HOUSING CHARACTERISTICS AND INDOOR AIR QUALITY IN HOUSEHOLDS OF AN CHILDREN WITH CHRONIC LUNG CONDITIONS

Arctic Health Sciences Seminar
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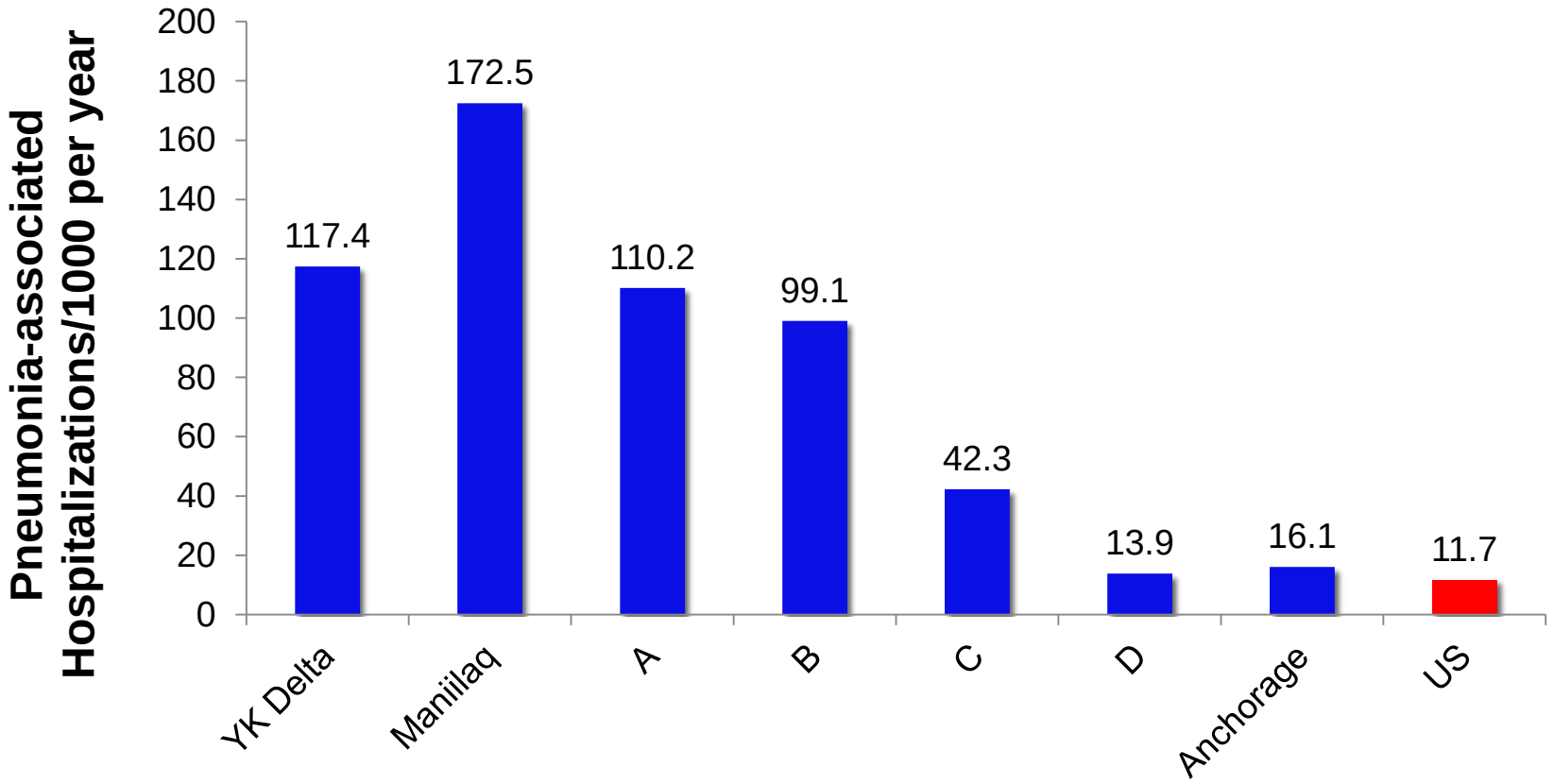
Pneumonia hospitalizations, Alaska Native infants, by region, 2009-2011



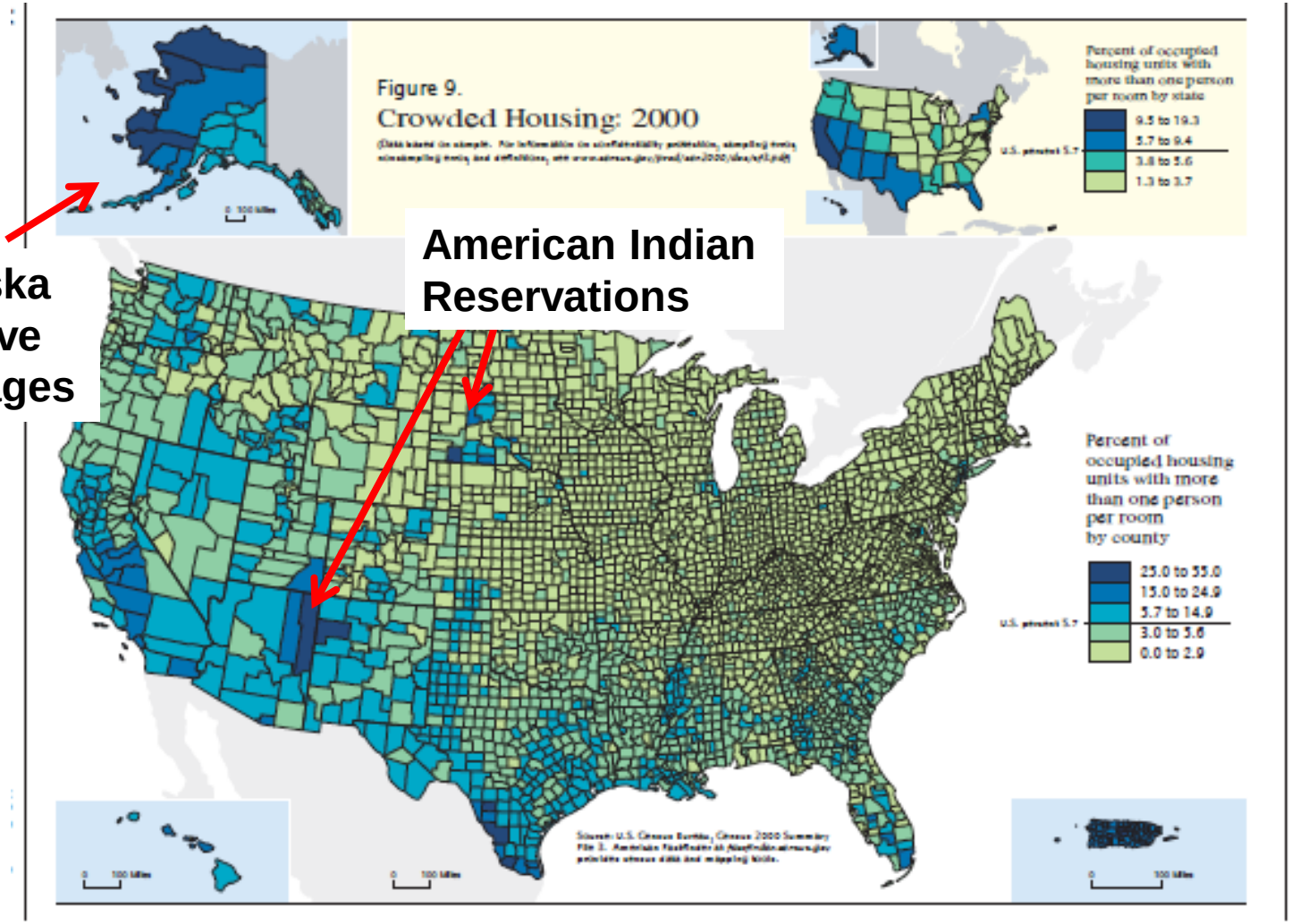
Foote et al., Alaska Native Research Conference, 2014

Risk Factors for LRTI and RSV Hospitalizations, Alaska Native children

- Medically high-risk (premie, congenital heart disease, or chronic lung disease)
- Absence of breastfeeding
- Household crowding
- <2 rooms with sinks
- No piped water
- Woodstove in the house
- Vomiting after feeding
- Low income

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

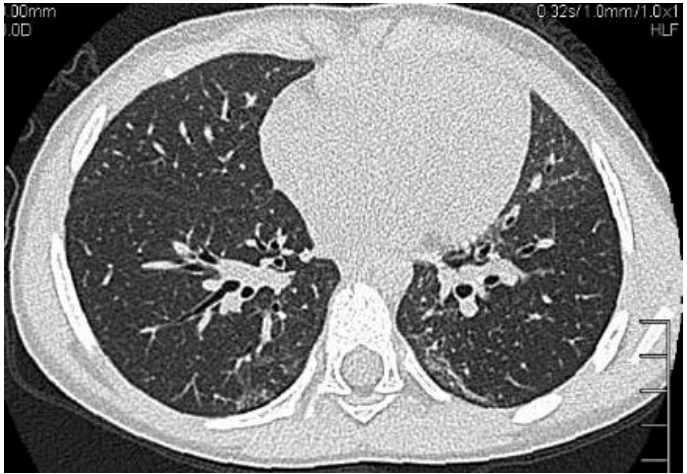
Household Crowding in the U.S. 2000 Census Data



Structural and Occupancy Characteristics of Housing: 2000. Census 2000 brief. US Census Bureau,

Long Term Effects of Pneumonia

- **Chronic Suppurative Lung Disease/Bronchiectasis**
  - Airway damage leads to loss of elasticity (“ectasia”) of bronchi
  - Classic symptom is **“Chronic Wet Cough”**
  - Progress: Protracted bronchitis ➡chronic suppurative lung disease ➡ CT scan confirmed Bronchiectasis
  - 1:63 YK children had bronchiectasis vs. 1:2,000 U.S. children w/ CF
- **Decreased lung function and COPD in Adulthood**
  - Adults with childhood pneumonia had lower FEV1 than others



Partnering with:
ANTHC Div. Environmental Health &Engineering
ANTHC Community Health and Environment

Improving the Respiratory Health of Alaska Native People through Home-based Interventions: The Healthy Homes Study

Background

- Alaska Native children have high rates of pneumonia and bronchiolitis hospitalizations and chronic lung disease/

Methods

- Evaluate the impact of simple home renovations and education on improving respiratory symptoms
- Measure indoor air quality, respiratory visits, and respiratory symptoms before and after interventions

Institutions:

- ANTHC DEHE
- AIP- CDC
- YKHC
- BBAHC

Investigators:

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- Troy Ritter REHS, MPH
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- Lisa Bulkow MS
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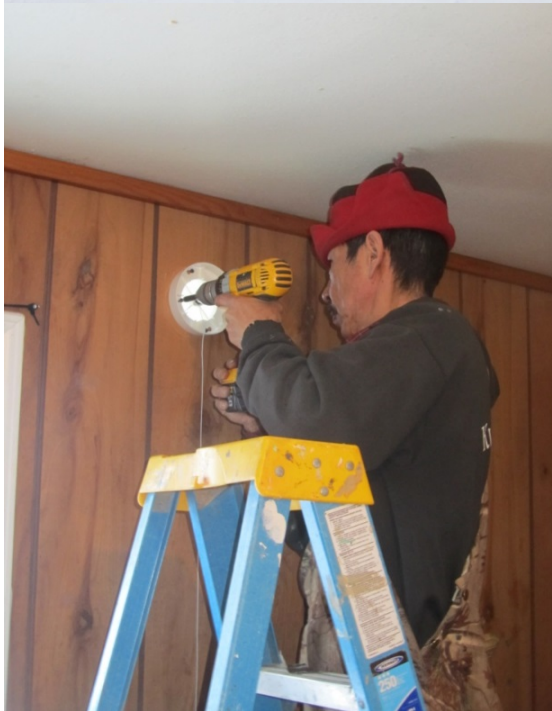
Status: Finished study activities. Manuscript with baseline data.

Methods

- Choose YKHC and BBAHC communities
- Choose eligible homes with child who has chronic lung problems
- ANTHC, Regional Health Corporation Staff, & Housing Authority Staff assess home:
  - Inadequate ventilation, leaky woodstove, moisture problems
  - Identify contaminants and risky behaviors
- The resident, housing and environmental health personnel decide scope of work
- ANTHC Environmental Health does air sampling and household education
- Housing Personnel complete modifications



New and/or Improved Vents

Ventilation intake plugged with a rag

New ventilation intake

Woodstove Replacement

Old woodstove

New EPA-certified, low-emission woodstove

How do study houses compare with other U.S. homes?

Housing	Study houses	US 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%

U.S. data from 2008-2012 Census, American Community Survey

Smaller, crowded, more smokers & woodstove use, less running water

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.

- **Household factors and child symptoms**
  - VOCs
  - Primary wood heat
  - PM2.5

- Cough between colds

  - VOCs

- Wheeze between colds
- Asthma diagnosis

Home Characteristics: Study vs. U.S.

Characteristic	Study (N=63) (90% CI)	United States*
Ft^2 – mean	**888 Ft^2**	(2,465 Ft^2 for homes built after 2000)
% >1 person/room	**73%**	3.2%
% Primary woodstove	**16%**	2.1%
% Fuel Oil as 1º heat	**78%**	6.5%
% with smokers	**49%**	26.2%
% no running water	**60%**	0.5%

* U.S. Census Bureau, 2008-2012 American Community Survey, 2012 American Community Survey, National Survey of Children's Health (NSCH, 2007).

Indoor Air Measures: Study Homes

Measure	Cut-off
PM 2.5 (ug/m3)	**51% over the cutoff**
CO2 (ppm)	**70% over the cutoff**
Ave. Rel Humidity (%)	<30 over half of time (**30%**) >60 over 1% of time (**18%**)
Temperature (ºF)	Average 74, Max 84

Volatile Organic Compounds: Study Homes

VOC (µg/m^3)	ATSDR MRL*	% > ASTDR MRL	Median	Maximum
Benzene	9.58	**23%**	3	170
m,p-Xylene	220	**8%**	11	640
o-Xylene	220	**2%**	4.5	430
BTEX**			45	2070
Total VOC			99	2794

* ATSDR MRL Agency for Toxic Substances and Disease Registry minimum risk levels
** BTEX = total of benzene, toluene, ethylbenzene, o-xylene & m,p-xylene

Household factors vs. Lung Symptoms in Study Household Children

Lung Sx.	Household Factor	Odds Ratio (p-value)	
		Unadjusted	Crowding, piped water, high risk
Cough between colds	Smoker in home BTEX >100 µg/m^3 1º Wood Heat PM2.5>25 µg/m^3	**3.1 (0.005)** **2.2 (0.037)**	**2.3 (0.037)** **4.42 (<0.001)** **3.18 (0.027)** **2.18 (0.026)**
Wheeze between colds	BTEX >100 µg/m^3	**2.1 (0.024)**	
Asthma Dx.	BTEX>100 µg/m^3 CO2>1000 ppm	**2.9 (0.011)** **0.3 (0.038)**	**3.02 (0.031)**

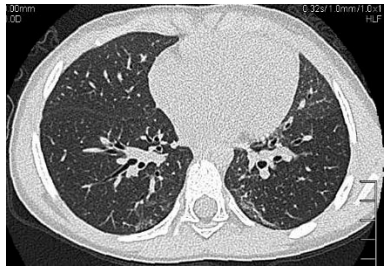
In Summary:

- We described the Alaska Native child health inequities in household IAQ factors and their relationship to child respiratory symptoms.

Next Steps:

- Pilot project to determine the feasibility of a hospital-based environmental consultation program at ANMC.

- Train tribal health providers in recognition and treatment of children with bronchiectasis.



Thank You!

INTRODUCTION: Alaska Native children experience high rates of respiratory infections and conditions. Household crowding, indoor smoke, lack of piped water, and poverty have been associated with respiratory infections.

METHODS: We monitored indoor particulate matter (PM2.5), CO2, relative humidity %, temperature and volatile organic compounds (VOCs), and interviewed caregivers about children's lung symptoms.

RESULTS: Compared with general U.S. households, study households were more likely overcrowded (73% vs. 3.2%); and had higher woodstove use as primary heat source (16% vs. 2.1%); higher proportion of children in a household with a smoker (49% vs. 26.2%); and higher proportion with no running water or sewer (60% vs. 0.5%).

VOCs (BTEX >100 $\mu g/m^3$), presence of a smoker, primary wood heat and PM2.5 >25 $\mu g/m^3$ were associated with higher risk for cough between colds; VOCs were associated with higher risk for asthma diagnosis in high risk and other household children.

CONCLUSIONS: In Alaska Native households with children who have chronic respiratory conditions, high indoor air pollutants levels were associated with respiratory symptoms in all of the household children, likely related to overcrowding, poor ventilation, woodstove use, use of homes as workshops, and tobacco smoke.