

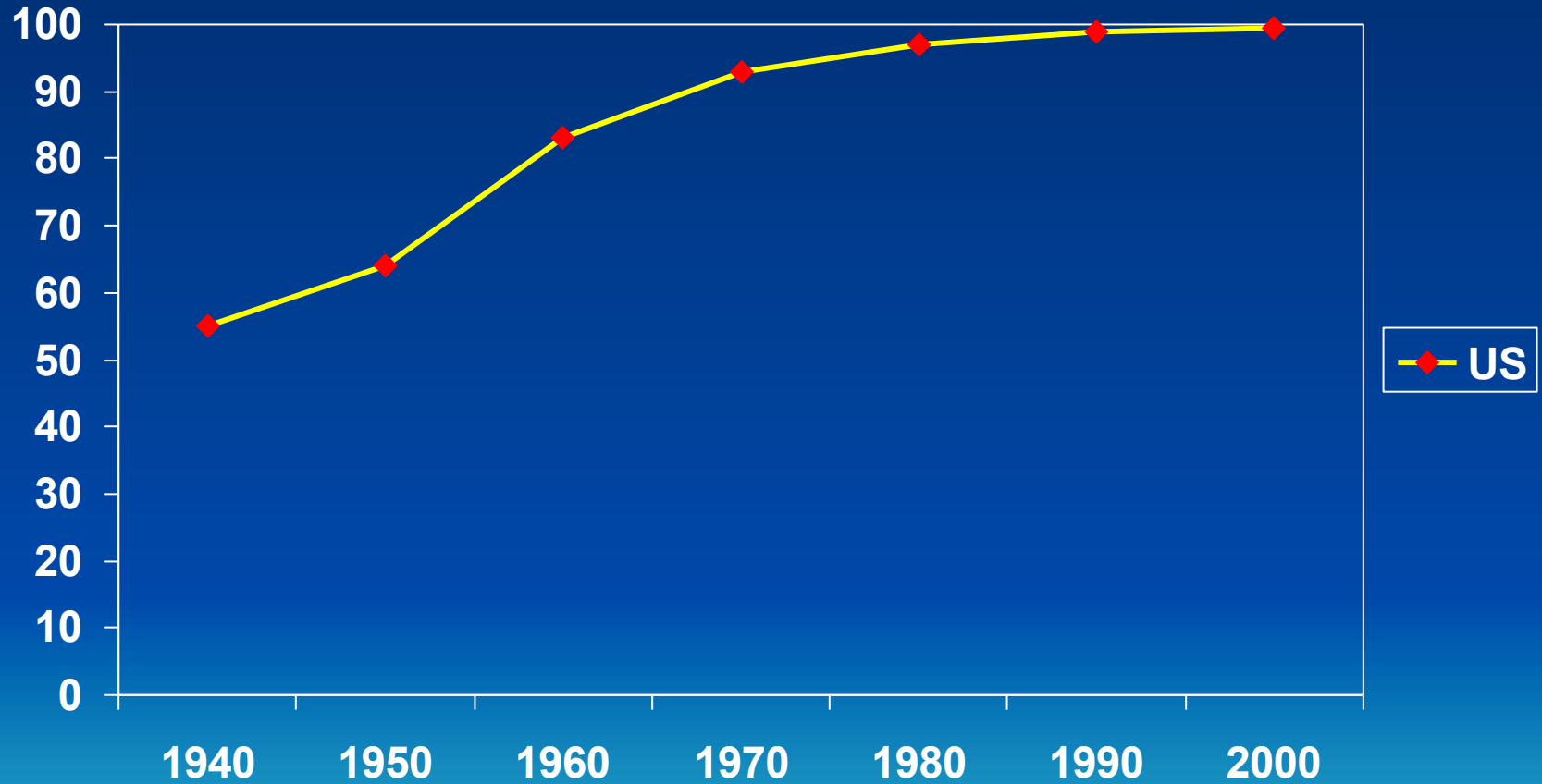
# Water and Human Health in Alaska

Tom Hennessy, MD, MPH

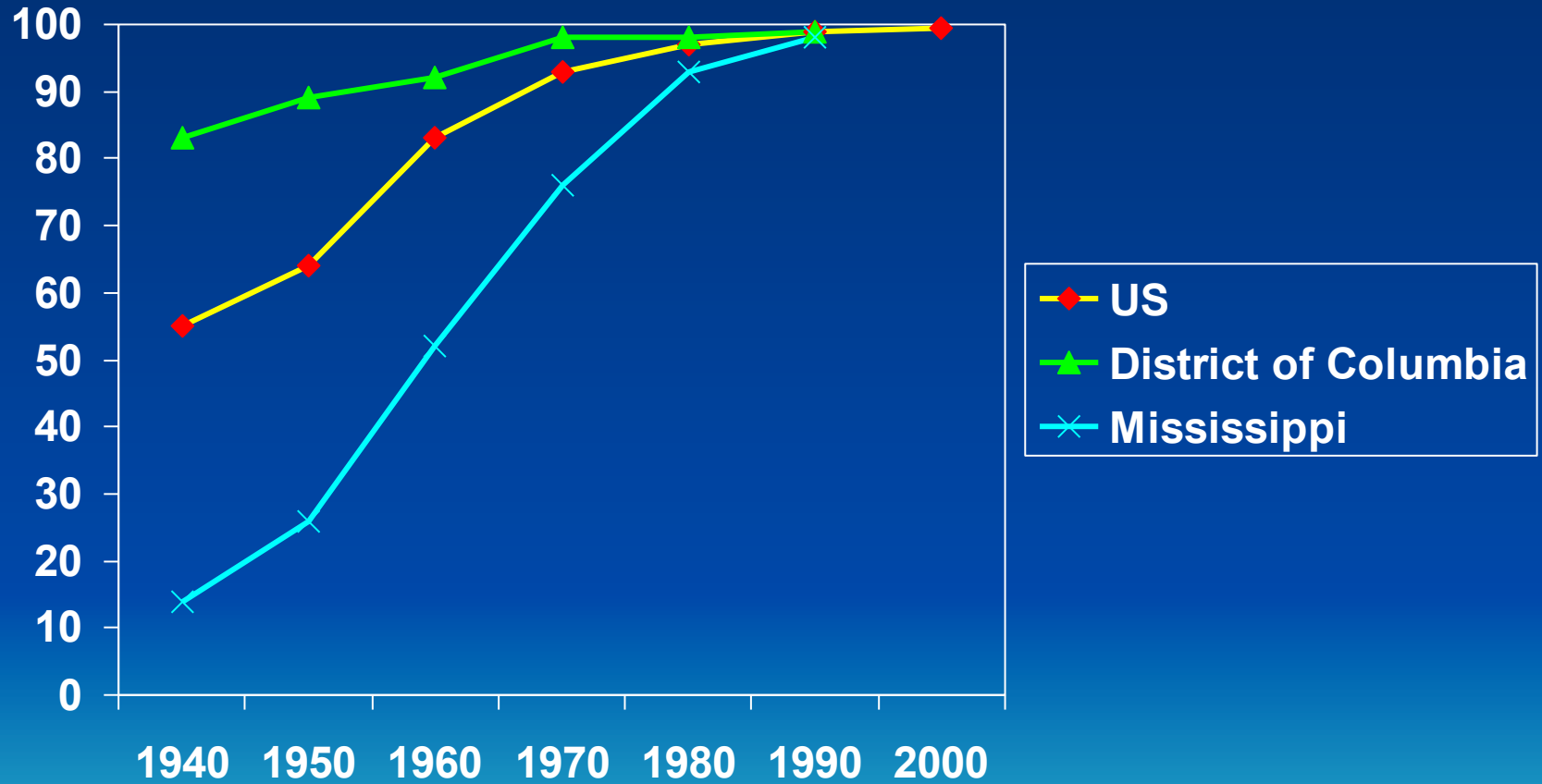
Arctic Investigations Program  
National Center for Emerging and Zoonotic  
Infectious Diseases  
Centers for Disease Control and Prevention (CDC)  
Anchorage, Alaska  
[tbh0@cdc.gov](mailto:tbh0@cdc.gov)



# Proportion of US homes with complete plumbing, 1940 - 2000

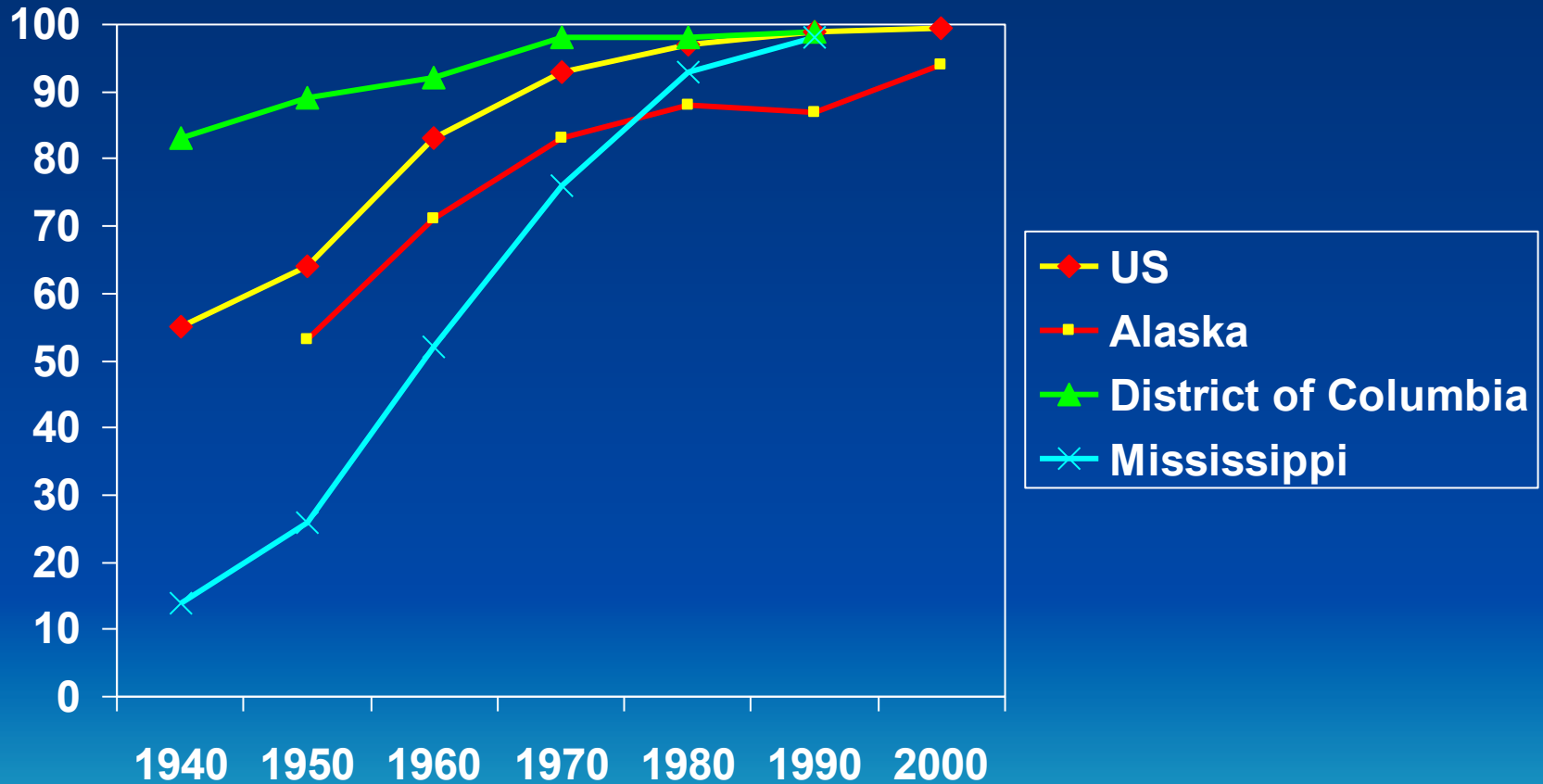


# Proportion of US homes with complete plumbing, 1940 - 2000

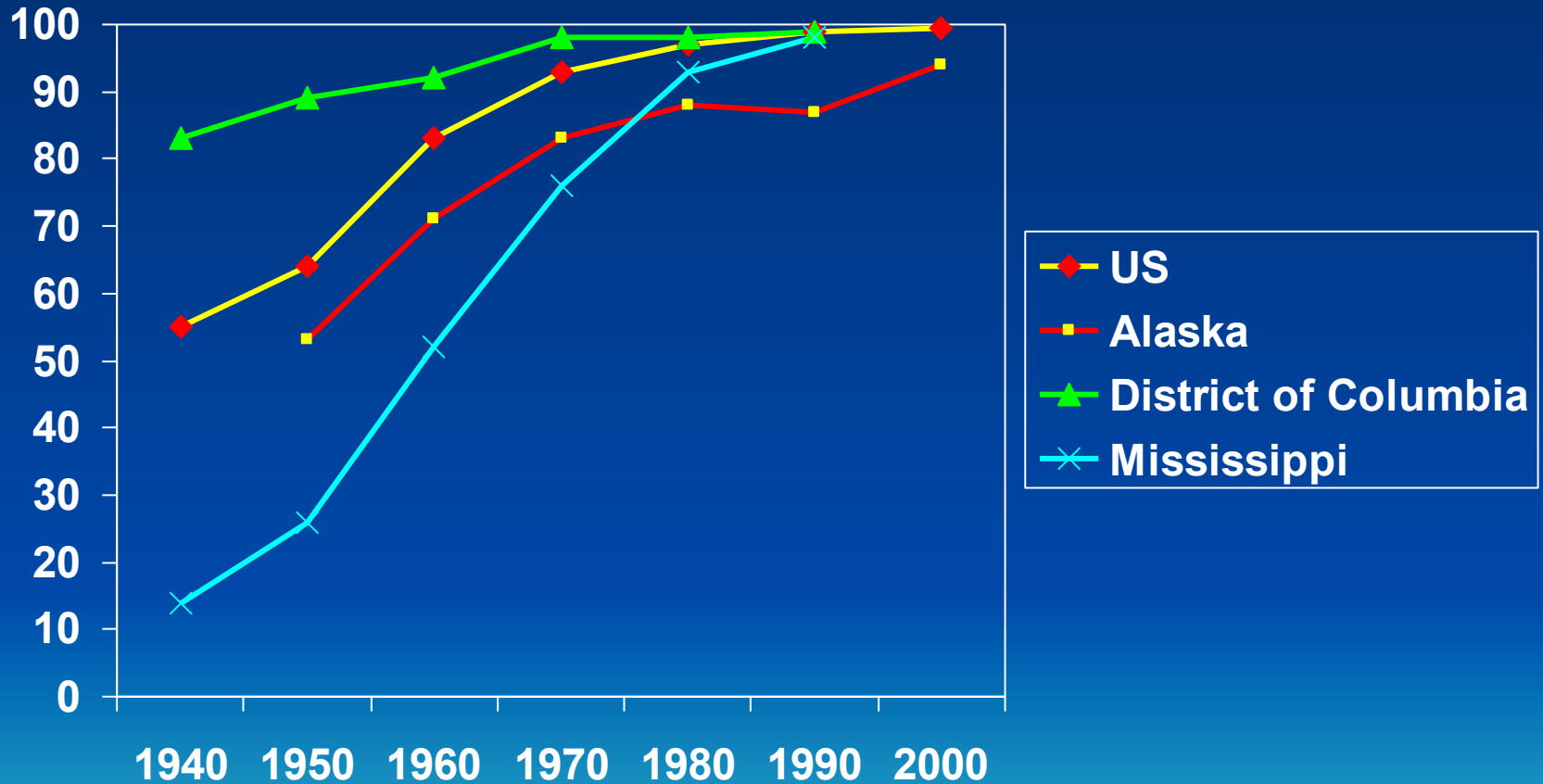




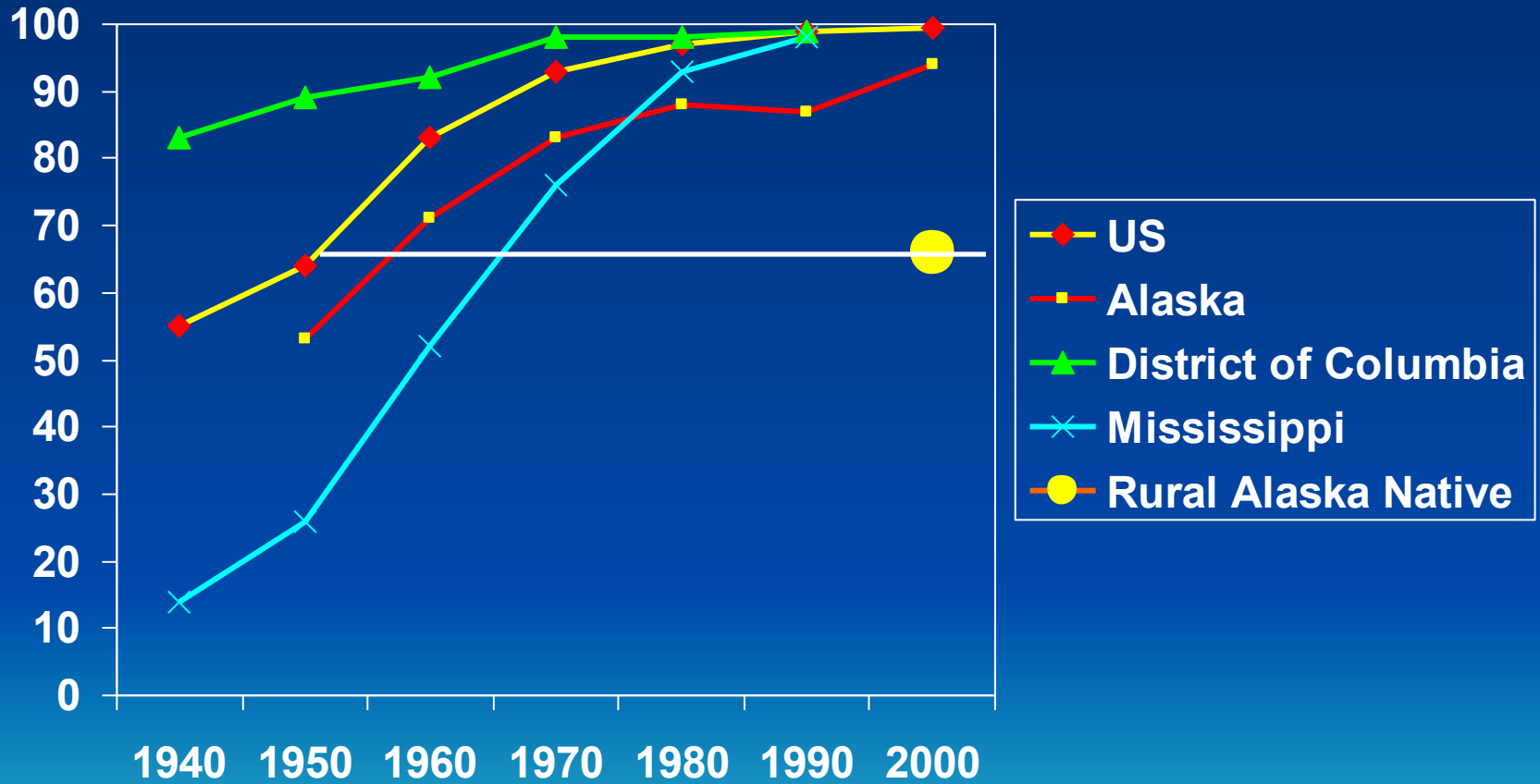
# Proportion of US homes with complete plumbing, 1940 - 2000



# Proportion of US homes with complete plumbing, 1940 - 2000



# Proportion of US homes with complete plumbing, 1940 - 2000



# What we know

- Alaska ranks last among U.S. States for in-home water services
- Increasing evidence that
  - Access to water service linked to improved health

# **Water-related infections: The Bradley Classification\***

- **Water-borne**
  - Pathogen ingested with water
    - Cholera, other enteric infections
- **Water-washed**
  - Person-to-person, lack of water for hygiene
    - Skin infections, trachoma
- **Water-based**
  - Aquatic intermediate host
    - Schistosomiasis, guinea worm
- **Water-related insect vector**
  - Insects breed or bite near water
    - Malaria, dengue

\* “Drawers of Water”; White, Bradley, White; U of Chicago Press, 1972

# Examples of “Water-washed” Diseases

- Handwashing education in Navy recruits
  - 45% less clinic visits for respiratory illness
    - Ryan, Am J. Prev Med, 2001
- Community trial of handwashing promotion
  - Karachi, Pakistan
  - Soap, antibacterial soap, education only
    - Luby, Lancet, 2005
  - Soap and education:
    - 50% less diarrhea, pneumonia
    - 33% less skin infection (impetigo)



# What we know

- Alaska ranks last among U.S. States for in-home water services
- Increasing evidence that
  - in-home water service linked to better health
- Prior to 2008, data linking water service to health in Alaska were limited
  - Has hurt funding for water infrastructure programs

PUBLIC HEALTH MONOGRAPH No. 54

# Relationship of Environmental Factors To Enteric Disease

DEPARTMENT OF HEALTH,  
EDUCATION, AND WELFARE LIBRARY  
SEP 15 1961



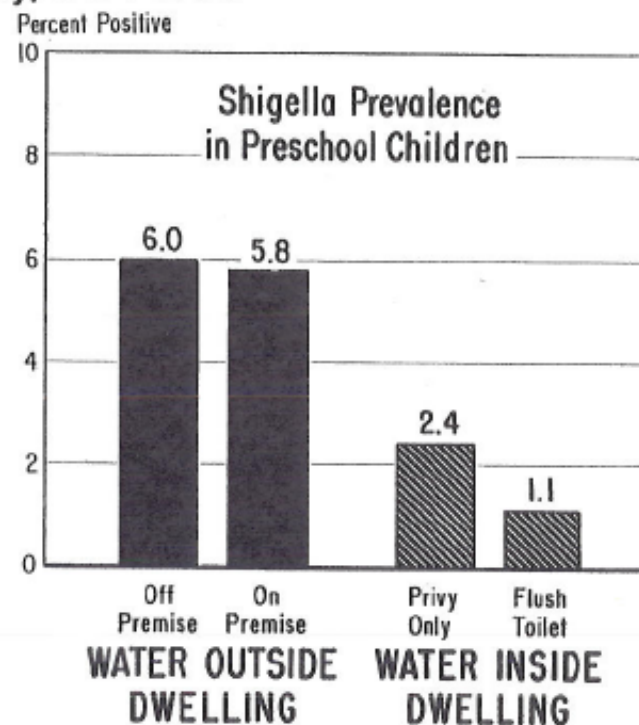
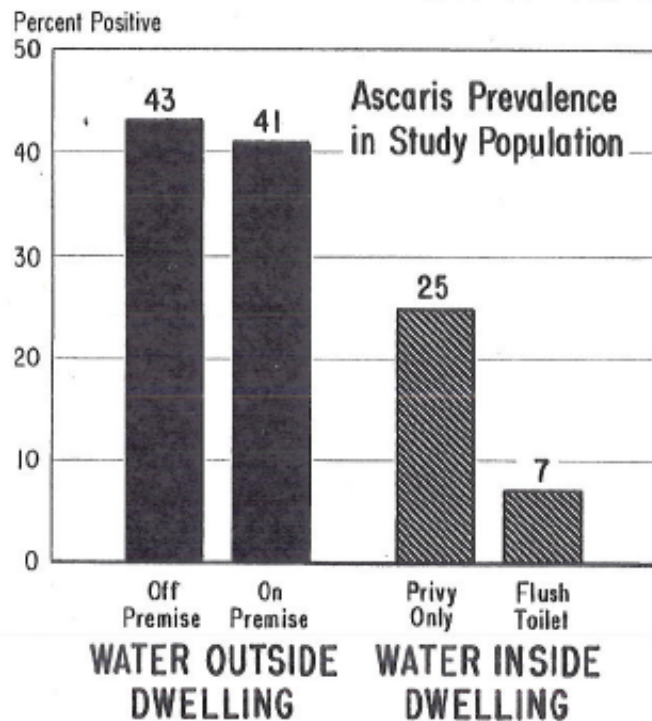
U. S. DEPARTMENT OF  
HEALTH, EDUCATION, AND WELFARE  
PUBLIC HEALTH SERVICE

RELATIONSHIP OF ENVIRONMENTAL FACTORS TO ENTERIC DISEASE

# ASCARIS AND SHIGELLA INFECTIONS

## ACCORDING TO SELECTED SANITARY FACILITIES

Eastern Kentucky, 1954-1956



Source: Public Health Monograph No. 54-1956 (PHS Publication No. 591)

**Does providing in-home water and sanitation service result in improved health for Alaska Native people?**



# Rural Alaska Housing Sanitation Inventory, 2001

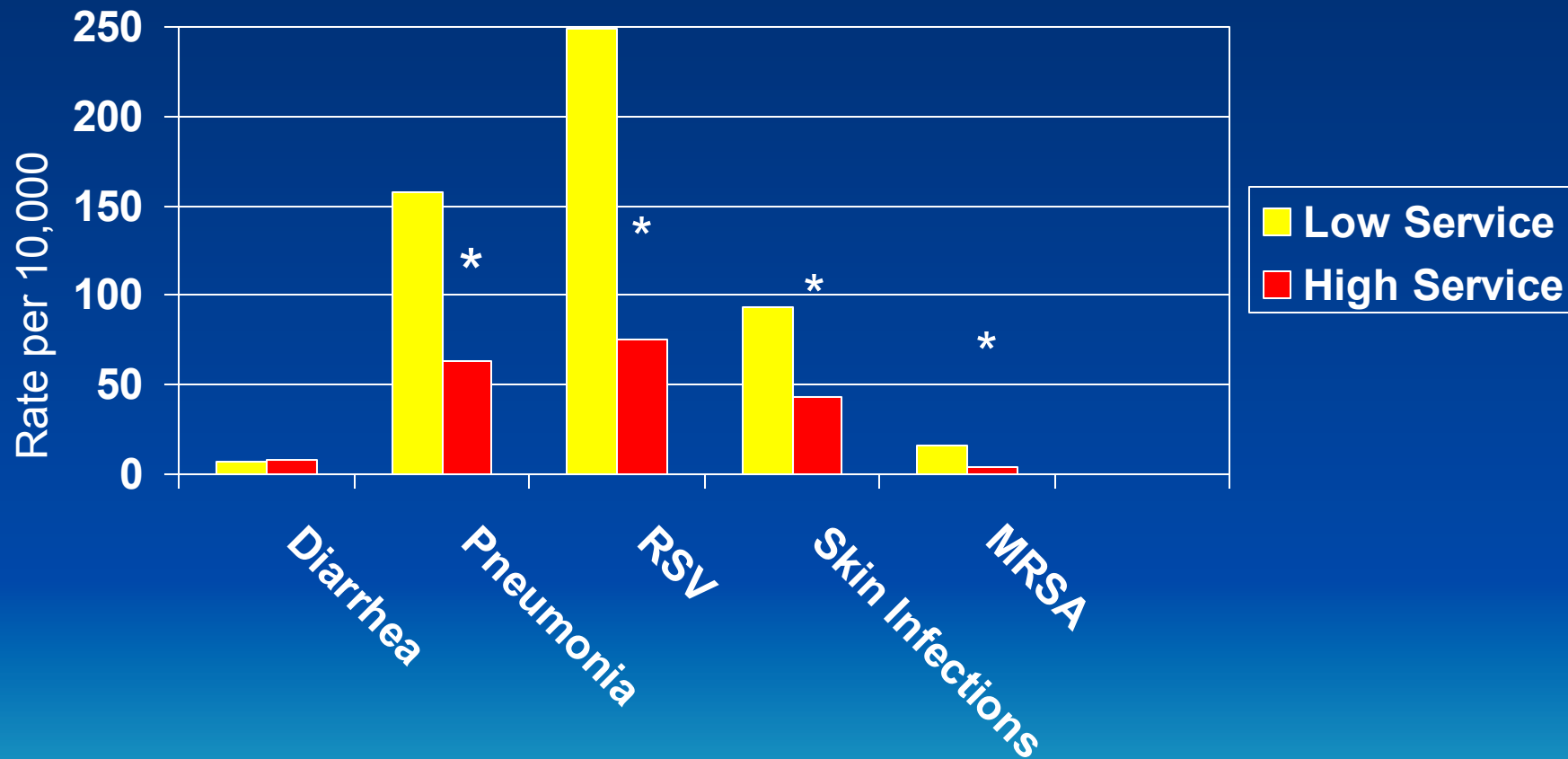
- **Statewide survey**
- **“Served” homes have internal plumbing**
  - Municipal piped water, pressure tanks, private wells
- **“Unserved” without internal plumbing**
  - Self-hauled water

# In-Home Water and Sewer Service, Rural Alaska Regions, 2001

Region	Communities surveyed	Homes surveyed	Homes with piped water	Homes with Flush Toilets
A	4	368	100%	100%
B	25	1555	89%	87%
C	26	2834	88%	85%
D	10	834	75%	75%
E	49	5513	61%	60%
F	14	1376	57%	55%
<b>Total</b>	<b>128</b>	<b>12,480</b>	<b>73%</b>	<b>71%</b>



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



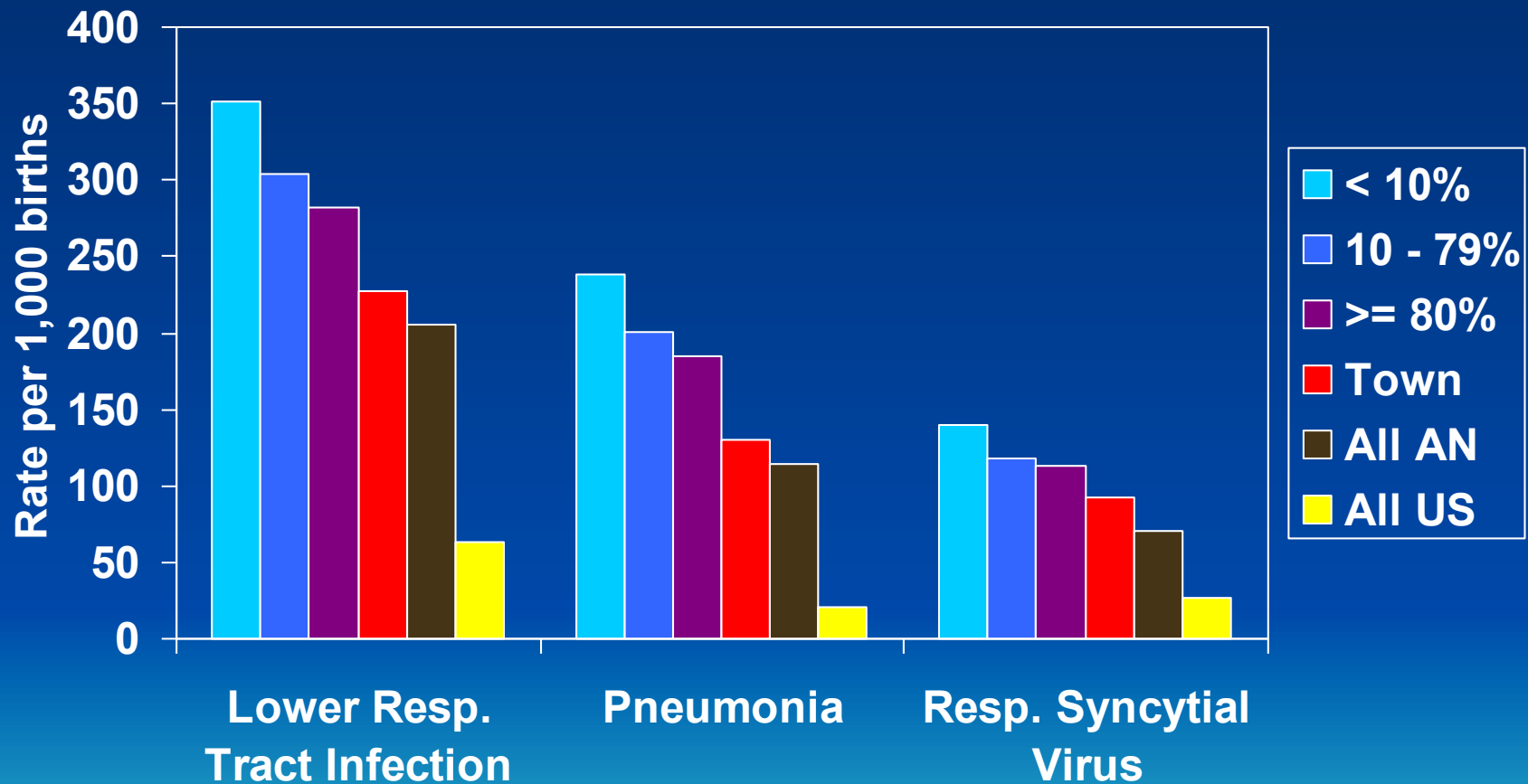
\*  $P < 0.05$





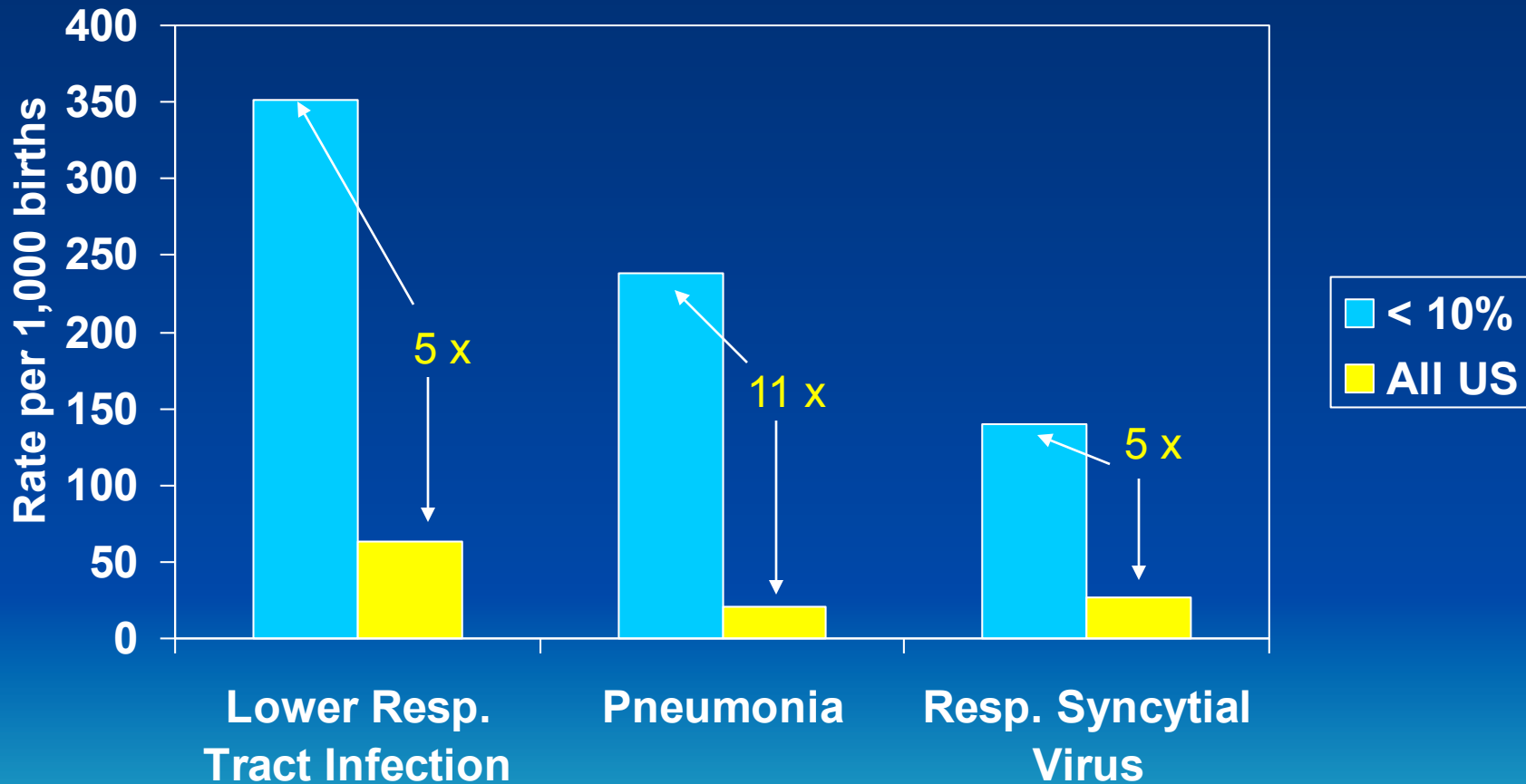


# Hospitalization rates for Alaska Native infants, according to percent of homes with water service 1999 - 2004\*

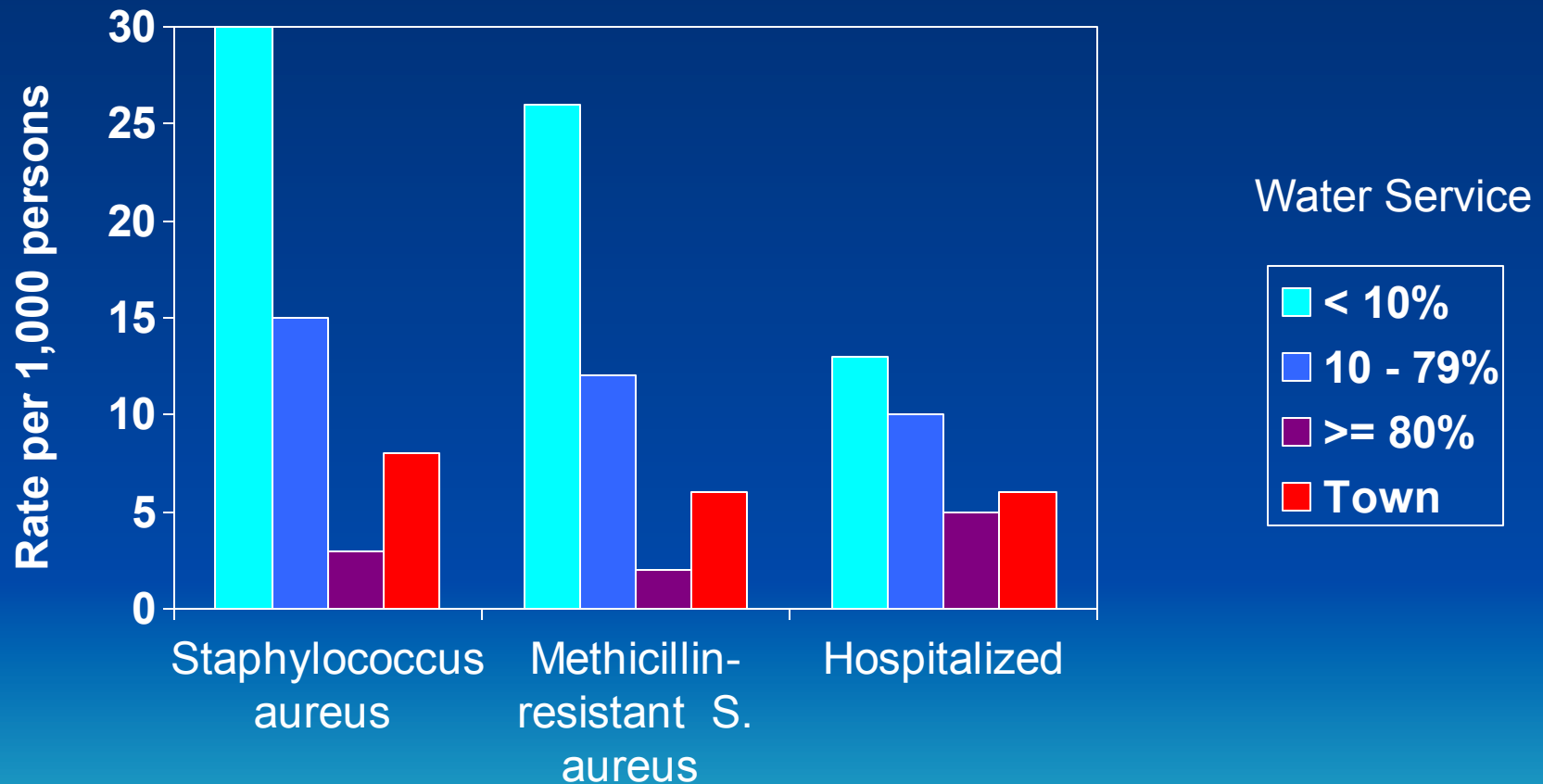


\* Hennessy, AJPH, 2008

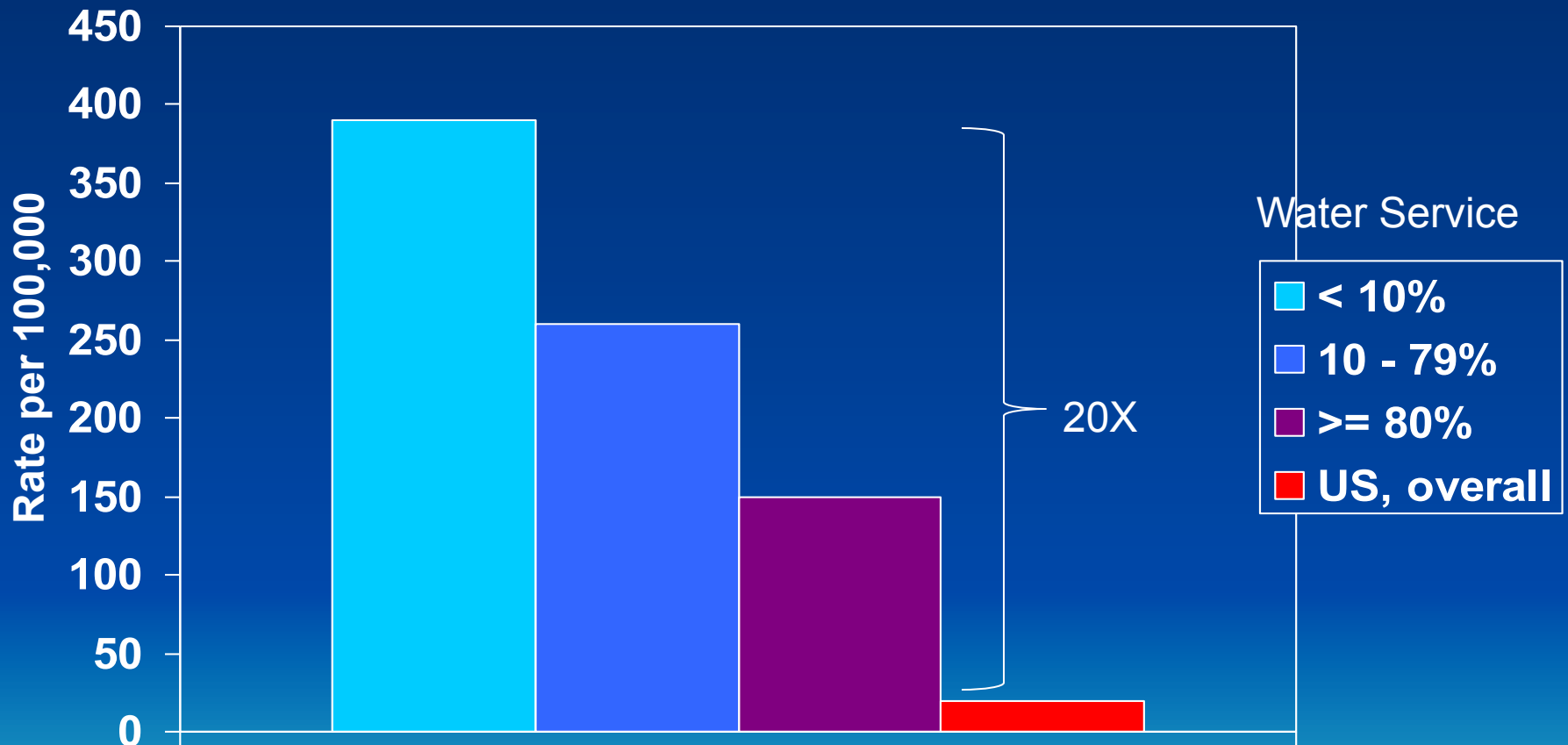
# Hospitalization rates for infants in villages with < 10% of homes with water service, compared with U.S. infants



# Skin infection rates, all ages, by village water service, Southwest Alaska, 1999 - 2000



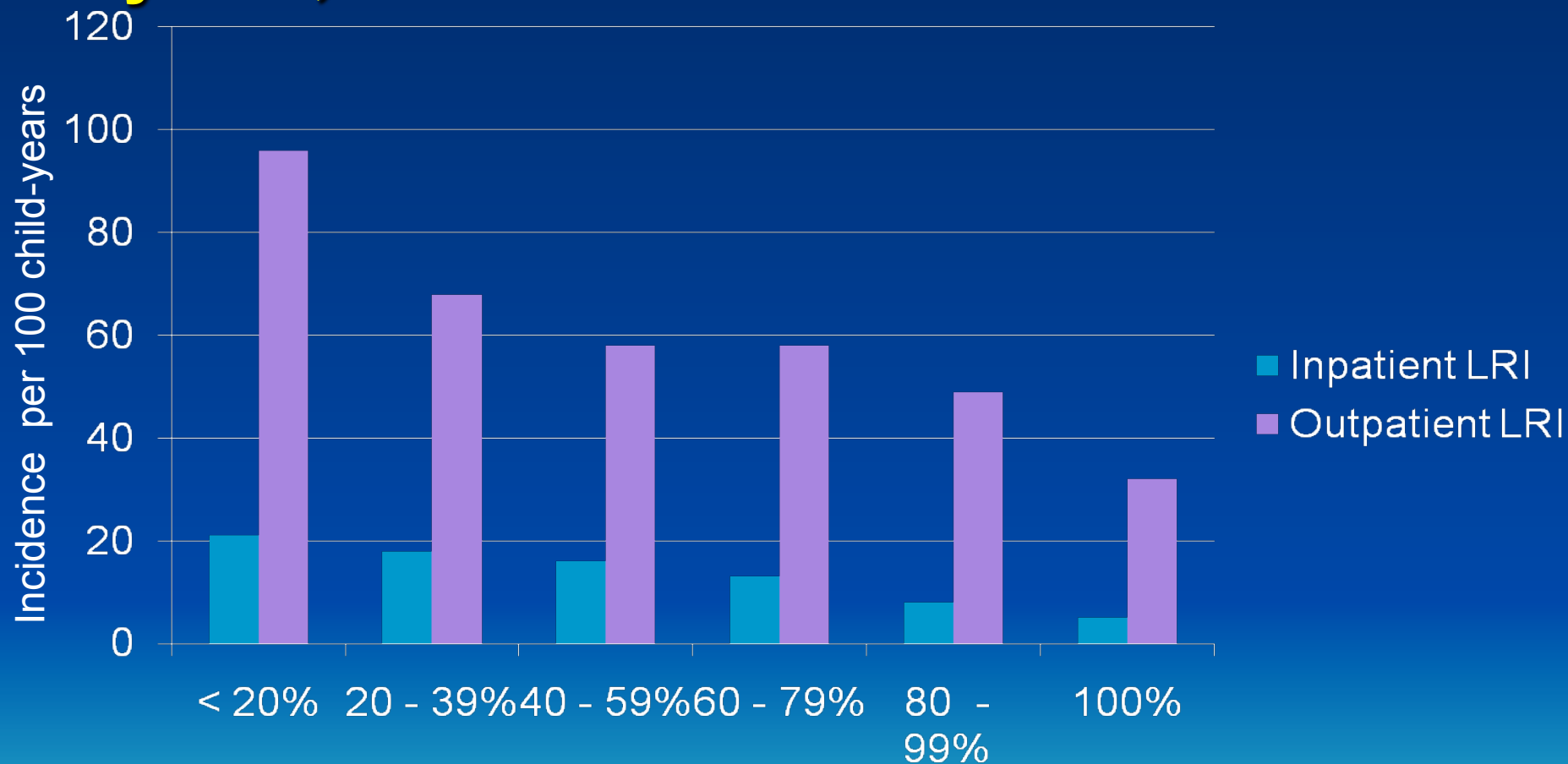
# Serious infections with *Streptococcus pneumoniae* in children < 5 years old, Southwest Alaska, 2001-2007



\* J Wenger, 2010, Pediatric Infectious Diseases



# LRI Incidence Among Alaska Children < 2 years, Enrolled in Medicaid 1998- 2003

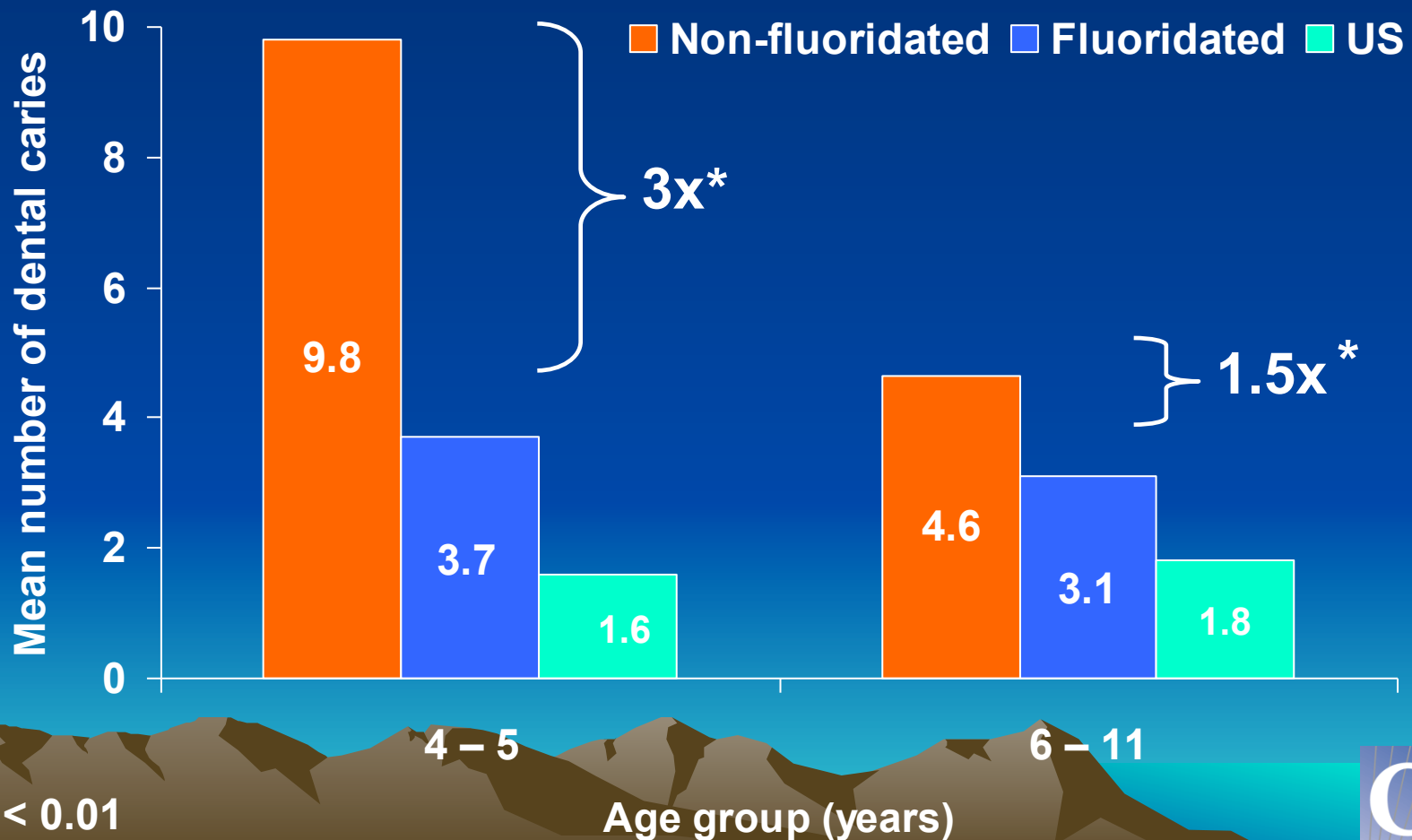


Community in-home water service

# Dental Caries, a Water-washed Disease?

- Dental caries a growing health problem
- Water fluoridation in rural Alaska is less available in last 15 years
  - Fluoride poisoning death in 1992
    - Fluoridation only offered in municipal piped systems
  - Southwest Alaska villages
    - 1990s: appx. 25 of 52 fluoridated water
    - 2009: 4 of 52 villages

# Dental Caries in Primary Teeth by Village Fluoridation Status, Southwest Alaska, 2008





# Summary of Alaska Data

- Low water service regions have higher hospitalization rates of
  - Pneumonia & influenza
  - RSV
  - Skin infections
  - NOT infectious diarrhea
- In Southwest region, low water service is linked to higher rates of
  - Respiratory hospitalizations in infants
  - Skin infections, all ages
  - Serious pneumococcal infections in children
  - Dental caries in children



# Other Studies in Progress

- Evaluate infectious disease rates in villages with new water systems
  - “4 village study”
    - ANTHC – CDC project (Troy Ritter, P.I.)
    - Water use promotion and health evaluation
    - Data analysis ongoing
  - Opportunities to repeat in other villages
- Economic analyses
  - Cost of RSV hospitalizations
  - Cost effectiveness of water fluoridation and other preventive dentistry approaches
- In-home water service and infectious diseases in other I.H.S. Areas



# Remaining questions

- How much water is needed to maximize healthy behaviors?
  - High cost, limited water supply lead to rationing in some “served” homes
- What other indicators are linked to in-home water service?
  - Diarrhea
  - Injuries
  - Lost economic opportunities



# Collecting Water:

*Red Devil, AK*

# Limitations of Health Data

- **Water availability is not the only determinant of infectious disease risk**
  - Household crowding, indoor air quality, nutrition, individual immunity, pathogen factors
  - Provision of in-home water will not eliminate disease completely
- **Economic gains from improved health will not equal costs of water systems**

# Uses of Health Data

- Provides added justification for new construction
  - Water services delivery is a tool to address ongoing health disparities
  - A way to measure progress
- May provide information about optimal water quantity needed
- Water use promotion activities can accelerate benefits of new water systems

# Summary

- Provision of in-home water service is associated with improved health in rural Alaska
- Alaska ranks last among US States for in-home water service
  - Providing adequate water to more homes can be expected to result in improved health for rural Alaska Native persons



# Thanks to...

- **Alaska Native Tribal Health Consortium**
  - Troy Ritter
  - Jeff Smith
  - Ros Singleton
- **Yukon Kuskokwim Health Corporation**
  - Joe Klejka
- **State of Alaska**
  - Joe McLaughlin
  - Brad Whistler
- **CDC Alaska**
  - Dana Bruden
  - Lisa Bulkow
  - Jay Wenger
  - Michael Bruce
  - Tim Thomas
- **CDC Atlanta**
  - Bob Holman
  - Kathy Byrd
- **Indian Health Service**
  - Jim Cheek



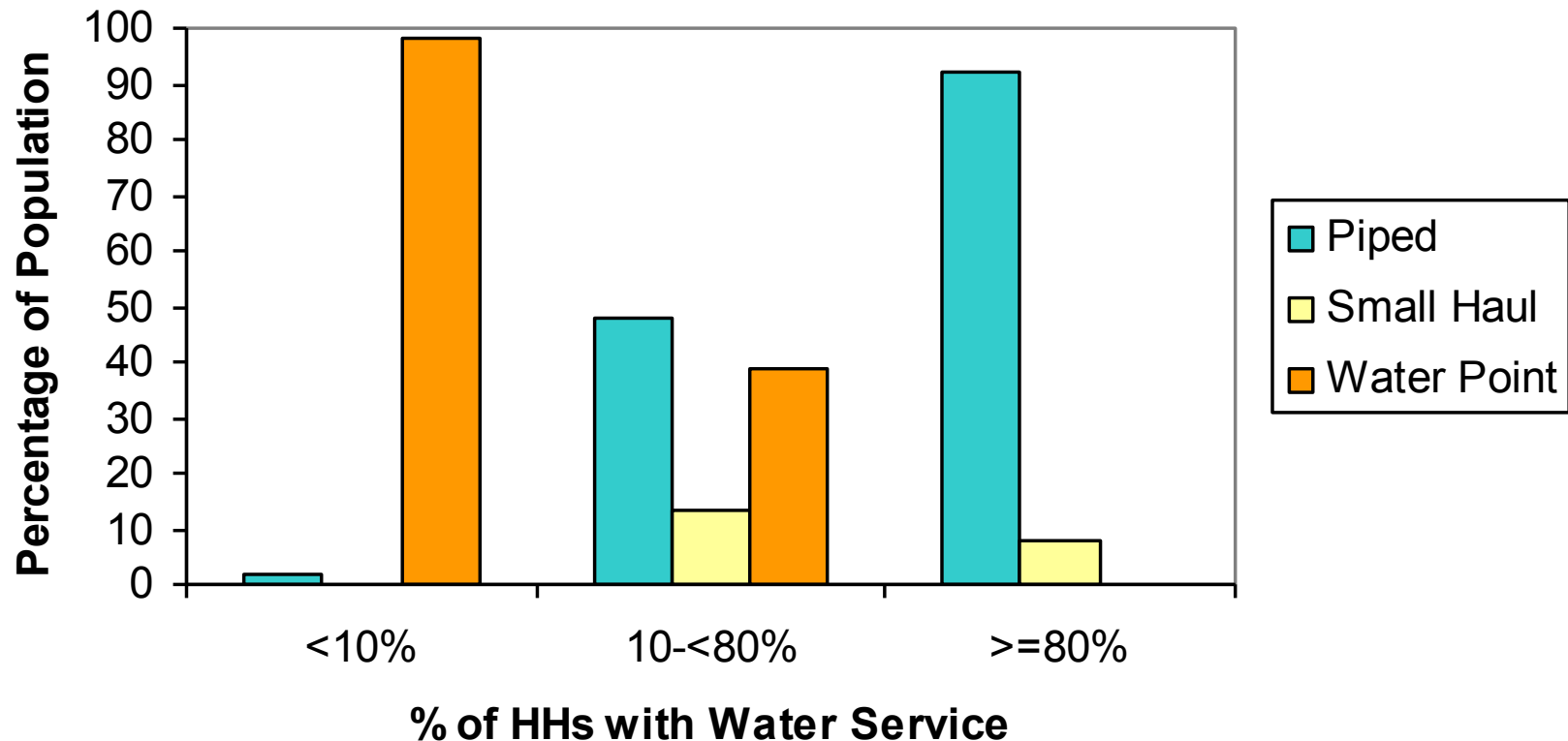
# Infectious Disease Hospitalizations by Region, 2000-2004

Region	Homes with Plumbing	Rate per 10,000 persons per year				
		Diarrhea	Pneumonia and Influenza	Resp. Syncytial Virus	Skin Infection	MRSA
Anchorage (urban)	100%	7	63	79	51	5
Barrow	100%	6	98	214	41	1
Bristol Bay	89%	6	86	148	47	3
Southeast	88%	10	42	30	26	1
<b>"High" Service</b>	<b>91%</b>	<b>8</b>	<b>63</b>	<b>75</b>	<b>43</b>	<b>4</b>
<b>"Low" Service</b>	<b>61%</b>	<b>7</b>	<b>158</b>	<b>249</b>	<b>93</b>	<b>16</b>
Kotzebue	75%	6	101	136	34	<1
Yukon Kuskokwim	61%	8	199	314	113	27
Norton Sound	57%	4	91	129	39	1

# Villages Grouped by Water Service, YK Region

	Homes with Plumbing			Bethel, 100%
	< 10%	10 – 79%	≥ 80%	
Villages	20	13	14	1
Population	6956	4743	6415	5459
Village Size, (median)	312	370	493	5459

# Type of Water Service, YK Region









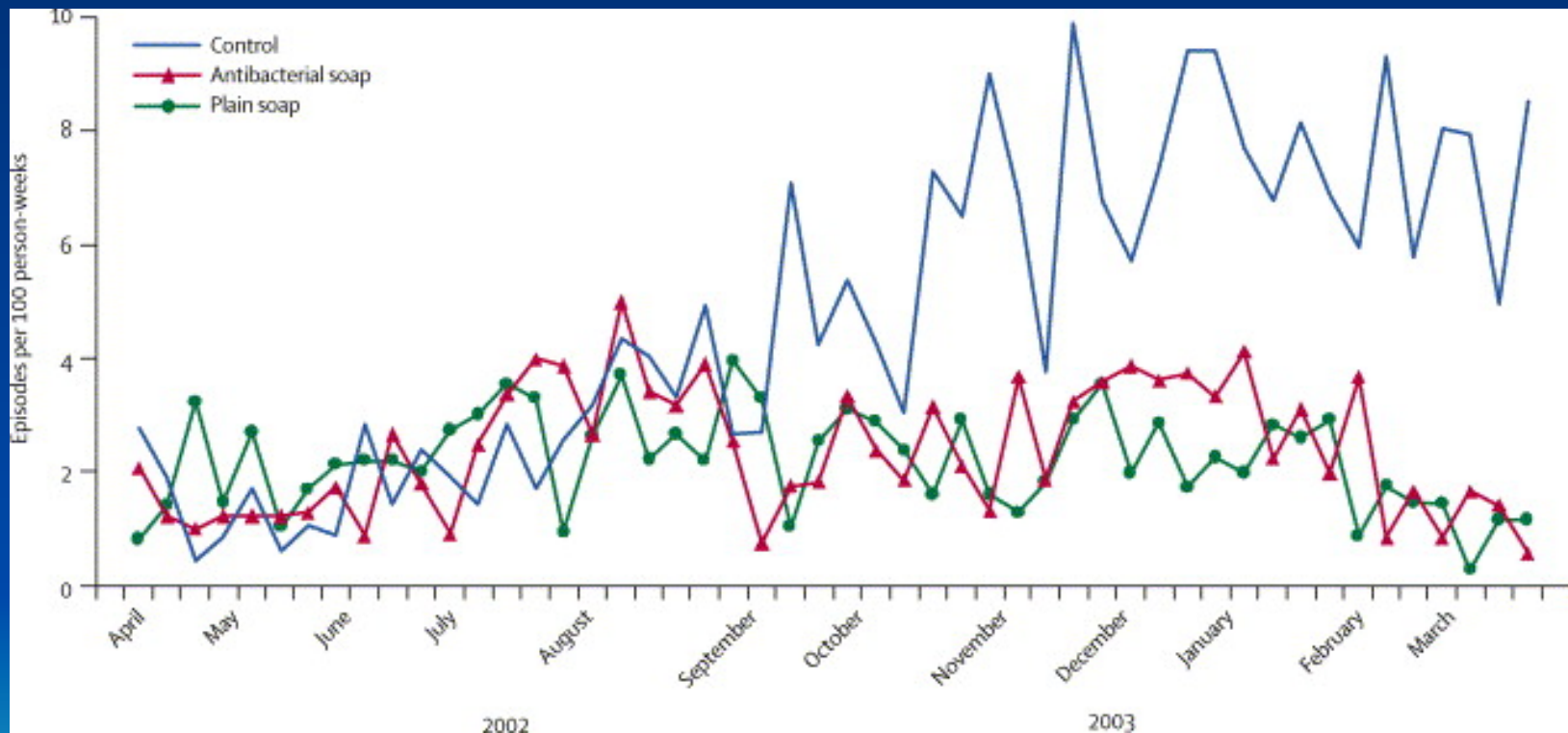
**Material Success Table 495: Home Features by Country**

	Canada	Greenland	Chukotka	Alaska	Total
Stove for cooking	>99%	99%	92%	95%	98%
Electricity	*	99%	94%	99%	97%
Double glass windows	*	92%	88%	81%	89%
Separate kitchen	*	88%	94%	77%	88%
Central heating or electric heaters	>99%	88%	84%	90%	88%
Hot running water	99%	84%	74%	81%	85%
Cold running water	>99%	86%	63%	85%	84%
Telephone	85%	88%	54%	88%	81%
Indoor flushing toilet	>99%	64%	67%	84%	76%
Bath or shower	*	81%	55%	84%	74%
Store room	*	78%	65%	69%	72%
A view to check the weather	*	91%	2%	91%	65%
Septic tank, sewer connection or sewage processor	94%	55%	24%	81%	60%
Smoke detector	95%	27%	6%	89%	45%
Place to cut meat and fish	*	23%	47%	80%	41%
Place to sit outside	*	57%	8%	38%	40%
Connection to the internet	*	45%	6%	36%	34%
Fire exit	*	26%	8%	80%	29%
Carbon Monoxide detector	18%	4%	*	38%	13%
Generator	7%	3%	6%	34%	8%
Estimated Total	20,470	39,249	20,478	11,039	91,236

\* Data Not Available

	Western	North Slope	NANA	Bering Straits	Total
Electricity	91%	100%	99%	98%	98%
Stove for cooking	92%	96%	97%	94%	97%
Double glass windows	88%	89%	83%	76%	89%
Separate kitchen	90%	82%	79%	74%	88%
Central heating or electric heaters	88%	93%	91%	87%	87%
Hot running water	86%	89%	76%	80%	85%
Cold running water	79%	94%	82%	81%	84%
Telephone	69%	90%	90%	87%	80%
Indoor flushing toilet	75%	88%	82%	82%	75%
Bath or shower	58%	92%	80%	82%	75%
Store room	72%	85%	63%	63%	73%
View to check the weather	1%	95%	85%	93%	68%
Septic tank, sewer connection or sewage processor	23%	84%	79%	80%	61%
Smoke detector	<1%	90%	89%	88%	46%
Place to sit outside	7%	51%	38%	30%	41%
Place to cut meat and fish	37%	89%	80%	75%	39%
Connection to the internet	9%	44%	39%	29%	33%
Fire exit	1%	82%	78%	80%	30%
Carbon monoxide detector	*	45%	33%	36%	13%
Generator	1%	38%	32%	33%	8%
Estimated Total	7,712	2,904	3,182	4,948	88,417
* Data Not Available					

# Incidence of pneumonia in children younger than 5 years, Pakistan



Effect of handwashing on child health: a randomised controlled trial. S. Luby, M. Agboatwalla, D. Feikin  
The Lancet. 2005: (366) 9481

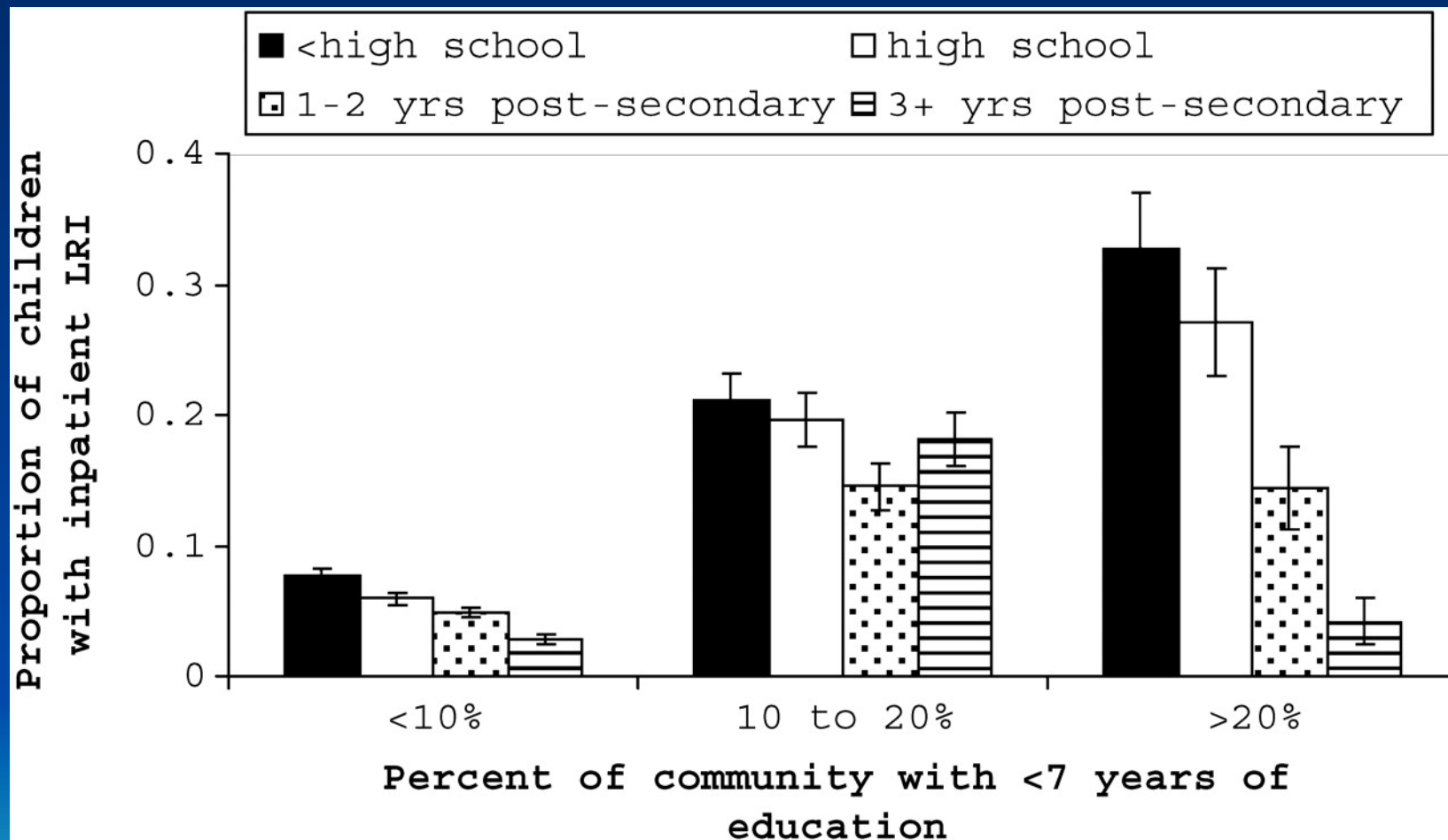


# Risk Factors for Dental Caries, Multivariate Analysis

	Primary teeth		Permanent teeth	
	Dental caries		Dental caries	
Variable	aOR	<i>P</i> - value	aOR	<i>P</i> - value
Lack of water fluoridation	3.1	<0.01	1.8	<0.01
Soda-pop consumption				
0 soda / day	ref	0.02	ref	<0.01
1 soda / day	1.1		1.3	
2 soda / day	1.3		1.6	
≥3 sodas / day	1.5		2.0	

- **“The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.”**

Cumulative proportion of Medicaid-enrolled children age <2 years with at least one inpatient lower respiratory infection (LRI) by maternal education and stratified by the proportion of the child's community with less than 7 years of education; Alaska, 1999-2003.



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