Presentation Objectives

- Inform about zoonotic pathogens
- Inform about Alaska zoonotic pathogen antibody survey
- Inform about initial antibody survey results
Background

Zoonotic infections in Alaska: disease prevalence, potential impact of climate change and recommended actions for earlier disease detection, research, prevention and control

Karsten Hueffer¹, Alan J. Parkinson²*, Robert Gerlach³ and James Berner⁴

¹Department of Biology and Wildlife, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AK, USA; ²Arctic Investigations Program, National Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Anchorage, AK, USA; ³Office of the State Veterinarian, Alaska Division of Environmental Health, Anchorage, AK, USA; ⁴Community Health Services, Alaska Native Tribal Health Consortium, Anchorage, AK, USA

Epidemiology and ecology of tularemia in Sweden, 1984-2012.

Dennes A. Turberg M. Hartvig M. Volmer L. Spaldt L. Rudin P. Johansson A.

Abstract

The zoonotic disease tularemia is endemic in large areas of the Northern Hemisphere, but research is lacking on patterns of spatial distribution and connections with ecologic factors. To describe the spatial epidemiology of and identify ecologic risk factors for tularemia incidence in Sweden, we analyzed surveillance data collected over 29 years (1984-2012). A total of 4,830 cases were notified, of which 3,524 met all study inclusion criteria. From the first to the second half of the study period, mean incidence increased 10-fold, from 0.26/100,000 persons during 1984–1998 to 2.47/100,000 persons during 1999–2012 (p<0.001). The incidence of tularemia was higher than expected in the boreal and alpine ecologic regions (p<0.001), and incidence was positively correlated with the presence of lakes and rivers (p<0.001). These results provide a comprehensive epidemiologic description of tularemia in Sweden and illustrate that incidence is higher in locations near lakes and rivers.
Characterizing wild bird contact and seropositivity to highly pathogenic avian influenza A (H5N1) virus in Alaskan residents

Carrie Reed, Dana Bruden, Kathy K. Byrd, Vic Veggilla, Michael Bruce, Debby Hurlburt, David Wang, Crystal Holiday, Kathy Hancock, Justin R. Ortiz, Joe Klejka, Jacqueline M. Katz, Timothy M. Uyek

Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, GA, USA. Influenza Division, Centers for Disease Control and Prevention, Atlanta, GA, USA. Arctic Investigations Program, Centers for Disease Control and Prevention, Anchorage, AK, USA. Departments of Medicine and Global Health, University of Washington, Seattle, WA, USA. Yukon Kuskokwim Health Corporation, Bethel, AK, USA.

Correspondence Carrie Reed, Influenza Division, Centers for Disease Control and Prevention, 1600 Clifton Rd NE MS A-32, Atlanta, GA 30333, USA. E-mail: CReed1@cdc.gov

Accepted 15 March 2014. Published Online 11 April 2014.

Background Highly pathogenic avian influenza A (HPAI) H5N1 viruses have infected poultry and wild birds on three continents with more than 600 reported human cases (59% mortality) since 2003. Wild aquatic birds are the natural reservoir for avian influenza A viruses, and migratory birds have been documented with HPAI H5N1 virus infection. Since 2005, clade 2.2 HPAI H5N1 viruses have spread from Asia to many countries.

Objectives We conducted a cross-sectional seroepidemiological survey in Anchorage and western Alaska to identify possible behaviors associated with migratory bird exposure and measure seropositivity to HPAI H5N1.

Methods We enrolled rural subsistence bird hunters and their families, urban sport hunters, wildlife biologists, and a comparison group without bird contact. We interviewed participants regarding their exposures to wild birds and collected blood to perform serologic testing for antibodies against a clade 2.2 HPAI H5N1 virus strain.

Results Hunters and wildlife biologists reported exposures to wild migratory birds that may confer risk of infection with avian influenza A viruses, although none of the 916 participants had evidence of seropositivity to HPAI H5N1.

Conclusions We characterized wild bird contact among Alaskans and behaviors that may influence risk of infection with avian influenza A viruses. Such knowledge can inform surveillance and risk communication surrounding HPAI H5N1 and other influenza viruses in a population with exposure to wild birds at a crossroads of intercontinental migratory flyways.

Keywords Alaska, H5N1, influenza.

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Objectives

- Baseline assessment of antibody prevalence of important zoonotic infections in four different Alaska populations
- Determine which infections warrant further investigation, surveillance, or prevention and control activities
Antibodies

- Having antibodies does not necessarily indicate illness
  - We did not check whether or not anyone had illness from the organisms
Antibodies

- Having antibodies does not necessarily indicate illness
  - We did not check whether or not anyone had illness from the organisms
- Some antibodies last a long time, so we do not know when an exposure happened
Methods

- **Study design**
  - Antibody prevalence at a single time point

- **One blood draw**

- **Study period**
  - 1 year (2007-2008)
Participant Inclusion Criteria

- Alaska subsistence bird hunters* and their family members, aged ≥ 5 years

* who have hunted for at least 2 of the past 5 years
Participant Inclusion Criteria

- Alaska subsistence bird hunters* and their family members, aged ≥ 5 years
- Alaska sport hunters*

* who have hunted for at least 2 of the past 5 years
Participant Inclusion Criteria

- Alaska subsistence bird hunters* and their family members, aged ≥ 5 years
- Alaska sport hunters*
- Wildlife biologists**

* who have hunted for at least 2 of the past 5 years
** who have had contact with wild birds for at least 1 Alaska field season in the past 5 years
Participant Inclusion Criteria

- Alaska subsistence bird hunters* and their family members, aged ≥ 5 years
- Alaska sport hunters*
- Wildlife biologists**
- Persons without wild bird exposure, aged ≥ 5 years

* who have hunted for at least 2 of the past 5 years
** who have had contact with wild birds for at least 1 Alaska field season in the past 5 years
Alaska Native Study Participants
Alaska Native Study Participants

- 454 Alaska Native subsistence bird hunters & family members
  - 6 communities in western Alaska
Alaska Native Study Participants

- 454 Alaska Native subsistence bird hunters & family members
  - 6 communities in western Alaska
- 60 Alaska Native persons without wild bird exposure
  - 1 community in western Alaska
  - 1 community in southcentral Alaska
Alaska Native Study Participants

- 454 Alaska Native subsistence bird hunters & family members
  - 6 communities in western Alaska
- 60 Alaska Native persons without wild bird exposure
  - 1 community in western Alaska
  - 1 community in southcentral Alaska
- 514 total
Zoonotic pathogens investigated

- **Parasites**
  - *Cryptosporidium parvum*
  - *Giardia intestinalis*
  - *Toxoplasma gondii*
  - *Trichinella spp.*
  - *Echinococcus granulosus*
  - *Echinococcus multilocularis*

- **Bacteria**
  - *Coxiella burnetii*
  - *Brucella spp.*
  - *Francisella tularensis*

- **Viruses**
  - California serogroup bunyaviruses (tested a subset of 324 [63%] people)
  - Hepatitis E
Methods of Transmission, Parasites (1)

- **Cryptosporidium parvum** (Cryptosporidiosis)
  - soil, water, food, or surfaces contaminated with feces containing oocysts
  - has been identified in dogs, caribou, blue mussels, some species of whale and seal
  - humans can infect each other!

- **Giardia intestinalis** (Giardiasis or “beaver fever”)
  - soil, water, food, or surfaces contaminated with feces containing oocysts
  - dogs, beaver, muskrat are common hosts
  - has been identified in marine mammals
  - humans can infect each other!

- **Trichinella** spp. (Trichinosis)
  - undercooked meat contaminated with oocysts
  - bear, walrus, pigs are common hosts
Methods of Transmission, Parasites (2)

- **Toxoplasma gondii** (Toxoplasmosis)
  - soil, water, or food, contaminated with feces containing oocysts
  - geese, caribou, muskrat, felid, fox, bear, dog, wolverine, marine mammals are common hosts
  - cats
  - mother to unborn child

- **Echinococcus granulosus** (Cystic echinococcus)
  - soil, water, or food contaminated with eggs
  - dogs, wolves, foxes, coyote, caribou, moose, elk, goats are common hosts

- **Echinococcus multilocularis** (Alveolar echinococcus)
  - soil, water, or food contaminated with eggs
  - dogs, wolves, foxes, coyote, felids, lemming, voles are common hosts
Methods of Transmission, Bacteria

- *Francisella tularensis* (Tularemia)
  - Infected animals
    - hare, muskrat, beaver, bear, cat, dog

- *Coxiella burnetii* (Q fever)
  - Infected animals
    - seals, sea lions, sheep, goats, cows
  - Bacteria-contaminated soil/dust

- *Brucella* spp. (Brucellosis)
  - Infected animals
    - reindeer, caribou
  - Contaminated animal products
    - unpasteurized milk
Methods of Transmission, Viruses

- California serogroup bunyaviruses – Jamestown Canyon & Snowshoe hare
  - Mosquito bites
- Hepatitis E
  - Eating undercooked pork, caribou?, deer?
Demographics of study groups

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Level</th>
<th>Subsistence hunter</th>
<th>Subsistence family member</th>
<th>No wild bird exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (original study)</td>
<td></td>
<td>237</td>
<td>229</td>
<td>204</td>
</tr>
<tr>
<td>n (zoonotic pathogen study)</td>
<td></td>
<td>233 (98%)</td>
<td>221 (97%)</td>
<td>196 (95%)</td>
</tr>
<tr>
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All subsistence hunters and their family member are Alaska Native.
### Demographics of study groups

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<td>221 (100%)</td>
<td>60 (31%)</td>
</tr>
<tr>
<td>Gender</td>
<td>n female</td>
<td>21 (9%)</td>
<td>187 (85%)</td>
<td>42 (70%)</td>
</tr>
</tbody>
</table>

All subsistence hunters and their family member are Alaska Native.
The majority of subsistence family members and persons with no wild bird exposure are female.
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<td>n (female)</td>
<td>21 (9%)</td>
<td>187 (85%)</td>
<td>42 (70%)</td>
</tr>
<tr>
<td>Age</td>
<td>≤15 years</td>
<td>38 (16%)</td>
<td>72 (33%)</td>
<td>4 (7%)</td>
</tr>
<tr>
<td></td>
<td>15-24 years</td>
<td>87 (37%)</td>
<td>52 (24%)</td>
<td>22 (37%)</td>
</tr>
<tr>
<td></td>
<td>25-34 years</td>
<td>37 (16%)</td>
<td>28 (13%)</td>
<td>11 (18%)</td>
</tr>
<tr>
<td></td>
<td>35-49 years</td>
<td>49 (21%)</td>
<td>38 (17%)</td>
<td>16 (27%)</td>
</tr>
<tr>
<td></td>
<td>≥50 years</td>
<td>22 (9%)</td>
<td>31 (14%)</td>
<td>7 (12%)</td>
</tr>
</tbody>
</table>

All subsistence hunters and their family member are Alaska Native.
The majority of subsistence family members and persons with no wild bird exposure are female.
Subsistence hunters and their family members tend to be younger.
Seropositivity by Organism

<table>
<thead>
<tr>
<th>Organism</th>
<th>Percent of persons with antibody</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. parvum</td>
<td>149</td>
</tr>
<tr>
<td>G. intestinalis</td>
<td>135</td>
</tr>
<tr>
<td>E. granulosus</td>
<td>54</td>
</tr>
<tr>
<td>C. burnetii</td>
<td>19</td>
</tr>
<tr>
<td>T. gondii</td>
<td>9</td>
</tr>
<tr>
<td>Brucella spp.</td>
<td>7</td>
</tr>
<tr>
<td>E. multilocularis</td>
<td>2</td>
</tr>
<tr>
<td>F. tularensis</td>
<td>1</td>
</tr>
<tr>
<td>Z1 pathogen</td>
<td>1</td>
</tr>
</tbody>
</table>

279
## Seropositivity by Study Group

<table>
<thead>
<tr>
<th>Organism</th>
<th>Subsistence hunter</th>
<th>Subsistence family member</th>
<th>No wild bird exposure</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. parvum</td>
<td>28%</td>
<td>32%</td>
<td>23%</td>
<td>0.01</td>
</tr>
<tr>
<td>G. intestinalis</td>
<td>31%</td>
<td>28%</td>
<td>2%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>California serogroup bunyaviruses</td>
<td>25%</td>
<td>23%</td>
<td>16%</td>
<td>0.60</td>
</tr>
<tr>
<td>C. burnetii</td>
<td>11%</td>
<td>10%</td>
<td>13%</td>
<td>0.68</td>
</tr>
<tr>
<td>Trichinella spp.</td>
<td>3%</td>
<td>2%</td>
<td>13%</td>
<td>0.0001</td>
</tr>
<tr>
<td>E. granulosus</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>1.00</td>
</tr>
<tr>
<td>T. gondii</td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
<td>0.35</td>
</tr>
<tr>
<td>Hepatitis E</td>
<td>0%</td>
<td>0.5%</td>
<td>2%</td>
<td>0.50</td>
</tr>
<tr>
<td>≥1 pathogen</td>
<td>56%</td>
<td>55%</td>
<td>45%</td>
<td>0.31</td>
</tr>
</tbody>
</table>

*across the study groups; adjusted for age and gender
## Seropositivity by Gender

<table>
<thead>
<tr>
<th>Organism</th>
<th>Female</th>
<th>Male</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. parvum</em></td>
<td>35%</td>
<td>23%</td>
<td>0.003</td>
</tr>
<tr>
<td><em>G. intestinalis</em></td>
<td>20%</td>
<td>32%</td>
<td>0.003</td>
</tr>
<tr>
<td>California serogroup bunyaviruses</td>
<td>22%</td>
<td>24%</td>
<td>0.60</td>
</tr>
<tr>
<td><em>C. burnetii</em></td>
<td>10%</td>
<td>11%</td>
<td>0.72</td>
</tr>
<tr>
<td><em>Trichinella</em> spp.</td>
<td>5%</td>
<td>3%</td>
<td>0.20</td>
</tr>
<tr>
<td><em>E. granulosus</em></td>
<td>2%</td>
<td>2%</td>
<td>1.00</td>
</tr>
<tr>
<td><em>T. gondii</em></td>
<td>1%</td>
<td>2%</td>
<td>0.76</td>
</tr>
<tr>
<td>Hepatitis E</td>
<td>1%</td>
<td>0%</td>
<td>0.24</td>
</tr>
<tr>
<td>≥1 pathogen</td>
<td>55%</td>
<td>53%</td>
<td>0.68</td>
</tr>
</tbody>
</table>

*unadjusted
### Seropositivity by Age Class

<table>
<thead>
<tr>
<th>Organism</th>
<th>&lt;15</th>
<th>15-24</th>
<th>25-34</th>
<th>35-49</th>
<th>≥50</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. parvum</em></td>
<td>4%</td>
<td>13%</td>
<td>32%</td>
<td>58%</td>
<td>65%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><em>G. intestinalis</em></td>
<td>39%</td>
<td>17%</td>
<td>16%</td>
<td>30%</td>
<td>32%</td>
<td>0.68</td>
</tr>
<tr>
<td>California serogroup bunyaviruses</td>
<td>19%</td>
<td>21%</td>
<td>28%</td>
<td>25%</td>
<td>30%</td>
<td>0.13</td>
</tr>
<tr>
<td><em>C. burnetii</em></td>
<td>4%</td>
<td>8%</td>
<td>13%</td>
<td>15%</td>
<td>18%</td>
<td>0.0007</td>
</tr>
<tr>
<td><em>Trichinella</em> spp.</td>
<td>0%</td>
<td>4%</td>
<td>4%</td>
<td>6%</td>
<td>5%</td>
<td>0.049**</td>
</tr>
<tr>
<td><em>E. granulosus</em></td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>7%</td>
<td>0.08</td>
</tr>
<tr>
<td><em>T. gondii</em></td>
<td>4%</td>
<td>0%</td>
<td>3%</td>
<td>0%</td>
<td>2%</td>
<td>0.28</td>
</tr>
<tr>
<td>Hepatitis E</td>
<td>0%</td>
<td>4%</td>
<td>4%</td>
<td>6%</td>
<td>5%</td>
<td>0.45</td>
</tr>
<tr>
<td>≥1 pathogen</td>
<td>46%</td>
<td>37%</td>
<td>49%</td>
<td>77%</td>
<td>85%</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*unadjusted

** no longer significant when adjusted for study group p=0.10
Conclusion I

- Exposure to a variety of zoonotic pathogens occurs in Alaska Native persons residing in western and southcentral Alaska
Conclusion I

- Exposures to a variety of zoonotic pathogens occurs in Alaska Native persons residing in western and southcentral Alaska
  - About 1/3 exposed to Cryptosporidium parvum
  - About 1/4 exposed to Giardia intestinalis and California serogroup bunyaviruses
  - About 1/10 exposed to Coxiella burnetii
Conclusion I

- Exposures to a variety of zoonotic pathogens occurs in Alaska Native persons residing in western and southcentral Alaska
  - About 1/3 exposed to Cryptosporidium parvum
  - About 1/4 exposed to Giardia intestinalis and California serogroup bunyaviruses
  - About 1/10 exposed to Coxiella burnetii

- Minimal exposures to Trichinella spp., Toxoplasma gondii, Hepatitis E, Echinococcus spp., or Brucella spp.

- No exposures to Francisella tularensis
Conclusions II

- When comparing across the study groups:
  - Subsistence hunters and their family members had significantly higher seropositivity to *Cryptosporidium parvum* and *Giardia intestinalis*
  - Persons with no wild bird exposure had significantly higher seropositivity to *Toxoplasma gondii*
Conclusions III

- When comparing by gender:
  - Females had significantly higher seropositivity to *Cryptosporidium parvum*
  - Males had significantly higher seropositivity to *Giardia intestinalis*
Conclusions IV

- When comparing by age:
  - Older aged persons had significantly higher seropositivity to:
    - Cryptosporidium parvum
    - Coxiella burnetii
Conclusions V

- This study provides a baseline prevalence of zoonotic pathogen exposure to which future studies can be compared.
Acknowledgements

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Gilbert Kersh
Ryan Pappert
Jeannine Petersen
Jeff Priest
Martin Schriefer
Robyn Stoddard
Eyasu Teshale
Patricia Wilkins

Yukon Kuskokwim Health Corporation
Joe Klejka

Public Health Agency of Canada
Mike Drebot
Questions?

Thank you!