One Arctic One Health: Human Infectious Diseases

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Review article

Human infectious diseases and the changing climate in the Arctic

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\textbf{ABSTRACT}

Climatic factors, especially temperature, precipitation, and humidity play an important role in disease transmission. As the Arctic changes at an unprecedented rate due to climate change, understanding how climatic factors and climate change affect infectious disease rates is important for minimizing human and economic costs. The purpose of this systematic review was to compile recent studies in the field and compare the results to a previously published review. English language searches were conducted in PubMed, ScienceDirect, Scopus, and PLOS One. Russian language searches were conducted in the Scientific Electronic Library “eLibrary.ru”. This systematic review yielded 22 articles (51\%) published in English and 21 articles (49\%) published in Russian since 2012. Articles about zoonotic and vector-borne diseases accounted for 67\% (\( n = 29 \)) of the review. Tick-borne diseases, tularemia, anthrax, and vibriosis were the most researched diseases likely to be impacted by climatic factors in the Arctic. Increased temperature and precipitation are predicted to have the greatest impact on infectious diseases in the Arctic.
1. Richard Reid, Nat Geo Image Collection
3. Audrey Waits, Oulu Finland
CLIMATE CHANGE

- Expansion of boreal tree line
- Milder winters, warmer summers
- Human development

ENVIRONMENT/HABITAT CHANGES

- Permafrost melting
- Pollution
- Contaminants as environmental stressors

ONE HEALTH

ENVIRONMENT - WILDLIFE - HUMAN INTERACTION

- Zoonotic and vector-borne diseases
- Exposure to new populations
- Better survival for vectors
- People spending more time outside
- Disruption in sanitation infrastructure
- Changes in traditional food storage

FOOD- AND WATERBORNE DISEASES

PREVENTION & SURVEILLANCE
- Education
- Vaccination
- Data collection

HUMAN- CAUSED CHANGE
Systematic Review

• To compile recent studies in this field and compare them to a previous review (Hedlund et. al 2014)
• English searches conducted in PubMed, ScienceDirect, Scopus, and PLOS One
• Russian searches conducted in the Scientific Electronic Library “eLibrary.ru”
• Searches conducted in March 2018
Waits et al. (2018) Human infectious diseases and the changing climate in the Arctic. Envir Int 121 703-713
Results

- Zoonotic/ vector-borne diseases (n= 29, 67%)
  - Tick-borne diseases (n= 10)
  - Tularemia (n= 9)
  - Anthrax (n= 6)
- Food- and waterborne diseases (n= 6, 14%)
  - Vibriosis (n=4)
- Airborne diseases (n= 2, 5%)

1 https://www.thelocal.ch/20190204/swiss-government-extends-vaccination-area-for-tick-borne-encephalitis-as-cases-increase
2 https://www.independent.co.uk/travel/europe/active-finland-travellers-guide-9614065.html
Airborne diseases

- Influenza A and human rhinovirus were investigated in relation to temperature and humidity
- Abundance of co-factors
- Low publication numbers
- Difficult to establish an association
<table>
<thead>
<tr>
<th>Warmer temperatures</th>
<th>Increased pathogen/vector exposure</th>
<th>Food and waterborne diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>People spend more time outdoors/swimming</td>
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<td>Range/habitat expansion</td>
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<td>Better pathogen growth and survival</td>
<td>Increased pathogen/vector population</td>
<td>Vector-borne diseases and zoonoses</td>
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<td>Milder winters result in more vectors surviving through winter</td>
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<td>Improved reproduction and development for disease vectors</td>
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| Extreme Flooding                     |                                    |                             |
| Disruption of waste and water treatment facilities | Increased pathogen exposure | Food and waterborne diseases |
| Decrease vector development           | Decreased vector population        | Vector-borne diseases and zoonoses |

| Permafrost Melting                   |                                    |                             |
| Disruption of sanitation infrastructure | Increased pathogen exposure | Food and waterborne diseases |
| Exposed cattle burial grounds         |                                    | Anthrax                     |
| Compromised traditional food storage methods |                                    | Botulism                    |
Food- and waterborne diseases

- Lack of sanitation/ water infrastructure
- Increased temperature and precipitation
- Disruption of waste and sanitation infrastructure
- Increased use of public bathing areas
- Vibriosis
  - Associated with increases in sea surface temperature
# Vector-borne diseases and zoonoses

## Tick-borne diseases
- Tick borne encephalitis (TBE)
- Tick borne borreliosis (TBB)
- Warmer temperatures affect habitat and life cycle

## Tularemia
- Climatic and ecological factors play important role in determining vector range and population
Anthrax

- Permafrost thaw exposes buried carcasses of infected animals
- Primary method of exposure is contact with infected animals
- Low or absent vaccination
- Main focus of the 72 articles included in this review (n=43) and a previous review (n=29) (Hedlund et al. 2014) divided by country
- All articles published between 1970-2017
- “Other” includes articles covering more than 1 country
Climate and health research by geographic region

- PubMed search only
- Used UN designated regions
- Made category for Arctic

https://commons.wikimedia.org/wiki/File:United_Nations_geographical_subregions.png
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Conclusion

• Increasing amount of research in the field published after 2010
• Tick-borne diseases, tularemia, anthrax, and vibriosis were the most researched infections likely to be impacted by climatic factors in the Arctic
• Increased temperature and precipitation are predicted to be the most influential climatic factors
• Surveillance, continued research, education, and vaccination can reduce the impact of climate associated changes in infections in the Arctic