

# Discrepancies in data reporting of zoonotic infectious diseases across the Nordic countries – a call for action in the era of climate change

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## ABSTRACT

Emerging infections have in recent years caused enormous health problems. About 70% of these infections are zoonotic e.g. arise from natural foci in the environment. As climate change impacts ecosystems there is an ongoing transition of infectious diseases in humans. With the fastest changes of the climate occurring in the Arctic, this area is important to monitor for infections with potentials to be climate sensitive. To meet the increasing demand for evidence-based policies regarding climate-sensitive infectious diseases, epidemiological studies are vital. A review of registered data for nine potentially climate-sensitive infections, collected from health authorities in Denmark/Greenland, Finland, Iceland, Norway and Sweden, found that performing such studies across countries is constrained by incompatible reporting systems and differences in regulations. To address this, international standardisation is recommended.

## ARTICLE HISTORY

Received 18 January 2019  
Revised 26 March 2019  
Accepted 27 March 2019

## KEYWORDS

Climate-sensitive infections; reporting systems; Nordic countries

## Introduction

Climate change in the Arctic occurs almost three times as fast as in the rest of the world [1]. It profoundly affects ecosystems and is a major driving force for the northward expansion of many species, including vectors and pathogens. A number of infectious diseases have expanded into new geographical areas where they have the potential to become established [2].

In the present study, nine zoonotic infectious diseases were selected by a panel of experts as being potentially climate-sensitive, due to their different routes of transmission. The associated micro-organisms move across borders, and there is, therefore, a need for international collaboration regarding these diseases. This paper aims to show that, although the Nordic countries are closely connected, there are significant differences in the registration of epidemic data historically. Even though efforts have been made to obtain comparable data across borders there is an urgent need to intensify these efforts in order to harmonize infectious disease data.

## Methods

The national authorities that survey reportable infectious diseases in Sweden, Finland, Norway, Iceland, and

Greenland, were asked to submit information of collected data of anthrax, borreliosis, brucellosis, cryptosporidiosis, leptospirosis, nephropathia epidemica (*Puumala virus*), Q-fever, tick born encephalitis (TBE), and tularemia. This data covered country, district, age, sex and date for each registered disease case from 1965 to 2016. Notifiable infections are reported directly from laboratories directly to the national authorities of each country except for erythema migrans (cutaneous borreliosis) that is a clinical diagnosis reported by clinicians when notifiable. The diagnostics are based on accredited methods, internationally established and similar for all Nordic countries.

## Results and discussion

The experience of compiling disease data has provided valuable insight into differences in disease data for the nine reported climate sensitive infections across the countries of the study area. There were considerable variations across countries regarding the availability and quality of data (Table 1), in particular for TBE, q-fever, cryptosporidiosis, leptospirosis and brucellosis. No data prior to 1965 were obtained. Only the Finnish data set includes complete information for all nine diseases (from 1995 and forward).

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**Table 1.** Comparison of registered data regarding nine communicable diseases across Sweden, Finland, Norway, Iceland and Greenland. Data were obtained from the Public Health Agency of Sweden, the Norwegian Institute of Public Health, the National Institute for Health and Welfare in Finland, the Directorate of Health in Iceland and the Greenlandic Board of Health in Greenland.

		Disease								
		Anthrax	Borreliosis	Brucellosis	Cryptosporidiosis	Leptospirosis	Nephropathia epidemica	Q-fever	Tick-borne encephalitis	Tularaemia
Data obtained from year	Sweden	1965 <sup>b</sup>	n/a <sup>a</sup>	2010	2004	2008	1997	2007	2004	1997
	Finland	1995 <sup>b</sup>	1995	1995	1995	1995	1995	1995	1995	1995
	Norway	1967	1990 <sup>e</sup>	2004	2012	n/a <sup>a</sup>	1991	2016	1998	1985
	Iceland	1979 <sup>b</sup>	n/a <sup>a</sup>	2005	2013	2014	1997	2005	n/a <sup>a</sup>	2005
	Greenland	1996 <sup>b</sup>	n/a <sup>b, f</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>b</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>
Disease notifiable from year	Sweden	n/a <sup>a</sup>	n/a <sup>a</sup>	2004	2004	2004	1985	2004	2004	1969
	Finland	1995	1995	1995	1995	1995	1995	1995	1995	1995
	Norway	1991	1991	1977	2012	n/a <sup>a</sup>	1991	2012	1975	1977
	Iceland	n/a <sup>a</sup>	n/a <sup>a</sup>	2005	2013	2014	1997	2005	n/a <sup>a</sup>	2005
	Greenland	1996 <sup>e</sup>	1996 <sup>e</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	1996	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>
Information regarding sex and age/age group from year	Sweden	n/a <sup>b</sup>	n/a <sup>a</sup>	n/a <sup>c</sup>	2004	n/a <sup>c</sup>	1997	n/a <sup>c</sup>	2004	1997
	Finland	n/a <sup>b</sup>	1995	1995	1995	1995	1995	1995	1995	1995
	Norway	n/a <sup>b</sup>	1990 <sup>d</sup>	2004	2012	n/a <sup>a</sup>	1991	n/a <sup>d</sup>	1998	1985
	Iceland	n/a <sup>b</sup>	n/a <sup>a</sup>	n/a <sup>b</sup>	n/a <sup>c</sup>	n/a <sup>b</sup>	n/a <sup>b</sup>	n/a <sup>b</sup>	n/a <sup>a</sup>	n/a <sup>b</sup>
	Greenland	n/a <sup>b</sup>	n/a <sup>e</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>	n/a <sup>a</sup>

<sup>a</sup> Not notifiable, sometimes voluntarily reported.

<sup>b</sup> No cases reported.

<sup>c</sup> Information was not given due to the possibility to retrace individual cases and violate patient integrity.

<sup>d</sup> Between 1983 and 1990, borreliosis was sporadically reported in Norway.

<sup>e</sup> In Greenland, only neuroborreliosis is notifiable.

Qualitative variations across countries also depend on different functionalities of registration systems and administrative regulations. Some diseases are not notifiable in all Nordic studied countries. For example, borreliosis is not notifiable in Sweden and leptospirosis not in Norway. In Greenland, only one case of q-fever has been identified (in 2007) through the scientific literature [3], and only anthrax, neuroborreliosis and leptospirosis are notifiable. In Iceland, only cases of cryptosporidiosis have been reported, although all diseases except for TBE and borreliosis are notifiable in the country. The collected data showed that no human cases of anthrax have been reported in Sweden (from 1965), Finland (from 1995), Greenland (from 1979) and Island (from 1997). However, in 2000 a case of injection anthrax was diagnosed in a heroin addict in Oslo, Norway. This was the first known case in the world of systemic anthrax transmitted through injecting drug use. Previously, the last human case of anthrax in Norway was in 1967.

Most of the studied diseases became notifiable in different years in these countries and, consequently, the time-span covered by available data varies significantly across countries. Availability of information on sex and age also varies significantly. This makes it difficult to compare disease prevalence and incidence rates across the Nordic countries. The process of acquisition data was more time-consuming than anticipated, in part due to some application processes being slightly rigorous.

This review highlights the difficulties in comparing disease data across the Nordic countries. Until present,

each country's health authority has carried out disease control according to its own national disease pattern with the consequence of large data variability across nations. This limits the possibilities to conduct multi-country studies to determine the impact of climate change on the epidemiology of infectious diseases and to identify measures to address the effects of climate change on infectious diseases in the Nordic countries. Harmonization of data collection for notifiable diseases could be achieved through standardization across national administrations and dissemination of disease data via shared services. In addition, collaboration and harmonization to include other Arctic nations, namely Russia, Canada and the US, would also be desirable. Such a collaboration already exists in the form of the International Circumpolar Surveillance System (ICS) that surveys five invasive bacterial diseases throughout the circumpolar area [4]. We suggest a Nordic summit aiming at producing a common list of reportable diseases and a common method of reporting them in order to improve international surveillance and actions. Such a summit might evolve into a circumpolar collaboration involving all eight Arctic countries.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by the NordForsk [76413].

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