CREST Symposium associated with 10th SEAWE in Hanoi
Development of Well-Balanced Urban Water Use System Adapted to Climate Change
-Toward Sustainable Water Use-

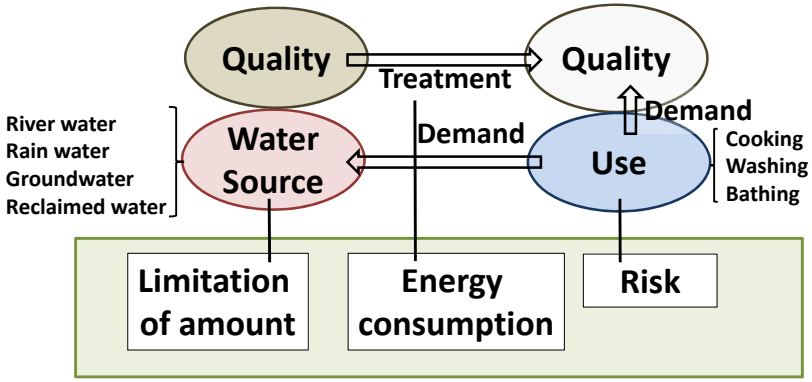
2012/11/07

Microbial water safety with novel virus indicators

Hiroyuki KATAYAMA
Manami INABA
The Univirsity of Tokyo

東京大学
THE UNIVERSITY OF TOKYO

Sustainable water use
with combination of multiple sources



Importance of microbial safety management

People perception depends on scientific evidence-based safety

Sustainable water use

Limitation of amount

Energy consumption

Risk — **Chemical risk**
Microbial risk

Difficult to evaluate

Water - Too much or too little

THE FOREMOST CAUSE OF NATURAL DISASTERS (WHO fact sheet 2001)

- Almost two billion people – one-third of humanity – were affected by natural disasters in the last decade of the 20th century. Floods and droughts accounted for 86% of them.
- Quick-onset disasters like earthquakes, volcanic eruptions and landslides may be more dramatic and take a very high toll in human lives. But floods and droughts – too much water or too little – often have longer lasting and more far-reaching effects on the health of their victims.

Diarrhea Key facts

- Diarrhoeal disease is the second leading cause of death in children under five years old. It is both preventable and treatable.
- Diarrhoeal disease kills 1.5 million children every year.
- Globally, there are about two billion cases of diarrhoeal disease every year.
- Diarrhoeal disease mainly affects children under two years old.
- Diarrhoea is a leading cause of malnutrition in children under five years old.

WHO Fact sheet N° 330, August 2009

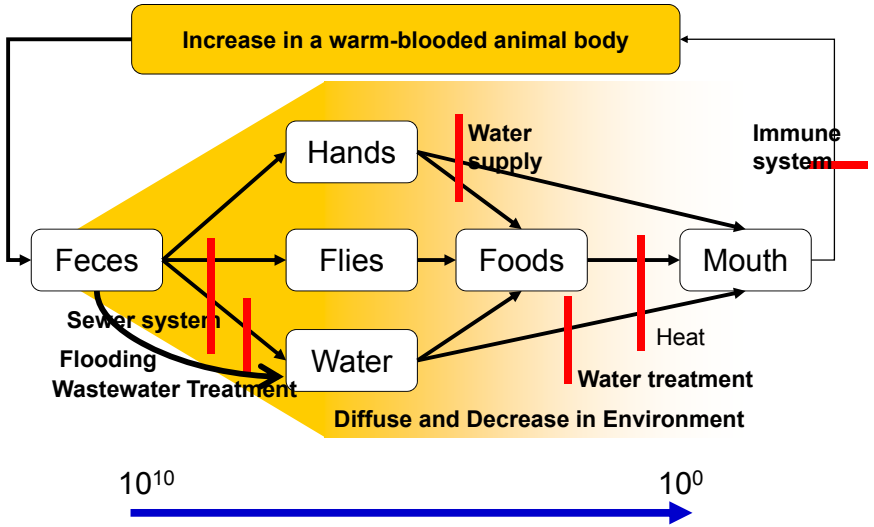
- Water, hygiene and sanitation interventions reduce diarrhoea incidence by 26% and mortality by 65%.

WHO, **28 August 2002**

Haiti's Cholera Crisis May 12, 2012 New York Times

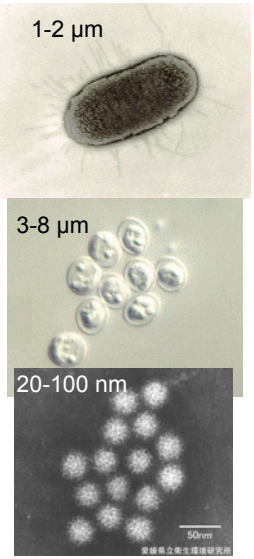
- The cholera epidemic in Haiti began in late 2010
- The outbreak occured ten months after a powerful earthquake
- The United Nations peacekeepers are suspected to have introduced the disease through sewage leaks at one their encampments.
- A chronic lack of access to clean water and sanitation
- Spring rains bring floods
- 200,000 to 250,000 disease this year. It has already killed more than 7,000. (The Pan American Health Organization)

Life cycle of pathogens of Fecal-oral infection



Microbial Water Safety Issues

- Bacteria (*Cholera, E. coli,* etc) were controlled under modernized water supply systems
- Protozoa (*Cryptosporidium*) caused serious outbreaks due to its high tolerance to chlorination, and countermeasures were taken from 1990s.
- Virus problems have been concerned from 1960s, among which Noroviruses are the most prevalent.



Microorganisms causing waterborne disease

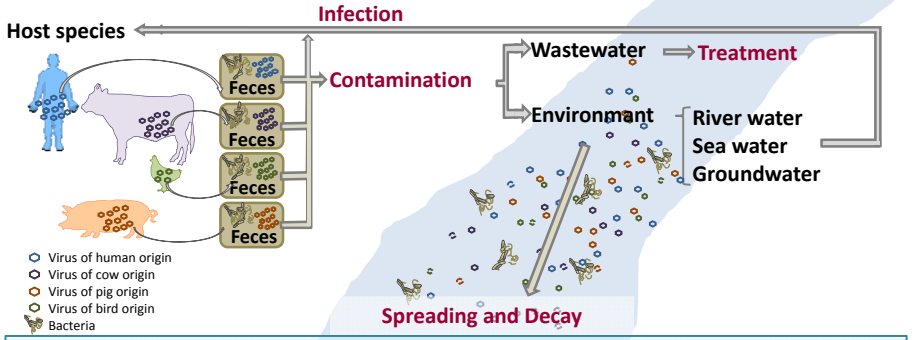
Microbial water safety issues

Bacteria	Viruses	Protozoa
・*Salmonella* spp ・*Shigella* spp ・*Campylobacter* spp ・*Vibrio cholerae*	・Hepatitis A virus ・Enterovirus ・Adenovirus ・Norovirus ・Rotavirus ・Sapovirus ・Astrovirus	・*Entamoeba histolytica* ・*Giardia intestinalis* ・*Cryptosporidium parvum*
Low tolerance to chlorination	**High stability in water (Surviving for a long period)**	**・High tolerance to chlorination ・Zoonotic disease pathogens**

The structure and size affect behavior and survival in water

Fecal contamination in water

Transmission of waterborne diseases



- **Microorganisms causing waterborne diseases can not grow in water environment**
- **Each fecal source has different type of threatening pathogen**

Problems of fecal indicators

Coliform and *E. coli* has been representative indicators in water environment.

→ **Appropriate indicators for pathogenic bacteria**

Problems

・Different tolerance to environment condition and treatment system from virus and protozoa

→ **Different behavior in water environments**

・Present in feces other than human

→ **Fail to identify the source of contamination**

Other indicators are necessary for assessment

Advantages of use of virus as an indicator

1. For human enteric viruses — **Same fate**

Morphological characteristics correspond to typical enteric viruses

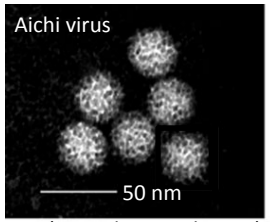
Behavior in environment is expected to be consistent with pathogenic viruses

2. For source tracking — **Host specific**

The virus can not be infected to other than original host
Human viruses can be infected to only human beings
Pig viruses can be infected to only pigs
→ **Host specific**

Source of fecal contamination can be predicted from occurrence of different type of viruses

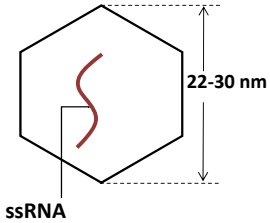
Candidate of virus indicators; genus Kobuvirus



(Yamashita *et al.* 2003)

- **Taxonomy ; Family *Picornaviridae***
- **Genome ; Single stranded RNA**
- **Diameter ; 22-30 nm**

These features are similar to typical viruses (Norovirus, Enterovirus)



- **Species ; Aichivirus (Human)**
  Bovine kobuvirus (Cows and Oxen)
  Porcine kobuvirus (Pig)

Characteristics of Kobuvirus

Aichivirus

- Reported world wide
  (Japan, Vietnam, Thailand, Hungary, Germany, Brazil, France, Tunisia and Venezuela)
- Not detected from other than human

Bovine kobuvirus

- Not detected from other than cows and oxen

Porcine kobuvirus

- Not detected from other than pigs

Possibility
- **Kobuviruses are abundant in environment**
- **Kobuviruses specificity to each host is high**

Aim of the study in CREST project

- **To estimate abundance of Aichiviruses in water environment in Hanoi**
- **To confirm presence of bovine kobuvirus and porcine kobuvirus**
- **To propose safe water use in terms of virus infectious risk**