The 75th Annual Meeting of the Japanese Society for Hygiene

Water and Health

Dr Wilfried Kreisel
Director, WHO Centre for Health Development
Niigata City, 29 March 2005
Selected Topics at previous meetings of the Japanese Society for Hygiene

• 1929: Hygiene related to sunlight and ventilation
• 1934: The role of temperature, humidity and ventilation in architecture
• 1942: Studies on changing impact of industrial pollutants.
• 1950: The status of school hygiene under the new educational system
• 1970: Hygienic aspects of air pollution
• 1980: Environmental carcinogens and expectations of public health
1. Water and health in Japan: a brief historical analysis

2. The global situation: WHO perspective on emerging challenges and water borne health risks

3. How to meet future challenges in water and health?
Water and health in Japan: a brief historical analysis

A. 1868-1900
B. 1901-1945
C. 1946-2004

Dondo dam, Hyogo Prefecture
Characteristics of water supply system at that time:
A. Pre-modern: continuation of the method from the Edo period
B. Utilization of wooden pipes
C. Usage of water from rivers
D. Hygiene and health as great concerns
Number of patients and mortality in major cholera outbreaks in Japan

Number of recorded patients in major dysentery outbreaks in Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>1893</td>
<td>167000</td>
</tr>
<tr>
<td>1894</td>
<td>155000</td>
</tr>
<tr>
<td>1899</td>
<td>108000</td>
</tr>
</tbody>
</table>

1. Drinking Water Caution Act was implemented in 1878.
2. First sewerage system was established in Tokyo in 1884.
3. In 1887, Mr Henry S. Palmer designed the first modern water distribution system (with iron pipes, sand filtering, pumps, and the process of disinfecting) for Yokohama City. Other cities followed, e.g. Nagasaki (1891), Osaka (1895), Hiroshima (1898), Tokyo (1898) and Kobe (1900).
4. Waterworks Clauses Act was established in 1890.
5. First major water pollution occurred at Ashio Copper Mine in Tochigi Prefecture, in 1891.
6. The Sewerage Law was introduced in 1900.
Population growth in Japan (1901-1945)

[Source: Statistical Survey Department, Statistics Bureau, Ministry of Public Management, Home Affairs, Posts, and Telecommunication, Japan]
1. Infectious diseases were still a major concern: e.g., cholera outbreaks in 1902, 1912, 1916, and 1920.
2. More cities established modern water supply system: Okayama City in 1905, Shimonoseki City in 1906, and Akita City in 1911.
3. Introduction of wastewater treatment tanks, i.e., septic tanks.
4. First patient of Itai-itai disease was identified in 1912.
5. Damage from the war was great: in 1945, for instance, about 80 percent of water pipes in the City of Kobe were leaking water.
6. Water consumption for industrial purposes increased.
Percentage of people with access to water supply (1950-2000)

[Source: Ministry of Health, Labour, and Welfare, Japan]
Population increase in Japan (1946-2000)

[Source: Statistical Survey Department, Statistics Bureau, Ministry of Public Management, Home Affairs, Posts, and Telecommunication, Japan]
1. Change in chlorination method: from periodic chlorination to regular chlorination

2. Waterworks Law was implemented in 1957.

Incidence and mortality from cholera in Japan (1946-1998)

[Source: Ministry of Health, Labour, and Welfare, Japan]
Incidence and mortality from typhoid fever in Japan (1946-1998)

Number of patients/mortality

Year

Incidence of typhoid fever
Mortality from typhoid fever

Source: Ministry of Health, Labour, and Welfare, Japan
## Access to water supply by Prefecture

<table>
<thead>
<tr>
<th>Access to water supply based on prefectures (2004)</th>
<th>Prefecture</th>
<th>Access to water supply by Prefecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
<td>Kumamoto</td>
<td>83.9 %</td>
</tr>
<tr>
<td>Highest</td>
<td>Tokyo</td>
<td>100 %</td>
</tr>
<tr>
<td>Average of all prefectures</td>
<td>All Prefectures</td>
<td>96.8 %</td>
</tr>
</tbody>
</table>

[Source: Ministry of Health, Labour, and Welfare, Japan]
Development of water supply and sanitation
- summary -

Source: Prof. Y. Magara, Hokkaido University
Control of feces-oral route related diseases in 1960-1975

Source: Prof. Y. Magara, Hokkaido University
Specific Chemical Pollution Related Diseases

1. Minamata disease (due to methylmercury contamination): the first patient identified in 1953; Based on the so-called Compensation Law of 1974, by March 2001, 2955 persons have been certified as Minamata Disease patients.

2. Itai-itai disease (as a result of cadmium contamination): the first patient was found in 1912; 184 patients were identified during the period 1967 - 2000.
Rates of non-conformity to water environmental quality standards for protecting human health

Note: Rates of non-conformity for health-related pollutants (based on old environmental quality standards)
(Non-conformity rate for alkyl-mercury has been 0% since 1971)
Rates of conformity to water environmental quality standards (BOD or COD, according to water area)

Source: Ministry of the Environment
Integrated Water Resources Management

- **Farmland**
  - Soil pollution measures
  - Prevention of pollution by agricultural chemicals

- **Sea areas**
  - Measures to prevent eutrophication
  - Conservation and restoration of seaweed beds and tidelands

- **Urban areas**
  - Effluent control
  - Measures for domestic wastewater
  - Groundwater pollution measures
  - Soil pollution measures
  - Ground subsidence measures

- **Lakes and Reservoirs**
  - Plan for the Conservation of Lake Water Quality
  - Measures to prevent eutrophication

Source: Ministry of the Environment
Where are we now globally?

• About 1 billion people still without proper access to improved water supply
• About 3 billion lack access to any form of improved excreta disposal services
• Microbiological quality of drinking and recreational water
• Chemical contamination of water
Selected water-related diseases

• **Diarrhoea:**
  1.8 million people, die of diarrhoea every year; 90% are children under 5, mostly in developing countries

• **Malaria:**
  1.2 million people, mostly children, die of malaria every year. Better management of water resources reduces transmission.

• **Schistosomiasis:**
  160 million are infected. It is strongly related to unsanitary excreta disposal and absence of sources of safe water.
  Basic sanitation reduces the diseases by up to 77%

• **Arsenicosis and Fluorosis**
  Up to 35 million at risk for arsenicosis in Bangladesh, and millions more in India, China and elsewhere. Sixty-six million at risk for fluorosis in India, 26 million in China, and elsewhere.
### Definition of Improved Drinking Water and Sanitation

**Improved water:** access to sources of water which are likely to provide safe water

**Improved water supply**
- Household connection
- Public standpipe
- Borehole
- Protected dug well
- Protected spring
- Rainwater collection

**Unimproved-water supply**
- Unprotected well
- Unprotected spring
- Vendor provided water
- Bottled water
- Tanker truck provided water

**Improved sanitation:** access to facilities which are likely to be sanitary

**Improved sanitation**
- Connection to a public sewer
- Connection to a septic tank
- Poor-flush latrine
- Simple pit latrine
- Ventilated improved pit latrine

**Unimproved sanitation**
- Service or bucket latrine (where excreta are manually removed)
- Public or shared latrines
- Latrines with open pit
Meeting the MDG Drinking Water and Sanitation Target: Mid-term Assessment of Progress
WHO and UNICEF, 2004
Improved Sanitation: Status in 2002

Sanitation coverage, 2002

Percentage of population using improved sanitation

Meeting the MDG Drinking Water and Sanitation Target: Mid-term Assessment of Progress
WHO and UNICEF, 2004
# Population Growth

<table>
<thead>
<tr>
<th>Time</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>~1830</td>
<td>1 billion</td>
</tr>
<tr>
<td>~1930</td>
<td>2 billion</td>
</tr>
<tr>
<td>~1970</td>
<td>4 billion</td>
</tr>
<tr>
<td>today</td>
<td>6.3 billion</td>
</tr>
<tr>
<td>2050</td>
<td>~9 billion</td>
</tr>
</tbody>
</table>
95% of the “build out” of human numbers will occur in the urban areas of developing countries (whose populations will double, to 4 billion, by 2050)
<table>
<thead>
<tr>
<th>Time</th>
<th>Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1700s</td>
<td>less than 10%</td>
</tr>
<tr>
<td>1900</td>
<td>25%</td>
</tr>
<tr>
<td>Today</td>
<td>50%</td>
</tr>
<tr>
<td>2050</td>
<td>67%</td>
</tr>
</tbody>
</table>
Transition of Slums

Earlier slums resulted largely from industrialization, drawing workers to cities (usually the centre), and tending to slow – or even reverse migration to countryside – as prosperity grew.
Today, in some places (e.g. China) the pressures of industrialisation are similar. But in other places (sub-Saharan Africa, Latin America, Middle East, parts of Asia), urbanization is radically decoupled from industrialisation, and even from development as such. This “perverse” urban boom contradicts orthodox economic models. So instead of being a focus for growth and prosperity, some cities have become dumping grounds for surplus populations.
Infant and Child Mortality Rates (under 5 yrs) in the Urban Slums of Nairobi (compared with other areas of Kenya).

<table>
<thead>
<tr>
<th></th>
<th>Infant Mortality</th>
<th>Under-five Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCSS**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nairobi Slums</td>
<td>91.3</td>
<td>150.6</td>
</tr>
<tr>
<td>National*</td>
<td>73.7</td>
<td>111.5</td>
</tr>
<tr>
<td>Rural *</td>
<td>75.9</td>
<td>113.0</td>
</tr>
<tr>
<td>Other Urban*</td>
<td>56.6</td>
<td>83.9</td>
</tr>
<tr>
<td>Nairobi*</td>
<td>38.7</td>
<td>61.5</td>
</tr>
</tbody>
</table>

* Based on 1998 KDHS data – Kenya Demographic and Health Surveys
** NCSS – National Cross Sectional Slums Survey, 2000
“Bacterial and viral diseases are the price humanity has paid to live in large and densely populated cities. Virtually all the familiar infectious diseases have evolved only since the advent of agriculture, permanent settlement and the growth of cities.
Most were transferred to humans from animals – especially domestic animals. For instance, influenza came from pigs; smallpox is related to cowpox. Humans share 296 diseases with domestic animals.”

From John Reader, the author of Cities (Heinemann, 2004)
61% of these emerging pathogens were zoonotic (adapted from Taylor, Latham & Woolhouse, 2001)
Potential drivers of the emergence and re-emergence of pathogens in water

New environments:
- Climate shifts/deforestation
- Water resources development projects (dams and irrigation)
- Water-cooled air conditioning plants
- Changing industrial and agricultural practices (e.g., intensive livestock rearing)
- Piped water systems and their inadequate design and operation
- An increasing number of humanitarian emergencies

New technologies:
- Water resources development projects (dams and irrigation)
- Water-cooled air conditioning plants
- Changing industrial and agricultural practices
- Waterborne sewage and sewage treatment alternatives
Potential drivers of the emergence and re-emergence of pathogens in water (continued)

<table>
<thead>
<tr>
<th>Changes in human behaviour and vulnerability:</th>
<th>Scientific advances:</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Human circulation and the accessibility and rapidity of transport worldwide</td>
<td>▪ Inappropriate, excessive use of antibiotics anti-parasitic drugs and public health insecticides</td>
</tr>
<tr>
<td>▪ Demographic changes</td>
<td>▪ Changing industrial and agricultural practices</td>
</tr>
<tr>
<td>▪ Increasing size of high risk populations</td>
<td>▪ Improved methods of detection and analysis</td>
</tr>
<tr>
<td>▪ Deliberate and accidental release of pathogens to water</td>
<td>▪ Inappropriate use of new generation insecticides</td>
</tr>
<tr>
<td>▪ An increasing number of humanitarian emergencies</td>
<td></td>
</tr>
</tbody>
</table>
WHO Guidelines Concerned with Water, Sanitation and Health

Guidelines for Drinking-water Quality
Guidelines for Safe Use of Wastewater and Excreta in Agriculture
Guidelines for Safe Use of Wastewater and Excreta in Aquaculture
Guidelines for Safe Recreational Water Environments
  - Coastal and freshwaters
  - Swimming pools and spas
Guide to Ship Sanitation
Guide to Sanitation in Aviation
WHO GDWQ - Basics

Aim

- Protection of human health (safe and acceptable)
- Advisory in nature - support national standard setting – flexible to account local social, cultural, economic & environmental context

Features

- Risk-benefit philosophy - local adaptation to priorities for health gain
- Best available evidence - science and practice

Approach

- Scientific consensus
- Use global information and experience
WHO GDWQ Coverage

- Microbes (infectious agents)
  e.g. protozoa (giardia, cryptosporidium)
  bacteria (Ecoli O157, Legionella)
- Chemicals – 95 GV recommended
  e.g. disinfectants; disinfectant by-products
- Radiological aspects
- Acceptability aspects
## Comparison of selected Drinking Water Quality Guidelines (WHO) and Standards (Japan)

<table>
<thead>
<tr>
<th>Item</th>
<th>WHO DWQS</th>
<th>Relationship</th>
<th>MoHLW DWQS</th>
</tr>
</thead>
<tbody>
<tr>
<td>cadmium</td>
<td>0.003 mg/litre</td>
<td>&lt;</td>
<td>0.01 mg/liter or less</td>
</tr>
<tr>
<td>lead</td>
<td>0.01 mg/litre</td>
<td>=</td>
<td>0.01 mg/liter or less</td>
</tr>
<tr>
<td>arsenic</td>
<td>0.01 mg/litre</td>
<td>=</td>
<td>0.01 mg/liter or less</td>
</tr>
<tr>
<td>carbon tetrachloride</td>
<td>0.004 mg/litre</td>
<td>&gt;</td>
<td>0.002 mg/liter or less</td>
</tr>
<tr>
<td>trichloroethylene</td>
<td>0.07 mg/litre</td>
<td>&gt;</td>
<td>0.03 mg/liter or less</td>
</tr>
<tr>
<td>simazine</td>
<td>0.002 mg/litre</td>
<td>&lt;</td>
<td>0.003 mg/liter or less</td>
</tr>
<tr>
<td>benzene</td>
<td>0.01 mg/litre</td>
<td>=</td>
<td>0.01 mg/liter or less</td>
</tr>
<tr>
<td>selenium</td>
<td>0.01 mg/litre</td>
<td>=</td>
<td>0.01 mg/liter or less</td>
</tr>
</tbody>
</table>

[Source: WHO; Ministry of Environment, Japan]
Setting National Standards

• Should consider a variety of geographical, socioeconomic, dietary and cultural conditions in addition to science
• Risk balancing
• Risk-benefit and cost-benefit considerations
• Feasible enforcement approaches
Changing Global Context

- Driving forces
  - Population
  - Urbanization
- Water resources decline
  - Quality
  - Quantity
- Increase in susceptible populations
  - Aging
  - HIV/AIDS
International Commitments: The MDGs related to health

 Goal 1: Eradicate extreme poverty and hunger.
 Goal 4: Reduce child mortality.
 Goal 5: Improve maternal health.
 Goal 6: Combat HIV/AIDS, malaria and other diseases.
 Goal 7: Ensure environmental sustainability.
   - Target 10: reduce by half the proportion of people without sustainable access to safe drinking water
   - Target 11: achieve significant improvements in lives of at least 100 million slum-dwellers by 2020
 Goal 8: Develop a global partnership for development.
At its 58th session, the United Nations General Assembly adopted a draft resolution, without a vote (A/RES/58/217), proclaiming 2005 to 2015 as the International Decade for Action - Water for Life. This recommendation, which comes at the close of the International Year of Freshwater 2003, calls for a greater focus on water-related issues and for actions to ensure the participation of women in water-related development efforts. It also recommits countries to achieving the water-related goals of the 2000 Millennium Declaration, the 2002 Johannesburg Plan of Implementation and of Agenda 21.
UN-Water

24 agencies
(e.g. WHO, UNICEF, UNDP, HABITAT, UNEP)
UN-Water Purpose

- '… to complement and add value to existing programmes and projects by facilitating synergies and joint efforts, so as to maximise system wide coordinated action and coherence as well as the effectiveness of the support provided to Member States in their efforts towards [MDGs]'
Identified priorities

**Issues**
- Water scarcity
- Sanitation, drinking water and hygiene
- Disaster risk reduction
- Pollution
- Transboundary waters
- Water, sanitation and gender

**Responses**
- Capacity building
- Financing
- Valuation

**Conceptual frame**
- IWRM

**Geographic focus**
- Africa
Level of Investment in Water and Sanitation (1990-2000)

Total annual national and external investment in water supply and sanitation in Africa, Asia and Latin America and the Caribbean, 1990-2000

Source: D. Tipping, UN Habitat
Level of Investment in Water and Sanitation (1990-2000)
(continued)

Total annual investment in water supply compared to total annual investment in sanitation in Africa, Asia and Latin America and the Caribbean, 1990-2000

Source: D. Tipping, UN Habitat
Level of Investment in Water and Sanitation (1990-2000) (continued)

Median total investment in water supply and sanitation as a percentage of overall government investment 1990-2000

Source: D. Tipping, UN Habitat
Prospects for Financing - Global/Regional Level

Established Mechanisms and Proposals include:

- EU Water Facility
- Slum Upgrading Facility

What is Needed as a Next Step

- More Loans and Grants, special reference to local level
- Increased ODA, particularly at local level
- Explore the role of the Private Sector contributions to a larger extent