

# Contaminants in the Urban Environment: Pharmaceuticals and Personal Care Products (PPCPs)— Part 1<sup>1</sup>

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*This publication is part of a series titled Contaminants in the Urban Environment. This series is intended to give state and local government officials, soil scientists, consulting engineers, extension agents, and citizens (1) a basic understanding of the occurrence, toxic effects and source of various contaminants in the environment and (2) guidance on ways to protect human and environmental health.*

## Introduction and Purpose

*Pharmaceuticals* are products that we ingest or give to our pets and domesticated animals to improve health and to prevent or treat human and animal diseases. Pharmaceuticals include over-the-counter drugs, prescription medicines, nutritional supplements, and veterinary drugs.

*Personal care products* are products used to improve the quality of daily life by adorning and cleaning our bodies. Personal care products include lotions, fragrances, shampoos, antibacterial soaps, detergents, sunscreens, insect repellents, and cosmetics.

Together, these products are known as *pharmaceuticals and personal care products*, abbreviated as PPCPs (Figure 1).

This publication, *Contaminants in the Urban Environment: Pharmaceuticals and Personal Care Products (PPCPs)—Part*

*1*, provides an overview of the use and sale of PPCPs in the United States and the world. The second publication, *Contaminants in the Urban Environment: Pharmaceuticals and Personal Care Products (PPCPs)—Part 2*, discusses the sources and impacts of PPCPs as well as the ways to protect our environment from PPCPs (<http://edis.ifas.ufl.edu/ss633>).



Figure 1. Common pharmaceutical and personal care products (PPCPs) in households

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## Use of Pharmaceuticals and Personal Care Products (PPCPs)

**Pharmaceuticals:** Pharmaceuticals can be broadly split into two groups: (1) over-the-counter medications that do

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not require a doctor's prescription and (2) medications that require a doctor's prescription. In the United States and the rest of the world, most of the medication use (sale) is for the prescription medicines.

**(1) Over-the-Counter (OTC) Medications:** In 2012, OTC medications (both for oral ingestion and topical use) worth \$23 billion were sold in the United States. Cold, pain, and heartburn medications were the top categories (see Table 1). According to a report by Visiongain (2014), the worldwide sale of OTC medications could exceed \$93 billion by 2015.

**(2) Prescription Medications:** In 2012, the sale of prescription medicines was \$856 billion worldwide. Of that \$856 billion, medications worth \$330 billion (39 percent of total) were sold in the United States alone (IMS Institute for Healthcare Information 2013), which is almost 15 times more than the OTC medications sold (\$23 billion).

Table 2 shows the top 20 prescription medications sold in the United States and worldwide in 2012. The top 20 medications sold in the United States had a value of about \$70 billion. In the United States, the top three therapeutic classes of medications were hypertension (\$656 million), pain (\$472 million), and mental (\$329 million; Fig. 2). Looking at the worldwide trends, the top three therapeutic classes of medications were oncology, pain, and hypertension.

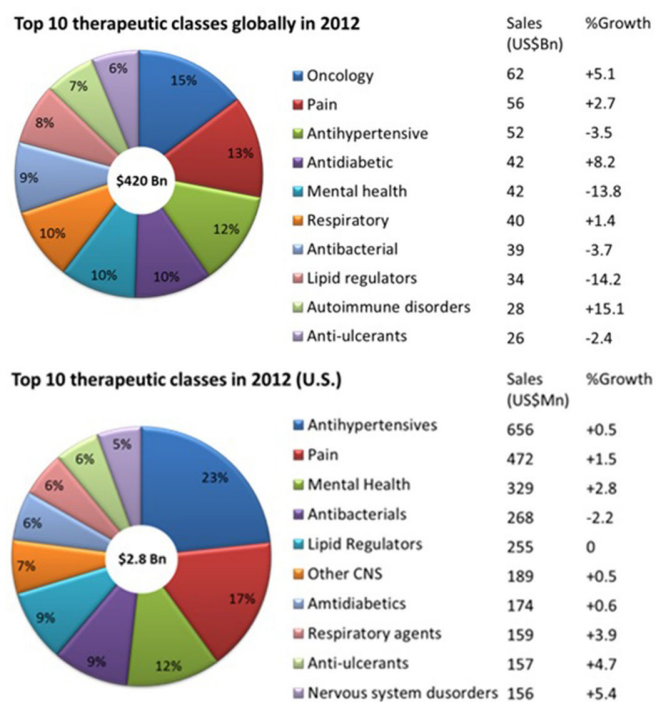


Figure 2. Sale of pharmaceutical based on therapeutic classes (a) worldwide and (b) in the United States  
Credits: <http://www.imshealth.com/> and <http://www.drugs.com/stats/top100/2012/sales>

The types of prescription medications most commonly used in the United States varied with age (Gu et al. 2010)—asthma medications for children (ages 0–11), central nervous system stimulants for adolescents (12–19), antidepressants for middle-aged adults (20–59), and cholesterol lowering and high blood pressure drugs for older Americans (60 and older).

The data on medication sales provide some perspective on how we use medications. For example, throughout the last decade the percentage of Americans who indicated they had used one prescription medication in the previous month increased by 4%, the use of multiple prescription medications increased by 6%, and the use of five or more medications increased by 5% (Gu et al. 2010).

Patients using prescription medications varied by age and gender. Data in Figure 3 shows that prescription use increased during the three time periods (1988–1994, 1999–2002, and 2007–2010). For example, men 65 years and older who claimed to have used three or more prescriptions in the previous month was 30% in 1988–1994. This increased to 45% in 1999–2002 and to 65% in 2007–2010. For women 65 years and older, the use of three or more prescriptions in the previous month was 38% in 1988–1994, and this increased to 55% in 1999–2002 and to 65% in 2007–2010. Based on these statistics, women were more likely to use medications than men (Fig. 3). During the three time periods, patient use of prescription medications increased with age: 5% for children, 10%–40% for working-aged adults, and 30%–70% for adults aged 65 and over. Overall, the use of three or more prescription medications in the previous month increased for all age groups of both males and females from 1988–1994 to 2007–2010.

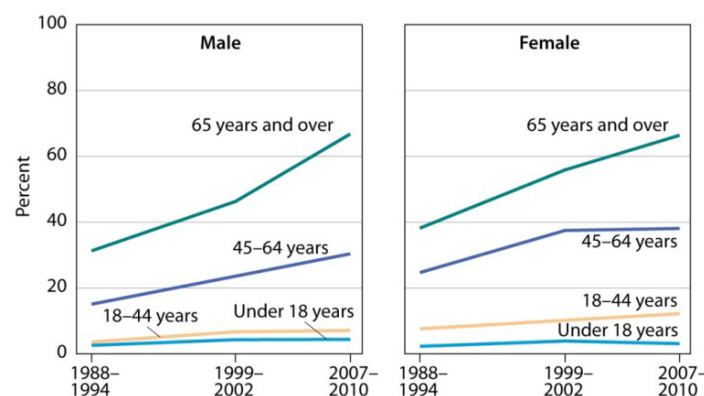


Figure 3. Use of three or more prescription medications in the previous month, by gender and age in the United States  
Credits: National Center for Health Statistics (CDC/NCHS). *Health, United States, 2012*. Data from the National Health and Nutrition Examination Survey

Consider that the United States is home to approximately 5 percent of the total world population and this population

uses about 39 percent of total prescription medication sales. Generally, a higher amount of a given medicine is prescribed and used so that there is a sufficient amount of medicine to work in the body and cure the symptoms or disease. A higher amount of medicine intake results in a greater amount of medicine excretion, either as the parent compound or as transformation products (or *metabolites*) in feces and urine. For example, research shows that of the total medicine taken, about 19%–22% is excreted as parent compound and additional 3%–49% is excreted as metabolites in the urine and feces (Lienert et al. 2007). Thus, the household wastewater that contains feces and urine ends up containing medicines and becomes a source of the parent medicine or its metabolites in the environment.

**Personal Care Products:** Many people use personal care products on a daily basis, be it hair or skin care products. The total global sale of personal care products was \$380 billion in 2010. It is estimated that spending on personal care products will continue to grow by 3% per year (Rexam 2011).

As shown in Fig. 4, worldwide hair care products are the number one seller (\$152 billion; 40% of total), followed by bath and shower products (\$91 billion; 24% of total), and facial skin care products (\$19 billion; 5% of total). In the global market of personal care products, Asia-Pacific region has the largest share (56%), followed by Europe (19%), Latin America (14%), North America (8%), and Middle East and Africa (2%).

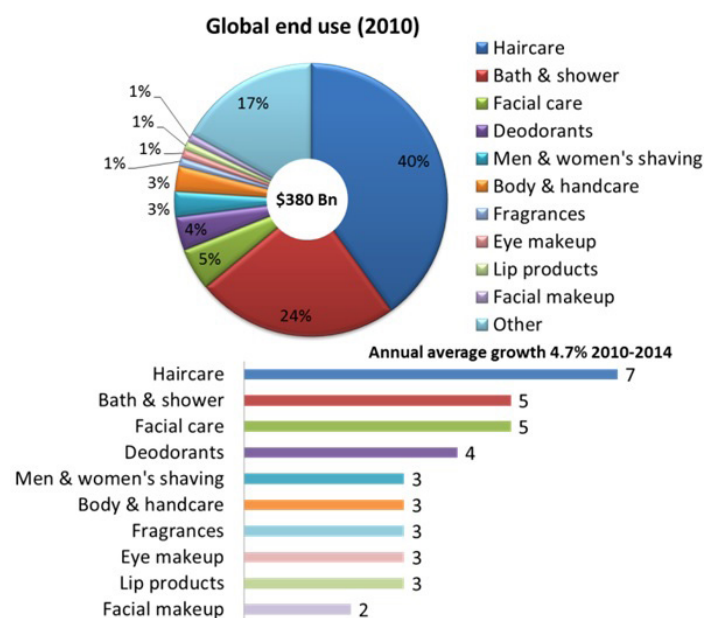


Figure 4. Total global sales of personal care products in 2010  
Credits: Rexam (2011)

Figure 5 shows that in the United States in 2013, skin care products sales were \$9.8 billion, followed by hair care products (\$7.8 billion) and makeup products (\$6.5 billion). Note that in comparison to sale of \$330 billion on prescription and \$23 billion on OTC medications, consumers in the United States spend far less (~\$30 billion) on personal care products.

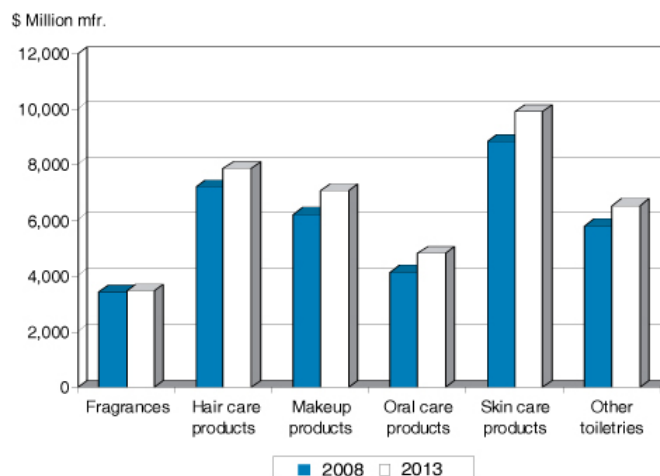


Figure 5. Projected dollar sales of the US cosmetics and toiletries industry by product class, 2008 to 2013

Credits: Kline & Company ([http://www.klinegroup.com/reports/emailings/newsletters/chemicals/december2009/timely\\_trends.asp](http://www.klinegroup.com/reports/emailings/newsletters/chemicals/december2009/timely_trends.asp))

Personal care products contain a variety of chemical substances. For example, phthalates are a group of compounds widely used in cosmetics, fragrances, hair products, and shampoo. Widely used as an antibacterial and antifungal agent, triclosan is present as an additive in a variety of consumer products, including soaps, deodorants, and toothpastes. For example, liquid soap may contain 0.3 to 0.5 percent of triclosan. Many of these products enter household wastewater from bath and shower, sinks, and washers and ultimately find their way into the environment. Continuous discharge of wastewater contributes to the accumulation of these substances in the environment.

Because of the presence of these substances, PPCPs discarded into the environment can be harmful to organisms. For example, triclosan and its transformation products have been found in water, plant, and fish samples; and they may have adverse effects on algal communities and aquatic organisms (Wilson et al. 2003). Consult the second publication, *Contaminants in the Urban Environment: Pharmaceuticals and Personal Care Products (PPCPs)—Part 2* (<http://edis.ifas.ufl.edu/ss633>) to learn about these harmful effects along with ways to protect ourselves and our environment.

## References

Gu, Q., C. F. Dillon, and V. L. Burt. 2010. "Prescription Drug Use Continues to Increase: U.S. Prescription Drug Data for 2007–2008." NCHS Data Brief, no 42. Hyattsville, MD: National Center for Health Statistics.

IMS Institute for Healthcare Information. 2013. Accessed December 2, 2013. <http://www.imshealth.com/>.

National Center for Health Statistics. 2013. *Health, United States, 2012: With Special Feature on Emergency Care*. Hyattsville, MD.

Rexam PLC. 2011. *Packaging Unwrapped: Rexam Consumer Packaging Report 2011/12*. Accessed January 26, 2015. [http://www.rexam.com/files/pdf/packaging\\_unwrapped\\_2011.pdf](http://www.rexam.com/files/pdf/packaging_unwrapped_2011.pdf).

Visiongain. 2014. "World OTC Pharmaceuticals market Forecast 2015–2025: Prospects for Leading Companies." Accessed January 26, 2015. <https://www.visiongain.com/Report/1368/World-OTC-Pharmaceuticals-Market-Forecast-2015-2025>.

Wilson, B. S., V. H. Smith, F. DeNoyelles, and C. K. Larive. 2003. "Effects of three pharmaceutical and personal care products on natural freshwater algal assemblages." *Environmental Science and Technology* 37: 1713–1719.

Table 1. Sale of top OTC medications in the United States

| Top OTC Medications Sales for Oral Ingestion                                                                                                                                                                              | Top OTC Medications Sales for Topical Use   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Cough/cold and allergy remedies (\$6.6 billion)                                                                                                                                                                           | Oral antiseptics and rinses (\$1.4 billion) |
| Analgesics and pain products (\$3.9 billion)                                                                                                                                                                              | First aid treatment (\$1.1 billion)         |
| Heartburn medicines and anti-gas products (\$2.3 billion)                                                                                                                                                                 | Eye care products (\$0.85 billion)          |
| Laxatives (\$1.4 billion)                                                                                                                                                                                                 |                                             |
| Anti-smoking (\$1.2 billion)                                                                                                                                                                                              |                                             |
| Source: <a href="http://pharma.about.com/od/Over-the-Counter-Medicine/a/Top-selling-Otc-Drugs-By-Category-2012.htm">http://pharma.about.com/od/Over-the-Counter-Medicine/a/Top-selling-Otc-Drugs-By-Category-2012.htm</a> |                                             |

Table 2. Top 20 prescription medications sales in 2012

| Product       | Active Ingredient                                  | Use                                                                                                                    | US   |                       | Global |                       |
|---------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------|-----------------------|--------|-----------------------|
|               |                                                    |                                                                                                                        | Rank | Sales (US \$ Billion) | Rank   | Sales (US \$ Billion) |
| Nexium        | Esomeprazole                                       | Gastroesophageal reflux disease                                                                                        | 1    | 5.64                  | 4      | 7.5                   |
| Abilify       | Aripiprazole                                       | Major depressive disorder                                                                                              | 2    | 5.6                   | 7      | 7.0                   |
| Crestor       | Rosuvastatin calcium                               | High cholesterol and high triglycerides in the blood                                                                   | 3    | 4.76                  | 3      | 8.3                   |
| Advair Diskus | Fluticasone propionate, salmeterol xinafoate       | Asthma in patients 4 years and older                                                                                   | 4    | 4.62                  | 1      | 8.9                   |
| Cymbalta      | Duloxetine hydrochloride                           | Major depressive disorder and general anxiety disorder                                                                 | 5    | 4.47                  | 10     | 5.8                   |
| Humira        | Adalimumab                                         | Rheumatoid arthritis, juvenile idiopathic arthritis, psoriatic arthritis, ankylosing spondylitis, and plaque psoriasis | 6    | 4.3                   | 2      | 8.5                   |
| Enbrel        | Etanercept                                         | Rheumatoid arthritis, ankylosing spondylitis, and psoriatic arthritis                                                  | 7    | 3.99                  | 5      | 7.5                   |
| Remicade      | Infliximab                                         | Rheumatoid arthritis, psoriatic arthritis, ulcerative colitis and Crohn's disease                                      | 8    | 3.72                  | 6      | 7.3                   |
| Copaxone      | Glatiramer acetate                                 | Multiple sclerosis                                                                                                     | 9    | 3.33                  | 18     | 4.5                   |
| Neulasta      | Pegfilgrastim                                      | Neutropenia                                                                                                            | 10   | 3.32                  | 20     | 4.3                   |
| Rituxan       | Rituximab                                          | Non-Hodgkin's lymphoma or chronic lymphocytic leukemia                                                                 | 11   | 3.13                  | —      | —                     |
| Singulair     | Montelukast sodium                                 | Seasonal allergic rhinitis and perennial allergic rhinitis                                                             | 12   | —                     | 16     | 4.7                   |
| Atripla       | Efavirenz, emtricitabine, and tenofovir disoproxil | Human immunodeficiency virus (HIV)                                                                                     | 13   | 2.77                  | —      | —                     |
| OxyContin     | Oxycodone hydrochloride                            | Moderate to severe pain                                                                                                | 14   | 2.69                  | —      | —                     |
| Spiriva       | Tiotropium                                         | Breathing difficulties caused by chronic obstructive pulmonary disease (COPD)                                          | 15   | 2.69                  | 13     | 5.1                   |
| Avastin       | Bevacizumab                                        | Patients with certain types of colorectal and lung cancers                                                             | 16   | 2.56                  | 11     | 5.4                   |
| Plavix        | Clopidogrel bisulfate                              | Prevent blood clots after a recent heart attack                                                                        | 17   | —                     | 12     | 5.2                   |
| Januvia       | Sitagliptin                                        | Type 2 (non insulin-dependent) diabetes                                                                                | 18   | 2.5                   | —      | —                     |
| Lantus        | Insulin glargine                                   | Type 1 (insulin-dependent) or type 2 (non insulin-dependent) diabetes                                                  | 19   | 2.21                  | 8      | 6.6                   |
| Truvada       | Tenofovir disoproxil and emtricitabine             | HIV                                                                                                                    | 20   | 2.21                  | —      | 6.0                   |
| MabThera      | Rituximab                                          | Rheumatoid arthritis                                                                                                   |      | —                     | 9      | 4.3                   |
| Glivec        | Imatinib mesilate                                  | Blood cancer                                                                                                           | 28   | 1.7                   | 19     |                       |
| Lipitor       | Atorvastatin                                       | High cholesterol, and to lower the risk of stroke, heart attack                                                        | 31   | —                     | 14     | 5.1                   |
| Herceptin     | Trastuzumab                                        | Breast cancer                                                                                                          |      | —                     | 15     | 5.0                   |

Source: <http://www.drugs.com/stats/top100/2012/sales>