Water and health in Alaska – not just a matter clean water

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ANTHC VISION:

Alaska Native people are the healthiest people in the world

Question 1

- Do you know where your patients get their water from?
  - Yes
  - No
  - Don’t know

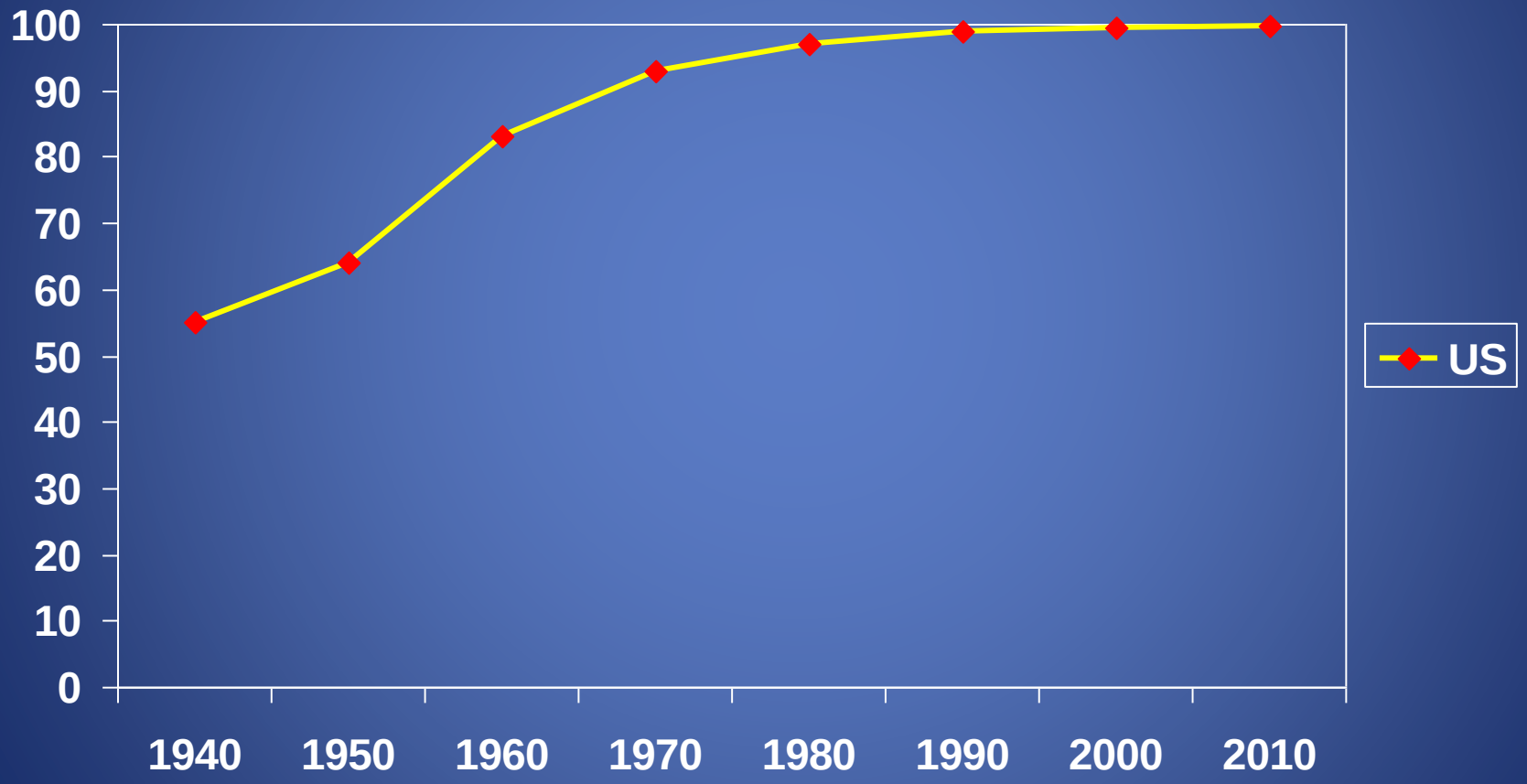
Question 2

- Do you ask your patients where they get their water from?
  - Yes
  - No

Question 3

- How much water per person does WHO recommend as a minimum for minimal health concerns?
  - 5 g/c/d
  - 10 g/c/d
  - 15 g/c/d
  - 20 g/c/d
  - 25 g/c/d

Percentage of US homes with complete plumbing, 1940 – 2010, US Census



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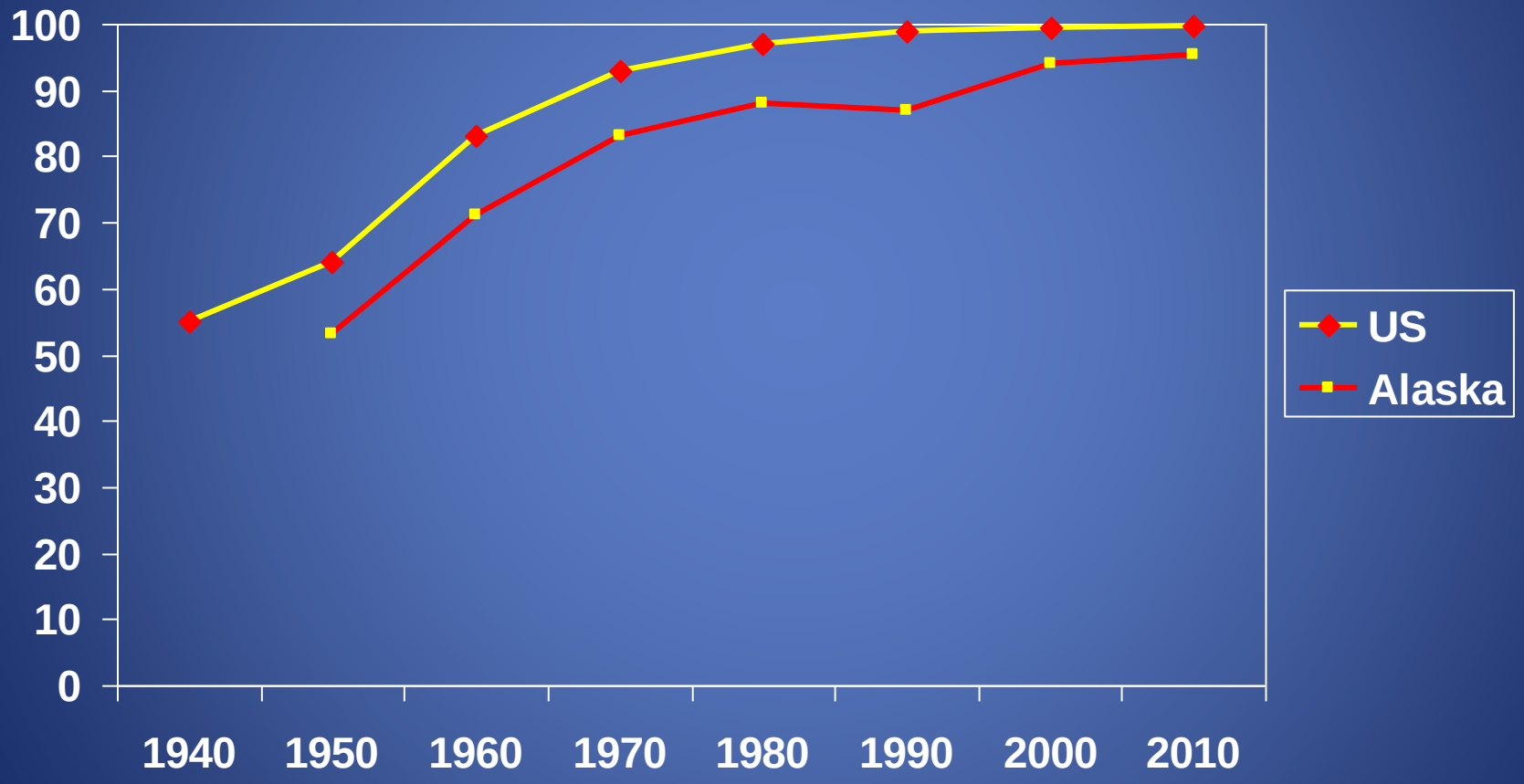

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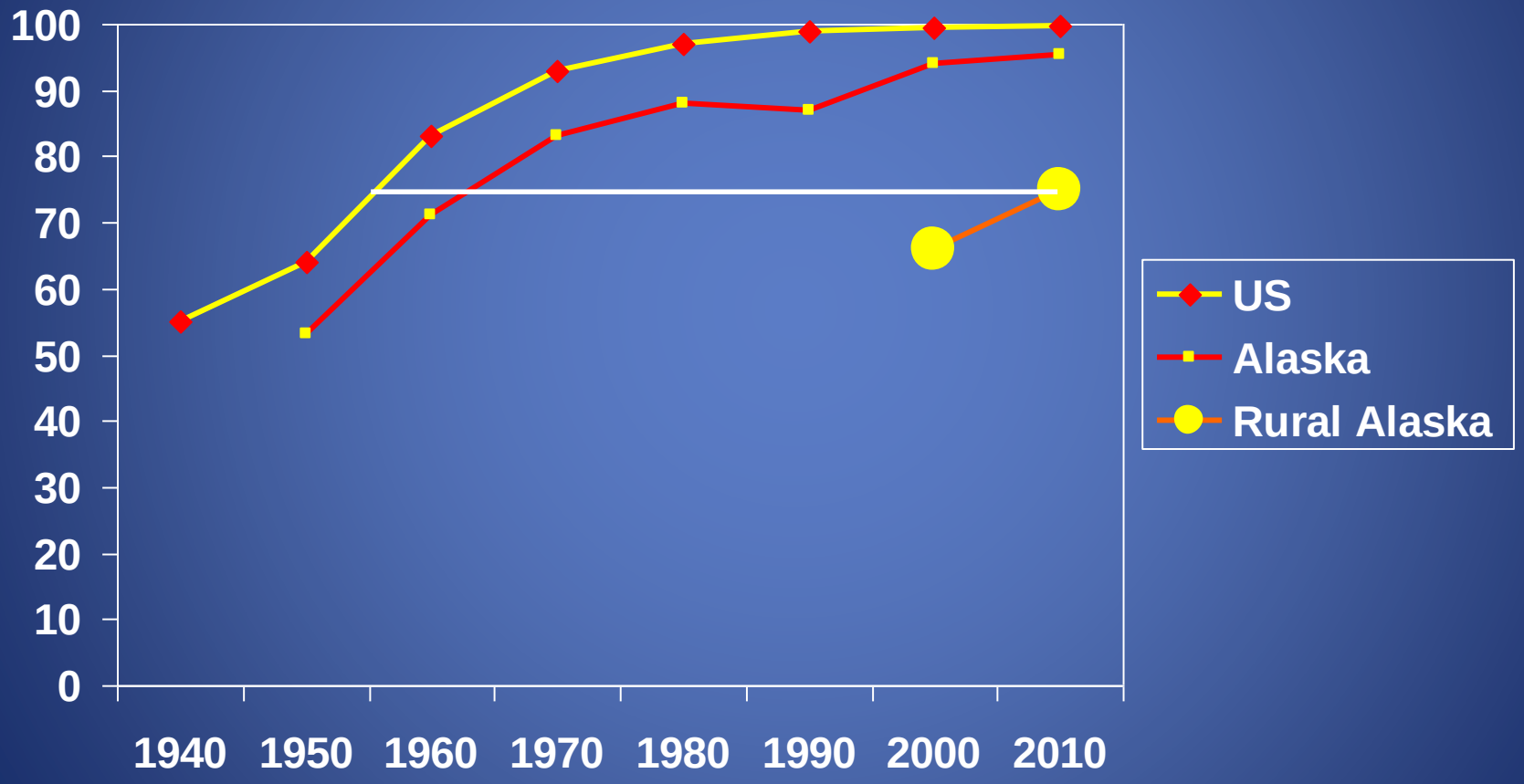
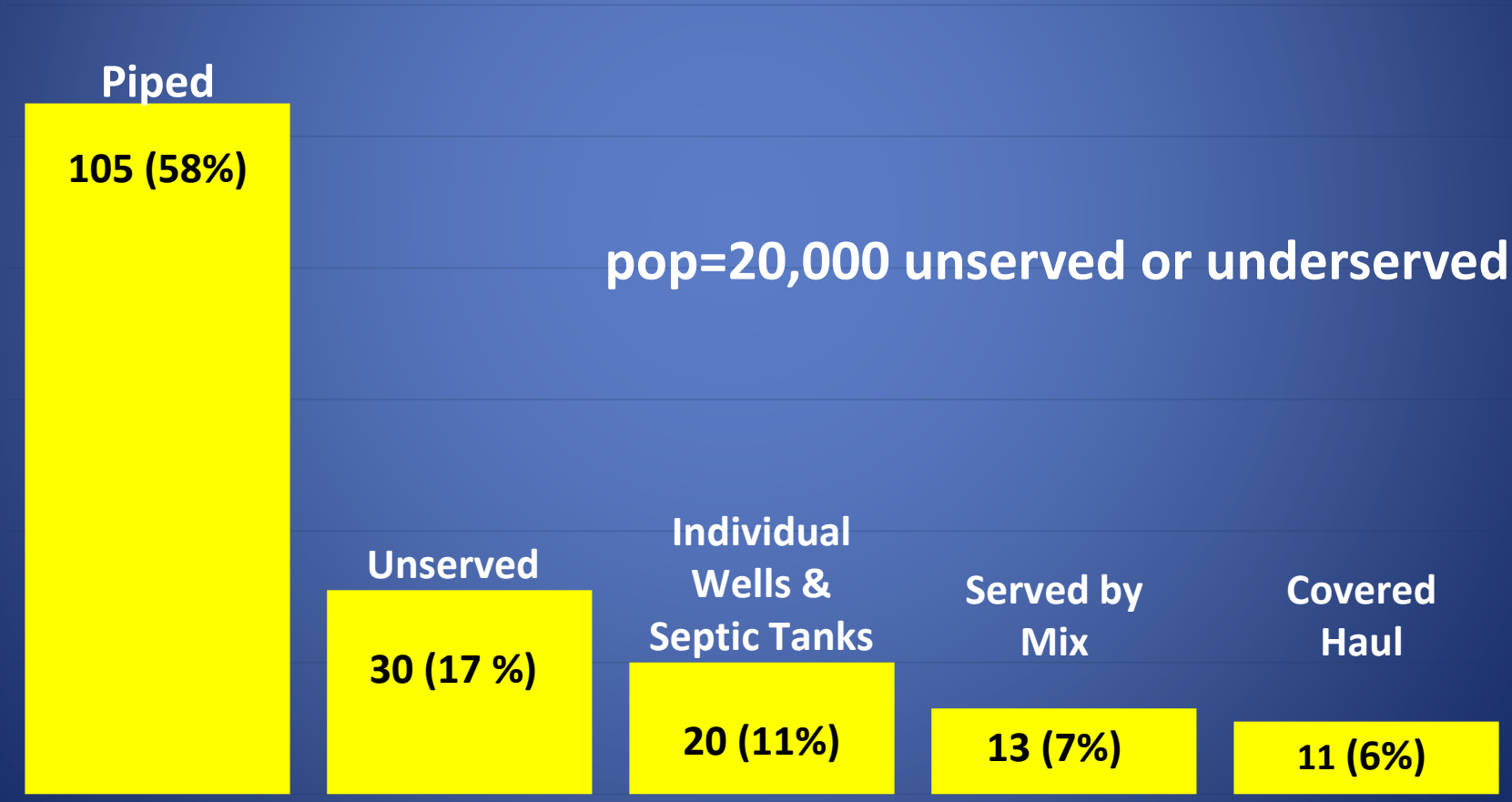
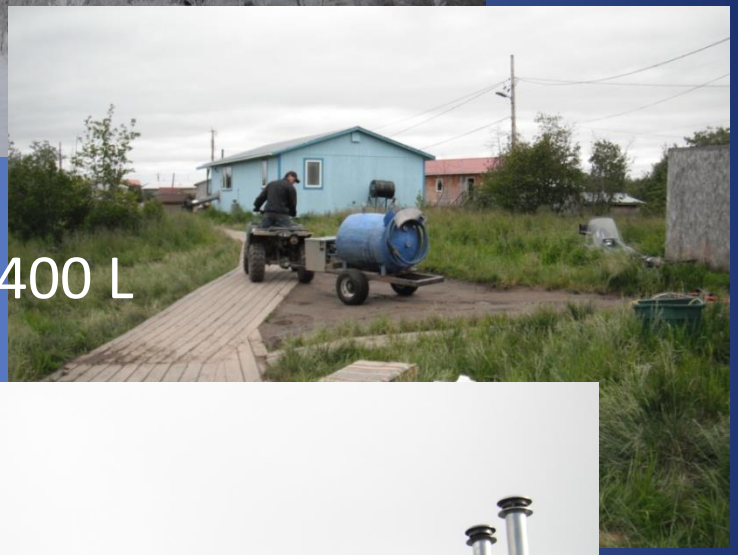


Water & Sewer System Types in Rural Alaska by number of communities



1 gallon = 3.8 liters

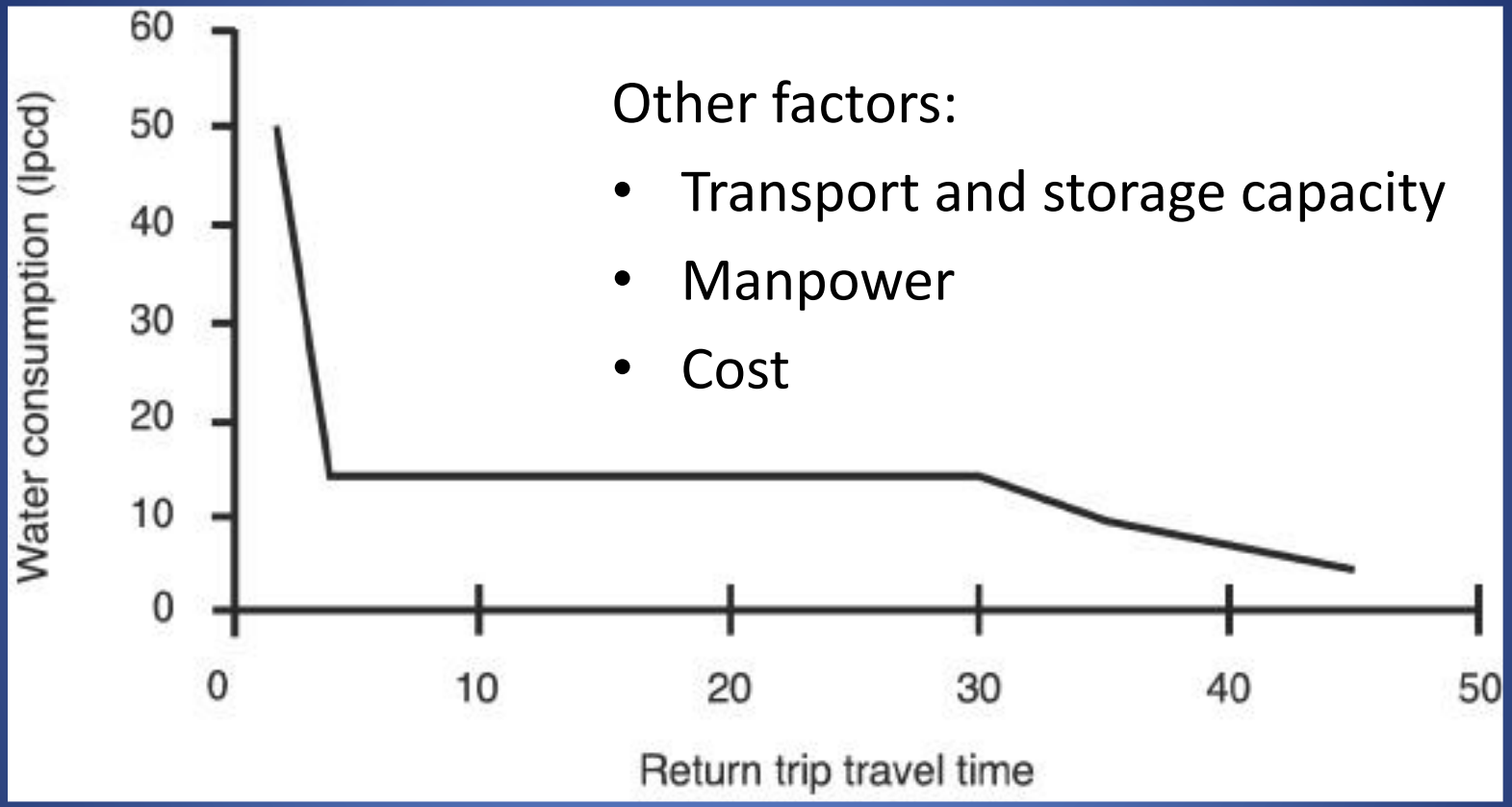
8000 L



400 L

20 L

Water consumed in relation to the time it takes to collect



The more time it takes to collect water the less water consumed

Cairncross S. 1987: The Benefits of Water Supply

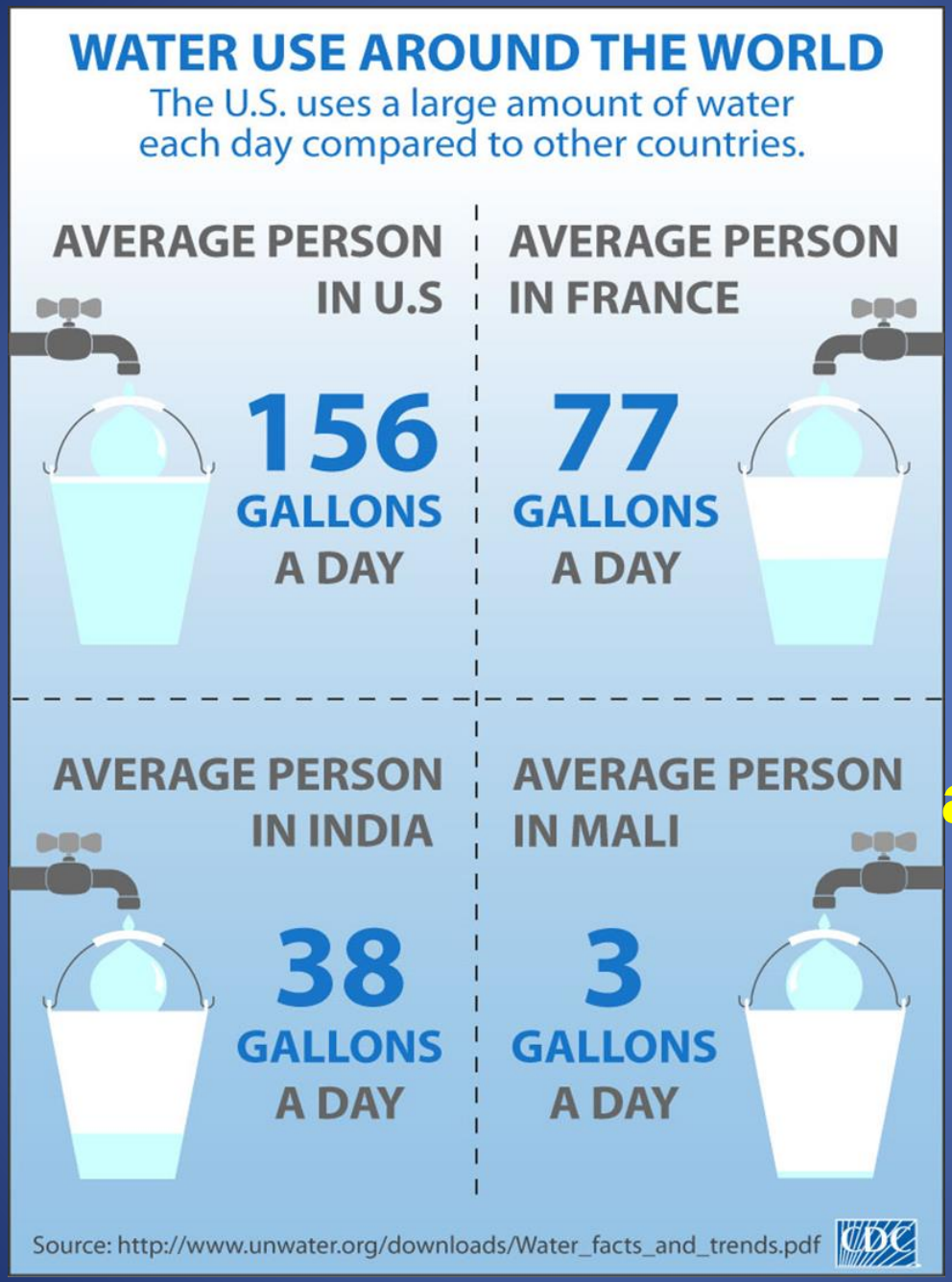
How much water is recommended?

Organization	**Recommendation** Litres / Person / Day (US gallons)
*Sphere: disaster response minimum	**15 (4)**
**CRUM: minimum piped	60 (16)
CRUM: standard for truck-haul system	90 (24)
WHO: very high health concern	**<5 (1)**
WHO: high health concern	**20 (5)**
WHO: low level of health concern	**50 (13.2)**
WHO: very low level of health concern	**100 or more (26)**

*Sphere: NGO handbook for disaster response
**Cold Regions Utility Monograph, 1996

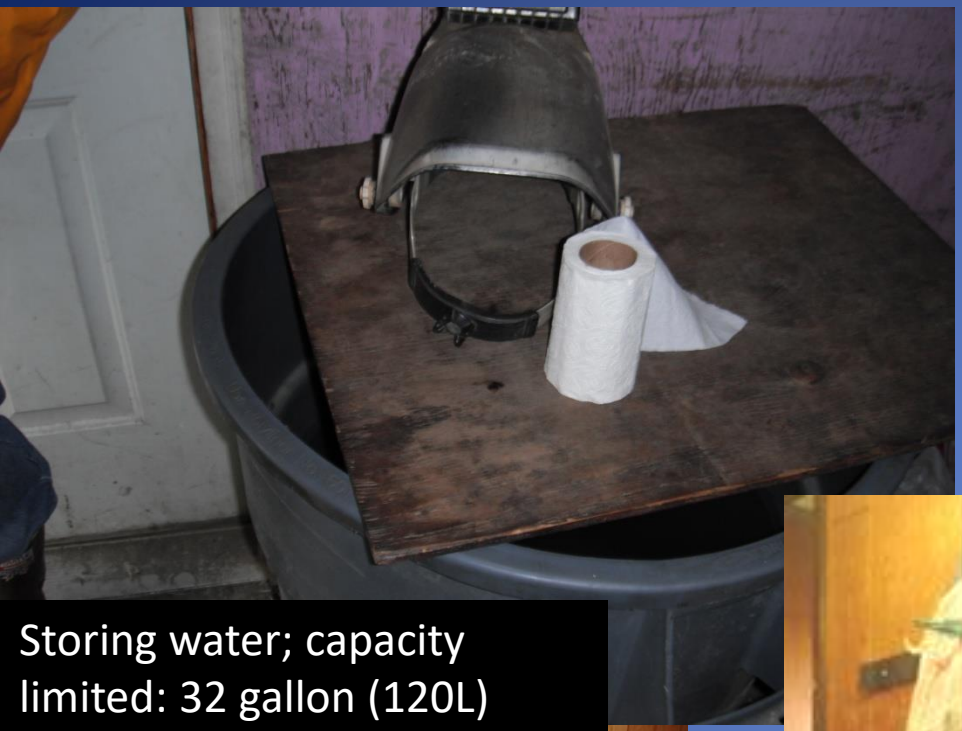
How much water are self-haul households using?

- Eichelberger estimated:
  - 2.4 g/c/d in villages in Northwest Alaska
  - 1.36-2.31 g/c/d in Newtok
- Thomas, Ritter et al estimated 1.4 g/c/d in villages in Southwest Alaska



and Rural Alaska

No pipes means:



Storing water; capacity limited: 32 gallon (120L) plastic container

Conserving water: Many people washing hands in the same water

The Honey bucket

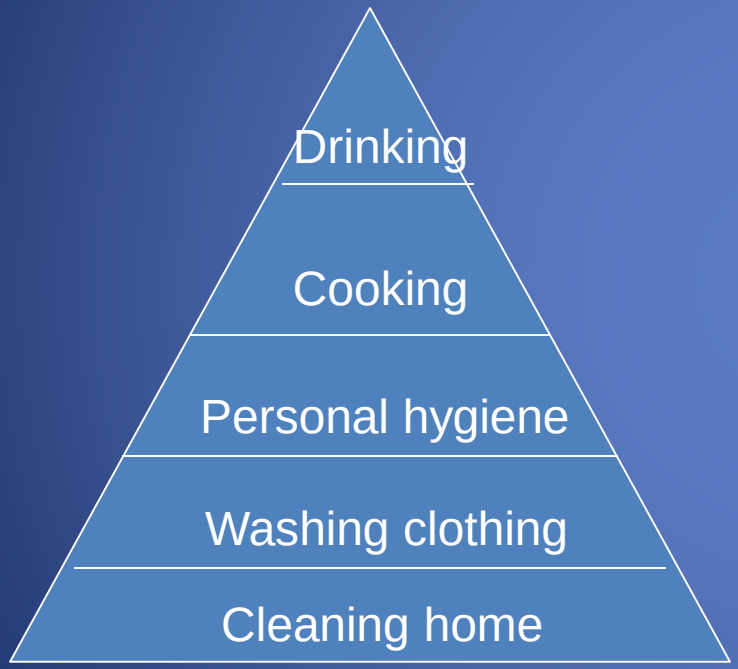
Dump Site

Emptying Honeybucket

Sewage Lagoon in Winter

Flooded Sewage Lagoon

Hierarchy of Water Requirements



Water-related Infections

- Water-borne
  - Pathogen ingested with water
    - Cholera, other enteric infections
    - Water-quality issue
- Water-washed
  - Person-to-person transmission
  - Lack of water for hygiene
    - Skin infections, trachoma, enteric infections
    - Water quantity issue

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

Really?

A 1998 report for the State of Alaska Members of Legislative Budget and Audit Committee recognized the

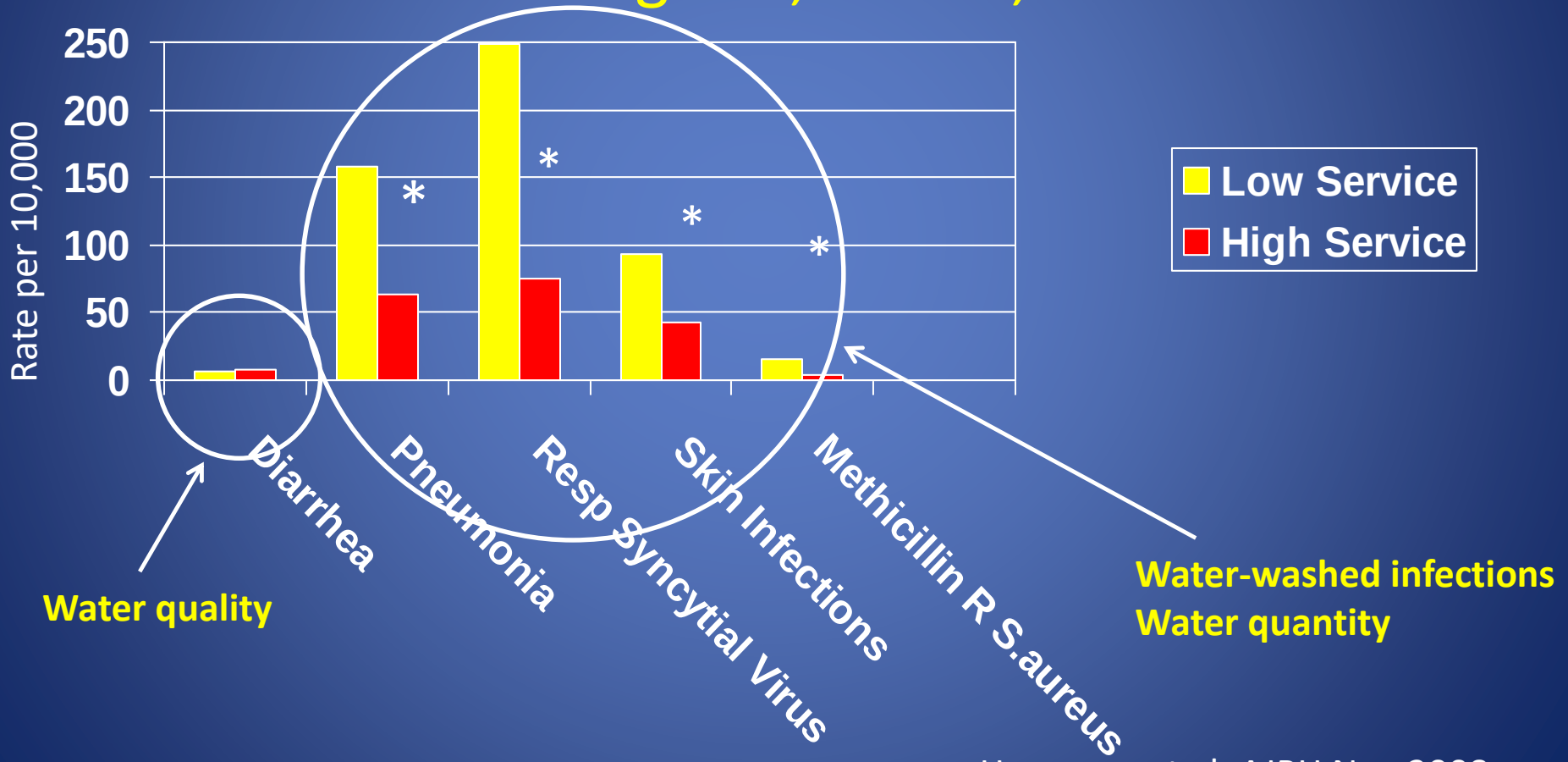
"generally accepted compelling and direct benefits…" of in-home piped water, but went on to state that these benefits have been "intuitively accepted as correct without the persuasion of any substantiating data".

The report recommended that an effort be carried out to document these benefits as they specifically pertain to Alaskans.

The Relationship Between In-Home Water Service and the Risk of Respiratory Tract, Skin, and Gastrointestinal Tract Infections Among Rural Alaska Natives

Thomas W. Hennessy, MD, MPH, Troy Ritter, REHS, MPH, Robert C. Holman, MS, Dana L. Bruden, MS, Krista L. Yorita, MPH, Lisa Bulkow, MS, James E. Cheek, MD, MPH, Rosalyn J. Singleton, MD, MPH, and Jeff Smith, MS, RS

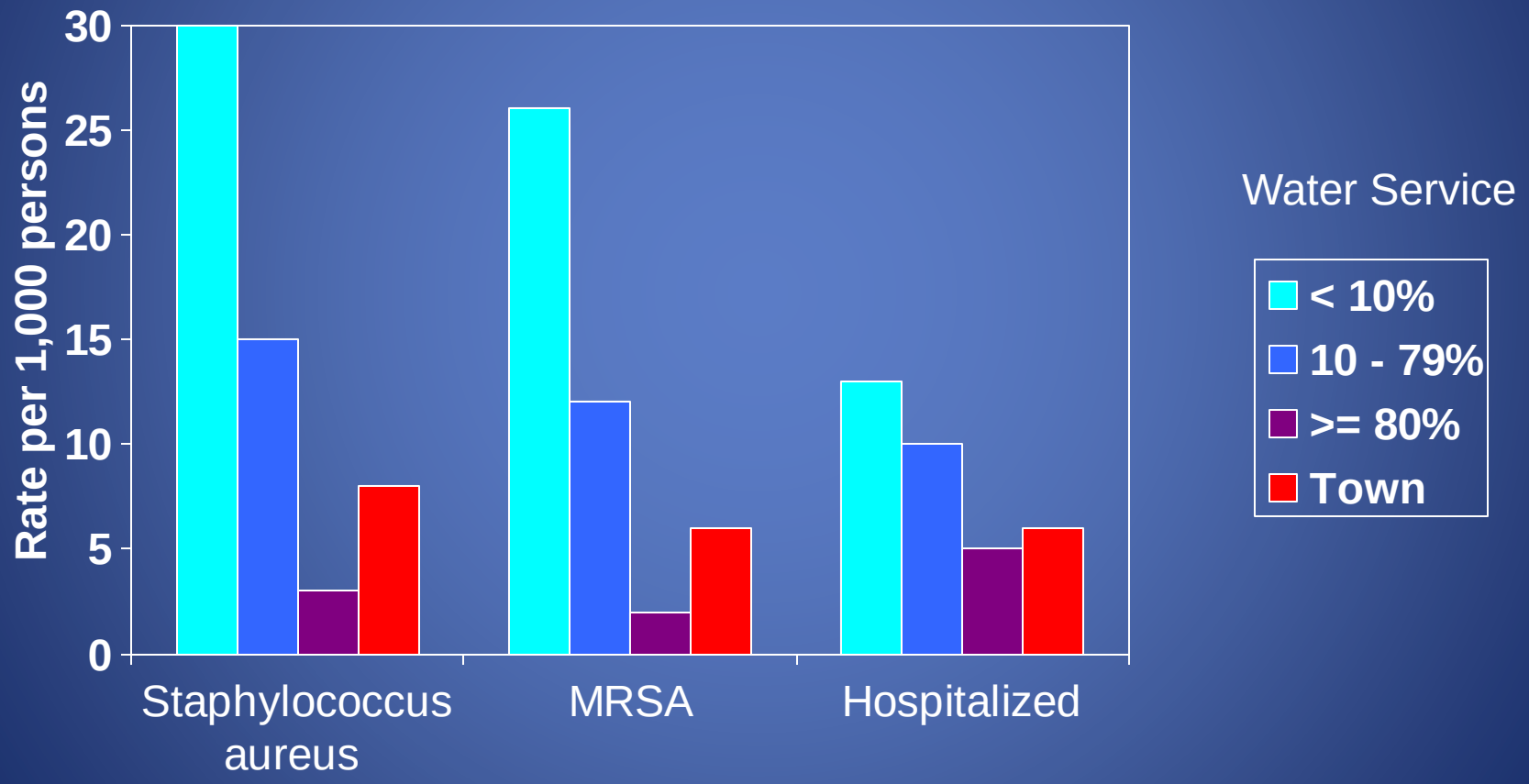
Hospitalization Rates for "High" and "Low" Water Service Regions, Alaska, 2000-2004



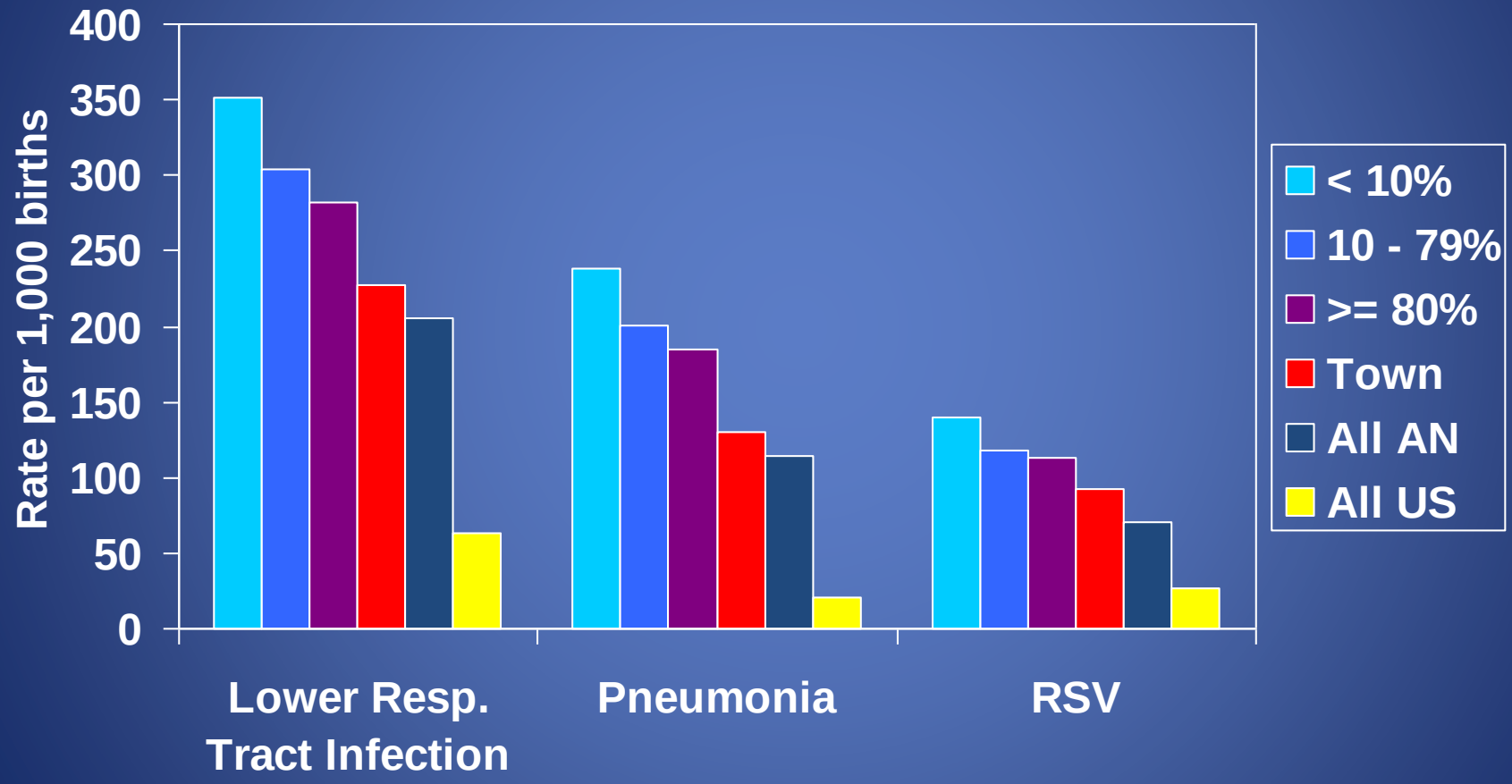
* P < 0.05

Hennessy et al; AJPH Nov 2008

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

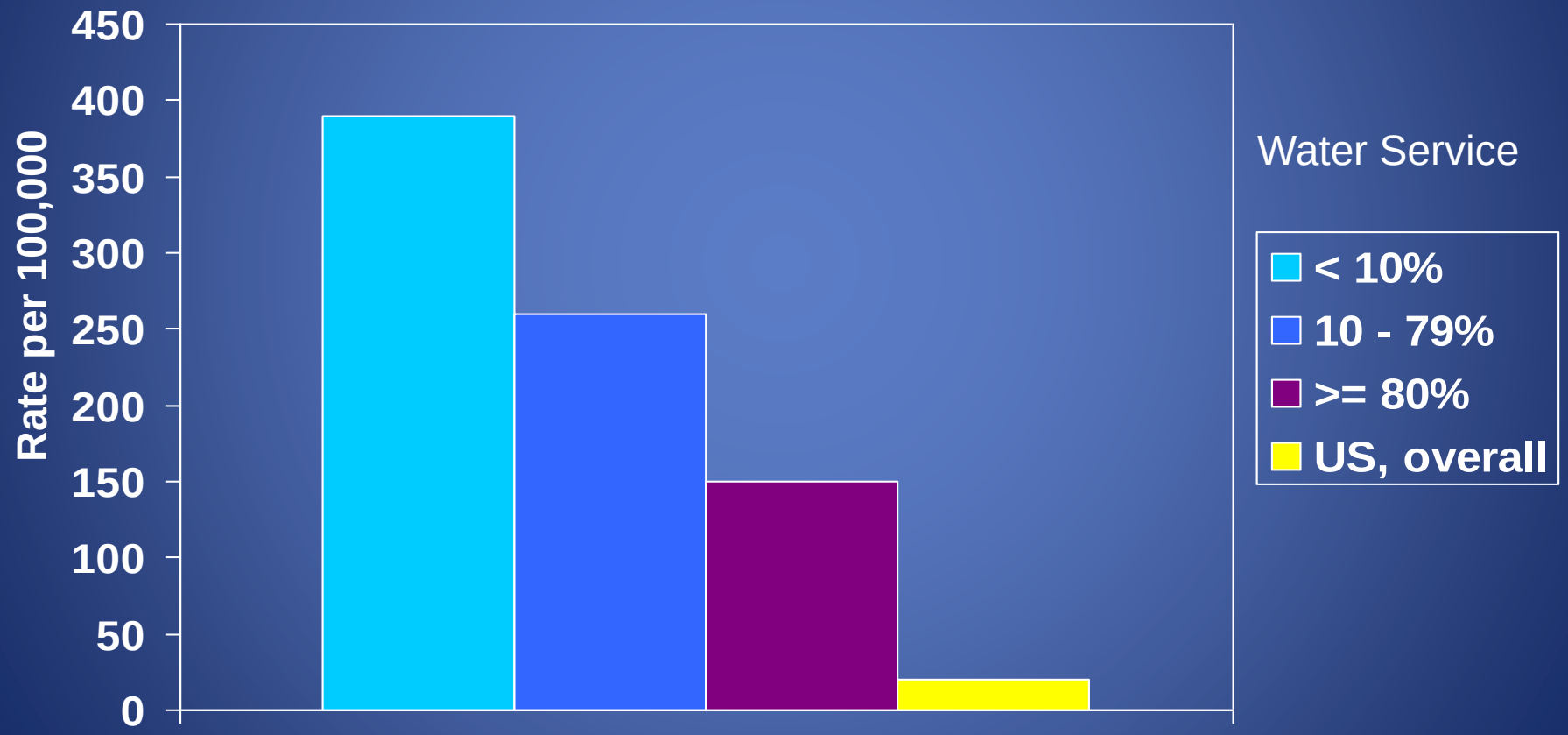


Hospitalization rates for Alaska Native infants, by percent of community homes with water service 1999 - 2004*



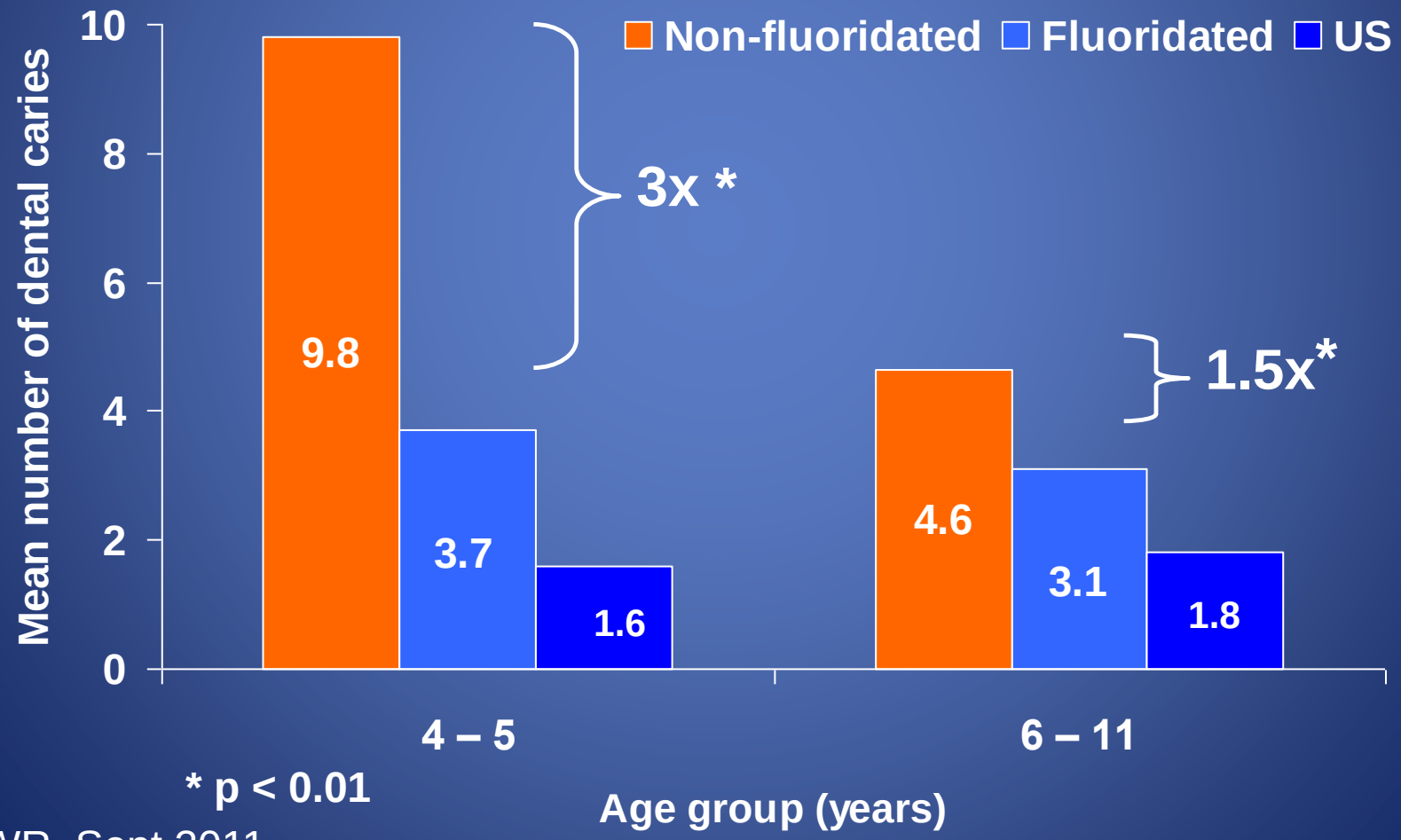
* Hennessy, AJPH, 2008

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

Infectious Diseases in Rural Alaska Communities
Without In-home Water Service

- Water-washed diseases
  - Infant pneumonia hospitalizations
    - 2x higher
  - Skin infection hospitalizations, all ages
    - 2X higher
  - Serious bacterial infections in children
    - 2X higher
  - Dental caries (cavities) in children
    - 3x higher

Prospective studies

- Studies needed to evaluate role of water quantity on water-wash infections;
  - Most have focused on diarrheal illness
- *Ryan et al, 2001*: Hand washing campaign among US Navy recruits:
  - 45% reduction in outpatient respiratory illness
- *Luby et al, 2005*: Communities in Karachi, Pakistan randomized to soap and hand washing vs none:
  - 50% reduction in pneumonia, children < 5 years
  - 53% reduction in diarrhea, < 15 years
  - 34% reduction in impetigo, < 15 years

Impact of In-home Piped Water on Rates of Infectious Disease

- Four villages (A-D) in western Alaska received funding and met requirements for completion of piped water installation 2007/2008
- Opportunity to conduct a prospective cohort study
- Objective:
  - Assess rates of water-wash and water-borne
    - acute gastrointestinal (GI), respiratory and skin infections
    - before and after installation of in-home sanitation services

Intervention

- "Intervention":
  - Installation of pipes to homes; water and sewage
  - Plumbing inside home
  - Education/Promotion of water use

Outcomes

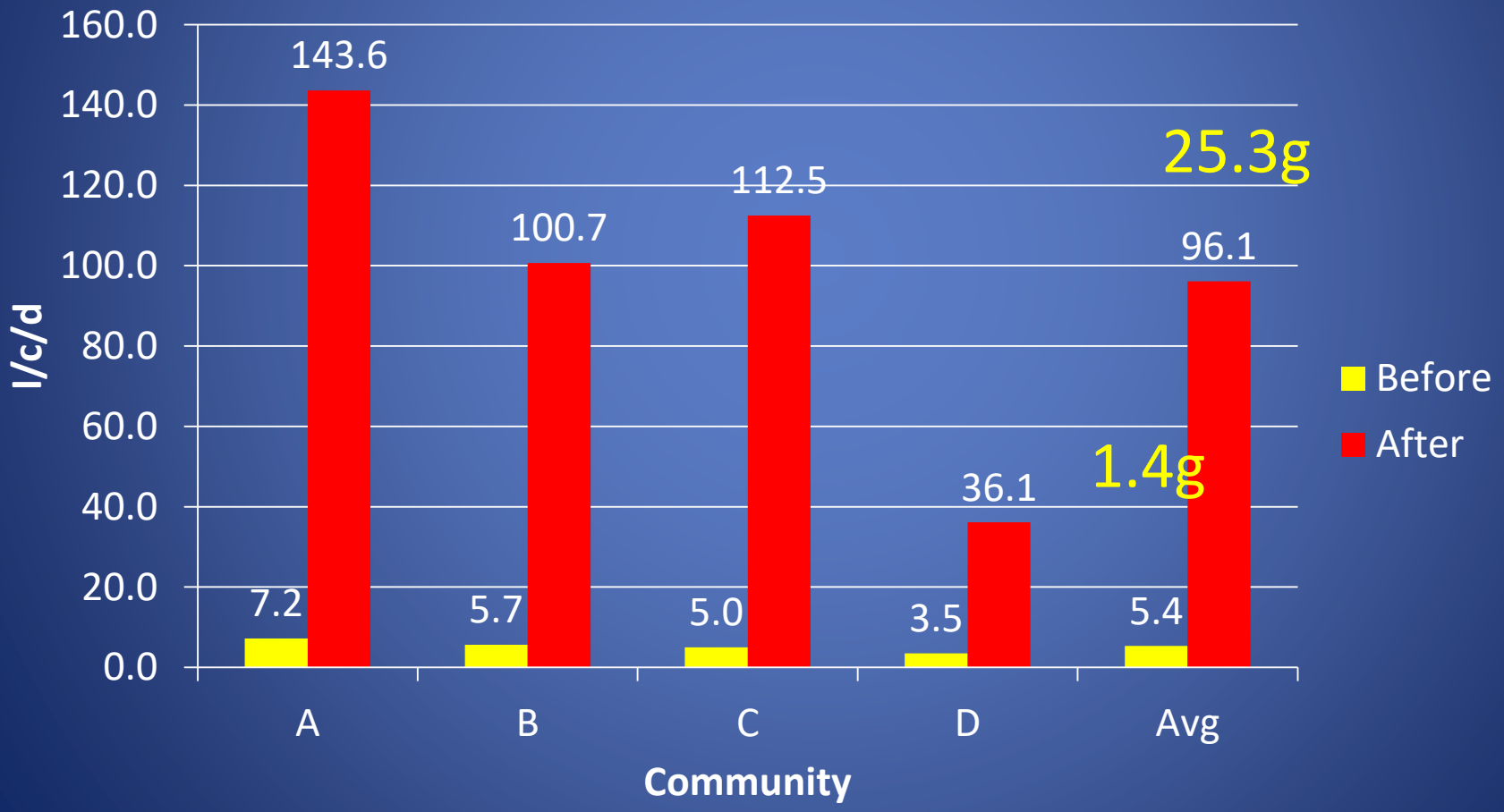
- Health
  - Review of electronic medical record
    - Village clinic and hospital visits
    - ICD-9 codes for acute GI, respiratory and skin infections
- Water Use
  - Pre-pipe installation
    - Households recorded number and volume of water hauls over one month
  - Post-pipe installation
    - Monthly water meter readings
  - Obtained number of household occupants
    - Calculated liters (gallons)/capita/day

Analysis

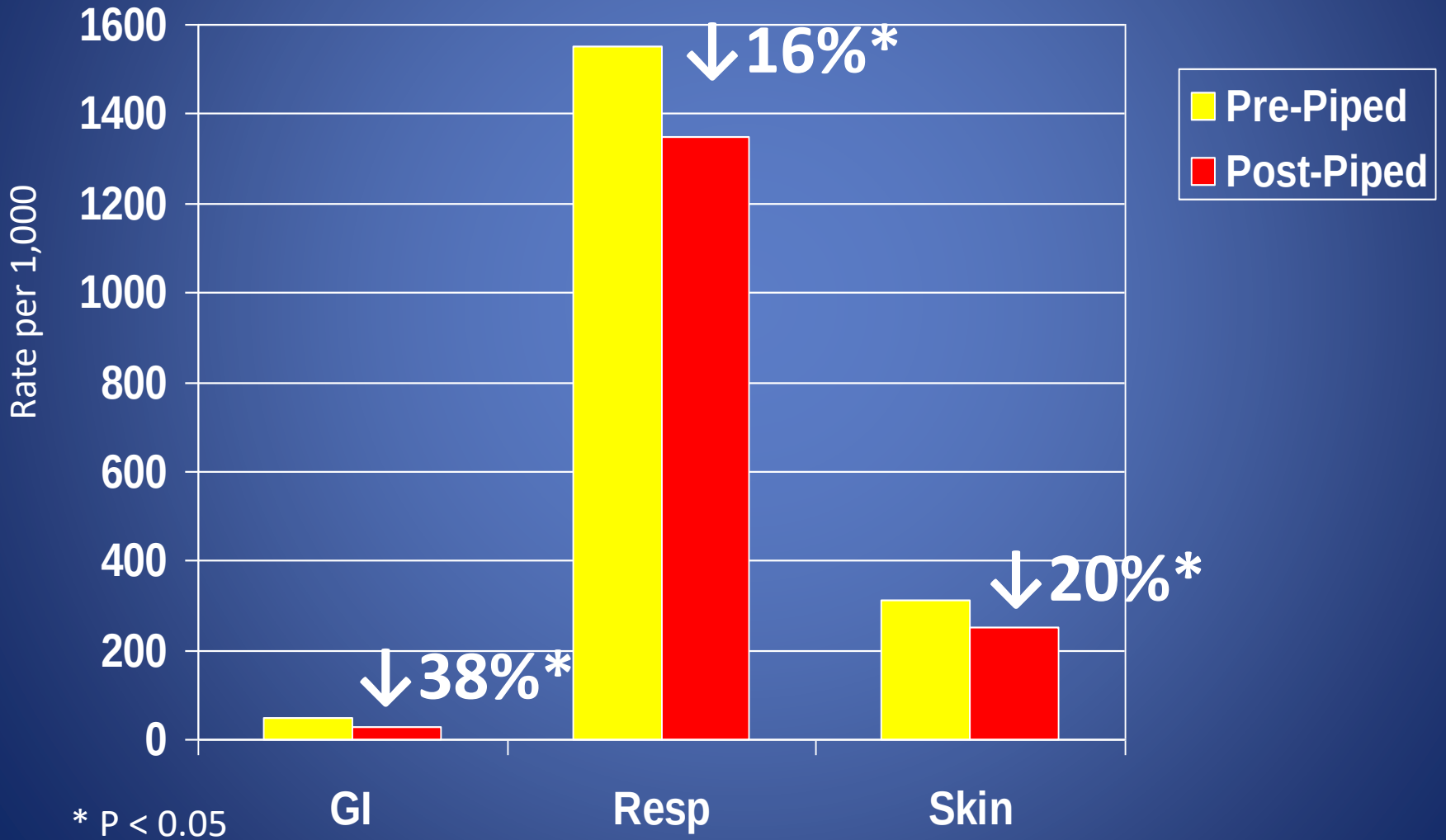
- Calculated annual illness event rates for each community for GI, respiratory and skin infections
  - 3 years before and 3 years after pipes installed
- Excluded visits with same ICD-9 code within 14 days
- Age adjusted rates for post-installation period
- Generalized estimating equations used to account for repeated observations on same individual over time

Mean household water use litres/capita/day (l/c/d) pre- and post-installation

1 gallon = 3.8 litres
10 gallons = 38 litres
20 gallons = 76 litres

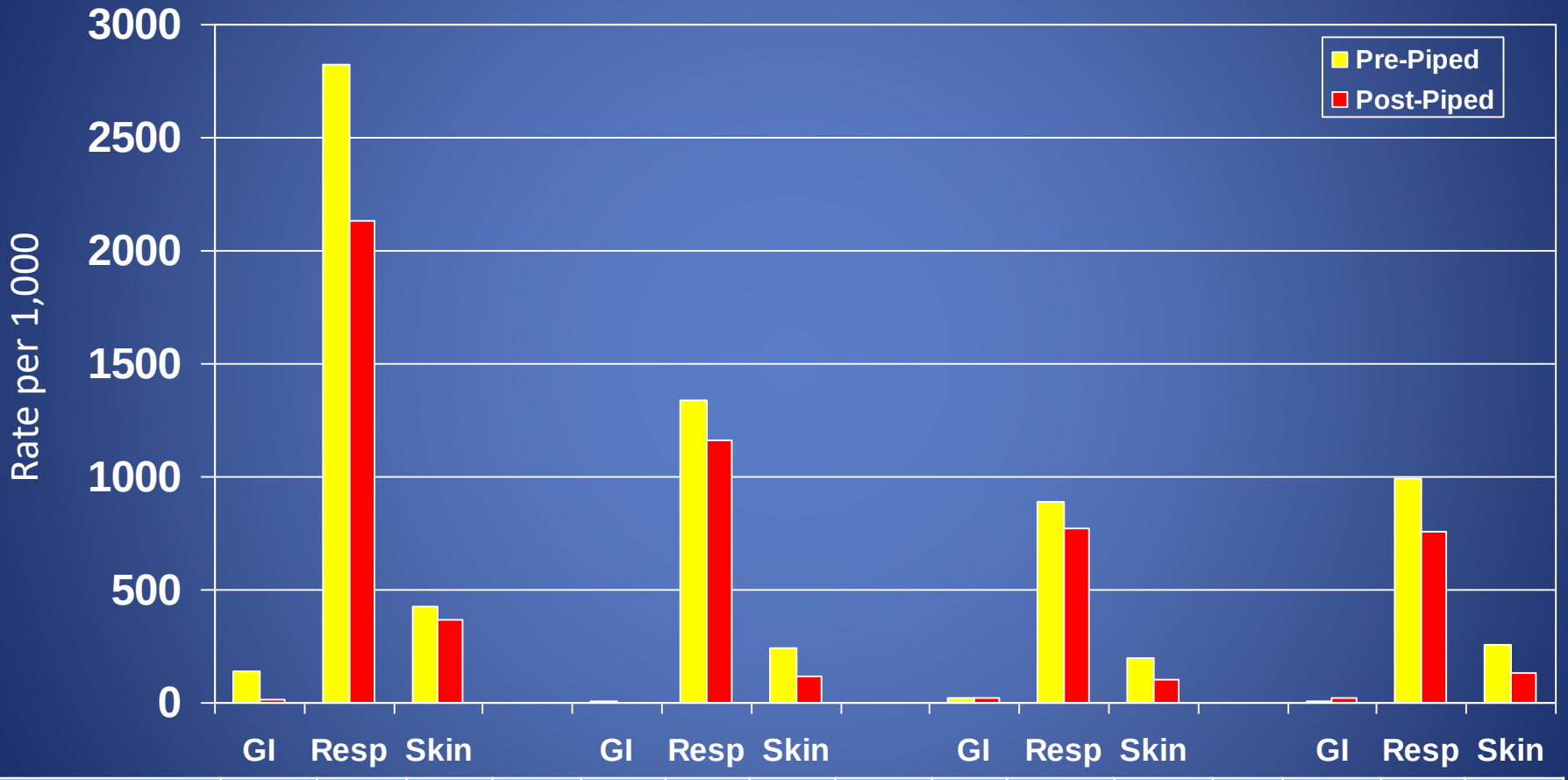


Age adjusted Annual Gastrointestinal, Respiratory and Skin infection Rates (per 1000) Pre- and Post-Piped Water for All Homes Installed with Piped Water



* P < 0.05

Age-adjusted Annual GI, Respiratory and Skin infection Rates (per 1000) Pre- and Post-Piped Water for All Homes Installed with Piped Water by Age Group



Percent Δ	91	24	14		---	13	50		---	13	50		---	---	50
Age group	< 10 yrs				10-19 yrs				20-35 yrs				35-49 yrs		

Impact beyond the four villages

- 4,500 homes in Alaska (est. 20,250 people) without piped water;
  - 5,100 fewer respiratory infections/year
  - 1,300 fewer skin infections/year
  - 400 fewer gastrointestinal infections/year

- Note: We removed visits within 14 days for same infection, so even greater reduction in burden on clinics and hospitals – 9,000 clinic visits/year

- Over 600,000 homes in United States lack complete plumbing

Study conclusions

- People in self-haul villages in Alaska are using extremely low quantities of water; do not meet SDG
- Provision of adequate QUANTITY of water results in a decrease in gastrointestinal, respiratory and skin infections
- Findings reinforce the earlier studies in Alaska
- Limitations:
  - Did not observe behavior change
  - Declines may be due to other causes; immunization, seasons
  - Transmission through other mechanism e.g. droplet spread
- Significant challenges for the future; funding, climate change
- Funding and innovation required to provide increased quantity of water to rural Alaska villages

Way forward

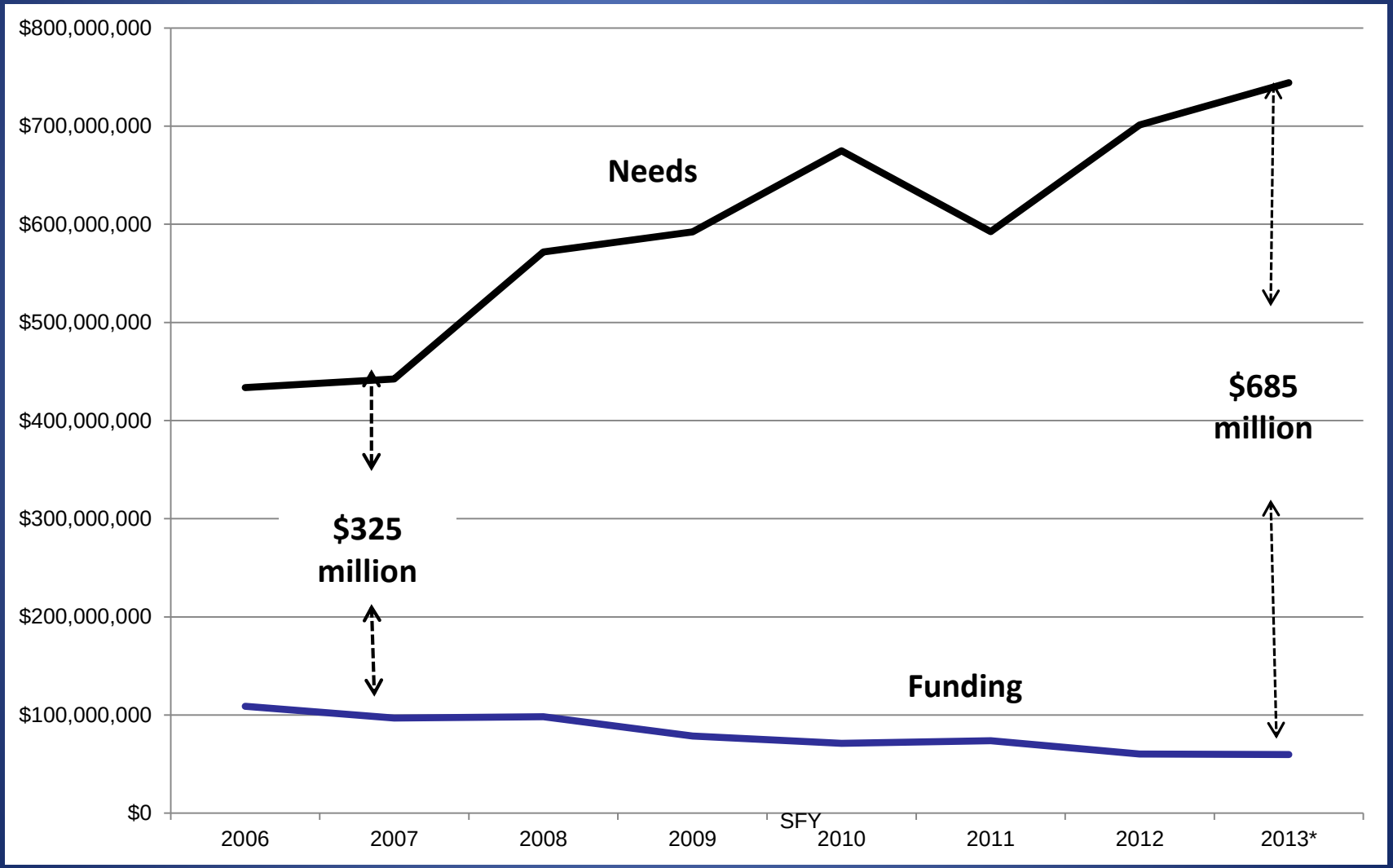
“Centralized” Approach Since 1970:

- 100% water treatment to full regulatory compliance (regardless of ultimate use)
- Storage of large quantities of water, usually requiring heat addition
- Distribution of treated water to individual homes via pipes or haul vehicle, usually requiring heat addition
- Collection of all household sewage for lagoon disposal, usually requiring heat addition

Threats to Alaska Rural Water and Sanitation infrastructure

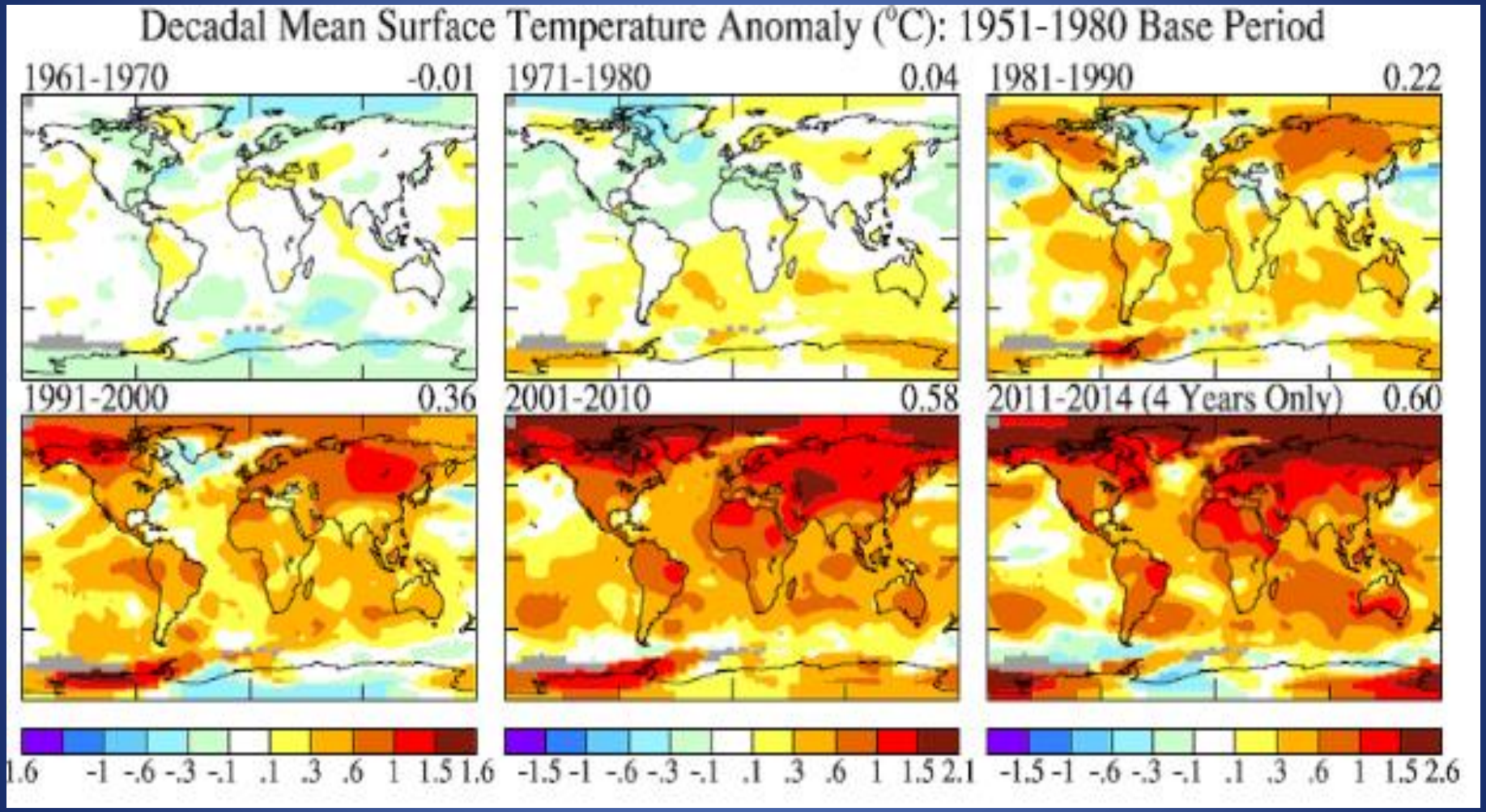
- Funding for new construction decreased
  - Estimate $400,000 per home to install piped water
- Existing systems are aging
  - Operations and maintenance
  - Replacement

Needs vs. Funding



Threats to Alaska Rural Water and Sanitation infrastructure

- Funding for new construction decreased
- Existing systems are aging
  - Operations and maintenance
  - Replacement
- Climate change
  - Shoreline erosion
  - Sea level rise
    - Salt water intrusion, infrastructure damage, flooding
  - Permafrost melt
  - Source water availability and quality


Decadal Mean Surface Temperature Anomaly (°C): 1951-1980 Base Period
1961-1970 -0.01
1971-1980 0.04
1981-1990 0.22
1991-2000 0.36
2001-2010 0.58
2011-2014 (4 Years Only) 0.60
1.6 -1 -.6 -.3 -.1 .1 .3 .6 1 1.5 1.6
-1.5 -1 -.6 -.3 -.1 .1 .3 .6 1 1.5 2.1
-1.5 -1 -.6 -.3 -.1 .1 .3 .6 1 1.5 2.6

Arctic Human Health

Challenges from Climate Change

Kivalina

- Barrier island, Chukchi sea
- Population: 412
- No piped water or sewage
- Increasing shoreline erosion
- Relocation in future
- No major infrastructure funding likely

Source: http://static2.nydailynews.com/polopoly_fs/1.1413175.1375222382%21/img/httpImage/image.gif_gen/derivatives/index_635_390/390-alaska-0730.gif

Are there other options?

- Decentralized systems

Engineering Challenges to Decentralized systems

- Adequate water quantity
  - Storage capacity
  - Rainwater catchment?
  - Greywater recycling in home?
- Sufficient water quality
  - On-site treatment?
  - Changing source water: salt, silt, organics, pathogens, toxins
- Make hand and body washing accessible
  - 2+ sinks, shower/bath, laundry
- Sustainable systems
  - Affordable, easy to maintain/repair, freeze capable
- System or regulatory improvements
  - Operations and management support
  - Standards for recycled H2O use?

Alaska Department of Environmental Conservation (http://watersewerchallenge.alaska.gov/)

State-funded project to spur research to develop innovative and cost effective water and sewer systems

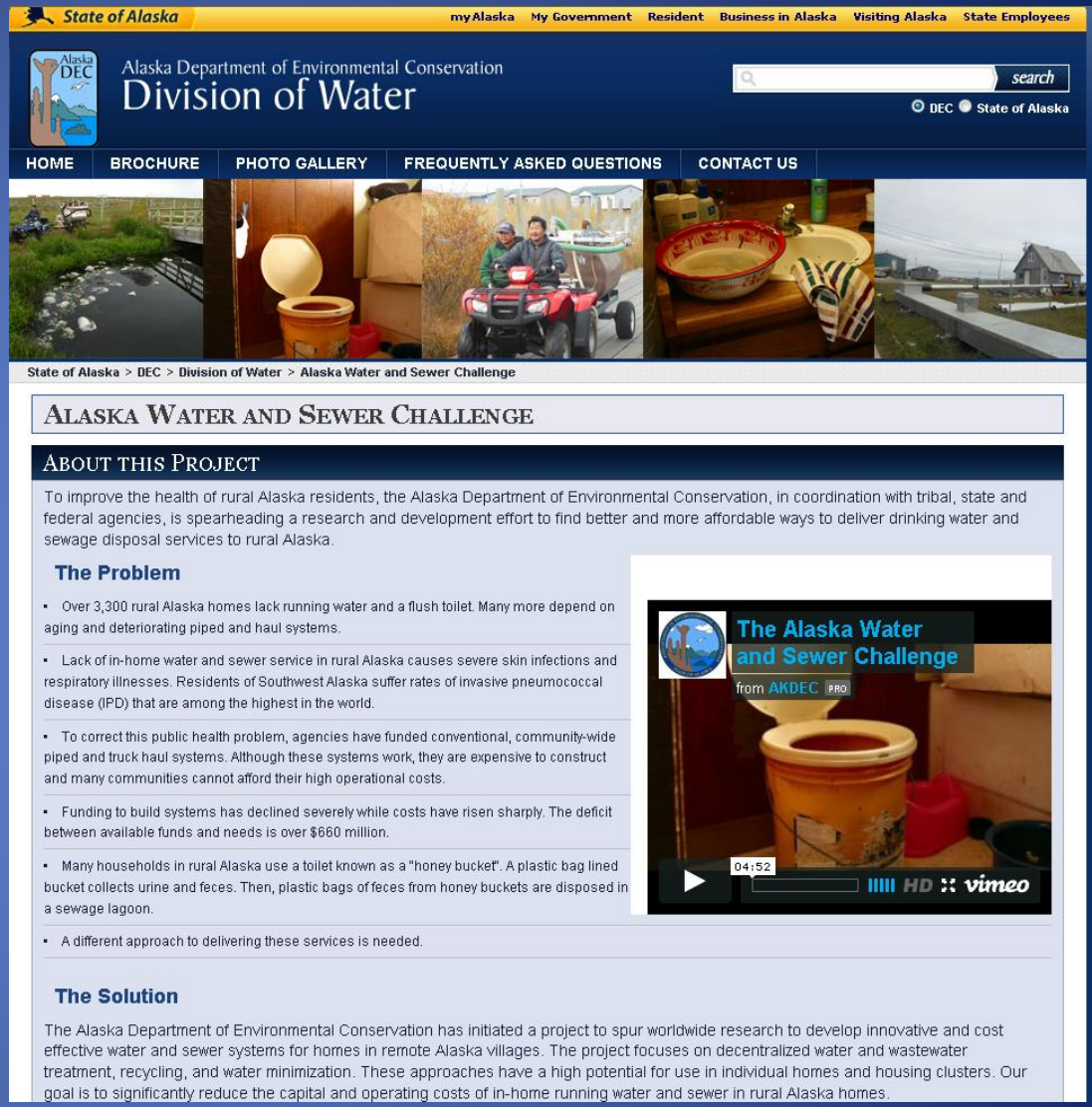
Focus on “decentralized” approaches – household based systems that utilize water re-use technologies

Target: provide 15 g/c/d

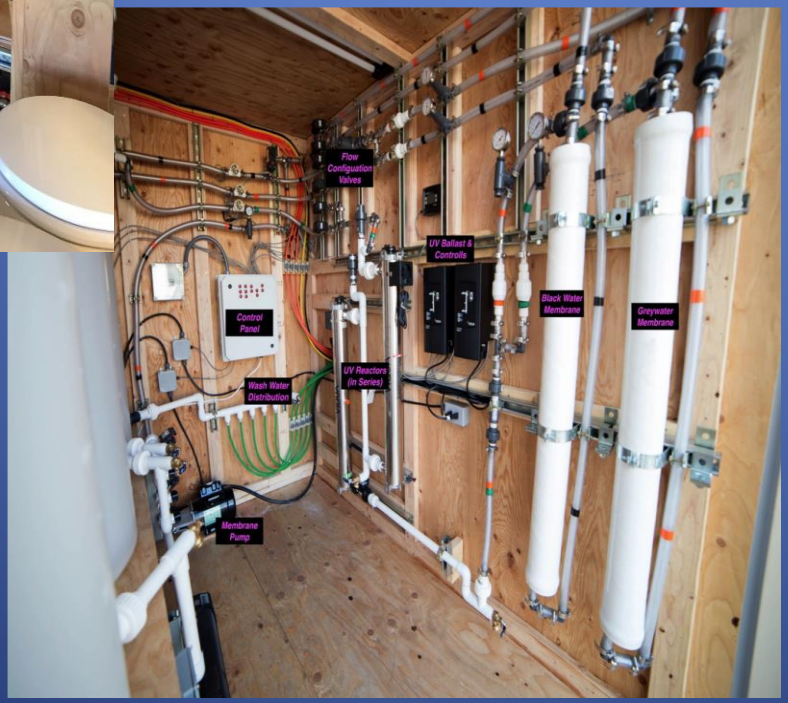
Projected to last 5 – 7 years

$4 million in state and federal funding

Three teams funded for Pilot phase



Prototype Development and Testing



Portable Arctic Sanitation System

Photo Credit: Molly Rettig, CCHRC

9 units installed to date
Homeowner satisfaction –
in their words

“Very satisfied from living here and growing up with the honeybuckets. I'm very satisfied. Communities without running water should have this. [It is] safer for communities and kids...”

“Fully satisfied...It's so good not to have the honeybucket we have to clean everyday and the smell.

“We like it a lot. [I] don't have to haul [a] heavy honeybucket to the dump. [There were] only 2 little bags for 2 weeks versus hauling heavy boxes every 3 to 4 days.”

Health Outcomes

- Unknown
- Unlikely that PASS will achieve 13 g/c/d
- May provide the water needed in the home for:
  - Drinking
  - Cooking
  - Handwashing
  - House cleaning
- Centralized facility for laundry and shower

Washeterias

- Need to be places that are conducive to showering and doing laundry

ANTHC VISION:

Alaska Native people are the healthiest people in the world

……a ways to go

Reminder

- Ask your patients where they get their water from?

Contact

- Tim Thomas: tkthomas@anthc.org

Quyana Apyutengqertuci?