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Guidelines for drinking-water quality

SECOND EDITION

Addendum to Volume 2

*Health criteria and
other supporting information*



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Preface

Between 1993 and 1997, the World Health Organization (WHO) published the second edition of *Guidelines for drinking-water quality* in three volumes: Volume 1, *Recommendations*, in 1993, Volume 2, *Health criteria and other supporting information*, in 1996, and Volume 3, *Surveillance and control of community supplies*, in 1997. As with the first edition, the development of these guidelines was organized and carried out jointly by WHO headquarters and the WHO Regional Office for Europe.

At the Final Task Group Meeting (Geneva, Switzerland, 21–25 September 1992), when the second edition of the *Guidelines* was approved, it was agreed to establish a continuing process of updating of the guidelines, with a number of chemical substances and microbiological agents subject to periodic evaluation. Addenda containing these evaluations will be issued as necessary until the third edition of the *Guidelines* is published, approximately 10 years after the second edition.

In 1995, a Coordinating Committee for the Updating of WHO *Guidelines for drinking-water quality* agreed on the framework for the updating process and established three working groups to support the development of addenda and monographs on chemical aspects, microbiological aspects, and protection and control of water quality.

The Committee selected the chemical substances to be evaluated in the first addendum, designated coordinators for each major group of chemicals, and identified lead institutions for the preparation of health criteria documents evaluating the risks for human health from exposure to the particular chemicals in drinking-water. Institutions from Canada, Finland, France, Germany, the Netherlands, Sweden, the United Kingdom, and the USA, as well as the ILO/UNEP/WHO International Programme on Chemical Safety (IPCS), prepared the requested health criteria documents.

Under the responsibility of the designated coordinators for each chemical group, the draft health criteria documents were submitted to a number of scientific institutions and selected experts for peer review. Comments were taken into consideration by the coordinators and authors before the documents were submitted for final evaluation by the 1997 Working Group Meeting on Chemical Substances in Drinking-Water. The Working Group reviewed the health risk assessments and, where appropriate, decided upon guideline values.

During the preparation of draft health criteria documents and at the 1997 Working Group Meeting, 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 nitrate and nitrite in addition to food additives.

Evaluations of chemical substances given in this Addendum supersede evaluations previously published in Volume 1 and Volume 2 of the *Guidelines*.

Acknowledgements

The work of the following coordinators was crucial in the development of this first addendum on chemical substances in drinking-water:

- P. Chambon, Health Environment Hygiene Laboratory of Lyon, Lyon, France (inorganic constituents)
- U. Lund, Water Quality Institute, Horsholm, Denmark (organic constituents)
- H. Galal-Gorchev, Urban Environmental Health, World Health Organization, Geneva, Switzerland (pesticides)
- E. Ohanian, Environmental Protection Agency, Washington, DC, USA (disinfectants and disinfectant by-products)

The coordinators for the overall administrative and technical aspects of this addendum were, respectively, J. Kenny and H. Galal-Gorchev, Urban Environmental Health, WHO, Geneva, Switzerland.

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

Special thanks are due to the authors and their institutions for the preparation of draft health criteria documents. The following institutions prepared such health criteria documents: Health Canada; Water Research Centre, England; National Public Health Institute, Finland; Health Environment Hygiene Laboratory of Lyon, France; Fraunhofer Institute for Toxicology and Aerosol Research, Germany; National Institute of Public Health and Environmental Protection, Netherlands; National Food Administration, Sweden; International Programme on Chemical Safety, Switzerland; and the Environmental Protection Agency, USA.

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A financial contribution for the convening of the Working Group Meeting on Chemical Substances in Drinking-Water and for printing the addendum was received from the European Commission and is gratefully acknowledged.

The preparation of the first addendum to the *Guidelines for drinking-water quality* involved the participation of numerous institutions and experts. The work of these institutions and scientists, whose names appear in Annex I, was central to the completion of this addendum and is much appreciated.

Acronyms and abbreviations used in the text ¹

ADI	acceptable daily intake
ATPase	adenosine triphosphatase
CAS	Chemical Abstracts Service
CI	confidence interval
DNA	deoxyribonucleic acid
EEC	European Economic Community
EPA	Environmental Protection Agency (USA)
FAO	Food and Agriculture Organization of the United Nations
IARC	International Agency for Research on Cancer
ILO	International Labour Organisation
IPCS	International Programme on Chemical Safety
IUPAC	International Union of Pure and Applied Chemistry
JECFA	Joint FAO/WHO Expert Committee on Food Additives
JMP	Joint Meeting on Pesticides
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
LC ₅₀	lethal concentration, median
LD ₅₀	lethal dose, median
LOAEL	lowest-observed-adverse-effect level
LOEC	lowest-observed-effect concentration
MTD	maximum tolerated dose
NCI	National Cancer Institute (USA)
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NTP	National Toxicology Program (USA)
PMTDI	provisional maximum tolerable daily intake
RNA	ribonucleic acid
TDI	tolerable daily intake
UNEP	United Nations Environment Programme
USA	United States of America
USP	US Pharmacopoeia
WHO	World Health Organization
w/v	weight/volume

¹ These are the acronyms and abbreviations that are used without definition in the text.

Introduction

Chemical substances evaluated in this addendum were selected by the 1995 Coordinating Committee for the Updating of WHO *Guidelines for drinking-water quality* for one or more of the following reasons:

- adequate data were not available to allow a guideline value to be derived, or only a provisional guideline value could be derived, in the second edition of the *Guidelines*;
- the substance was recommended for evaluation by the Task Group convened to finalize the second edition of the *Guidelines*;
- new health risk assessments were available from IPCS through its Environmental Health Criteria monographs, JMPR, or JECFA;
- a new evaluation of the carcinogenic risk of the chemical was available from IARC;
- requests to evaluate the chemical were made to the WHO Secretariat.

Concepts of guideline value and provisional guideline value, assumptions made, and scientific principles for the assessment of risk to human health from exposure to chemicals in drinking-water used in this addendum are described in Volume 1, *Recommendations*, of the second edition of the *Guidelines*. Only a brief summary of the approaches used to derive the guideline values is given here.

In developing the guideline values for potentially hazardous chemicals, a daily consumption of 2 litres of drinking-water by a person weighing 60 kg was generally assumed. Where it was judged that infants and children were at a particularly high risk from exposure to certain chemicals, the guideline values were derived on the basis of a 5-kg infant consuming 0.75 litre per day or a 10-kg child consuming 1 litre per day.

For compounds showing a threshold for toxic effects, a tolerable daily intake (TDI) approach was used to derive the guideline value. A portion of the TDI was allocated to drinking-water, based on potential exposure from other sources, such as food and air. Where information on other sources of exposure was not available, an arbitrary (default) value of 10% of the TDI was allocated to drinking-water.

For compounds considered to be genotoxic carcinogens, guideline values were determined using a mathematical model. The guideline values presented in the addendum to Volume 1 are the concentrations in drinking-water associated with an estimated excess lifetime cancer risk of 10^{-5} (one additional cancer case per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years). In this addendum to Volume 2, concentrations associated with excess lifetime cancer risks of 10^{-4} , 10^{-5} , and 10^{-6} are presented to emphasize the fact that each country should select its own appropriate risk levels.

It is emphasized that the guideline values recommended are not mandatory limits. Such limits should be set by national or regional authorities, using a risk-benefit approach and taking into consideration local environmental, social, economic, and cultural conditions.

