

Wind Direction and Its Linkage with *Vibrio cholerae* Dissemination

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Abstract : Cholera is an acute intestinal infection caused by ingestion of food or water contaminated with the bacterium *Vibrio cholerae*. It has a short incubation period and produces an enterotoxin that causes copious, painless, watery diarrhoea that can quickly lead to severe dehydration and death if treatment is not promptly given. In an epidemic, the source of the contamination is usually the feces of an infected person. The disease can spread rapidly in areas with poor treatment of sewage and drinking water. Cholera remains a global threat and is one of the key indicators of social development. An estimated 3-5 million cases and over 100,000 deaths occur each year around the world. The relevance of climatic events as causative factors for cholera epidemics is well known. However, the examination of the involvement of winds in intra-continental disease distribution is new. The study explore the hypothesis that the spreading of cholera epidemics may be related to the dominant wind direction over land by presenting the influence of the wind direction on windborn dissemination by flying insects, which may serve as vectors. Chironomids ("non-biting midges") exist in the majority of freshwater aquatic habitats, especially in estuarine and organic-rich water bodies typical to *Vibrio cholerae*. Chironomid adults emerge into the air for mating and dispersion. They are highly mobile, huge in number and found frequently in the air at various elevations. The huge number of chironomid egg masses attached to hard substrate on the water surface, serve as a reservoir for the free-living *Vibrio* bacteria. Both male and female, while emerging from the water, may carry the cholera bacteria. In experimental simulation, it was demonstrated that the cholera-bearing adult midges are carried by the wind, and transmit the bacteria from one body of water to another. In our previous study, the geographic diffusions of three cholera outbreaks were examined through their linkage with the wind direction: a) the progress of *Vibrio cholerae* O1 biotype El Tor in Africa during 1970-1971 and b) again in 2005-2006; and c) the rapid spread of *Vibrio cholerae* O139 over India during 1992-1993. Using data and map of cholera dissemination (WHO database) and mean monthly SLP and geopotential data (NOAA NCEP-NCAR database), analysis of air pressure data at sea level and at several altitudes over Africa, India and Bangladesh show a correspondence between the dominant wind direction and the intra-continental spread of cholera. The results support the hypothesis that aeroplankton (the tiny life forms that float in the air and that may be caught and carried upward by the wind, landing far from their origin) carry the cholera bacteria from one body of water to an adjacent one. In addition to these findings, the current follow-up study will present new results regarding the possible involvement of winds in the spreading of cholera in recent outbreaks (2010-2013). The findings may improve the understanding of how climatic factors are involved in the rapid distribution of new strains throughout a vast continental area. Awareness of the aerial transfer of *Vibrio cholerae* may assist health authorities by improving the prediction of the disease's geographic dissemination.

Keywords : cholera, *Vibrio cholerae*, wind direction, *Vibrio cholerae* dissemination

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