Breathing, Virus Transmission and Social Distancing – An Experimental Visualization Study

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The majority of the past research focuses on understanding droplet generation and transport through the most violent spasmodic expiration Coughing and Sneezing. However, "Breathing," the most common phenomenon, is scarcely studied as a virus transmission source. In the present study, we report an experimental visualization of the droplet's transport through breathing to quantify the reach of a typical breath for various Exhale to Inhale ratio (EI). The efficacy of various standard (surgical, five-layered, and N-95) and non-standard (homemade) protective measures like face masks and face shields are also evaluated. An exhaled breath at E:I = 1:1 can travel up to 4 ft in 5 sec; however, this reach reduces to 3 ft for E:I = 1:2. Two-layer homemade and commercial cotton masks are unable to impede the leakage of the droplet in the forward direction. A combination of a two-layer mask and face shield is also not effective in preventing the droplets' leakage and diffusion. The surgical mask alone is not recommended during normal conversations as the leakage of the droplets is noticeable. A commercial N -95 mask completely impede the leakage of the droplets in the forward direction. However, the droplets' leakage from the gaps between the mask and nose is observed to be significant. A commercial five-layered mask is the most effective preservative measure with minimum leakage of the droplets. A social distancing of 4ft is required to be maintained during normal conversations; however, to avoid exposure to rare events like coughing and sneezing, it is recommended to maintain at least 6ft social distancing with protective measures.

The present study highlighted that most of the commonly used protective measures like face masks and shields are unable to prevent the escape of droplets generated during breathing. The leaked aerosol particle may contain the virus, which may trigger the airborne transmission of COVID-19 and other similar diseases. Under these circumstances, the conventional CO_2 level measurement in confined space for assessing Air Quality Index may not be sufficient to regulate the airflow. New guidelines need to be formulated for deciding air circulation rate in confined space considering the leakage of the aerosol particle from protectives measures.

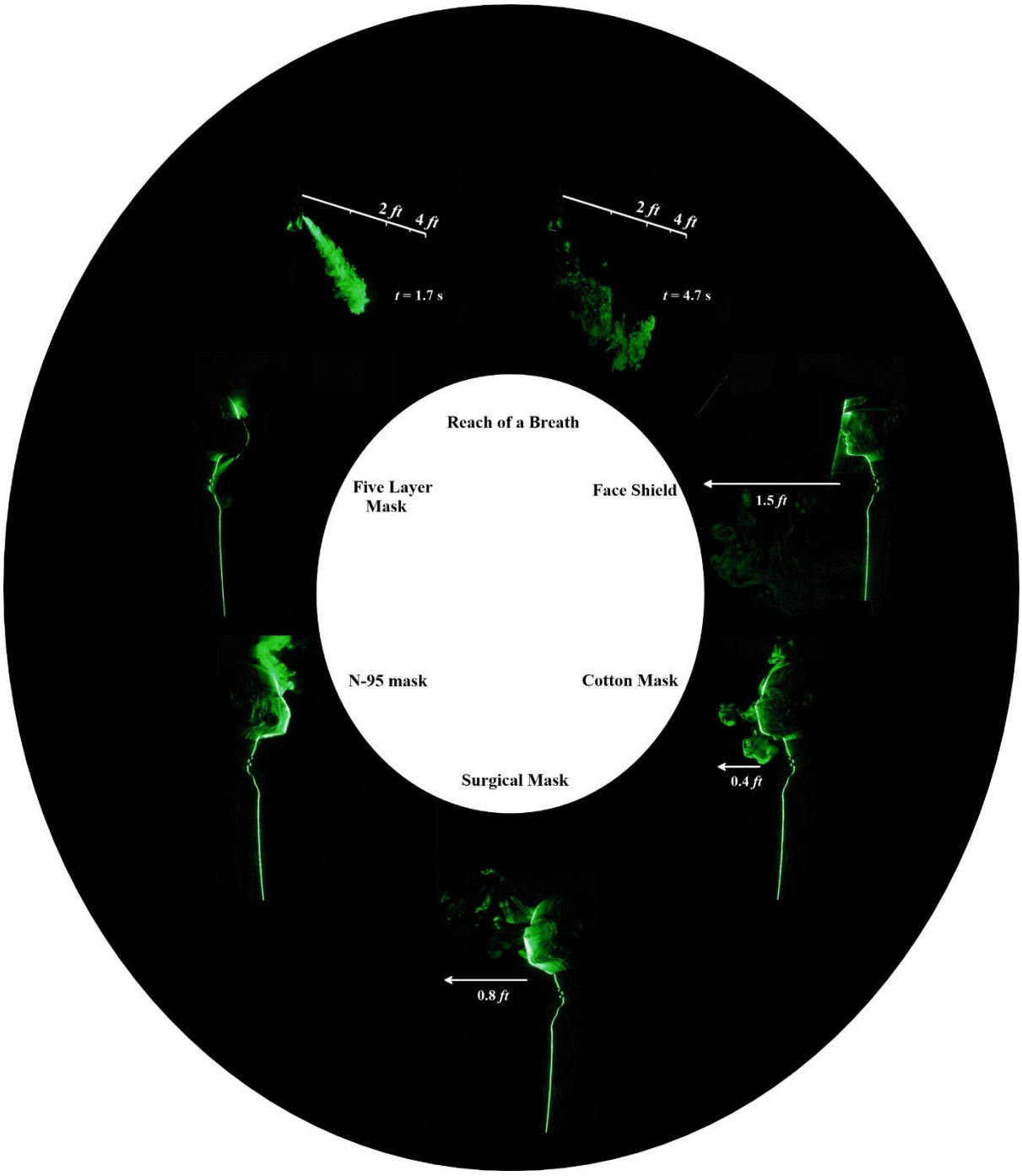

Figure 1: Summary of Results