

The RAL Seminar Series



NCAR

Absolute Humidity and the Survival, Transmission and Seasonality of Influenza

by

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Much of the observed wintertime increase of mortality in temperate regions is attributed to seasonal influenza. Here we use laboratory experiments to show that absolute humidity strongly modulates the airborne survival and transmission of the influenza virus. We then use epidemiological data to demonstrate that the onset of increased wintertime influenza-related mortality in the United States is associated with anomalously low absolute humidity levels during the prior weeks. A mathematical model, in which observed absolute humidity conditions temper influenza transmission rates, is then shown to successfully simulate the seasonal cycle of observed influenza-related mortality. The model results indicate that direct modulation of influenza transmissibility by absolute humidity alone is sufficient to produce this observed seasonality. These findings provide laboratory and epidemiological support for the hypothesis that absolute humidity drives seasonal variations of influenza transmission in temperate regions. In addition, we show that variations of the basic and effective reproductive numbers for influenza, caused by seasonal changes in absolute humidity, are consistent with the general timing of pandemic influenza outbreaks observed for 2009 A/H1N1 in temperate regions. Indeed, absolute humidity conditions correctly identify the region of the United States vulnerable to a third, wintertime wave of pandemic influenza. These findings suggest that the timing of pandemic influenza outbreaks is controlled by a combination of absolute humidity conditions, levels of susceptibility and changes in population mixing and contact rates.