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Sub-Saharan Africa SARS-CoV-2 Surveillance System: Policy, Persistence & Transmission

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Background: In sub-Saharan Africa (SSA), many countries responded aggressively to COVID-19 with lockdown measures and border closures. Insufficient testing, asymptomatic infections, and poor reporting practices in many countries limit our understanding of the virus's impact, creating a need for enhanced surveillance.

Objective: The goal of this study is to improve disease surveillance by complementing standardized tracking with new, decomposable surveillance metrics of COVID that overcome data limitations and contamination inherent to public health surveillance systems. In addition to observed daily and cumulative testing, positivity rates, morbidity and mortality, we derive COVID transmission in terms of: 1) speed, 2) acceleration or deceleration, 3) change in acceleration or deceleration (jerk), and 4) 7-day transmission rate lag which explains where and how rapidly COVID is transmitting and quantifies shifts in the rate of acceleration or deceleration, in order to inform policies to limit COVID transmission and food insecurity in SSA.

Methods: We extracted 60 days of COVID data from public health registries and employed an empirical difference equation to measure daily case numbers in 47 sub-Saharan countries 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: Kenya, Ghana, Nigeria, Ethiopia and South Africa have the most observed cases of COVID. Seychelles, Eritrea, Mauritius, Comoros, and Burundi have the fewest. In contrast, the speed, acceleration, jerk, and 7-Day Lag indicate rates of COVID transmissions differ from observed cases. In September 2020, Cape Verde, Namibia, Eswatini, and South Africa had the highest speeds of COVID transmissions at 13.1, 7.1, 3.6, and 3 infections per 100,0000; Zimbabwe has a high acceleration rate of transmission while Zambia has the largest rate of deceleration this week compared to last week (jerk). Finally, the 7 Day Lag indicates the number of cases on Sept 15, 2020 that are a function of new infections from September 8, 2020 decreased in South Africa from 216.7 to 173.2 and Ethiopia from 136.7 to 106.3 per 100,000. The statistical approach is validated based on the regression results, which demonstrate recent changes in the pattern of infection. During the weeks of September 1-8 and September 9-15 there were substantial country differences in the evolution of the pandemic. This

change represents a decrease in the R value for that week and is consistent with a de-escalation in the pandemic for SSA.

Conclusions: 1) Standard surveillance metrics, such as new COVID cases or deaths, are necessary but insufficient to prevent COVID transmission. Public health leaders also need to know where transmission rates are changing, whether they increase or decrease over short time frames and how many cases today are a function of new infections 7 days ago. 2) Although SSA is home to some of the world's poorest countries, development and population are not predictive of COVID transmission, meaning higher income countries can learn from African countries how best to implement mitigation efforts.

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