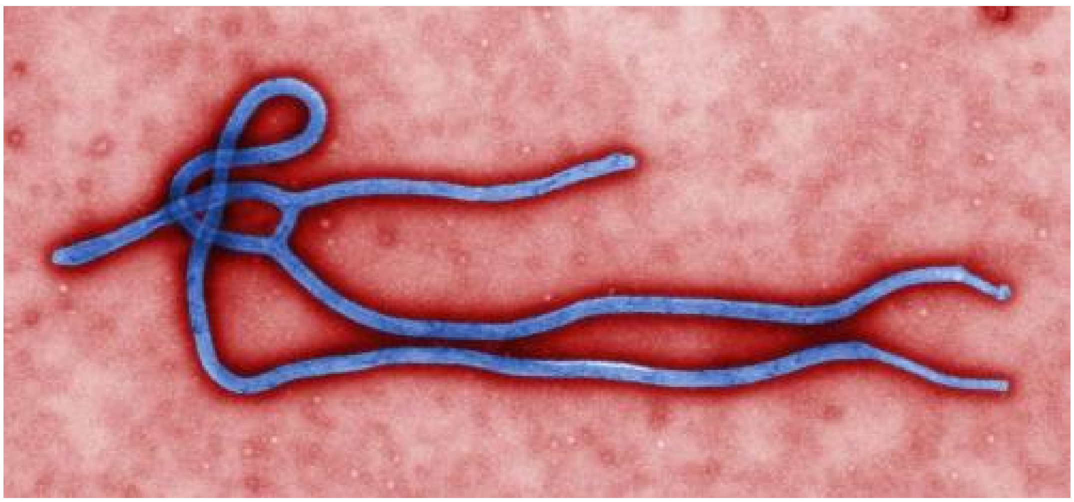
How the latest Ebola strain may escape to kill again another day

September 3 2014, by Molly Wexler-Romig



Ebola virus virion. Credit: CDC

When Korean Air announced last month it would halt its three weekly flights to Nairobi due to fears of an Ebola pandemic in Liberia and Sierra Leone both of which are several thousand miles away critics accused the airline of overreacting. As the pandemic spread first to Nigeria, and then to Congo airlines have steadily canceled flights to afflicted nations to limit the risk, despite the protestations of the World Health Organization. But research conducted by the New England Complex Systems Institute in 2006 suggests the airlines de facto quarantine is correct.

When it comes to pandemics, it only takes a little global connectedness to trigger a cascade of infections. The outbreak of Ebola raging in West Africa� labeled a Public Health Emergency of International Concern by the World Health Organization�echoes a scenario mapped out by NECSI in 2006. In a computer simulation of pathogens and hosts, long-range routes of transmission � most prominently, international air routes � can allow the deadliest viral strains to outrun their own extinction, and in the process kill vastly more victims than they would have otherwise.

In an evolutionary model accounting for spatial distribution, a pathogen like the Ebola virus can cause its own demise by killing all the hosts in its immediate vicinity. If there is no one left alive to infect, a viral strain will die off. Successful pathogens leave their hosts alive long enough to spread infection. Typically, the most virulent mutations burn themselves out, and a stable balance is achieved between host and pathogen. But avenues of long-range dispersal break this pattern.

Ebola cannot spread through the air; infection can only be transmitted through close contact with bodily fluids. Yet, in the age of global travel, patients in the dormant stage of infection can travel long distances before showing signs of illness, creating epicenters of secondary infection in geographically distant locations. Long-distance travel thus gives an unnatural advantage to the most virulent strains, allowing them access to new hosts even if they wipe themselves out at the local scale.

The most relevant features of NECSI�s model to the current crisis is the critical threshold of connectedness at which a virulent strain can spread out of control. Even if a system seems stable, it may only take a few more routes of travel to trigger secondary outbreaks. �It wouldn�t take much for the current Ebola outbreak to spread to more countries or continents,� says NECSI president Yaneer Bar-Yam. �It only takes one infected individual making it through an airport checkpoint.� There is no cure for the Ebola virus; only early detection and basic medical care can improve a patient�s chance of survival. Thus, awareness of how quickly the scales of transmission can tip is paramount to getting the current outbreak under control and preventing more from starting.

More information: The complete article is available online: necsi.edu/news/2014/ebola

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