Global Health Day

Longitudinal Trend Analysis of Static and Dynamic Surveillance Metrics of SARS-CoV-2 Transmission in the United States

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Background: The emergence of SARS-CoV-2 has led to a widespread pandemic that has affected all corners of the world. The United States, especially, has been severely affected, accounting for the most COVID-19 cases and deaths around the world. Without a national COVID-19 public health response, the effects of the COVID-19 pandemic have varied regionally due to differences in socio-cultural factors and local governmental policy responses.

Objective: To test COVID-19 control policies at the federal and state level with surveillance metrics including 1) speed, 2) acceleration, 3) jerk, 4) 7-day persistence. We will surveil COVID transmission using standard surveillance techniques, novel rates of increase and persistence, combined with overall caseload. Novel indicators improve our understanding of where and how rapidly SARS-CoV-2 is transmitting, and quantifies shifts in the rate of acceleration or deceleration by state to inform policy targeting mitigation and prevention strategies in the U.S.

Methods: Using a longitudinal trend analysis study design, we extracted 60 days of COVID data from public health registries. We use an empirical difference equation to measure daily case numbers in 50 US states and Washington D.C. as a function of the prior number of cases, the level of testing, and weekly shift variables based on a dynamic panel model that was estimated using the generalized method of moments (GMM) approach by implementing the Arellano-Bond estimator in R.

Results: Larger U.S. States have high COVID-19 caseloads as a function of population size, density, and deficits in adherence to public health guidelines early in the epidemic, while other states have alarming rates of speed, acceleration, jerk, and 7-Day persistence in novel infections. SD, ND, WI, MT, UT lead the U.S in increases of new infections while SD, MT, LA, MS, and KY lead the USA in increases in acceleration of novel infections. SD, MS, AK, LA, and KY have the highest rates of acceleration. Of greatest concern are SD, MS, LA, and KY who have both the leading rates of acceleration in novel infections and highest positive upward jerks in infections. The U.S. speed of the pandemic and acceleration in infections increased from 12.7 to 13.3 infections per 100k and 0.24 to 0.28, respectively, in the past week. The US experienced an upwards jerk of .82 and .18 in the past two weeks. Finally, the 7-Day persistence was 11.05 and 11 per 100k population pointing to an underlying condition that echoes forward into today's caseload of novel infections.

Conclusions: There is variation between and within states with some exemplars of good public health practice such as VT, NH, and ME. The overall U.S. caseload and increases in rates of infection translate into the country with highest caseload of coronavirus infections and deaths. The US 7-Day Persistence rate means super spreader events not only infect large numbers of people, but those infections echo forward with additional infections. Without a change in the national response, increasing rates of acceleration, current rates of, jerk, acceleration, and persistence predict an alarming rate of rising COVID-19 infections in the coming months.