INTERNATIONAL PROGRAMME ON CHEMICAL SAFETY

Guidelines for drinking-water quality

SECOND EDITION

Volume 2

Health criteria and other supporting information

World Health Organization
Geneva

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Preface

In 1984 and 1985, the World Health Organization (WHO) published the first edition of *Guidelines for drinking-water quality* in three volumes. The development of these guidelines was organized and carried out jointly by WHO headquarters and the WHO Regional Office for Europe (EURO).

In 1988, the decision was made within WHO to initiate the revision of the guidelines. The work was again shared between WHO headquarters and EURO. Within headquarters, both the unit for the Prevention of Environmental Pollution (PEP) and the ILO/UNEP/WHO International Programme on Chemical Safety (IPCS) were involved, IPCS providing a major input to the health risk assessments of chemicals in drinking-water.

The revised guidelines are being published in three volumes. Guideline values for various constituents of drinking-water are given in Volume 1, *Recommendations,* together with essential information required to understand the basis for the values. Volume 2, *Health criteria and other supporting information,* contains the criteria monographs prepared for each substance or contaminant; the guideline values are based on these. Volume 3, *Surveillance and control of community supplies,* is intended to serve a very different purpose; it contains recommendations and information concerning what needs to be done in small communities, particularly in developing countries, to safeguard their water supplies.

The preparation of the current edition of the *Guidelines for drinking-water quality* covered a period of four years and involved the participation of numerous institutions, over 200 experts from nearly 40 different developing and developed countries and 18 meetings of the various coordination and review groups. The work of these institutions and scientists, whose names appear in Annex 1, was central to the completion of the guidelines and is much appreciated.

For each contaminant or substance considered, a lead country prepared a draft document evaluating the risks for human health from exposure to the contaminant in drinking-water. The following countries prepared such evaluation documents: Canada, Denmark, Finland, Germany, Italy, Japan, Netherlands, Norway, Poland, Sweden, United Kingdom of Great Britain and Northern Ireland and United States of America.

Under the responsibility of a coordinator for each major aspect of the guidelines, these draft evaluation documents were reviewed by several scientific institutions and selected experts, and comments were incorporated by the coordinator

and author prior to submission for final evaluation by a review group. The review group then took a decision as to the health risk assessment and proposed a guideline value.

During the preparation of draft evaluation documents and at the review group meetings, careful consideration was always given to previous risk assessments carried out by IPCS, in its Environmental Health Criteria monographs, the International Agency for Research on Cancer, the Joint FAO/WHO Meetings on Pesticide Residues, and the Joint FAO/WHO Expert Committee on Food Additives, which evaluates contaminants such as lead and cadmium in addition to food additives.

It is clear that not all the chemicals that may be found in drinking-water were evaluated in developing these guidelines. Chemicals of importance to Member States which have not been evaluated should be brought to the attention of WHO for inclusion in any future revision.

It is planned to establish a continuing process of revision of the *Guidelines for drinking-water quality* with a number of substances or agents subject to evaluation each year. Where appropriate, addenda will be issued, containing evaluations of new substances or substances already evaluated for which new scientific information has become available. Substances for which provisional guideline values have been established will receive high priority for re-evaluation.

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The work of the following coordinators was crucial in the development of Volumes 1 and 2 of the *Guidelines*:

J. K. Fawell, Water Research Centre, England (inorganic constituents)
J. R. Hickman, Department of National Health and Welfare, Canada (radioactive materials)
U. Lund, Water Quality Institute, Denmark (organic constituents and pesticides)
B. Mintz, Environmental Protection Agency, United States of America (disinfectants and disinfectant by-products)
E. B. Pike, Water Research Centre, England (microbiology)

The coordinator for Volume 3 of the *Guidelines* was J. Bartram of the Robens Institute of Health and Safety, England.

The WHO coordinators were as follows:

Headquarters: H. Galal-Gorchev, International Programme on Chemical Safety; R. Helmer, Division of Environmental Health.
Regional Office for Europe: X. Bonnefoy, Environment and Health; O. Espinoza, Environment and Health.

Ms Marla Sheffer of Ottawa, Canada, was responsible for the scientific editing of the guidelines.

The convening of the coordination and review group meetings was made possible by the financial support afforded to WHO by the Danish International Development Agency (DANIDA) and the following sponsoring countries: Belgium, Canada, France, Italy, Netherlands, United Kingdom of Great Britain and Northern Ireland and United States of America.

In addition, financial contributions for the convening of the final task group meeting were received from the Norwegian Agency for Development Cooperation (NORAD), the United Kingdom Overseas Development Administration (ODA) and the Water Services Association in the United Kingdom, the Swedish International Development Authority (SIDA), and the Government of Japan.

The efforts of all who helped in the preparations and finalization of the *Guidelines for drinking-water quality* are gratefully acknowledged.

Acronyms and abbreviations used in the text

AAS	atomic absorption spectrometry
A/C	asbestos-cement
ADA	ampicillin-dextrin agar
ADI	acceptable daily intake
a.i.	active ingredient
AIDS	acquired immunodeficiency syndrome
ALAD	aminolaevulinic acid dehydratase
ALAT	alanine aminotransferase
AOC	assimilable organic carbon
APHA	American Public Health Association
BOD	biochemical oxygen demand
Bq	Becquerel
BSP	bromosulfophthalein
BUN	blood urea nitrogen
bw	body weight
CAS	Chemical Abstracts Service
cfu	colony-forming units
CHO	Chinese hamster ovary
CMC	carboxymethyl cellulose
DENA	diethylnitrosamine
DMAA	dimethylarsinic acid
DNA	deoxyribonucleic acid
DOPA	3,4-dihydroxyphenylalanine
ECG	electrocardiogram
EDTA	edetic acid
EEG	electroencephalogram
EIEC	enteroinvasive *E. coli*
EP	erythrocyte protoporphyrin
EPA	Environmental Protection Agency (USA)
ETEC	enterotoxigenic *E. coli*

FAO	Food and Agriculture Organization of the United Nations
FPD	flame photometric detection
GC	gas chromatography
GCI	general cognitive index
GEMS	Global Environment Monitoring System
GOT	glutamic-oxaloacetic transaminase
GPT	glutamic-pyruvic transaminase
h	hour
HD	Hodgkin disease
HDL	high-density lipoprotein
HPLC	high-performance liquid chromatography
IARC	International Agency for Research on Cancer
ICRP	International Commission on Radiological Protection
ID	infective dose
Ig	immunoglobulin
IgG	immunoglobulin G
IgM	immunoglobulin M
ILO	International Labour Organisation
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_{50}	lethal concentration, median
LD_{50}	lethal dose, median
LH	luteinizing hormone
LOAEL	lowest-observed-adverse-effect level
LT	heat-labile enterotoxin
MAC	*Mycobacterium avium* complex
MAIS	*Mycobacterium avium, M. intracellulare, M. scrofulaceum* complex
MDI	mental development index
MFL	million fibres per litre
MIB	2-methylisoborneol
MMAA	monomethylarsonic acid
MNCV	motor nerve conduction velocity
MS	mass spectrometry
MSCA	McCarthy Scales of Children's Abilities
MTD	maximum tolerated dose

NADPH	nicotinamide adenine dinucleotide phosphate (reduced)
NAG	non-agglutinable
NCI	National Cancer Institute (USA)
NCV	non-cholera vibrios
NEU	nitrosoethylurea
NHANES	US National Health and Nutrition Examination Survey
NHL	non-Hodgkin lymphoma
NOAEL	no-observed-adverse-effect level
NTA	nitrilotriacetic acid
NTP	National Toxicology Program (USA)
NTU	nephelometric turbidity unit
Pa	Pascal
PDI	psychomotor development index
pK_a	log acid dissociation constant
PMTDI	provisional maximum tolerable daily intake
PTWI	provisional tolerable weekly intake
PVC	polyvinyl chloride
RNA	ribonucleic acid
SAED	selected-area electron diffraction
SAP	serum alkaline phosphatase
SGOT	serum glutamic-oxaloacetic transaminase
SGPT	serum glutamic-pyruvic transaminase
SMR	standardized mortality ratio
ST	heat-stable enterotoxin
STS	soft tissue sarcoma
T_3	triiodothyronine
T_4	thyroxine
TCU	true colour unit
TDI	tolerable daily intake
TDS	total dissolved solids
TEM	transmission electron microscopy
TOC	total organic carbon
TPA	tetradecanoyl-phorbol-acetate
UNEP	United Nations Environment Programme
UV	ultraviolet
WHA	World Health Assembly
WHO	World Health Organization

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