



ASSESSMENT AND AWARENESS REGARDING UNUSED DRUGS IN HOUSEHOLD – A REVIEW

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KEYWORDS :

Consumption of medicine has increased over the years due to an increase in the availability of treatment for most diseases and growing public interest in health and health products.⁽¹⁾

Medicines has a major role in the treatment and cure of many diseases, however not all medications are consumed by patients. This may lead to medication wastage and can become a risk to humans and the environment. Medications in households lead to medication wastage which has an economic impact. According to Oxford dictionary, "wastage" is defined as "an act or instance of using or expending something carelessly, extravagantly or to no purpose".⁽²⁾ This definition indicates that anything that is used carelessly, inefficiently or ineffectively is waste. Drug waste is defined as „Any drug product either dispensed by prescription or purchased Over the Counter (OTC) that is never fully consumed“. ⁽³⁾ Factors such as poor adherence, discontinuation of medication, adverse effects, dose changes, patient consuming medications partially, purchased OTC medicines, inappropriate or partially used syringes, ampoules, vials of drugs have leads to the causes of unused medications in households. The risk of drug waste arises from three primary source:

- Storage
- Disposal
- Nonuse

Improperly stored medications in households can cause harm in several ways like ingestion of medications accidentally by the children, recreational use of stored medicines. Proper storage of medicines is essential for two reasons:

1. to maintain the stability and integrity of formulated medicines,
2. to prevent accidental injury and waste of medicines.

Disposal is another risk of drug waste. Unused medications that are inappropriately disposed could endanger the environment by contaminating surface and drinking water; and increase medication resistance (eg: Antibiotics), with possible genetic effects in humans and marine life in the long-term.⁽⁴⁻⁶⁾ Nonuse that can arises due to patients don't take their medications as directed, develop any adverse effects during treatment or failure to give desired therapeutic outcomes. There is a lack of knowledge on how to dispose expired, unwanted and unused medications among our population. Some international and national studies showed that most patients stored their medications improperly at home that may lead to undesirable side effects or unintentional risks like improper self-medications, accidental overdose and prescription drug abuse. These patients keep medications because they do not want to waste them, they do not know how

to read and check the expiry date, or they do not know a proper and safe way to dispose them.⁽⁷⁻⁹⁾ Improper wastage and disposal can lead to delay in treatment, disease progression, treatment of ensuring complications that include exacerbation or prolongation of illness, uncontrolled chronic disease, hospitalization, infertility, cancer, disability and death adding to overall increase in cost of treatment. Pharmaceuticals have been widely detected in the environment and in some cases can lead to detrimental effects on wildlife. Traces of pharmaceuticals have consistently been detected in effluents from sewage facilities, surface water and drinking water.⁽¹⁰⁾

MEDICATION WASTAGE

Since there is no consistent definition of medication waste in any of the literature, making difficult to reduce the problem and compare studies. According to Oxford Dictionary, "waste" is defined as "an act or instance of using or expending something carelessly, extravagantly, or to no purpose". In the literature, medication waste has many definitions, which includes:

1. Medicines issued but not consumed by the patient.
2. Drug substance, either dispensed by a prescription or purchased over the counter (OTC), that is never fully consumed by the patient.
3. "Medicine which have been dispensed but are unused or partially taken by patients and eventually leads to disposal".

Medicine has a major role in the treatment of many diseases; however, not all medications are taken by patients. If the patients are not consuming medications properly, they are wasted and it become a risk to humans and the environment. The risk of drug waste arises from three main sources; storage, disposal and nonuse.

NONUSE:

This may arises due to lack adherence with medications. Some patients forget or skip their daily dose of medicines and this leads to medication wastage in households. Some of another reasons for nonuse are failure to give desired therapeutic outcome, development adverse effects, physician ask to stop the medications, expired drugs etc.

- **STORAGE:** Improperly stored medicines can cause many harms to humans and environment. This may leads to accidental consumption of medications by the children. Another one is the diversion of stored medications for recreational use. The leftover medicines or controlled substances may share with friends or family members. Proper storage of medications such as vitamins and

vitamin supplements in house is very important for their proper use and safety. This helps to keep them in the physical conditions for optimum efficacy.

- **DISPOSAL** Drug disposal is one of the major risk from drug waste. Improper disposal practices of medications could endanger the environment. Nowadays, the improper disposal of unwanted medicines from houses is becoming a major problem to our environment. Also these medicines may accumulate in the soil, ground water and drinking water and contaminating them. This may leads to increase medication resistance (e.g. antibiotics) with possible genetic effects in humans and marine life.

Reason for Improper Exposure of Medication Waste:

According to World Health Organization (WHO): 1. Lack of awareness about the inherent hazards caused by improper management of medication wastes. 2. Insufficient allocation of resources (financial and human) for the safe management of wastes. 3. Improper control of the waste management system. 4. Absence of a national policy for the management of the medication wastes. 5. Lack of or inadequate regulatory framework. 6. Insufficient evidence on the negative impact of medication wastes. 7. Insufficient information on waste management and treatment options^[11]

**Impact of Improper Disposal of Medications
Contraceptive Pills**

The hormones found in the birth control pills alter the genes in the fishes this is a new study from Lund university. EE2 (ethinyl-estradiol) is a hormone which is the active ingredient in many birth control pills. The EE2 have a great impact on fishes even it is in low concentration which resulting to the disappearance of an entire fish population and consequents for entire ecosystem. Estrogen receptors are more in the fishes than human so it makes them more vulnerable to estrogen in water^[12].

Antidepressants

Researches shows that antidepressants affect aquatic invertebrates at concentration now found in the environment. The antidepressants act by serotonin, dopamine and norepinephrine. In invertebrates the biological functioning are carried out by the help of serotonin, dopamine and norepinephrine, so which results in the change of metabolism and behavior. Reports shows that the light stimulated or movement based on the earth gravity for orientation (photo and geotactic behavior) are altered because of the presence of antidepressants in the water^[13].

Antibiotics

Antibiotic having complex molecule and different functional group within the chemical structure. Antibiotic are divided into different categories based on their mechanism of action: cell wall synthesis, protein synthesis inhibition, alternation of cell membrane, synthesis of nucleic acid inhibition and metabolism, etc^[14]. The concentration of antibiotic is ranges from few nanograms to hundreds of nanograms per litre or kg of soil. The highest quantity present in the areas; hospital effluents, waste water influents and effluents and soil treated with manure or soil used for livestock. Recent environmental

studies shows that the antibiotics in water found that quinolons, sulfonamides and trimethoprim are most analyzed and detected.

The steady and continuous introduction of antibiotics in the environment will causes, the soil organism are chronically exposed to these chemicals. The active ingredients and additives used in the formulation are toxic even low concentration. And also presence of other pharmaceuticals simultaneously with antibiotics may cause synergistic effects. The presence of antibiotics below the minimal inhibitory concentration also can kill or inhibit the growth of at least one or some microorganism. The effects of antibiotics are depends on the concentration (concentration dependent). Antibiotics can act on bacteria with a bactericidal and bacteriostatic effect, at high concentration. Bacteriostatic agents are those inhibit the growth of bacterial cell but do not kill them, but in case of bactericidal agents will kill bacteria. The direct effect of antibiotics on the natural microbial community could be the disappearance or inhibition of some microbial group involved in key ecosystem function. Antibiotic exposure may lead to develop resistance, develop genetic and phenotypic variability and also influence on physiological activities

Antibiotics Direct Effects on Microbial Community

For the maintenance of biological process in water and soil, microbial biodiversity play a functional role. Microorganisms are act as a mediator in most biogeochemical cycles. As the ecological factor in environment antibiotics can change the structure of natural bacterial community (inhibition or disappearance). Also will affect non target organism with important ecological role. Recent studies shows that presence of antibiotics causes the reduction in microbial biodiversity. In case of broad spectrum antibiotics have a selective effect on various microbial group, the group may be narrower like single specious or large like fungi or bacteria. Moreover the effect of antibiotics on biochemical process cannot be standardized because of the lack of standardized test.

Antibiotics Indirect Effects on Microbial Community

Via population dynamics antibiotic can have long-term indirect effect on microbial species at low concentration. Below minimal inhibitory concentration the antibiotics can act by different ways:

- Selecting resistance
- Generating genetic and phenotypic variability
- As signaling molecule

Antineoplastics

Anticancer drugs and by-products in the wastewater negatively impact on survival of many organisms, from recent studies. Cytostatic drugs, which are used to treat cancer, may stop the growth and division of cell and release of these drugs in the environment may affect ecosystem through altered fertility and increased genetic defects. Eco-toxicological studies of cytostatic (acute and chronic effect) on algae, bacteria, crustaceans and zebra-fish shows that crustaceans were the most heavily affected group, algae bacteria were less sensitive In crustaceans growth inhibition and DNA damages at low concentration were reported^[15].

DISPOSAL METHODS

Table 1: Pharmaceutical Categories and Disposal Methods as per the WHO Guidelines^[16]

COMMENTS	DISPOSAL METHODS	CATEGORY
No more than 1% of the daily municipal waste should be disposed of daily in an untreated form (non-immobilized) to a landfill.	Landfill	Solids
	Waste encapsulation	Semi-solids
	Waste Inertization	Powders
Antineoplastics not to sewer.	Sewer	Liquids
Antineoplastics not to sewer.	Crush ampoules and flush diluted fluid to sewer	Ampoules

Liquids antibiotics may be diluted with water, left to stand for several weeks and discharged to a sewer.	Waste encapsulation	Anti-infective drugs
	Waste inertization	
	Medium and high temperature incineration (cement kiln incinerator)	
Not to landfill unless encapsulated.	Return to donor or manufacturer	Antineoplastics
Not to sewer	Waste encapsulation	
No medium temperature incineration	Waste inertixation Medium and high temperature incineration (cement kiln incinerator) (chemical decomposition)	
Not to landfill unless encapsulated.	Waste encapsulation	Controlled drugs
	Waste inertization	
	Medium and high temperature incineration (cement kiln incinerator)	
Not to burnt; may explode.	Landfill	Aerosol canisters
	Waste encapsulation	
No diluted disinfectants to sewers or water courses.	Use	Disinfectants
Maximum 50 liters per day diluted to sewer of fast-flowing watercourse.	To sewer of fast-flowing watercourse: small quantities of diluted disinfectants (maximum 50 liters per day under supervision)	
No disinfectants at all to slow moving or stagnant watercourses.		

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