

ISTC Reports

Illinois Sustainable Technology Center

PPCPs in the Illinois Environment: Current Information and Research Recommendations

Gary Miller

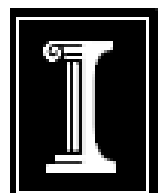
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Printed by the Authority of the State of Illinois
Patrick J. Quinn, Governor

Introduction

There is increasing awareness of the occurrence of residuals from pharmaceuticals and personal care products (PPCPs) in water supplies and aquatic ecosystems in Illinois and throughout the U.S. (1-3). Subsequently, there are concerns about the effects of these residuals on aquatic life and human health (4-7). PPCPs are generally defined as any product used by individuals for personal health or cosmetic reasons or used by agribusiness to enhance growth or health of livestock. PPCPs include a diverse collection of thousands of chemical substances, including prescription and over-the-counter therapeutic drugs, hormones, veterinary drugs, fragrances, and cosmetics (8).

Why should Illinois citizens be concerned?

PPCPs have probably been present in water and the environment for as long as humans have been using them. When we use these compounds, or when animals are given these substances, they are not entirely absorbed by the body and excreted amounts can get passed into wastewater and surface water. As advances in analytical techniques and technology have allowed us to detect and quantify very low levels of these chemicals in recent years, we have become more aware of their existence in the environment and in biota and humans (2,5,8,9).

In spring 2008, the Illinois Environmental Protection Agency (IEPA) analyzed raw and finished drinking water from five communities in the state for the presence of pharmaceuticals. The project identified 16 PPCPs in the untreated and potable water of the five public water supplies that were tested (10). After comparison to conservative screening levels established by IEPA and Illinois Department of Public Health (IDPH), IEPA concluded that the PPCP concentrations in the water supplies do not present a public health hazard at this time. But, due to considerable uncertainties, they suggested that further sampling be conducted if funding could be obtained. The widespread occurrence of PPCPs has led to increasing questions about what effect these chemicals have on human and environmental health (5,6,8,9). Some of the compounds, such as hormones, are similar to substances that are known to have harmful effects on biota (5,6).

Symposium

In order to understand the current status of research on PPCPs in the state of Illinois and provide an opportunity for discussion about research needs, in April 2008 the Waste Management and Research Center (WMRC)*, a division of IDNR, organized a symposium on this subject. WMRC contacted colleges, universities and agencies in the state to identify researchers working on topics related to PPCPs in the Illinois environment. Representatives from IEPA, IDPH, and U.S. EPA, as well as from the pharmaceutical industry and water and wastewater utilities, were invited to participate in the discussions at the symposium. Appendix A lists the presenters and their topics and Appendix B gives the names of all individuals attending the symposium. Most of the presentations given at the symposium are archived for viewing at www.istc.illinois.edu.

Findings

- The PPCP-related research capabilities of certain agencies and universities were identified, but there have been few studies conducted to date on PPCPs in Illinois.

- The occurrence and seasonal variation of PPCPs in different water supplies and various aquatic environments in Illinois is not well-known.
- There is some evidence that these environmental contaminants may cause adverse effects on human and ecological health; however, there have not been enough specific studies conducted on these issues.
- There is a lack of analytical capabilities in laboratories in Illinois for analyzing (detecting and identifying) PPCPs and it is expensive to analyze for PPCPs on a routine basis.
- Illinois agencies, water utilities, manufacturers, and universities are all interested in working together on this issue, but the state lacks a cohesive plan to address concerns with PPCPs in our water supplies and aquatic ecosystems.

Recommendations

In order to understand the impact that PPCPs may have on human health and organisms in Illinois, there will need to be:

- An organized public-private effort across the state to monitor PPCPs entering water supplies and the environment;
- Expanded analytical laboratory capability in the state to test for PPCPs;
- Coordinated efforts among agencies, public utilities, and other entities to prevent PPCPs from entering the environment;
- Studies of the effects of PPCPs on human health - especially for high risk populations such as infants and children, pregnant women, and the elderly;
- Studies on ecological effects; and
- Studies of new PPCPs that will be coming on the market and their impact.

Because of the potential emerging health and environmental issues related to PPCPs, there will likely be federal funds available for the study of PPCPs. State agencies and universities need to position themselves to obtain these funds and develop Illinois' research infrastructure. If the state has a plan in place, it can secure federal funding to help it with its assessment and mitigation of the potential problems associated with PPCP residuals in the environment. To accomplish these goals, it is recommended that the state consider creating a working group to coordinate these efforts.

The IEPA is currently working on the issues of education, collection, and disposal of PPCPs and has recently established a Medication Education Disposal Solutions (MEDS) Action Committee to facilitate an organized approach on these topics. In addition, they have performed initial testing of several drinking water supplies in Illinois for the presence of PPCPs. Other agencies such as the Illinois Sustainable Technology Center (ISTC, formerly WMRC), university departments, U.S. EPA, and state and local groups have begun to become involved with education, collection, and/or research. To focus the various activities and assist in collaboration by the different entities, the working group would need to:

- Develop, or oversee the development of, a plan for education of industries, hospitals, nursing homes, and the public on the proper disposal of PPCPs;

- Work with communities and other groups on proper procedures for implementing and maintaining a program to provide easy collection and disposal sites and evaluate the effectiveness of these programs;
- Examine legal issues involved with collection and disposal; and work with local environmental groups to help support these efforts;
- Evaluate the status of current research and promote studies on the occurrence of PPCPs, the effects of PPCPs on aquatic ecosystems (studies on effects on vertebrates, invertebrates, and microbes) and the effects on human health, as well as studies to determine which compounds are of most concern (e.g., hormones);
- Help researchers collaborate to seek funding from public and private sources to undertake needed research;
- Foster the development of analytical techniques for different PPCPs and encourage expanding analytical capability at several labs around the state so that when water utilities and other industries need analyses of PPCPs there are standard methods developed for various matrices and the analytical capability to do so within the state;
- Examine technology to work to reduce residuals entering waste streams;
- Set up a database for research results and for dissemination of information; and
- Hold a regular workshop with the working group on PPCPs in Illinois.

These recommendations and specific tasks are based on presentations as well as suggestions and comments by participants at the symposium.

The suggested roles and responsibilities on this issue for various entities in the state were outlined and are shown in Table 1.

Resources and Capabilities in the State

Appendix C provides the names and contact information of researchers and individuals who were identified as working on various aspects related to PPCPs in Illinois. Additional information on PPCPs may be obtained from the U.S. EPA website (www.epa.gov/ppcp/) and their PPCP bibliography (www.epa.gov/ppcp/lit.html), and the IEPA website www.epa.state.il.us under Medication Disposal, along with the IL-IN Sea Grant website www.iisgcp.org/unwantedmeds. The U.S. Geological Survey Toxic Substances Hydrology Program has a substantial bibliography of articles related to PPCPs in the environment (<http://toxics.usgs.gov/bib/bib-ecoccurrence.html>). Also, information on PPCPs research will be available in the PPCPs bibliography that is being compiled by ISTC librarian Laura Barnes. It will be published on our website www.istc.illinois.edu in spring 2009.

Please contact Nancy Holm at nholm@istc.illinois.edu for more information or with questions about the symposium.

*As of July 1, 2008, WMRC is called the Illinois Sustainable Technology Center (ISTC) and is now part of the University of Illinois at Urbana-Champaign.

References

1. Koplín, D. et al. 2002. "Pharmaceuticals, hormones, and other organic wastewater contaminants in U.S. streams, 1999-2000: A national reconnaissance." *Environmental Science and Technology* 26:1201-1211.
2. Donn, J. et al. 2008. "Drugs in Our Water Supply." Associated Press. March 10-12, 2008. *USA Today*.
3. U.S. Geological Survey. 2006. *Environmental Occurrence – Emerging Chemical Contaminants*. Online at http://toxics.usgs.gov/regional/emc/environmental_occurrence.html
4. U.S. Geological Survey. 2006. *Are Pharmaceuticals in Your Watershed? Understanding the Fate of Pharmaceuticals and Other Contaminants in Watersheds*. Online at http://toxics.usgs.gov/highlights/pharm_watershed/
5. Kreisberg, J. 2007. "Pharmaceutical Pollution: Ecology and Toxicology." *Teleosis: The Journal of Sustainable Medicine*. Spring/Summer 2007, pp. 5-13. www.teleosis.org.
6. Halford, B. 2008. "Side Effects." *Chemical and Engineering News*. February 25, 2008, Vol. 86, No. 8, pp. 13-17. Online at www.cen-online.org
7. Kostitch, M. and J. Lazorchak. 2006. *An informatic approach to estimating ecological risks posed by pharmaceutical use: Human prescription pharmaceuticals*. Washington, D.C.: U.S. Environmental Protection Agency. 70 pp.
8. U.S. EPA. *Pharmaceuticals and Personal Care Products as Pollutants (PPCPs)*. 2008. Online at <http://www.epa.gov/ppcp/>
9. Daughton, C.G. 2004. "PPCPs in the Environment: Future Research – Beginning with the End always in Mind." In: *Pharmaceuticals in the Environment*. Kummerer, K. (Ed.) Second edition. Springer. Chapter 33, pp. 463-495.
10. Illinois EPA. 2008. *Report on Pharmaceuticals and Personal Care Products in Illinois Drinking Water*. Springfield, Illinois: Illinois Environmental Protection Agency. 10 pp.

Appendix A

Symposium on PPCPs in the Illinois Environment – April 25, 2008

Presentations:

Tom Hornshaw and Marcia Willhite - IL EPA

"Illinois EPA Study of Pharmaceuticals in Drinking Water"

Mike Caughy - IL State Water Survey

"A Pilot Study of PPCPs in Central Illinois Surface Waters"

John Kelly - Dept. of Biology, Loyola University-Chicago

"Ecological Impacts of Pharmaceuticals and Personal Care Products in Illinois Rivers and Streams"

Patrick Hayes - Dept. of Chemistry, Northwestern University

"Oxytetracycline at Environmental Interfaces Studied by Second Harmonic Generation"

Kevin Johnson - Dept. of Chemistry and Environmental Sciences, SIU-Edwardsville

"Determination of Pharmaceuticals in the Surface waters of the Upper Mississippi and Lower Illinois Rivers"

Teresa Chow - Analytical Services, WMRC

"Evaluation of Analytical Methods for Pharmaceuticals and Personal Care Products"

Jeff Levensgood - IL Natural History Survey and Dept. of Veterinary Biosciences, UIUC

"Effects of PPCPs on Wildlife: What Do We Really Know?"

Elizabeth Murphy - U.S. EPA Great Lakes National Program Office (by videocam)

"Pharmaceuticals and Personal Care Products (PPCPs), Hormones, and Alkylphenol Ethoxylates (APEs) in the North Channel of the Chicago River"

Susan Boehme - IL-IN Sea Grant/U.S. EPA GLNPO (by videocam)

"Disposal of Unwanted Medicines"

David Lordi – Metropolitan Waste Reclamation District of Greater Chicago (by videocam)

Timm Strathmann - Center of Advanced Materials for the Purification of Water with Systems, Dept. of Civil and Environmental Engineering, UIUC

"Developing Targeted Treatment Strategies for Pharmaceuticals and Personal Care Products and Wastewater-Derived Micropollutants"

Terry Johnson – Groundwater Protection Program, Waste Management

"Modern Landfill Technology and Conditions: Implications for PPCP Management"

Esther Dundore - Environmental Management and Compliance, Illinois American Water

"Illinois American Water Perspectives on Pharmaceuticals in Drinking Water"

Appendix B

Symposium on PPCPs in the Illinois Environment - April 25, 2008

Participants:

Name	Affiliation
Dundore, Esther	American Water Corp.
Boehme, Susan	IL-IN Sea Grant/U.S. Environmental Protection Agency, Great Lakes National Program Office
Bordson, Gary	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Caughy, Mike	University of Illinois at Urbana-Champaign, State Water Survey
Chow, Teresa	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Davis, Jennifer	IL Dept. of Public Health
Flaws, Jodi	University of Illinois-Urbana-Champaign, Dept. of Veterinary Biosciences
Hayes, Patrick	Northwestern University, Dept. of Chemistry
Holm, Nancy	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Hornshaw, Tom	IL Environmental Protection Agency
Johnson, Gary	U.S. Geological Survey - Illinois
Johnson, Kevin	Southern Illinois University - Edwardsville, Dept. of Chemistry & Environmental Sciences
Johnson, Terry	Waste Management Inc.
Kelly, John	Loyola University - Chicago
Kelly, Walt	University of Illinois at Urbana-Champaign, State Water Survey
Larson, Richard	University of Illinois at Urbana-Champaign, Dept. of Natural Resources & Env. Sciences
Levengood, Jeff	University of Illinois at Urbana-Champ, Natural History Survey & Dept. of Veterinary Biosciences
Lordi, David	Metropolitan Waste Reclamation District of Greater Chicago
Meyerhoff, Roger	Eli Lilly
Miller, Gary	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Murphy, Elizabeth	U.S. Environmental Protection Agency, Great Lakes National Program Office
Rajagopalan, Kishore	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Runkle, Ken	IL Dept. of Public Health
Sneed, Lindell	Abbott
Strathmann, Timm	University of Illinois at Urbana-Champaign, Dept. of Civil & Environmental Engineering
Sullivan, Bill	University of Illinois at Urbana-Champaign, Environ. Council & Dept. of Landscape Architecture
Warner, Richard	University of Illinois at Urbana-Champaign, Office of Sustainability
Wilcoxon, Monte	University of Illinois at Urbana-Champaign, Illinois Sustainable Technology Center
Willhite, Marcia	IL Environmental Protection Agency

Appendix C

Researchers and other individuals involved with Environmental Aspects of PPCPs in Illinois*

Name	Address	Telephone	Email/web site
Anderson, Paul	Dept. of Civil, Architectural, and Environmental Engineering, Illinois Institute of Technology, Chicago, IL 60616	312-567-3531	andersonp@iit.edu
Boehme, Susan	IL-IN Sea Grant College Program/U.S. EPA Great Lakes National Program Office, 77 West Jackson Blvd., Chicago, IL 60604	312-353-4383	boehme.susan@epa.gov
Caughy, Mike	State Water Survey, Water Research Center, University of Illinois, 2204 Griffith Drive, Champaign, IL 61820	217-333-1611	mcaughey@illinois.edu
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Hornshaw, Thomas	IL Environmental Protection Agency, Toxicology Assessment Unit, 1021 N. Grand Ave. E., P.O. Box 19276, Springfield, IL 62794	217-785-0832	thomas.hornshaw@illinois.gov
Johnson, Kevin	Dept. of Chemistry and Environmental Sciences, Southern IL Univ. - Edwardsville, Edwardsville, IL 62026	618-650-5051	kevjohn@siue.edu
Kelly, John	Dept. of Biology, and Center for Urban Environmental Research and Policy, Loyola University, 6525 N. Sheridan Rd., Chicago, IL 60640	773-508-7097	jkelly7@luc.edu
Kelly, Walt	Division of State Water Survey, Water Research Center, University of Illinois, 2204 Griffith Drive, Champaign, IL 61820	217-333-3729	wkelly@illinois.edu
Larson, Richard	Dept. of Natural Resources & Environmental Sciences, 372 National Soybean Research Lab, University of Illinois, Urbana, IL 61801	217-333-7269	ralarson@uiuc.edu
Levengood, Jeff	State Natural History Survey, and Dept. of Veterinary Biosciences, University of Illinois, Champaign, IL 61820	217-333-6767	jleven@inhs.illinois.edu
Lordi, David	Metropolitan Water Reclamation District of Greater Chicago, Research & Development Dept., 6001 W. Pershing Rd., Cicero, IL 60804	312-751-5600	David.Lordi@mwrddc.dst.il.us
Lydy, Michael	Fisheries and Illinois Aquaculture Center, Southern IL Univ - Carbondale, Carbondale, IL 62901	618-453-4091	mlydy@siu.edu
Murphy, Elizabeth	Great Lakes Fish Monitoring Program Manager, U.S. EPA, Great Lakes National Program Office, Mail Code G-17J, 77 W. Jackson Blvd., Chicago, IL 60604-3590	312-353-4227	Murphy.Elizabeth@epa.gov
Nettesheim, Todd	U.S. EPA, Great Lakes National Program Office, Mail Code G-17J, 77 W. Jackson Blvd., Chicago, IL 60604-3590	312-353-9153	Nettesheim.Todd@epa.gov
Rosi-Marshall, Emma	Dept. of Biology, and Center for Urban Environmental Research and Policy, Loyola University, 6525 N. Sheridan Rd., Chicago, IL 60640	773-508-8889	erosi@luc.edu
Runkle, Ken	IL Dept. of Public Health, 535 W. Jefferson St., Springfield, IL 62761	217-785-1666	Ken.Runkle@illinois.gov
Strathmann, Tim	Center of Advanced Materials for the Purification of Water with Systems, Dept. of Civil and Environmental Engineering, 3209 Newmark Lab, University of Illinois, Urbana, IL 61801	217-244-4679	strthmnn@illinois.edu
Willhite, Marcia	Chief, Bureau of Water, IL Environmental Protection Agency, 1021 N. Grand Ave. E., Springfield, IL 62794	217-782-1654	marcia.willhite@illinois.gov
Zheng, Wei	Illinois Sustainable Technology Center, University of Illinois, One E. Hazelwood Dr., Champaign, IL 61820	217-333-7276	weizheng@illinois.edu

*List may be incomplete

Table 1. Suggested Roles and Responsibilities for Working on Issues Involving PPCPs in the Illinois Environment

		State/Local Government	Universities	Manufacturers	Healthcare Providers	Drinking Water and Wastewater Utilities
	Current Status and Needs					
Responsibility						
Monitoring	IEPA sampled drinking water in 5 cities in 2008; a few other reports have some occurrence data in d.w. or surface water in IL; no uniform monitoring policy by state of IL or by utilities. Need more information on occurrence and concentrations; also more research needed on development of quicker and less expensive analytical methods; very costly for analysis of PPCPs currently; new drugs coming into use all of the time that will need to be monitored.	State and local EPA - establish monitoring of more sites in IL; solicit or provide funds for analytical method development and study.	All interested universities and colleges in IL - work with state agencies on analytical method development and assist with the establishment of an environmental monitoring network.			Work with government agencies to establish monitoring programs for various PPCPs, especially those considered potentially more harmful such as hormones.
Research	Insufficient data on effects of PPCPs at low concentrations on aquatic environment or on human health. Need study to identify any effects and especially need research on the more at-risk populations - children, pregnant women, elderly.	State and Great Lakes EPA and State Legislature - fund research on PPCPs' effects on aquatic environment and human health.	Universities/colleges in IL - develop research projects aimed at providing data on environmental and health effects of PPCPs needed to help policy makers with decisions on setting "safe" levels; provide research on keeping PPCPs out of the waste stream and the cleaning of water supplies.	Support research on environmental and human health effects of PPCPs in the residual concentrations found in the environment; work to develop drugs that breakdown into non-harmful components after use.	Hospitals, nursing homes, doctors' offices - work with universities on research projects; help fund or collaborate to obtain funding for research projects on effects of low levels of PPCPs on human health.	Collaborate with researchers as they examine water supplies; help support research to decrease residual amounts of PPCPs in water supplies and research on effects on environmental/human health.
Public Education	Some information recently in media on PPCP residuals in water supplies; a few communities have started collection programs; IEPA and IL-IN Sea Grant are distributing information on proper disposal and funding a few pilot collection programs, mostly one day events. IEPA recently established a Medication Education Disposal Solutions (MEDS) Action Committee to work on this issue. Need to make public aware of relative low concentrations out there and potentially slim health risks; need to make them aware of proper disposal of PPCPs.	State and Local EPA and Dept. of Health; IL-IN Sea Grant - work together on education programs, brochures for pharmacies, doctors' offices, hospitals, and nursing homes.	UI Extension offices provide talks and various publications/brochures on results of research work and collection programs.	Better educate the public on use and proper disposal of medications; work with other agencies on public service announcements and include information in their product ads on the proper disposal of PPCPs.	Hospitals, doctors' offices, nursing homes - work with other agencies on education of their staff on proper disposal of PPCPs at their facilities.	Work with other agencies on brochures and public service announcements on proper disposal of PPCPs.
Collection	Very few collection programs ongoing in the state. Need to establish programs in all larger communities and allow everyone interested in participating to have access to the collection programs.	State/ Local EPA and Dept. of Health; City Police Depts. - help establish collection programs at drug stores and hospitals, nursing homes and other facilities and ensure safe handling and disposal of the PPCPs collected.		Work with other agencies on promoting the use of these collection programs.	Hospitals, doctors' offices, nursing homes - work with state and local agencies and police on establishing collection programs for proper disposal of PPCPs by staff at facilities.	Work with other agencies on promoting the use of these collection programs.