

Disposal practices for unused medications in New Zealand community pharmacies

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ABSTRACT

INTRODUCTION: One of the recommended methods for households to dispose of unused medications in many countries is to return them to community pharmacies. However, such a practice will only reduce the environmental levels of pharmaceuticals if the medications are also disposed of and destroyed properly by the pharmacies.

AIM: This study reports the results of a questionnaire sent to New Zealand community pharmacists regarding disposal practices for unused or expired medications in their workplaces.

METHODS: A pre-tested, self-administered questionnaire was sent to 500 randomly selected community pharmacies from all areas of New Zealand. The participants were asked how they disposed of a variety of medications. In addition, participants were also asked about whether they knew how unused medications were destroyed if their pharmacy used a third-party contractor or distributor to dispose of them.

RESULTS: Of the 265 respondents, 80.4% and 61.1% respectively reported that solid and semi-solid medications were removed by contractors. However liquid and Class B controlled drugs were predominantly disposed of down the pharmacy sink. Over 60% of the participating pharmacists indicated that they believed the contractors incinerated the collected pharmaceutical waste, and over 90% of the participating pharmacists indicated their wish for a state-run disposal and destruction system.

DISCUSSION: Liquid medications and Class B controlled drugs, which were commonly reported to be disposed of down the sewerage system, may increase the potential for environmental pollution by pharmaceuticals in New Zealand. There is a need for increased environmental awareness amongst community pharmacists in New Zealand.

KEYWORDS: Medication disposal; pharmaceutical waste; environment; excess medication; community pharmacist

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Introduction

Pharmaceuticals have been widely detected in the environment and in some cases can lead to detrimental effects on wildlife.^{1,2} For example, the commonly-used non-steroidal anti-inflammatory drug (NSAID) diclofenac has been shown to induce renal failure in vultures following the ingestion of carrion from cattle treated with the drug.³ Estrogenic compounds used in combined oral contraceptives such as 17- α -ethinylestradiol feminise fish even in low concentrations, leading to reproductive failures.⁴ Traces of pharmaceutical residues have consistently been detected

in effluents from sewerage facilities,⁵⁻⁸ surface water⁹⁻¹² and drinking water.^{13,14} Despite the growing use of pharmaceuticals in modern health care, some countries do not have official state guidelines for the disposal of unwanted and unused medications.^{15,16} In New Zealand, there is no official guideline for the disposal of unused and unwanted medications; however, one of the recommended methods to dispose of unwanted pharmaceuticals in many countries, including New Zealand, is to return them to pharmacies.^{17,18}

This practice of returning unused medications to pharmacies reduces the likelihood of patients

J PRIM HEALTH CARE
2011;3(3):197-203.

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disposing of them at home via the sewerage system or rubbish bin. However, the exposure of the natural environment to pharmaceutical residues will only be reduced if the medications collected in pharmacies are also disposed of and destroyed in an appropriate manner. Currently, little data exists on how unused medications are disposed of after they have been returned to pharmacies. Some countries, such as Sweden, send unused waste medications returned to pharmacies to high-temperature incineration which effectively destroys the active ingredients.¹⁹ This disposal and destruction system is state-run in conjunction with the nationwide pharmaceutical wholesaler and overseen by the Swedish Pharmaceutical Society. Not all US pharmacies accept returned medications,²⁰ particularly controlled drugs.²¹ A survey of 100 community and hospital pharmacies in the US has shown that 68% of them disposed of unused medications into the rubbish or the sewerage system, but only 3% had specific policies to return such medication to the manufacturers.²² Many US pharmacists are unaware of the proper way to dispose of waste medication in pharmacies, and indeed they advised patients to undertake their own disposal in a manner that was, unintentionally, environmentally unsafe.²³ Similar attitudes and practices in pharmacies are common worldwide and increase the likelihood of pharmaceuticals entering the environment in addition to that arising from direct household disposal.²⁴

Previous studies have shown that the most commonly returned medications are frequently used in chronic conditions, e.g. levodopa, therefore non-compliance to the prescribed therapy may contribute to such unused medications.²⁵ Unused medications may also arise from changes to the prescribed treatment during the supply duration.²⁶ Such practices ultimately lead to the expiry of the medications and, eventually, these are either stored or disposed of directly by the household into the sewerage system or rubbish, or they are returned and accumulated in community pharmacies.²⁷

There is currently a lack of literature that describes the methods and protocols used by pharmacies to dispose of unused medications. The aim of this study is to report the results of a questionnaire sent to a random selection of New

Zealand community pharmacists to assess their disposal practices for unused pharmaceuticals. In particular, the major routes of disposal for the various formulations supplied by the typical New Zealand community pharmacy were identified, and whether such disposal methods may potentially be detrimental to the environment were determined. In addition, pharmacists were asked whether they knew how unused medications were disposed of and destroyed, and if they used a third party contractor (external disposal services funded by the respective DHB or individual pharmacies depending on DHB agreements to collect unwanted medications from pharmacies) or distributor (a return to the original wholesalers) for this purpose. The pharmacists were also asked for their opinion on whether New Zealand needs a formalised state-run disposal and destruction system for unused medications returned to their practices.

Methods

A four-page self-administered questionnaire (available as supplementary information online) was drafted and used as the instrument to gather information on disposal practices for unused and unwanted medications. Before sending out the questionnaire, a pilot of the questionnaire was trialled on three practising New Zealand-registered pharmacists and was pre-tested for reliability, readability, logic and errors. A revised questionnaire was devised after this pre-testing procedure and sent on 3 May 2010 to 500 community pharmacies randomly selected from all areas of New Zealand. The questionnaire was accompanied by a letter from the researchers addressing the nature of the study and a University of Otago 'Information for Participants' leaflet, which is a common practice for research involving human participants carried out at the university. Prepaid self-addressed envelopes were provided with the questionnaires for ease of reply. All participants who completed the survey were entered into a draw to win one of five NZ\$50 grocery vouchers as appreciation for their time spent in completing the survey. No reminders for completing the questionnaires were given. Completion of the survey was understood to be consent to partake in the study. The study was approved by the University of Otago Ethics Committee.

Results

A total of 265 surveys were completed and returned giving a response rate of 53%. Table 1 shows the demographics of the pharmacists who completed the survey.

District Health Boards (DHBs) are statutory organisations responsible for maintaining health care and allocating resources at the local community level in New Zealand, and each pharmacy in New Zealand is contracted to one of these DHBs. The percentage of questionnaires sent to and returned from each of these DHBs in New Zealand is listed in Table 2.

The percentage of surveys returned from each DHB was representative of the percentage of surveys initially sent to each DHB area and was fairly proportional to the population of each DHB area.

The most common route of disposal for unused solid formulations (Table 3), such as tablets and capsules, and semi-solid preparations, such as ointments and creams, (80.4%, n=229 and 61.1%, n=174 of responses respectively) was through third-party contractors.

Liquids, however, were predominantly reported to be poured down the sink (44.7%, n=151) while some pharmacists reported they flushed liquid medications down the toilet (7.4%, n=25). As with liquid medications, similar results were obtained for the disposal of Class B controlled drugs. Over 58% (n=167) of pharmacists reported the disposal of Class B drugs down the sink, with 15.3% (n=44) of pharmacists flushing the medications down the toilet and the remaining 26.5% (n=76) of pharmacists disposed of their Class B drugs via other methods. Only 23.3% (n=67) of pharmacists used third-party contractors to dispose of Class B controlled drugs. The most common dosage forms to be disposed of in the rubbish were semi-solid preparations (24.6%, n=70) with the remaining 75.4% (n=215) of pharmacists disposing of semi-solid preparations by other means. The predominant disposal route for Class C controlled drugs was via contractors (65.3%, n=175), although a significant proportion of the pharmacists poured Class C controlled drugs down the sink (20.9%, n=56).

WHAT GAP THIS FILLS

What we already know: Large quantities of unused and expired pharmaceuticals are returned to community pharmacies in New Zealand. Many of these unused pharmaceuticals result from excess quantities prescribed and patient non-adherence to therapies.

What this study adds: This study investigates whether returned unused and expired pharmaceuticals are disposed of or destroyed in an environmentally friendly manner by community pharmacists.

Table 1. Demographics of participating pharmacists in the survey (n=265)

Variable and categories	Number of responses (%)
Age (years)	
0–24	13 (4.9)
25–34	53 (20.0)
35–44	49 (18.5)
45–54	74 (27.9)
55–64	52 (19.6)
65 and over	24 (9.1)
Gender	
Male	152 (57.3)
Female	113 (42.6)
Years of practice as a pharmacist	
<10	67 (25.3)
11–20	39 (14.7)
21–30	77 (29.0)
31–40	52 (19.6)
Over 40	30 (11.3)

For the questions regarding pharmacists' knowledge of the methods used by contractors and distributors to destroy medications, 62.2% (n=145) of the participants suggested their contractors incinerated the collected pharmaceutical waste, whilst 34.8% (n=81) of the participants reported no knowledge of how their contractors dealt with this waste material. The responses from those pharmacies which used distributors to collect pharmaceutical waste suggested that the majority (53.7%, n=7) of those pharmacists did not know how the pharmaceutical waste was destroyed.

The response to the question "Do you think New Zealand needs a state-run medicines disposal

Table 2. Percentage of surveys sent and received from community pharmacies per District Health Board

District Health Board	% New Zealand population*	Surveys sent (%) (n=500)	Surveys received (%) (n=265)	DHB contractor funding?†
Auckland	10.0	78 (15.6)	37 (14.0)	Yes‡
Bay of Plenty	4.8	26 (5.2)	12 (4.5)	Yes
Canterbury	11.6	56 (11.2)	32 (12.1)	No
Capital and Coast	6.6	28 (5.6)	15 (5.7)	Yes
Counties Manukau	10.8	53 (10.6)	20 (7.5)	Yes‡
Hawke's Bay	3.7	20 (4.0)	14 (5.3)	No
Hutt	3.4	14 (2.8)	13 (4.9)	Not known
Lakes	2.4	14 (2.8)	7 (2.6)	Yes
Mid Central	3.9	21 (4.2)	10 (3.8)	Yes
Nelson Marlborough	3.2	16 (3.2)	10 (3.8)	Yes
Northland	3.7	15 (3.0)	8 (3.0)	Yes
South Canterbury	1.3	6 (1.2)	4 (1.5)	Yes
Otago–Southland	7.1	39 (7.8)	23 (8.7)	Yes
Tairāwhiti	1.1	4 (0.8)	1 (0.4)	Yes
Taranaki	2.6	12 (2.4)	6 (2.3)	Yes
Waikato	8.4	34 (6.8)	14 (5.3)	Yes
Wairarapa	1.0	5 (1.0)	4 (1.5)	Not known
Waitemata	12.0	49 (9.8)	27 (10.2)	Yes‡
Whanganui	1.5	9 (1.8)	6 (2.3)	Yes
West Coast	0.8	1 (0.2)	1 (0.4)	Yes
Unknown	–	–	1 (0.4)	N/A

* Source: Statistics New Zealand.

† Personal communication from several practising community pharmacists in their respective DHBs.

‡ These DHBs fund contractor disposal services by a Metro Variation scheme. DHB disposal funding for particular pharmacy proportional to volume of medications dispensed.

Table 3. Routes of unused medication disposal in New Zealand community pharmacies for dosage forms specified

	Disposal route (%)							
	Contractor	Toilet	Sink	Rubbish	Hospital incineration	Backyard burning	Return to distributor	Other: includes charity
Solids (n=285)*	229 (80.4)	3 (1.1)	6 (2.1)	11 (3.9)	9 (3.2)	2 (0.7)	14 (4.9)	11 (3.9)
Liquids (n=338)*	129 (38.2)	25 (7.4)	151 (44.7)	11 (3.3)	–	1 (0.3)	9 (2.7)	12 (3.6)
Semi-Solids (n=285)*	174 (61.1)	1 (0.4)	13 (4.6)	70 (24.6)	1 (0.4)	1 (0.4)	10 (3.5)	15 (5.3)
Class B controlled drugs (n=287)*	67 (23.3)	44 (15.3)	167 (58.2)	4 (1.4)	–	1 (0.3)	–	4 (1.4)
Class C controlled drugs (n=268)*	175 (65.3)	17 (6.3)	56 (20.9)	2 (0.7)	4 (1.5)	2 (0.7)	4 (1.5)	8 (3.0)

* Multiple responses allowed.

scheme accessible to all pharmacies across the country?" was predominantly "yes" (92.1%, n=244) compared to "no" (5.7%, n=15). For the participants who answered "yes", a number suggested that the Government organisation PHARMAC should be responsible for funding a collection and destruction system for unused medication (63.3%, n=155). 'Stat' dispensing was the main reason specified by the participants why they considered PHARMAC should fund a medication collection and destruction system (61.4%, n=150). Some participants suggested local DHBs should be responsible (35.5%, n=87) and this was because many of these pharmacists thought DHBs had the resources and funds to run efficient systems tailored to the needs of the community (21.0%, n=18).

Discussion

The data in Table 3 clearly indicate that the dosage form influences the disposal route for medications returned to New Zealand community pharmacies. This is consistent with previous findings in New Zealand regarding household and community disposal of unused medications.²⁷ As third-party contractors are a major route of disposal for solid, semi-solid and Class C controlled medications, there must be some level of awareness amongst New Zealand community pharmacists of how to deal with unused pharmaceuticals, and many New Zealand pharmacies may indeed have standard operating procedures to dispose of unused medications appropriately. This finding is comparative to the previous results obtained in the US²³ where over 80% of pharmacists surveyed before the educational intervention stated they had been taught 'proper' disposal practices either by reading the pharmacy literature, continuing education courses or in undergraduate/postgraduate training. In addition, 47% of the participants considered inappropriate disposal of pharmaceuticals to be a major environmental problem even before participating in the educational intervention carried out in the study.

As third-party contractors seemed to be an important route for the disposal of unused medications in the community pharmacy, information on the level of financial support DHBs provide

in funding contractor disposal services for community pharmacies in their DHB were also obtained. Indeed, 17 DHBs partially or fully fund contractor services (Table 2). Such financial support may fuel the frequently reported use of contractor services as an appropriate and viable method for the disposal of unused medications, particularly solid dosage forms, although such an association is purely speculative at this stage. While incineration was stated by many participants as the destruction method for contractor-collected pharmaceuticals, it is unknown from the responses whether New Zealand contractors incinerate collected medications in an environmentally friendly manner. In Australia, the Return of Unused Medication service (RUM) runs a medication collection and destruction service through community pharmacies which utilises a high-temperature incineration method approved by the US Environmental Protection Agency (EPA). Such a practice of destroying unwanted medications will undoubtedly reduce environmental pollution by pharmaceuticals if employed by third-party contractors in New Zealand.

From the results of the present study, there is a potential risk for environmental pollution from medications available in liquid formulations. In one study carried out in the Taranaki DHB the most frequently encountered medication returned to community pharmacies was paracetamol, with ibuprofen within the top 20 returned medications.²⁸ Both of these medications are commonly available in liquid formulations, can be purchased over the counter, and are frequently taken or given on a 'prn' basis. Another potentially problematic medication is carbamazepine. This antiepileptic is not readily removed by conventional sewage treatment processes and it has been detected in wastewater and surface water around the world.²⁹ Carbamazepine is also available in a liquid formulation as a suspension in New Zealand and therefore the discharge of this antiepileptic into the environment is a possibility.

The disposal of Class B drugs usually follows a strict and legally binding protocol whereby the particular quantity to be discarded is marked off on a Controlled Drugs Register which is then countersigned by a pharmacist who renders the dosage forms unfit for human consumption and

disposes of the drugs on-site. Since few, if any, community pharmacies have their own high temperature incineration facilities, most of these drugs are crushed in hot water and flushed down the sink. However, one of the limitations of this present survey is the lack of quantitative data to answer how often Class B controlled drugs are disposed of. Indeed, some pharmacies reported that it was a rare occurrence to dispose of Class B controlled drugs; thus it is likely there is minimal risk to the environment from disposal of these controlled drugs, at least by these pharmacies. However, the return of Class B controlled drugs to community pharmacies is not unheard of. In 2007, a bag of medications worth NZ \$14,500 was returned to a Dunedin community pharmacy and the contents included oxycodone

improper disposal of pharmaceuticals. As with all survey questionnaires, participant recall bias of disposal practices may have occurred, particularly if unused medication disposal in the pharmacy was an occasional event. Also, a range of participants, with varying pharmacy practice experience undertook this study. No particular group or type of pharmacist (i.e. locum, owner, or manager) was targeted in this study. Therefore the professional experience and knowledge of the participating pharmacist of disposal practices and standard operating procedures within a pharmacy may have affected the responses. Finally, it was possible that most respondents were more interested in disposal practices for unused medications within the community pharmacy and had stronger opinions on the issue than non-responders, and

New Zealand Class B controlled drugs have been detected in sewage effluent and surface waters in other countries, and thus further research is needed to determine whether legally binding practices of destroying controlled drugs in community pharmacies are likely to lead to unacceptable levels of these drugs in the New Zealand environment.

and morphine.²⁶ Indeed, New Zealand Class B controlled drugs have been detected in sewage effluent and surface waters in other countries,³⁰ and thus further research is needed to determine whether legally binding practices of destroying controlled drugs in community pharmacies are likely to lead to unacceptable levels of these drugs in the New Zealand environment.

Limitations of this study

This study aimed at identifying the methods by which pharmacists dispose of unused and unwanted medication in New Zealand community pharmacies. However, the specific types of medication and formulations disposed of were not identified; nor were the volume of medications disposed of quantified. Further studies in these areas would be warranted to quantify the risk associated with

this may have also affected the outcome of the collected responses.

Conclusion

The findings of this survey questionnaire can be summarised as follows:

- Solid and semi-solid dosage forms returned to New Zealand community pharmacies are commonly reported to be collected and disposed of by contractors, as are Class C controlled medications.
- Liquid medications and Class B controlled drugs are the typical medications commonly reported to be directly discharged by the pharmacies into the sewerage system.
- Most of the contractors used by the pharmacies are believed to use incineration to

destroy the collected pharmaceutical waste; however, a significant proportion of survey participants did not know how their contractors destroyed collected medications.

- Most pharmacists want a disposal and destruction system that is operated and resourced by the state agency PHARMAC.

Ultimately the most important issue is the levels of these medications entering the New Zealand environment and these data are not presently available. Also, it is unknown how efficiently sewage treatment facilities in New Zealand remove trace levels of pharmaceuticals from sewage waste streams. To minimise the potential environmental risk arising from the discharge of unused medications into sewage by pharmacies, community pharmacies in New Zealand need to dispose of all medications responsibly. Community pharmacists should also have an increased awareness of the potentially detrimental effects on the environment arising from improperly disposed of medications.

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ACKNOWLEDGEMENTS

The authors would like to thank Dr Simon Horsburgh (Department of Preventive and Social Medicine, University of Otago) for discussion and review of this manuscript, Vicky McLeod (School of Pharmacy, University of Otago) for help with data collection and administration, and John Fraser, Anita Olivier and James Windle (School of Pharmacy, University of Otago) for trialling the questionnaires.

COMPETING INTERESTS

None declared.

APPENDIX A: Survey questions

SECTION 1: Demographic information of participant for statistical purposes. *Please provide ONE answer as appropriate to you in the following questions.*

Please note all information obtained in this section will be treated confidentially and any personal or business-related information, if appended, will be removed.

1. Which age group do you belong to?
 - 24 years or below
 - 25–34 years
 - 35–44 years
 - 45–54 years
 - 55–64 years
 - 65 years and over

2. Which gender group do you belong to?
 - Male
 - Female

3. How long have you been practising as a pharmacist? This excludes time which you may have been on leave from the profession.
 - Less than 10 years
 - 11–20 years
 - 21–30 years
 - 31–40 years
 - Over 40 years

4. Which District Health Board (DHB) is your pharmacy contracted to?
.....

SECTION 2: Prescription and over the counter (OTC) medicines (EXCLUDING controlled drugs).
Please tick ALL the boxes that apply in your pharmacy.

Note: Contractors = Disposal services employed by District Health Boards, whereas
Distributors = Wholesalers such as Propharma.

For expired or returned prescription and OTC medications in your pharmacy, excluding controlled
drugs: How would you dispose of...

- 5. SOLID dosage forms (e.g. tablets, capsules, suppositories, pessaries, transdermal patches)?
 - In the rubbish bin
 - In the sink
 - In the toilet
 - In a medicines' bin collected by contractors—See Section 4
 - Sent back to pharmaceutical distributor—See Section 4
 - Other (please specify)

- 6. LIQUID dosage forms (e.g. suspensions, elixirs, topical lotions, injections)?
 - In the rubbish bin
 - In the sink
 - In the toilet
 - In a medicines' bin collected by contractors—See Section 4
 - Sent back to pharmaceutical distributor—See Section 4
 - Other (please specify)

- 7. SEMI-SOLID preparations (e.g. creams, ointments)?
 - In the rubbish bin
 - In the sink
 - In the toilet
 - In a medicines' bin collected by contractors—See Section 4
 - Sent back to pharmaceutical distributor—See Section 4
 - Other (please specify)

SECTION 3: Controlled drugs disposal. *Please tick ALL the boxes that apply in your pharmacy.*

8. In your pharmacy, how are expired or returned Class B controlled drugs (i.e. morphine, methylphenidate) of any dosage form disposed of AFTER they have been entered out of the register for destruction?
- In the rubbish bin
 - In the sink
 - In the toilet
 - In a medicines' bin collected by contractors—See Section 4
 - Sent back to pharmaceutical distributor—See Section 4
 - Other (please specify).
9. How would you NORMALLY dispose of expired or returned Class C controlled drugs (i.e. codeine, diazepam) of any dosage form?
- In the rubbish bin
 - In the sink
 - In the toilet
 - In a medicines' bin collected by contractors—See Section 4
 - Sent back to pharmaceutical distributor—See Section 4
 - Other (please specify).

SECTION 4: Role of pharmaceutical distributor or contractor in medicines destruction. *If you dispose of any medicine through contractors or distributors, answer ONE or BOTH questions as appropriate. Otherwise go to Section 5.*

10. How do the contractor(s) you deal with destroy the collected wasted medicines?
- By placing medicines in garbage before disposal in landfill
 - By incineration (or other forms of heat destruction)
 - By flushing the medicines down the toilet
 - By flushing the medicines down the sink
 - Don't know, never been told how the medicines are destroyed
 - Other (please specify).
11. How do the pharmaceutical distributor(s) you deal with destroy the collected wasted medicines?
- By placing medicines in garbage before disposal in landfill
 - By incineration (or other forms of heat destruction)
 - By flushing the medicines down the toilet
 - By flushing the medicines down the sink
 - Don't know, never been told how the medicines are destroyed
 - Other (please specify).

SECTION 5: Funding for a state-run disposal and destruction system for wasted medicines. *Please tick ONE box from each question.*

12. Do you think New Zealand needs a national medicines disposal scheme accessible to all pharmacies across the country?

- Yes—Go to Question 13
- No—Go to Question 14
- Don't know or no comment

13. If YES, who should fund a state-run medicines disposal and destruction system and why?

- Patients
- PHARMAC
- District Health Boards
- Pharmaceutical companies
- Community pharmacies

Reason

14. If NO, why?

Reason

Please return this form in the self-addressed envelope supplied with the questionnaire. In appreciation for the time and effort spent in completing the survey, you will be entered in a draw for one of 5 x \$50 grocery vouchers. Thank you.