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Inactivation of overlooked respiratory viruses in human saliva droplets at variable relative humidity

Objective: Respiratory infections from viral pathogens cause significant morbidity and mortality each year globally. Respiratory secretions, including virus-laden droplets, serve as a primary reservoir for viral particles in the environment; persistence of infectious viruses within these droplets can increase the risk of onward spread to susceptible hosts. Various factors, such as relative humidity (RH), play a critical role in influencing viral stability while these viruses are in the environmental phase of transmission. Most studies investigating environmental stability of respiratory viruses focus on influenza virus, human coronavirus, or surrogate viruses, like bacteriophages, even though there are many other respiratory viruses, including adenovirus and rhinovirus, that continuously circulate in human populations and generate a significant disease burden year over year. Understanding the differences in inactivation kinetics of a broad range of these viruses is critical to establishing effective mitigation strategies in settings with elevated transmission risk. The objective of this work is to comprehensively evaluate the reduction in infectivity of structurally distinct enveloped and nonenveloped human respiratory viruses, including influenza virus, adenovirus, coronavirus, and rhinovirus.

Methods: To achieve our objective, we are evaluating the degradation of prominent but distinct enveloped and nonenveloped human respiratory viruses (e.g., influenza A virus, human rhinovirus 16, human adenovirus 4, seasonal human coronavirus OC43) in droplets under a range of environmental conditions (i.e., 20%, 50%, 80% RH) representative of indoor settings. Many of the persistence studies conducted to date rely on the use of artificial respiratory fluids or laboratory-derived solutions for generating virus-laden droplets; here, we address this knowledge gap by determining virus decay in a physiologically relevant fluid, human saliva. We compare persistence in saliva to survival in milliQ to better understand the factors driving inactivation across different viral species.

Results: Our preliminary findings reveal that respiratory human adenovirus remains infectious in human saliva for over six hours at ambient indoor temperature and 20% RH with minimal decay (i.e., < 1-log10). Kinetics at 50% and 80% RH follow a similar trend. Interestingly, respiratory human adenovirus appears more resistant to environmental inactivation than a seasonal H1N1 influenza A virus, a structurally distinct respiratory virus, at midrange RH. These data highlight the unique persistence of distinct respiratory viruses, underscoring the need to comprehensively study a diverse array of different viral pathogens before drawing conclusions about effective mitigation strategies.

Conclusion: Our findings will provide an expanded dataset of the relative persistence of prominent human respiratory viruses to better understand settings conducive to environmental virus inactivation. This information is critical to informing engineering treatments targeted at specific pathogens to rapidly decrease infectious viral loads during intervals of elevated community spread.

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