

Infectious risks and vaccinations in the Arctic



NECTM₉

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Disclosures

- Have received support from Tillotts Pharma and Gilead to participate in ECCMID 2022 and ID Week 2023

Purpose

- To present and discuss living conditions, infectious disease risk and vaccinations in Arctic – Greenland, Arctic Canada and Alaska



Questions to travel health specialists

- *Do you consider vaccinations for travellers to the Arctic or Antarctica?*
- *And if so, which?*

The Arctic / Circumpolar area

- Geography
 - Polar circle
 - 10° July isotherm
 - Treeline
- Small populations
- Scattered settlements
- Difficult transportation
- Politically Arctic areas parts of other countries (USA, Canada, Denmark, Russia, Scandinavian countries)



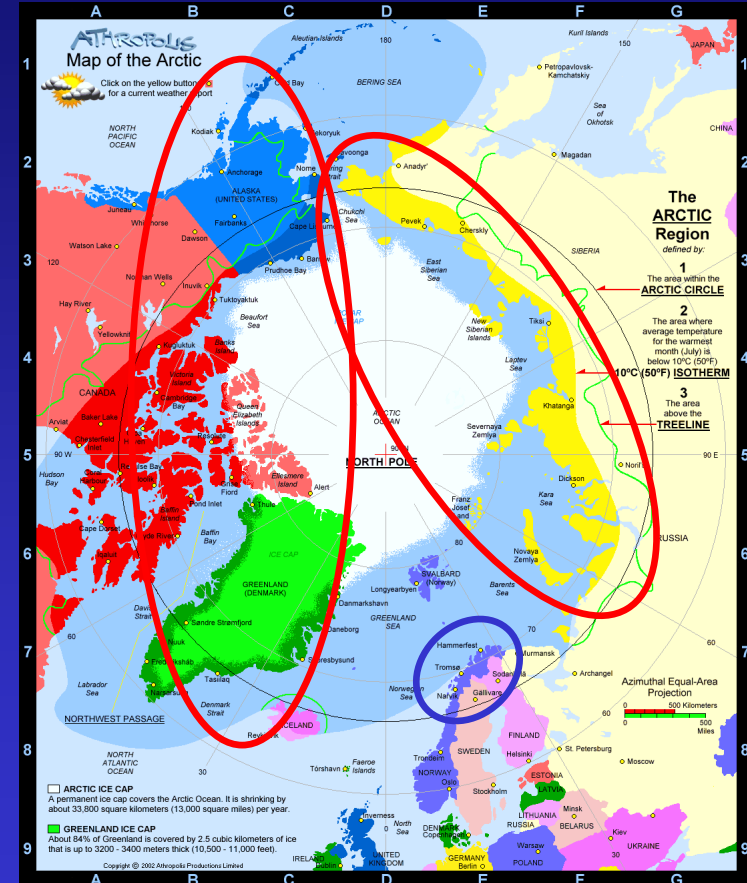
Arctic populations

Native populations

- Alaska, Northern Canada, Greenland
 - Inuit, Yupik
 - Other Alaskan natives/First Nations
- Northern Russia
 - Siberian peoples
- Northern Scandinavia
 - Sami

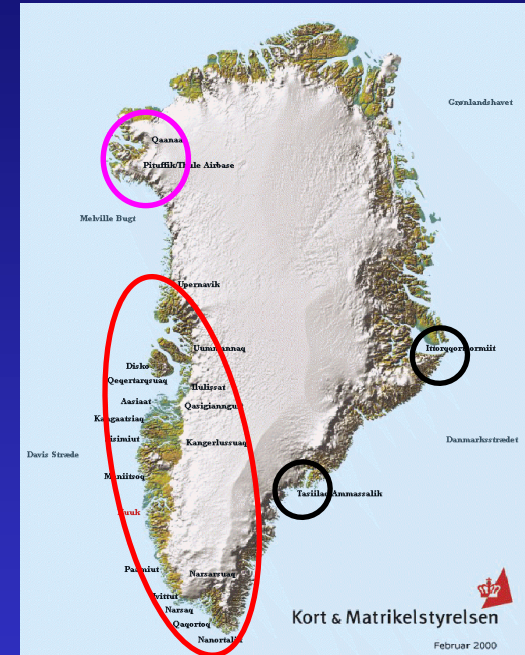
Non-native populations

- Persons from more southerly areas (e.g. USA, Canada, Denmark)



Greenland

- World's largest island
- Self rule from Denmark
- Population 56,000
 - 89% born in Greenland (Inuits)
 - 11% born in Denmark (Caucasians)
- Only narrow coastal strip inhabited
 - Capital Nuuk – 35% of pop.
 - 16 towns – 53%
 - > 50 settlements – 12%
- One central hospital, 16 small hospitals with 1-5 MDs



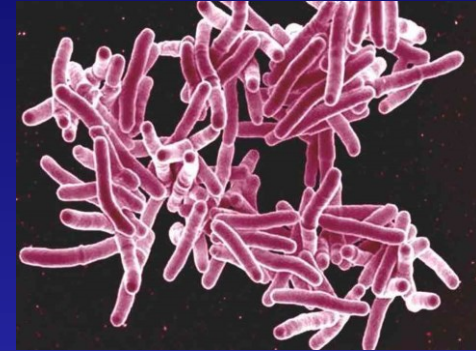
Living conditions in North American Arctic

- Traditional life style based on hunting, mainly sea mammals
- Small settlements
- Crowded housing conditions
- Low income
- Shorter life expectancy as e.g. in Denmark (~10 years)
- Infectious diseases frequent
 - Tuberculosis, invasive bacterial diseases, respiratory tract infections, otitis media, sexually transmitted diseases, hepatitis B infection, zoonoses
- Rapidly changing living conditions towards western life style

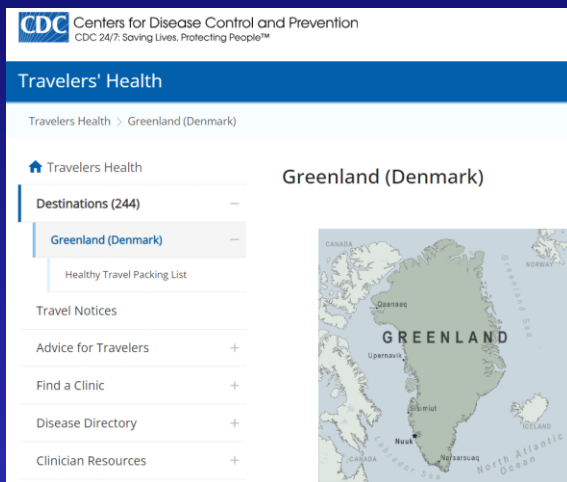


Infectious disease risks to Arctic travellers

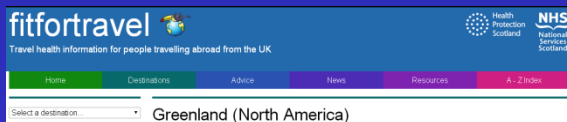
- Human infectious disease patterns
- Zoonoses



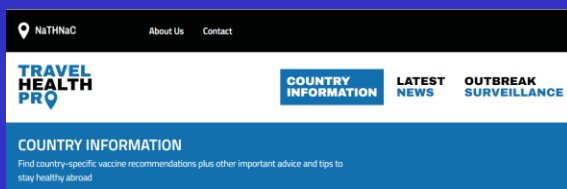
Travel health advice – selective vaccinations



- CDC 2024
 - Greenland and Canada: HAV, HBV, Rabies (outdoor activities, occupational hazard)
- Fitfortravel Scotland 2024
 - Greenland: HAV, Rabies, HBV for high risk
 - Alaska (USA): HAV, HBV & Rabies for high risk
 - Canada: HAV & HBV & Rabies for high risk



- NaTHNaC UK 2024
 - Greenland: Rabies & TB for some travellers, Tetanus
 - Alaska (USA): Rabies for some travellers
 - Canada: Rabies for some travellers



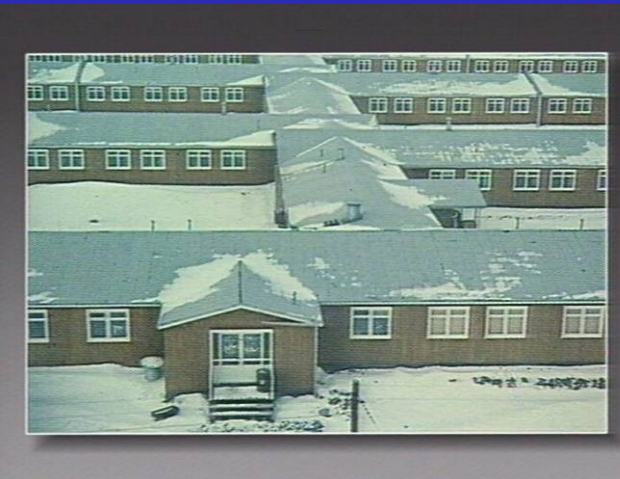
Tuberculosis Greenland 1900 - 1956



Coughing man (tuberculosis)
1902



Ward for TB patients
Jakobshavn 1936



Queen Ingrid's Sanatorium 1954

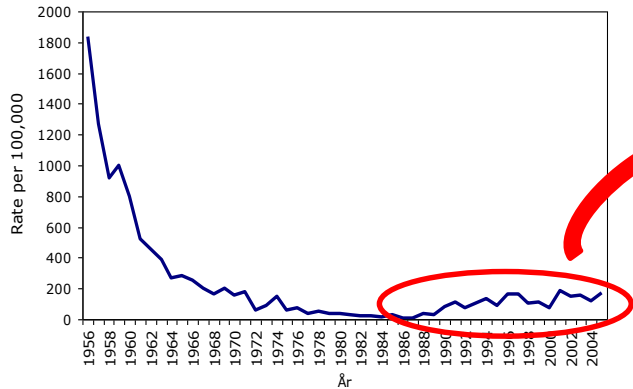


Tuberculosis ship 'Misigssut' 1956

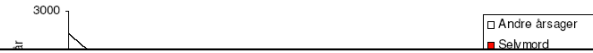


Tuberculosis Greenland & North American Arctic

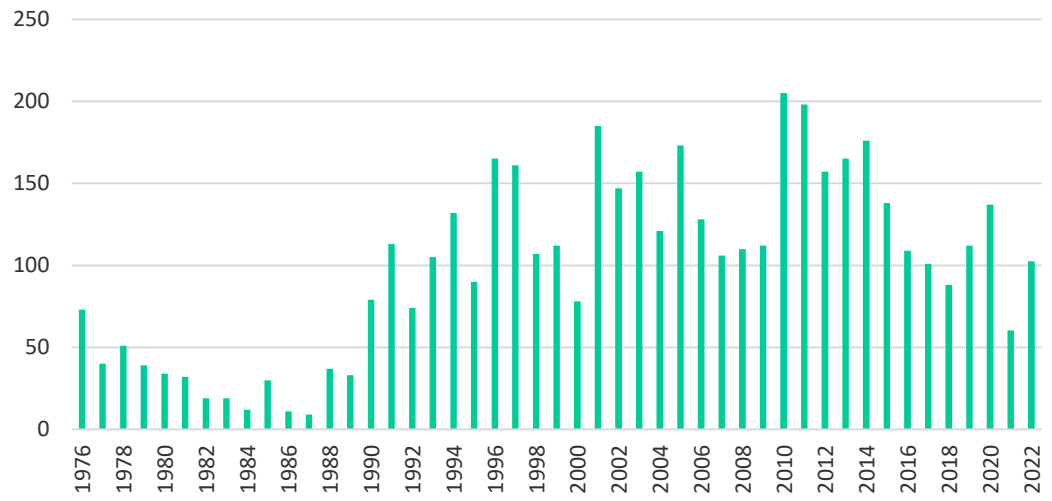
TB incidence Greenland 1954 - 2000



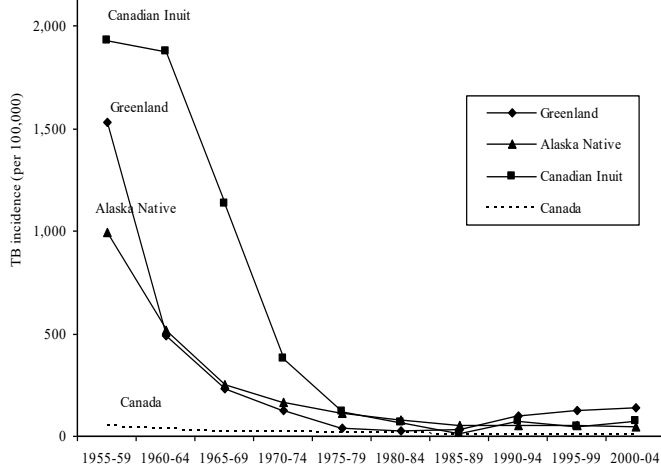
Causes of death 1924 - 2000



TB cases per 100,000 Greenland 1976-2022

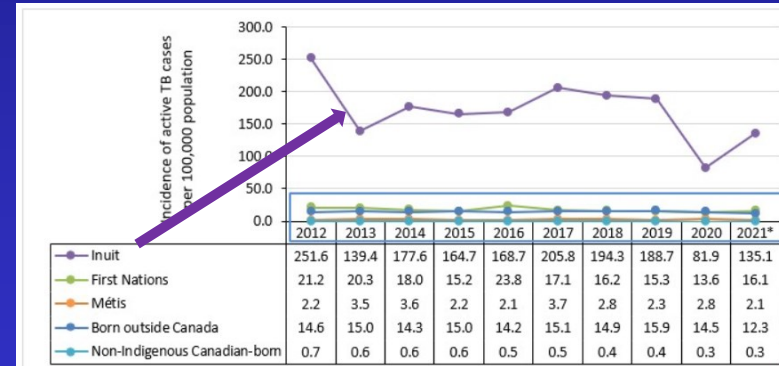
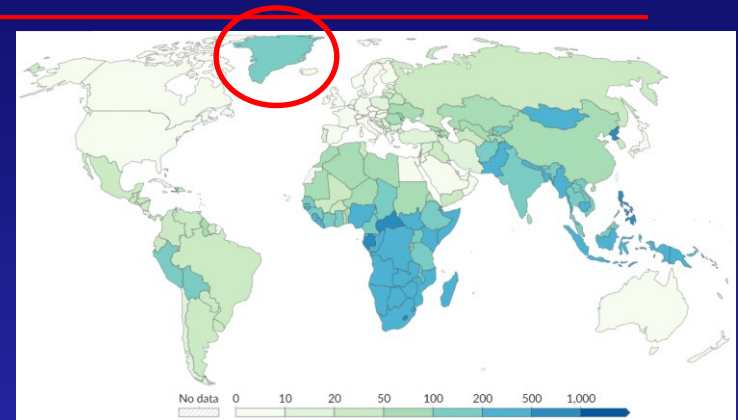


TB incidence Alaska, Canada, Greenland 1955-2004

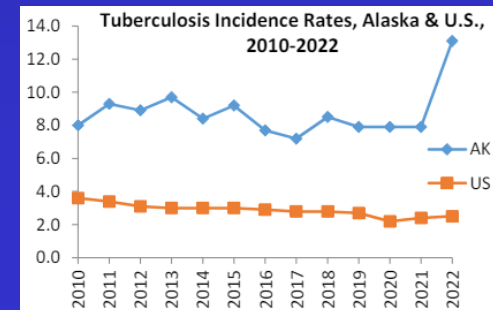


TB in North American Arctic

- Greenland 2022
 - Incidence 118 cases/100,000 persons
 - WHO high TB burden country
- Canada 2012-2021
 - 350-fold higher incidence in Inuit than in indigenous Canadian born
- Alaska 2022
 - Highest TB incidence in USA (13.1/100,000)
 - Alaska natives TB incidence 70.6/100,000



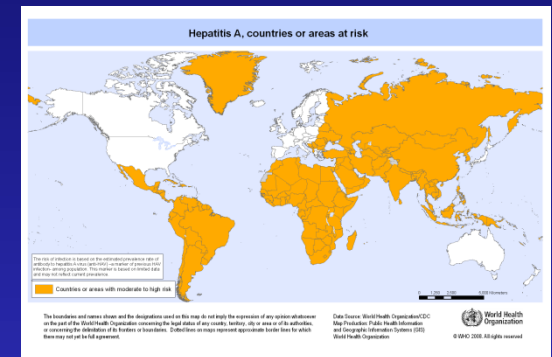
Illit aamma sakiallulersinnaavutit
Tuberkulose kan også ramme dig



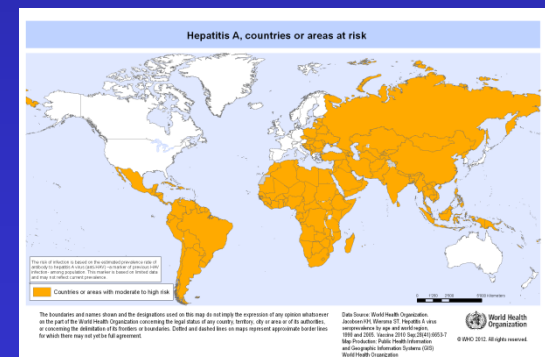
Hepatitis A

- Major epidemics in the Arctic
- In Greenland 'epidemic jaundice' noted from shortly after colonization in 1721
- Last major epidemic in Greenland in 1970'ies with 11% of population developing clinical hepatitis A infection
- HAV outbreaks in Alaska and Canada, vaccination campaigns since 1990'ies, rapidly declining incidence
- By 2014 the Arctic rated as low risk area by the WHO

WHO 2008

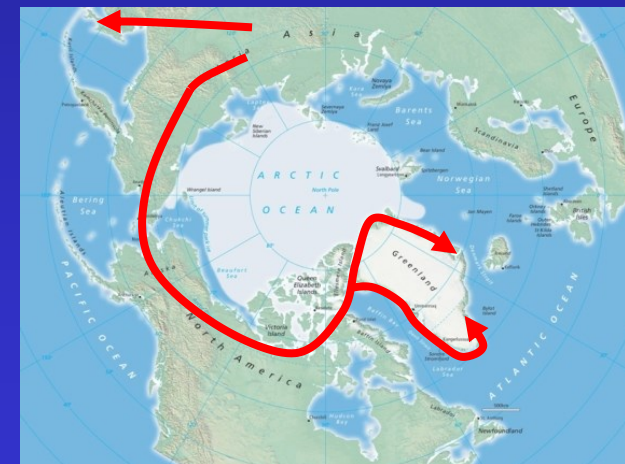
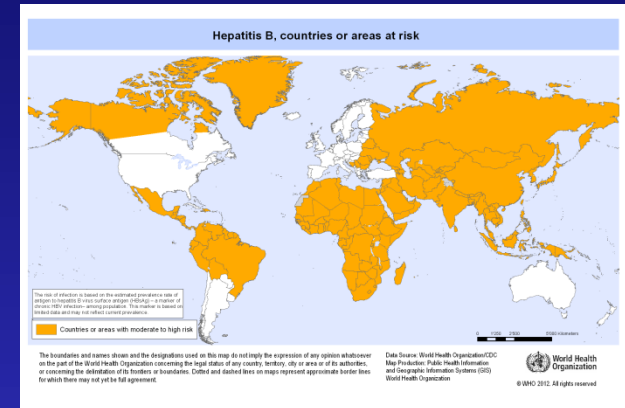


WHO 2012



Hepatitis B

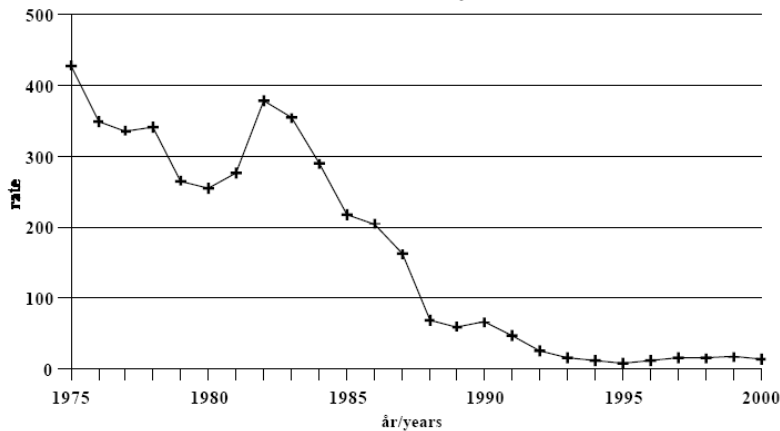
- Hepatitis B infection endemic in Inuit areas
~7% chronic infected (HBsAg positive)
- Particular epidemiological features
 - Apparently fewer long-term complications than expected
 - In Greenland childhood HBV vaccination not introduced before 2010
- Particular 'Arctic' B₆ sub-genotype identified, related to benign Japanese B₁ sub-genotype – expression of population migrations?



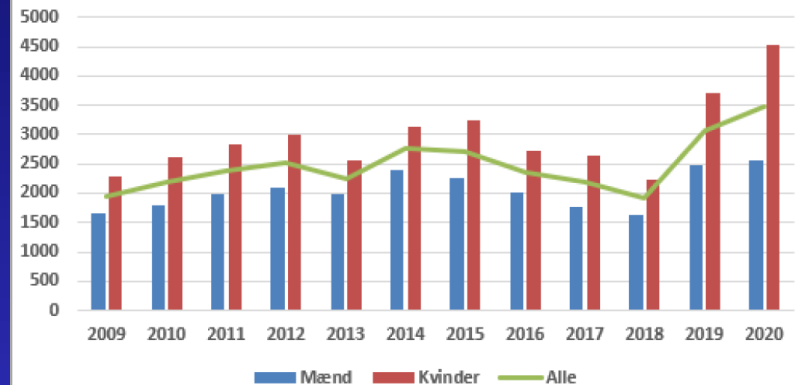
Sexually transmitted infections

Gonoré-incidensen/incidens of gonorrhoea 1975-2000

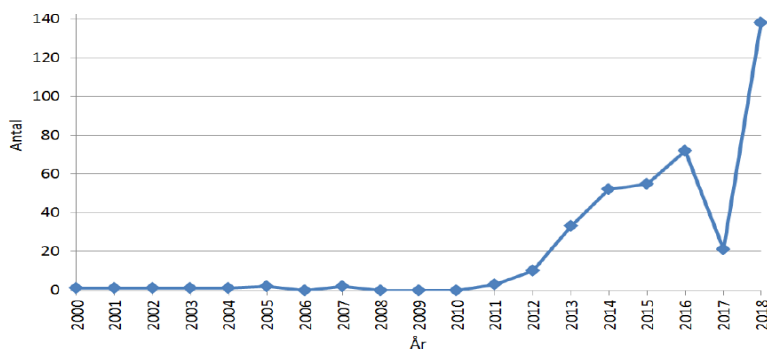
Per 1.000 15-59 år/years



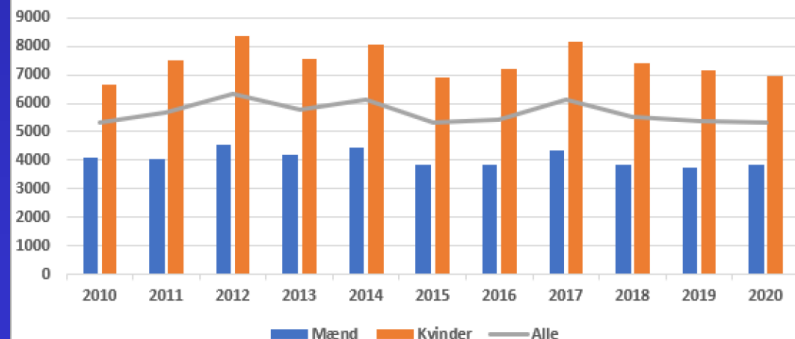
Figur 1: Gonorrétilfælde i Grønland 2009-2020 per 10⁵ indbyggere



Syphilis in Greenland 2000 - 2018

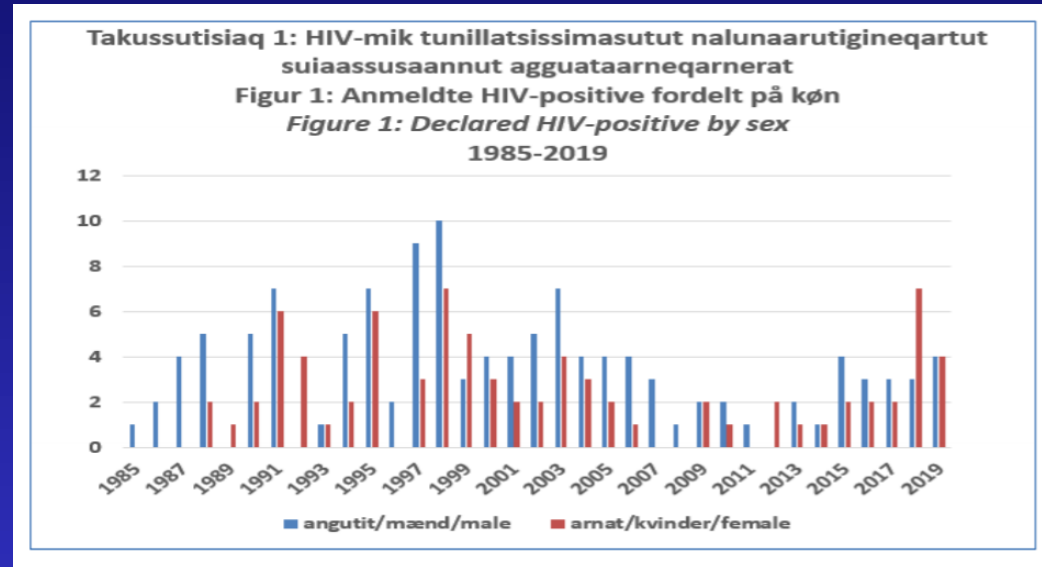


Figur 2: Klamydiatilfælde i Grønland 2010-2020, per. 10⁵ indbyggere

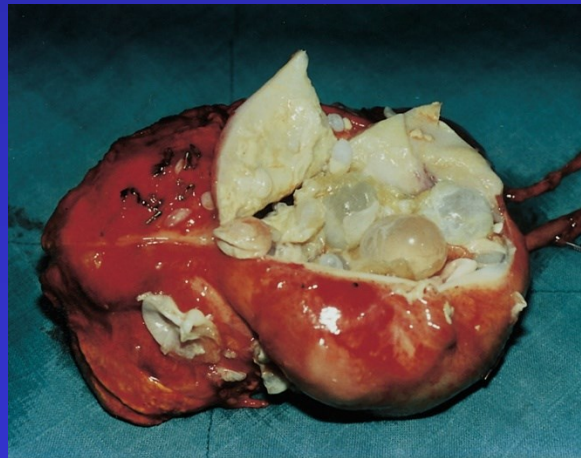


HIV Greenland

- 171 cases 1985-2011
 - Prevalence <0.2%
 - 71% infected in Greenland
 - 10% Denmark
 - 12% elsewhere
- Routes of infection
 - 74% heterosexually
 - 18% homosexually
 - 2% IV-abuse
 - 6% unknown
- Median age 46 years (IQR 34-56)
- Many HIV patients alcoholised, low SES, low compliance
- No association with TB epidemic



Zoonoses

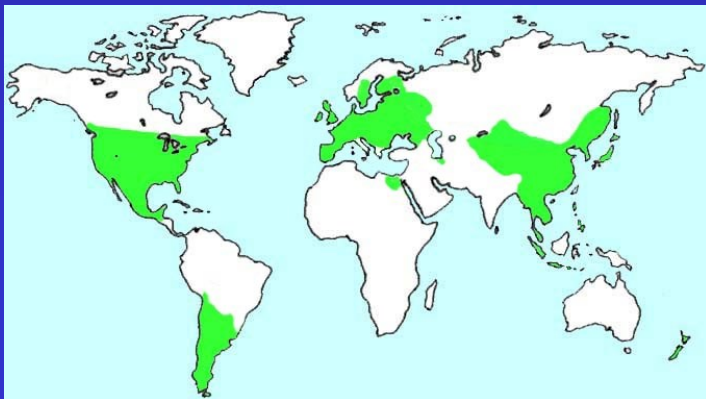


Trichinellosis

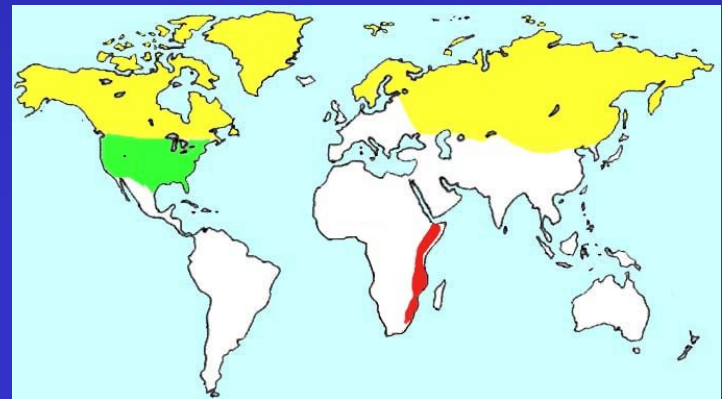


- Nematode (round worm) living in muscle tissue of infected animals
- Infection by eating infected meat
- Gastrointestinal symptoms, fever, muscle pains
- Most *trichinella* species killed by freezing or cooking meat
- Arctic species *T. nativa* freeze resistant
- Earlier official Greenland recommendations to cook OR freeze game meat!

T. spiralis



T. nativa (freeze resistant)



Trichinella in animals in Greenland

Host	Prevalence (%)	Reference
Sledge dog	61.9	Madsen, 1961
Polar bears	24.2	Madsen, 1961
	32.0	Born et al., 1990
	22.8	Henriksen et al., 1993
Polar fox	1.4	Madsen, 1961
	6.0	Kapel et al., 1996
Walrus	1.0	Madsen, 1961
	1.6	Born et al., 1982
Ringed seal	0.2	Møller 2006
Hooded seal	2.3	"

Botulism



- *C. botulinum* – neurotoxin
- Home-prepared uncooked/fermented aquatic game foods from fish, whales, seals, walruses and beavers (Alaska)
- Recent transition from preparation in traditional earthen pits to preparation in synthetic (plastic) containers
- Increase in human cases during the 1970s and 1980s in Alaska
- Regular outbreaks in Greenland
 - Thule, Greenland, September 2013

CDC
MMWR
Weekly
January 11, 2003 / 52(01):24-28

Outbreak of Botulism Type E Associated with Eating a Beached Whale --- Western Alaska, July 2002

Botulism is a neuroparalytic illness caused by toxins produced by the bacterium *Clostridium botulinum*, an obligate anaerobe found commonly in the environment. Intoxication with toxin type E is associated exclusively with eating animal foods of marine (salt or fresh water) origin. Persons who eat raw or fermented marine fish and mammals are at high risk for botulism from type E toxin. On July 17, 2002, the Alaska Division of Public Health investigated a cluster of suspected botulism cases among residents of a fishing village in Alaska. This report summarizes the findings of the outbreak investigation, which linked disease to eating raw muktuk (skin and a pink blubber layer) from a beached whale (Figure). To avoid delays in treatment, health-care providers evaluating patients suspected of having botulism should base treatment decisions on clinical findings. Public health authorities should be notified immediately about any suspected botulism case.

During July 13–15, residents of a western Alaska village on the Bering Sea shore shared a meal consisting of muktuk harvested from a beached adult bowhead whale found near their village. The villagers estimated that the whale had been dead for at least several weeks. They cut the whale fluke (fat) into pieces and stored them in zipper-sealed plastic bags in a refrigerator until they were eaten 1 or 2 days later. On July 17, after a physician from western Alaska reported three suspected cases of botulism among patients who had eaten the muktuk, the Alaska Section of Epidemiology began an investigation.

A case of foodborne botulism was defined as illness in a person who had eaten the muktuk and subsequently had symmetric descending flaccid paralysis of motor and autonomic nerves. Persons who ate muktuk were interviewed and examined, and their hospital records were reviewed. Serum, stool, and gastric contents from patients and

Kalaallit Nunaata Radio
Greenlandic Broadcasting Corporation

Funda Nyheder TV Radio Billedoptagelse Vejret

NYHEDER

Indland Udland Politik Erhverv Kriminalitet Kultur Sport

Indhold: Tirsdag 20. Jul 2011 09:30

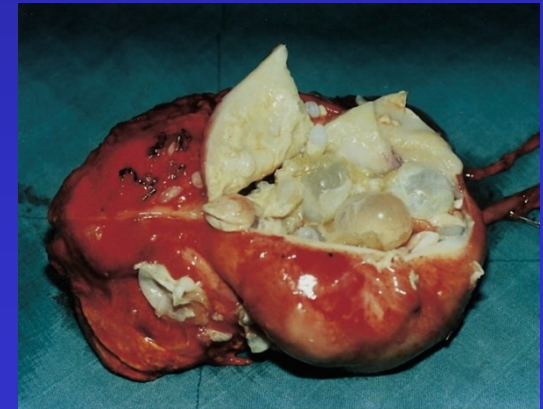
Dødeligt forgiftet ved sin fars begravelse

af: JONAS LEVRSCHALL-WEDEL

23 ting
En tragedie har ramt Grønlands nordligste bygd Sisarapalu.

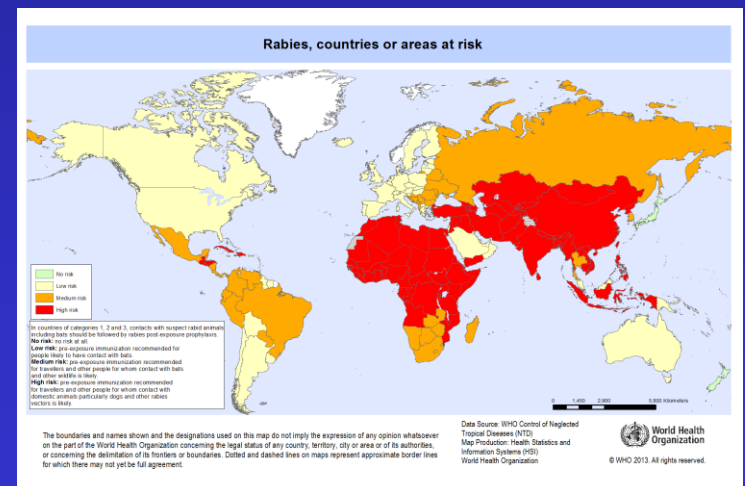
Echinococcal disease

- *E. granulosus* and *E. multilocularis*
- Alaska, Canada, Northern Norway, Sweden, and Finland
- Not Greenland
- Wolves, foxes and dogs definite hosts
- Reindeer, moose and voles intermediate hosts
- Avoid contact with host feces
- Thoroughly cooked meat from hoofstock
- Rare disease



Rabies

- Found in Arctic wildlife
 - Foxes, sledge dogs, wolves, polar bear, seal, wolves, caribou etc.
- 1859: 'Eskimo dog disease'
- 1959: First lab-confirmation in dogs and foxes in Greenland
- Interaction between foxes and sledge dogs
- Vaccination of sledge dogs, but unvaccinated young dogs a risk
- One human case in Greenland 1960

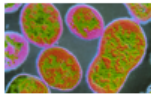
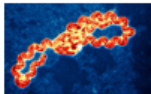
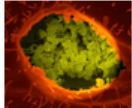






Climate changes and infectious diseases in the Arctic?

- *Vibrio parahaemolyticus*
 - 2004 Alaska cruise ship outbreak
 - Local oysters
 - Most northerly occurrence of bacterium



McLaughlin et al. NEJM 2005

	 <u>Brucellosis</u>	 <u>Leptospirosis</u>	 <u>Q fever</u>	 <u>Rickettsiosis</u>	 <u>Tularemia</u>	 <u>Borreliosis</u>	 <u>Tick borne encephalitis</u>
All Greenland 2013 + East Greenland 2013-15	1%	21%	0%	8%	1%	-	-
West Greenland 1998	-	2.5%	-	12.5%	-	-	-
Northern <u>Sweden</u>	1%	4%	0%	11.5%	3%	2%	5%

Tetanus

> Arctic Med Res. 1986;42:7-9.

Tetanus in Greenlandic soil

P Bjerregaard, N Kromann, M Arpi

PMID: 3300679

No abstract available




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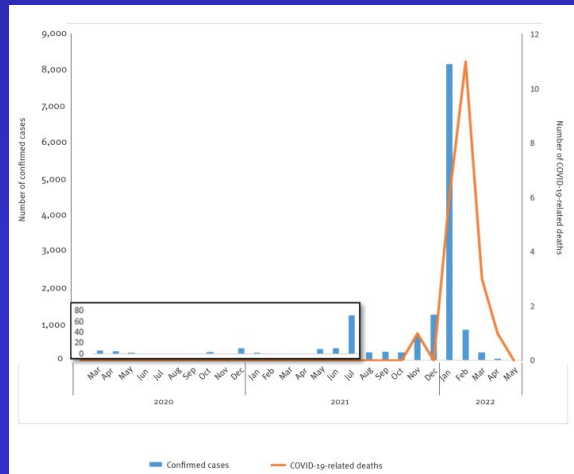
  

- Theoretically, Greenlandic soil too cold for *C. tetani* to grow, yet tetanusvaccine given in childhood vaccination programs
- No cases of tetanus observed in Greenland
- Warming of soil with climate changes?

Covid-19 in the Arctic



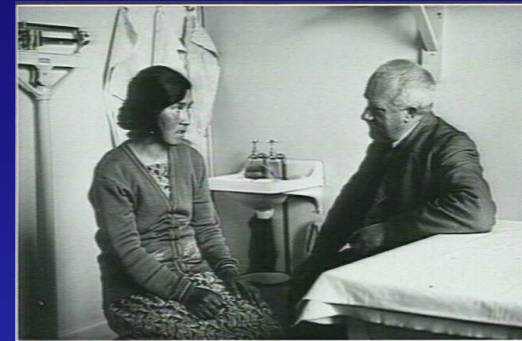
Greenland 2020-22



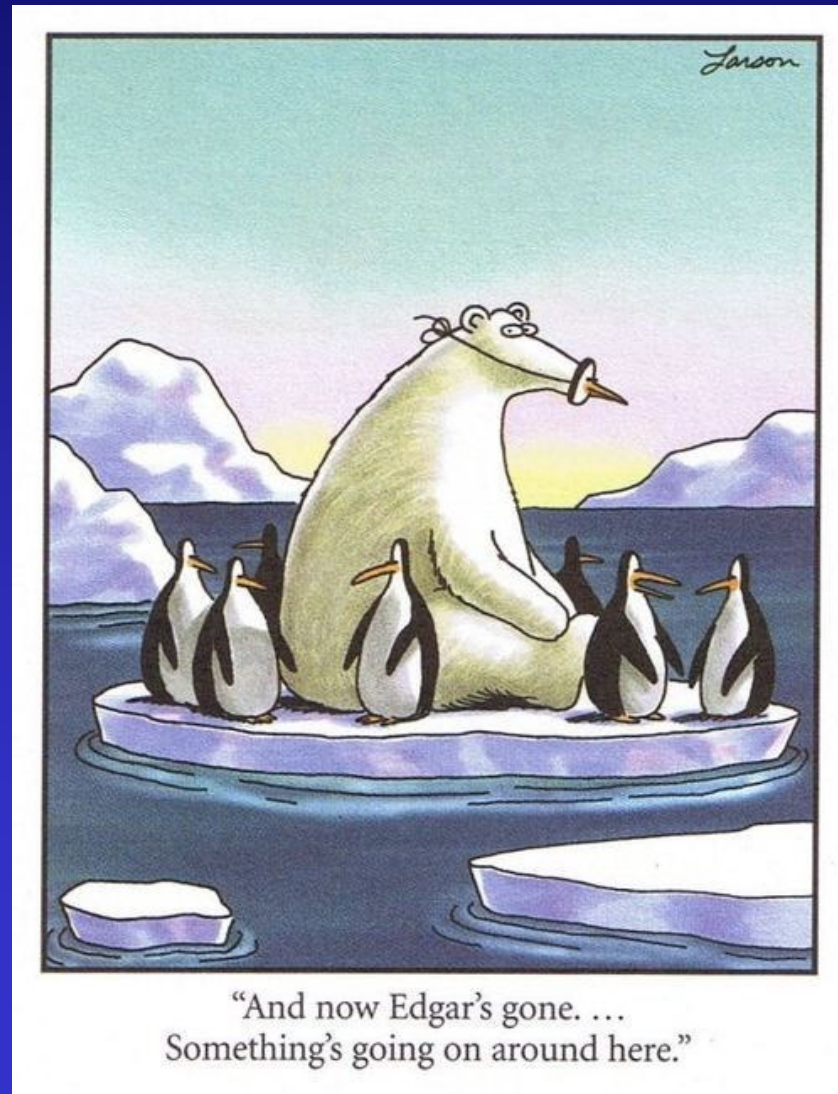
Noahsen et al.
Eurosurv. 2023

Health considerations for Arctic travellers

- In long-term travellers, residents or health staff consider vaccination against
 - Hepatitis B
 - (Hepatitis A in case of outbreaks)
 - Tuberculosis
 - Rabies – occupational hazard
- Safe sex
- Zoonoses and animals
 - Game meat (polar bear, walrus, reindeer etc.) thoroughly cooked
 - Care with fermented foods
 - Care with close contact with dogs or wild canids



Thank you for your attention



“And now Edgar’s gone. ...
Something’s going on around here.”