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ORIGINAL ARTICLE

Practice, awareness and opinion of pharmacists toward disposal of unwanted medications in Kuwait

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Abstract *Background:* The disposal of unwanted medications has been a concern in many countries, as pharmaceutical waste enters the ecosystem, ultimately having an effect on human health and environment. Earlier studies in Kuwait found that the method of disposal by the public was by disposing in the garbage or by flushing down the drain. In accordance with patient preference and environment safety, it would be appropriate to use local government pharmacies as collection points for proper disposal.

Objective: To determine the practice of pharmacists, working in government healthcare sectors, with regard to disposal of returned unwanted medications by the public. This study also aims to assess pharmacists' awareness toward the impact of improper disposal on the environment and to investigate whether pharmacists agree to have their pharmacies as collection points for future take-back programs.

Method: A random sample of 144 pharmacists from the six main governmental hospitals and 12 specialized polyclinics in Kuwait, completed a self-administered questionnaire about their practice of disposal, awareness and opinion on using pharmacies as collection points for proper disposal of UMs. Data were analyzed using descriptive statistics.

Results: A total of 144 pharmacists completed the survey. Throwing UMs in the trash was the main method of disposal by majority of the respondents (73%). Only 23 pharmacists disposed UMs according to the guidelines of Ministry of Health, Kuwait (MOH). However, about 82% are aware that improper disposal causes damage to the environment and 97% agree that it is their responsibility to protect the environment. About 86–88% of the pharmacists agree to

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have government hospital pharmacies and polyclinics as collection points for future take-back programs.

Conclusion: Even though the current practice of disposal by majority of pharmacists is inappropriate, they are aware of the damage and acknowledge their responsibilities toward environment protection. Concerned authorities should monitor and implement proper disposal guidelines in all pharmacies. Majority of pharmacists support the idea of having the government pharmacies as collection points for safe disposal of UMs in Kuwait.

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1. Introduction

The presence of pharmaceuticals in the environment, especially in water resources, has been confirmed by several reports (US EPA, 2011), and it is suggested that living beings are exposed to the effects of pharmaceuticals through contaminated food and water. Evidence exists of the toxic effects on aquatic life (Kidd et al., 2007) as well as in vitro human cells (Pomati et al., 2008). Pharmaceuticals can enter the environment in a number of ways through human and animal excretion or bathing (Daughton, 2007) and through the disposal of unwanted medications (Ruhoy and Daughton, 2008). Unwanted medications (UMs) include expired, unused, spilt and contaminated pharmaceutical products, drugs, vaccines and sera that are no longer required and need to be disposed of appropriately (WHO, 1999b). It also consists of leftovers generated from extemporaneous preparations in the pharmacy laboratories. The World Health Organization (WHO) recommends that UMs should never be used and should always be considered as pharmaceutical wastes (WHO, 1999a).

Unwanted medications can arise from households or from healthcare activities and, therefore, there are different factors that contribute to their generation. For example, they may be the result of non-compliance by patients, promotional practices by manufacturers', physicians' prescribing practices, or dispensers' practices (Ruhoy and Daughton, 2008). Adverse consequences due to the accumulated UMs include their diversion to those for whom they were not intended, accidental poisoning or their improper disposal into trash or sewage, from where they may enter the environment creating risks for humans and wildlife.

The presence of appropriate official guidelines for disposal of UMs has a major influence on how the public dispose of UMs (Tong et al., 2011a). The European Union (EU) has a directive which states that 'Member states shall ensure that appropriate collection systems are in place for medicinal products that are unused or have expired' (Directive 2001/83/EC; Directive 2004/27/EC). Sweden has a system introduced in 1971 by the Swedish pharmacy chain Apoteket AB, by which unused drugs are returned to the pharmacies. Apoteket AB guarantees that the returned unused drugs are handled properly by placing the drugs in sealed boxes and transported to incineration centers and burned under supervision. The gas is cleaned before release and the ash is placed at approved refuse places. A Swedish study has shown that an increasing number of Swedish people return unused drugs to the pharmacies for disposal. They also found that an increasing fraction of the people is concerned about the environmental impact of pharmaceuticals and it is likely that the campaigns have raised the awareness of the public on this issue (Persson et al., 2009). In New Zealand there is no official guideline for the disposal of UMs; however, the

public is recommended to return UMs to the pharmacies (Tong et al., 2011b). In other countries such as the United States (US), guidelines on drug disposal for the public are issued by different government agencies such as the Food and Drug Administration (FDA) and Environmental Protection Agency (EPA) (US FDA, 2012; US EPA, 2012). These guidelines and regulations are sometimes conflicting, and especially in the case of the US, can be at odds with guidelines issued by different states, which complicates the process of drug disposal (Prescott and Estler, 2011). The FDA has listed 26 drugs as 'dangerous' medications which should be flushed down the toilet (Mitka, 2009), but for all the other medications and in the absence of a take-back program, the unwanted solid medications should be crushed and mixed with an unpalatable substance such as cat litter and disposed in trash in a leak-proof, sealed container. Such disposal method will reduce the chances of poisoning and diversion, but the long term consequences due to the environmental exposure to such pharmaceuticals in the landfills or sewage are currently unknown (Tong et al., 2011a). Other methods of disposal include the use of 'reverse distribution network' or drug take-back programs which provide a safer avenue for disposal of medications from homes. In these systems, the public is requested to return UMs, often to local community pharmacies, from where pharmaceutical distributors or approved agents collect and dispose of them. In the US, many state and local governments have pharmaceutical collection programs which are aimed at decreasing the quantity of UMs polluting the environment and reducing the quantity of drugs available for accidental poisoning, theft or diversion. These programs provide the legal support and resources to allow the public return UMs to be disposed of safely (Glassmeyer et al., 2009).

Some form of drug collection system on the national, state, or local levels is implemented in about 30 countries and the methods used for the collection of UMs vary among them, but in general, pharmacies play a central role (Glassmeyer et al., 2009).

Households are not the only source of UMs, but hospitals and other healthcare establishments also generate wastes, of which chemicals and pharmaceuticals account for about 3% of the total healthcare waste (WHO, 2011). In 1999, the WHO released the first global and comprehensive guidance document on the safe management of wastes from healthcare activities, and in which it addresses regulatory framework, planning issues, waste minimization and recycling, handling, storage and transportation, treatment and disposal options, and training of workforce (WHO, 1999b). This document attributes the failure of proper waste management to the lack of awareness about the health hazards related to healthcare waste, inadequate training in proper waste management, absence of waste management and disposal systems, insufficient financial and human resources and the low priority given to the topic.

This study focuses on Kuwait, a developing country with a shorter history of environmental monitoring and protection. In this country, there is one guideline issued by the Ministry of Health (MOH) for disposal of medical wastes, which has to be followed by hospitals and other healthcare centers in Kuwait (Kuwait, 2007). According to this guideline, pharmacies are required to return UMs generated from their stock, for any reason such as expiry or overstock, to the Central Medical Stores, which dispose of them according to the procedures of the EPA of Kuwait. The EPA requires incineration as a method of disposal for medications and the agency ensures the implementation of their recommendation by witnessing the actual destruction each time (Kuwait EPA, 2001). Unwanted medications, such as leftovers generated from compounding in pharmacy labs, are considered healthcare medical wastes and therefore should follow another procedure stipulated by the MOH guideline. The implementation of both MOH and EPA guidelines will ultimately lead to the actual destruction of the pharmaceuticals and medical wastes, in Kuwait, in an environmentally friendly manner.

However, the MOH guideline has neither specific rules regarding receiving and disposal of returned medications from the public, nor does the country have any take-back programs that accepts UMs from the public (Abahussain et al., 2006).

Pharmacists have the greatest interaction with consumers and prescription and over-the-counter medications and are therefore, in an excellent position to influence the use of medications and, by extension, drug disposal (Prescott and Estler, 2011). A previous study in Kuwait reported that returning UMs to the pharmacies was considered appropriate by 54% of the participants (Abahussain et al., 2006). We report here the results of a study which investigated whether pharmacists actually received UMs from the public and how they handled the disposal of such UMs, in the absence of any specific regulations in Kuwait. Another objective for this study was to assess the pharmacists' awareness of environmental impact of improper disposal and to assess whether pharmacists agree to have their pharmacies as collection points for future take-back program. According to a recent review on global disposal practices of UMs, there has been little analysis on practice and attitudes of pharmacists with regard to disposal of UMs from pharmacies and has recommended further investigation (Kidd et al., 2007). To date, our study is the first such study done in the Middle East region.

2. Materials and methods

The survey was carried out from May 2009 to December 2009. This survey-based research was reviewed and approved by the Research Unit, Faculty of Medicine, Kuwait University and the ethical approval was obtained from the Ethics Committee, Ministry of Health, Kuwait.

Participants were assured that there were no risks in this study and information obtained would be considered anonymous and confidential. Only the researchers would have access to the information. An informed consent form, explaining the research procedures, attached to each questionnaire was read and signed by the pharmacist, who participated in the survey.

The healthcare system of Kuwait consists of the private and the government sector. The government sector consists of three levels, the polyclinics (primary care), six main government

hospitals (secondary care) and specialized hospitals and clinics (tertiary care), which are governed by the MOH, Kuwait. The target population was pharmacists working in the six government hospitals (secondary setting) and in the polyclinics (primary setting), in Kuwait. As per the registration records of the Kuwait Pharmaceutical Association (KPA), May 2009, there were 993 pharmacists, who worked in the government sector. The targeted sample size was 10% (99) of this group. From the governmental hospitals, 17 pharmacists were selected from each of the six government hospitals by random selection, using a sample frame, containing a list of names of pharmacists. From this group (102) only 98 participants responded. At the time of this study, there were 84 polyclinics, of which, there were 72 general polyclinics and 12 specialized polyclinics such as diabetes, asthma clinics, etc. and the latter were selected for this study as there were more pharmacists, each having three to four pharmacists and more medications in these centers. All of the 46 pharmacists, working in the selected specialized polyclinics, responded to the survey. A total of 144 pharmacists who responded were selected from both primary and secondary sectors. The selected pharmacists were visited by one of the authors at their work sites and invited to participate. The authors waited until the participants filled out the questionnaire and handed it back. Pre-testing was done with 10 pharmacists, using an English version, to test clarity and time required to answer the questionnaire. However, the English questionnaire was translated to Arabic, as some pharmacists had difficulty in understanding the questions. To ensure proper validation, the Arabic version was translated again into English. This was done by a staff member of the English Department, Faculty of Arts, Kuwait University. The sequence of the questionnaire was rearranged and some of the questions were omitted to avoid repetition. Certain difficult, open-ended questions were made closed-ended. These changes did not affect the objectives and meaning of the questionnaire. The final Arabic and English versions were used for the Arabic and non-Arabic speaking pharmacists respectively. The 10 pharmacists, who were involved in the pre-test, were excluded from the survey due to the major changes that were incorporated in the final version of the questionnaire.

Items on awareness of consequences on the environment and responsibility to protect the environment were adapted from studies that investigate such concepts in the context of pro environmental behaviors such recycling (Bratt, 1999; Guagnano, 2001). These items were measured using a 5-point Likert scale.

The questionnaire which is available from the author by request was divided into four sections:

Section A: Practice of disposal of unwanted medications at pharmacist's pharmacy.

Section B: Awareness related to environmental hazards.

Section C: Opinions related to future plans to control unwanted medications.

Section D: Background information.

A sample frame was generated, by the researcher during a visit to the chief pharmacist at the pharmacy and a randomized sample was selected by using the computerized random tables. The questionnaires were then distributed to the respondents, with the consent form.

Descriptive statistics and chi-square test were used for data analysis using SPSS (R) version 17.

3. Results

Among the 144 pharmacists who completed the survey questionnaire; 98 (68%) were from the government hospitals in Kuwait and 46 (32%) were from the specialized polyclinics. The sample was composed of higher proportions of males (58%) than females and higher proportions of non-Kuwaitis (60%) than Kuwaitis, ranging in age between 24 and 65 years (median = 34 years). About half (46%) of the respondents gained their pharmacy degree in Egypt. The pharmacists surveyed had a median work experience of 11 years and their job title distribution is shown in Table 1.

3.1. Sources of unwanted medications and disposal methods

The majority of the pharmacists surveyed ($n = 102$, 72%) reported receiving UMs and disposing ($n = 98$, 71%) UMs at their work place. Among those who reported never receiving UMs, 21 of them reported that they refuse taking back UMs because they were unsure of what to do.

Table 2 describes sources of the UMs received and the methods of disposal used by the pharmacist. The UMs came mainly from the public; who wanted to get rid of their household UMs. Other sources of UMs received by the pharmacists included those returned from hospital staff, and those leftover from compounding lab in both hospital and polyclinic. In relation to methods for disposal, the most commonly reported one was throwing medications away in the trash (73%). About 16% of the pharmacists reported disposing UMs by following guidelines of the MOH pertaining to medical waste generated from healthcare institutions.

Table 1 Demographic characteristics of respondents, $N = 144$.

Parameter	n (%)
<i>Age (years)</i>	
Median = 34 years (max = 65, min = 24)	
<i>Gender</i>	
Male	82(58)
Female	60(42)
<i>Nationality</i>	
Kuwaiti	56(40)
Non-Kuwaiti	85(60)
<i>Official title at MOH</i>	
Beginner pharmacist	24(17)
Pharmacist	43(31)
Senior pharmacist	14(10)
Specialist pharmacist	29(21)
Senior specialist pharmacist	19(14)
Chief specialist pharmacist	11(8)
<i>Country of graduation</i>	
Kuwait	37(27)
Egypt	63(46)
Others	37(27)
<i>Experience as pharmacist (years)</i>	
Median = 11 (max = 41, min = 1)	

Table 2 Responses of the pharmacists in relation to disposal of unwanted medications, $N = 144$.

Item	n (%)
<i>Sources of unwanted medications</i>	
Returned from patients	100(71)
Returned from hospital staff	42(30)
Leftover from compounding laboratory	43(31)
<i>Methods of disposal</i>	
Throw it away in trash	88(73)
Pour in sink	36(32)
Pour in toilet	10(9)
Pass it to someone	22(20)
<i>Other methods</i>	
Return to Ministry's Central Drug Store	14(10)
Disposed with hospital medical waste	9(6)

3.2. Awareness of environmental hazards due to UMs disposal

Table 3 shows responses to items intended to measure awareness regarding the negative impact on the environment due to improper disposal of UMs and respondents' sense of responsibility toward protecting the environment. The majority of respondents stated that damage occurs to the environment when UMs are disposed in trash (83%) and when they are disposed of in the sink or toilet (82%). Almost all of the pharmacists (97%) agreed that protecting the environment is one of their personal responsibilities.

3.3. Opinions regarding future UMs collection plans

When asked about their opinion on locations for placing secure containers to collect UMs for future take-back programs in Kuwait, the majority of pharmacists included their place of work as a good place; 88% for hospital pharmacies and 86% for pharmacies in primary care clinics. Other places that were reported by respondents to collect UMs were the private pharmacies (67%) and supermarkets (70%) as shown in Table 4.

There were no significant associations between the demographic characteristics of the respondents with any of the items measured in the survey questionnaire $p > 0.05$.

4. Discussion

The proper collection and disposal of UMs through a well-run disposal system and collection programs are paramount in ensuring safety of humans and the natural environment. Drug take-back programs are well established in certain countries where the pharmacy and the pharmacists have significant roles as collection points and as advocates for proper drug disposal respectively (Glassmeyer et al., 2009; Tong et al., 2011a). In Kuwait, the process of incineration for disposal of UMs exists. The establishment of a drug take-back program is urgently needed for which adequate data from surveys about the practice and awareness of drug disposal among healthcare professionals and the public are required to support such programs. The present study sheds light on the practice, awareness and opinion of pharmacists with regard to disposal of UMs returned from the public.

The pharmacists in this study disposed UMs mostly in trash followed by sink and toilet. These practices are similar to the

Table 3 Awareness of respondents, $N = 144$.

Item	Response	n (%)
<i>Disposal of unwanted medications^a</i>		
Disregarding what others are doing, how much damage will affect the environment if you, as an individual, had thrown away unused medications in the trash?	Causes damage	116(83)
Disregarding what others are doing, what extent of damage on the environment if you, as an individual, disposed of unused medications by throwing them away in the sink or toilet(sewage)?	Causes damage	115(82)
<i>Acknowledgment of personal responsibility^b</i>		
It is my responsibility to protect the environment even if others are unconcerned or irresponsible	Agree	138(97)
It is my responsibility to ensure the safety of other living species on earth	Agree	138(97)

^a Assessment of awareness of the extent of damage: A 5-point Likert scale of 0–4. 0 = do not know, 1 = no damage, 2 = no serious damage, 3 = some damage, 4 = serious damage. For convenience of statistical analysis, responses, 'some damage' and 'serious damage' were merged to the response 'causes damage'.

^b Assessment of responsibility: A 5-point Likert scale of 0–4. 0 = strongly disagree, 1 = disagree, 2 = uncertain, 3 = agree, 4 = strongly agree. For convenience of statistical analysis, responses, 'agree' and 'strongly agree' were merged to the response 'agree'.

Table 4 Respondent's opinion on best location for collecting unwanted medications, $N = 144$.

Location	Response		
	Good idea n (%)	Uncertain n (%)	Not good idea n (%)
Secure containers inside pharmacies within polyclinics	118(86)	5(4)	14(10)
Secure containers inside pharmacies within government hospitals	120(88)	2(2)	15(11)
Secure containers inside private pharmacies	91(67)	18(13)	27(20)
Secure containers inside supermarkets	100(70)	14(10)	28(20)

practices followed by the public in Kuwait (Abahussain and Ball, 2007). The pharmacists who did not receive returned UMs from the public reported that they were concerned about what to do with these UMs in the absence of policies allowing pharmacists to accept returned UMs from the public. This might be common in different parts of the world, where reverse distribution systems to take back UMs from the public are not available, including countries in the Middle East (Abdo-Rabho et al., 2009; Abou-Auda, 2003; Kheir et al., 2011) even to the practicing pharmacists who encounter the problem in daily basis.

The availability of national guidelines for disposal of UMs is a major influence on how people dispose of them (Tong et al., 2011a). Therefore, in the absence of guidelines on what to do with returned medications from the public, our findings show that most pharmacists use trash to dispose of them. In general, disposal of UMs by trash, sink or toilet is not the ideal method (Prescott and Estler, 2011). Therefore there is an urgent need for a policy from MOH to allow pharmacists to accept returned UMs from the public and guide the pharmacists on their proper disposal in Kuwait. Furthermore, only a few pharmacists disposed of UMs according to MOH guidelines. This low compliance needs further investigation. An educational campaign to make the pharmacists aware of the MOH disposal guidelines would be beneficial (Jarvis et al., 2009) along with proper implementation of the guidelines to ensure proper drug disposal.

Although the practice is not optimal, an encouraging finding is that the pharmacists surveyed show good awareness toward protecting the environment from improper disposal of UMs. The majority agreed that harm can occur to the environment if pharmacists dispose medications in either trash or the sewage. Also, the majority indicated that they are personally

responsible for protecting the environment from such risks. Also, the pharmacists are willing to have their pharmacies designated as a collection site for UMs. The above is a reflection of the willingness from their side to help with such problem and it is mirroring patient preferences found in a previous study in Kuwait, where the most preferred method for returning UMs was through government health centers (Abahussain et al., 2006). All these findings positively support the establishment of drug take-back programs. However, before an efficient and effective drug take-back program can be in place in Kuwait, there are several barriers such as lack of information on the quantities and types of the returned UMs from the public. Greater awareness of the extent of the problems has to be created among the public and healthcare professionals and the government officials. Cooperation from various sectors would be required such as law enforcement agencies, etc. to implement an efficient drug take-back program.

The student pharmacists in Kuwait have a golden opportunity to participate in promoting awareness and establishing a national drug take-back program. They are the future pharmacists who will eventually be employed in the government and private sectors and their involvement can make a lot of positive changes in the guidelines and its proper implementation. They can carry out patient and community education and increase the understanding of the consequences of accumulating UMs and improper disposal. A study in the US (Gray-Winnett et al., 2010) has shown that student pharmacists can contribute in providing safe and appropriate medication disposal by partnering with community officials and businesses. This is applicable to Kuwait as well.

There were some limitations in this study. The data were collected by self-administered survey and therefore, although

anonymous, the responses of pharmacists might have been distorted due to the sensitivity of the topic and the need to give a socially desirable response. Inappropriate disposal might have been looked at by the pharmacist as an indicator of their unprofessional conduct, therefore, some of the pharmacists might have been reluctant to state the actual practice and therefore an underestimation of inappropriate disposal might have resulted. Similarly, the environmentally related items might have been inflated to the social desirable factor. However, despite the possible under or over estimation, the results clearly indicate the presence of the problem of improper disposal of UMs. If certainty is required, future studies can ascertain the actual practice, such as participant observation. The assessment of awareness on environmental issues could have been strongly assessed with a more elaborate set of specific questions, which could be addressed in the future. The participating pharmacists in this study benefited by directing their attention to the issue of disposal of UMs, which will eventually promote awareness among other pharmacists and improve their practice of disposal. We believe that the results of this study will motivate the concerned authorities both in hospitals and government legislative societies to consider pharmacies as collection points for UMs for future take-back programs and to monitor and implement proper disposal guidelines in all pharmacies in government healthcare sector in Kuwait. And finally, the benefits of this study will eventually be extended to the public in Kuwait if the results lead to the establishment of a public program, involving pharmacists to take back and properly dispose of UMs.

5. Conclusion

The current practices of the pharmacist for the collection and disposal of UMs returned from the public are not optimal in Kuwait. To make the most out of pharmacists' positive attitude toward the environment and their willingness to have their pharmacies serve as centers for the collection of UMs, policies and programs need to be established to organize the collection of returned UMs using pharmacies and subsequent disposal and destruction in an environmentally friendly manner.

Conflicts of interest

The authors have no conflicts of interest to declare.

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References

- Abahussain, E.A., Ball, D.E., 2007. Disposal of unwanted medicines from households in Kuwait. *Pharm. World Sci.* 29 (4), 368–373.
- Abahussain, E.A., Ball, D.E., Matowe, W.C., 2006. Practice and opinion towards disposal of unused medication in Kuwait. *Med. Princ. Pract.* 15 (5), 352–357.
- Abdo-Rabho, A., Al-Ansari, M., Gunn, B.C., Suleiman, B.J., 2009. The use of medicines in Oman. Public knowledge, attitudes and practices. *SQU Med. J.* 9 (2), 124–131.
- Abou-Auda, H.S., 2003. An economic assessment of the extent of medication use and wastage among families in Saudi Arabia and Arabian Gulf Countries. *Clin. Ther.* 23 (4), 1276–1292.
- Bratt, C., 1999. The impact of norms and assumed consequences on recycling behavior. *Environ. Behav.* 31 (5), 630–656.
- Daughton, C.G., 2007. Pharmaceuticals in the environment: sources and their management. In: Petrovic, M., Barcelo, D. (Eds.), *Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle*. Elsevier Science, pp. 1–58.
- Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the community code relating to medicinal products for human use. *Official journal L* – 311, 28/11/2001, pp. 67–128, article 127b.
- Directive 2004/27/EC of the European Parliament and of the Council of 31 March 2004 amending 2001/83/EC on the community code relating to medicinal products for human use. *Official journal L* – 136, 30/4/2004, p. 57, article 127b.
- Glassmeyer, S.T., Hinchey, E.K., Boehme, S.E., Daughton, C.G., Ruhoy, I.S., Conerly, O., et al., 2009. Disposal practices for unwanted residential medications in the United States. *Environ. Int.* 35 (3), 566–572.
- Gray-Winnett, M.D., Davis, C.S., Yokley, S.G., Franks, A.S., 2010. From dispensing to disposal: the role of student pharmacists in medication disposal and implementation of a take-back program. *J. Am. Pharm. Assoc.* 50, 613–618.
- Guagnano, G.A., 2001. Altruism and market-like behavior: an analysis of willingness to pay for recycled paper products. *Popul. Environ.* 22 (4), 425–438.
- Jarvis, C.I., Seed, S.M., Silva, M., Sullivan, K.M., 2009. Educational campaign for proper medication disposal. *J. Am. Pharm. Assoc.* 49 (1), 65–68.
- Kheir, N., El Hajj, M.S., Wilbur, K., Kaissi, R.M.L., Yousif, A., 2011. An exploratory study on medications in Qatar homes. *Drug Healthc. Patient Saf.* 3, 99–106.
- Kidd, K.A., Blanchfield, P.J., Mills, K.H., Palace, V.P., Evans, R.E., Lazorchak, J.M., et al., 2007. Collapse of a fish population after exposure to a synthetic estrogen. *Proc. Natl. Acad. Sci. USA* 104 (21), 8897–8901.
- Kuwait EPA (Environment Public Authority), 2001. Kuwait Al Youm. Appendix of issue No. 533 Decision No. 210/2001. Management of health care waste, Article 37.
- Kuwait MOH (Kuwait Ministry of Health), 2007. Operational manual for the management of healthcare waste in Ministry of Health, Kuwait. Revised.
- Mitka, M., 2009. FDA: flush certain unused medications. *J. Am. Med. Assoc.* 302, 2082.
- Persson, M., Sabelstrom, E., Gunnarsson, B., 2009. Handling of unused prescription drugs – knowledge, behavior and attitude among Swedish people. *Environ. Int.* 35, 771–774.
- Pomati, F., Orlandi, C., Clerici, M., Luciani, F., Zuccato, E., 2008. Effects and interactions in an environmentally relevant mixture of pharmaceuticals. *Toxicol. Sci.* 102 (1), 129–137.
- Prescott, J., Estler, K. Waste not, want not: drug disposal and role of pharmacist. *Pharmacy Times*. Available: < <https://secure.pharmacytimes.com/lessons/201002-01.asp> > (accessed 15.05.11).
- Ruhoy, I.S., Daughton, C.G., 2008. Beyond the medicine cabinet: an analysis of where and why medications accumulate. *Environ. Int.* 34 (8), 1157–1169.
- Tong, A.Y.C., Peake, B.M., Braund, R., 2011a. Disposal practices for unused medications around the world. *Environ. Int.* 7 (1), 292–298.

- Tong, A.Y.C., Peake, B.M., Braund, R., 2011b. Disposal practice for unused medications in New Zealand community pharmacies. *J. Prim. Health Care* 3 (3), 197–203.
- US EPA (US Environmental Protection Agency), 2011. Pharmaceuticals and personal care products, relevant literature. Available: <<http://www.epa.gov/ppcp/lit.html>> (accessed 10.01.11).
- US EPA (US Environmental Protection Agency), 2012. Pharmaceuticals and personal care products as pollutants. Available: <<http://www.epa.gov/ppcp/>> (accessed 10.03.12).
- US FDA, 2012. How to dispose of unused medicines? Food and Drug Administration. Available: <<http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm101653.htm>> (accessed 10.03.12).
- WHO, 1999a. Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies. World Health Organization. Available: <<http://apps.who.int/medicinedocs/en/d/Jwhozip51e/>> (accessed 10.01.11).
- WHO, 1999b. Safe management of wastes from healthcare activities. World Health Organization. Available: <http://www.who.int/water_sanitation_health/medicalwaste/wastemanag/en/> (accessed 10.01.11).
- WHO, 2011. Waste from health-care activities. Fact sheet 253. World Health Organization. Available: <<http://www.who.int/mediacentre/factsheets/fs253/en/index.html>> (accessed 29.11.11).