage?	Store medications according to instructions; check your medications monthly for the amount and expiration date.	Return unused medications to a pharmacy as soon as you can.
6	How do you dispose of medications safely?	For tablets/capsules, syrups/mixtures, creams/ointments, injections, dry powder inhalers, and eye/nose drops, return to a pharmacy, and they will send your unused medications for incineration.	Pressurized medications such as metered dose inhalers cannot be incinerated; these medications can be thrown as normal waste in the garbage.

Instruments used

Baseline demographic questionnaire

A baseline demographic questionnaire was used to record the demographic characteristics of participants.

The Return and Disposal of Unused Medications (ReDiUM) questionnaire

The validated Return and Disposal of Unused Medications (ReDiUM) questionnaire consisted of 30 items with three domains: KAP.[12] The knowledge domain consisted of 10 items, with each item having "true," "false," and "do not know" options. One point was given for correct answers, while zero points were given for incorrect or "don't know" answers. Scores were then converted to percentages. The attitude and practice domains each had 10 items, each having a 5-point Likert-scale response, where 1 represented "strongly disagree" and 5 represented "strongly agree." Only item 14 was reverse-scored, as this item was worded in a negative manner. Participants took 10-15 minutes to answer the questionnaire.

Procedure

Convenience sampling was used to recruit participants. The purpose of the study was explained to potential participants using a participant information sheet. For those who agreed to participate, written informed consent was obtained. Participants were first asked to fill out the baseline demographic questionnaire and the ReDiUM questionnaire (i.e., "pre-intervention"). Participants were then asked to read the six educational Safe D.U.M.P posters (i.e., the intervention) and then complete the ReDiUM questionnaire again (i.e., "post-intervention"). Participants had to answer all the questions in the ReDiUM. All questionnaires were checked by a researcher at the point of submission. If any missing items were found, the researcher asked the participant to complete the missing items. Coding by number was used to ensure matching of the same participant's pre- and post-intervention forms while maintaining his/her anonymity. Ethics approval was obtained prior to the study from the University of Malaya Medical Ethics Committee (approval no. 20161028-4450).

Data analysis

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 22. As normality could not be assumed, continuous data were presented as median and inter-quartile range, while categorical data were presented as number and frequency.

Results

A total of 390 out of 456 participants agreed to participate (response rate=85.5%). Most of the participants were female (71%), with a median age of 42 years (Appendix 1).

All items in the knowledge domain were significantly different pre- and post-intervention. The overall knowledge of participants significantly increased from 60% (pre-intervention) to 80% (post-intervention, $p<0.001$) [**Table 2**]. Prior to the intervention, the participants already scored well: More than 75% knew the correct answers for items 1 (the harmful effects of improper drug disposal on the environment), 7 (unsafe to discard needles in the garbage), and 8 (acceptable to return unused medicines to a local pharmacy or healthcare facility for disposal). Nonetheless, despite the high level of baseline knowledge, the percentage of correct answers increased significantly for these three items following the intervention. Pre-intervention knowledge was poor in items 2, 6, and 9, with less than 50% correct answers, and moderate in items 3, 4, 5, and 10, with a correct score in 50%-75% of the answers. All items with a low and moderate level of pre-intervention knowledge improved significantly after the intervention.

Table 2: Knowledge of participants pre- and post-intervention

Item no.	Item	Pre-intervention	Post-intervention	Chi-square or z-value	p-value
		No. of participants who answered the item correctly (n=390) n (%)	No. of participants who answered the item correctly (n=390) n (%)		
1	Improper drug disposal has harmful effects on the environment and ecosystem.	344 (88.2)	370 (94.9)	16.1	<0.001*
2	Wastewater treatment removes most of the medicines from the environment and ecosystem.	112 (28.7)	236 (60.5)	30.8	<0.001*
3	It is acceptable to dispose of solid medicines (such as tablets, capsules, and patches) in the garbage.	267 (68.5)	343 (87.9)	7.5	0.006*
4	It is acceptable to dispose of liquid medicines by throwing them down the sink.	250 (64.1)	359 (92.1)	2.3	<0.001*
5	It is acceptable to dispose of medicines by flushing them down the toilet.	256 (65.6)	364 (93.3)	9.1	0.003*
6	Incineration is the environmentally sound way of disposing of unwanted medicines.	139 (35.6)	183 (46.9)	21.3	<0.001*
7	It is acceptable to dispose of needles and syringes in the garbage.	304 (77.9)	339 (86.9)	15.2	<0.001*
8	It is acceptable to return or dispose of unused medicines to a local pharmacy or healthcare facility.	327 (83.8)	358 (91.8)	8.5	0.003*
9	It is acceptable to dispose of pressurized metered-dose inhalers (like a Ventolin inhaler) in the garbage.	74 (19.0)	185 (47.4)	7.9	0.005*
10	It is acceptable to dispose of creams and ointments in the garbage.	215 (55.1)	313 (80.3)	5.8	0.016*
	Total knowledge score: median (IQR)	60.0 (40.0-70.0)	80.0 (70.0-90.0)	-13.3	<0.001*

Chi-square test was used for all categorical variables, Wilcoxon Signed-Rank test was used for all continuous variables; *statistically significant at p<0.05

The overall attitude of participants did not change significantly from pre- to post-intervention (**Table 3**). However, a significant change occurred from pre- to post-intervention for items 11 ("It is my responsibility to protect the environment even if others are unconcerned or irresponsible"), 15 ("Media reports and campaigns can influence my willingness to return unused medicines"), 19 ("If I have paid for my prescribed medicines, I expect a refund when I return my unused medicines"), and 20 ("If I have excess medicines, I will share my medicines with others").

Similarly, the participants' overall practice did not change significantly from pre- to post-intervention (**Table 3**). However, a significant change occurred from pre- to post-intervention for items 22 ("I dispose of my medicines when the medicines have expired"), 27 ("I have unused medicines because I do not feel better after I take them"), and 30 ("I keep medicines that I no longer require just in case I will need them in the future").

Table 2: Attitude and practice of participants regarding the return and disposal of unused medications pre- and post-intervention

Domain	Item	Pre-intervention		Post-intervention		Wilcoxon Signed- Rank test
		Mean±SD	Median (IQR)	Mean±SD	Median (IQR)	p-value
Attitude	11. It is my responsibility to protect the environment even if others are unconcerned or irresponsible.	4.3±0.8	4.0 (4.0-5.0)	4.4±0.9	5.0 (4.0-5.0)	0.023*
	12. It is my responsibility to ensure the safety of other living species on earth.	4.4±0.8	5.0 (4.0-5.0)	4.4±0.9	5.0 (4.0-5.0)	0.110
	13. It is my responsibility to protect my household members from unintended harmful exposure to unused medicines.	4.4±0.8	5.0 (4.0-5.0)	4.5±0.8	5.0 (4.0-5.0)	0.443
	14. If medicines are free or heavily subsidized by the government, I will not collect all the prescribed medicines even if I have sufficient amounts of the medicines at home.#	3.7±1.2	2.0 (1.0-3.0)	3.8±1.2	2.0 (1.0-3.0)	0.192
	15. Media reports and campaigns can influence my willingness to return unused medicines.	4.0±1.0	4.0 (4.0-5.0)	4.1±1.0	4.0 (4.0-5.0)	0.009*
	16. I believe discarding unused medicines that are still in good condition is a waste of resources.	3.8±1.2	4.0 (3.0-5.0)	3.8±1.2	4.0 (3.0-5.0)	0.995
	17. I am willing to donate my unused medicines before expiry to reduce wastage.	3.9±1.1	4.0 (4.0-5.0)	3.8±1.2	4.0 (4.0-5.0)	0.196
	18. If there is a monetary incentive for me to return unused medicines, I am more likely to do so.	3.6±1.2	4.0 (3.0-4.0)	3.5±1.2	4.0 (3.0-4.0)	0.190
	19. If I have paid for my prescribed medicines, I expect a refund when I return my unused medicines.	3.2±1.1	3.0 (2.0-4.0)	3.2±1.2	3.0 (2.0-4.0)	0.005*
	20. If I have excess medicines. I will share my medicines with others.	2.8±1.3	3.0 (2.0-4.0)	2.6±1.3	2.0 (1.8-4.0)	0.006*
	Total score (%)	76.1±10.9	76 (72.0-84.0)	75.8±11.9	76 (72.0-82.0)	0.764

Domain	Item	Pre-intervention		Post-intervention		Wilcoxon Signed- Rank test
		Mean±SD	Median (IQR)	Mean±SD	Median (IQR)	p-value
Practice	21. I have unused medicines because I stop taking the medicines when I feel better.	3.3±1.2	4.0 (2.0-4.0)	3.2±1.3	4.0 (2.0-4.0)	0.061
	22. I dispose my medicines when the medicines have expired.	3.7±1.2	4.0 (3.0-4.0)	3.5±1.3	4.0 (2.0-4.0)	0.001*
	23. I have unused medicines because I experience unwanted side effects.	3.2±1.1	3.0 (2.0-4.0)	3.3±1.2	4.0 (2.0-4.0)	0.141
	24. I dispose my medicines when I experience unwanted side effects.	3.0±1.2	3.0 (2.0-4.0)	3.0±1.2	3.0 (2.0-4.0)	0.840
	25. I have unused medicines because my doctor has changed my treatment.	3.3±1.1	4.0 (2.0-4.0)	3.3±1.1	4.0 (2.0-4.0)	0.899

	26. I dispose my medicines when they smell bad, taste bad or look bad.	3.5±1.3	4.0 (2.0-4.0)	3.4±1.3	4.0 (2.0-4.0)	0.473
	27. I have unused medicines because I do not feel better after I take them.	3.1±1.2	3.0 (2.0-4.0)	3.2±1.2	4.0 (2.0-4.0)	0.024*
	28. I dispose my medicines when I have not stored them correctly and my medicines turned bad.	3.5±1.2	4.0 (3.0-4.0)	3.4±1.2	4.0 (2.0-4.0)	0.175
	29. I have unused medicines because I have not taken the medicines as instructed/ prescribed.	2.9±1.2	3.0 (2.0-4.0)	2.9±1.2	3.0 (2.0-4.0)	0.813
	30. I keep medicines that I no longer require just in case I need them in the future.	3.2±1.2	4.0 (2.0-4.0)	2.8±1.3	2.0 (2.0-4.0)	<0.001*
	Total score (%)	65.4±14.8	68.0 (58.0-76.0)	64.2±17.7	68.0 (52.0-76.0)	0.183

* significantly significant at $p<0.05$; #This item was reversed scored as it was worded in a negative manner.

Discussion

Our study found that the knowledge of community-dwelling Malaysians improved immediately after a poster-based education session. However, no improvement was seen regarding their attitude and practice.

In this study, the participants' overall knowledge regarding the safe disposal of unused medications increased by 20% (from 60% to 80%) after the Safe D.U.M.P. educational intervention. This outcome was not unexpected since the posters contained information that specifically addressed issues relating to the wastage of unused medications, along with the harm on the environment or public health caused by the inappropriate disposal of these unused medications. We were, however, unable to compare our findings with prior studies as no studies had previously assessed the effectiveness of an educational intervention on this topic. Although knowledge increased significantly in all items, post-intervention knowledge was still poor for item 6 ("Incineration is the environmentally sound way of disposing of unwanted medicines") and 9 ("It is acceptable to dispose of pressurized metered-dose inhalers (like Ventolin inhaler) in the garbage"), with fewer than 50% of the participants providing the correct answer. This result may be due to the deeply ingrained knowledge that burning (i.e., incineration), in general, causes the release of toxic gases into the environment. However, burning in an incinerator is carried out under highly controlled conditions and at an extremely high temperature of >1100°C, which can destroy pathogens and toxins, rendering the medicinal waste nontoxic to the environment.[13] Therefore, in the case of medication disposal, incineration is the more environmentally sound method compared to disposal in the garbage or sewage system, which in turn contaminates surface water, possibly poisoning aquatic or land animals and entering the food chain.[9,14,15] Furthermore, pharmaceuticals that enter the environment through inappropriate disposal methods can also contribute to antibiotic resistance[14,16] and affect the human endocrine system.[17] However, for medicinal items such as pressurized metered-dose inhalers, incineration may potentially cause an explosion due to the presence of chlorofluorocarbons, which can also release toxic gases into the environment. Hence, throwing a pressurized inhaler into the garbage is the better option as opposed to incineration.[18] Future educational sessions should apply more emphasis on improving knowledge in these two items.

Knowledge is known to have an impact on attitude formation. One study found that both benefit and risk knowledge either directly contributes to attitude formation or indirectly affects attitudes through the mediating roles of benefit and risk perceptions.[19] Therefore, it is not surprising that certain attitude items (items 11, 15, and 20) showed a significant (albeit small) change. An individual who is more aware of the hazard unused medications can pose on the environment and on his/her own health has a greater likelihood of feeling more responsible toward his own actions (item 11), more willing to return unused medicines (item 15), and less likely to want to share his excess medicines with others (item 20).

Similarly, we expected to see some change in practice resulting from increased knowledge of the adverse impact of inappropriate disposal of unused medications on the environment, human health, and healthcare resources.[20] Our study found that post-intervention, the participants agreed that they were less likely to dispose of their medicines that have expired (item 22) or to keep medicines they no longer required in case they might need them in the future (item 30). This change in practice can be

important, as it could potentially reduce the risk of accidental poisoning of vulnerable persons, including children, older persons, or the cognitively/visually impaired person. However, as the post-intervention questionnaire was administered immediately after the viewing of Safe D.U.M.P. posters, the participants' responses on the practice domain could only be interpreted as "perceived future practice" in light of their newfound knowledge.

Even though a few of the attitude and practice items showed favorable changes, the participants' overall attitude and practice did not change significantly immediately after the Safe D.U.M.P educational session. This outcome is likely because it is more difficult to improve attitude and practice (when compared to knowledge) with a single educational session. Our findings were consistent with a previous study that reported that mailed educational leaflets failed to increase the practice of returning unused medications to health authorities for safe disposal.[21] However, when a face-to-face interview and educational material were included and physical assistance was provided to collect unused medications, the researchers reported a high yield of households returning unused medications.[21] Notwithstanding the improved outcome, such a labor-intensive intervention may not be sustainable in the long run. Another study found that patient counseling was associated with an increase in the proportion of patients returning unused medications to a pharmacy or healthcare provider.22 All these studies highlight the need for continuous education, repeated counseling, and practical incentives to effect a change in the attitude and practice of the public.

The strengths of this study included the use of a validated questionnaire to assess the KAP and the inclusion of a sufficiently large sample size. However, the weakness of our study was that participants were assessed immediately after their educational intervention. We are aware that the second questionnaire, administered immediately post-intervention, was not able to assess practice but instead may have only assessed perceived future practice. The ReDiUM should ideally be administered two weeks later to determine whether any sustained change in knowledge, attitude, and practice has occurred. Therefore, we were unable to assess the long-term benefits of the Safe D.U.M.P. We also acknowledge that although a statistically significant difference in several items was evident in the attitude and practice section, it is uncertain whether this outcome translates to a meaningful difference overall in the participants' attitude and practice.

Conclusion

The Safe D.U.M.P. educational intervention regarding the safe disposal of unused medications significantly increased participants' overall knowledge level. However, no improvement was seen regarding their overall attitude and practice. Further studies can be conducted to develop an intervention with the aim of effecting a sustained change in the KAP of patients in a clinical setting, pre- and post-intervention. The study findings may help policymakers design appropriate interventions or educational sessions to raise public awareness regarding the safe disposal of unused medications. Facilities and logistics would also have to be in place for a sustained return of unused medications for safe disposal.

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Conflicts of interest

None

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How does this paper make a difference to general practice?

- Ideally, unused medications should be returned to authorized collectors for proper disposal to reduce releasing unwanted active pharmaceutical ingredients into the environment.
- However, most community-dwelling adults dispose of unused medications by throwing them away with normal garbage or by burning them.
- Safe D.U.M.P (which consists of six educational posters) improved the knowledge, attitude, and practice of community-dwelling adults toward the return and disposal of unused medications.
- General practitioners and other healthcare professionals can use Safe D.U.M.P. to educate patients on the proper return and disposal of medications.

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