



A Review on Emerging Viruses from Glacier Ice Melt

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ABSTRACT

Viruses are obligatory intracellular parasites and are regarded as links between living and nonliving entities. Viruses are considered ubiquitous in nature i.e it is found in dynamic environmental conditions ranging from polar ice caps to hot springs as well as in deep seas. Viruses even exist in trapped glaciers found in high altitudes as well as in polar regions such as the arctic and Antarctica. Global warming-induced climate change characterized by an increase in global temperature has led to the melting of ice caps of glaciers polar and tundra world. Recent studies have made it evident that novel viruses exist in these freezy conditions, some of which may be of ancient origin and still infective. Ice melt can further augment the chances of the revival of these viruses in nature. These novel viruses can cause pandemics in both humans and animals in near future. Thus, global warming not only brings environmental hazards but also a hazard popularly called the permafrost pandemic. In light of the large-scale impact that Covid 19 pandemic caused it is important to look into the issue of climate change-linked emerging diseases, especially viral ones. This review aims to provide a holistic understanding of novel viruses emerging from global glacier melt and various studies carried out concerning this issue.

Keywords: -obligatory intracellular parasites, ubiquitous, permafrost pandemic

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INTRODUCTION

Viruses are one of the most dynamic entities on our planet and have been favorites among researchers due to their dynamic range of existence. These viruses have shown presence in hostile environmental conditions. Modern-day earth is facing environmental issues most prominent being climate change. There lies a correlation between climate change and the emergence of novel and ancient viruses. Climate change-induced viral diseases have now become a topic of discussion. According to the Intergovernmental panel on climate change (IPCC) sixth assessment report 2021 global temperature would breach the set limit of 1.5 degrees Celcius by 2030 [13]. It predicts an arctic ocean free of sea ice in extended summers due to warming by 1.5 degrees per decade. Various studies made evident that every rise in 1 degree of global temperature would thaw tundra area by one quarter. Earth's multi-year layered ice declined by approximately 90% between the years 1976 to 2018 (span of four decades). It is important to discuss the close connectedness between melting ice and potential virus emergence as the world experienced many virus-induced pandemics such as Spanish flu, malaria, and most recently covid 19. These viruses wiped out the bulk of the human population in the 17th, 18th, and 19th century. As time passed, the world naively thought that these dangerous pathogens got eradicated. However, it is not true. These pathogens especially viral ones are trapped in ice and glaciers all around polar and high-altitude tundra and could pose a threat of viral epidemic and pandemic in near future. Some of which may be novel ones that the world had never encountered before. Permafrost soils for centuries existed in icy solid form for but now melting at rapid rates. This meltwater could carry novel/ancient viruses in oceans, seas, rivers, and other fluvial forms. Here real danger lies in the fact that these ancient viruses are capable to spring back to life. This was even demonstrated by an experiment carried out with the novel virus Pithovirus sibericum. Some viruses won't remain viable after freezing but some like the influenza virus possess a unique ability to survive in cold and transmit zoonotically [2].

VIRUS FROM GLACIERS -Studies have been carried out at different places where glaciers exist which are on verge of retrieval. These places include deep arctic regions like Russian Siberia, Canadian arctic,

Norwegian arctic, etc. and high-altitude tundra glaciers like the Tibetan plateau (22,000 feet) above sea level [1].

Recently, scientists from Russia and France carried out an experiment where they successfully isolated a virus from a piece of Siberian permafrost which is almost 30,000 years old. According to a paper from Proceedings of the national academy of science 2014 this virus was one of the largest viruses ever seen. It significantly deviated in structural aspects from other traditional viruses. It was documented as a virus of 1500 nanometers in size (billionth of a meter) [6]. It could be seen from a normal microscope and was 10 times larger than HIV. It was named *Pithovirus Sibericum* and sprang up to life and could infect host like the amoeba [7].



Fig:1. The virus *Pithovirus sibericum* which was inactive for centuries until it was revived in the laboratory of France in host amoeba (source:www.bbc.com)

Some other viruses which were found from this permafrost included *Mollivirus sibericum* and *Mimivirus*. Another outstanding study was carried out by scientists where they pulled out smallpox and Spanish flu from thawing permafrost. Interestingly these pathogenic viruses had been eradicated from the wild long ago but were found dormant in permafrost.

Even high-altitude regions like the Tibetan plateau have the presence of glaciers. These glaciers may also contain ancient viruses. This is evident from research carried out in the Guliya Ice cap situated at 22000 feet above sea level [1]. Scientists found genetic codes for 33 viruses trapped in ice caps when they drilled a 164-foot hole in the cap. These viruses were estimated to be 15000 years old. 4 of them were previously identified and at least 28 of them were found to be novel.

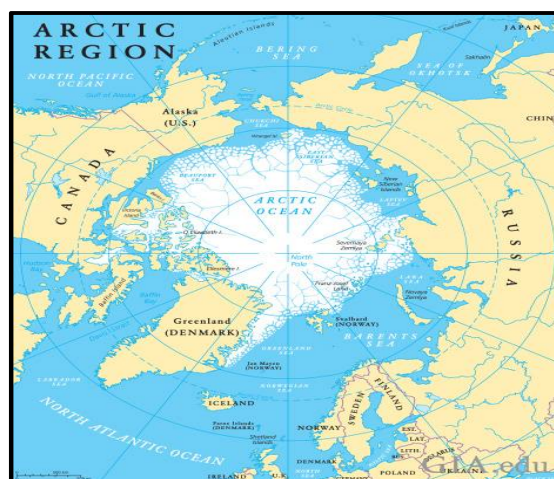


Fig:2 Arctic region containing glaciers (source: www.gia.edu)

1.1 VIRUS FROM DEEP SOUTH (ANTARCTICA)

It was believed that Antarctica, a continent where scanty life forms exist would be free from viruses until studies proved the presence of ancient viral specimens. A study (2009) of a frozen freshwater lake in Antarctica revealed the DNA of around 10,000 viral species which were not identified before [8]. DNA viruses like bacteriophages, circular ds DNA viruses, algae infecting phycodna

viruses, virophages, and picornaviruses along with quasi-species were dominant in Antarctic permafrost [2]. These viral specimens date back to 25 million years old [2].

2.1 REGIONS SUSCEPTIBLE TO VIRUS OUTBREAKS FROM GLACIERS:

The human population living near glaciers in some regions of the Arctic is prone to encountering these novel viruses. These regions are as follows along with the stated reasons:

1. Siberia (Here corpses buried in the 18th and 19th centuries in cemeteries exist. Present near the Kolyma river which may contain nucleic acids of the smallpox virus)
2. At Gorny Altai near southern Siberia which was the burial site of the stone age.
3. Alaskan tundra (This was the site where corpses of patients infected with Spanish flu were buried) [4].

Even though this kind of region does not host live viruses which had been eradicated but meltwater from glaciers could aid in the revival of these viruses in their active and infective form shortly. This can be explained by a case study of an Anthrax outbreak in the Siberian region. The infection killed a 12-year-old child and caused the hospitalization of around 100 people. Investigation revealed that the anthrax outbreak was due to the release of deadly anthrax spores from a melt thaw of carcass infected with anthrax years ago [6]. These spores lay dormant in freeze-cold conditions until they were released with meltwater. Even though it was bacterial in origin same thing can be said with viruses that lay dormant in glaciers.

CONCLUSION

Global warming is causing glaciers to melt at a rapid pace. These glaciers are possibly reservoirs of viruses. Some of them are ancient and may possess novel features that were shown by various studies. Meltwater could carry these viruses in fluvial forms in contact with humans and animals and pose a serious threat to novel epidemics and pandemics. Urgent remedial measures are required to address climate change and ice melts from Polar Regions and ice tundra to prevent new viral disease outbreaks.

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