Sustainable Control of Water-Related Disease:
The intersection between water quality, water quantity, and human behavior

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1st College of Engineering Clean and Sustainable Water Technology Initiative
Agenda

1. Controlling water quality
2. Managing water quantity
3. Sanitation and Hygiene
4. Developing human capital in W.A.S.H. sector
Grand Challenge
Provide Access to Clean Water

Lack of clean water is responsible for more deaths in the world than war. About 1 out of every 6 people living today do not have adequate access to water, and more than double that number lack basic sanitation, for which water is needed. In some countries, half the population does not have access to safe drinking water, and hence is afflicted with poor health. By some estimates, each day nearly 5,000 children worldwide die from diarrheal diseases, a toll that would drop dramatically if sufficient water for sanitation was available.
Water-Related Diseases and Their Causes

Account for ≈ 7% of the total disease burden globally

- Malaria
- Dengue
- Yellow Fever
- Zika
- West Nile
- Encephalitis
- Cholera
- Salmonella typhi
- Shigella spp.
- E. Coli
- Campylobacter
- Hepatitis A/E
- Norovirus
- Enterovirus
- Rotavirus
- Schistosomiasis
- Giardia
- Intestinal worms
- Trachoma
- Arsenicosis
- Fluorosis
- Lead
- Chromium
- Pesticides
231 Alerts for 17 Waterborne Disease in Past Week

http://www.healthmap.org/en/
More than 3.4 million people deaths each year with 99% of these deaths occurring in the developing world

Illness and associated productivity loss from water-related diseases linked to 2-5% GDP loss

Preventable water-related diseases cost 443 million school days each year

~50% of the hospital beds in the developing world are occupied by people suffering from preventable waterborne disease

Access to Safe Water 11%
Lack Adequate Sanitation 37%
Wash Hands Properly 5%
Surveyed College Undergrads Who Know This
19%
30%
5%
Chlorinated Water Treatment

“The kind of assisted emigrant we can not afford to admit” – Illustration, 1883
100 Years of NYC Mortality

Benefits of water quality
Public Health Benefit From Municipal Water Systems (1900-1940)

Cost-benefit analysis conducted by Cutler & Miller, 2005

- Mortality from diarrheal disease decreases from 140 → 20 per 100,000.
- Child mortality rates decrease from 130 → 60 per 1000.
- Life expectancy at birth increased by 16 yrs.
- Cost-benefit analysis indicated that every life saved cost $500 resulting in $11,500 gain (1:23 cost-benefit ratio).
Adequate Sanitation
Method of disposal of human waste one of the strongest predictors of child survival

- Improved water supply reduces infant mortality up to 23%
- Access to improved sanitation (flush toilet or pit latrine) reduces infant mortality up to 59%

Fecal-Oral Disease Prevention

Break the routes of exposure

Sanitation

Feces
Water
Hands
Flies
Soil

Clean water

Hygiene (and safe food preparation)

Food

New host
Life cycle of the Aedes mosquito

Adding water to a community can increase standing water which is mosquito breeding habitat
Karachi Soap Trial

Study conducted by the CDC, Health Oriented Preventive Education, Aga Khan University, Proctor & Gamble
Incidence of pneumonia in children younger than 5 years decreased by half in groups given soap.

Incidence of diarrhea and impetigo in children younger than 15 years

Intervention group was given soap which significantly reduced the incidence of disease.

<table>
<thead>
<tr>
<th></th>
<th>Diarrhoea Incidence (n=197,049)</th>
<th>Impetigo Incidence (n 200,156)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean Incidence</td>
<td>Mean Incidence</td>
</tr>
<tr>
<td>Plain Soap</td>
<td>1.91</td>
<td>0.62</td>
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<tr>
<td></td>
<td><strong>-53%</strong> (95% CI: -65% to -41%)</td>
<td><strong>-36%</strong> (95% CI: -53% to -18%)</td>
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<tr>
<td>Control</td>
<td>4.06</td>
<td>0.94</td>
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</tbody>
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*Mean incidence (episodes per 100 person weeks) calculated with mean of neighborhood rates weighted by person-week at risk from every neighborhood.*
When we get it wrong

Arsenic crisis in Ganges Delta is affecting millions of people
Threats from water-related diseases are constant and evolving

Ecosystem services and built environment require continuous protection, maintenance, and improvement
Control measures for water-related disease

Categorize the causes of disease by how they spread

**Waterborne**
- Water quality
- Sanitation
- Hygiene

**Water-washed**
- Water quantity
- Hygiene

**Chemical**
- Water quality

**Water-vector**
- Water quantity
Sustainable Control of Water-Related Disease

Requires investment in human capital, infrastructure, and governance

- Qualitative skills
  - Talk to community and identify barriers and needs

- Economic skills
  - Secure financial support for projects

- Cultural competency
  - Interact effectively with people of different cultures

- Scientific and health skills
  - Design, build, and maintain infrastructure

- Educational skills
  - Empower people to adopt and value W.A.S.H.

- Leadership skills
  - Governance and management of public goods and services

Talk to community and identify barriers and needs
Secure financial support for projects
Interact effectively with people of different cultures
Design, build, and maintain infrastructure
Empower people to adopt and value W.A.S.H.
Governance and management of public goods and services
Thank you

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