THE COLLABORATIVE INITIATIVE ON HEALTH RISKS REDUCTION STRATEGIES IN NATIVE POPULATIONS OF ALASKA AND CHUKOTKA EXPOSED TO PERSISTENT ENVIRONMENTAL CONTAMINANTS

(White Paper Extended Summary)

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INTRODCTION

The Collaborative Research and Education Initiative on Health Risks Reduction Strategies in Populations of the Chukotka and Alaska Exposed to Persistent Environmental Contaminants was implemented by the University of Illinois at Chicago (UIC) School of Public Health, Chicago, Illinois, USA (http://publichealth.uic.edu) and the North-Western State Medical University named after I.I. Mechnikov (NWSMU), St. Petersburg , Russia (www.szgmu.ru).

The preparation of this white paper is part of a broader strategy on health risks reduction strategies in this population, and it was led by Professor Irina Dardynskaia, US Director of University of Illinois at Chicago School of Public Health Arctic Health Program and Professor Valeriy Chashchin, Director of the same program at the North-Western State Medical University named after I.I. Mechnikov, St. Petersburg, Russia.

The program was funded by Eurasia Foundation U.S.-Russia University Partnership Program (UPP) which promotes academic collaboration between U.S. and Russian citizens by connecting higher education institutions and supporting the launch of new bilateral academic partnerships. UPP employs a unique partnership model that allows Russian and U.S. universities to connect with each other through an online database and participate in funding competitions for new partnership projects.

The Goal of the White paper as well as **Initiative** is to:

- present analyses of previously conducted studies to examine and compare baseline community health information needed to fully evaluate potential impact of disease and toxic environmental contaminants burden on Chukotka and Alaska Arctic communities;
- set priorities for environmental and health protection of exposed populations and to provide relevant policy development, research and training;
- conduct assessment of needs and opportunities in the area of environmental and health protection of Chukotka and Alaska these communities;
- conduct a research needs assessment in the area of food, water, and health security in the areas of Chukotka and Alaska contaminated by persistent toxic pollutants through the establishment of bi-national research teams to address issues of health risks of contaminant exposure, food and water safety, and the spread of infectious diseases, as well as trophic transfer and bioaccumulation pathways.

The **White paper** is intended to serve as an ongoing resource for public health planners, community leaders, and governmental agencies to better understand and work with Chukotka and Alaska communities to address the health issues they face. We hope that information presented in the White Paper will prompt the discussion, collaboration, and commitment of public health institutions necessary to make the indigenous community the healthiest community possible.

Data Sources for the paper. A variety of data sources are used in this analysis in an attempt to develop a comprehensive picture of evolving health in Alaska and Chukotka communities. Health indicators, data sources, and health topics were identified and selected by online data searches, review of official published governmental and health system databases, scientific reports, review of peer-reviewed published literature, reports and bulletins, personal communication with public health experts, and community health profiles prepared by a variety of organizations. Data sources were also identified through Alaska Department of Health and Social services and Chukotka Department of Public Health, as well as published data provided by the Alaska Native Tribal Health Consortium. Additional data were obtained through specific requests to the agencies or departments holding the data. The list of on-line official published governmental and health system databases: The State of Alaska Bureau of Vital Statistics; the Alaska Native Epidemiology Center; Alaska Area Indian Health Service; Alaska Native Tribal Health Consortium Alaska Tumor Registry; Behavioral Risk Factor Surveillance System; U.S. Census and the American Community Survey; the State of Alaska Epidemiology - HIV/STD Program. Alaska HIV/STD Program; The Surveillance Epidemiology and End Results Program (SEER) which is part of the National Cancer Institute; the Indian Health Service's National Patient Information Reporting System and the National Data Warehouse

BACKGROUND

Project Background. According to US National Snow and Ice data Center the Arctic is defined as the region above the Arctic Circle, an imaginary line that circles the globe at approximately 66° 34' N. However, there are other definitions of the Arctic to suit specific scientific or political interests. For example some scientists define the Arctic as the area north of the Arctic tree line, where the landscape is frozen and dotted with shrubs and lichens. Other researchers define Arctic based on temperature. Using this definition, the Arctic includes any locations in high latitudes where the average daily summer temperature does not rise above 10 degrees Celsius (50 degrees Fahrenheit).

The map of the share of Indigenous populations in the Circumpolar North is shown in Figure 1.

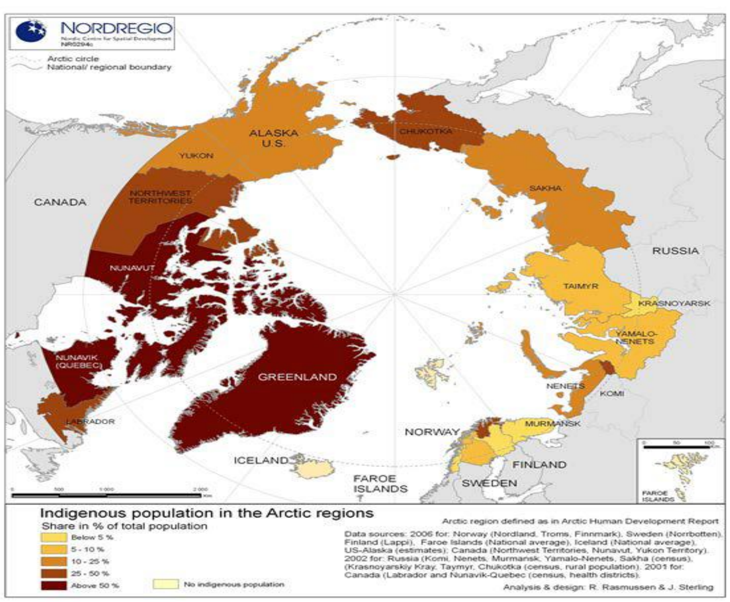


Figure 1. Indigenous population in the Arctic regions as a per cent of the total population. Source: NORDREGIO

The Arctic region is home to a number of indigenous peoples with diverse cultural, social, economic, and historical background, including the Inuit of Russia, Alaska, Canada, and Greenland; Aleut; North-American Natives (Athabascans, Gwich'ins, Métis); Sámi people of Fennoscandia; and numerous groups in Russia (e.g., Chukchi, Eveny, Evenki, and Nenets)(Arctic Marine Governance: Opportunities for Transatlantic Cooperation, 2014).

The Arctic region is a unique environment from biogeochemical and cultural perspectives. However, it has become a region where toxic chemical accumulate. Atmospheric transport of evaporated persistent organic pollutants (POPs) is a major pathway for global spread and distribution (Hardell et al., 2010; Travis & Hester, 1991; Lohmann et al., 2007; Burkow & Kallenborn, 2000). POPs, materials from former military complexes and industrial waste are among the pollutants that are disposed of in the Artic, while pollutants that arrive via long-range transport mechanisms include those used as insecticides, such as DDT (AMAP Report, 2004). POPs volatilize from lower latitudes, where they were predominantly used, and are transported to the Arctic where they are then deposited via precipitation and through other mechanisms (Jones & de Voogt, 1999; Wania et al., 1998). POPs can also be transported to the Arctic by rivers and ocean currents (AMAP, 1998). Several large rivers that enter the Arctic also carry contaminants that could be transported to coastal waters. Additionally, toxic pollutants that are produced, used, stored, or disposed of locally pollute Arctic. Air and water currents as well as some migratory species move these contaminants into the Arctic waters, sea ice, land, and from them to Arctic biota. Some of the POPs are taken up by biota including phytoplankton, algae, microorganisms, and plants which could be consumed by fish and biomagnified within food chains. POPs have a high affinity for lipids and bioaccumulate in fatty tissue (Holoubek, 2001).

The Arctic is undergoing noticeable climate changes. Arctic land surfaces are experiencing strongly amplified warming with Arctic land temperatures jumping 3 °C above the mean for the preceding 30 years (Lawrence et al., 2008). The near-surface air temperatures are rising at two to four times the global average rate (Screen & Simmonds, 2010). The overall warming trend is driving thawing of continuous permafrost, which is the perennially frozen soil that currently covers 10.5 million km^2 of the Arctic land surfaces. This thawing is rapid in some regions, e.g. Northern Alaska where extensive thermokast lakes have formed (Jorgenson et al., 2006). There was also record discharge of Eurasian rivers draining into the Arctic in 2007, linked to extreme changes in atmospheric circulation (Rawlins et al., 2009). The overall warming trend is driving thawing of continuous permafrost, which is the perennially frozen soil that currently covers 10.5 million km^2 of the Arctic land surfaces. This thawing is rapid in some regions, e.g. Northern Alaska where extensive thermokast lakes have formed (Jorgenson et al., 2006). The summer minimum area cover of Arctic sea-ice has declined markedly in recent decades, most strikingly in 2007, followed by the second lowest areal coverage in 2008. Winter sea-ice is also declining in area (though less rapidly), with a loss of 1.5 million km2 of multi-year ice coverage over 1997–2007 (Nghiem et al., 2007). Exposure of the dark ocean surface causes increased absorption of solar radiation. This warming is contributing significantly to melting on the bottom of the sea-ice (Lenton, 2012). There is a concern about the impact of ocean temperatures and increased marine traffic on bowhead whale migration patterns, disappearing nesting grounds for migrating bird species (Reiss, 2010). Climate change is also expected to accelerate the long-range atmospheric transport of persistent pollutants (Octaviani, 2015).

The Arctic warming is causing the release of chemicals that were long trapped in the region's snow, ice, ocean and soil. Chemicals that had been unavailable to ecosystems when there had been frozen in permafrost can now accumulate in fish, wildlife, and humans, threatening the integrity of the ecosystem and posing serious risks to human health. In addition to leading to the release of frozen, local toxins, climate change is expected to accelerate the long-range atmospheric transport of persistent pollutants (Octaviani, 2015).
Many persistent organic pollutants found in the Arctic, such as dioxin, furans, and polychlorinated biphenyls, are considered by the International Agency for Research on Cancer (IARC) as known human carcinogens. Others are known to have effects on endocrine system, and could impact fertility, growth, and brain development. In addition climate change shifts the geographic and temporal distribution of a range of infectious diseases. Thus, the negative impacts on public health from climate change are potentially very substantial.

The rate of development, survival and reproduction of pathogens is influences by temperature and humidity and this could influence the incidence and prevalence of many infectious diseases. Higher temperatures may also allow infected host species to survive winters in larger numbers, increase the population size and expand their habitat range (Parkinson et al., 2014). Many infectious diseases are climate sensitive, where their emergence in a region is dependent on climate-related ecological changes (Parkinson et al., 2008). There is concern that climate change may shift the geographic and temporal distribution of a range of infectious diseases, and the impact of these changes on human disease in the Arctic has not been fully evaluated.

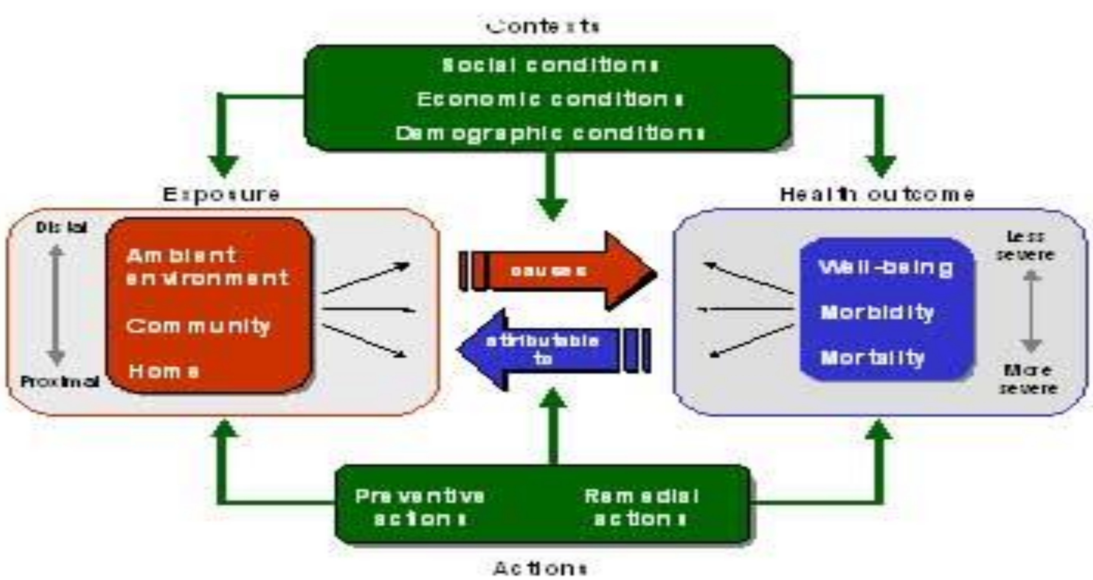
It is well known that without provision of access to clean air, soil, water, and food in a sustainable way disease and inequality can manifest uncontrollably. Environmental contaminants have been linked to serious health problems in humans and animals. They can pass from mother to the fetus during critical developmental stages, and through breast milk.

Researchers and public health officials have the responsibility to identify potential risks to *health of the Arctic populations that could cause increased rates of disease and dysfunction. These challenges are shared by all the countries with territories in the Arctic.*

The Arctic Council which represents eight nations (including the Russian Federation and US) addresses contaminants in the region and the health and well-being of the population. In April 2015, the United States assumed the chair of the Arctic Council and will have the opportunity to focus the world's attention on priorities and challenges of the region.

THE CONCEPTUAL FRAMEWORK AND METHODS

Conceptual Framework.. The conceptual framework used in this paper follows the Multiple Exposure–Multiple Effects Model (MEME), and utilizes a definition of health, which states that: *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." (*WHO, 1948*)*
The Multiple Exposure–Multiple Effects Model (MEME) (World Health Organization, 2004 p. 11).



Methods. For the purpose of this paper the Alaska and Chukotka population refers to population living in State of Alaska and the Chukotka Autonomous Okrug. This report includes data on all residents of the State of Alaska and the Chukotka Autonomous Okrug, as well as Alaska Native residents and Chukotsky district total residents constituting as many as 89.3% indigenous people. The data on Alaska indigenous population is the statewide data, and published data on the following regions of Alaska: Anchorage/Mat-Su Region, Aleutians&Pribilofs Region, Arctic Slope Region, Bristol Bay Region; Cooper River/PWS region, Interior Region, Kenai Peninsula Region, Kodiak Region, Northwest Arctic Region, Norton Sound Region, Southeast Region, and Yukon-Kuskokwim Region. In general, race and/or ethnic group and geographic region definitions and terminology are kept as they are in the source material. The data on Chukotka Indigenous population is the statewide data, and published data from Chukotka regional health statistics departments.

GEOGRAPHY

The Alaska and Chukotka Geography. The Alaska major geographical regions include the Arctic Coastal Plain, North Slope, Brooks Mountain Range, a central upland dissected by the Yukon River, the massive Alaska Mountain Range, the Pacific Coastal areas and eastern Inside Passage, and the Alaskan Peninsula, and Aleutian Islands of the southwest (World Atlas). Alaska territory is the largest state in the United States in land area at 663,268 square miles (1,717,856 km^2).
Chukotka Autonomous Okrug (ChAO) is the northeastern extremity of Asia in the Arctic Zone of Russian Federation. ChAO territory is 721,500 km2, which constitutes 4, 2% of the Russian Federation's territory
It is washed by the East Siberian, the Chukchi and the Bering Seas. Chukotka is bordered by Cape Rubicon in the south (62°N), Cape Shelagsky in the north (70°N), the left bank of the Omolon River low flows (158°N) in the west and Cape Dezhnev, which is also the eastern extremity of Russia and the entire Eurasia, in the east (170°W). About half of its territory lies beyond the Arctic Circle.
Alaska and Chukotka are divided by the Bering Strait, which is about 55 miles at its narrowest point. In the middle of the Bering Strait are two small, sparsely populated islands: Big Diomede, which sits in Russian territory, and Little Diomede, which is part of the United States. The map of Alaska and Chukotka is shown in Figure 2.

Fig.2 Alaska and Chukotka map

CLIMATE CHANGE

The Alaska and Chukotka Climate. The climate in the extreme north of Alaska is an Arctic climate with long, very cold winters and short, cool summers. The climate in Juneau and the southeast panhandle is a mid-latitude oceanic climate in the southern sections and a subarctic oceanic climate in the northern parts (The

United States of America, book). The climate in Southcentral Alaska is a subarctic climate due to its short, cool summers. The climate of the interior of Alaska is a true subarctic climate, as the highest and lowest recorded temperatures in Alaska have both occurred in the interior. Permafrost is found to some extent beneath nearly 85 percent of Alaska (Alaska Public Lands Information center).

The winter air temperature in the western continental parts of Chukotka quite often drops below −40 °C (life-time record is −60°C). The eastern districts are characterized by particularly strong winds and snow storms, which sometimes last for many days. The summer is very short, rainy and cold here, in some parts snow does not even thaw. Permafrost land covers the entire area and lies very close to the surface of soil. The climate of Chukotka is determined by its geographical location in a zone influenced by 2 oceans, with a complex atmospheric movement involving cyclones of the European Asian front, Arctic anti-cyclones and Southern cyclones. Chukotka has broken many climate records: maximum number of days without sun (Wrangel Island), highest average annual wind speed and highest frequency of snowstorms and hurricanes in Russia (Navarin Cape).

Climate Change effects in Alaska and Chukotka. Over the past 60 years, Alaska has warmed more than twice as rapidly as the rest of the United States (Chapin, et al., 2014). The state-wide average annual air temperature increasing by 3°F and average winter temperature by 6°F, with substantial year-to-year and regional variability. Arctic sea ice extent and thickness have declined substantially, especially in late summer (September), when there is now only about half as much sea ice as at the beginning of the satellite record in 1979. The University of Alaska Fairbanks Geophysical Institute study results show that much of the undisturbed discontinuous permafrost south of the Yukon River has warmed significantly and some of it is thawing (Romanovsky et al., 2013). In 2013, new record high temperatures at 20 m depth were measured at two northernmost permafrost observatories on the North Slope of Alaska and in the Brooks Range, Alaska (Romanovsky et al., 2013). All these changes raise the possibility that roads, buildings, and other structures on thawed areas will collapse, that could lead to potential for destabilization of infrastructure in many Arctic communities. In rural Alaska, permafrost thaw will likely disrupt community water supplies and sewage systems, with negative effects on human health (National Climate Assessment US Global Change Research Program, 2014).

Climate change and the related problem of coastal erosion were top concerns among some Alaska Native costal residents who were surveyed.

Permafrost temperature has also increased by 1-2°C in northern Russia during the last 30 to 35 years (Romanovsky et al., 2010b). This is similar to the warming observed in Alaska during the same period.

From 1998 through 2012 active-layer thickness has increased in the Russian European North, northern East Siberia and Chukotka. Permafrost extends from the upper layers of soil to a depth of tens and hundreds of meters in Chukotka.

The majority of indigenous people of Chukotka Autonomous Okrug (ChAO) noticed that the climate changes are significant. The following changes were often mentioned:

1. Changes in weather are becoming more noticeable with each year. Thunderstorms and lightning are frequent, which never happened before.
2. Changeability and unpredictability of the weather during all seasons is noted.
3. The spring comes earlier by one month, and winter is delayed by a month (it is apparent in the formation and breakup of ice on the sea and on rivers and lakes).
4. The summer has become hotter. In some places, which were previously covered by snow year round, snow has melted in recent years. Melting of the frozen ground is observed.
5. During periods of thaw in the fall, which occurred earlier, there are rains, which never happened before.
6. Winters have become milder and the frequency of blizzards has increased.

People also identified melting of frozen ground, coastline erosion, and increase in sea level. The state of the sea, and more specifically, the ice cover, evoke particular anxiety among marine mammal hunters. Respondents also identified the absence of "old" ice as the most significant change, and a complete absence of ice in the summer and in early fall. However some studies (Onuchin et al., 2014) showed large differences in monthly air temperature trends between Chukotka and other parts of northern Asia, with January air temperatures found to decrease considerably in Chukotka and increase simultaneously in other regions. This asynchrony was presumably a result of seasonal sea current restructuring associated with global circulation. Warming was less evident from Taymir Peninsula to Chukotka compared to interior regions (MacDonald et al., 2008). It has been hypothesized that the northwestern Pacific currents are subject to both seasonal restructuring and the regional atmospheric circulation change that seems to be responsible for wintertime cooling in northeastern Russia.

Almost thirty three percent of populations of Chukotka live in rural areas. The areas of concern in these rural areas are solid waste burning, wood smoke, and diesel emissions which come mainly from the diesel power generation, road dust, and in some areas oil and gas extraction activities (North Slope Borough Baseline Community Health Analysis, 2012; Desirae et al., 2013). Arctic climate-related factors could contribute to decreased air quality and increased levels of exposure to air pollution. It has been shown that low Arctic temperatures increase incomplete combustion products and create temperature inversions, trapping pollution near homes and people (Gordian, M.E.). Diesel exhaust contains air pollutants such as carbon monoxide, PAHs with 4- to 6-ring hydrocarbons, as well as fine particles. Motor vehicles are an additional contributor to diesel emissions. All these emissions are associated with a number of negative health effects such as eye, throat, and lung irritation, exacerbation of an existing lung condition like asthma, cough and increased phlegm, and lung cancer (AMAP Assessment 2002, 2004).

Arctic has become a region where toxic chemical accumulate, including chemicals that have been frozen in permafrost, these chemicals can now accumulate in fish, wildlife, and humans, threatening the integrity of the ecosystem and posing serious risks to human health in Alaska and Chukotka.

FOOD CONTAMINANTS

Alaska and Chukotka Native communities heavily rely on subsistence foods, for physical, cultural, and spiritual health, and also out of economic necessity (Wheatley &Paradis 1996; Suk et al., 2004; Smith, 2013). However in recent years, the diet of many indigenous people in the Arctic has changed. This is partly due to an increased availability of imported foods and partly due to fear of contaminants in subsistence foods.

Marine mammals are available for Alaska and Chukotka coastal communities, and some of these communities also incorporate muskox, moose and caribou, where available, into the traditional diet rather than relying heavily on marine resources. Riverine settlements depend more on freshwater fish and land mammals for traditional food, unless there is sharing occurring between the riverine and coastal villages (AMAP Assessment, 2015). By 1998, the harvest of marine mammals had increased in Chukotka and has remained stable since. The increase was mainly accounted for by the intensification of harvest of small pinnipeds (seals, but not walruses) (Kozlov, 2004).

Dudarev et al. (2012) performed a dietary survey that was based on self-reported weekly (monthly) food frequencies (n=453). The survey was obtained as part of a larger questionnaire completed by the participants of the AMAP-coordinated study. Two regions of Chukotka were selected for investigation, specifically, the inland Kanchalan settlement area inhabited by inland Chukchi (reindeer herders), and the coastal Uelen settlement populated by coastal Chukchi and Eskimo. The survey showed that the main food sources of coastal Chukchi and Eskimo (Uelen) were marine and fish (mainly polar cod, smelt and salmon), compared to reindeer meat and fish (mainly whitefish and grayling) consumed by the inland Chukchi (Kanchalan). The coastal group consumed more birds and wild plants, while the consumption of berries was higher among the inland Chukchi.

Alaska and Chukotka Native populations have a higher risk of contaminant exposure than non-Arctic populations Contaminants in the blubber and tissues of several Arctic wildlife species, such as polar bears, seals, Arctic fox, and beluga whales, have been found in levels equal to or higher than those in experimental lab animals. Contaminants have also been found in fish, which constitute up to 60% of the traditional foods relied upon by Alaska Natives (Kaatz, 2002). POPs of concern include aldrin, dieldrin, endrin, chlordane, DDT, heptachlor, mirex, toxaphene, hexachlorobenzene (HCB), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins (dioxin), polychlorinated furans (furans) organochlorine pesticides, polychlorinated and polybrominated diphenyl ethers (PBDEs). They are synthetic organic chemicals that break down slowly in the environment and are fat-soluble. HCH is also widely considered as a significant Arctic contaminant. During last decade the poly- and perfluorinated organic compounds (PFCs) were also studied in the Arctic environment.

The study performed by Hardell et al. (2010) examined the levels of PCBs and three pesticides (p, p9-DDE, mirex, and hexachlorobenzene (HCB) in muscle tissue from nine fish species from several locations around the Aleutian Islands of Alaska. The highest median PCB level was found in rock sole, while the lowest level was found in rock greenling. Lipid adjusted PCB values were also calculated and significant interspecies differences were found. Among the pesticides, p, p9-DDE generally dominated, and the highest level was found in sockeye salmon. Levels and distribution patterns of PTSs were studied by Dudarev et al. (2012) in selected food samples from Chukotka collected during 2001–2003. The levels of POPs in birds were 2–4 times higher than in reindeer and fish. The data also showed that all species of seals were extensively more contaminated with mercury, than terrestrial mammals, birds and fish. The highest mercury levels were observed for Bearded Seal, particularly in the liver. Meat of walruses and Grey Whales was less contaminated with mercury, while kidneys and liver had mercury levels 2–4 times higher than the Russian maximum permissible concentrations (MPC). Mercury levels in whale kidney were lower than in liver. Waterfowl mercury content for muscle tissue was also high. Livers of whales, walruses and seals were also highly contaminated with cadmium. The authors also found elevated levels of cadmium and mercury in reindeer meat, liver and kidneys, more specifically 5–15 times higher than MPC. PBDEs and HBCD spatial trends in seabirds and marine mammals were similar to those seen previously for polychlorinated biphenyls (PCBs), with highest concentrations found in organisms from East Greenland and Svalbard. PBDE and HBCD concentrations are higher in marine top predators such as some killer whale populations in Alaska and glaucous gulls from the Barents Sea area (de Wit et al, 2010). Findings of BTBPE, HxBBz, PBEB, PBT and TBECH in seabirds and/or marine mammals indicate that these compounds reach the Arctic, most probably by long range atmospheric transport and accumulate in higher trophic level organisms and that increasing use as PBDE replacements will lead to increasing concentrations. Scientists have detected flame retardants hundreds of miles from human sources, including in the tissue of sperm whales, which spend most of their time in deep ocean waters, and of Arctic marine mammals, suggesting long-distance transport by water and air currents. In wildlife perfluorooctane sulfonate (PFOS) was generally measured in the highest concentration, followed by either perfluorononanoate (PFNA) or perfluoroundecanoate (PFUnA) (Butt et al., 2010). However, some whale species show relatively high levels of perfluorooctane sulfonamide (PFOSA) and seabirds are typically characterized by high proportions of the C11–C15 PFCAs. PFOA is generally infrequently detected and is present in low concentrations in Arctic biota. PFOS have been detected in the liver of the Canadian Arctic polar bear in the ranges from 1,700 to more than 4,000 nanograms per gram (ng/g) (Lau et al., 2007; Martin et al., 2004; Young et al., 2007). Causes of long-range PFC transport include (1) atmospheric transport of precursor compounds (such as perfluoroalkyl sulfonamides), followed by degradation to form PFCs and (2) direct, long-range transport of PFCs via ocean currents or in the form of marine aerosols (Armitage et al., 2006; Post et al, 2012). The PFCs are transferred from low to higher trophic level organisms which increase their potential for bioaccumulation and bioconcentration. Because of their persistence and long-term accumulation, higher trophic level wildlife such as fish, piscivorous birds and other biota can continue to be exposed to PFOS and PFOA (EPA, 2006a; UNEP, 2006). The bioaccumulation potential of PFCs increases with increasing carbon chain length (ATSDR 2009; Furdui et al., 2007). PFOS is the only PFC that has been shown to accumulate to levels of concern in fish tissue. The estimated bioconcentration factor in fish ranges from 1,000 to 4,000 (EFSA, 2008; MDH, 2011; OECD, 2002; ATSDR, 2009; EPA, 2009).

HUMAN EXPOSURE TO CONTAMINANTS IN ALASKA AND CHUKOTKA

Native communities of **Alaska and Chukotka** have exposure to high concentrations of toxins, such as persistent toxic substances, particularly PCBs, DDT, lead and methylmercury due to progressive magnification through the food chain (Van Oostdam et al., 1999). Overexposure to POPs and heavy metals have been shown in indigenous people living in Murmansk, Nenets, Taimyr and Chukchi districts of Russia from both distant (5-20%) and local sources (80-95%) (Chashchin, 2009). Canadian studies have shown that the concentration of PCBs in the blood of adult Inuit is approximately seven times higher than in other North American populations (Heiman, M., 2000).

To address concerns arising from possible increased human exposure in the Arctic and possible effects of POPs, all circumpolar countries agreed in 1994 to monitor specific human tissues for contaminants in the Arctic under the Arctic Monitoring and Assessment Program. Indigenous volunteers in eight circumpolar countries contributed blood samples that were analyzed for 14 PCB congeners and 13 organochlorine pesticides. The results of the **Alaskan** Native Maternal Organics Monitoring (AN MOM) study showed that concentrations of oxychlordane, p, p'-DDT, *p, p'*-DDE, Mirex and PCB138 declined steadily between 1999–2003 and 2009–2012 (AMAP Assessment 2015). The concentrations of *trans*-nonachlor, HCB, β-hexachlorocyclohexane (HCH) and in the sample population from 2004–2006 were higher than those found in 1999–2003. For *trans*-nonachlor and HCB, concentrations in 2009–2012 were lower than those of 2004–2006, but not yet as low as 1999–2003. For both β-HCH and PCB153, the current concentrations were lower than those seen in the past two sampling periods, despite the higher concentrations in 2004–2006. The concentrations of PBDE 153 were higher in 2009–2012 than in 2004–2006, although the other PBDEs were lower than in 2004–2006. High levels of PBDEs were found in the maternal population in Alaska with the most elevated levels of PBDE47 and PBDE99 among all Arctic regions. Data from AN MOM study also shows that perfluorooctane sulfonate and perfluorooctanoic acid increased in mothers over the time period. Perfluorononanoate also showed a small increase. The geometric mean concentration of perfluorodecanoate remained similar, although the maximum decreased. Perfluorohexane sulfonate (PFHxS) was measured for the first time. Comparing the recent metals analysis ((AMAP Assessment 2015) with data reported by AMAP (2009) shows that levels Cd, Pb and Hg have been decreased in Yupik mothers. Although the statistical significance of these trends was not measured, there has been a steady decline in Cd concentrations across the three sampling periods, and Pb and Hg concentrations in 2009–2012 were less than half the values of 2004–2006. Selenium (Se) was also reported for the first time. Levels reported in Yupik mothers are similar to those found in US females (all ages), which had a geometric mean of 188 μg/L blood Se in the National Health and Nutrition Examination Survey (NHANES) (CDC 2014).

Study carried out within the framework of the large-scale international project "Persistent Toxic Substances (PTS), Food Security and **Indigenous People of the Russian North**" showed that persistent toxic substances (PTS) in human blood of the Russian Arctic natives were similar to those in the coastal areas of Greenland and Canada, including elevated levels of oxychlordane and polychlorinated biphenyls (PCBs) (AMAP 2004). However for some POPs such as toxaphens and mirex, these levels were lower (Dudarev et al., 2003). Geographically, the highest blood levels of the majority of pollutants were detected in coastal Chukotka due to traditional marine mammal consumption and additional contamination of foodstuffs during storing (Dudarev et al., 200). Concentrations of PCBs and mercury in women of reproductive age from coastal Chukotka were found to exceed the internationally recommended levels of concern and, in some cases (up to 20%), action levels. Concentrations of lead in about 35% of blood samples from women and 75% from men from coastal Chukotka, and about 60% from men from inland Chukotka were found to exceed the action level.
Chukotka Mother-Child study of 346 pregnant women and their newborns showed association between adverse pregnancy outcomes, women menstrual status, and newborns health with mother exposure to PCBs. This association was statistically significant for some parameters even at relatively low concentrations of PCBs in maternal serum. The weight of evidence strongly suggests that some POPs have the potential to cause adverse health effects in humans such as low birth weight, premature births, still births and birth defects statistically tightly correlated with the level of serum concentrations of PCBs, lead and DDTs measured in maternal blood (AMAP Report 2004). The phenomenon of altered offspring sex ratio has also been found in indigenous population of Chukotka Peninsula with highest exposure to PCBs as measured by concentrations of 15 selected PCB congeners. Elevated levels of total PCBs in the range from 1.0 to 4.0 μg/L were associated with increased sex ratio (1.66±0.32; $p<0.001$), whereas the PCB serum concentrations higher than 4.0 μg/L were significantly correlated with the decreased sex ratio (0.41±0.28). However that observation has a number of limitations and uncertainties. A follow-up study on contaminants and human health for the period from 2001 to 2012 in the monitored indigenous population living in the Pacific Chukchi district of Chukotka clearly shows that previously observed decline in sex ratio is likely to be still present. For the same period of observation there have been reported 1513 births given by indigenous women resident of the district. The sex ratio was 0.754 with the lower proportion of male offspring, comparing to the national average of 1.06 ($p< 0.0001$). The offspring

sex ratio in the coastal indigenous population of Chukotka is comparable to that reported for highly irradiated persons in occupational settings (Hama Y, et al., 2001). Lower proportions of male offspring have been also observed in populations exposed to polychlorinated biphenyls (PCBs) (Del Rio Gomez et al., 2002; Weisskopf et al., 2003), and tetrachlorodibenzo-p-dioxin (TCDD) (Dardynskaia et al., 2006).

A case-control study of 170 women (75 cases, 95 controls) recruited from the **Alaska** Native Medical Center showed that the odds of being a breast cancer case were higher for those with above the median urinary mono-(2-ethylhexyl) phthalate (MEHP) concentrations, and that the BDE-47 was significantly higher in breast cancer case women (GM=38.8 ng/g lipid) than in controls (GM=25.1 ng/g lipid) (p=0.04) (Holmes et al., 2014).
It is also likely that the climate change and contaminant exposure could result in changes of rates of respiratory, skin and intestinal infections, and many other conditions caused by bacterial, viral and parasitic agents in Arctic populations (Parkinson et al, 2014).

SOCIAL DETERMINANTS OF HEALTH IN ALASKA AND CHUKOTKA RESIDENTS

According to the WHO, the social determinants of health are the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power and resources at global, national and local levels. The social determinants of health are mostly responsible for health inequities - the unfair and avoidable differences in health status seen within and between countries (WHO SDH). Social and physical conditions shape whether individuals stay healthy or become ill. Moreover, these conditions are likely determinants of health and may serve as useful lens through which to view the health disparities that could lead to preventable health outcomes (Driscoll 2013).

Alaska. According to Healthy Alaskans 2020, Alaska is an extreme frontier state with 1.2 persons per square mile spread throughout 362 communities compared to the entire U.S. which has 87.4 persons per square mile. In 2012, Alaska had a population of 732,298 (.2% of US populations) spread across an area larger than California, Texas, and Montana combined or 1/5 the landmass of the entire U.S. The area of Alaska is 663,399 sq. mi (1,717,856 sq. km) vs Chukotka 284,800 sq. mi (737,700 sq. km). One quarter of the population lives in communities with less than 2,500 people. Some 200 villages are reachable only by air or boat. Since statehood in 1959, when the population was roughly 224,000, Alaska has grown at varying rates. Both “natural increase” (the difference between births and deaths) and “net-migration” (the difference between in-migration and out-migration) have played important roles. Since statehood, natural increase has provided Alaska with steady growth. The discovery of oil in Prudhoe Bay in 1968 and the subsequent construction of the Trans-Alaska Oil Pipeline in the 1970s had a massive effect on Alaska’s population, both immediately and in the following decades (Alaska Department of Labor, 2014).
Alaska’s population is projected to increase from 732,298 in 2012 to 925,042 in 2042. Alaska’s Native population is expected to continue to grow over the projection period, from 122,944 in 2012 to 161,483 in 2042. As of July 1, 2013, Alaska’s population was 15% Alaska Native or American Indian, 67% white, 6% Asian, 4% African American, 1% Native Hawaiian or other Pacific Islander, and 7% multi-race. Alaskans of Hispanic origin made up 7%. Boroughs and census areas in northern and western Alaska had larger proportions of Alaska Natives. (Alaska population estimates, 2015). At present Alaska Natives comprise 19 percent of the population of the State of Alaska (Norris et al., 2010). About two-thirds of Alaska Natives reside in rural communities with no road connections to major urban population centers.

Chukotka. The total population of Chukotka in 2011 was 50,800, with a population density of 0.07 person/km^2. About 16,000 persons were officially classified as ‘‘numerically small nationalities of the Russian North’’, that is, indigenous people, among whom are Chukchi (75%), Eskimo (9%), Even (8%) and Chuvan (6%). During the past 20 years, the population of Chukotka has decreased by two-thirds due to emigration of non-indigenous people, including the families of military personnel. Within Chukotka there are 3 cities (the capital Anadyr, Bilibino and Pevek), 15 townships and 45 villages in 6 administrative districts (Anadyrskiy, Bilibinskiy, Chaunskiy, Chukotsky, Iultinskiy and Providenskiy (Dudarev et al., 2013). The 2 major groups of indigenous people in Chukotka are the Chukchi and the Eskimos (Abryutina, 2007). Their population has remained relatively stable, fluctuating between 11,000 and 13,000 Chukchi, and between 1,000 and 1,500 Eskimos. According to the 2002 census, 15,767 Chukchi lived in the Russian Federation, of whom 12,622 persons (about 70%) lived in Chukotka. Chukchi live in settlements of Chukotka together with Russians, Eskimo, Evens and other ethnic groups. There are no exclusively Chukchi settlements, although the Chukchi constitute the majority group in most of the villages. Today, the Chukchi are mainly engaged in commercial reindeer breeding. Chukotka is the only region in the world where stock of domestic reindeer is growing, but it is much less than it was during the Soviet period. While reindeer breeding is a collective occupation, fishing and hunting are common as personal and family activities of the indigenous population (Dudarev et al., 2013). Eskimo live in the eastern coastal settlements of Chukotka. There are about 1,450 Eskimos today. Almost 80% of the Eskimo population is concentrated in Providenskiy and Chukotsky districts, especially in 2 villages – Novoje Chaplino and Sireniki. Relatively large Eskimo communities can also be found in 5 villages – Provideniya, Lavrentija, Lorino, Uelkal and Uelen. The proportion of mixed marriages of Eskimo (with Russians and Chukchi) varies from 40 to 65%. The current distribution of the Eskimo population is the result of large-scale forced relocations of some 800 Eskimos in 1958, about 70% of the population, leaving behind some of the previously large villages, such as Naukan and Chaplino (Krupnik & Chlenov, 2007).

Alaska. Among the overall Alaskan population, 91.4% had a high school diploma or higher, and 26.6% had a bachelor's degree or higher. However, American Indians and Alaska Natives have lower educational achievement that the general population: 82.2% of American Indians and Alaska Natives 25 and older have at least a high school diploma or GED certificate. In addition, 17.6% obtained a bachelor's degree or higher (American Community Survey).

Among overall **Chukotka** population 93 % graduated from secondary school, 23% have a bachelor's degree or higher. 42 persons (0.08%) have PhD degree.
Educational characteristics of surveyed indigenous populations clearly indicate that those people who successfully finished a secondary school (11 years of education) or graduated technical college (12 years of education) are the majority of indigenous residents. In the meantime there is quite a significant number of those either never taught in school or was able to obtained only rudimentary education (4 years) - 9.6 % vs 1.8% in non-indigenous group in ChAO.

ECONOMIC FACTORS

Alaska. Several impending factors challenge Alaska's economy. First, the decline in federal spending and employment Secondly, Alaska expects continued low oil prices and potential reductions in state oil and gas tax credits to the petroleum industry. Alaska has a deficit, likely to exceed $3.5 billion in FY16 that threatens the state's Constitutional Budget Reserve Fund (Gunnar Knapp et al., 2016).
For the general Alaskan population, the median household income (in 2014 dollars) for 2010-2014 was $71,829 whereas for of single-race American Indian and Alaska Native households in 2013 were $36,252. Overall 11.2% of Alaskans were considered in poverty, and 29.2% of single-race American Indian and Alaska Natives were in poverty, the highest rate of any race group in the U.S. (US Census; 2013 American Community Survey). Moreover, only 29% of American Indians and Alaska Natives age 16 and over work in management and professional occupations, in comparison to 40% of Whites (USHHS OMS).

Chukotka. Chukotka underwent massive social and economic changes since the breakup of the Soviet Union, although the economy has rebounded and infrastructure has improved during the 2001-2008. Time-trend of monetary income clearly indicates advancing growth of this indicator in ChAO as compared to the Russia's average. In 2014 this indicator has reached 208% of the national average.
Average per capita money income at 2010 prices in Chukotka Autonomous Okrug (ChAO) was 44,821.1 rubles.
The socio-economic situation of the indigenous peoples in the Russian Arctic is more sensitive.

The living conditions of the Indigenous people continue to be a cause of concern with high rates of poverty and unemployment. The surveys of household budgets for this group have demonstrated that the monthly GDP per capita is 4.1 times below the regional average.

ALCOHOL, TOBACCO AND SUBSTANCE ABUSE IN ALASKA AND CHUKOTKA POPULATION

Alcohol Use and Abuse

Alaska. Alcohol was introduced into Alaska during the Russian period (Spein, 2008). By the 19th century it became an important trading commodity and its use and misuse was widespread among indigenous populations. Many US data sources combine American Indian and Alaskan Natives (AI/AN). Jointly AI/AN persons had a substantially higher rate of alcohol-attributable death than Whites from 2005 to 2009 (rate ratio = 3.3). For acute causes, the largest relative risks for AI/AN persons compared with Whites were for hypothermia (14.2) and alcohol poisoning (7.6). For chronic causes, the largest relative risks were for alcoholic psychosis (5.0) and alcoholic liver disease (4.9) (Landen, et al., 2009).

Of total deaths (1999-2009), AI/ANs had a substantially greater percentage of alcohol-attributable deaths than US Whites. AI/males had the highest race-and sex-specific rate. The Alaska region had the highest AI/AN rate and the highest AI/AN female rate. Among leading causes of death, the highest relative risks for hypothermia, alcohol poisoning, alcoholic psychosis, alcoholic liver disease, and alcohol dependence. Alcoholic liver disease is a significant prevention opportunity for AI/persons with a high relative risk and is the cause of the most alcohol-attributable deaths.

In Alaska, data from the late 1990s indicated that alcohol-related deaths abstracted from particular causes of death codes accounted for 7% of all deaths among Alaska Natives in contrast to <1% for the US population (Spein, 2008). In the period 2004-2008, alcohol abuse represented 4.8% of the leading causes of death among Alaska Natives versus only 0.3% for US whites. Mental and behavioral disorders due to alcohol abuse are the fifth leading cause of death among AN/AI people with a mortality rate 16.1 times that of US whites. Between 1980-1983 and between 2004-2008, AN/AI alcohol abuse mortality rates rose 34% while US White mortality rates increased 20% (Holck et al., 2013)

The percentage of Alaskan adults who binge drink has fluctuated slightly over the past 2 decades, ranging from a high of 25% in 1994 to a low of 16% in 2008 (ADHHS Binge Adult). In 1997-2000, the adult rate was 20% (30.7% men; 11.1% women). In Alaska, 20.8% of adults and 16.7% of high school students reported binge drinking in 2011 (CDC Prevention Status Report, 2013).

The prevalence of binge drinking is higher among men (26%) than women (14%). Alaskans over the age of 64 are less likely to binge drink (6%) than Alaska adults in other age groups (17% to 29%). Asian and Pacific Islander adults have a lower binge drinking prevalence (4%) than most other racial/ethnic group in Alaska (ranging from 18% to 23%). There are no differences in binge drinking prevalence by region, education, or income level. The Alaska adult binge drinking rate has consistently been slightly higher than the median for the United States. (ADHHS Binge Adult). However, the prevalence of alcohol dependence among current drinkers was significantly higher among American Indians or Alaskan Natives (9.0%; 95% CI, 6.8%–11.8%) relative to other racial/ethnic groups. Moreover, American Indians or Alaskan Natives binge drinkers had a significantly higher prevalence of alcohol dependence than those in their cohorts in the US (Esser 2014).

Chukotka. The indicator of total alcohol consumption in the Chukotka AO exceeds the national average by more than 2 times. Alcohol related disorders in the morbidity (ICD 10 Code F10) are also at a highest level. In general, the Far East Federal District primary indicator of the incidence of chronic alcoholism (alcoholic psychosis, alcohol dependence syndrome) was 190.3 per 100 thousand people. Of the subjects constituting the Far Eastern Federal District, the highest rates of chronic alcoholism is reported for the Chukotka Autonomous District - 549.6 per 100 thousand people. The total increase in the prevalence of alcoholism in the past 5 years was 16.3%. The highest incidence rates of alcoholism in 2008 were reported for Pacific coastal areas predominantly resided by indigenous population. In Providenskiy district area – 1,000.0 per 100 thousand people, or 1.0% of the total population of the area. High rates are also observed in Beringovsky area - 961.5 per

100 thousand residents and in Chukchi district - 934.8 per 100 thousand residents. This district was the leader in the prevalence rates of alcoholism. Up to 46% of total deaths are related to alcohol abuse in Chukotka.

Alcohol use during pregnancy

Alaska. In 2012, 3.5% of Alaska Native mothers reported any use of alcohol during pregnancy. Alcohol use among Alaska Native mothers was significantly higher than that of Alaska White mothers (2.4%, $p<0.01$). From 1990 to 2012, the percentage of Alaska Native mothers consuming alcohol during pregnancy decreased significantly ($p<0.01$), and prenatal alcohol use varied by tribal health region, ranging from <1% to 6.0%. The Arctic Slope, Northwest Arctic and Aleutians & Pribilofs Tribal Health regions have the highest prevalence of alcohol use in Alaska (Alaska Bureau of Vital Statistics). Alaskan Native teen mothers have a higher prevalence of alcohol, tobacco, and other substance use. During 1989 to 2010, the percentage of Alaska Native mothers who reported consuming alcohol during pregnancy decreased significantly ($p<0.01$) from 21.4% to 5.3% (vs White women dropping from 7.6% to 2.2%), with most of the reduction in the 1990's though alcohol use varied by tribal health region, ranging from a high of 6.7% to a low of 1.7%.

Chukotka Judging from questionnaire studies alcohol abuse during pregnancy in the Chukotka region was rather high reaching 23% of total number of pregnant women but the ethnicity specific data is not available. According to the Yearly Reports on Regional Health Statistics alcohol related disorders among female population of Chukotka is gradually decreased. This positive effect may well have been related to the regional alcohol abuse prevention program implemented in 2010 with special emphasis to pregnant women and children.

Adolescent Alcohol Use

Alaska has conducted a statewide Youth Risk Behavior Survey in 1995 and biennially from 2003. Current alcohol consumption among adolescents has declined by over 50% between 1995 and 2015 for both all Alaskans and Alaska Natives. The prevalence rate was 47.5% for all Alaskans in 1995, declining to 22.0% in 2015.

Alcohol consumption is the most commonly used substance by adolescents in Alaska while current uses of marijuana and cigarettes exceed current alcohol use among Alaska Native adolescents. Although the majority of adolescents reported using alcohol during their lifetime for the period between 1995 and 2015, major declines have occurred in the percentage reporting first use of alcohol before age 13, from 36.7% among all Alaskans in 1995 to 14.3% in 2015.

Declines in current alcohol use have been greater among males. Adolescent Alaska Natives are at decreased risk of current alcohol use as compared to those who are White and Hispanic adolescents. However, the percentage of current alcohol use increases with age among adolescents and through the four years of high school. Higher academic achievement (mostly As and Bs) is associated with lower current alcohol use.

Chukotka. Annual per capita alcohol consumption in Chukotka is 26 liters, versus 18 liters in the whole of Russia. The problem is so serious that the sale of hard liquor is banned throughout Chukotka from between 8 o'clock in the evening until noon the next day. However alcoholism still affects 3.5 percent of the population of Chukotka As indicated in the preamble of the Regional alcohol abuse prevention program the prevalence of alcohol use disorders among adolescents is at the level of national average. The prevalence rate among 16-17 years old adolescent was 454.4 per 100,000 in year 2010, decreasing to 323.4 in year 2014.

According to Bernard Segal & Brian Saylor (2007) drinking has been reported to be high among **Alaska Natives** (Segal, 1999; Hesselbrock et al., 2000), as well as among **Chukotka Natives**. Drinking among Chukotka Natives was much higher than among Alaska Natives for both men and women. Earlier research in the Chukotka region (Avksentyuk et al, 1995) reported a pattern of drinking among Chukotka Natives that could be characterized as episodic drinking (several times a month), with very big amounts of alcohol consumed per drinking occasion. It can be assumed that this pattern of drinking continues to be perpetuated.

This is a drinking style that has also been found to be present among Alaska Natives. Both Alaska Native men and women reported lower rates for having consumed alcohol compared to their Russian Native counterparts. Both the Alaska Native and Russian Native women reported less drinking than males.

Poisonings: Drugs and Alcohol

Alaska. Data on drug and alcohol poisoning are reported as unintentional or intentional injuries. Unintentional poisonings result from unplanned overconsumption of alcohol or drugs. Intentional poisoning is the deliberate overconsumption of alcohol or drugs and is typically categorized as a suicide, suicide attempt, homicide, or assault.

During 2002–2011, alcohol and drug poisoning combined were the mechanisms for 15.8% of all unintentional injury deaths for people of all ages in Alaska and 14.4% of all AN/AI injury deaths. Among the 276 AN/AI unintentional poisoning deaths, 51.4% were caused by drugs, 41.3% by alcohol, and 7.2% by solvents, gases, vapors and other poisons (Alaska Native Epidemiology Center).

In contrast, in 2010 nationwide, 90.8% of unintentional poisoning deaths involved drugs per the Centers for Disease Control and Prevention. The age-adjusted rate of unintentional alcohol and drug poisoning deaths for AN/AI (25.3 per 100,000) was 2.3 times that of non-Natives (10.9 per 100,000) in Alaska. Alcohol and prescription or illicit drugs were the most frequently reported poisons involved in hospitalization of children under age 17. Other poisons reported included non-potable alcohols and petroleum products (Strayer).

Almost two out of three (63.2%) of intentional and almost one in three (32.5%) of unintentional injury hospitalizations among Alaska Native people were reported as alcohol-related. Moreover, almost three out of five (57.5%) suicide attempt and self-harm and 71.4% of assault injury hospitalizations were alcohol-related.

Chukotka. Acute fatal alcohol poisoning in Chukotka was 44. 1 per 100,000 residents decreasing to 32.8 in year of 2014 exceeding the national average which is 28.17 per 100,000 residents.

Tobacco use: adults

Alaska. The State's percentage of all adult smokers has declined approximately 24% since 1996 to a statistically significant 21.9% in 2013. Among non-Native adults, smoking has decreased significantly from 24.9% in 1996 to 18.9% in 2013 (ADHS 2015 Tobacco facts).

In 2013, approximately 1 in 4 young adults age 18 to 29 (25.8%) as well as 1 in 4 adults aged 30 to 54 (24.5%) reported current smoking. This proportion remains significantly higher than the smoking prevalence for adults age 55 and older.

Alaska Native men are significantly more likely to smoke than any of the other race and gender groups (ADHS 2015 Tobacco facts). Smoking is widespread in all Inuit regions and the proportion of the population who smoke is higher than in most other regions of the world. (Spein, 2008). Among Alaskan Natives, in 1991-3, 42% of adult males and 36% of females were daily/regular smokers (Kaplan 1997).

Smoking prevalence has remained high for Alaska Native adults, and has not changed significantly since 1996. According to the BRFSS, in 1997-2000 39% of adults Alaskan Natives smoke cigarettes (38.4% men; 38.6% women)(BRFSS, 2003). In 2013 about 2 in 5 (42.3%) Alaska Native adults smoke compared to 1 in 5 (19%) non-Native adults (Hispanic, White, African American, or Asian adults). (ADHS 2015 Tobacco facts)

Alaska Native women are significantly less likely to smoke than Alaska Native men. Even though smoking prevalence between non-Native men and women in Alaska is not significantly different, Alaska Native women are significantly more likely to smoke than both non-Native men and women. (ADHS 2015 Tobacco facts)

Adult smoking is significantly higher among non-Native adults of low socio-economic status (SES) (38.4%) and among Alaska Native adults (42.3%), than their counterparts. Among non-Native adults age 25 to 64, those of higher SES are significantly more likely than those of low SES to use smokeless tobacco (4.8% vs 2.4%). (ADHS 2015 Tobacco facts)

Chukotka. The official tobacco smoking statistics is rather scarce. It is reported that population of Chukotka annually spent 1.2 -1.5 million roubles for buying tobacco products (about 3% of total buying expenditures in the market). From the questionnaire study (AMAP,2004) it was found that 73.1% of adult indigenous men and 59.4% women are regularly smoking vs 28% and 68% obtained from the referent population of Murmansk region.

Tobacco use: Youth

Alaska. Most tobacco users become addicted as teenagers. In 1995 among adolescents and youth in Alaska, 63% of male youth and 61% of females smoked (Peterson et al., 2004). Smoking among high school students has declined more than 70%, from 37% in 1995 to 11% in 2013. However, Alaska Native high school students—both boys and girls—are significantly more likely to smoke than students from other race groups, although the gap has decreased considerably since 2003. From 2007 to 2015 there were significant decreases in initiation of smoking (32.5% ever tried, 2015), current (11.1% in 2015), frequent (3.7% smoked on 20 of last 30 days, 2015), and daily smoking (2.6% in 2015). (ADHS 2014 Tobacco Facts).

Chukotka. Data was not available.

Smoking during pregnancy

Alaska. Overall, prenatal cigarette use in Alaska has decreased significantly from 21.6% in 1996 to 15.1% in 2008 to 13.1% in 2012, as well as among non-Native women (from 18% to 9%). However, most of the decrease occurred between 1996 and 1997. Prenatal smoking prevalence has not changed significantly among Alaska Native women. Among Alaska Native women, for the period 2004 to 2008, prenatal smoking prevalence was significantly higher in four tribal health regions: Arctic Slope, Bristol Bay, Northwest Arctic, and Norton Sound (Young, 2011)

Chukotka. Data was not available.

Physical activity

Alaskans follow national trends of becoming more sedentary. 52.2% of adults achieved at least 300 minutes a week of moderate-intensity aerobic physical activity or 150 minutes a week of vigorous intensity aerobic activity (or an equivalent combination); 22.4% of Alaska's adults reported that during the past month, they had not participated in any physical activity (CDC,BRFSS Physical Activity Trends by State 2009-10).
Due to less than optimal dietary and physical fitness levels, overweight and obesity continue to be a serious health concern in Alaska. About 2 out of every 3 Alaska adults are now overweight or obese affecting individuals of all ages, from all areas of the state, of all racial and ethnic backgrounds, and with all levels of education and income. Both conditions increase the risk for a number of health problems, including chronic diseases, which can lead to reduced quality of life and premature death (Alaska obesity 2014).

Chukotka. Region specific and ethnicity specific data was not available.

OVERALL HEALTH OF ALASKA AND CHUKOTKA POPULATION

Data Source: Alaska Bureau of Vital Statistics; Centers for Disease Control and Prevention, National Center for Health Statistics, Alaska Native Epidemiology Center. Chukotka Data sources: Federal State Statistics Service Portal and Regional Health Statistics Reports.

Alaska. The percentage of Alaska adults who report having very good or excellent health status declined slightly between 1993 (64%) and 2010 (57%). Significantly more non-Natives (64%) than Alaska Natives

(43%) rate their health as very good or excellent. Ratings of general health status increase with education and income (2008-2010 BRFSS).

Birth rate

According to **Alaska** Native Epidemiology Center, in 2013 the unadjusted birth rate for Alaska Native people statewide was 19.2 births per 1,000 persons, and Alaska Whites was 13.8 births per 1,000 persons, which is 1.4 times higher that of Alaska Whites in 2013.
The unadjusted birth rate for Alaska Native people decreased during period of time between 2000 and 2013. During 2009 to 2013, unadjusted birth rates varied significantly by tribal health region, ranging from 12.9 to 30.3 births per 1,000 population.

Chukotka. According to World Atlas in 2013 Chukotka Autonomous Okrug unadjusted birth rate was 13.1 births per 1,000 persons.

Preterm birth

Alaska. During 2000-2013, the percentage of Alaska preterm births fluctuated, with no significant overall change during the time period. In 2013, 12.1% of Alaska Native infant births were preterm, significantly higher than Alaska White infants (7.9%).
Chukotka. During 2006-2014, the proportion of preterm births (gestational age less than 37 weeks) in Chukotka general population had a temporal trend to increase from 2.2% of live births in 2006 to 6.7-5.5
% in 2010-2014.

Low birth weight

Alaska. There was no significant difference between the percentage of Alaska Native and Alaska White **low** birth weight infants ($p>0.01$). In 2013, 5.8% of Alaska Native infants statewide were born with low birth weight, and during 2009-2013, the percentage of low birth weight Alaska Native infants varied by region ranging from 3.6% to 7.7%.

Chukotka. Statistics is not available for newborns having weight lower than 2500 g at birth.

Life expectancy at birth

Alaska. Life expectancy at birth among the Alaska Native population (both genders combined) has increased by 5.2 years since 1980-1983, reaching 70.5 years in 2004-2008. Alaska Native females have a higher average life expectancy than males (73.5 vs. 67.5 years); however, the gender gap has decreased with each decade since 1980. Life expectancy has increased steadily, however a disparity continues to exist between the Alaska Native and Alaska White life expectancies. In 2004-2008 there was a gap in life expectancy of 7.2 years. Alaska Native life expectancy varies by tribal health region, ranging from 67.6 years to 72.6 years and on average constitutes 70.5 years. The lowest life expectancy among Alaska Natives is in the Arctic Slope Region (67.6) and at the Aleutian-Pribilof Region (68.1).

Chukotka. Life expectancy at birth (LE) computed for the year of 2014 in Chukotka population is significantly lower as compared to the national averages. Urban female population is of 65.56 years and rural is of 59. 64 versus the national averages of 76. 83 and 75. 43 correspondingly. Chukotka urban male population LE is of 63.22 and rural – only 46.41 years versus the national averages as 65.75 and 64.07. It is worth to mention that rural population of Chukotka represents 78, 2%

All-cause mortality

Alaska. American Indians and Alaska Natives (AI/ANs) experience a high burden of mortality and other disparities compared with the general population (Dankovchik J et al., 2015). According to Alaska Native Mortality Update: 2009- 2013, during the period, 2009-2013, a total of 4,345 Alaska Native deaths were reported. The average annual age adjusted mortality from all causes for Alaska Native people, both genders combined, was 1076.7 compared to 736.9 per 100,000 population for U.S. Whites; a statistically significant rate ratio (RR) of 1.5. The rates for Alaska Native males and females were both significantly higher than U.S. Whites. The three leading causes of excess mortality among Alaska Native people, both genders combined were unintentional injury (22.2%), cancer (16.1%), and suicide (11.3%). Among Alaska Native men, unintentional injury (38.3%), suicide (34.9%), and homicide (7.9%) were the leading causes of excess mortality. Among Alaska Native women, unintentional injury (19.8%), cancer (12.3%), and chronic liver disease (7.9%) were the leading causes of excess mortality. These three leading causes of death for Alaska Native people, cancer, heart disease, and unintentional injury, were responsible for 2,183 deaths, just over half of the total 4,345 deaths. The Alaska Native and U.S. White populations shared eight of the ten leading causes of death, although in different rank order.

The Average annual age-adjusted all-cause mortality among Alaska Native people was 1133.1 per 100,000 population in 2008-2011.There has been a significant decrease in all-cause mortality among Alaska Native people between 1980 and 2011 ($p<0.01$). During the same time period, all-cause mortality has decreased more for Alaska non-Native people, leading to a widening disparity in mortality rates. The Alaska Native all-cause mortality rate was 1.7 times higher than the non-Native rate in 2008-2011 ($p<0.05$). Alaska Native males have an all-cause mortality rate that is 1.3 times higher than Alaska Native females. This is similar to the gender differences seen in the non-Native and U.S. White populations.

All-cause mortality rates vary by tribal health region, ranging from a low of 809.4 to 1672.4 per 100,000. The highest average annual age-adjusted all-cause mortality rate per 100,000 population in 2008-2011 was in Interior, Arctic Slope and Norton Sound tribal health regions of Alaska (1672.4; 1580.8 and 1474.6 respectively).

Chukotka. A crude all-cause death rate in total Chukotka population for 2014 was 10.9 per 1000 population. Crude all-cause death rates in total Chukotka population for the period from 2000 to 2015 were at the lowest level in 2015 – 9.5 per 1000 residents and the highest in 2010 – 13.8 per 1000 residents. The national average death rates for the same period fall in the range of 13.0- 16.4 per 1000 residents. The lowest rate was in 2015 and the highest in 2003.

Leading causes of death

Alaska. Cancer has been the leading cause of death in Alaska for almost two decades. According to Alaska Native Mortality Update: 2009- 2013, heart disease, unintentional injuries (accidents), and intentional self-harm (suicide), and chronic lower respiratory disease are other major causes of death in Alaska. Alaska Native people had significantly higher rates than U.S.Whites for nine of the ten leading causes of death i.e., cancer, heart disease, unintentional injury, suicide, COPD, cerebrovascular disease, chronic liver disease and cirrhosis, pneumonia and influenza, and alcohol abuse. The diabetes mortality rate for Alaska Native people was not significantly different than that for U.S. Whites.

Cancer was the leading cause of death among Alaska Native people, both genders combined, as well as among both Alaska Native males and females separately. The heart disease mortality rate was significantly higher; both genders combined, but were only significantly different for males. Unintentional injury was the third leading cause of death among Alaska Native people, both genders combined. It ranked third among both males and females. The Alaska Native suicide rate, both genders combined, was 2.9 times the U.S. Whites rate. The Alaska Native chronic obstructive pulmonary disease mortality rate, both genders combined, was 1.5 times the U.S. White rate. The Alaska Native cerebrovascular disease mortality rate, both genders combined, was also 1.5 times the U.S. White rate. Chronic liver disease and cirrhosis mortality rates for Alaska Native people, both genders combined were 2.4 times the U.S. White rate. Rates for Alaska Native males were 1.5 times the rate for U.S. White males. Rates for Alaska Native females were 4.1 times higher than those for U.S. White females. The Alaska Native pneumonia and influenza mortality rate, both genders combined, was 1.7 times the U.S. White rate. The Alaska Native diabetes mortality rate, both genders combined, was higher than the rate for U.S. Whites, but this difference was not statistically significant. For the first time period (2009-2013) diabetes was in the top ten leading causes of death among Alaska Native people.

Chukotka. The top cause of death in the period 2000-2015 in both Chukotka and total Russia's populations was the diseases of the circulatory system (CVD, I00-I99). For the populations of ChAO the mean was 382. 59±63.9 per 100,000 urban residents and 600.42±107.39 – for rural. The national average death rates from CVD were statistically significant: 770.80±77.14 for urban residents and 920, 00± 129, 38 for rural.
Second top causes of death were different in ChAO and whole Russia's populations. In ChAO this was External causes of morbidity and mortality (V01-Y98): urban - 213.36±53, 32 and rural 47425±119.30 (vs the national averages: urban 168.75± 44. 08 and rural 211.91±39.87) whereas the second top for Russia's urban population was cancer 210.02± 1.79 significantly exceeding ChAO urban – 107.46± 17.20.

Infant mortality

Alaska. During 1981-2013**,** infant mortality declined among Alaska Native, Alaska White and U.S. White populations. During 1981-2013, the Alaska Native infant mortality rate declined 49.4%, a significant decrease (p<0.01).
Alaska Native infants experience higher mortality in the post-neonatal period (28 days to 1 year of age) than in the neonatal period (<28 days of age). The leading causes of Alaska Native infant deaths during 2000-2013 were congenital abnormalities (17.9%), sudden infant death syndrome (17.3%), and unintentional injuries (15.9%). During 2009-2013, rates of infant mortality varied by tribal health region, ranging from 2.6 to 10.9 per 1,000 live births with the highest rates in Aleutian-Pribilof Region (25.5), and Yukon- Kuskokwim Region (15,2).

Chukotka. During 2000 -2015, infant mortality in total population of Chukotka varied from lowest of 9, 2 in 2008 to the highest 23.9 in 2013 per 1000 live births. In 2015 it was at intermediate level - 16.0. Comparison to the national averages clearly pointed out a big excess the Chukotka's infant mortality rates over whole Russia's population rates. The mean rural infant mortality in Chukotka for the period 2000-2015 was 30.11±10. 72 vs 11.25± 2. 75 for the same type population of whole Russia. Differences between urban infant mortality rates were much lower: 14.82 ± 8.28 in Chukotka and 9.34 ± 2.73 in whole Russia.
According to the ChAO Yearly Regional reports on Health Statistics (2006-2015) the maternal morbidity among pregnant women is rather higher as compared to that reported at national level. Thus, form 40.6 to 55.5% women giving births were suffered from anemia (ICD 10 Code O99.0) with the annual incidence rates from 253.1 to 459.9 per 1000 births. This is approximately by 2.7 times higher than that reported aa the national average) The morbidity of newborns detected at births is reported from 29.9 to 42.7% of live births, Newborns with major structural malformations represented 1.8- 6.4% of live births (averaged 4.5 ±0.3) whereas the national average is lower (3.3%).

CANCER

Alaska. Cancer incidence has been reported to be about 10% higher in recent years among Alaskan Native (AN) Americans than among U.S. whites (Alaska Native Epidemiology Center 2016). Cancer incidence rates have been particularly high among living in the Kenai Peninsula (586, 95%CI=522-658), Copper River/Prince William Sound (603.9, 95%CI=514-707), and Kodiak (592.9, 95%CI=515-593) regions of Alaska. Cancer incidence increased significantly among AN between 1970-1971 (356.7 per 100,000) and 2012-2013 (477.8 per 100,000). In particular, breast cancer rates and lung cancer rates among AN have increased dramatically from the 1970s (Alaska Native Tribal Health Consortium 2015, Carmack et al., 2015).

A statistically significant increase was reported for all cancer sites among Native Americans relative to White Americans (Rate Ratio (RR=1.1). This excess was only evident among women (RR=1.2). A statistically significant excess among Alaska Native Americans compared to U.S. Whites has been reported for oral cavity and pharynx (RR=1.5), which was largely due to a large increase in the risk of nasopharyngeal cancer (RR=17.3). Several digestive cancer sites are significantly elevated among Alaska Native Americans relative to U.S. Whites including cancers of the stomach (RR=3.2), colon and rectum (RR=2.2), liver (RR=1.5), gallbladder (RR=22.6) and other biliary sites (RR=2.2). A significant excess in lung (RR=1.5) and kidney cancer (1.6) has been reported among Native Americans in Alaska when compared with U.S. Whites. There is also a significant deficit in the incidence of malignant melanoma (RR=0.2), urinary bladder (RR=0.6), lymphoma (RR=0.7) and leukemia (RR=0.7) among Alaskan Natives relative to U.S. Whites. The cause specific findings are very similar for males and females. No evidence of an increased risk was observed for cancers of the prostate or breast. A similar pattern of risk has been observed among AN for cancer mortality. Cancer risk for all sites is significantly greater (RR=1.3) than expected based on U.S. rates during 1992-2011. A significant increases in mortality has been reported for oral cavity and pharynx (RR=2.6), nasopharynx (RR=21.0), digestive system (RR=1.7), colon-rectum (RR=1.7), stomach cancer (RR=3.7), kidney cancer (RR=2.1), and lung cancer (RR=1.3 (Carmack et al., 2013). Again a similar pattern was observed for men and women; however, a significant excess of cervical cancer (RR=2.9) was observed among women.

The presented data show that cancer incidence is significantly greater among AN than the U.S. White population. In particular, AN experience significantly increased rates of nasopharyngeal, colorectal, stomach, kidney, gall bladder, liver and lung cancer. The incidence of cancer has increased dramatically over the past few decades, particularly for lung and breast cancer.

The excess of lung cancer risks may be explained by the high rates of tobacco consumption among Alaska is significantly higher than among U.S. White adults (18%) (Alaska Native Epidemiology Center, 2016). Alcohol abuse is also well recognized to be a problem among AN (Allen et al., 2007), which may explain the excess of liver cancer observed among AN. Obesity is also high among AN compared to U.S. Whites. In 1992-2012 approximately 34% of AN were obese compared with 27% of the U.S. white population. Obesity has been linked with an increased risk of colon, rectal, kidney, pancreas, gallbladder, and breast cancer (Arnold et al., 2015), which are sites that are elevated among AN. Nonetheless, it's quite possible that these lifestyle risk factors may not fully explain the cancer excess among AN, and that other environmental factors may play a significant role.

Chukotka. It has been found already since the early 70th last century that the indigenous people of the north-eastern Russia had a higher incidence of esophageal and stomach cancer (Gulaya, 1979). In a great number of publications it has been indicated that the Arctic indigenous people were at high risk of lung cancer. In contrast the age-adjusted incidence rates of breast cancer is lower than that in non-indigenous residents of the region as well as skin cancer, cervical and uterine occur very rarely (Zaridze et al., 1993). The incidence rates of breast cancer among indigenous women living in tundra are reported to be 2.9 times lower than that in non-indigenous (12.6 ± 2,1 vs 25.1 ± 2,0 per 100,000). The author suggested that the reduced risk of breast cancer in the Arctic indigenous people is associated with a polymorphism of the p53 gene (Arg72Pro) (Odintsova, 2011).
As reported by Dudarev A et al., 2013, the indigenous Chukchi and Eskimo people living in Chukotsky district were at higher risk of death from cancer during the 30-year period between 1961 and 1990, with ASMR among men twice that of Russia, and among women 3.5 times higher. The excess is attributed to the extremely high mortality from esophageal cancer and lung cancer. The mortality data from the study is believed to be well corresponded to the pattern of incidence reported among other indigenous people of the Russian Arctic. Little information is available since 1990, and the feasibility of ethnic-specific health data is now severely limited. The data derived from ChAO Health statistics reports shows that the past trend to increase of stomach cancer rates among indigenous Natives of Chukotka is still a pressing public health problem. Population of Chukchi District 85% of that is the Pacific coastal indigenous people (Chukchi, Eskimos) manifested a faster grows

compared the total population of Chukotka AO. It is important to mention that the high exposure to PCBs experienced by many Arctic Natives especially those living in the Pacific coastal area doesn't seem to contribute to the risk of breast and genital cancer in women which is in agreement with some other epidemiological evidence published (Wolff et al., 2000).

INFECTIOUS DISEASES

Alaska. Since the threat of climate change may exacerbate some of these disparities, planning for potential intervention requires a thoughtful look at existing data. There is a need to understand current disease rates for the diseases most likely to be impacted and to interpret these data in light of climate change. Risk for infectious diseases in Alaska Natives is affected by many factors. For example, according to the Alaska Native Health Status Report (2009), more than 22% of Alaska Native children under age 18 live below the poverty level. This figure is more than double the rate for Alaska Whites. Low literacy, an established risk factor for disease, is also a factor in this population. Whereas 28% of Alaskan Natives 25 years and older have less than a high school education, only 7.5% of US Whites have a similar low level of education. Complicating risk for pulmonary diseases, the prevalence of smoking in Alaska Natives is 41%, twice that of non-Natives. Compared to the general US infant population, hospitalization rates for lower respiratory tract infections (LRTI) are 5 times higher and for documented pneumonia are 11 times higher (Hennessy et al, 2008; Gessner, 2008; Groom, et al., 2014). Crowded living conditions and poor indoor air quality also may play a role. Many Alaska Natives also have underlying co-morbid conditions such as diabetes and obesity. Water, sanitation, and hygiene are directly threatened by climate change as permafrost melting and erosion and storm surge have threatened or damaged community shower, laundry, and toilet systems and threatened water and sewer lines (Hennessy & Bressler, 2016). These problems could exacerbate diarrheal disease rates. Public health surveillance data were provided by the Alaska Department of Health and Social Services for the years 2001 through 2014. The selection of reportable diseases was based on their potential to be impacted by climate change. In addition, tuberculosis and hepatitis B were examined due to their importance as emerging infectious diseases. Special attention was focused on Alaskan Natives due to their potential for greater vulnerability to climate change and since risk factors may not be generalizable for one or more of these diseases to Alaskan residents overall. Data for plague, West Nile virus, leptospirosis, toxoplasmosis, hepatitis D, and hepatitis E were not available for this report and were not reported in the Alaska State Health Department's annual infectious disease bulletins.
The most prevalent diseases among those reviewed above include giardiasis, a waterborne disease, nontyphoidal salmonellosis, a foodborne disease, and tuberculosis, a respiratory disease and important cause of mortality among Alaskan Natives.

Giardiasis is worth additional attention in future work not only because of its magnitude but because race information was unknown for 64% of cases. Alaskan Natives comprise almost 15% of the state's population and 6% of reported giardiasis cases. As a result of so much missing data, it is not clear if this disease disproportionately impacts the Alaskan Native population. The rates in Alaska are higher than in other parts of the US. It is a disease of special interest due to climate change as water sources are threatened or disrupted in the future, Alaskan Natives might have their risk increase. For example, disruption of wells or unreliable clean fresh water availability could lead to river water ingestion which may be contaminated with giardia. The incidence of giardiasis appears to have increased in recent years, although not among reports of Alaskan Natives in whom it appears stable.

Nontyphoidal salmonellosis data also had a substantial proportion (53%) without race information. This also makes it hard to conclude the level of impact in Alaskan Natives. Although changes in climate could theoretically affect the incidence of this disease since ambient conditions may affect organism survival and/or animal reservoir populations, there are few data about salmonellosis in Alaska and most cases are thought to be sporadic. The rate in Alaska Natives did not reveal a rising or falling trend in recent years.

Tuberculosis is a well-studied disease in Alaska and early treatment trials have derived from this region. TB disproportionately occurred in Alaska Natives and since an initial decline from 2000 to 2001, rates have generally been stable with minor fluctuations from year to year. Given its high prevalence and morbidity and mortality, TB continues to be an important public health disease in this population.

Foodborne botulism is especially noteworthy since the number of cases is nearly 100 and this disease is often fatal if not urgently recognized and treated. Nearly all cases of botulism occurred in Native Alaskans. This population is at increased risk due to ingestion of marine mammals and fish, including beached whale. Risk for botulism might be impacted by climate change, especially if food insecurity were exacerbated leading to greater reliance on consumption of mammals found dead. Alternatively, it is not known if warmer or wetter weather might increase the prevalence of Clostridium botulinum in natural environments where fish and marine mammals live.

Cryptosporidiosis, another waterborne disease, also had nearly 100 cases reported during the time period reviewed. Cryptosporidiosis has been associated with agricultural and wildlife sources and may contaminate untreated surface water. Migration of host animals due to climate change could lead to increased incidence of cryptosporidiosis among Alaska Natives as well as to changes in the epidemiology. Increased runoff into drinking water sources may also exacerbate this disease in the future.

Chukotka. According to the Yearly Reports on Regional Health Statistics the most frequent infectious diseases in the Pacific coastal Native population of Chukotka are Tuberculosis, viral hepatitis B. Other infectious diseases during the last decade have been reported there as occasional events that seems to be doubtful in the view of their high prevalence in the Arctic indigenous populations widely consuming uncooked (salted or dried) fish and meat and having insufficient water and food security (Parkinson et al., 2008; Kutz S. et al., 2004)

The obvious concern is only caused by accelerated rise of tuberculosis reported in this population regardless development and implementation of targeted TB-preventive programs both at national and regional levels
Even though the rate of viral hepatitis B is gradually decreased, however this controllable infection is still at a higher level in the indigenous population of Chukotka (Chashchin, 2011).

Even though the rates of viral hepatitis B are gradually decreased, however this controllable infection is still at a higher level in the indigenous population of Chukotka.
As for parasitic diseases (zoonoses) there has been found a huge underreporting the actual prevalence of many helminthiases in the population of ChAO. Thus, 24.3% out of 259 residents of coastal settlements were found to have a positive immune response to Trichinella antigen. All the seropositive cases were represented by people belonging to three ethnic groups: Chukchi (97.8%), Eskimos (1.2%), and Yakuts (1.0%). The antibody titers varied from 1:100 (32.8%) to 1:1600 (8.7%). The highest titer reactivity was observed in marine mammal hunters, retired persons, and non-manual employees. There was a direct relationship between the antibody titer values and the dietary habits of the respondents preferring traditional foods prepared from marine mammal meat (Burkina et al., 2015). As a result of the research study conducted in 2010 for the Russian Ministry of Public Health (Chashchin, 2011) clinically estimated prevalence of the diphyllobothriasis was found to be of 110,0 per 1000 residents of ChAO. In order to roughly calculate the expected prevalence based on the officially reported mean annual incidence rates 0,099 for the period from 2000 to 2011 this value was multiplied by the regional life expectancy (51.1 years), Thus, the life-time expected prevalence of diphyllobothriasis is going to be at level of 5.06 versus clinically estimated 110.0. For Echinococcosis – clinically estimated -19.7, life-time expected – 7.10; Trichinellosis – clinically estimated – 78.4, life-time expected – 4.19 per 1000 residents.

SUICIDE

Alaska. According to Alaska Native Mortality Update: 2009- 2013, suicide was the fourth leading cause of death among Alaska Native people, both genders combined. It ranked fourth among Alaska Native males and

seventh among Alaska Native females (Alaska Native Mortality Update: 2009- 2013). It ranked fourth among Alaska Native males and seventh among Alaska Native females. Among Alaska Native people, both genders combined, 5.8% (n=250) of all deaths were suicides. The suicide rate for Alaska Native people, both genders combined, was 2.9 times the U.S. White rates. There has been a significant decrease of 3% in suicide mortality rates among Alaska Native people between 1980-1983 and 2009-2013. U.S. Whites experienced a significant 5% increase during this period. The majority of suicides (58%) among Alaska Native people, both genders combined, involved firearms. In addition to firearm deaths, 35% of suicides among Alaska Native males involved hanging. For Alaska Native females, in addition to firearm deaths, 34% were due to hanging, and 8% of suicides were due to poisoning. Alaska Native people, both genders combined, experienced 0.9 to 8.8 times the suicide rates of U.S. Whites across age groups.
During 2008-2011 Suicide mortality rates vary widely by region, ranging from 20.2 to 81.6 per 100,000. Alaska Norton Sound service region had higher rates of suicide than rates for the rest of the state, and the Yukon- Kuskokwim service region experienced an increase in suicide (156%) rates between 1980-1983 and 2009-2013.

Chukotka As reported for many other Arctic nations suicide death rates in Chukotka were around 2 times higher as compared to the national averages; for urban population of ChAO in the period from 2000 to 2015 there were reported 41.14± 12.62 cases per 100,000 residents versus whole Russia's urban population of 23.14±6,98. As for rural populations there were significantly larger differences: in ChAO 134.62 ± 46.82 and for the whole Russia 42.90 ± 9.37.

REPORT RECOMENDATIONS

It is recommended to:

- prioritize health care in the Arctic communities as primary goal of local policy;
- consider at international level the needs for harmonization of exposure limits and environmental and human health policies relevant to the Arctic circumstances;
- perform surveillance evaluation of some or all of the surveillance systems in Alaska and Chukotka in order to determine how to strengthen these systems so they provide reliable information going forward;
- pay special attention to routine collection of race data that would be especially helpful towards determining more accurately the incidence of diseases in Chukotka Natives;
- discuss a new model for healthy Arctic communities at both national and international levels;
- adjust public health practice to the Arctic circumstances which is particularly important to indigenous health;
- more studies are needed to understand the climate change and environmental impacts on health of Alaska and Chukotka Native populations with special attention to maternal and children's health; and studies related to suicide prevention in Native populations;
- perform studies that determine the climate change-related infections among diarrheal diseases in Alaskan and Chukotka Native communities and preventable risk factors for these diseases to better understand risk factors, and explore the role of ambient temperature on the incidence of these diseases and to better understand these problems in the Arctic more generally;

- identified risk factors as well as new pathways to prevention of suicide cases in Alaska and Chukotka Native communities

It is also essential to:

- develop and implement new tobacco cessation and alcohol abuse prevention programs for Native communities;
- identify the priority Arctic health risk factors and specifying the public health policy and practice needs to deliver comprehensive education for the professionals to serve in the Arctic indigenous communities;
- select the best values in health care providers and treatment;
- establish of an international network of indigenous public health professionals;
- identify critical gaps and broad level principles for Indigenous health curricula within public health and medical training programs and to respond with innovative teaching modules;
- increase the rate of indigenous graduates nationally awarded a MPH degree;
- increase the number of indigenous public health graduates by teaching public health using a community based approach and best international experience;
- encourage the Arctic people of take personal responsibilities for their own health and for others by helping them to obtain health promoting services.

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