

Ecopharmacology – In the Offing

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Abstract- Over the last three decades there has been increasing global concern over the public health impacts attributed to environmental pollution. The world health organisation (WHO) estimates that about a quarter of the diseases facing mankind today occurs due to prolonged exposure to environmental pollution. Ecopharmacology is a broad term that includes studies of pharmaceuticals and personal care products (PPCPs) irrespective of doses and their route of entry into environment disturbing the balance of ecology. The environmental impact of these products is largely speculative, these are the substances used by individuals for personal health or cosmetic reasons, and they enter the environment through individual human activity and as residues from manufacturing units. The toxic releases from the pharmaceutical industry include on-site discharge to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land. Varying concentrations of drugs found in water sources can have ill effect on the aquatic life and human health. Existing wastewater treatment facilities are inadequate and are not designed to remove them from the waste stream. Green Pharmacy aims at zero pharmaceutical waste in our environment. Public health activities intended to protect individuals, groups and populations from environmental hazards, pharmaceutical contamination is very much essential. Now is the time to prevent further harm to living organisms and the environment as causation and mitigation are both in our hands.

Index Terms- Ecopharmacology, Pharmaceutical and personal care products (PPCPs), Ecoshadow, Green chemistry, Environmental management system (EMS).

I. INTRODUCTION

The consistent increase in the use of potent pharmaceuticals is creating a corresponding increase in the amount of pharmaceutical waste generated. Proper pharmaceutical waste management is a highly complex new frontier in environmental management for health care facilities. Failure to comply with hazardous waste regulations by improperly managing and disposing of such waste can result in potentially serious violations and large penalties. The environmental impact of pharmaceuticals and personal care products (PPCPs) is largely speculative, these are substances used by individuals for personal health or cosmetic reasons. PPCPs have been detected in water bodies throughout the world [1]. As they tend to dissolve relatively easily and don't evaporate at normal temperatures, they often end up in soil and water bodies. Most of the pharmaceuticals are often filtered ineffectively by waste water treatment plants. Pharmaceuticals may also be deposited in the environment through improper disposal, runoff from sludge,

fertilizers, reclaimed waste water irrigation and leaky sewage [2]. The recent increase in awareness of environmental issues is creating an opportunity for sectors involved in health care—pharmaceutical manufacturers, hospitals, individual physicians and all those involved in the health care system, law enforcement agencies, pharmacies, waste management agencies, consumers, environmental protection organizations, and governmental agencies to take action and reduce potential harm.

COMPOSITION OF PPCPs:

Pharmaceuticals or prescription and over the counter medications made for human use or veterinary or agribusiness purposes are common PPCPs found in the environment.

Antibiotics, sexual enhancement drugs, Veterinary drugs, Fragrances, Cosmetics, Sun-screen products are contained in this group [3].

II. ENVIRONMENTAL POLLUTION FROM THE PHARMACEUTICAL FIRMS

a) Air Pollution - The release of gaseous fumes, dust, particulates from pharmaceutical firms to atmosphere is the reason for air pollution, 50 % of firm's hazardous waste is wrongly handled, leading to spillage.

b) Water Pollution - Adverse functioning of Effluent treatment plants (ETP), lack of monitoring of these treatment plants by qualified personnel is leading to profuse water pollution, discharged to Common effluent treatment plants (CETP) with extra allowance.

c) Land /Soil Pollution – Seepage of chemicals, oils and lubricants causes non fertility to soil /lands.

d) Heat Stress - Uncontrolled work environment, high temperature, exothermic reactions, and use of solvents ultimately affects the environment.

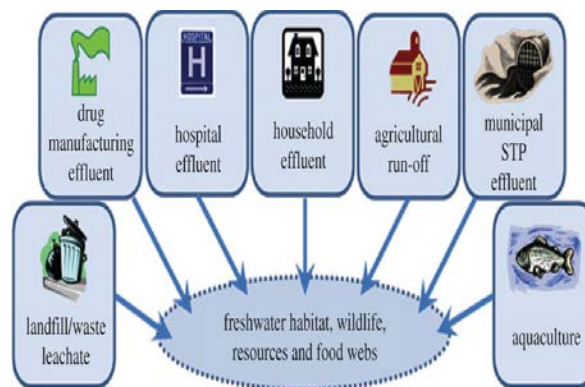


FIGURE 1: SOURCES OF PHARMACEUTICAL CONTAMINATION.

III. ENTRY AND PRESENCE IN THE ENVIRONMENT

Pharmaceutical pollution is an emerging concern worldwide. The drugs that we take are not entirely absorbed by our bodies and are excreted without being fully metabolized. Drug components leach out and seep into groundwater and find their way into local wastewater treatment plants. Some persistent, bio accumulative and toxic substances pollute the air, land and both surface water and groundwater.

The pollutants have ill effect on human health too. In accordance with a report, researchers have found out that human cells fail to grow normally in the laboratory when exposed to trace concentrations of certain pharmaceuticals. Some drugs found in water have promoted antibiotic-resistant germs. When the bacteria are exposed to a drug, there are chances that bacteria will mutate in such a way that would render the drug ineffective. In India, according to a news source at Patancheru near Hyderabad, water samples from a stream have shown presence of 21 different drugs, which ranged in purpose from hypertension, heart disease, chronic liver ailments, depression, ulcers.

Some microbiologists believe that if antibiotic concentrations are higher than the Minimum inhibitory concentrations (MICS) of a species of pathogenic bacteria a selective pressure would be exerted and as a result, antibiotic resistance would be selectively promoted [4].

Researchers have found that a class of antidepressants may be found in frogs and can significantly slow their development. Since some of these substances take a long time or cannot be degraded biologically, they make their way up the food chain. Antidepressants have caused lobsters to be more aggressive. Tadpoles have gone smaller by 40% in size when exposed to water from the treatment plant



FIGURE 2: DISTURBANCE IN AQUATIC LIFE

SYNTHETIC HORMONES:

Some research studies suggest that concentration of ethinyl estradiol, an oestrogen used in oral contraceptive medications and one of the most commonly prescribed pharmaceuticals can cause endocrine disruption in aquatic and amphibian wild life like fishes, frogs, alligators and molluscs in concentrations as low as 1 ng/l which has been linked to increased vitellogenin production and structural change in their sex organs leading to feminization [5].

CARDIO VASCULAR MEDICINES:

The Non selective beta blocking agent propranolol was found to cause a significant decrease in egg production in medaka Fish at a concentration close to that demonstrated in a sewage treatment plant.

ANTIBIOTICS:

In India bacteria resistant to ciprofloxacin have been found downstream pharmaceutical plants and genes for multi resistance were found in drinking water.

The term Ecoshadow has been introduced to describe the ecological impact of antibiotics. Antibiotics with a wide spectrum that are stable will have a greater impact on the bacterial flora (a long eco-shadow) than those with a narrow antibacterial spectrum which disintegrates more rapidly (a short ecoshadow)

The development of resistant bacteria in sewage plants is stimulated by high concentration of antibiotics (in plant sewage)

ANTIDEPRESSANTS:

Fluoxetine (Serotonin reuptake inhibitor)

Fluoxetine has been shown to affect swimming activity in shell fish whether it is linked to a disturbance of serotonin function in the brain is still unknown.

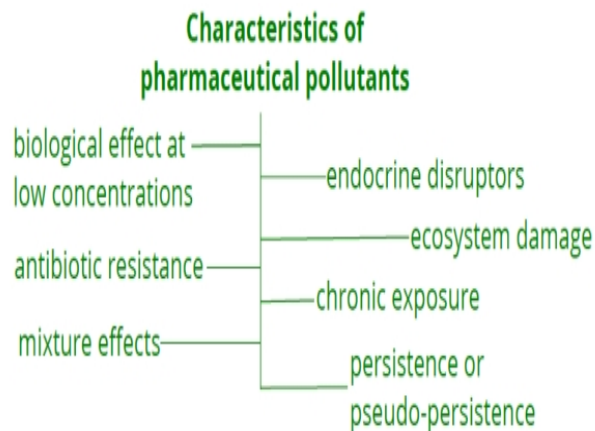


FIGURE 3: CHARACTERISTICS OF PHARMACEUTICAL POLLUTANTS

IV. CASEREPORT

PATANCHERU – HYDERABAD – A DEADLY COCKTAIL OF ANTIBIOTICS.

This area is an important hub for the world's production of bulk drugs and features a very large number of industries congregated in a limited area. The concentrations in the effluent from a treatment plant receiving wastewater from about 90 manufacturing units were, for some pharmaceuticals, greater than those found in the blood of patients taking medicine. A study conducted in 1999 by four researchers from the National Geophysical Research Institute, Hyderabad, documented extensive groundwater pollution and over-exploitation of groundwater and called for reduction of effluent concentrations in wastewater released from individual industries and from combined effluent treatment plants in patancheru. A study

conducted by Greenpeace in 2004 recorded that the pollution contributes to respiratory disorders, cancers, reproductive problems, chronic depression, and congenital problems including mental retardation and physical abnormalities. A local doctor reported "very strange cases," including a baby born without eyeballs. Villagers reported human morbidity, crop declines, and livestock deaths and attributed these impacts to local industrialization. The concentration of ciprofloxacin, which is a broad-spectrum antibiotic, was as high as 31 mg l^{-1} which is approximately one million times greater than the levels that are regularly found in treated municipal sewage effluents. The estimated total release of ciprofloxacin for 1 day was 44 kg, sufficient to treat everyone in a city with 44 000 inhabitants [6].

V. DISCUSSION

There are different approaches for the reduction of pharmaceutical pollution in the environment. To attain green challenges for the pharmaceutical industry, green pharmacy has a vital role to play. This approach brings a difference to the existing setup. Green pharmacy would comprise green chemistry and green design of a pharmaceutical plant.

GREEN CHEMISTRY:

"The design of chemical products and processes that are environment friendly to reduce negative impacts on human health and the environment." is the basic principle involved in green chemistry.

Green chemistry looks at pollution prevention on the molecular scale and is an extremely important area of Chemistry.

The Green Chemistry program supports the invention of more environment friendly chemical processes which reduce or even eliminate the generation of hazardous substances.

GREEN DESIGN:

Work place environment monitoring and ambience improvements with designed aspect Impact controls, Waste minimization by improving material consumptions and Organizations adapting to ISO-14001, Environmental management system(EMS) for continual improvement are the steps involved in green design of a pharmaceutical plant.

The ISO-14001 – Environmental management system (EMS) standard consists of five sections namely,

Environmental policy, planning, implementation and operations, checking and corrective action and management review.

VI. CONCLUSION

As countries around the world continue to source pharmaceuticals from India, pharmaceutical pollution of water, air and land will remain on a higher side due to lack of ecofriendly production measures. Hence Green Pharmacy aims at zero waste and offers an opportunity for social action that will greatly benefit our environment at all levels of our society. Manufacturers should design drugs that are more ecologically sensitive and medicines that biodegrade more quickly and yield end products that are less harmful. To purchase drugs in small amounts, limiting expired medications, use medications with low environmental impact, disposal of unused or unwanted medications at take-back sites are the immediate measures to be taken. Hospitals should develop methods for proper disposal of waste. Pharmacies should serve as take-back sites for proper pharmaceutical disposal. They can have recycle bins, which allow consumers to bring their unused/expired medicines back whenever they shop. Our contribution towards safe and healthy environment by adopting Green Pharmacy can prove to be a powerful approach with a fast developing solution which has the potential to affect much of life on Earth.



FIGURE 4: THE POLLUTED STREAM IN PATANCHERU, HYDERABAD. [8]

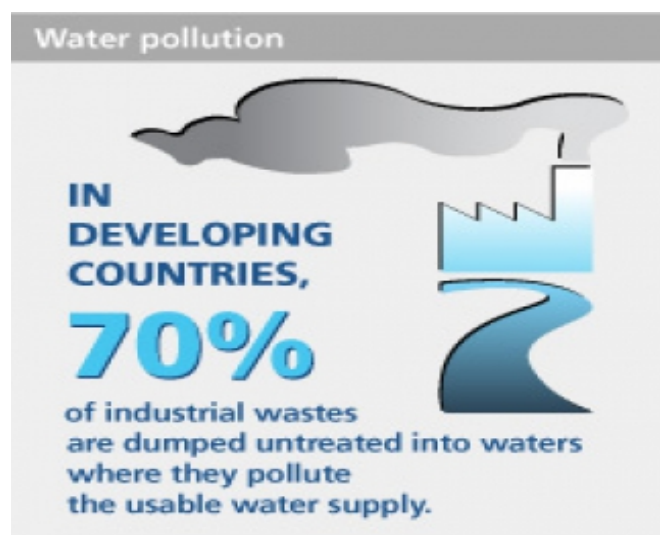


FIGURE 5: THE UNITED NATIONS WATER REPORT [7]

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