Respiratory Hospitalizations in the Delta
What do we know?
What are we doing?

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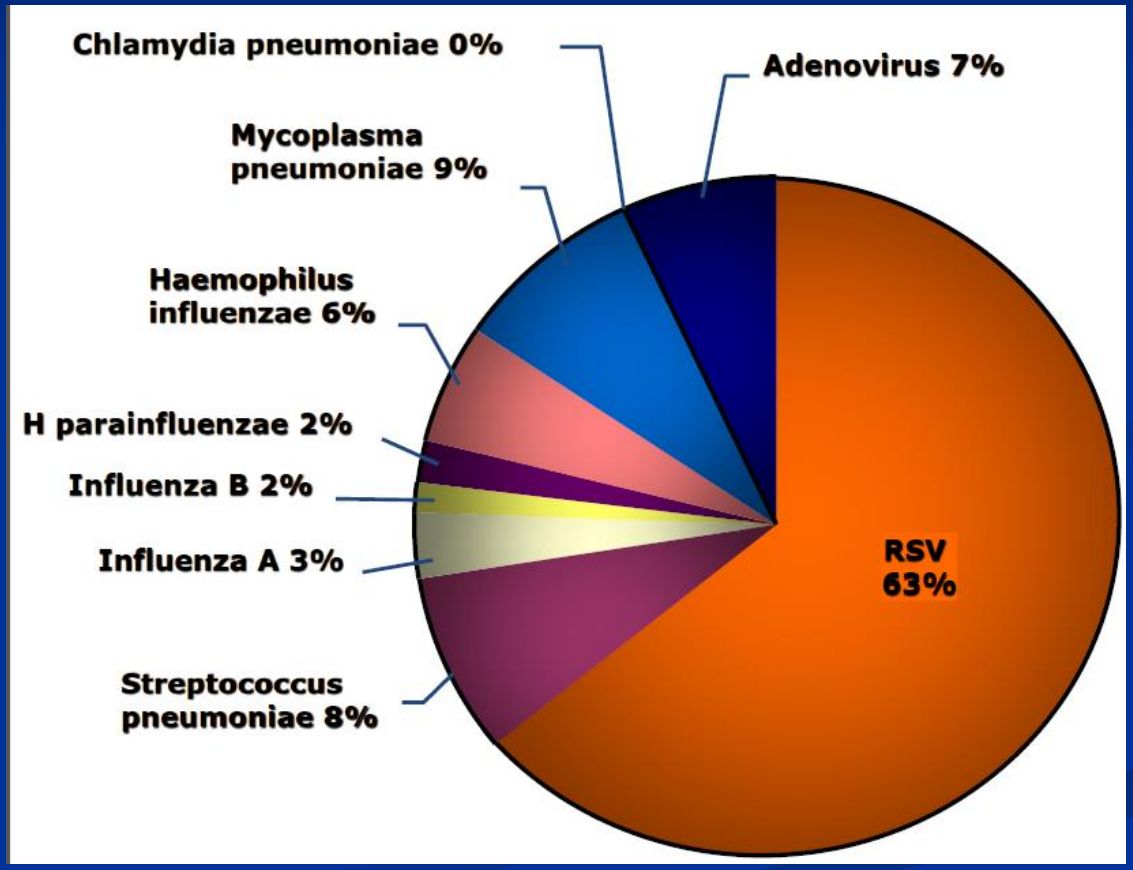
RSV: Worldwide Impact on Children

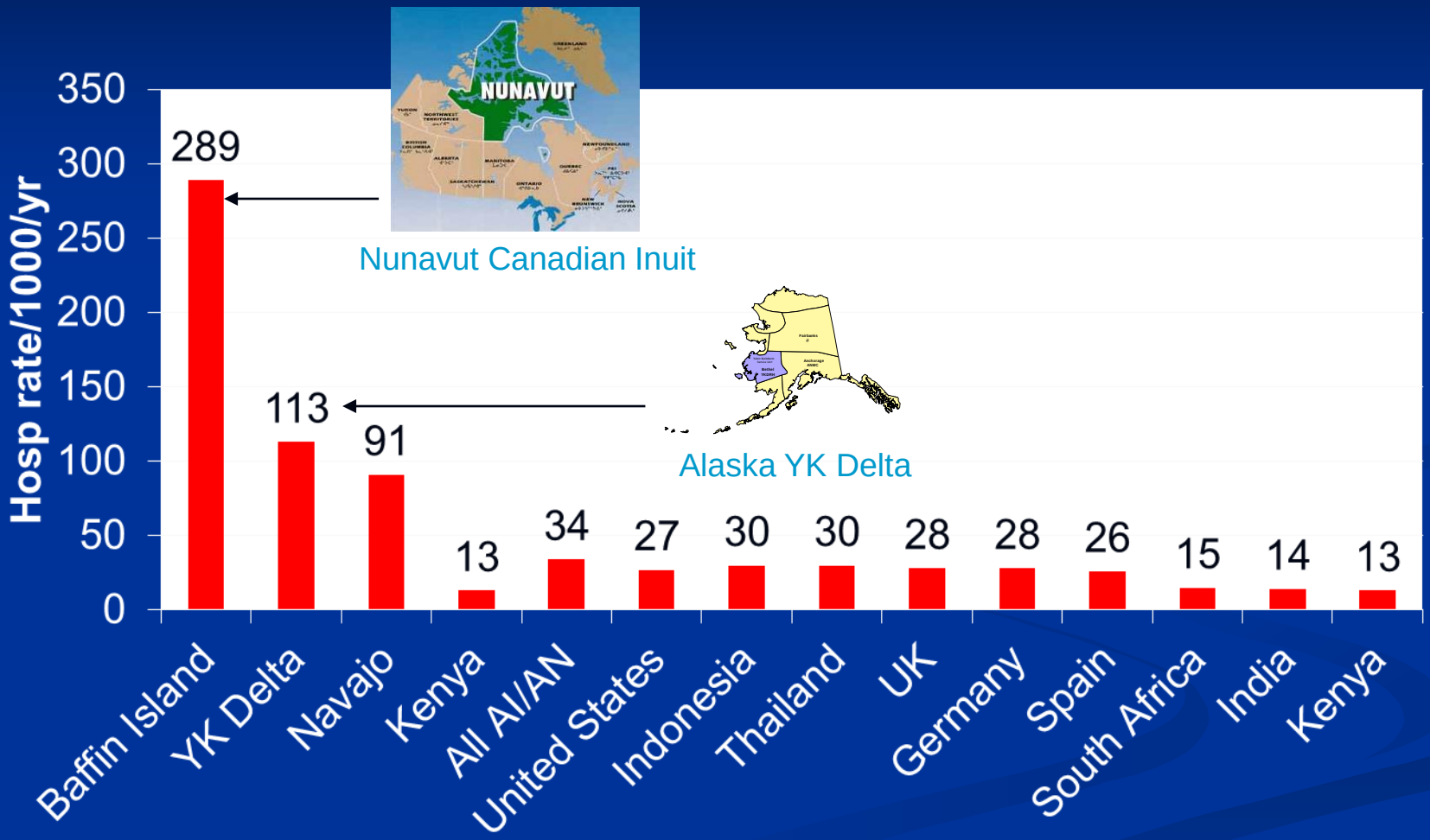
- >60% of acute respiratory infection is due to RSV
- 80% of those affected less than 1 year old



Piedimonte & Perez, PIR 2014

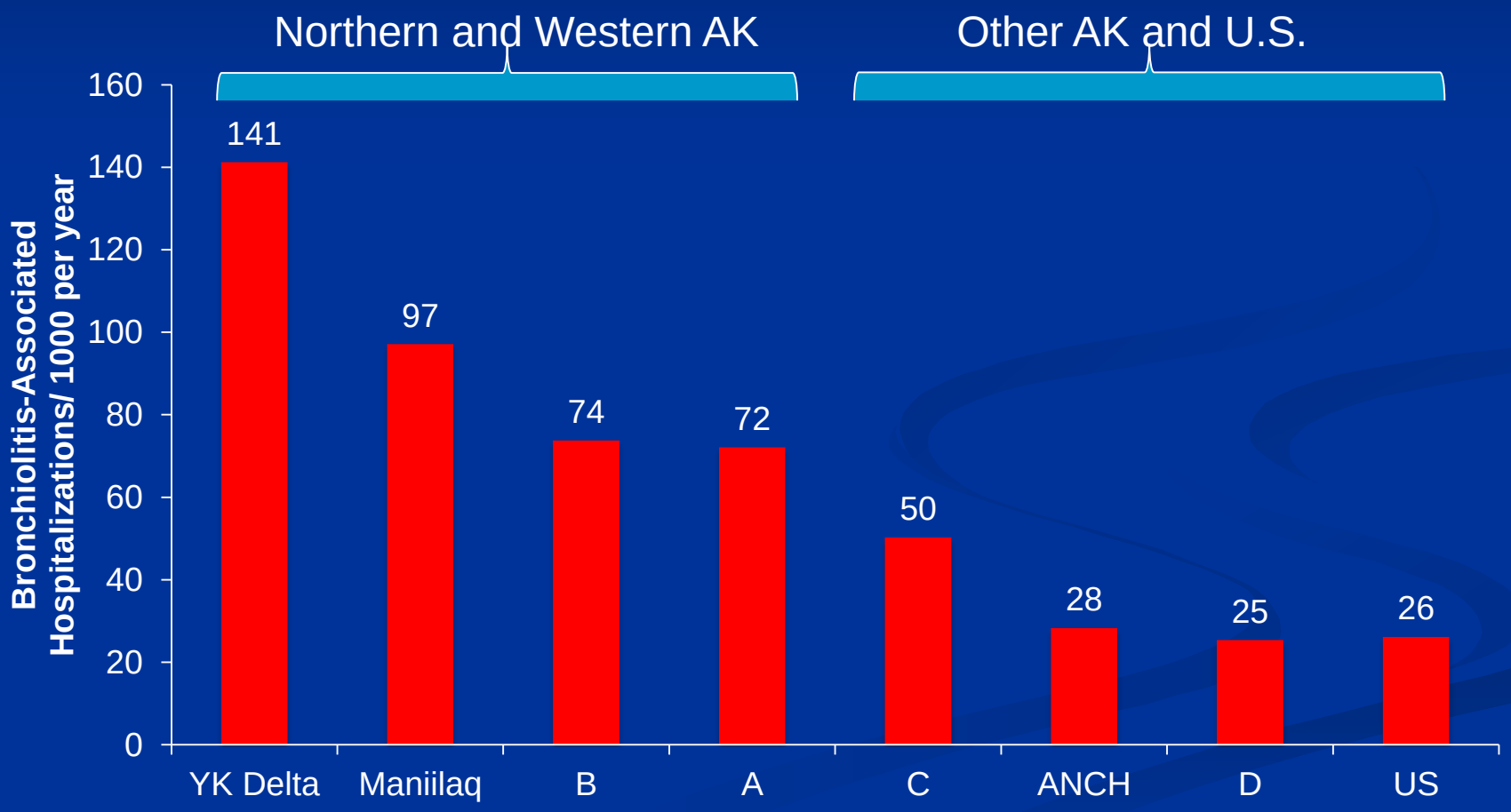
Global estimates of severe RSV:

Rate of Severe or Hospitalized RSV/1000 infants/yr



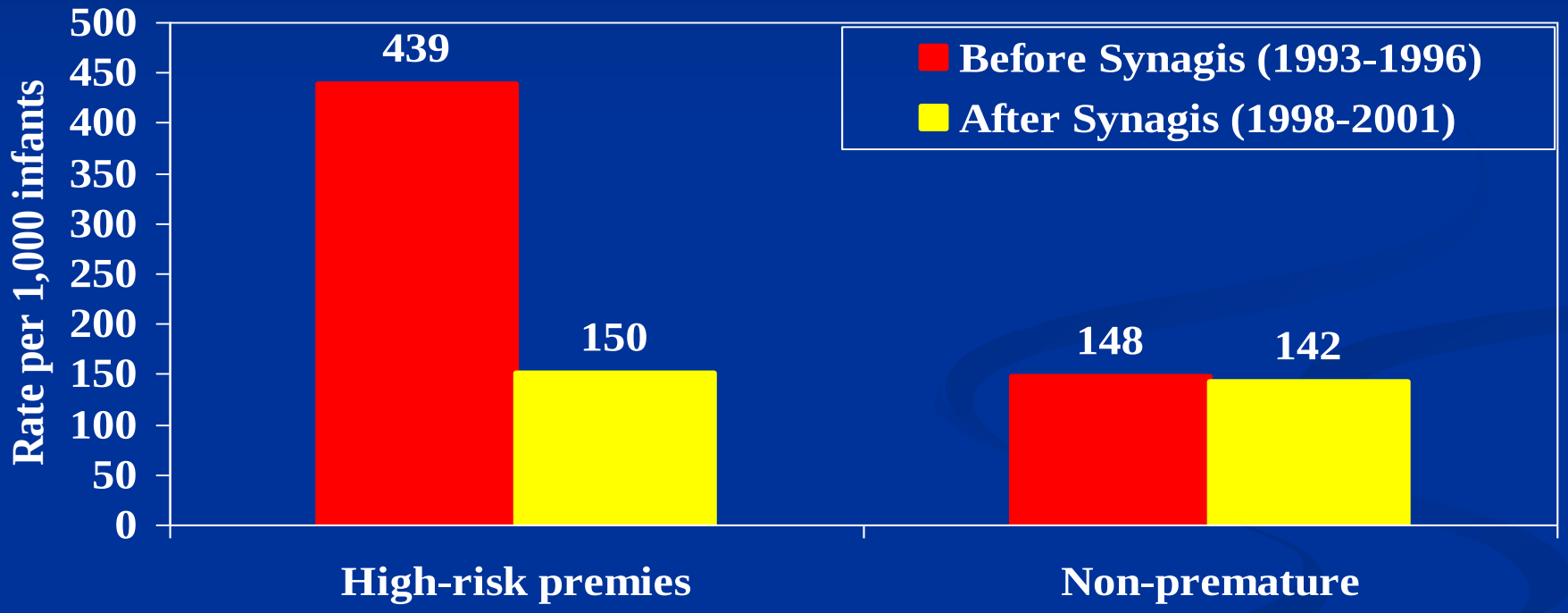
Nair H et al. Global burden of RSV…Lancet 2010;375:1545-55;
Banerji. PIDJ Cost of hospitalization for RSV in Canadian Inuit Pediatr Infect Dis 2009;28:.

Bronchiolitis Hospitalizations/1000/yr
Alaska Native infants by region, 2009-2011



Unpublished data, Singleton RJ, AIP-CDC, from IHS NIPRS data

RSV Hospitalization Rate, YK infants, before and after Synagis®, 2001



After Synagis, the rate in premies decreased 3-fold, while the rate in non-premies remained stable.

Singleton R et al. Pediatr Infect Dis J, 2003;22:540-545

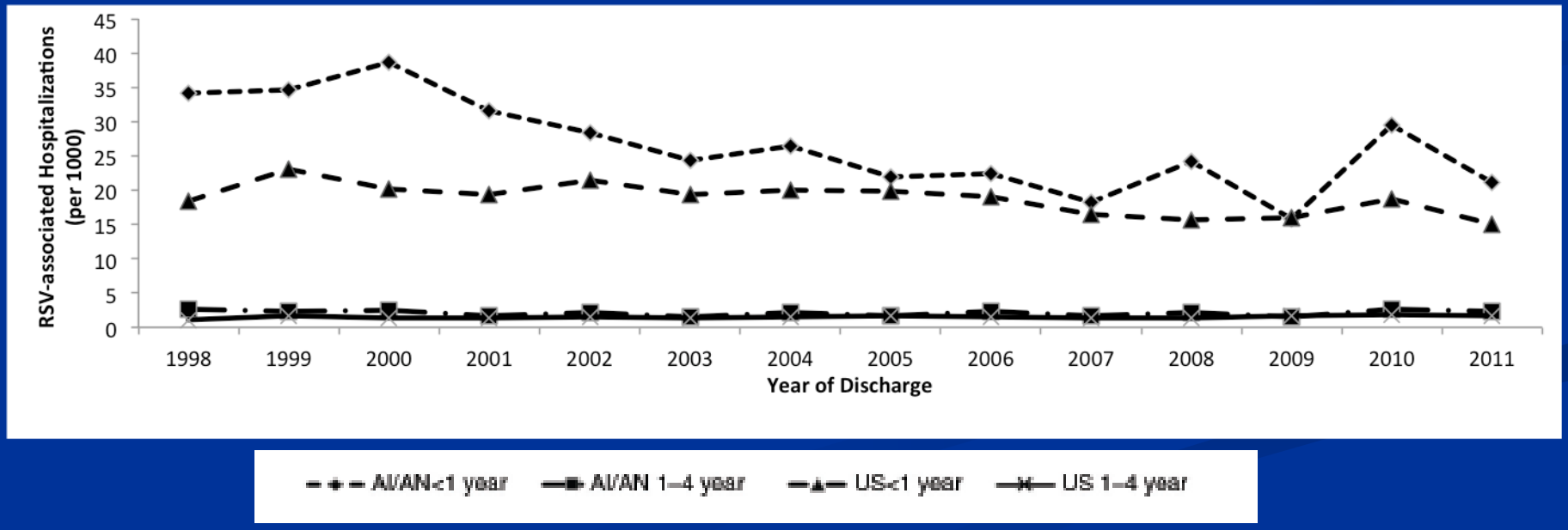
RSV Hospitalizations, AI/AN 1998-2011

Methods:

Analysis of 1998-2011 hospital discharge with RSV-related diagnosis.
AI/AN – Indian Health Service Direct/Contract Inpatient Dataset
U.S. – Nationwide Inpatient Sample

Results: 1998-99 to 2009-11

RSV-related hospitalizations declined 36% in AI/AN, 20% for US infants



Foote EM, Singleton RJ, Holman RC et al. Int J Circumpolar Health 2015;74:29256

Major Changes 2014 Redbook

- Palivizumab prophylaxis is recommended for infants born at less than 29 weeks gestation.
- Infants with chronic lung disease (CLD) qualify for prophylaxis only if they require supplemental oxygen for >28 days after birth.
- With rare exception (CLD meeting criteria), prophylaxis is not recommended during the second year of life.
- Monthly prophylaxis should be discontinued in any infant who experiences a breakthrough RSV hospitalization.
- Prophylaxis can be considered for <24 month old who are profoundly immunocompromised.

Redbook Statement on Alaska

Timing of Prophylaxis for Alaska Native/American Indian Infants.

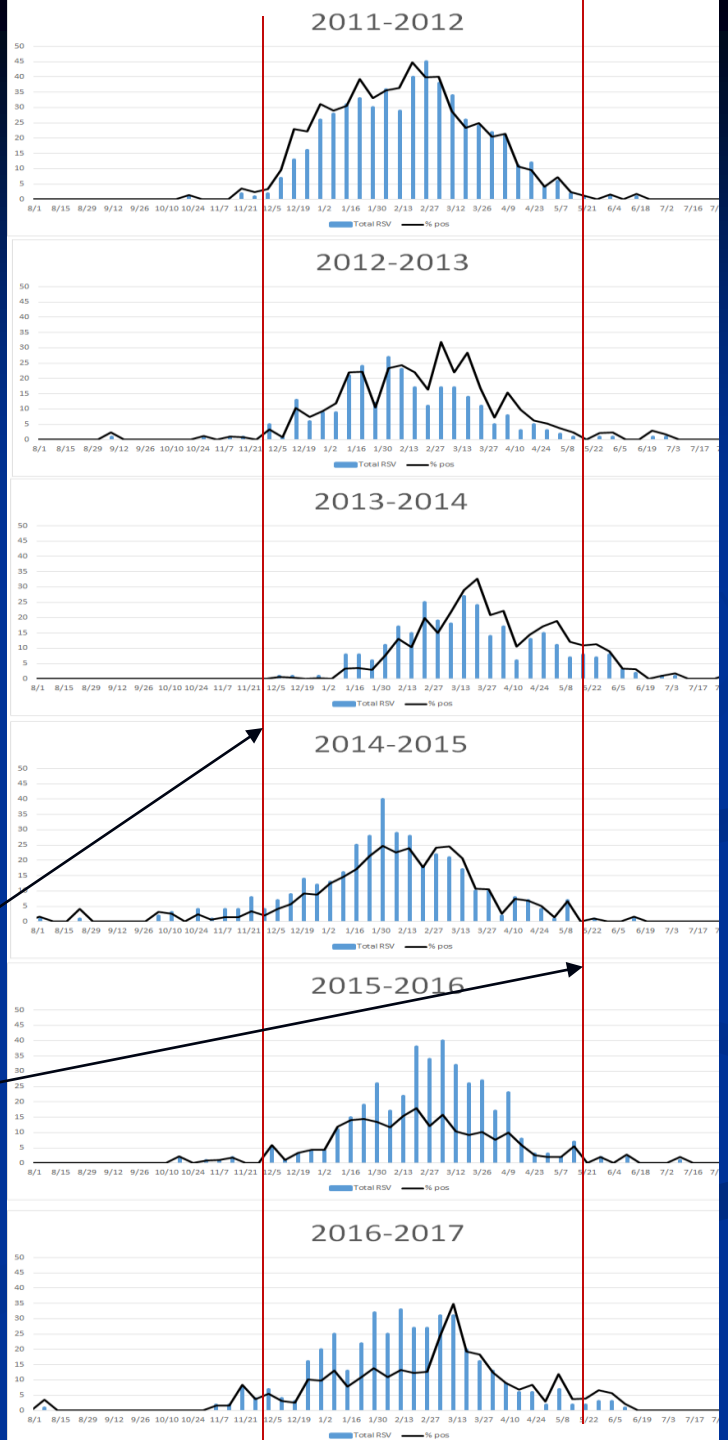
Alaska Native infants in southwestern Alaska experience higher RSV hospitalization rates and a longer RSV season. On the basis of epidemiology of RSV in Alaska, particularly in remote regions where the cost of emergency air transport may alter a cost analysis, the selection of infants eligible for prophylaxis may differ from the remainder of the United States. Clinicians may wish to use RSV laboratory surveillance data generated by the state of Alaska to assist in determining onset and end of the RSV season

for appropriate timing of palivizumab administration

We have an Alaska state-wide workgroup that meets annually to review RSV data and make recommendations

https://redbook.solutions.aap.org/chapter.aspx?sectionId=88187226&bookId=1484&resultClick=1

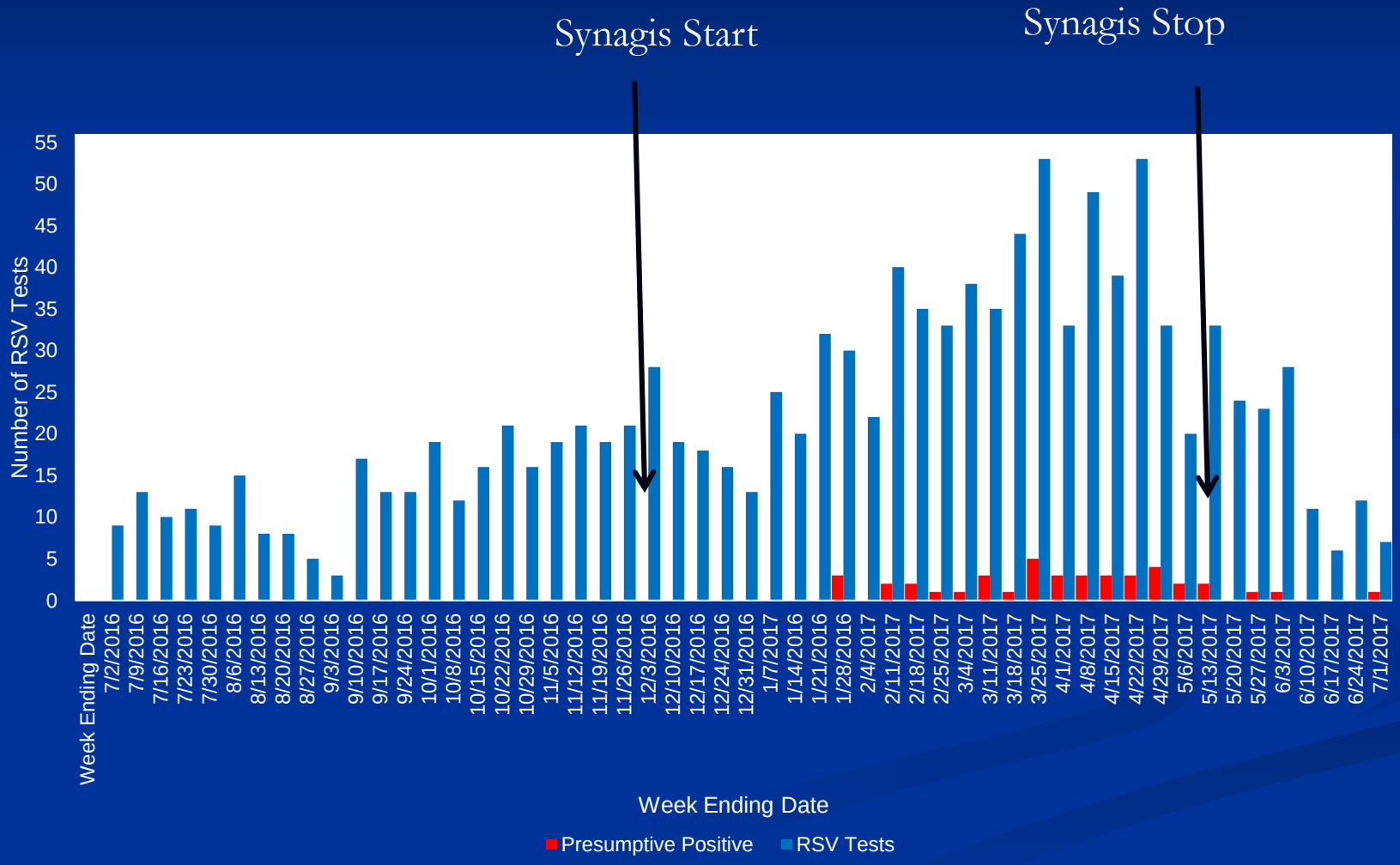
RSV positives, Alaska State Virology Laboratory, 2011-2017



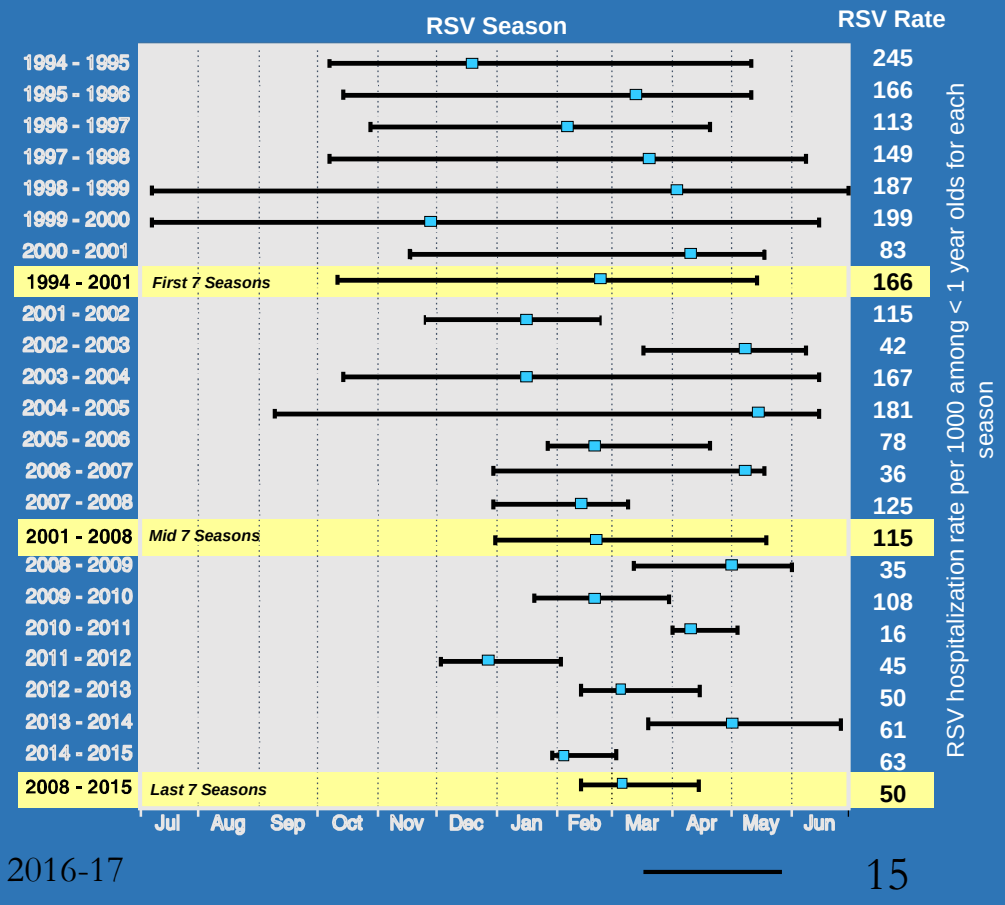
Synagis start

Synagis end

YKHC RSV tests 9/1/16-5/10/17



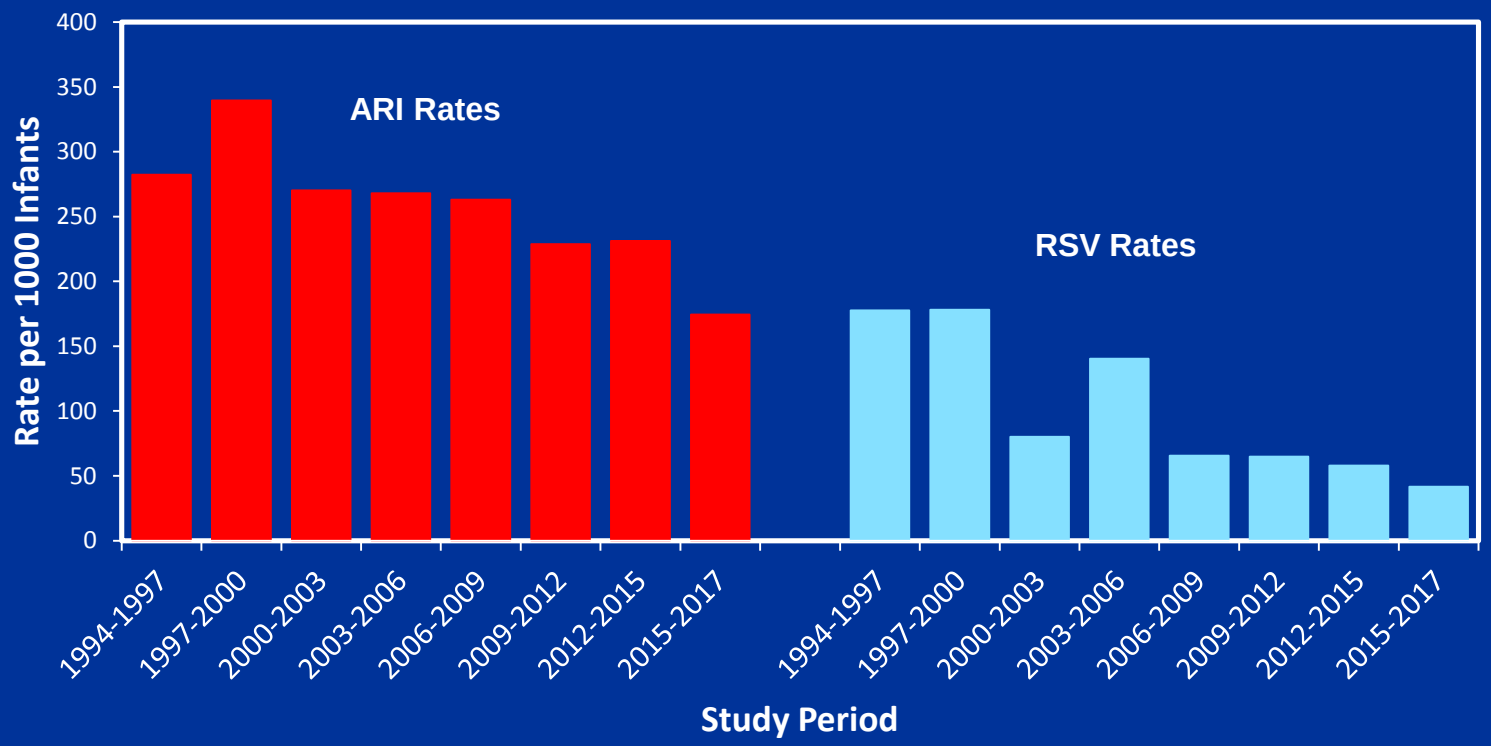
RSV season onset and offset and peak week during 21 years of RSV surveillance, YK Delta



2016-17 was the lowest incidence RSV season for YK infants

Mullins JA et al. Pediatr Infect Dis J, 2003;22:857-62

Acute Respiratory Infection (ARI) and RSV Hospitalization Rates, YK Delta, <1 year, 1994-2015



CDC, National Center for Emerging and Zoonotic Infectious Diseases. Arctic Investigations Program
Bruden et al, 18 years of RSV surveillance…PIDJ, 2015;34:945 and unpublished

RSV Seasonality: Summary

- There is considerable year-to-year and regional variation in RSV season.
- In 2016-17, there was low RSV activity in some regions.
- November 30 - May 15 appears to remain a good match for the RSV season.

Synagis
2017-18 AK Medicaid Authorization

Condition	Age	Max doses/season
Chronic Lung Disease	<24 months	5
Congenital Heart Disease	≤24 months	5
<29 wk gestation Premie	<12 months	5
29-<32 wk gestation Premie	<6 months	5
32-<35 wk gestation Premie with sib <5yr, daycare, no running water, ≥3 in bedroom or ≥ 7 in household	<3 months	3
Congenital airway/NeuroMusc. disease	<12 months	5

Synagis Season: November 27 through May 15. Maximum 5 doses.

http://dhss.alaska.gov/dph/Epi/id/Pages/dod/rsv/default.aspx

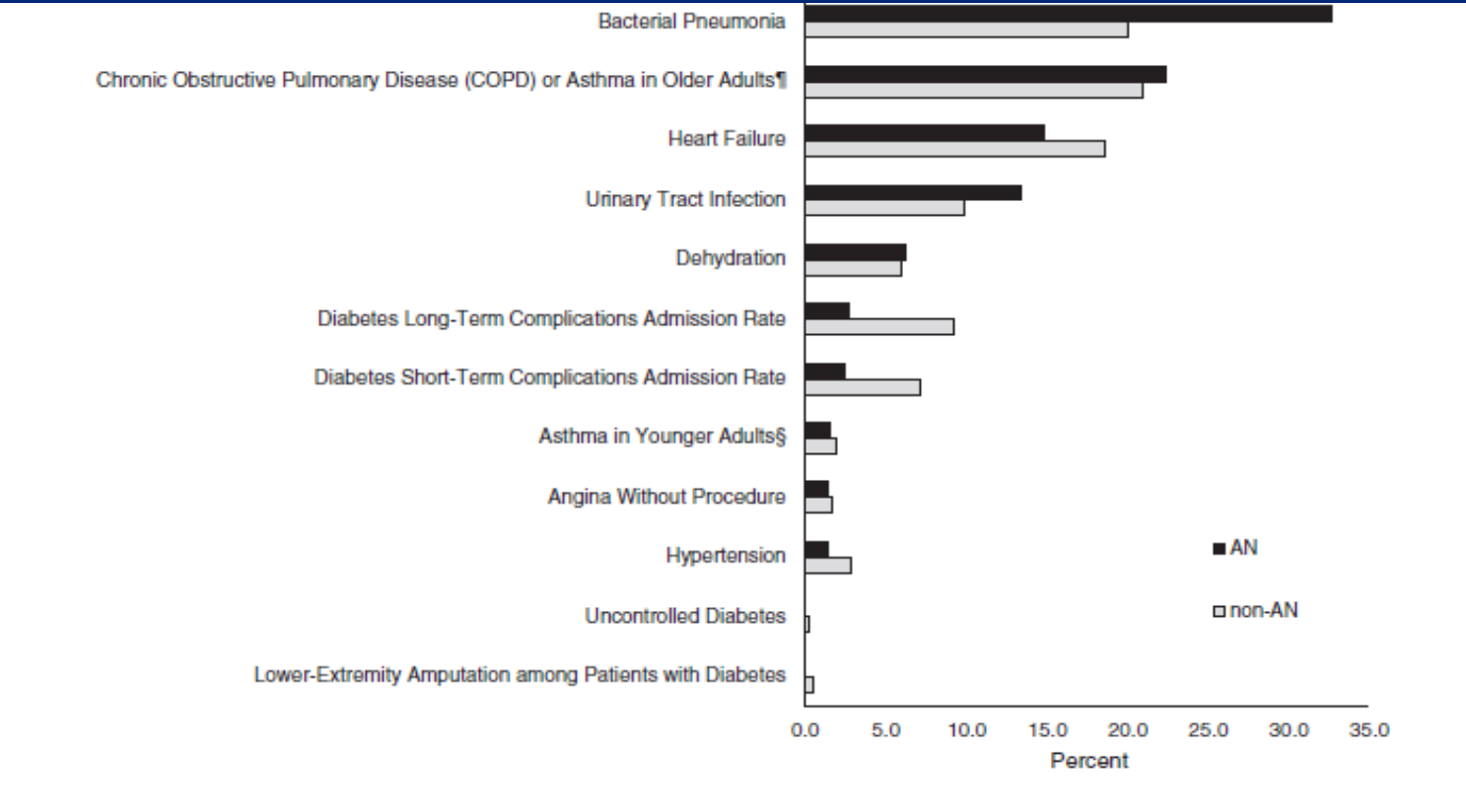
The Future: RSV vaccines

- **Infants**: RSV vaccines for infants not effective enough
- **Adults:** RSV vaccines may be effective - in late clinical trials
- **Potential adult RSV uses**:
  - Adults with high risk conditions: COPD, asthma, CHF, immunocompromise
  - Pregnant women – to protect their newborn infants
    - Maternal vaccination look promising - high maternal-infant transfer of RSV antibodies

RSV Epidemiology in Adults

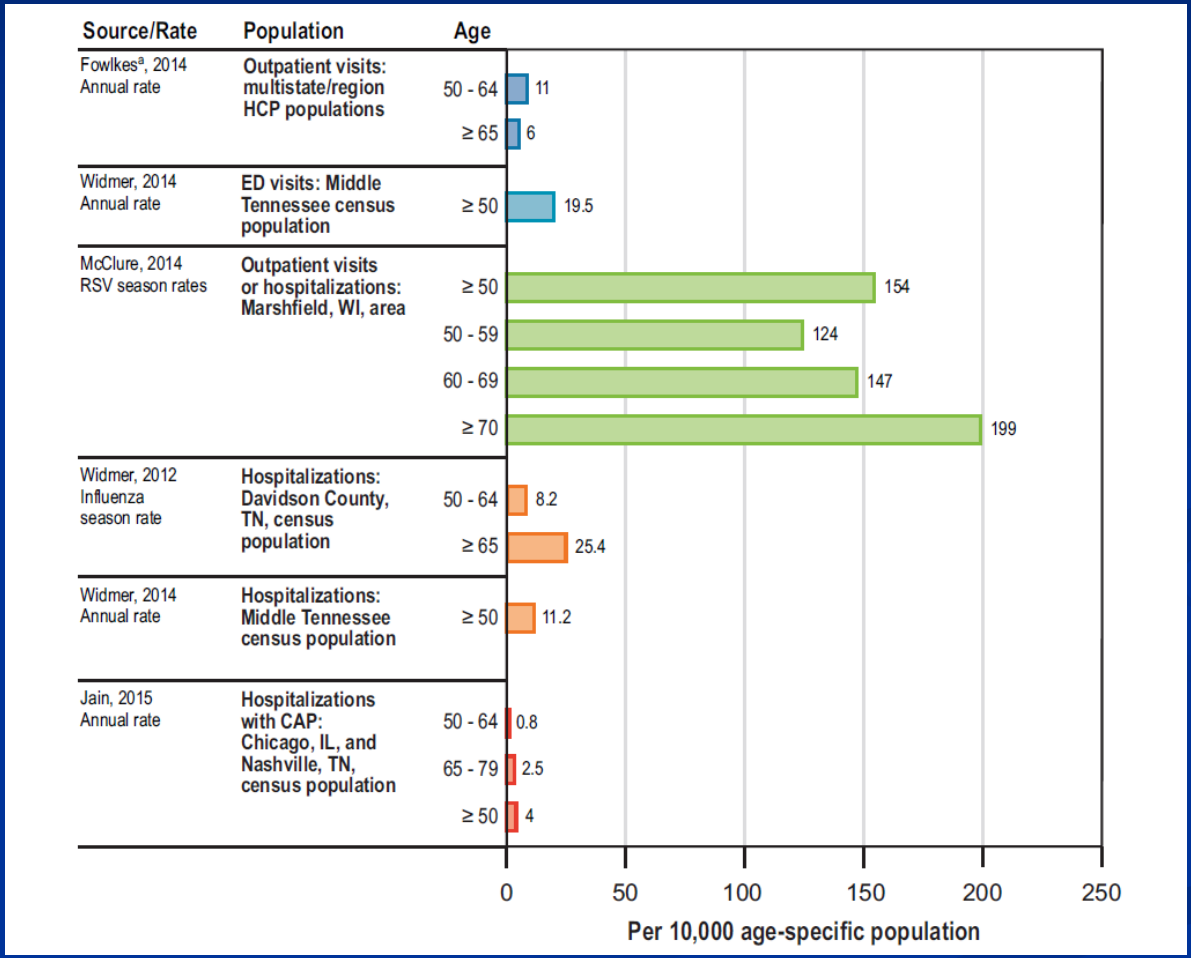
- U.S. adults
  - Annual attack rate 2-10%
  - Hospitalization rate similar to flu in one study
  - 10.6% of pneumonia hospitalizations, 11.4% COPD
- Alaska Native adults
  - **No data on RSV!**
  - Pneumonia/flu death rate twice that of other U.S. populations
  - Pneumonia and COPD most common causes of potentially preventable hospitalization in YK adults

Preventable hospitalizations, Alaska, 2010-12

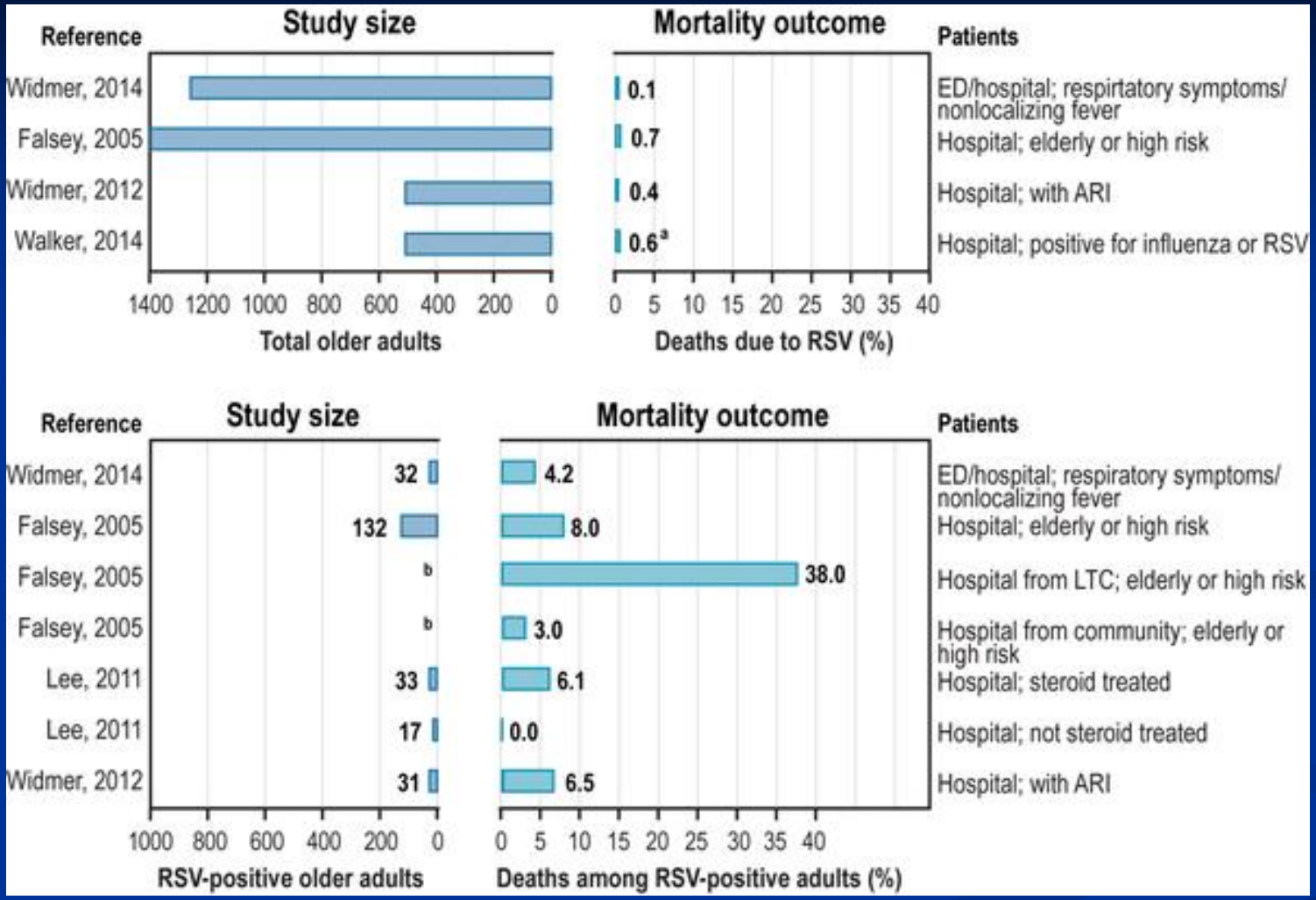


Gounder PP et al. Preventive Medicine Reports 2016, http://dx.doi.org/10.1016/j.pmedr.2016.03.017

Incidence of RSV medical visits



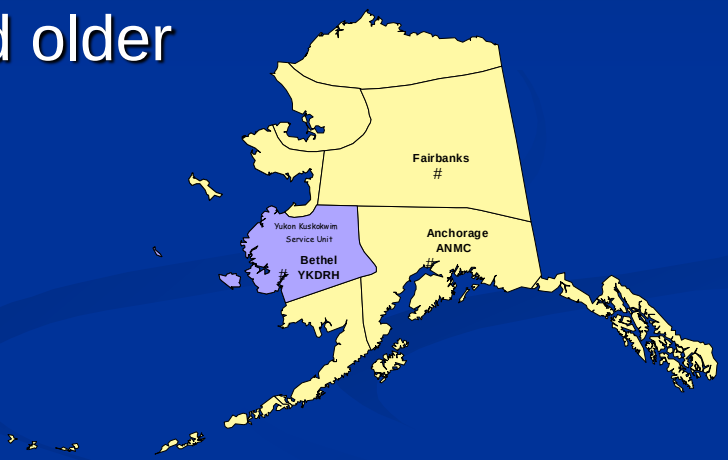
. Mortality due to RSV in older adults from special populations, by population and clinical setting.



Colosia AD. PLOS ONE 12(8): e0182321. https://doi.org/10.1371/journal.pone.0182321

YK Adult RSV Surveillance Study

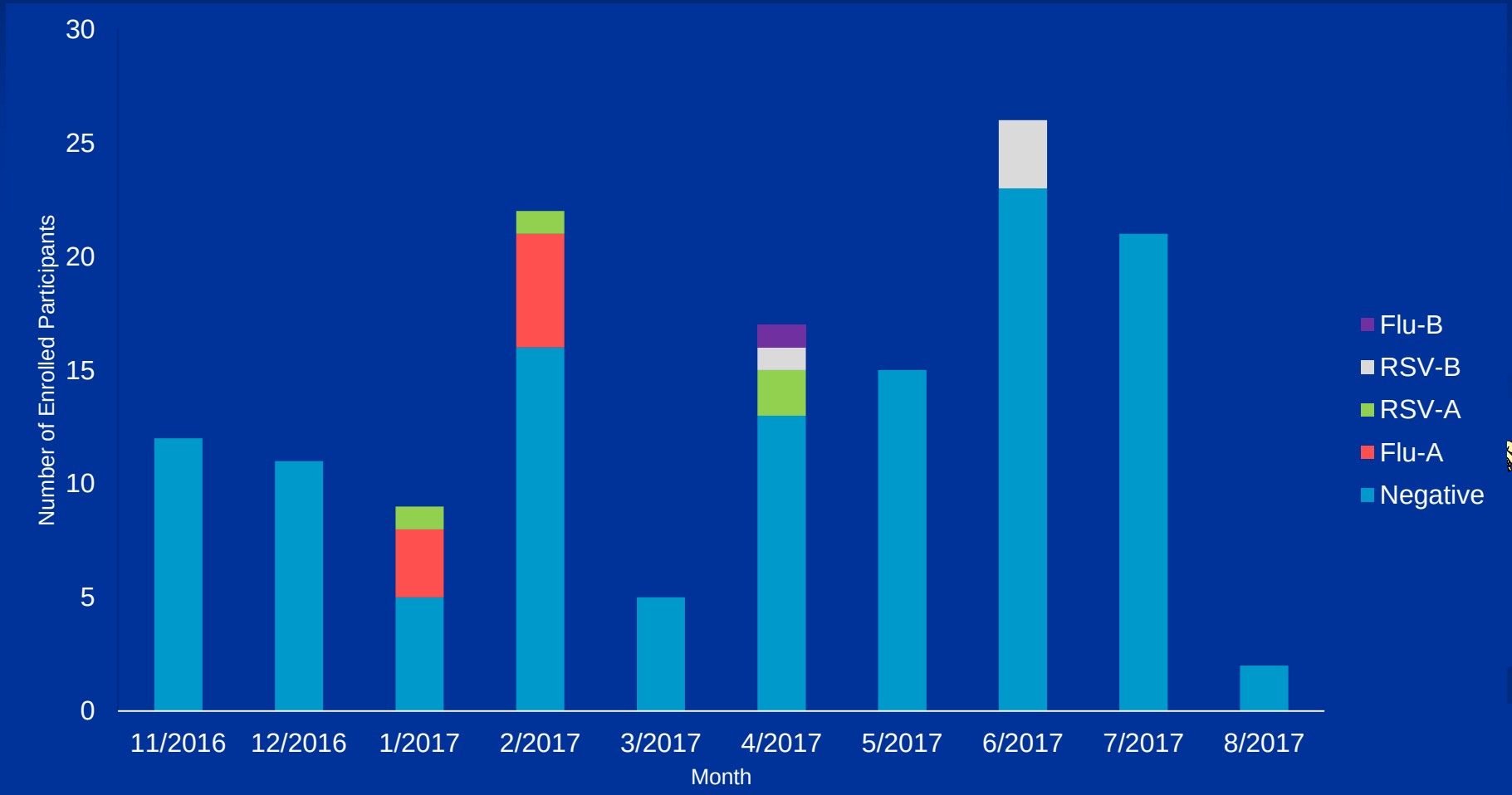
- **Active Surveillance:** NP swab on consenting adults hospitalized for respiratory illness, COPD, asthma, CHF
- **Population**: YK Adults 18 years and older
- **Time Period:** 11/2016-9/2018
- **Location**: YKDRH, ANMC
- **Tests**: PCR for RSV, Flu, hMPV
- **Investigators**: CDC Atlanta & AIP, UW, ANTHC, YKHC
- **Research staff**: Research nurse recruits



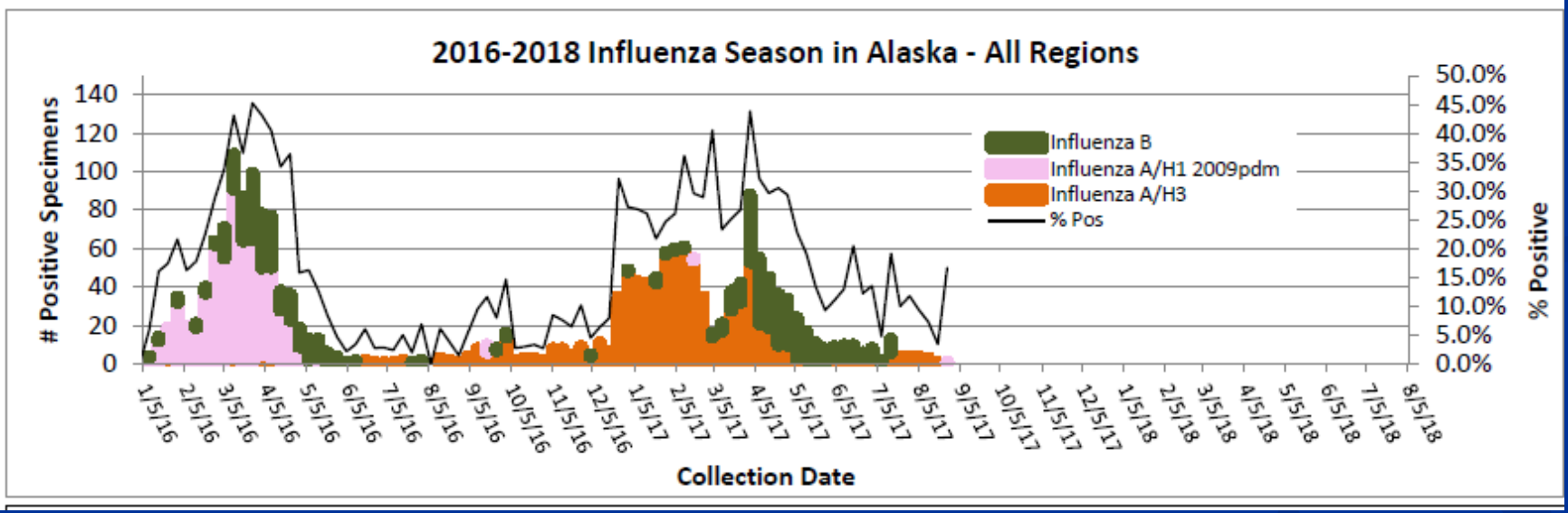
Study Aims

1. Burden of RSV in hospitalized adults
2. Transmission of RSV in households
3. Reinfection with RSV during same season
    - Reinfection or new virus?

YK Adult RSV Surveillance Study\ First Year Results



Influenza 2016-17



Week of Aug 21: Three of 40 samples tested were positive for influenza A--1 influenza A H1 2009, 1 influenza A/H3

Influenza Recommendations 2017-18

- LAIV (FluMist) not available because of low efficacy in 2013-14 and 2015-16
- Quadrivalent Flu vaccines:
  - Change in H1N1 to A/Michigan/45/2015 (H1N1)pdm09–like virus,
  - A/Hong Kong/4801/2014 (H3N2)–like virus
  - B/Brisbane/60/2008–like virus (Victoria lineage),
  - B/Phuket/3073/2013–like virus (Yamagata lineage).
- Flublok quadrivalent licensed
- FluLaval (IIV3) licensed ≥6 months at 0.5 ml (not from State)
- Afluria Tribalent licensed >5 y; Afluria Quad licensed >18 y
- Pregnant women can get any licensed flu vaccine

2017-18 Flu vaccines provided by State Immunization Program

- Pediatric Flu Vaccine
  - Sanofi Fluzone pre-filled syringe, 0.25ml, quadrivalent, 2-35 months
  - Sanofi Fluzone multi-dose vial, 5ml, quadrivalent, 6 months+
  - GSK Fluarix pre-filled syringe, 0.5ml, quadrivalent, 36 months+

- Adult Flu Vaccine
  - Sanofi Fluzone multi-dose vial, 5ml, quadrivalent, 6 months+
  - GSK Fluarix pre-filled syringe, 0.5ml, quadrivalent, 36 months+
  - Sanofi Fluzone High-Dose pre-filled syringe, 0.5ml, trivalent, 65yr+

The Healthy Homes Study

Partnering with:

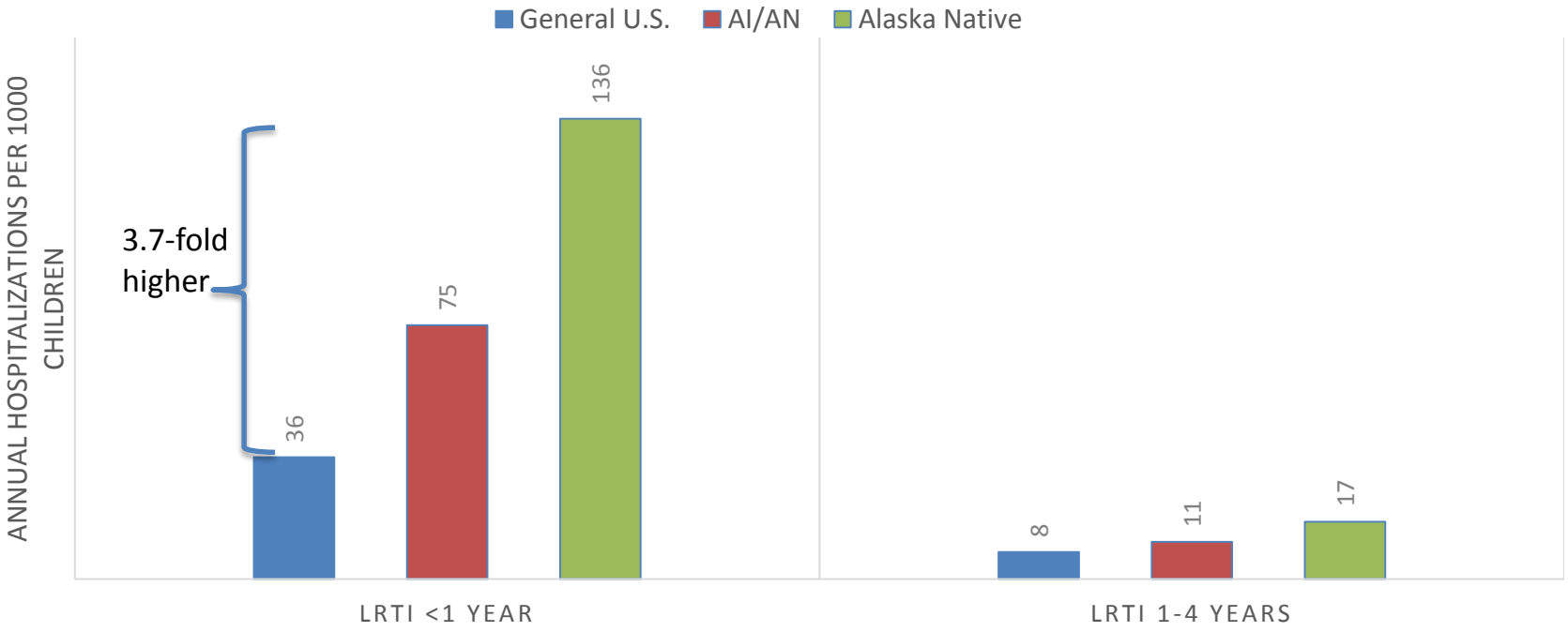
ANTHC Div. Environmental Health &Engineering

ANTHC Community Health and Environment

YKHC and BBAHC Office of Environmental Health

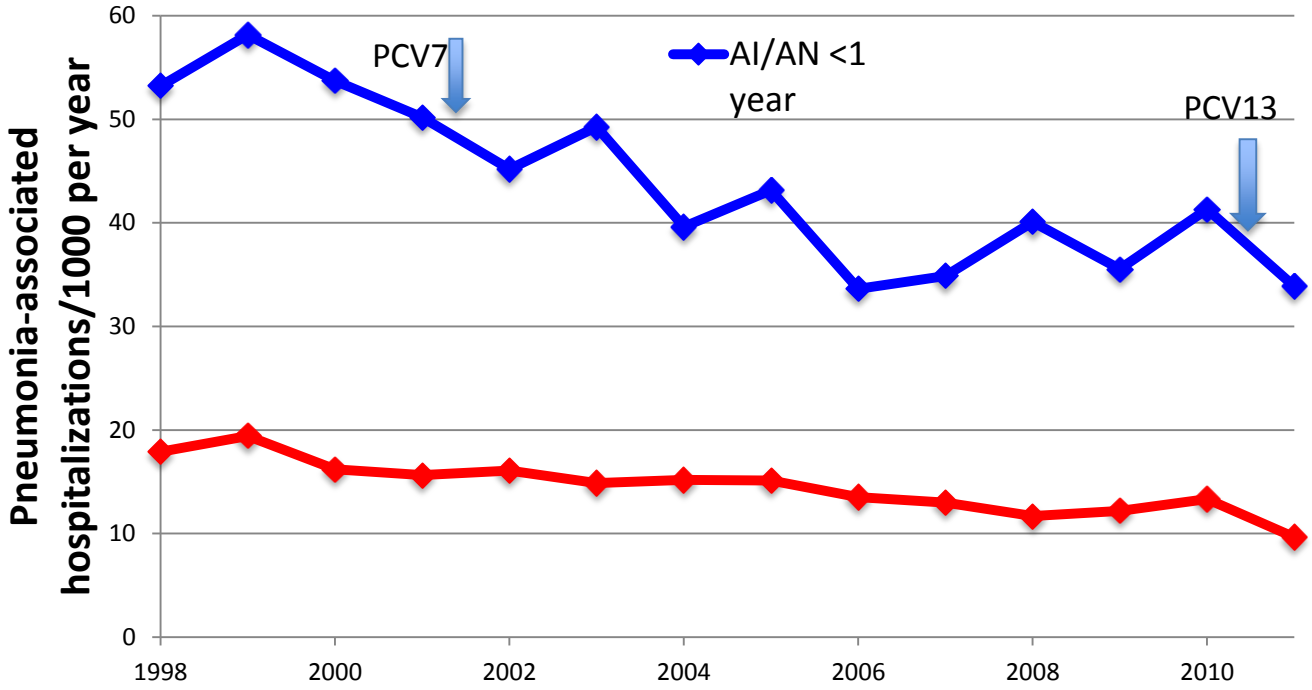
AVCP Village Housing

Lower Respiratory Tract Infection Hospitalization Rates; general US vs. American Indian/Alaska Native vs. Alaska Native, 2009-2011



ALASKA NATIVE TRIBAL HEALTH CONSORTIUM

Pneumonia-associated hospitalizations in AI/AN and US infants, 1998-2011



Pneumonia rates are decreasing but >2.5 fold higher than the general U.S..
Rates for YK infants are 10-fold higher than for U.S.

Foote E, et al. Int J Circumpolar Health, 2016

ALASKA NATIVE TRIBAL HEALTH CONSORTIUM

LRTI in Indigenous Canadian, Australian, New Zealand Children

Australia

- Despite Australia being one of the wealthiest countries, Australian Indigenous children have a health status comparable to developing countries.
- Indigenous infants have 10 times the mortality rate for respiratory conditions.
- The LRTI rate in Australian Indigenous children is as high as that of children in developing countries, triple that of non-Indigenous Australian infants (201.7 vs. 62.6/1000, respectively).

O'Grady KA. J Paediatr Child Health 2010;46:461-465

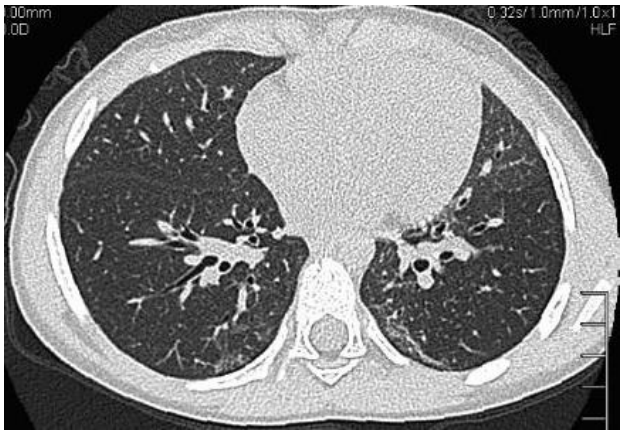
Canadian Arctic

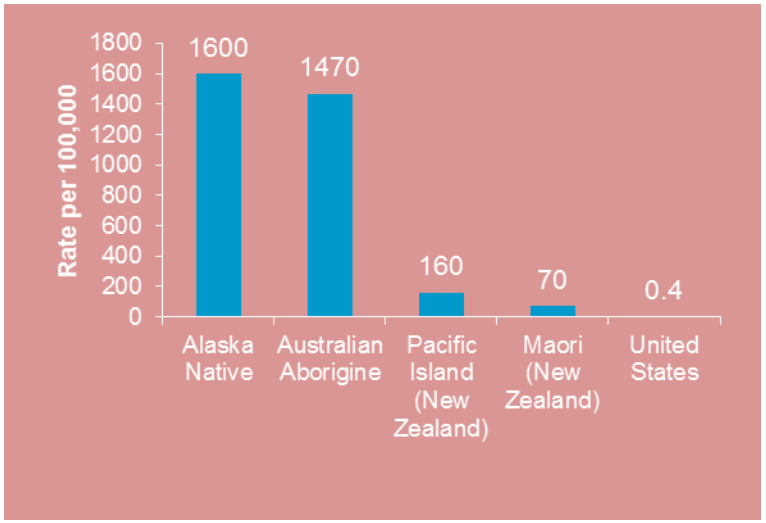
- LRTI rates varied: 39/1000 NW Territories to 456/1000 Nunavik
- LRTI rates in Nunavik/Nunavut are 10x rest of Canada and some of the highest worldwide

Banerji A. CMAJ Open. 2016. DOI:10.9778/cmajo.20150051; Dallaire (2006) Canadian J Public Health 97:62-369

Long Term Effects of Pneumonia

- **Chronic Suppurative Lung Disease/Bronchiectasis**
  - Airway damage leads to loss of elasticity ("ectasia") of bronchi
  - Chronic Wet Cough ➡ CSLD ➡ Bronchiectasis
  - 1:63 Y.K. children w/ bronchiectasis vs. 1:2,000 U.S. children w/ CF





- **Decreased lung function and COPD in Adulthood**
  - Adults with childhood pneumonia have decreased lung function

Indoor Environment Matters!

- Household crowding
- Tobacco Smoke
- Wood-burning
- Chemicals – fuel, fixing engines
- No in-home running water
- Poor ventilation

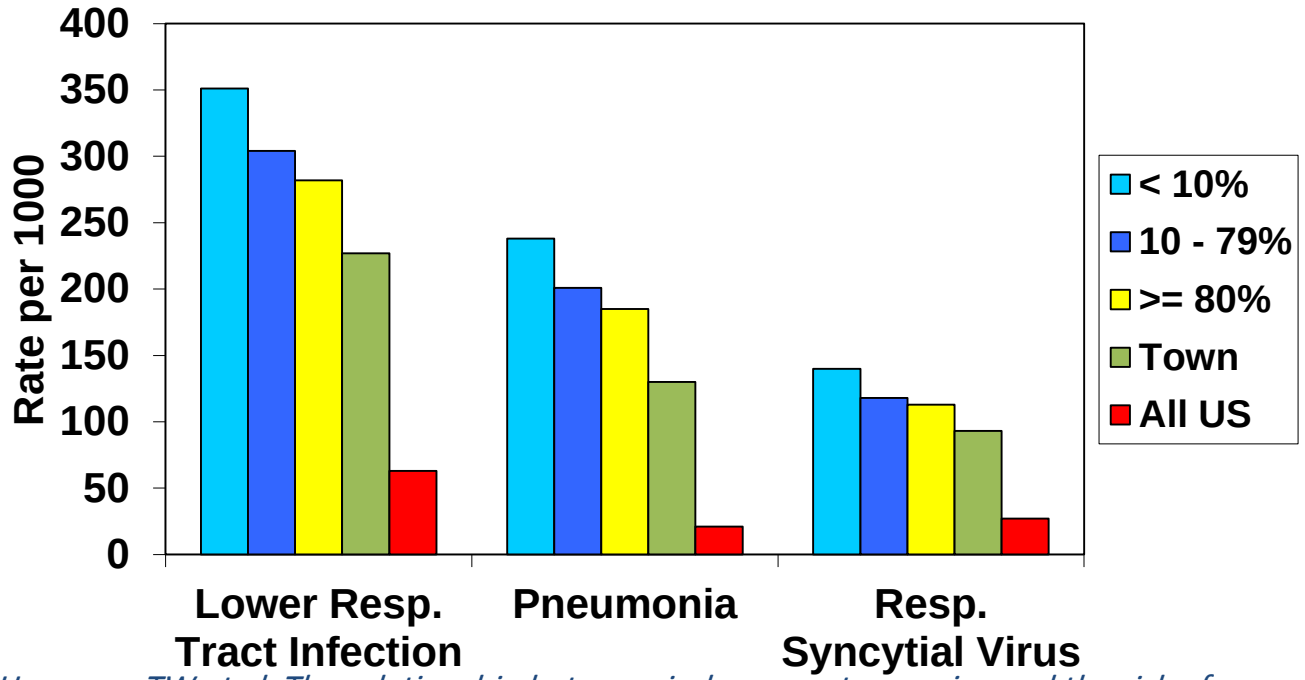
Rural Alaska houses are small, crowded, use woodstoves.

Risk Factors for LRTI and RSV Hospitalizations, Alaska Native children

- Medical conditions (premie, heart disease, chronic lung disease)
- Absence of breastfeeding
- Household crowding
- No piped water; <2 rooms with sinks
- Woodstove in the house
- Vomiting after feeding
- Low income

Bulkow LR et al. Risk factors for severe RSV infection among Alaska native children. Pediatrics 2002
Bulkow LR et al. Risk Factors for Hospitalization With LRTIs in Children in Rural Alaska. Pediatrics 2012
Bruden et al, 18 years of RSV Surveillance. Ped Infect Dis J, 2015.

Hospitalization rate among infants by percentage of rural Alaska village homes with water service, 1999–2004



Hennessy TW et al. The relationship between in-home water service and the risk of respiratory tract, …. infections among rural Alaska Natives. AJPH 2008.

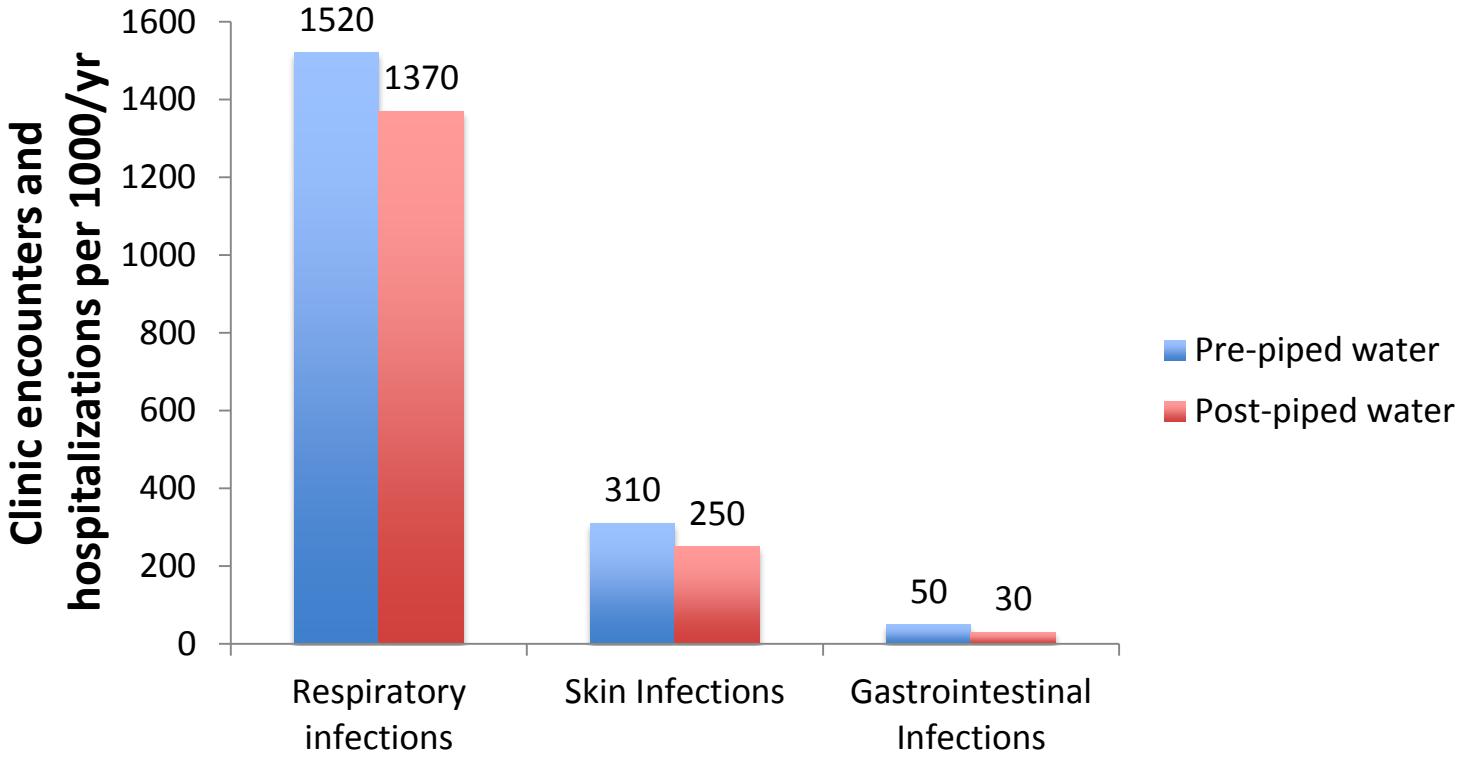
Invasive Pneumococcal Disease rates, Children <5 years, YK Delta, 2001-2007, by water service and socioeconomic factors

Socioeconomic Factor	Socioeconomic Level	IPD Rate (Cases/100,000 per Year)	Univariate *P*
Water service	<10%*	390.9	0.008
	10%–80%*	262.9	
	80%+*	146.7	
Income per person	<$6000 per year	286.3	0.71
	≥$6000	256.6	
Median family income	<$32,000 per year	302.6	0.33
	≥$32,000	232.4	
Household size	≥5 persons	345.0	0.06
	<5 persons	199.2	

*Of homes served with running water.

Wenger JD et al. Invasive pneumococcal disease in Alaskan children. Pediatr Infect Dis J 2009

Rates of infectious disease in 4 rural Alaska villages 3 years before and after introduction of water service adjusted for age



Thomas T. Impact of In-home Water Service on the Rates of Infectious Diseases. In: The 20th IEA World Congress of Epidemiology 2014.

Indoor Air Pollution:
Navajo and Alaska Native Children

- Any wood burning stove in the home increased odds of childhood lower respiratory tract infection (LRTI) by 4.9 times in Navajo children
- Household particulate matter concentration >65 µg/m^3 resulted in an increase of odds of LRTI by 7 times in Navajo children
- Risk Factors for LRTI hospitalizations in rural Alaska included household crowding and woodstove use.

Robin LF et al. Wood-burning stoves and lower respiratory illness in Navajo children. Pediatr Infect Dis J 1996.
Morris K, et al. Wood-burning stoves and LRTI in American Indian children. Am J Dis Child 1990.
Bulkow LR et al. Risk Factors for Hospitalization With LRTIs in Children in Rural Alaska. Pediatrics 2012

Tobacco smoke exposure in AI/AN children

- 21% AI/AN prenatal exposure vs. 9-17% for general US population
- 75% AI/AN children exposed to passive tobacco smoke vs. 40% for general US population
- 21-38% of AI/AN youth smoke tobacco vs. 23% for general US youth

Redding GJ et al. Chronic respiratory symptoms .. among indigenous children. Pediatric Clinics of North America 2009.
MMWR September 2010

It started with a call from lung specialist, Dr. Madhani, to Environmental Health Specialist, Troy Ritter.

I think household air problems are making my COPD patients sicker

Woodstoves could be one possible source. We'll look into this.

The Healthy Homes Study

Partners

- Alaska Native Tribal Health Consortium (lead)
- Yukon Kuskokwim Health Corporation
- Bristol Bay Area Health Corporation
- Arctic Investigations Program - CDC

Goal

- See if home improvements can reduce pollutants and improve health in children with lung disease

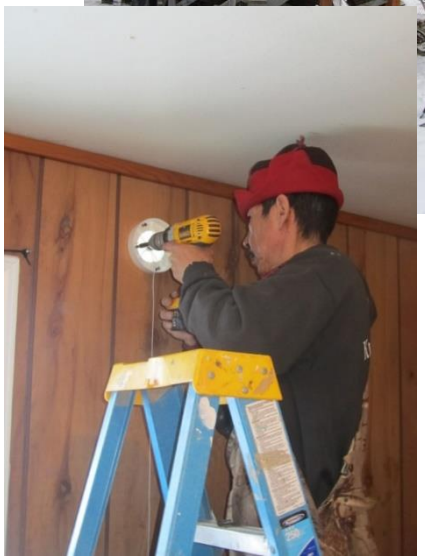
AJ Salkoski,
Environmental specialist

Methods

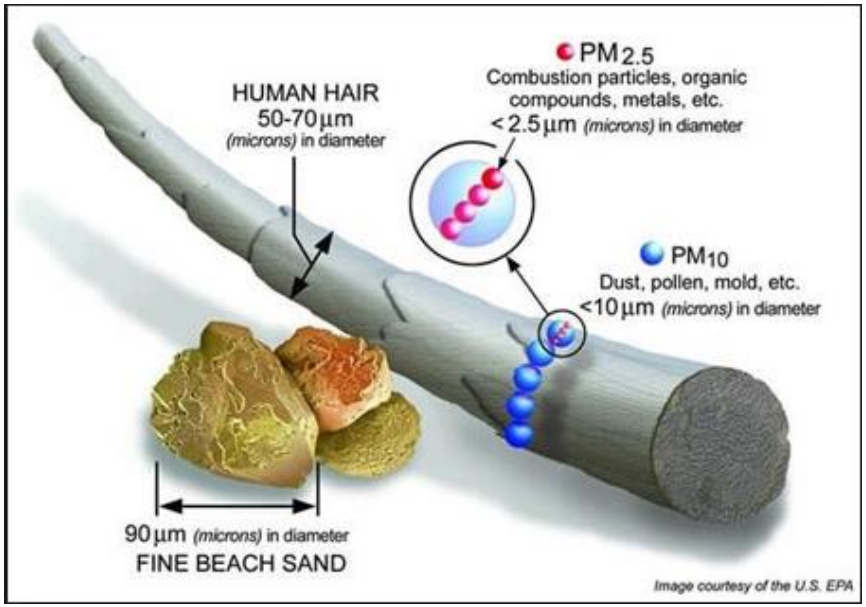
- Identify homes of children with lung problems
- Informed Consent
- Assess homes for indoor air quality
- Simple home renovations (woodstove changeout, vents, range hoods etc.) and education
- Check indoor air quality (PM2.5, VOC, CO2) and lung symptoms before and after

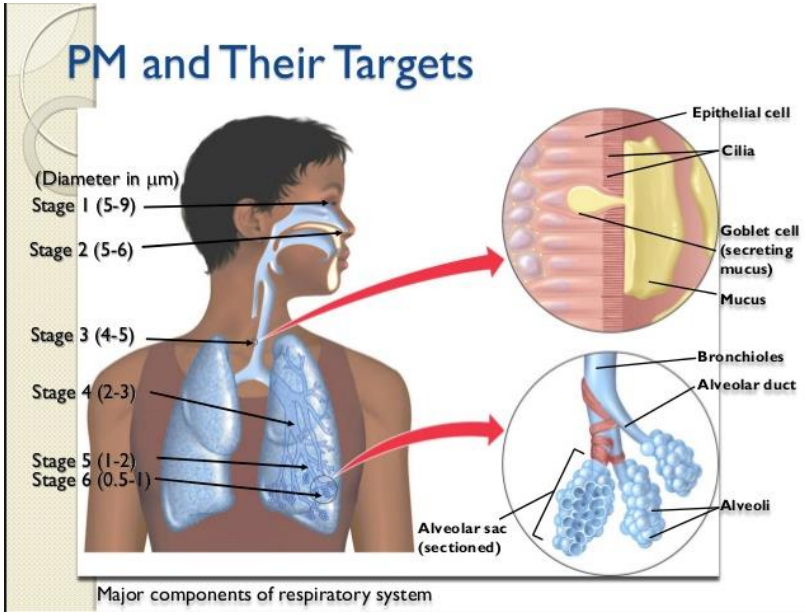
Methods

- Choose YKHC and BBAHC communities
- Eligible homes with child who has chronic lung problems
- Environmental Health and Housing Authority staff assess home:
  - Inadequate ventilation, leaky woodstove, moisture problems
  - Identify contaminants
  - Other factors (e.g., smoking, fuel storage inside home)
- The resident, housing and environmental health personnel decide scope of work
- Air sampling and household education
- Housing personnel complete modifications



Indoor air pollutants: PM2.5





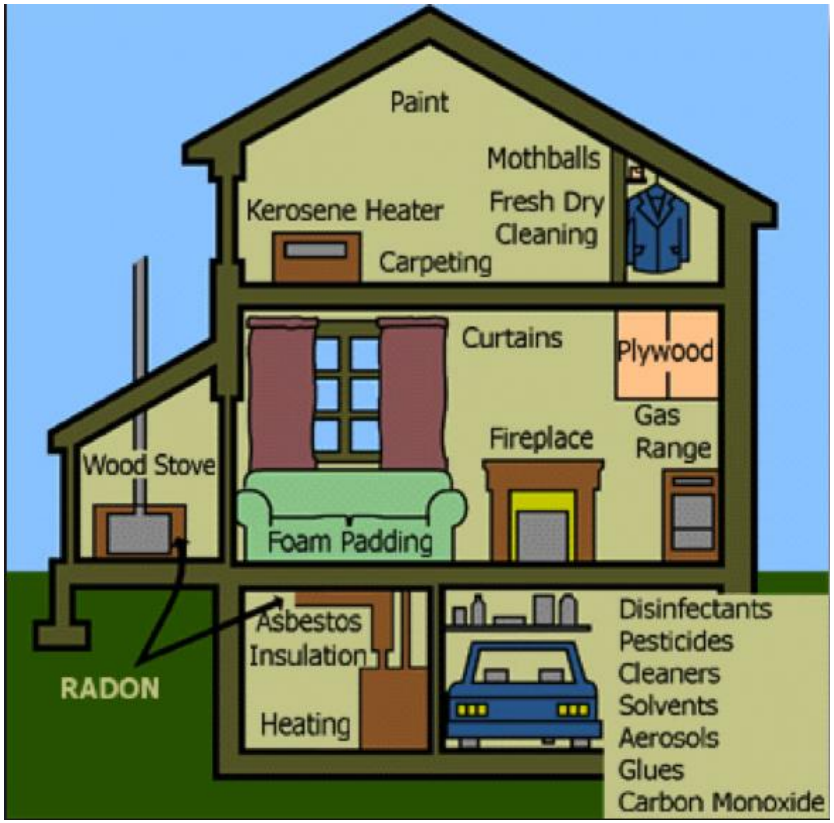
PM2.5 gets into the lungs!

https://www.slideshare.net/faizanmohdiitb/air-pollution-and-smog

Volatile Organic Compounds

Chemicals containing carbon which easily become vapors

Household products, including:
paints, paint strippers & solvents
wood preservatives
aerosol sprays
cleansers and disinfectants
moth repellents and air fresheners
stored fuels and automotive products
hobby supplies
dry-cleaned clothing
pesticide

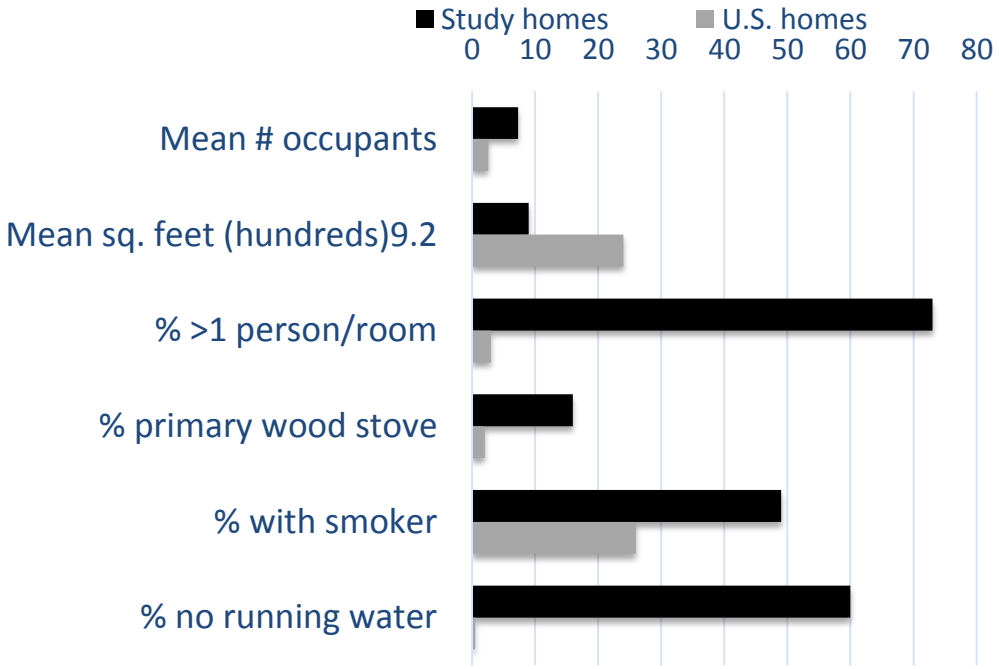


Home Assessment and Remediation

- ANTHC, YKHC-OEH, and Tribal Housing Authority Staff, walk through each home to assess potential air quality issues
  - Inadequate ventilation, leaky woodstove, moisture problems
- The resident, housing personnel, regional health organization staff, and ANTHC personnel determine a scope of work for each home to remediate indoor air quality issues
- Tribal Housing Authority staff complete household remediation
  - Replace woodstoves, install range exhausts, improve ventilation, replace furnaces

How did study houses compare with general U.S. houses?

Housing	Study houses	U.S. houses
Mean # occupants	7.3	2.6
Median sq. feet	920	2,465
% >1 person/room	73%	3%
% with woodstove primary heat	16%	2%
% w/ smokers	49%	26%
% no running water	60%	0.5%



Singleton R, Salkoski AJ, Bulkow L, Fish C, Dobson J, Albertsson L et al. Indoor Air 2017 Mar;27(2):478-486.

New and/or Improved Vents

Ventilation intake plugged with a rag

New ventilation intake

Cooking Stove Exhaust Installed

Cooking stove with no range exhaust

New range exhaust

Cooking Stove Exhaust Installed

Cooking stove with no range exhaust

New range exhaust

Results: Home Assessments and Remediation

- 63 homes were assessed. 60 homes completed interventions

- Remediation in homes included:
  - Ventilation improvements (Fresh 80 vents, Range hoods, Bathroom fans) - 59 homes (98%)
  - Woodstove replacement – 28 homes (47%)
  - New oil-fueled furnace (Toyo stoves) – 14 homes (23%)
  - Moisture abatement 6 (10%)

Healthy Homes Study: Baseline findings

- **Indoor Air Quality**
  - High Volatile Organic Compounds (VOCs) and Particulates (PM2.5)

- **Respiratory symptoms in study household children**
  - high rates of cough between colds, hospitalization for lung infections, history of pneumonia, and wheezing in all household children.

- **Household factors and child symptoms**

VOCs
Primary wood heat
PM2.5

Cough between colds

VOCs

Wheeze between colds
Asthma diagnosis

Household factors contributing to indoor air pollution

Household smoking	PM2.5
Woodstove use	PM2.5, BTEX
# persons in house	PM2.5, BTEX, VOC, CO_2, Relative Humidity
No Piped water	BTEX, VOC, CO_2

Healthy Homes Study Results

AFTER HOME IMPROVEMENT

- Decreased parent-reported symptoms in children
  - ⬇ colds or runny nose
  - ⬇ cough between cold
  - ⬇ wet cough
  - ⬇ wheezing with cold
  - ⬇ need for inhaler of nebulizer

- Decreased parent-reported missed school
- Decreased visits for lung infections in high risk children

Next Step…..

Environmental Health Hospital Consultation Study

Years: 2016-2019

Organizations: ANTHC, SCF, YKHC, Maniilaq, BBAHC

Objectives: Pilot project to test feasibility of hospital-based ANMC environmental consults
Methods: Environmental health specialists does consult with caregivers of inpatient children hospitalized with respiratory illness

- Provide education on home environment, best burn practices, cleaning, water mitigation etc.
- Mail Indoor Air "Toolkit" – CO monitor, wood moisture tester, cleaning supplies etc.
- Village Housing referrals – to fix woodstoves, improve ventilation, fix furnace etc.

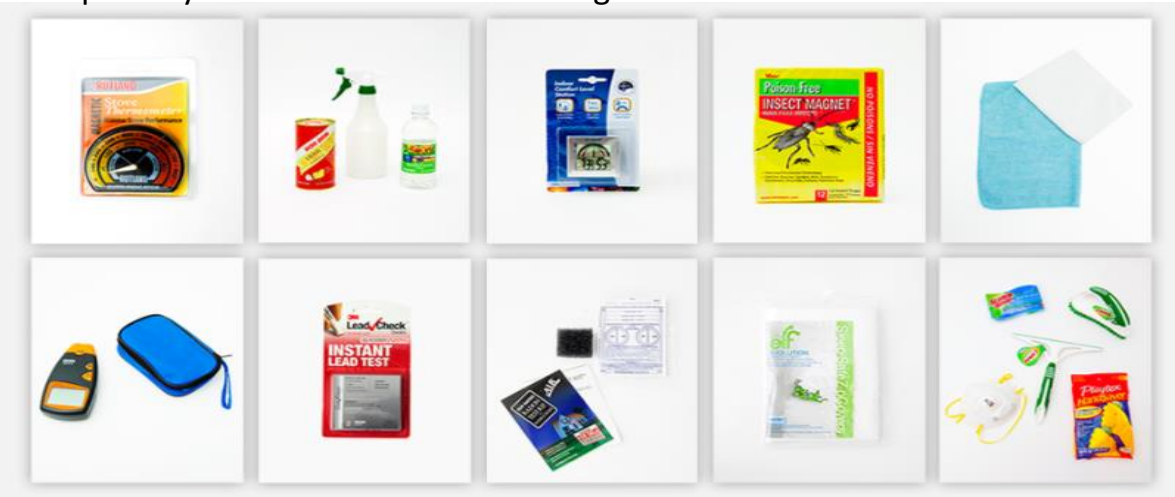
Questions?

1. Is it feasible to provide environmental health consults as a regular hospital service?
2. Do consults change caregiver behaviors. Do houses receive the remediation?

AIR MATTERS Toolkit

Developed by Tribal Healthy Homes Network

The Air Matters toolkit is comprised of items meant to promote health and safety in the home. The items either measure or control contaminants and encourage behaviors, like burning dry wood and controlling moisture, that will hopefully result in a healthier home environment for all and lower respiratory infections for children living in rural communities.



Includes:

- Chimney thermometer
- Green cleaning kit/ surface mold removal kit (Bon Ami cleaner, spray bottle, sponge, scrub brush, squeegee, N95 mask, and a microfiber cloth)
- Hygrometer
- Non-toxic pest trap
- Digital wood moisture meter
- Instant lead test kit
- Radon gas detection kit
- Allergen free pillowcase
- Carbon monoxide detector
- Cue cards

Screenshot from Tribal Healthy Homes Network website

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