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Waterborne Zoonoses

Identification, Causes, and Control

Edited by
J.A. Cotruvo, A. Dufour, G. Rees, J. Bartram,
R. Carr, D.O. Cliver, G.F. Craun, R. Fayer and
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World Health Organization

Published on behalf of the World Health Organization by
IWA Publishing, Alliance House, 12 Caxton Street, London SW1H 0QS, UK
Telephone: +44 (0) 20 7654 5500; Fax: +44 (0) 20 7654 5555; Email: publications@iwap.co.uk
www.iwapublishing.com

First published 2004

Printed by TJ International (Ltd), Padstow, Cornwall, UK
Index prepared by Indexing Specialists (UK) Ltd, Hove, East Sussex, UK.

British Library Cataloguing-in-Publication Data
A CIP catalogue record for this book is available from the British Library

WHO Library Cataloguing-in-Publication Data
Waterborne zoonoses : identification, causes, and control / edited by
J. A. Cotruvo ... [et al.].
(Emerging issues in water and infectious diseases series)
1.Water microbiology 2.Water - parasitology 3.Zoonoses - etiology
4.Disease reservoirs 5.Emerging diseases - etiology I.Cotruvo, Joseph A.
ISBN 92 4 156273 0 (LC/NLM classification: QW 80)
ISSN 1728-2160
ISBN 1 84339 058 2 (IWA Publishing)

Contents

Preface

Investigating important emerging issues in water and infectious disease and communicating discoveries create challenges, which are addressed by an initiative being undertaken by the World Health Organization (WHO) Water Sanitation and Health Unit, the US Environmental Protection Agency (US EPA) Office of Research and Development, and other collaborators. The initiative seeks to accelerate the identification of actual and perceived issues, to bring together information and knowledge in critical areas, and to disseminate information to policy-makers and practitioners in a timely fashion. This initiative has resulted in the publication of several cutting-edge documents that critically analyse emerging issues in water and infectious disease and present balanced assessments of how these will impact disease transmission through water with emphasis on management options for preventing and controlling waterborne disease.

Other issues dealt with in the Emerging Issues in Water and Infectious Disease initiative include:

- heterotrophic plate counts and drinking-water safety;
- pathogenic mycobacteria in water;
- the H_2S method for the detection of faecal contamination of drinking-water;
- water recreation and disease;
- respiratory transmission of faecally excreted viruses; and
- toxic cyanobacteria in water.

This publication was developed from the workshop on "Zoonosis and Waterborne Disease," held in Annapolis, Maryland, USA, on 2–4 September 2003. The workshop was sponsored by the WHO units dealing with Water, Sanitation and Health and with Strategy Development and Monitoring of Zoonoses, Foodborne Disease and Kinetoplastidae, working with US EPA's Office of Research and Development and Office of Ground Water and Drinking Water. Twenty-nine experts from 14 countries and diverse disciplines, including sanitary and veterinary microbiology, animal health, agriculture, animal waste management, public health, water epidemiology, medicine, sanitary engineering, food safety, and regulatory policy, attended the workshop. They examined the roles of zoonoses in current and future waterborne disease and prepared the chapters published here.

Participants at the workshop were asked to:

- review current waterborne zoonotic disease threats;
- identify new disease candidates based on disease agent characteristics; and
- evaluate current control strategies to identify agents that might fall outside of the current control envelope.

The workshop participants reviewed information on zoonotic organisms linked to waterborne diseases in humans and focused on the organism characteristics, human activities, and environmental conditions that could lead to future concerns from evolving or emerging organisms. Animal vector factors discussed included feral/wild animals, domestic animals, intensive grazing, feedlots, abattoirs, and other elements. Emergence related to translocation of microorganisms resulting from human and animal movement, food production, irrigation, food handling, distribution from distant areas, climate change, and other appropriate contributing factors was discussed.

This publication was developed from technical inputs to the workshop, workshop deliberations and revisions to the technical materials based on the suggestions of expert technical reviewers.

The goal of this publication is to provide guidance to agencies concerned with human and animal health and water and wastewater service providers worldwide to anticipate potential future waterborne zoonotic disease problems

and to determine whether current practices will be protective or whether new approaches need to be developed or deployed to protect health. This publication presents information on how zoonotic pathogens can be best managed at the source (i.e., through animal management practices, treatment of animal wastes, runoff management); through water treatment (wastewater and drinking-water); or through a combination of multiple barriers.

We hope that this publication provides useful information in describing the significance of zoonotic microorganisms as threats to the quality of ambient water and drinking-water and to public health throughout the world. We hope that this will facilitate the development of cross-sectoral initiatives to manage current health threats and to anticipate and manage health threats from emerging waterborne zoonotic pathogens.

Acknowledgements

The World Health Organization (WHO) wishes to express its appreciation to all those whose efforts made the production of this book possible.

We acknowledge and appreciate the exceptional efforts of all of the workshop participants, authors who contributed to the development of individual chapters in this book, and expert reviewers as listed below:

Jamie Bartram, WHO, Geneva, Switzerland
Carole Bolin, Michigan State University, East Lansing, MI, USA
Peter Braam, WHO, Geneva, Switzerland
Corrie Brown, University of Georgia, Athens, GA, USA
Lynda M. Browning, Scottish Centre for Infection and Environmental Health, Glasgow, Scotland
Rebecca L. Calderon, Office of Research and Development, US Environmental Protection Agency, Research Triangle Park, NC, USA
Richard Carr, WHO, Geneva, Switzerland
John Cicmanec, Office of Research and Development, US Environmental Protection Agency, Cincinnati, OH, USA

Dean O. Cliver, Food Safety Laboratory and WHO Collaborating Centre for Food Virology, School of Veterinary Medicine, University of California, Davis, CA, USA
Joseph Cotruvo, Joseph Cotruvo & Associates, Washington, DC, USA
Gunther Craun, G.F. Craun and Associates, Staunton, VA, USA
Michael F. Craun, G.F. Craun and Associates, Staunton, VA, USA
John Cross, Division of Tropical Public Health, Department of Preventive Medicine and Biometrics, Uniformed Services University, Bethesda, MD, USA
Friederike Dangendorf, Institute of Hygiene and Public Health, University of Bonn, Bonn, Germany
Alfred Dufour, Office of Research and Development, US Environmental Protection Agency, Cincinnati, OH, USA
Andrea Ellis, WHO, Geneva, Switzerland
Takuro Endo, Department of Parasitology, National Institute of Infectious Diseases, Tokyo, Japan
Ronald Fayer, Agricultural Research Service, US Department of Agriculture, Beltsville, MD, USA
Kate Field, Department of Microbiology, Oregon State University, Corvallis, Oregon, USA
Daniel Y.C. Fung, Department of Animal Science and Industry, Kansas State University, Manhattan, KS, USA
Victor P.J. Gannon, Public Health Branch, Animal Diseases Research Institute, Health Canada, Lethbridge, Alberta, Canada
Frank Humenik, College of Agricultural and Life Sciences, Animal Waste Management Program, North Carolina State University, Raleigh, NC, USA
Sasitorn Kanarat, Hygiene and Microbiology, Ministry of Agriculture, Bangkok, Thailand
Diane Lightfoot, Microbiological Diagnostic Unit, Public Health Laboratory, University of Melbourne, Victoria, Melbourne, Australia
Santiago Mas-Coma, Department of Parasitology, Faculty of Pharmacy, University of Valencia, Burjassot, Valencia, Spain
Graham McBride, National Institute of Water and Atmospheric Research, Hamilton, New Zealand
Francois-Xavier Meslin, WHO, Geneva, Switzerland
Christine Moe, Department of International Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA
Kåre Mølbak, Statens Serum Institut, Copenhagen, Denmark
Yasuyuki Morishima, Department of Parasitology, National Institute of Infectious Diseases, Tokyo, Japan
Rosa Gabriella Ramírez-Porras, Department of Veterinary Epidemiology and Public Health, Veterinary Faculty, Yucatan, Mexico

Gareth Rees, Askham-Bryan College, Askham-Bryan, York, North Yorkshire, UK
William Reilly, Scottish Centre for Infection and Environmental Health, Glasgow, Scotland
Mark Rice, College of Agricultural and Life Sciences, Animal Waste Management Program, North Carolina State University, Raleigh, NC, USA
Joan Rose, Michigan State University, East Lansing, MI, USA
Stephen Schaub, Office of Water, Office of Science and Technology, US Environmental Protection Agency, Washington, DC, USA
Flemming Scheutz, Statens Serum Institut, Copenhagen, Denmark
Jeevan B. Sherchand, Tribhuvan University Teaching Hospital, Kathmandu, Nepal
Huw V. Smith, Scottish Parasite Diagnostic Laboratory, Glasgow, Scotland
James E. Smith, Jr., Office of Research and Development, US Environmental Protection Agency, Cincinnati, OH, USA
Mark Sobsey, University of North Carolina, Chapel Hill, NC, USA
K. Suresh, Department of Parasitology, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia
Desmond Till, Public Health Microbiologist Consultant, Wellington, New Zealand
Jose Williams, Department of Veterinary Epidemiology and Public Health, Veterinary Faculty, Yucatan, Mexico

Special thanks are due to Penny Ward, Water, Sanitation and Health Programme, WHO, Geneva, who provided administrative support for the meeting and to the development of this book, and Marla Sheffer of Ottawa, Canada, who edited the final document.

We would like to express our gratitude to the US Environmental Protection Agency Office of Research and Development for sponsoring the initiative on Emerging Issues in Water and Infectious Disease and providing financial support for this workshop and publication. We would also like to thank the US Environmental Protection Agency Office of Water for further support to this workshop.

List of acronyms and abbreviations

A/EEC	attaching and effacing *E. coli*
AFLP	amplified fragment length polymorphism
AFO	animal feeding operation
AGI	acute gastrointestinal illness of unknown origin
AIDS	acquired immunodeficiency syndrome
ARCC	average rate of correct classification
ATP	adenosine triphosphate
BFP	bundle-forming pilus
BSE	bovine spongiform encephalopathy
CAFO	concentrated animal feeding operation
CDSC	Communicable Disease Surveillance Centre (England and Wales)
CFU	colony-forming unit
CI	confidence interval
CJD	Creutzfeldt-Jakob disease
CUP	carbon-source utilization
CWD	chronic wasting disease
DAEC	diffuse adherent *E. coli*
DALY	disability-adjusted life year

DBP	disinfection by-product
DEC	diarrhoeagenic *E. coli*
DNA	deoxyribonucleic acid
DT	definitive phage type
EAEC	enteroadherent *E. coli*
EAggEC	enteroaggregative *E. coli*
EHEC	enterohaemorrhagic *E. coli*
EIEC	enteroinvasive *E. coli*
EPA	Environmental Protection Agency (USA)
EPEC	enteropathogenic *E. coli*
epg	eggs per gram of faeces
ESWTR	Enhanced Surface Water Treatment Rule (USA)
ETEC	enterotoxigenic *E. coli*
HACCP	hazard analysis and critical control points
HAV	hepatitis A virus
HBV	hepatitis B virus
HEV	hepatitis E virus
HIV	human immunodeficiency virus
HUS	haemolytic uraemic syndrome
ID	infective dose
ID_{50}	median infective dose
Ig	immunoglobulin
IID	infectious intestinal disease
IPCC	Intergovernmental Panel on Climate Change
LEE	locus of enterocyte effacement
LH-PCR	length heterogeneity polymerase chain reaction
LT	heat-labile enterotoxin
LU	livestock unit
MAP	*Mycobacterium avium* (ssp. *paratuberculosis*)
MAR	multiple antibiotic resistance
MBM	meat and bone meal
MCL	Maximum Contaminant Level (USA)
MCLG	Maximum Contaminant Level Goal (USA)
MOR	matched odds ratio
MPN	most probable number
mRNA	messenger ribonucleic acid
MST	microbiological source tracking
NASBA	nucleic acid sequence-based amplification
NPDES	National Pollutant Discharge Elimination System (USA)
NTU	nephelometric turbidity unit

OIE	Office International des Epizooties (World Organization for Animal Health)
PCR	polymerase chain reaction
PEAS	possible estuary-associated syndrome
PFGE	pulsed-field gel electrophoresis
PT	phage type
QMRA	quantitative microbial risk assessment
QRA	quantitative risk assessment
rDNA	ribosomal deoxyribonucleic acid
REP-PCR	repetitive extragenic palindromic polymerase chain reaction
RFLP	restriction fragment length polymorphism
RNA	ribonucleic acid
rRNA	ribosomal ribonucleic acid
SARS	severe acute respiratory syndrome
SCCWRP	Southern California Coastal Water Research Project (USA)
SMX	sulfamethoxazole
STEC	Shiga toxin-producing *E. coli*
STh	heat-stable enterotoxin (human)
STp	heat-stable enterotoxin (porcine)
TMDL	total maximum daily load
TMP	trimethoprim
T-RFLP	terminal restriction fragment length polymorphism
TSE	transmissible spongiform encephalopathy
UDG	uracil-D-glycosylase
USA	United States of America
US EPA	United States Environmental Protection Agency
UV	ultraviolet
VBNC	viable but non-culturable
vCJD	variant Creutzfeldt-Jakob disease
VTEC	verocytotoxin-producing *E. coli*
WHO	World Health Organization
WSP	water safety plan
YLD	years lived with a disability
YLL	years of life lost to premature death