Results of an Arctic Council Survey on Water and Sanitation Services in the Arctic

Improving Health through Safe and Affordable Access to Household Running Water and Sewer (WASH), an endorsed project of the Arctic Council Sustainable Development Working Group

Sustainable Development Working Group

ARCTIC COUNCIL

Contents

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INTRODUCTION

Access to clean drinking water and sanitation is a basic human right. The 2015 UN Goals for Sustainable Development include providing access to safe and affordable drinking water and adequate sanitation and hygiene for all by 2030 (1). In the Arctic region, inadequate water and sanitation services are associated with poorer health status, and this burden is higher among rural and indigenous populations (2). For Arctic nations, providing and maintaining water and sanitation services presents unique challenges including emerging threats related to climate change (3). In 2016, as an endorsed project of the Arctic Council's Sustainable Development Work Group (SDWG), we surveyed professionals and government authorities and Arctic and sub-Arctic residents to describe the current state of water and sanitation services. This survey also ascertained which water-related diseases are monitored by public health and identified climate change-related threats affecting water and sanitation in northern circumpolar populations.

METHODS

The survey was conducted from April 10 to October 1, 2016, in English, and used the internet-based survey tool "SurveyMonkey", which allowed respondents to participate using a personal computer. The survey was intended to reach professionals and residents of Arctic nations and was open to all interested persons. The link to the survey was distributed through email lists and direct contacts, including the Arctic Human Health Experts Group. Some additional information was solicited through presentations at local and regional meetings, known experts, and other experts recommended by survey respondents

The survey had three sections: Water and Sanitation Services, Disease Surveillance, and Climate Changes Affecting Water and Sanitation. Survey results were supplemented by information obtained from direct contacts at the 2016 conference on Water Innovations for Health Arctic Homes (WIHAH), the U.S. Census (4), and the Alaska Department of Environmental Conservation. Where applicable, the definitions for urban and rural populations were specified by each respondent. Data provided by the World Health Organization (WHO) through the Joint Monitoring Programme (JMP) (5) were compared to the figures supplied by respondents. For these comparisons, JMP numbers on improved and shared sanitation facilities were combined since shared facilities are considered sanitary in most places in the arctic where they are used, such as in Finland, Sweden, and Iceland. JMP figures for unimproved drinking water sources were combined with surface water sources for this study.

Because some respondents reported figures for water and sanitation access that were speculations, we used only figures from government, tribal, or service authorities in this summary. Survey respondents were contacted to confirm the figures they provided. The figures provided on access to water and sanitation services in each country are approximations, not exact figures, and definitions vary, so comparisons between areas should be done with caution.

Information on which water-related infectious diseases are reportable by area were provided and confirmed by survey respondents and were supplemented by online resources and publications from each area (6-9). For climate change-related threats affecting water and sanitation, respondents were asked whether or not certain effects attributable to climate change had occurred. They were asked to describe these events and provide supporting information such as news articles or other publications.

RESULTS

In total, 142 individuals responded to the survey, however most responses were not complete. Among 51 complete responses, there were five from Canada, three from Finland, three from Greenland, one from Iceland, one from Norway, three from Sweden, 35 from Alaska, and none from Russia. Many of these respondents completed only the sections on which they were experts. For the water and sanitation access and disease tables in this report only the confirmed responses from government authorities and researchers were included. Responses from community members are discussed below.

All respondents from Finland, Iceland, Norway, and Sweden reported universal availability of improved water services for the entire population; incomplete service was reported from Canada, Greenland, and Alaska (Table 1). Respondents from Iceland and Norway reported universal access to improved sanitation; gaps in sanitation service were reported from Canada, Finland, Greenland, Sweden, and Alaska. While no responses were received from Russia, other sources report incomplete coverage of water and sanitation services in much of Arctic Russia (5, 10). Reported access to services differed from the percentages described by the JMP. In most cases survey respondents reported on smaller geographical areas within countries, whereas the JMP data cover the entire country, so direct comparisons between some responses and the JMP data are not possible. Most respondents who reported 99% access in their areas specified that this was an approximation, and likely closer to 100% of households had access, but they wished to indicate that a gap in access of less than 1% still existed.

Access to improved water and sanitation services is very high in urban areas while gaps in service exist mainly in rural areas. For example, in rural Greenland, approximately 25% of households have no access to improved water services and approximately 65% of households have no access to improved sanitation. In Greenland, unimproved sanitation services refer to bucket toilets that use plastic bags, also known as honey buckets. Yet, JMP figures for Greenland suggest that 100% of both urban and rural populations have access to improved water and sanitation. While JMP figures for Finland also suggest universal improved sanitation access, a response from the Lapland region suggested that about 5% of residents in the urban areas of Inari and Utsjoki lack improved sanitation services. In the northern provinces and territories of Canada, numbers are similar to the JMP figures. Of the areas described in Table 1 in Alaska, none have complete access to improved water and sanitation. Respondents noted that in many cases, lack of access is a choice made by residents rather than an inability to obtain access.

Some community members reported that few or no households in their community have access to improved water. Many small communities in Alaska and Greenland have only self-haul systems with no plumbing, and many rely on unimproved bucket toilets as the sole means of sanitation. Although no responses in this survey were submitted from Russia, the JMP figures suggest that gaps in water and

sanitation service exist, with approximately 9% of rural Russians lacking improved water and 30% lacking improved sanitation. Even urban populations in Russia appear to lack improved water (1%) and sanitation (8%). However, an expert contact in Russia expressed doubt about the accuracy of the JMP figures since comprehensive surveys of water and sanitation access have not been conducted in that nation.

Reported water quality and quantity standards varied by geography (Table 2). Respondents described the existence of water quantity standards (the amount of water that is recommended to be provided per capita) in Canada (Northwest Territories, Nunavut, and Yukon), Finland, and Norway. Respondents and contacts from Greenland, Iceland, Russia, Sweden, and Alaska reported no water quantity standards. The water quantity standard ranged from 90 to 200 liters per person per day. Respondents reported that the standard was generally met where applicable.

National wastewater treatment standards were reported for Canada, Finland, Norway, and Alaska. Respondents and contacts reported no wastewater treatment standards in Greenland, Iceland, or Russia. While a national standard exists in Canada, respondents reported that it does not apply north of the 60th parallel where Yukon, Nunavut, and the Northwest Territories are located. In these areas, treatment standards are site-specific and were reported as usually met. Responses from Finland, Norway, Sweden, and Alaska report that treatment standards are usually met.

Table 3 shows which water-related infectious diseases (water-borne and water-washed) are reportable to public health authorities according to survey respondents. Diseases that are reportable differ by area, but in most cases water-borne diseases are reported while few water-washed diseases are.

Climate change-related threats to water and sanitation access were described by survey respondents throughout the Arctic. Decreases in water quantity and quality, damage to water and sanitation infrastructure, maintenance and treatment issues, and infrastructure planning related to climate change were reported from Nunavut, Greenland, Norway, Sweden and Alaska. The only respondents from Finland and Iceland reported being unaware of climate change-related threats to water and sanitation in those countries.

In addition to the threats described in the response options in Table 3, respondents described receding glaciers, less snow pack, warmer temperatures, and loss of groundwater aquifers as affecting source water quantity. Gradual changes in water color and greater turbidity following streambank erosion due to permafrost melt has affected water quality. Other infrastructure damage included permafrost thawing that has led to loss of reservoirs and flooding that raises the risk of sewage lagoon overflow. The high cost of operating and building water and sewage treatment systems in small communities has precluded the construction of adequate systems. Other water treatment issues include the flooding and infiltration of storm water into wells and sewage treatment plants—which reduces treatment effectiveness—and the need to replace filters more frequently and use excessive amounts of disinfectants. Climate change has affected planning in several ways. Water treatment plants have undergone design changes to prevent flooding and to treat flood water that infiltrates plants and contaminates treated water. Installation of flexible piping systems and replacement of buried systems

with temporary on-site tanks are being used or are in future plans to mitigate the impact of permafrost melt on uneven building settling. Some governments have been hesitant to fund infrastructure projects in communities that might need to be relocated in the near future due to rising sea levels or other climate change threats, and some incomplete projects have remained unfinished due to lack of funding, leaving residents with only unimproved water and sanitation options. Finally, much research is being conducted to identify solutions for communities coping with climate change and its effects on access to water and sanitation.

DISCUSSION

While the figures for access to water and sanitation from the JMP are generally accurate, they largely mask the situation in the Arctic. In Greenland, the figures reported to JMP are not accurate: JMP reports 100% urban and rural access to improved water and sanitation, but experts in this effort reported much lower access, especially in rural areas of the island. Furthermore, a few responses from individual municipality and community authorities reported gaps in access in those areas that JMP numbers mask, such as in Inari and Utsjoki, Finland, and in Shishmaref and the Northwest Arctic Borough in Alaska. Some speculative responses omitted from these results describe communities with no access to improved water and sanitation. With regard to water and sanitation, the concentration of Arctic populations around urban and municipal centers skews coverage figures such that almost all of the population appears to have access, while small communities very far from urban areas have low or no access. Low-population and remote communities in Alaska, Russia and Greenland with no connections to infrastructure, such as roads or power grids, are often entirely lacking water and sanitation services and the cost of installing such services is seen as prohibitive.

In some places, a national standard for volume of water per-person per-day has been set, and in these places respondents reported that the standard was usually met. However, water quantity can vary considerably throughout the year: late-summer drought or inadequate winter snowpack can reduce water quantity and lead to water rationing. Wastewater treatment standards were usually met where applicable. When standards are not met, action is often taken quickly to rectify treatment issues. The changing climate not only increases the risk of losing access to safe and sufficient water—it presents unprecedented issues for water treatment and infrastructure.

Access to an adequate quantity of running water is associated with better health (2, 11-16). While waterborne diseases are reported to public health authorities in most places throughout the Arctic, few water-washed diseases are. If these diseases are not monitored, the health threats of inadequate access to safe water could go unrecognized and unmeasured.

Unprecedented climate change is threatening water security and access to sanitation in the Arctic in ways that are arguably different and more rapid than in other parts of the world (3). Loss of water supply, reduction of water quality and damage to infrastructure add to existing challenges of system maintenance and water treatment, and the high costs of delivering safe water and wastewater service are common in remote Arctic communities. The results of this survey also show that climate and environmental change threatens water and sanitation infrastructure in traditionally well-served and

developed urban areas like those in Arctic Europe. Rising sea levels have led to increased salt content of drinking water from sources close to shore and caused shoreline erosion, which threatens aging infrastructure that used to be adequately far from shore. Melting permafrost causes further infrastructure damage and leads to the loss of surface water sources. Warmer water promotes the growth of algae and pathogens that previously posed few issues in Arctic water sources. Decreased snowpack results in reduced water supplies, while more intense storms cause damage and contamination from flooding. Population growth further stresses outdated infrastructure while communities are forced to use temporary solutions to long-term problems. Fortunately, innovative solutions are being developed throughout the Arctic region to deal with these looming issues, but Arctic nations have struggled to share these adaptations.

RECOMMENDATIONS

Above all, the issue of water and sanitation access in the Arctic must be brought to the global fore. For good reason, the UN Sustainable Development Goals have focused on the less developed, highly populated regions of the world where billions of people still lack basic water and sanitation services. However, since progress reports are structured geographically by country, the apparently high service coverage in the very large Arctic nations masks the extraordinary disparity between developed urban areas and distant, disconnected rural communities. The following measures are recommended to advance this issue and begin to reduce this disparity in the Arctic.

- Begin regular reporting to the Arctic Council about water and sanitation coverage within Arctic nations, including regional or county level data, to monitor progress towards the Sustainable Development Goal #6.
- Encourage Arctic nations and regional governments to begin tracking and reporting on water-washed infectious diseases in the Arctic to monitor the health benefits of access to water and sanitation.
- Under the AC Sustainable Development Working Group, create a regular forum for Arctic nations and communities to share innovations in water and sanitation technology, cost management methods, and climate change adaptation strategies.

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Table 1. Comparison of reported access to water and sanitation services by survey respondents with WHO Joint Monitoring Program figures, 2016*

		Water Access		Sanitation Access	
		Improved	Unimproved/Surface water	Improved/Shared	Unimproved
Canada	Northwest Territories	99%	1%	99%	1%
	Nunavut	100%	0%	100%	0%
	Yukon	99%	1%	99%	1%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	99%	1%	99%	1%
	JMP: Total	100%	0%	100%	0%
Finland	Total	100%	0%	100%	0%
	Lapland	100%	0%	100%	0%
	Inari & Utsjoki	100%	0%	95%	5%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	100%	0%	100%	0%
	JMP: Total	100%	0%	100%	0%
Greenland	Total	92%	8%	75%	25%
	Urban	99%	1%	95%	5%
	Rural	75%	25%	35%	65%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	100%	0%	100%	0%
	JMP: Total	100%	0%	100%	0%
Iceland	Total	100%	0%	100%	0%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	100%	0%	100%	0%
	JMP: Total	100%	0%	100%	0%
Norway	Total	100%	0%	100%	0%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	100%	0%	100%	0%
	JMP: Total	100%	0%	100%	0%
Sweden	Total	100%	0%	100%	0%
	Älvsbyn	100%	0%	99%	1%
	Lycksele	100%	0%	100%	0%
	Umeå	100%	0%	100%	0%
	JMP: Urban	100%	0%	100%	0%
	JMP: Rural	100%	0%	100%	0%
	JMP: Total	100%	0%	100%	0%
Russia	JMP: Urban	99%	1%	92%	8%
	JMP: Rural	91%	9%	70%	30%
	JMP: Total	97%	3%	86%	14%
Alaska	Kotzebue	90%	10%	95%	5%
	Shishmaref	30%	70%	30%	70%
	North Slope Borough	99%	1%	99%	1%
	Northwest Arctic Borough	89%	11%	89%	11%
	Total (U.S. Census)	96%	4%	----Not available----	
	Urban	99%	1%	99%	1%
	Rural	84%	16%	84%	16%
U.S.	JMP: U.S. Urban	99%	1%	100%	0%
	JMP: U.S. Rural	98%	2%	100%	0%
	JMP: U.S. Total	99%	1%	100%	0%

*Survey responses are approximate and not necessarily comparable.

Table 2. Water quantity and wastewater quality standards in the Arctic, as reported by survey respondents, 2016

	Water quantity standard in place?	Standard	Is standard usually met?	Wastewater treatment standard in place?	Is standard usually met?
Canada: Northwest Territories	Yes	90 L/person/day (trucked service) 225 L/person/day (piped)	Yes	Yes	Yes*
Canada: Nunavut	Yes	90 L/person/day	Yes	Yes	Yes*
Canada: Yukon	Yes	Site-specific	Yes	Yes	Yes*
Finland: Lapland	Yes	120 L/person/day	Yes	Yes	Yes
Greenland	No	No standard	Not applicable	No	Not applicable
Iceland	No	No standard	Not applicable	No	Not applicable
Norway	Yes	200 L/person/day	Yes	Yes	Yes
Sweden	No	No standard	Not applicable	Yes	Yes
Russia	No	No standard	Not applicable	No	Not applicable
U.S.: Alaska	No	No standard	Not applicable	Yes	Yes

*National Canadian wastewater treatment standards do not apply north of the 60th parallel. In Nunavut, Northwest Territories, and Yukon, standards are site-specific and generally met.

Table 3. Water-related infectious diseases reportable to public health authorities in the Arctic, as reported by survey respondents, 2016

		Canada: Northwest Territories	Canada: Nunavut	Canada: Yukon	Greenland	Finland	Iceland	Norway	Russia±	Sweden	U.S.: Alaska
Water-washed diseases†	Skin infection hospitalizations (impetigo, furunculosis)										
	Lower respiratory tract hospitalizations in children		X								
	Influenza, all ages	X	X	X		X				X	X
	Influenza, children	X	X	X		X				X	X
	Invasive *Streptococcus pneumoniae* infections	X	X	X	X	X	X			X	X
	Invasive *Staphylococcus aureus* infection		X								
	Methicillin-resistant *S. aureus* infection	X	X	X	X	X	X			X	
Water-borne diseases*	Hepatitis A	X	X	X	X	X	X	X	X	X	X
	Enterohemorrhagic *E. coli* (EHEC) infection	X	X	X	X	X	X	X	X	X	X
	Typhoid fever	X	X	X	X	X	X	X	X	X	X
	Cholera	X	X	X	X		X	X		X	X
	Bacillary dysentery (Shigellosis)	X	X	X	X	X	X	X	X	X	X
	Campylobacter sp. infection	X	X	X		X	X	X	X	X	X
	Salmonella sp. infection	X	X	X		X	X	X	X	X	X
	Giardia sp. infection	X	X	X		X	X	X	X	X	X
	Legionella pneumophila infection	X	X	X	X	X	X	X		X	X
	Cryptosporidia infection	X	X	X		X	X	X	X	X	X
	Vibrio species infection		X				X	X		X	X
	Naegleria fowleri (amoeba) infection							X			
	Gastroenteritis hospitalizations		X	X				X			
	Norovirus infection		X	X		X		X	X		

*Water-borne diseases are those that can cause infection by being present in drinking water.

†Water-washed diseases are those where personal sanitation practices involving water can interrupt transmission.

±Reportable diseases in Russia vary by region, and are not necessarily reportable nationwide.

Table 4. Climate change-related threats to water and sanitation access in the Arctic, as reported by survey respondents, 2016

		Number of responses						
		Canada: Nunavut	Finland	Greenland	Iceland	Norway	Sweden	U.S.: Alaska
TOTAL RESPONDENTS		**3**	**1**	**1**	**1**	**1**	**2**	**13**
Decrease in source water quantity?	Decrease in groundwater supply.						1	4
	Loss or decrease of tundra pond water or other surface water.	2						7
	Change in the course of a river that reduced access to water.	1						4
	Other decrease in quantity or volume not described here.	2		1				1
	No decrease observed	1				1		5
	Do not know	1	1		1		1	
Decrease in source water quality?	Increased salt content, dissolved solids, or other contaminants in groundwater.						1	3
	Flooding of coastal areas by storms, causing contamination of surface water with seawater.							4
	Increased salt and bromide content in river intakes due to sea-level rise.	1						
	Excessive algal, bacterial, fungal, insect, or other biological growth in source water.							3
	Other decrease in quality not described here.			1		1		2
	No decrease observed	1						1
	Do not know	1	1		1		1	5
Damage to water and sanitation infrastructure?	Damage to infrastructure due to high overland water flow (runoff) after intense storms.					1	1	3
	Damage to infrastructure from riverbank erosion after intense rainstorms.	1		1		1		3
	Damage to structure founded on frozen soil due to thawing permafrost.	3		1				4
	Other damage to water infrastructure due to event(s) not described here.	1		1				1
	No damage occurred							
	Do not know		1		1			8

Table 4 (cont.) Climate change-related threats to water and sanitation access in the Arctic, as reported by survey respondents, 2016

		Number of responses						
		Canada: Nunavut	**Finland**	**Greenland**	**Iceland**	**Norway**	**Sweden**	**U.S.: Alaska**
TOTAL RESPONDENTS		**3**	**1**	**1**	**1**	**1**	**2**	**13**
Climate-caused maintenance?	Use of dirty, contaminated, or unsafe water due to high cost of repairing or replacing damaged structures or contaminated water sources.	1					1	2
	Increase in cost of operations and maintenance.	2		1		1		6
	Other operations or maintenance issue(s) caused by climate change not described here.	1		1				3
	No climate-related issues/Do not know							
	Do not know		1		1			6
Water treatment affected?	Rise in bromide concentration requiring treatment of water source.						1	
	More difficult to appropriately treat water after increase in turbidity, pathogens, or natural contaminants in the water.	2						4
	More frequent or severe algal blooms affecting water treatment.							
	Other treatment issue(s) not described here.			1		1		3
	Treatment not affected							2
	Do not know	1	1		1			7
Climate change affected planning	Yes	2		1		1	2	6
	No							2
	Do not know	1	1		1			5