Water, Sanitation and Health in Alaska: A brief review of the evidence

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Disclaimer

The audience should know that…
	his presentation represents the conclusions of the presenter and

does not necessarily represent the official position of CDC
Why are still doing studies to evaluate water, sanitation and health?
164th Anniversary of the London Cholera Outbreak

John Snow, Physician and Epidemiologist
Relationship of Environmental Factors To Enteric Disease

1958

RELATIONSHIP OF ENVIRONMENTAL FACTORS TO ENTERIC DISEASE
ASCARIS AND SHIGELLA INFECTIONS ACCORDING TO SELECTED SANITARY FACILITIES
Eastern Kentucky, 1954-1956

Percent Positive

<table>
<thead>
<tr>
<th>Presence</th>
<th>Off Premise</th>
<th>On Premise</th>
<th>Privy Only</th>
<th>Flush Toilet</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER OUTSIDE DWELLING</td>
<td>43</td>
<td>41</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>WATER INSIDE DWELLING</td>
<td></td>
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Percent Positive

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<tbody>
<tr>
<td>WATER OUTSIDE DWELLING</td>
<td>6.0</td>
<td>5.8</td>
<td>2.4</td>
<td>1.1</td>
</tr>
<tr>
<td>WATER INSIDE DWELLING</td>
<td></td>
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</table>

Source: Public Health Monograph No. 54-1958 (PHS Publication No. 591)
Effect of Improved Sanitary Facilities on Infant Diarrhea in a Hopi Village

A. Rubenstein, J. Boyle, M.D., C. L. Odoroff, Ph.D., and S. J. Kunitz, M.D.

Diarrhea is a major health problem among southwestern Indian infants (1, 2). Many environmental factors have been implicated in the high prevalence of diarrheal disease on Indian reservations and in all socio-economic levels where living conditions are poor. Among these factors, the availability of water for personal hygiene is of prime importance in the control of diarrheal disease (3-6).

Adequate sewage disposal systems including indoor flush toilets are also important in diarrheal disease control (6).

Although the infant in his first year of life neither uses a toilet nor washes himself, the sanitary problems of his mother are reflected in the infant's health status. Because children in the first 18 months of life are extremely susceptible to infectious diarrhea and therefore to the results of poor sanitation, the number of infants who become ill with diarrhea provides a subtle indication of the effectiveness of sanitary control measures. We investigated the influence of indoor water and toilets on the prevalence of infant diarrhea in the first year of life, as reflected in hospital use of infants living in a Hopi pueblo in northern Arizona.

Subjects and Methods

Mosakopi, a Hopi Indian village of approximately 700 people, is 3 miles from the Public Health Service Indian Hospital in adjacent Tuba City, Arizona. Mosakopi is divided both politically and geographically into traditional (lower Mosakopi) and progressive factions (upper Mosakopi).

Nagata gives a detailed ethnographic study of this village (7). In this paper we can only indicate the ways that the two segments of the village differ.

The upper village elects representatives to the tribal council and at least superficially appears to be more cooperative with government representatives. Its traditional ceremonial cycle and clan system are not intact.

The lower village does not participate in tribal council affairs and still attempts to rely on the traditional theocratic forms of social control. It, too, has a ceremonial cycle and clan system that is no longer intact and self-con-
HEALTH BENEFITS FROM IMPROVEMENTS IN WATER SUPPLY AND SANITATION:
SURVEY AND ANALYSIS OF THE LITERATURE ON SELECTED DISEASES


by
Steven A. Eray
James B. Potash
Leslie Roberts
and
Clive Shiff

July 1990
Many Arctic and Subarctic residents don’t have adequate access to in-home running water and sewer.

Alaska, Canada, Greenland, Russia
Percentage of US homes with complete plumbing, 1940 – 2010, US Census
Goal 6: Ensure access to water and sanitation for all
Threats to Alaska Rural Water and Sanitation infrastructure

- Decreased funding for new construction
- Existing systems are aging
  - Operations and maintenance
  - Replacement
- Climate change
  - Shoreline erosion
  - Sea level rise
  - Permafrost thaw
  - Source water availability and quality
Still not enough evidence?

Publications on Water/Sanitation and Health in Alaska

1. Jonathan Bressler, Thomas Hennessy
   Results of an Arctic Council Survey on Water and Sanitation Services in the Arctic
   International Journal of Circumpolar Health 2018, in press

2. Thomas Hennessy, Jonathan Bressler
   Improving health in the Arctic region through safe and affordable access to household running water and sewer services: an Arctic Council initiative.
   Int. Journal of Circumpolar Health 2016, 75: 31149 - http://dx.doi.org/10.3402/ijch.v75.31149

3. T. K. Thomas ; T. Ritter ; D. Bruden ; M. Bruce ; K. Byrd ; R. Goldberger ; J. Dobson; K Hickel; J. Smith ; T. Hennessy

   Impact of providing in-home water service on the rates of infectious diseases: results from four communities in Western Alaska
   Journal of Water and Health Available Online: 2015 Aug, DOI: 10.2166/wh.2015.110

   Prospective study of health in communities that transition from honey buckets to running water.

4. Thomas TK, Hickel K, Heavener M
   Extreme water conservation in Alaska: limitations in access to water and consequences to health

   Review article of consequences of scarcity and unintended consequences of Safe Drinking Water Act
Levels of Evidence

- Compelling stories
  - Giardia outbreak, Ketchikan 1984
  - Kivalina washeteria closure
Levels of Evidence

- Compelling stories
- Look-back studies
  - “Cross-sectional”
  - Exposure and outcome collected at same time
    - Not evidence of causation
    - Complicating factors
Hospitalization Rates for “High” and “Low” Water Service Regions, Alaska, 2000-2004

Rate per 10,000

* P < 0.05

Hennessy, AJPH, 2008
Hospitalization Rates for “High” and “Low” Water Service Regions, Alaska, 2000-2004

Rate per 10,000

Diarrhea: Water-borne infections
Pneumonia: Water-wash infections
Resp Syncytial Virus: Water quantity
Skin Infections: Water quality
Methicillin R S.aureus: Water quantity

Low Service
High Service
Hierarchy of Water Requirements

- Drinking
- Cooking
- Personal hygiene
- Washing clothing
- Cleaning home
Factors Linking Water to Health

- **Water Quality**
  - Prevents illness from drinking water
    - Water-borne diseases
      - Cholera, Typhoid fever, dysentery

- **Adequate water Quantity**
  - Drink, cook, wash: hands, body, clothes
  - Prevents infections spread person-to-person
    - Water-washed diseases
      - Respiratory infections, skin infections
Serious Infections with Pneumococcus in Children < 5 years old, Southwest Alaska, 2001-2007

* Wenger, 2010, Pediatric Infectious Diseases
Number of Cavities in Primary Teeth by Village Fluoridation Status

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Mean number of dental caries</th>
</tr>
</thead>
</table>
| 4 – 5             | Non-fluoridated: 9.8
|                   | Fluoridated: 3.7
| 6 – 11            | Non-fluoridated: 4.6
|                   | Fluoridated: 3.1

* p < 0.01

MMWR, Sept 2011

Gessner, Pediatrics, 2008
... Complicating factors....
Respiratory Hospitalizations, by Education Level of Parent

Gessner BD et al. J Epidemiol Community Health 2010;64:130-135
Respiratory Hospitalizations, by Education Level of Parent

Gessner BD et al. J Epidemiol Community Health 2010;64:130-135
Levels of Evidence

- Compelling stories
- Look-back studies
- Prospective studies
  - Before and after water service installation
    - Comparison group
    - Alaska “4 village study”
      - Tim Thomas and a cast of thousands
      - J Water and Health 2015
  - Evidence for causation
    - May be complicated by other factors
Gastrointestinal, Respiratory and Skin infection Rates, Before and After Piped Water

* P < 0.05

<table>
<thead>
<tr>
<th></th>
<th>Pre-Piped</th>
<th>Post-Piped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastro</td>
<td>↓38%*</td>
<td>↓20%*</td>
</tr>
<tr>
<td>Resp</td>
<td>↓16%*</td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Levels of Evidence

- Compelling stories
- Look-back studies
- Prospective studies
- Randomized controlled trial
  - “Treatment trial” of water/sanitation
Levels of Evidence

- Compelling stories
- Look-back studies
- Prospective studies
- Randomized controlled trial
  - “Treatment trial” of water/sanitation
  - Ethical issues
Types of Data

- Illness and death
  - Hospitalizations, clinic visits
    - Skin infections, diarrhea, hospitalization
  - Humanitarian appeal
    - Works for people who believe pain and suffering is bad
Types of Data

- Illness and death
- Indirect consequences
  - Illness
  - School absences
    - Lower economic status, poorer health for life
  - Family burden
    - Lost money, work or subsistence activities
Types of Data

- Illness and death
- Indirect consequences
  - Reduced access to drinking water
  - Increased soda consumption
  - Dental cavities, obesity, diabetes
Types of Data

- Illness and death
- Indirect consequences
- Costs
  - Direct medical costs $
    - Compare villages with and without water/sewer
  - Indirect costs
    - “Ripple effects”
    - Stories or $$
  - Useful for “bottom line” types
    - Will savings offset costs of services?
    - Who’s budget benefits?
Health benefits of running water and sewer service

- Prevention of:
  - Respiratory infections
  - Skin infections
  - Severe bacterial infections
  - Dental cavities
  - Diarrhea

- Other benefits
  - Overall hygiene
  - Mental wellness
    - Water security
  - Others?
Next Steps

- Revisit infectious disease outcomes
  - YKHC 2013 – 2016
    - Honey bucket, covered haul, piped systems
- Develop other lines of evidence
  - Cost studies
  - Compelling personal stories
- Develop a communication plan for different audiences
  - Alaska public
  - Agency and tribal leaders
  - Legislators: State, Congressional