EXPECTED REDUCTION IN MORBIDITY FROM IMPROVED WATER SUPPLY AND SANITATION

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Summary

Waterborne diseases such as diarrheal diseases infect billions of people annually and the mortality reaches up to five to ten million cases. Inappropriate excreta handling or insufficient water to keep oneself clean can lead to enormous risk of Ascariasis, other helminthes diseases, or leprosy. Poor water management can also result in shistosomiasis or malaria. The World Health Organization (WHO) states that 70% of disease episodes in developing countries are deeply related to polluted water and/or inappropriate excreta treatment. It also states that six million children die of gastro-intestinal diseases, and 500 million people suffer trachoma through lack of clean water for face washing, annually.

The increasing world population leads to an increase in the requirement of fresh water for drinking, hygiene and household purposes, as well as for agricultural irrigation. Population growth also brings in its train a high load of municipal sewage, livestock excreta and industrial wastewater, posing a threat to sources of drinking water, both surface and ground-water. With a few exceptions such as hepatitis viruses, most

fecal-oral pathogens cause gastrointestinal illnesses. There may also be myriads of emerging pathogens which are excreted by humans or animals. The greatest impact of water pollution on human health comes through drinking water acting as a vehicle for the transmission of a large variety of infectious diseases. In many industrialized countries, the widespread occurrence of the protozoan parasites *Cryptosporidium* and *Giardia* in surface waters means that any drinking water treatment plant which draws its water from a surface source is at risk.

Cryptosporidium parvum, an obligate parasitic protozoan pathogen of which oocysts are shed in infected human and animal feces, has become a significant public health concern that has potential to be readily transmitted through contaminated drinking water. Traditionally, the barriers for safe drinking water have included source water protection, physicochemical treatment (coagulation, flocculation, sedimentation and filtration), disinfection and protection of the distribution system. Such treatment is not effective 100% of the time in removing *Cryptosporidium* oocysts from drinking waters, and unusual resistance of the oocysts to conventional disinfectants permits penetration of viable oocysts into the treated water supply. It is, thus, unwise to increase capital outlay on installation of additional treatment plants that would be needed to remediate poor sanitary source waters without paying attention to better source protection. Before it is too late, people should go back to the very basic concept that source water protection is crux to both sanitary engineering (mitigation of the impacts of waterborne infections) and cost-effective provision of safe drinking water. This is one of the realistic ways of developing water resources to ensure adequate and safe drinking water for the next generation.

Strengthening alliances between local authorities and public health authorities, as well as with water utilities for immediate appraisal of the potential health risk (local liaison arrangement) is conceptually another way to develop water resources for safe drinking water, especially under conditions where there is less choice of source. At the same time, sharing with the public the health risks, monitoring efforts, treatment processes and all other related information, as well as with the media, is also crucial in protecting consumers from waterborne diseases, when the performance of conventional systems becomes questioned.

Development of water supply and sanitation can lead to reduction of water-born disease, and in this chapter, the historical lessons of the Japanese experience are described to show their effectiveness.

1. Introduction

Water is one of the essential materials not only for domestic life but also for public activities, and at the same time, wastewater must be discarded from the use point as soon as it has fulfilled its purpose. If one analyzes the mass balance of water around human beings, or social activities, it becomes obvious that water usage means the use of its properties, such as solubility, thermal capacity, or density, and that the change of state in its properties results in production of wastewater. Water and wastewater are, therefore, yoked by human lives and productive activities. Water itself supports social and economic activities, and it also works maintaining ecosystems. Polluting water or altering the state in its properties reduces its value, and this change may transmit pollutants and/or pathogens and endanger human health.

Waterborne diseases such as diarrheal diseases infect billions of people annually and the mortality reaches up to five to ten million cases. Inappropriate excreta handling or insufficient water to keep oneself clean may cause enormous risk of ascariasis, other helminth diseases, or leprosy. Or poor water management may lead to shistosomiasis or malaria. The World Health Organization (WHO) states that 70% of disease episodes in developing countries are deeply related to polluted water and/or inappropriate excreta treatment. It also remarks that six million children die annually of gastro-intestinal diseases, and 500 million people suffer trachoma as a result of lack of clean water for face-washing.

The increasing world population leads to an increase in the requirement of fresh water for drinking, hygiene and household purposes, as well as for agricultural irrigation. Population growth also brings in its train a high load of municipal sewage, livestock excreta and industrial wastewater, posing a threat to sources of drinking water, both surface and ground-water. With a few exceptions such as hepatitis viruses, most fecal-oral pathogens are known cause gastrointestinal illnesses. There may also be myriads of emerging pathogens which are excreted by humans or animals. The greatest impact of water pollution on human health comes through drinking water acting as an important vehicle for transmission of a large variety of infectious diseases. In many industrialized countries, the widespread occurrence of the protozoan parasites *Cryptosporidium* and *Giardia* in surface waters means that any drinking water treatment plant which draws its water from a surface source is at risk. At the same time, water utilities which use groundwater under the direct influence of surface water are not necessarily free from this threat.

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Biographical Sketches

Takuro Endo is Chief of the Protozoology Laboratory at the National Institute of Infectious Diseases, where he has been at his present post since 1985. He graduated from the Department of Pathology, Tokyo University of Fisheries in 1970. Then he continued his research as a research student of the Department of Parasitology at the National Institute of Infectious Diseases (NIID). From 1971, he served as Assistant Professor of the Department of Parasitology, School of Medicine at Jikei University. From 1974, he became Technical official of Department of Parasitology at NIID; he took a Senior Researcher’s post in 1984. In the meantime, he obtained a Ph.D. from Nippon Veterinary and Zootechnical College with a thesis titled “Toxoplasma gondii: Electron Microscopic Studies on the Dye Test Reaction”. Today, his main research interest is cell biology and molecular epidemiology and diagnostics of *Coccidia* and pathogenic free-living amoebae.
Dr. Endo has executed several overseas activities. He served as Guest Professor of the Department of Medical Parasitology at Bonn University, West Germany funded by the Alexander von Humboldt Foundation from 1979 to 1981. He then worked for University of Philippines as Visiting Professor from 1992 to 1995, and for Szeged University, Hungary from 1994 to 1995. He was the Japanese delegate for the WHO Guidelines for Drinking-water Quality in 1998 and 2000, and since 1998, he has been a member of the Steering Group of OECD Workshops on Molecular Technologies for Safe Drinking Water.
He is a member of the Japanese Society of Ophthalmology, American Society of Protozoology, a Committee Member of Japanese Society of Parasitology, and an Executive Committee Member of Japanese Society of Protozoology,

Yasumoto Magara is Professor of Engineering at Hokkaido University, where he has been on faculty since 1997. He was admitted to Hokkaido University in 1960 and received the degree of Bachelor of Engineering in Sanitary Engineering in 1964 and Master of Engineering in 1966. After working for the same university for 4 years, he moved to National Institute of Public Health in 1970. He served as the Director of the Institute since 1984 for Department of Sanitary Engineering, then Department of Water Supply Engineering. He also obtained a Ph.D. in Engineering from Hokkaido University in 1979 and was conferred an Honorary Doctoral Degree in Engineering from Chiangmai University in 1994. Since 1964, his research subjects have been in environmental engineering and have included advanced water purification for drinking water, control of hazardous chemicals in drinking water, planning and treatment of domestic waste including human excreta, management of ambient water quality, and mechanisms of biological wastewater treatment system performance. He has also been a member of governmental deliberation councils for several ministries and agencies including Ministry of Health and Welfare, Ministry of Education, Environmental Agency, and National Land Agency. He meanwhile performs the international activities with JICA (Japan International Cooperation Agency) and World Health Organization. As for academic fields, he plays a pivotal role in many associations and societies, and has been Chairman of Japan Society on Water Environment.

Professor Magara has written and edited books on analysis and assessment of drinking water. He has been the author or co-author of more than 100 research articles.