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'폐의약품 수거사업'을 통해 지역약국으로 회수된 처방전의약품의 성분 및 약가 분석

천부순#
인제대학교 약학대학
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Analysis of Active Pharmaceutical Ingredients and Drug Cost of Prescription Medications Returned to Community Pharmacies through 'Drug-Take Back' Program

Pusoon Chun#
College of Pharmacy, Inje University, Gimhae 621-749, Korea

Abstract — Unused medication disposal is a burden due to the cost of disposing as well as the cost of the drugs. Investigating medication returns is expected to suggest areas of intervention to reduce unused medications. **Purpose:** The aim of this study was to examine types, quantity, costs, active pharmaceutical ingredients, and therapeutic category of the medications returned to community pharmacies. **Method**: From January 15, 2014 to February 28, 2014, the medications returned to the 17 community pharmacies in Gimhae, Jinju, and Incheon, Korea were examined. The pharmacists and student volunteers worked cooperatively to identify the medications and analyze drug cost of prescription pill medications returned to the pharmacies. **Results**: A total of 2,720 pills of prescription medication were analyzed and 91 active pharmaceutical ingredients were identified. According to the Anatomical Therapeutic Chemical (ATC) classification, the most predominant group was A (alimentary tract and metabolism) with 33.3%, followed by N (nervous system) with 15.0%. With regard to the drug cost of groups, group A was the highest with 26.6%, followed by J01 (antibacterials for systemic use) with 20.2% and N (nervous system) with 18.3%. The total cost of the oral pill prescription medications was 468,477 won. **Conclusion**: The result from this study implies that unused drugs impose a significant cost to the health care system in Korea. In this study, medicines used to treat gastrointestinal conditions were returned most frequently with the highest drug cost. Further research in nationwide level is necessary to establish strategies to reduce the wastage of unused medicines.

Keywords □ Drug-Take Back, unused drugs, medication waste, active ingredient, drug cost

Unused medication is a burden to public health system due to the cost of the drugs as well as potential chemical stressors in the environment through improper disposal. Disposal of drugs to trash and sewage allows active pharmaceutical ingredients to enter the ambient environment and poses risk of exposures for wildlife or eventually for humans via drinking water supplies or food.[1-4] On the other hand, accumulation of unused drugs at home can further lead to unintentional pharmaceutical poisonings in humans, especially children and the elderly, and facilitate abusive use.[5-7]

For proper disposal of expired, unwanted, or unused medicines, many countries, including South Korea, U.S.A., Canada, Portugal, Sweden, France, Belgium, and Australia, have established medicine return systems.[8,9] In the case of South Korea, since 2008 people have been encouraged to return any unused drugs to their local pharmacy for appropriate disposal through "Drug-Take Back" program. The "Drug-Take Back" program was established to prevent drug misuse/abuse as well as improper disposal of medications. The organizations, including Korean Pharmaceutical Association, Korea Pharmaceutical Distribution Association, Ministry of Health & Welfare, National Health Insurance Service, and Ministry of Environment, par-

#**Corresponding Author**
Pusoon Chun
College of Pharmacy, Inje University, 197 Inje-ro, Gimhae, Gyeongnam 621-749, Korea
Tel.: 055-320-3886 Fax.: 055-320-3940
E-mail: pusoon@inje.ac.kr

ticipate in the program. Through the program, the drugs returned to a community pharmacy are collected in the disposal boxes which are posted in each pharmacy. Then the drugs are sent to public health centers and stored until they are finally sent to waste incinerating facility and destructed safely. Although design of environmentally prudent and safe disposal programs is being pursued, no type of disposal process is free of the potential to generate hazardous by-products or release pollutants and all have energy costs for transportation, storage, or destruction.[10)]

In fact, medication wastage has a huge impact over the world, especially in monetary terms. A number of previous studies have attempted to estimate the cost of waste medicines at a regional and a national level. Morgan estimated that the annual value of wasted medications only for adults older than 65 years in the U.S. would exceed $1 billion per year.[11)] In the UK, the unused prescription medicines impose an estimated 300 million on the National Health Service every year.[12)] In the case of Korea, data show an annual increase in the quantity of medications returned to a community pharmacy: in 2009, 43,510 kg; in 2010, 165,652 kg; in 2011, 287,395 kg; in 2012, 302,552 kg.[13)] Based on the data from Korean Environment & Resources Corporation, the cost of drug incineration is approximately 200,000~250,000 won/ton. Thus summing up the costs of the unused drugs with the costs for transportation, storage, and destruction, the economic value of unused medications should be no small waste of money in Korea, also.

Taking into consideration all the things written above, it is necessary to establish strategies to reduce the proportion of unused medications. The medications returned to community pharmacies represent financial loss, possible treatment failure and/or excessive purchases. In order to provide preliminary data for further research in a national level, this study analyzed the types, quantities, active ingredients, therapeutic category, and drug costs of the medications returned to the 17 community pharmacies.

Method

Data on medications

From January 15, 2014 to February 28, 2014, the medications returned to the 17 community pharmacies in Gimhae, Jinju, and Incheon, Korea were examined. The pharmacies where the average number of medication returns per week were one or over and the pharmacists who agreed to participate in this research were included: 8 pharmacies in Gimhae; 5 pharmacies in Jinju; 4 pharmacies in Incheon.

The whole medications returned by a single person were packaged with one plastic bag. With the help of the pharmacists, the pharmacy students classified the returned drugs as oral medications or external ones. The inhaler, nasal spray, and eye drops were included in external drugs and counted like ointment, cream, gel, and lotion. The oral medications were further divided into prescription and non-prescription drugs. The pharmacy students measured the amounts of the returned medications using balance that has an accuracy of 0.01 g and mess cylinder with increments of 1 m*l*, gram for pills, and milliliter for liquid medications, respectively, and the number of returned pill/ointment/cream/gel/lotion/inhaler/spray/eye drops. The total amounts of returned medications did not include the volume of powdered drugs and granules.

The pharmacists and pharmacy students collaborated to identify the oral pill prescription medications, including trade name, active pharmaceutical ingredients, strength, and insurance price. All oral pill prescription medications were identified using databases of BIT Druginfo[14)] and Korea Pharmaceutical Information Center[15)] and coded according to the Anatomical Therapeutic Chemical (ATC) classification system of the WHO.[16)] The cost of the returned oral prescription pill medications was calculated by multiplying the number of the medications collected by the drug cost per unit according to the insurance price of Korean Ministry of Health and Welfare.

The powdered drugs, granules, liquid drugs, inhaler, spray, ointment, cream, gel, lotion, eye drops, and non-prescription drugs were excluded from analysis of active ingredients, therapeutic category, and drug costs because there were difficulties in identifying, calculating the amount remaining, or determining accurate pricing information.

Statistical analysis

Data were recorded and managed using Microsoft Excel 2010, and later analyzed using SPSS version 21.0 (SPSS Inc., Chicago, IL). Frequency analysis was utilized to analyze the data on the active ingredients and its ATC classification of the oral pill prescription medications.

Table I – The number of cases and amounts of the medications returned to the community pharmacies

Collection site	No. of bags	Oral prescription drug		Oral non-prescription drug		External medications		
		Amounts		Amounts		Eye drops	Inhaler*	Ointment#
		Pills (g)	Liquid (m*l*)	Pills (g)	Liquid (m*l*)	Number	Number	Number
Gimhae	61	43.3	83	2.46	265	15	1	7
Incheon	65	21.99	769	6.45	20	0	1	2
Jinju	36	19.71	1307	2.57	407	4	0	0
Total	162	85.0	2159	11.48	692	19	2	9

"Pills" indicates tablets and capsules; Inhaler* indicates inhaler and nasal spray; Ointment# indicates ointment, cream, gel, and lotion.

Results

Medication quantification

From January 15, 2014 to February 28, 2014, a total of 162 bags returned to the 17 community pharmacies for disposal. In total, 96.48 g of oral pill medications were collected: 88.1% were prescription drugs and 11.9% were non-prescription drugs, respectively. On the other hand, a total of 2,851 m*l* of liquid medications were collected: 75.7% were prescription drugs and 24.3% were non-prescription drugs, respectively. A total of 30 external medications were returned: 19 eye drops, 1 inhaler, 1 nasal spray; 2 ointments, 4 creams, 1 gel, 2 lotions (Table I).

Medication identification and cost analysis

Of the oral pill medications, a total of 2,720 pills of oral prescription medication were fully analyzed and 91 active pharmaceutical ingredients were identified with International Nonproprietary Names (INN). When the active ingredients were classified according to the Anatomical Therapeutic Chemical (ATC) classification, the dominant groups were A (alimentary tract and metabolism) with 33.3%, N (nervous system) with 15.0%, M (musculo-skeletal system) with 14.5%, and R (respiratory system) with 12.4%. The total cost of the oral pill prescription medications was 468,477 won. With regard to the drug cost of groups, group A was the highest with 26.6%, followed by J01 (antibacterials for systemic use) with 20.2% and N (nervous system) with 18.3% (Table II).

Of the 2,720 pills, the top 10 most returned medicines based on number of pills were: mosapride (183 tablets, 6.7%), ranitidine/sucralfate/bisthmuth (157 tablets, 5.8%), eperisone (112

Table II – The number and drug cost of oral pill prescription medications returned to the community pharmacies according to the ATC classification

	Therapeutic class	No. (%) of pills	Drug cost, ₩ (%)
A	A02 (drugs for acid related disorders)	430 (15.8)	68,842 (14.7)
	A03 (drugs for gastrointestinal disorders)	420 (15.4)	44,419 (9.5)
	A10 (drugs used in diabetes)	33 (1.2)	6,844 (1.5)
	A07 (antidiarrheals)	25 (0.9)	4,032 (0.9)
N	N03 (antiepileptics)/N05 (psycholeptics)/ N06 (psychoanaleptics)	263 (9.7)	75,956 (16.2)
	N02 (analgesics)	145 (5.3)	10,002 (2.1)
M	M01 (antiinflammatory/antirheumatic products)	271 (10.0)	39,535 (8.4)
	M03 (muscle relaxants)	120 (4.4)	13,176 (2.8)
	M05 (drugs for treatment of bone diseases)	4 (0.1)	20,272 (4.3)
R	R01 (nasal preparations)/R05 (cough and cold preparations)/ R06 (antihistamines for systemic use)	337 (12.4)	28,656 (6.1)
J	J01 (antibacterials for systemic use)	242 (8.9)	94,552 (20.2)
C	C01 (cardiac therapy)	150 (5.6)	26,786 (5.7)
	C10 (lipid modifying agents)	29 (1.1)	19,374 (4.1)
H	H02 (corticosteroids for systemic use)	68 (2.5)	4,187 (0.9)
B	B01 (antithrombotics)/B03B (vitamin B12 and folic acid)	183 (6.7)	11,844 (2.5)
	Total	2,720 (100)	468,477 (100)

"Pills" indicates tablets and capsules; Drug cost is expressed in Korean won, ₩. ATC classification: A, alimentary tract and metabolism; N, nervous system; M, musculo-skeletal system; R, respiratory system; J, antiinfectives for systemic use; C, cardiovascular system; H, systemic hormonal preparations; B, blood and blood forming organs.

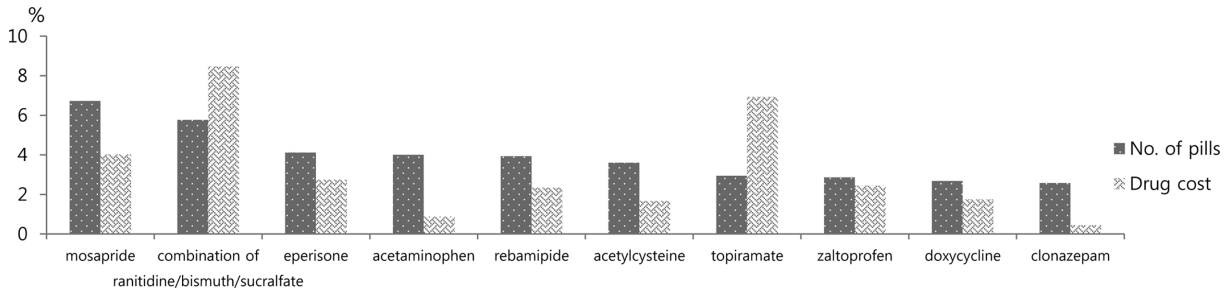

Fig. 1 – The percent ratios of the number and cost of the top 10 most returned medications to the total number and cost of the oral pill prescription medications returned to the community pharmacies.

tablets, 4.1%), acetaminophen (109 tablets, 4.0%), rebamipide (107 tablets, 3.9%), acetylcysteine (98 capsules, 3.6%), topiramate (80 capsules, 2.9%), zaltoprofen (78 tablets, 2.9%), doxycycline (73 capsules, 2.7%), and clonazepam (70 tablets, 2.6%). In contrast the ratios of the drug cost of the top 10 medications to the total cost of the oral pill prescription medications were: mosapride (₩18,849, 4.0%), ranitidine/sucralfate/bisthmuth (₩39,663, 8.5%), eperisone (₩12,880, 2.7%), acetaminophen (₩4,122, 0.9%), rebamipide (₩10,977, 2.3%), acetylcysteine (₩7,827, 1.7%), topiramate (₩32,480, 6.9%), zaltoprofen (₩11,466, 2.4%), doxycycline (₩8,176, 1.7%), and clonazepam (₩2,100, 0.4%) (Fig. 1).

Discussion

From January 15, 2014 to February 28, 2014, the types and quantity of medications returned to the 17 community pharmacies in Korea were examined. Among them, 88.1% of the pill medications and 75.7% of the liquid medications were prescription drugs, respectively. Considering the fact that in South Korea, prescription drugs can be paid by healthcare security system, partially by National Health Insurance Program and totally by Medical Aid Program,[17] the waste of prescription drugs might be a big burden to the national health care system. According to the data from Korean Pharmaceutical Association, in 2012 the total amount of the returned drugs at the national level was more than 302 tons.[13] In the analysis of drug cost, 85 g oral pill prescription medications were worth 468,477 won. In fact, the cost analysis of this study was conducted with only oral pill prescription drugs since there were difficulties in identifying liquid medications as well as non-prescription drugs, and quantifying the volume of the external medications remaining in each container. Taking all the returned medications including oral pill medications, liquid drugs, and external medications into consideration, it is not too much to say that a huge amount of money is being thrown out due to the unused medications in South Korea.

In this study, mosapride, ranitidine/sucralfate/bisthmuth, eperisone, acetaminophen, and rebamipide were most frequently found in the returned oral pill prescription drugs. Categorizing the returned oral pill prescription drugs according to the ATC system, the dominant groups were A (alimentary tract and metabolism) with 33.3%, N (nervous system) with 15.0%, M (musculo-skeletal system) with 14.5%, and R (respiratory system) with 12.4%. These findings were similar to the results previously reported in different countries. In New Zealand, acetaminophen was most frequently found in the medications returned to the community pharmacies.[18-20] When the returned drugs were classified using the ATC system, the predominant groups were A, N, and C (cardiovascular system), representing about 85% of all returns.[20] Similarly, among the medications returned to the community pharmacies in Spain and England, the dominant groups were A, N, and C, corresponding to over 50% of all returns *in both cases*.[21,22] On the other hand, in the studies conducted in Egypt and Oman, group C was the most predominant group, followed by group J (antiinfectives for systemic use).[23,24]

It is worth noticing that previous studies reported 'over-supply' or 'over collection' as an important reason for medication wastage.[18,20,25,26] Millar *et al.*[27] suggested that partial dispensing for newly prescribed medicines to be taken for more than two weeks could be helpful to reduce drug wastage. In addition to excessive purchases, non-compliance and poor adherence by the patient can be factors that induce non-use of medications. Thus investigating active pharmaceutical ingredients of the returned medications will help to find areas where pharmacists' interventions might contribute to reduce medication wastage.[24] In order to establish strategies to reduce medi-

cation wastage, further research to investigate the reasons for non-use of medications is needed.

There are some limitations in this study. Firstly, the study duration was short and therefore returns of the unused medicines could be subject to seasonal variation. Secondly, this study was carried out in the 17 community pharmacies in Gimhae, Jinju, and Incheon, Korea, so the returned medications may not represent the entire drugs returned to a community pharmacy nationwide. Lastly, this study failed to identify liquid drugs, external drugs, and some non-prescription drugs. Thus those drugs were excluded from the analysis of drug costs and active pharmaceutical ingredients. Nevertheless, the findings of this study provide significant information on the drug costs as well as active pharmaceutical ingredients of the medications returned to the community pharmacies.

Conclusion

In this study, medicines used to treat gastrointestinal conditions were returned most frequently. With regard to the drug costs, the result from this study implies that unused drugs impose a significant cost to the health care system in Korea. Further research in nationwide level is necessary to establish strategies to reduce the wastage of unused medicines.

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