World Health Organization

PHARMACEUTICALS IN DRINKING-WATER

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Contents

List of acronyms and abbreviations

ADI	acceptable daily intake
DWEL	drinking-water equivalent level
EDC	endocrine disrupting chemical
FAO	Food and Agriculture Organization of the United Nations
GAC	granular activated carbon
GC	gas chromatography
LC	liquid chromatography
LOAEL	lowest-observed-adverse-effect level
LOQ	limit of quantification
MF	microfiltration
MOE	margin of exposure
MS	mass spectrometry
MS/MS	tandem mass spectrometry
MTD	minimum therapeutic dose
nd	not detected
NF	nanofiltration
NOAEL	no-observed-adverse-effect level
NSAID	non-steroidal anti-inflammatory drug
PAC	powdered activated carbon
PoD	point of departure
PUB	Public Utilities Board (Singapore)
RO	reverse osmosis
SF	sand filtration
TDI	tolerable daily intake
UF	ultrafiltration
USA	United States of America
USEPA	United States Environmental Protection Agency
UV	ultraviolet
WHO	World Health Organization
WSH	Water, Sanitation, Hygiene and Health unit (WHO)

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Executive summary

Background

In the last decade, traces of pharmaceuticals, typically at levels in the nanograms to low micrograms per litre range, have been reported in the water cycle, including surface waters, wastewater, groundwater and, to a lesser extent, drinking-water. Advances in analytical technology have been a key factor driving their increased detection. Their presence in water, even at these very low concentrations, has raised concerns among stakeholders, such as drinking-water regulators, governments, water suppliers and the public, regarding the potential risks to human health from exposure to traces of pharmaceuticals via drinking-water.

Following requests from several Member States for information regarding the potential health impacts of residual concentrations of pharmaceuticals in drinking-water, this issue was added to the work plan of the World Health Organization (WHO) Drinking-water Quality Committee in 2005. It was proposed that a working group of experts be assembled to undertake a rapid review of the state of the science of pharmaceuticals in drinking-water and develop guidance and recommendations in a report and fact sheet.

A WHO working group that comprised experts in toxicology, water chemistry, water quality and health, water treatment, pharmacology, and drinking-water regulation and policy was formed in 2009. Consultations were held in 2009 and 2010 with the Drinking-water Quality Committee and additional experts to review and summarize the available scientific knowledge and evidence.

A literature review was a key source of evidence. This examined the fate and

More importantly, it emphasizes the need to prioritize this emerging issue in the overall context of water safety management, which includes microbial and other chemical risks that may threaten the safety of drinking-water.

Scope

This report focuses primarily on reviewing the risks to human health associated with exposure to trace concentrations of pharmaceuticals in drinking-water. It does not discuss the potential impacts on aquatic ecosystems or the broader physical environment.

Occurrence of pharmaceuticals in water

Pharmaceuticals are synthetic or natural chemicals that can be found in prescription medicines, over-the-counter therapeutic drugs and veterinary drugs. Pharmaceuticals contain active ingredients that have been designed to have pharmacological effects and confer significant benefits to society. The occurrence of pharmaceuticals in the environment and the water cycle at trace levels (in the range of nanograms to low micrograms per litre) has been widely discussed and published in literature in the past decade. The increase in detection is largely attributable to the advances in analytical techniques and instrumentation. Many surveys and studies have confirmed the presence of pharmaceuticals in municipal wastewater and effluents, and these have been identified as a major source of pharmaceuticals in drinking-water (Figure ES1).

Routine monitoring programmes to test drinking-water for pharmaceuticals