

Chapter 55

Pharmaceuticals and Personal Care Products as Emerging Water Contaminants

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ABSTRACT

With the advent of better detection, more micro-contaminants are being found in water. Many of these micro-contaminants come from medical therapies and personal care products. These chemicals are comprised of a wide-range of substances including pharmaceuticals, dietary supplements, veterinary drugs, fragrances, hair care products, body lotions, oral care, and cosmetics. Many of these products enhance our quality of life and in some cases, provide life-saving therapies. But, they come with an environmental cost. Scientific research has found sub-therapeutic levels of many of these chemicals in our waterways and in our finished drinking water, causing concern about the potential environmental and public health impacts associated with very low, chronic exposure. As tailored therapies and personal care products are developed, it is crucial to consider how to control emerging contaminants from medical therapies and personal care products. Specific actions and policies can be implemented now by adopting upstream approaches to prevent waste and decrease environmental exposures.

INTRODUCTION

The 1950's adage, *better living through chemistry*, still resonates today through our use of pharmaceuticals and personal care products. America is the prescription nation, with more than four billion prescriptions dispensed annually, and with the average citizen using not only prescribed medications, but over-the-counter drugs, homeopathic treatments, and herbal remedies as well (Lindsley, 2015). The average female consumer uses at least 12 personal care products, while males use at least six products (Leonard, 2010). Humans are not alone in their use of pharmaceuticals. The increased use of pharmaceu-

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ticals among animals, especially antibiotics, is well documented. And the use of all of these chemicals comes with an environmental cost: much of what we use ends up in our water and little can be removed through water treatment processes.

The purpose of this chapter is to:

1. Describe how pharmaceuticals, and personal care products (PPCP) as well as some medical therapies end up in various water sources, and identify some pharmacological, chemical, and toxicological properties of PPCP.
2. Identify how medical therapies and PPCP are detected and evaluated in various water sources, and identify some of the issues associated with determining levels of exposure and risks associated with exposure.
3. Define the problems associated with emerging contaminants (EC) from medical therapies and personal care products (PCP), using two general categories of EC (antibacterials and endocrine-disruptors) and two specific examples (Iodine 131 and nanotechnology) to illustrate these problems, by:
 - a. Identifying the chemicals associated with the medical therapy or PCP and their potential and actual human health hazards;
 - b. Characterizing potential policy implications as a result of these examples.
4. Examine the life-cycle of emerging contaminants from design through disposal to consider the following questions:
 - a. How can the design and production of these contaminants be improved to decrease bioactivity, increase absorption, reduce waste, and lessen their carbon footprint?
 - b. What incentives may be helpful in the development of new products and/or the redesign of existing products that utilize green chemistry and decrease the impact upon the environment?
 - c. What production methods would decrease chemical waste, use less or least harmful materials, and reduce the carbon footprint?
 - d. How can policies and practices be changed to reduce the waste and decrease pollution from emerging contaminants?
5. Explore potential recommendations to decrease the effects of emerging contaminants and future contaminants based upon existing research and some new areas for consideration.

With thousands of pharmaceuticals and chemicals that make up different PPCP, there is no way a chapter like this can be all-inclusive. By discussing key components of emerging contaminants in water, this chapter is an exploration of what needs to be considered now and in the future to mitigate exposure and safeguard our drinking water.

BACKGROUND

Pharmaceuticals and medical therapies not only save lives by preventing and treating diseases, but also by enhancing the quality of life for those with chronic diseases. Personal care products also improve our daily living by providing products that ease discomfort, improve our perceptions of appearance, and make

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