

Preface

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection.

The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international policy forums. This includes, most recently, the adoption of the Sustainable Development Goals by countries, in 2015, which include a target and indicator on safe drinking-water. Further, the United Nations (UN) General Assembly declared in 2010 that safe and clean drinking-water and sanitation is a human right, essential to the full enjoyment of life and all other human rights. These commitments build on a long history of support including the UN General Assembly adopting the Millennium Development Goals in 2000 and declaring the period 2005–2015 as the International Decade for Action, “Water for Life”.

Access to safe drinking-water is important as a health and development issue at national, regional and local levels. In some regions, it has been shown that investments in water supply and sanitation can yield a net economic benefit, because the reductions in adverse health effects and health-care costs outweigh the costs of undertaking the interventions. This is true for investments ranging from major water supply infrastructure through to water treatment in the home. Experience has also shown that interventions in improving access to safe water favour the poor in particular, whether in rural or urban areas, and can be an effective part of poverty alleviation strategies.

The World Health Organization (WHO) published four editions of the *Guidelines for drinking-water quality* (in 1983–1984, 1993–1997, 2004, and 2011), as successors to the previous WHO *International standards for drinking water*, which were published in 1958, 1963 and 1971. Since 1995, the Guidelines have been kept up to date through a process of rolling revision, which leads to the regular publication of addenda that may add to or supersede information in previous volumes, as well as expert reviews on key issues in preparation for the revision of the Guidelines.

Leading the process of the development of the fourth edition was the Water, Sanitation, Hygiene and Health Unit within WHO Headquarters. The Chemical Safety Unit and the Risk Assessment and Management Unit provided input on chemical hazards, and the Radiation Programme provided input on radiological hazards. All six WHO regional offices participated in the process, in consultation with Member States.

This version of the Guidelines integrates the fourth edition, which was published in 2011, with the first addendum to the fourth edition published in 2016. It supersedes previous editions of the Guidelines and previous International Standards.

The primary goal of the Guidelines is to protect public health associated with drinking-water quality. The overall objectives of the Guidelines are to:

- provide an authoritative basis for the effective consideration of public health in setting national or regional drinking-water policies and actions;
- provide a comprehensive preventive risk management framework for health protection, from catchment to consumer, that covers policy formulation and standard setting, risk-based management approaches and surveillance;
- emphasize achievable practices and the formulation of sound regulations that are applicable to low-income, middle-income and industrialized countries alike;
- summarize the health implications associated with contaminants in drinking-water, and the role of risk assessment and risk management in disease prevention and control;
- summarize effective options for drinking-water management; and
- provide guidance on hazard identification and risk assessment.

This edition of the Guidelines, incorporating the first addendum, further develops concepts, approaches and information introduced in previous editions, including the comprehensive preventive risk management approach for ensuring drinking-water quality that was introduced in the third edition. This edition considers:

- drinking-water safety, including minimum procedures and specific guideline values, and how these are intended to be used;
- approaches used in deriving the Guidelines, including guideline values;
- microbial hazards, which continue to be the primary concern in both developing and developed countries. Experience has shown the value of a systematic approach to securing microbial safety. This edition builds on the preventive principles introduced in the third edition on ensuring the microbial safety of drinking-water through a multiple-barrier approach, highlighting the importance of source water protection;
- climate change, which results in changing water temperature and rainfall patterns, severe and prolonged drought or increased flooding, and its implications for water quality and water scarcity, recognizing the importance of managing these impacts as part of water management strategies;
- chemical contaminants in drinking-water, including information on chemicals not considered previously (e.g. pesticides used for vector control in drinking-water); revisions of existing chemical fact sheets, taking into account new scientific information; and reduced coverage in the Guidelines in cases where new information suggests a lesser priority;
- key chemicals responsible for large-scale health effects through drinking-water exposure (e.g. arsenic, fluoride, lead, nitrate, selenium and uranium), with the Guidelines providing guidance on identifying local priorities and on management;

- the important roles of many different stakeholders in ensuring drinking-water safety; this edition furthers the discussion introduced in the third edition of the roles and responsibilities of key stakeholders in ensuring drinking-water safety; and
- guidance in situations other than traditional community supplies or managed utilities, such as rainwater harvesting and other non-piped supplies or dual-piped systems.

The Guidelines are accompanied by a series of supporting publications. These include internationally peer-reviewed risk assessments for specific chemicals (see list of [chapter 12](#) background documents in [Annex 2](#)) and other publications explaining the scientific basis of the development of the Guidelines and providing guidance on good practice in their implementation (see [Annex 1](#)). The publication *Guidelines for drinking-water quality Volume 3—Surveillance and control of community supplies* (1997, revision forthcoming) provides guidance on good practice in surveillance, monitoring and assessment of drinking-water quality in community supplies.

The Guidelines are addressed primarily to water and health regulators, policy-makers and their advisors, to assist in the development of national policies and regulations. The Guidelines and associated documents are also used by many others as a source of information on water quality and health, and on effective management approaches.

The Guidelines are recognized as representing the position of the UN system on issues of drinking-water quality and health by “UN-Water”, the body that coordinates among the 24 UN agencies and programmes concerned with water issues.

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Abbreviations used in text

2,4-D	2,4-dichlorophenoxyacetic acid
2,4-DB	2,4-dichlorophenoxybutyric acid
2,4-DP	dichlorprop
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	2,4,5-trichlorophenoxy propionic acid; fenoprop
AAS	atomic absorption spectrometry
Absor	absorptiometry
ADI	acceptable daily intake
AES	atomic emission spectrometry
AIDS	acquired immunodeficiency syndrome
AMPA	aminomethylphosphonic acid
ARfD	acute reference dose
BDCM	bromodichloromethane
BMD	benchmark dose
BMDL	lower confidence limit on the benchmark dose
BMDL _x	lower 95% confidence limit on the benchmark dose for an x% response
BTEX	benzene, toluene, ethylbenzene and xylenes
Bti	<i>Bacillus thuringiensis israelensis</i>
bw	body weight
CAS	Chemical Abstracts Service
Col	colorimetry
CSAF	chemical-specific adjustment factor
Ct	product of disinfectant concentration and contact time
DAEC	diffusely adherent <i>E. coli</i>
DALY	disability-adjusted life year

DBCM	dibromochloromethane
DBCP	1,2-dibromo-3-chloropropane
DBP	disinfection by-product
DCA	dichloroacetic acid
DCB	dichlorobenzene
DCP	dichloropropane
DDT	dichlorodiphenyltrichloroethane
DEHA	di(2-ethylhexyl)adipate
DEHP	di(2-ethylhexyl)phthalate
DNA	deoxyribonucleic acid
DPD	<i>N,N</i> -diethyl-1,4-phenylenediamine sulfate
EAAS	electrothermal atomic absorption spectrometry
EAEC	enteroaggregative <i>E. coli</i>
ECD	electron capture detector
EDTA	ethylenediaminetetraacetic acid; edetic acid
EHEC	enterohaemorrhagic <i>E. coli</i>
EIEC	enteroinvasive <i>E. coli</i>
ELISA	enzyme-linked immunosorbent assay
EPEC	enteropathogenic <i>E. coli</i>
ETEC	enterotoxigenic <i>E. coli</i>
F ₀	parental generation
F ₁	first filial generation
FAAS	flame atomic absorption spectrometry
FAO	Food and Agriculture Organization of the United Nations
FD	fluorescence detector
FID	flame ionization detector
FPD	flame photodiode detector
GAC	granular activated carbon
GC	gas chromatography
GL	guidance level (used for radionuclides in drinking-water)
GV	guideline value
HAA	haloacetic acid
HAV	hepatitis A virus
HCB	hexachlorobenzene
HCBD	hexachlorobutadiene
HCH	hexachlorocyclohexane
HEV	hepatitis E virus
HIV	human immunodeficiency virus

ABBREVIATIONS USED IN TEXT

HPC	heterotrophic plate count
HPLC	high-performance liquid chromatography

IARC	International Agency for Research on Cancer
IC	ion chromatography
ICP	inductively coupled plasma
ICRP	International Commission on Radiological Protection
IDC	individual dose criterion
IPCS	International Programme on Chemical Safety
IQ	intelligence quotient
ISO	International Organization for Standardization
JECFA	Joint FAO/WHO Expert Committee on Food Additives
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
LC	liquid chromatography
LOAEL	lowest-observed-adverse-effect level
LRV	\log_{10} reduction value
MCB	monochlorobenzene
MCPA	4-(2-methyl-4-chlorophenoxy)acetic acid
MCPB	2,4-MCPB; 4-(4-chloro-o-tolyloxy)butyric acid; 4-(4-chloro-2-methylphenoxy)butanoic acid
MCPP	2(2-methyl-chlorophenoxy) propionic acid; mecoprop
MDL	method detection limit
MMT	methylcyclopentadienyl manganese tricarbonyl
MS	mass spectrometry
MS/MS	tandem mass spectrometry
MTBE	methyl <i>tertiary</i> -butyl ether
MX	3-chloro-4-dichloromethyl-5-hydroxy-2(5H)-furanone
NDMA	<i>N</i> -nitrosodimethylamine
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NTA	nitrilotriacetic acid
NTP	National Toxicology Program (USA)
NTU	nephelometric turbidity unit
PAC	powdered activated carbon
PAH	polynuclear aromatic hydrocarbon
PCP	pentachlorophenol
PCR	polymerase chain reaction
PD	photoionization detector
PMTDI	provisional maximum tolerable daily intake
PPA	protein phosphatase assay

PT	purge and trap
PTDI	provisional tolerable daily intake

PTMI	provisional tolerable monthly intake
PTWI	provisional tolerable weekly intake
PVC	polyvinyl chloride
QMRA	quantitative microbial risk assessment
RNA	ribonucleic acid
SI	Système international d'unités (International System of Units)
SODIS	solar water disinfection
sp.	species (singular)
spp.	species (plural)
subsp.	subspecies (singular)
TBA	terbuthylazine
TCB	trichlorobenzene
TCU	true colour unit
TD ₀₅	tumorigenic dose ₀₅ , the dose associated with a 5% excess incidence of tumours in experimental animal studies
TDI	tolerable daily intake
TDS	total dissolved solids
THM	trihalomethane
TID	thermal ionization detector; total indicative dose
UF	uncertainty factor
UN	United Nations
UNICEF	United Nations Children's Fund
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USA	United States of America
UV	ultraviolet
UVPAD	ultraviolet photodiode array detector
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme
WSP	water safety plan
YLD	years of healthy life lost in states of less than full health (i.e. years lived with a disability)
YLL	years of life lost by premature mortality

