Original Article

DISPOSAL PRACTICES OF UNUSED AND EXPIRED PHARMACEUTICALS IN KARACHI AND THEIRIMPACT ON HEALTH AND ENVIRONMENT

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ABSTRACT

Objective:

A large number of drugs going into the land fill or in water system have received great attention. In the present study, a survey was conducted to find out the household drug disposal practice and to determine the level of awareness regarding the proper method to discard these drugs. More than 80% volunteers reported the disposal practice through dustbin, 11.5% responds it is acceptable to flush them in sink or toilet, only 2% return them to pharmacy and 3.8% of the population do not have any background what to do with the expired or unused medication. To minimize the entry of pharmaceutical in environment proper guidance should be provided to the physician for prescribing less number of drugs in small amount moreover, public may be educated to discard the medicine safely.

Key words: Pharmaceuticals, Disposal Practice, environment, health, Karachi.

INTRODUCTION:

Karachi is the largest city, biggest industrial estate and presently the only port of Pakistan with the population of around 16 million. This city alone produces 9,000 tons per day of municipal solid waste including pharmaceuticals, consisting of expired, unused drugs, containers or packaging materials (Rehan and Noman 2008). Waste disposing into sewerage passes through the natural drainage *nalas, naddi* of which only 20% is treated while rest of the sewerage goes untreated into the sea. (Figure 1)

Pharmaceuticals enter the environment as they are disposed of as solid waste into landfills or through sewerage into water system. Throughout the world the use of pharmaceuticals is increasing with time (Jonathan D.Rockoff 2010) and because of these pharmaceuticals, relatively newly recognized pollutants can become a threat to the environment in future (Daughton C.G. 2008). Pharmaceuticals can find their way in to the environment through the excretion of urine and feces containing drugs (un-metabolized as well as bioactive metabolite), topical applications (release from the skin during washing or bathing) drug manufacturing process, animal excretion and disposal of expired, unused or unwanted drugs into the sewerage or trash (Daughton CG 2007; Gielen et al.,2009; Sarmah et.al.,2008; Chee-Sanford, J.C., et al.2001; Boxall, A 2008.).

Significant environmental risk because of the improper drug disposal was first discovered around 35 years ago (Garrison, A.W et al. 1976 and Hignite C., et al 1977) and up till now different studies showed the presence of trace amount of drugs in water system for example NSAIDS, antihypertensive, and antibiotics (Borgmann U., et al. 2007). These pharmaceuticals and their metabolites revealed their presence in trace amount but long term existence may produce toxic effects (Heberer T.2002, Woodhouse B 2003; Jones

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et al. 2003; kostich and Lazorchak 2008). Their impact could be hazardous directly, if present in drinking water by producing antibiotic resistance, as presence of antibiotics has effect on the bacteria present in waterways (Costanzo SD, et al;2005) and by showing impaired sexual development and increase the feminization of fish resulting from a trace amount of oral contraceptive component, ethinyl estradiol (Jobling S, et al 2006, Ankley et al., 2001) or indirectly if untreated waste is going into the sea and affecting marine life like edible fishes, shrimps, lobsters and crab, a big food source and also used as feed for poultry and other life stocks.

The first step to protect the environment from pharmaceuticals is to create awareness about proper disposal method (guidelines given by WHO in table-1) and the impact of pharmaceuticals, polluting the environment. In the present work, survey was conducted to find out the general practices, behavior, awareness, concerning the correct disposal of unused drugs. This study will be helpful to set and organize campaigns needed to guide the general public for proper disposal of pharmaceutical waste to minimize the possible hazards to environment.

METHODOLOGY:

SURVEY FORM AND TARGETED GROUP:

The survey was conducted via questionnaire from 1022 respondents. The target group was undergraduate students of pharmacy, physiology, biochemistry and chemistry, University of Karachi. Before conducting the survey, a brief introduction was given about the study and how to fill the form. Only close-ended questions were designed to get the required information with maximum possible options in short time period.

In the first section volunteers were asked about the different therapies such as allopathic, homeopathic, herbal or home remedy practices popular in their homes. In Pakistan, multiple therapies are very common and people use herbal or homeopathic remedies along with the allopathic therapy. In second part of the form we selected nine classes of allopathic drugs (Figure 2), which are prescribed and used in huge amounts. (Jonathan P. Bound and Nikolaos Voulvoulis 2005) and different studies showed the risk associated with these drugs. (Halling-Sorensen et al. 1998 and Webb 2001).

On the basis of the assumption that NSAIDs and antibiotic are commonly used drugs which are sold in high volume, a question was added to inquire the specific brand used (to specify the chemicals going into our environment frequently, so that further research would be carried out to find the impact of these chemicals). Moreover the prescribed only medicines (POM) are easily available over-the counter (OTC) therefore individuals are inquired that whether they get the medicine through prescription or purchasing without prescription. In Pakistan, generally the medicines are not dispensed by the pharmacist. Community pharmacy is not well established therefore, every type of drug is in easy access to the consumers.

In the third part of questionnaire volunteers were inquired about the awareness and practice of disposal and the utilization of unused and expired medicine by asking them about the quantity of purchased drug remained unused at their home and their understanding of pharmaceutical disposal practice.

In fourth section the individuals were asked about the awareness regarding the effect of pharmaceuticals on environment.

RESULT:

The survey was carried out among the students of University of Karachi, during the session of July to September in 2009. The total population of the survey was n=1022 (19% male and 81% female). Respondents were between 20-25 years of age.

The attitude of the group towards the answer of the first question depicting the normal practice of our population using different main stream allopathic prescription alone or in combination with alternate drugs is shown that almost 74% of population used allopathic medicine and 12% used homeopathic therapy. Figure 3 elaborates the pattern of the respondents towards these therapies.

Among the selected classes of drugs, NSAIDs was found highest to be used (30%), while antibiotics (21%), anti-hypertensive (17%), anti-diabetic (12%) also showed significant consumption. Rest of the classes used was in low quantity among the population. (Figure: 2).

73% of the population purchased medication on prescription (POM) and while the rest took medicine over the counter (OTC). Among the respondents using POM, 53% were completely satisfied with physician prescription where as 44% was partially and 3% were not satisfied with doctor's advice.

Table 2 shows responses concerning practices and beliefs about disposal of unused or expired medication. Around 80% of the population stored unused medication at their home while 20% completely consumed purchased medication. Among these 82% reported that they keep storing the unused medication at their homes until they expired, 12% reported returning unused medication to medical store and only 6% donated medication to a health care provider or welfare. More than 80% volunteers reported the disposal practice through dustbin, 11.5% found it acceptable to flush them in sink or toilet, only 2% returned them to the pharmacy and 3.8% of the population does not have any knowledge as what to do with the expired or unused medication.

Two third of respondents discarded the expired medications as it is, 22% crushed them before discarding, only 3% said that expired medication are throwing after diluting and only 9% do not know about the practice of expired medication disposal (Fig4).

To create awareness about proper drug disposal practice, 42% of the respondents thought that it is the responsibility of public, 24% said of the government, 18.4% believe that PPA(Pakistan pharmacy association) and 16% said that pharmaceutical industries should play their role.

More than 80% of the respondents showed their concern that improper disposal of medication can affect the environment and health while remaining 20% do not have knowledge about hazardous effects of unused and expired medication. In order to minimize the entry of pharmaceuticals into environment 37% of the people suggested that medication should be prescribing in less quantity and only for time period that ensures patient compliance, 33% suggested that proper guidance should be given to the consumer, 20% said by donating the unused medication to health care provider or welfare and 10% belief that it can be controlled by lowering number of medications in the prescription.

In response to a question about how to create the awareness in the society, 51% answered that the best source is electronic media, 20% respondents voted for newspaper, while rest were in favor of pharmacy, physician and industry.

DISCUSSION:

Karachi being a metropolitan city faces many problems related to sanitation and health. Large population demands organized solid waste management this is because the management in the past few decades had been shifted to different organizations and still number of institutes and organizations are involved (government and non-government) making the process complicated and slow.

The city has two landfill areas which can accommodate the waste produced on daily basis but hardly 40 % waste can reach to those sites while the rest remained dumped on their primary waste sites in the city and may undergo degradation and leachate to the ground surface water.

Drugs reportedly, consumed completely going into the environment through excretion are also threatening the environmental safety. Only 30% of the sewerage water is treated and remaining goes into the sea through *nallahs* and *naddi*. Modern treatment plants are incapable to remove the pharmaceuticals and their metabolites showing their presence in water thereby affecting the aquatic life. (Daughton.C. G.and Ternes;1999).

In Pakistan 80% vegetables and fruits are irrigated through sewerage water (John et al, 2005 and Khuda B. and Sarfaraz H. 2006) which may contaminates them and harm the population eating those vegetables or fruits. Shepherds also bring their animals for grazing grass, small herbs or vegetation growing around sewerage water and in some portions of the dumping sites. These may lead to harm due to potential entry into the food chain. With time population will increase with more utilization of pharmaceuticals which will become the part of environment through the waste.

To minimize the entry of pharmaceuticals into environment the majority of respondents said that physicians are the best source who can play their role by prescribing less number of drugs and in low quantities.

In Pakistan average no. of drugs prescribed is 2.77 and in Karachi it is 4.7 (A.Hafeez et al. 2004) which is higher than the figure two drugs per prescription recommended by WHO. In our study the use of prescribed medicines is much higher than that of the OTC but almost half of the respondents are not completely satisfied with 'prescription' medicines as a result of which change of therapy may occur and produce large amount of leftover medication.

As our result showed that ponston (29%), paracetamol (24%), disprin(22%) and augmentin (35%) are the highly used drugs among pain killers and antibiotics (studied showed that 52% prescription comprises antibiotics along with other drugs) (Hafeez A.2004) while drugs for anti-hypertensive effects are 17%. Among these paracetamol and beta blockers have been studied for their harmful effect on environment (Jonathan et al 2005).

This revealed that there is neither guidance nor awareness regarding the proper disposals by the majority of pharmaceuticals and practice of disposal as majority of the respondents discarded by throwing them to trash bin as it is, while small quantity was disposed of into sink or toilet. This behavior is somewhat opposite in accordance to WHO guidelines (table-1). Fortunately WHO has given a list of drugs and poisons which must be flushed to avoid the accidence and harm associated with them.

Another important factor is the cost of these discarded medicines (unwanted and expired). Our results showed that most of the time, the reason of having large amount of leftover drugs is because of change in therapy due to the ineffectiveness or adverse effects of drugs prescribed earlier (diabetes, blood pressure, cardiac) and second reason is to stop the treatment immediately after treatment (antibiotics). These medicines going into the trash bins or getting expired, if returned to charity or welfare organizations can be used by the people who cannot afford such costly medicines.

Table 1 Guidelines for proper disposal of medicine by W.H.O

1.	Take unused, unneeded, or expired prescription drugs out of their original containers and throw them in the trash.
2.	Mixing prescription drugs with an undesirable substance, such as used coffee grounds or kitty litter, and putting them in impermeable, non-descript containers (such as empty cans or sealable bags) will further ensure the drugs are not diverted.
3.	Flush prescription drugs down the toilet *only* if the label or accompanying patient information specifically instructs doing so.

TABLE 2 RESPONDENTS PRACTICES AND BELIEFS CONCERNING UNUSED AND EXPIRED MEDICATION DISPOSAL

PERCENTAGE %	
Did any quantity of purchase medicine remain UNUSED at your home?	
• Yes	79.6%
• No	20.4%
What do you do with the UNUSED medicines?	
• Donate to Welfare or Hospital	6.3%
• Return to medical store	11.6%
• Keep at home until expired	82.1%
What do you do with the EXPIRED medicines?	
• Flush in toilet or Sink	11.5%
• Throw in dust-bin	82.8%
• Return them to Medical Store	1.9%
• Do not know	3.8%

How the expired medicines are discarded at your home?

- Crushed before discarding 21.7%
- Diluted 2.9 %
- Don't know 8.5 %
- As they are 67 %

Who is responsible to create awareness for proper disposal of medicines?

- Government 24.1 %
- Industries 15.8 %
- Public 41.7 %
- Pakistan Pharmacy Association (P.P.A) 18.4 %

Improper disposal of medicines can affect the Environment and Health?

- Yes 85.2%
- No 6.7 %
- Don't know 8.1 %

How could be hazardous effect of unused and expired medicines minimized or controlled?

- Lowering the No. of Prescribed medicine by Doctor 10 %
- By donating the unused medicines 20 %
- By providing proper guidance to the consumer 33 %
- By prescribing in quantities and for duration that ensure Patient compliance 37%

What would be the BEST source of awareness for society?

- Newspaper 18. 6%
- Electronic Media 8.7%
- Pharmacy 10. 5%
- Physician 12. 2 %

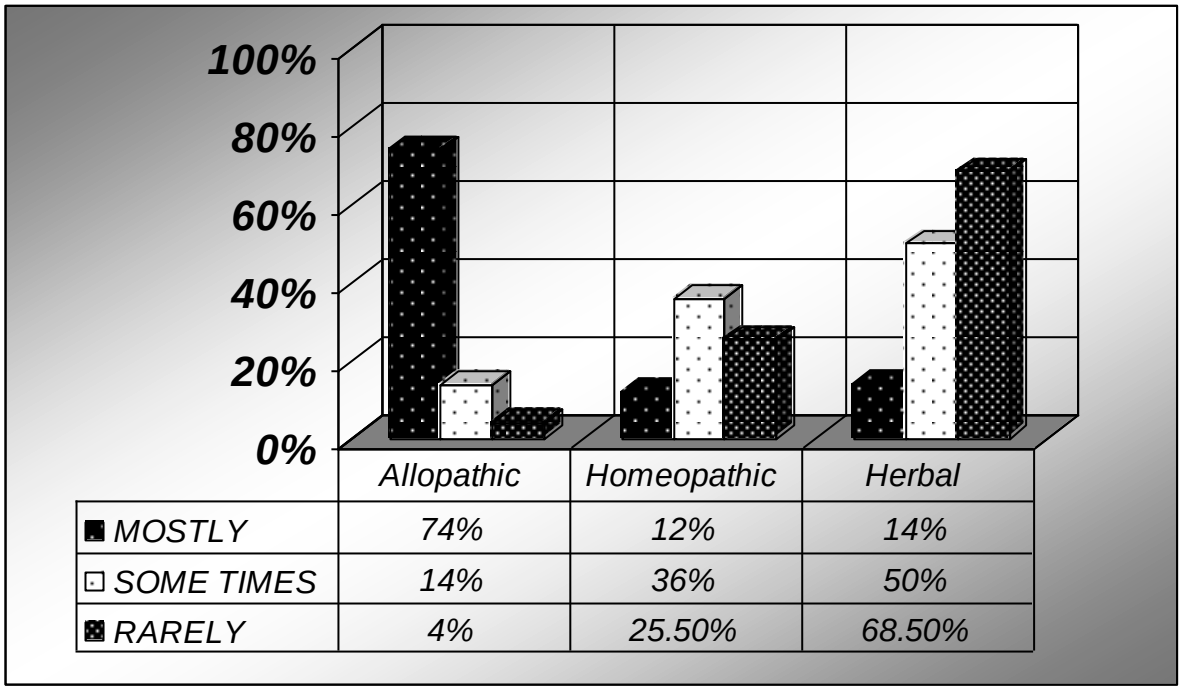

Figure: 2 Types of Therapies Commonly Used

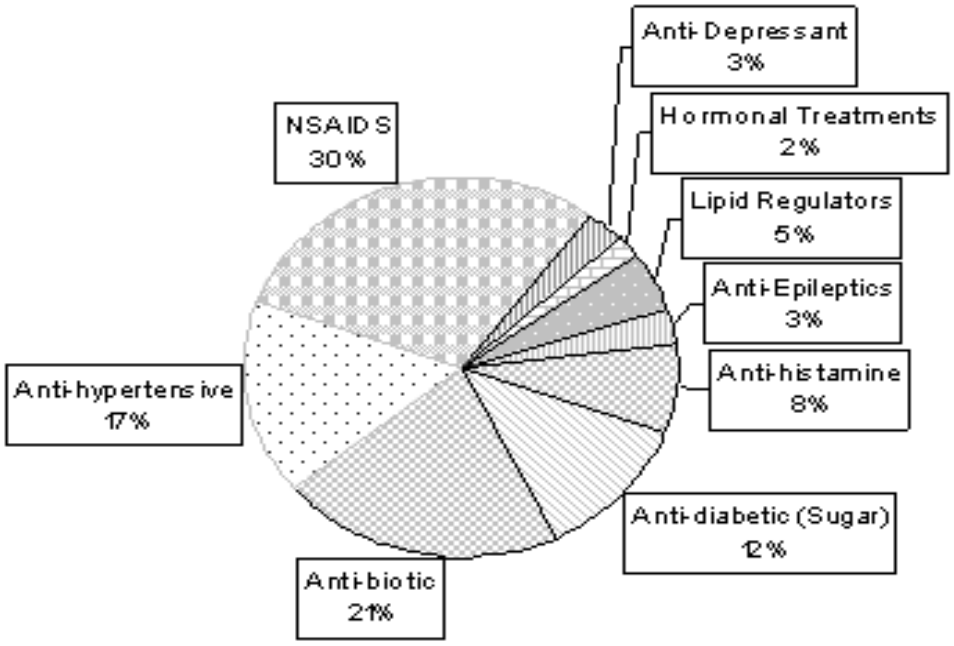

Figure: 3 Trend of Medicines according to Research study

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