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

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# Disclaimer

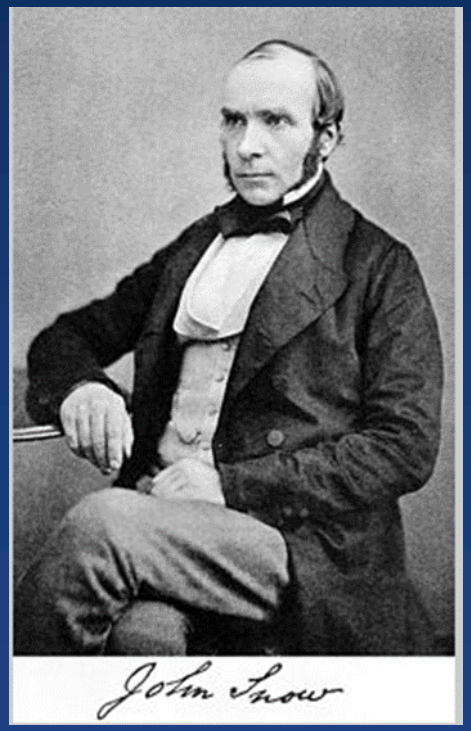
The audience should know that…

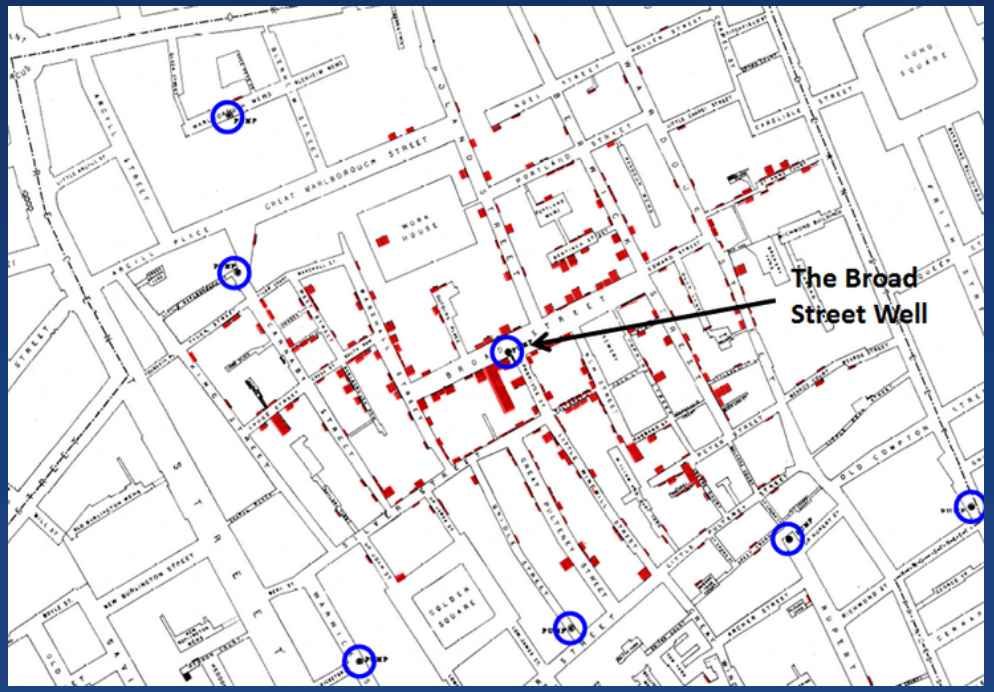
this presentation represents the conclusions of the presenter and

does not necessarily represent the official position of CDC

# Why are still doing studies to evaluate water, sanitation and health?

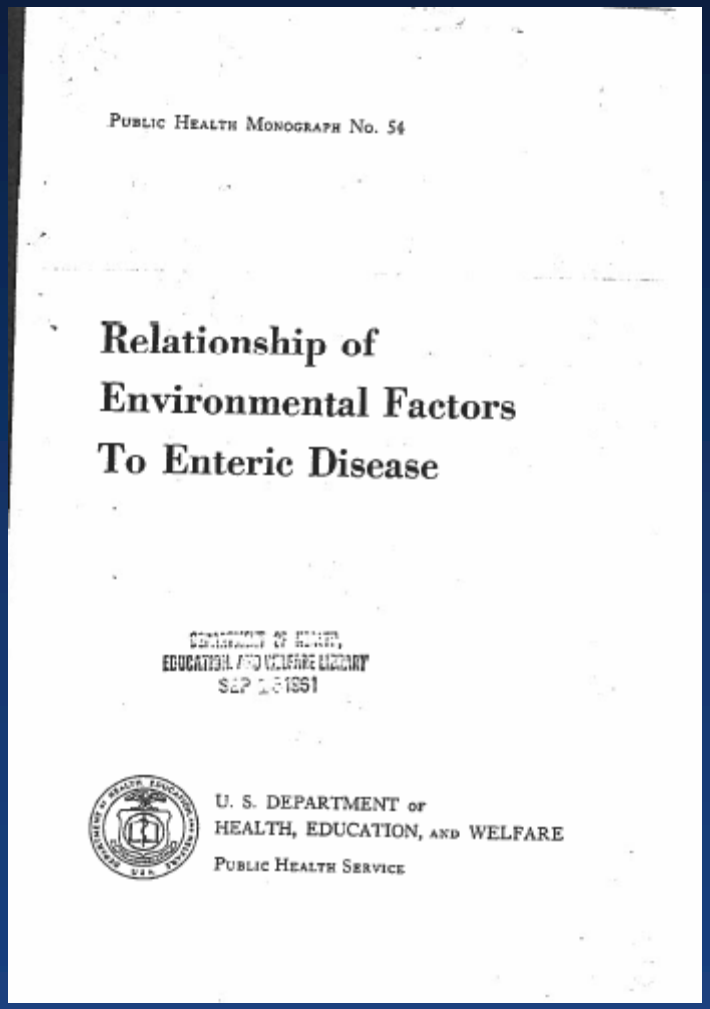
# 164th Anniversary of the London Cholera Outbreak




John Snow, Physician and Epidemiologist

# 1958



PUBLIC HEALTH MONOGRAPH No. 54

Relationship of
Environmental Factors
To Enteric Disease

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EDUCATION AND WELFARE LIBRARY
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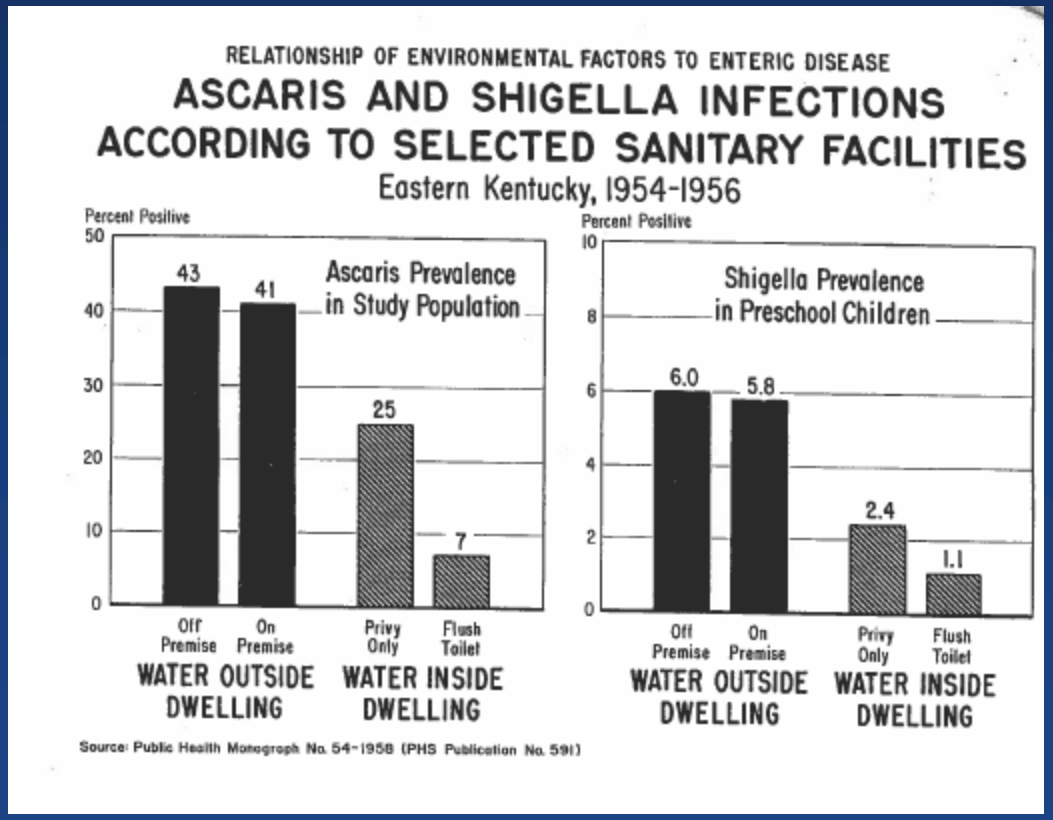
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE



# 1969

## 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 at all socioeconomic 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 (*3–5*). 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 12 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.

*Mr. Rubenstein is a medical student at the Tufts University School of Medicine, Dr. Boyle is an intern in the department of medicine, University Hospitals of Cleveland, Dr. Odoroff is assistant professor of psychiatry and preventive medicine (statistics), University of Rochester School of Medicine and Dentistry, and Dr. Kunitz is a postdoctoral fellow, department of sociology, Yale University.*

*At the time of the study Mr. Rubenstein was supported by a Public Health Service summer traineeship in preventive medicine (AT–134–R) granted to the department of preventive medicine, University of Rochester School of Medicine and Dentistry; Dr. Boyle was supported by the Public Health Service's Commissioned Officers Student Training and Extern Program.*

### Subjects and Methods

Moenkopi, a Hopi Indian village of approximately 700 people, is 2 miles from the Public Health Service Indian Hospital in adjacent Tuba City, Ariz. Moenkopi is divided both politically and geographically into traditional (lower Moenkopi) and progressive factions (upper Moenkopi).

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-

# 2000

WASH Technical Report No. 66

## HEALTH BENEFITS FROM IMPROVEMENTS IN WATER SUPPLY AND SANITATION:

### SURVEY AND ANALYSIS OF THE LITERATURE ON SELECTED DISEASES

Prepared for the Office of Health,
Bureau for Science and Technology,
U.S. Agency for International Development,
under WASH Task No. 035

by

Steven A. Esrey
James B. Potash
Leslie Roberts
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Clive Shiff

July 1990

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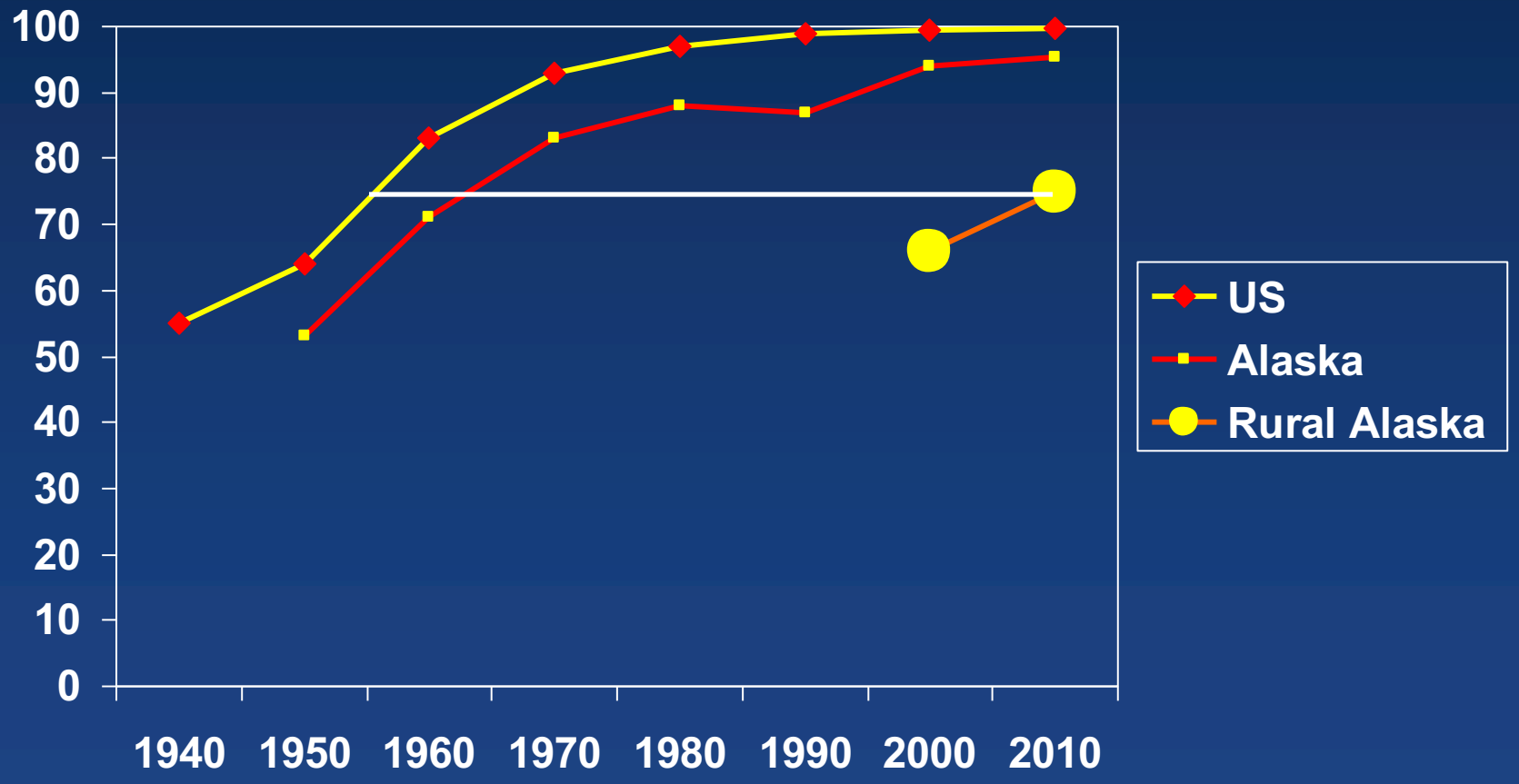
U.S. Agency for International Development
Washington, DC 20523

# 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



SUSTAINABLE DEVELOPMENT GOALS
17 GOALS TO TRANSFORM OUR WORLD

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# SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD



# 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**
   Public Health 2016; Aug 137: 59-61. doi: 10.1016/j.puhe.2016.06.002

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

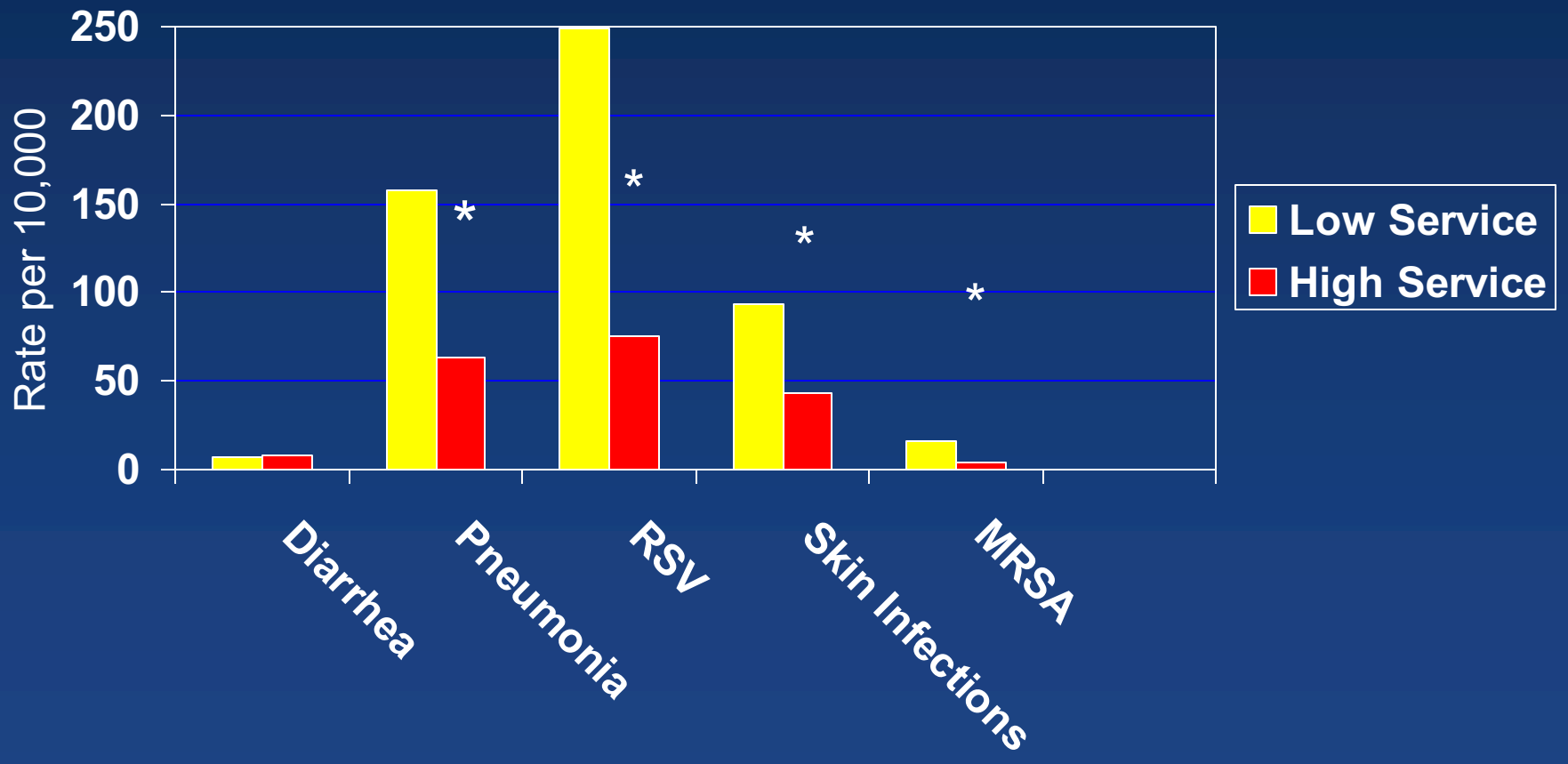
# Levels of Evidence

- 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




* $P < 0.05$

Hennessy, AJPH, 2008

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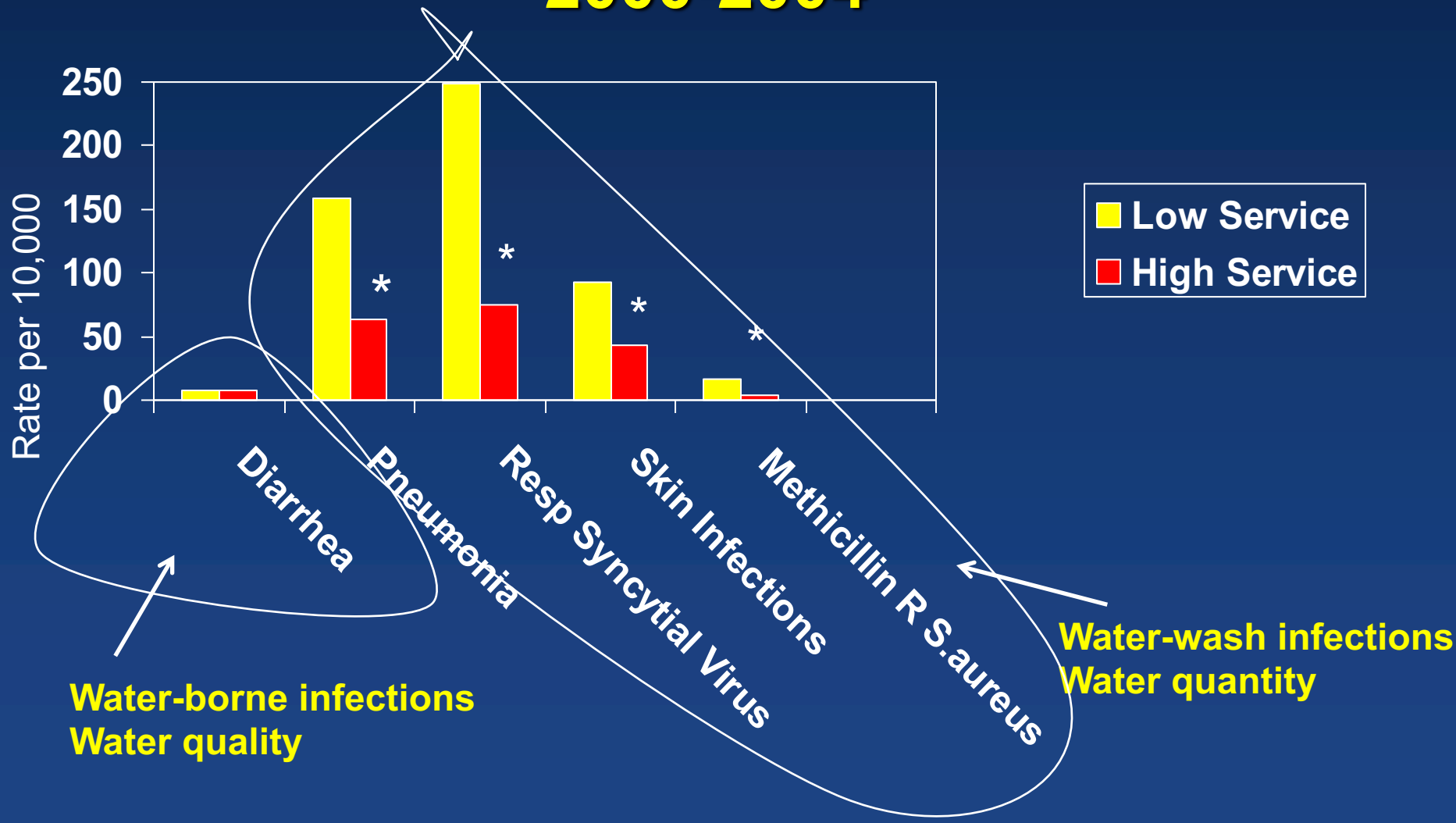
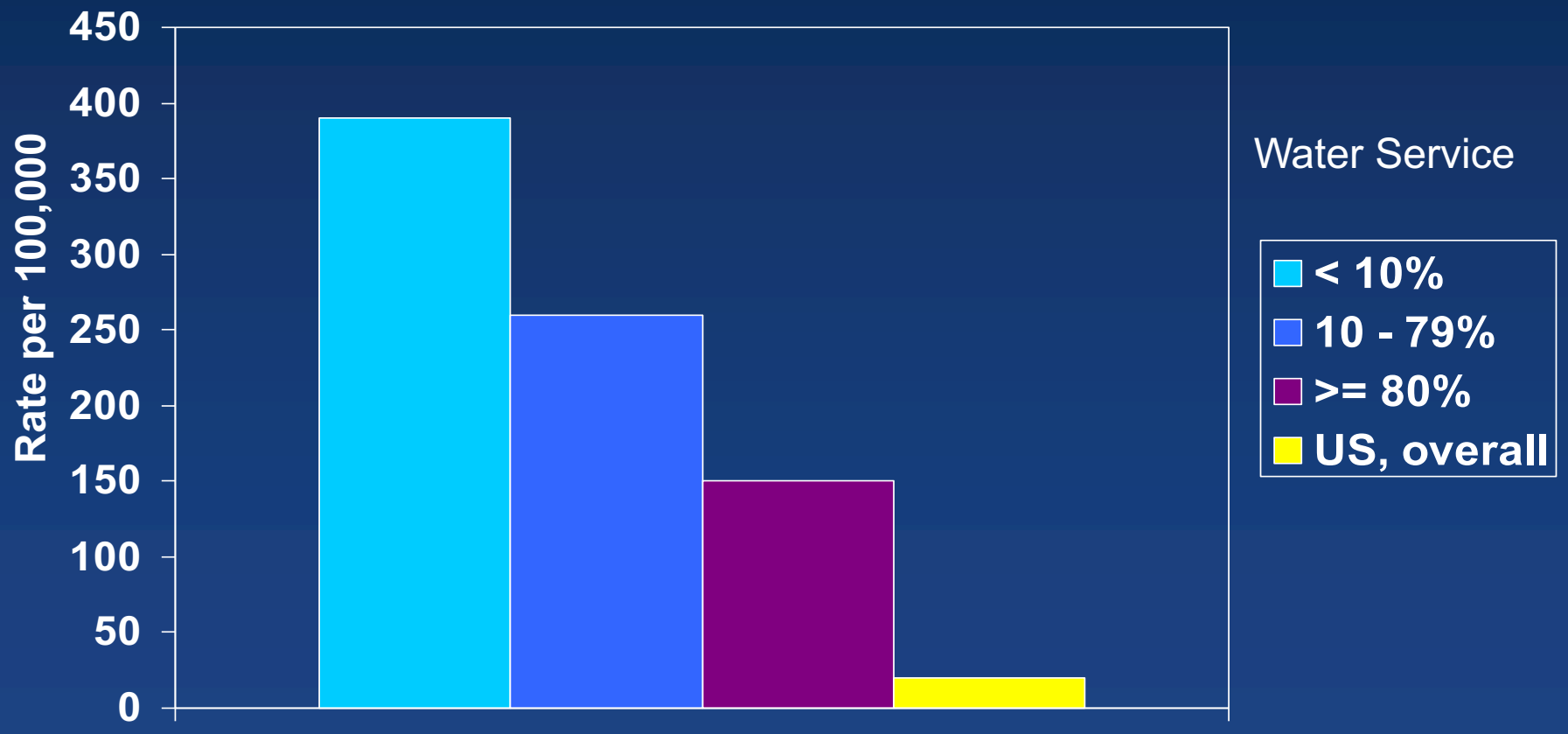


# Hierarchy of Water Requirements

# Factors Linking Water to Health

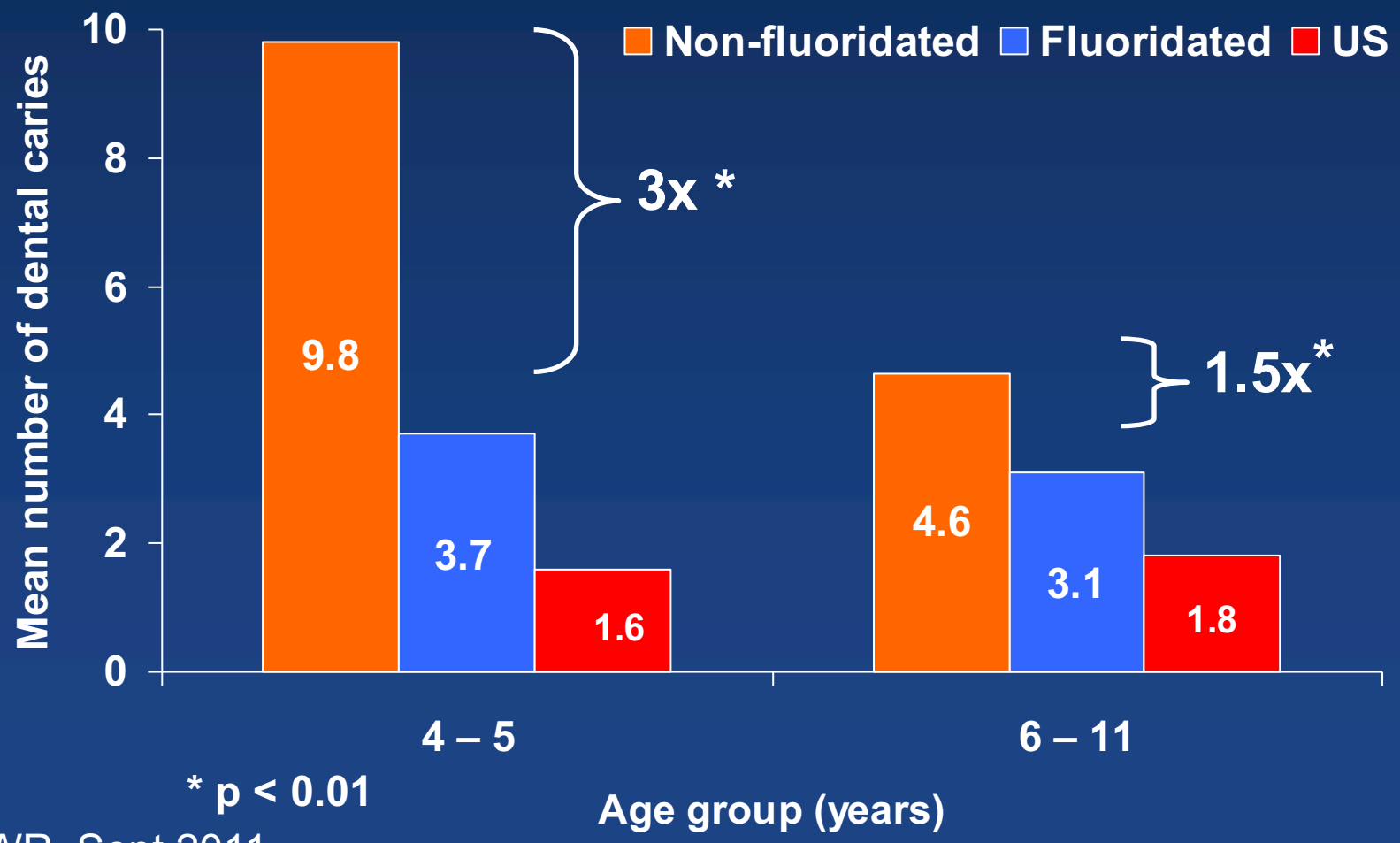
- Water Quality
  - Prevents illness from drinking water
    - Water-borne diseases
      - Cholera, Typhoid fever, dysentery
- Adequate water Quantity
  - Drink, cook, wash: hands, body, clothes
  - Prevents infections spread person-to-person
    - Water-washed diseases
      - Respiratory infections, skin infections

# Serious Infections with Pneumococcus in Children < 5 years old, Southwest Alaska, 2001- 2007



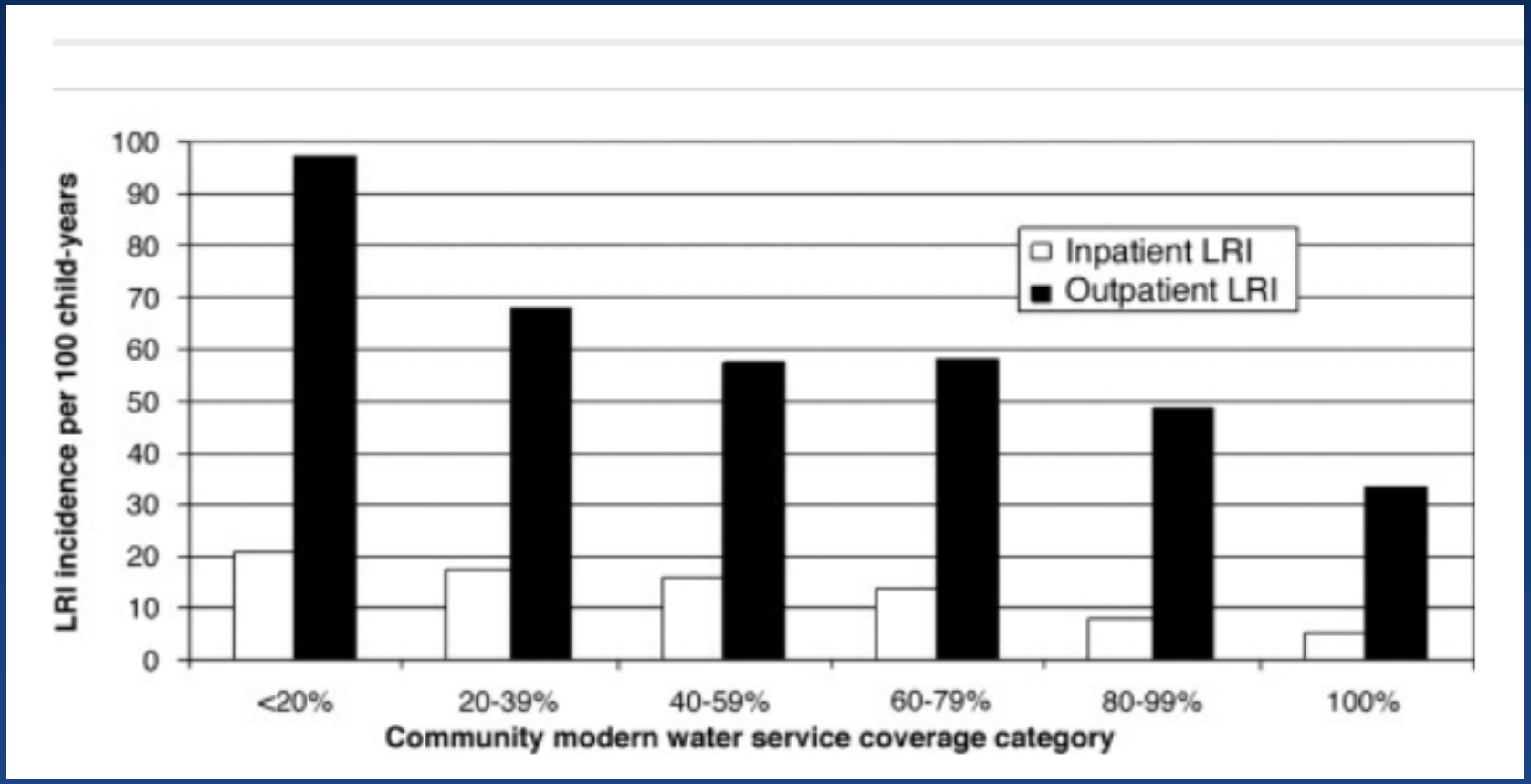

* Wenger, 2010, Pediatric Infectious Diseases

# Number of Cavities in Primary Teeth by Village Fluoridation Status




MMWR, Sept 2011

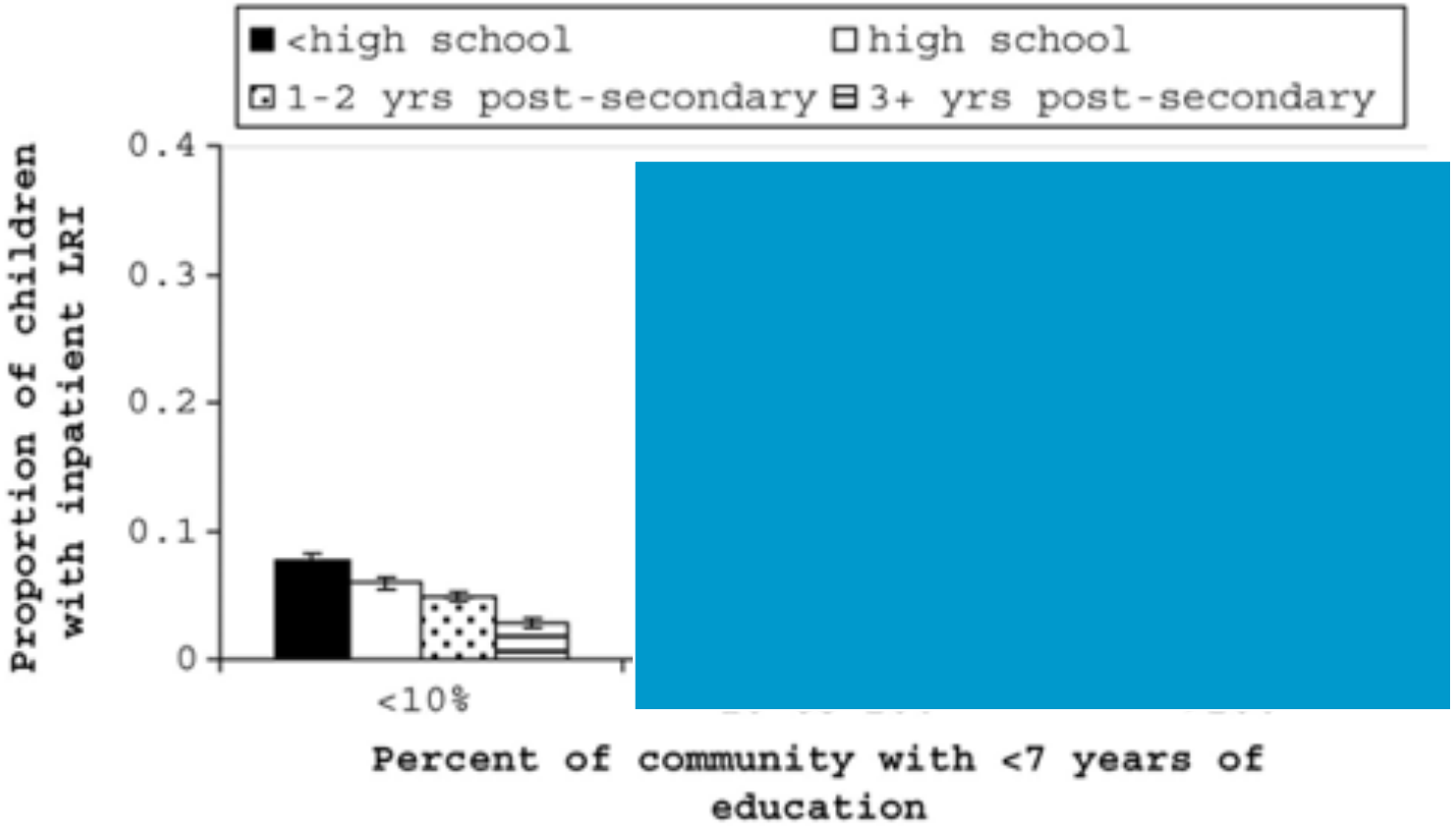
# Respiratory Hospitalizations, by Water Service, 1998 – 2003, Alaska Medicaid




Gessner, Pediatrics, 2008

# … Complicating factors….

# Respiratory Hospitalizations, by Education Level of Parent




Gessner B D et al. J Epidemiol Community Health 2010;64:130-135

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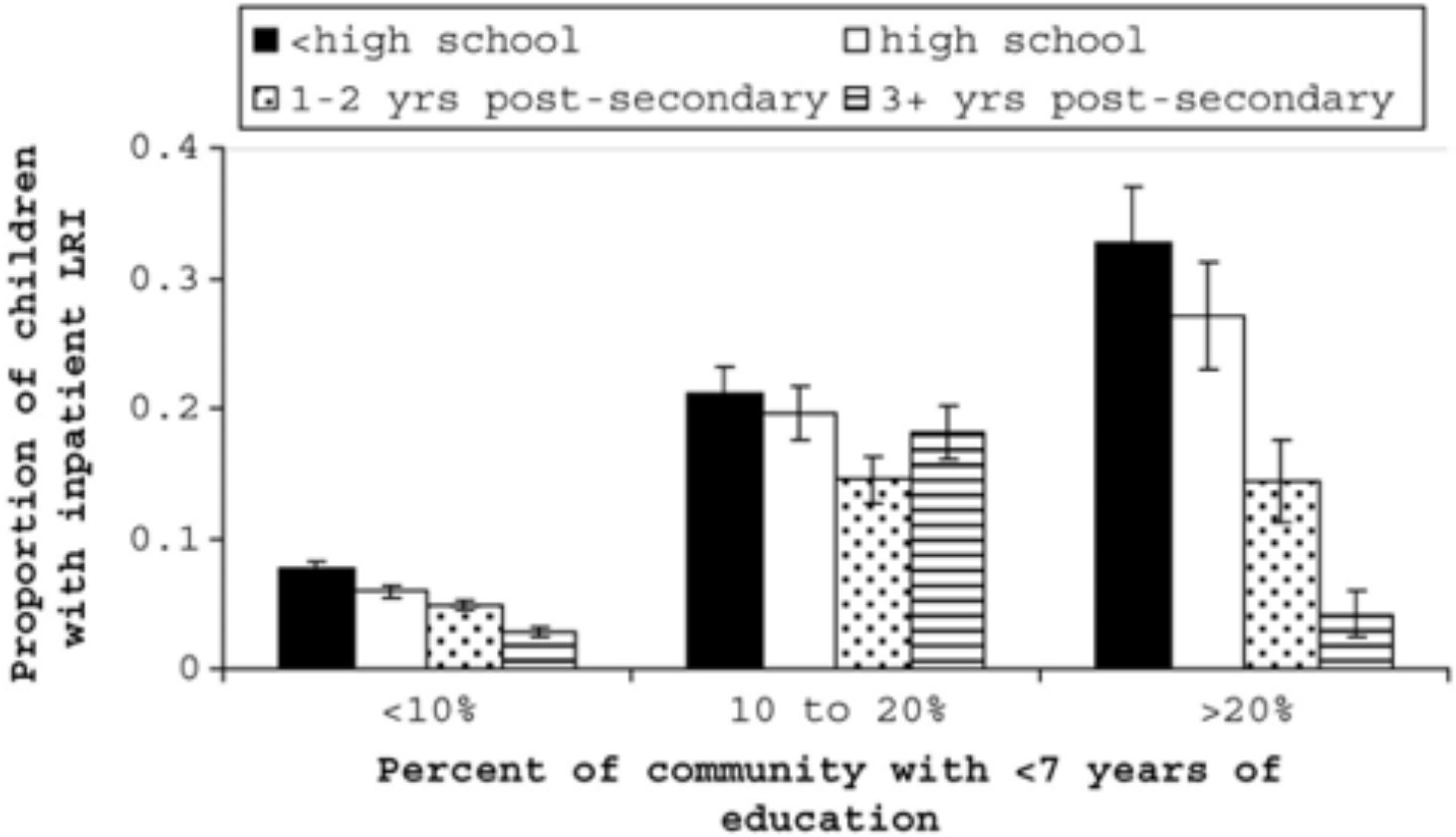
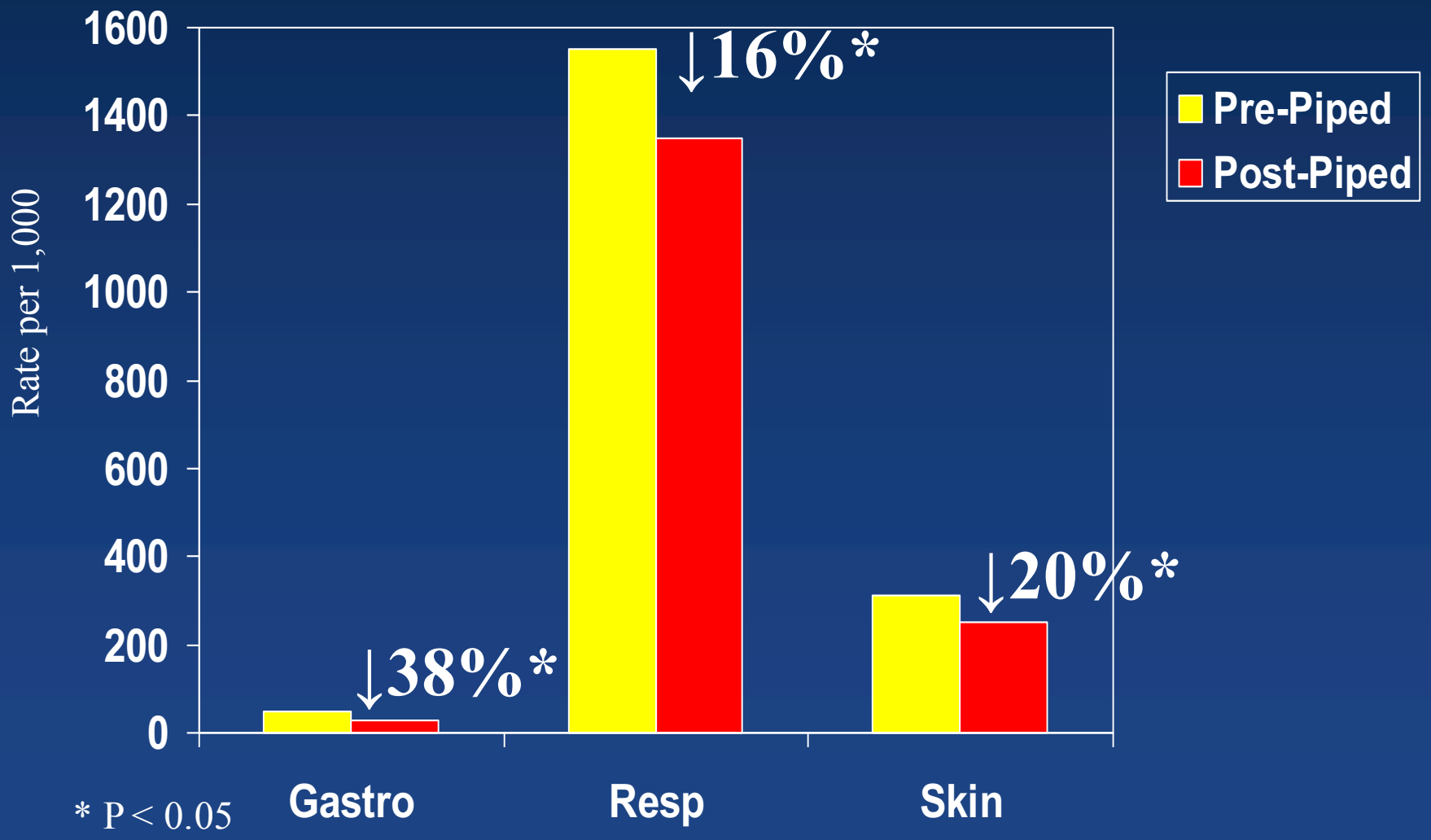



Gessner B D et al. J Epidemiol Community Health 2010;64:130-135

# 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




* $P < 0.05$

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- Compelling stories
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  - “Treatment trial” of water/sanitation

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- 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