Research Highlight

Understanding COVID-19 Seasonality

Mathematical modeling can be used to better understand the spread and effects of COVID-19. Recent findings by DMS-supported researchers Jeffrey Shaman, Wan Yang, and colleagues delineate the issues that must be monitored to better understand the endemic burden of COVID-19 in the post-pandemic period, underscore the importance of early intervention and aggressive control in combatting COVID-19 outbreaks, and estimate the true burden of the pandemic during the spring wave in New York City and its differential impact by age.

The perspective piece [1] discusses factors that will determine the ultimate pattern of endemicity for SARS-CoV-21, in particular the effects of immunity, seasonality, interventions, and virus-to-virus interactions, and how these effects will characterize the persistence and burden of COVID-19 in the post-pandemic period. Much of our understanding of virus seasonality (the phase locked patterns of seasonal incidence), how viruses can transition from pandemic to endemic transmission, rates of antigenic drift and immune escape, and how different viruses compete at population scales comes from mathematical modeling of these phenomena.

The study [2] uses a metapopulation model of SARS-CoV-2 transmission in conjunction with Bayesian inference, human mobility data, and confirmed COVID-19 case and mortality data at county resolution to estimate time-varying conditions and epidemiological characteristics of the pandemic during the
spring wave. The time-varying epidemiological characteristics provide estimates of the aggregate effects of locality (such as population density) and non-pharmaceutical interventions (such as shelter-in-place orders, mask usage, and social distancing) on the space- and time-varying reproduction number, a measure of the transmissibility within each county. The reproduction number shows how policies and public compliance varied in time and space and how rapidly and effectively individual localities responded to the pandemic. The findings establish that that marked, asynchronous reductions of the reproduction number occurred throughout the U.S. in association with social distancing and other control measures.

The modeling study [3] used detailed records of COVID-19 from the New York City Department of Health and Mental Hygiene to fit an age-stratified metapopulation model-inference framework to confirmed case, death, and mobility data at the neighborhood scale. This fitting allowed estimation of the total number of infections (both confirmed cases and undocumented infections) and the infection fatality rate by age during the spring wave. The study estimated an overall infection-fatality risk of 1.39% (95% credible interval 1.04–1.77) in New York City during that first wave. The estimated infection-fatality risk for the two oldest age groups (65–74 and ≥75 years) was much higher than the younger age groups, with a cumulative estimated infection-fatality risk of 0.116% (0.0729–0.148) for those aged 25–44 years and 0.939% (0.729–1.19) for those aged 45–64 years versus 4.87% (3.37–6.89) for those aged 65–74 years and 14.2% (10.2–18.1) for those aged 75 years and older.

References

