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The Dynamic of COVID-19 Landscape in Eastern Africa

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Key messages

- COVID-19 non-pharmaceutical interventions (NPIs) would slow down the infections in the shortrun
- Under the current NIP, between 0.18%- 34% of the population in Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda will be infected by January 2022.
- Implementation of NPIs along COVID-19 vaccine is likely to enhance herd immunity for long-term management of the virus

COVID-19 disruptions evident in Eastern Africa

The emergence of Coronavirus disease 2019 (COVID-19) presents a grave threat to the health and livelihoods of millions of people around the world, with severe impact on vulnerable groups, the majority of the African populace. In Africa, millions were already suffering from poor health care, hunger, and malnutrition before the virus hit. Relying mainly on agriculture, the pandemic threatens food security and nutrition in Eastern African countries through increasing food prices, loss of jobs, and disrupted food production and market value chains. COVID-19 came in the middle of multiple threats in Africa, including the infestation by the Fall Armyworm, desert locust[1], and flooding[2] exacerbating the already fragile food system, especially among the poor rural men and women. Since reporting of the first case in Africa on February 14, 2020, in Egypt, a total of 6,543,882 COVID-19 confirmed cases and 166,234 deaths have been reported in 54 African countries by July 28, 2021,[3] with significant cases and deaths reported in East Africa[3]. To mitigate the transmission and impacts of COVID-19, measures including self-isolation, the closure of schools, banning of public gatherings, social distancing, and border closures were implemented, resulting in direct or indirect disruption of many important private and public services worldwide. As also recommended by the United Nations[4], to make informed decisions about pandemic planning, resource allocation, and implementation of priority actions to reduce the impacts of the pandemic including non-pharmaceutical interventions (NPIs), the COVID-19 trajectory needs to be clearly understood.

Using the case of Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda, the objective of this study, BMC Infectious Diseases (under review in the *Research Square journal*) was to;

(i) Provide estimates of the cases and fatalities due to COVID-19 by Jan 2022

(ii) Apply a data-driven approach for deducing the transmission dynamics of the pandemic, infection prevention and evaluate policy implementation

(iii) Forecast the impact of government interventions in the selected EACs countries.

The predictive analysis is important to guide decision-making but also to facilitate the engagement of different actors in strengthening COVID-19 mitigation interventions. The availability of data for modelling guided the choice of the study countries. The COVID-19 non-pharmaceutical interventions (NPIs) including various forms of social distancing, and lockdown have had varying degrees of success in reducing the virus transmission. The timing of the intervention is key to their success. To influence public health policy among other interrelated policies, it is imperative to quantify the impact of NPIs regarding their efficacy, timing, and appropriate use.

[1] http://www.fao.org/ag/locusts/en/info/info/index.html
[2] https://reliefweb.int/sites/reliefweb.int/files/resources/Special_Report_East_Africa_202005.pdf
[3] https://africacdc.org/covid-19/
[4] https://reliefweb.int/report/world/policy-brief-impact-covid-19-food-security-and-nutrition-june-2020

Data and methodology

The study employed publicly available COVID-19 daily recorded time-series data for the seven EACs from WHO and the Johns Hopkins University Center for Systems Science and Engineering (JHU CCSE) from 22 January 2020[5]. The data include information on daily counts of COVID-19 confirmed cases, recovered cases, and deaths. The study utilized the extended edition of the previously used classical susceptible-infected-removed (SIR) model for estimating the dynamics of infections and diseases. The extended SIR (eSIR) compartmental model[6] incorporates NPIs such as quarantine and vaccination to account for transmission dynamics and vaccine-induced immunity over time. Time-varying parameters (i.e. transmission rates, quarantine, antibody (herd immunity), and vaccination), were used to estimate the COVID-19 cases and fatalities and assessment of the impact of governmental interventions.

Key findings

The simulation results show the number of new and confirmed cases increased exponentially from March 2, 2020, to April 1, 2021, across the seven East African Countries (EACs). Without any intervention, we observed a rampant prevalence of infection, and the endpoints of the pandemic were prolonged. When regional governments introduced NPI measures during the initial phases of the pandemic, the infection prevalence declined. However, the epidemiological trend of the disease[7] remained above 1, suggesting that most EACs were still under threat, with Kenya facing a higher risk. Infection prevalence was high when the simulation of the epidemic was allowed to take its natural course without interventions, especially during the 2020/2021 time period when herd immunity was low in the population. Under the current intervention measures, the long-term projection indicated that about 0.97%, 6.15%, 33.94%, 3.17%, 3.45%, 0.18%, 6.88% (or 115,505; 7,072,584; 18,249,566; 410,599; 386,020; 107,265; and 3,145,602 people) of the population would be infected by 16th January 2022 in Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda respectively. The high number of cases however could be attributed to the weak health infrastructure, crowded social life, and poor personal hygiene. Besides, disease comorbidities such as hypertension, obesity, type II diabetes, HIV, tuberculosis, and malaria, which are highly prevalent in Africa, may contribute to the weak immune response to COVID-19. We show that the low apparent morbidity and mortality observed in EACs is likely biased by underestimation of infected and mortality cases.

The above prediction is based on the assumption that 2% of the population was vaccinated. Consequently, if we extend the vaccination to 10% we are likely to reduce infection by a significant margin. The vaccination coverage required to establish herd immunity against COVID-19 is quite heterogeneous, ranging from 0%, 2.0%, 2.2%, 3.5%, 0.46%, 0.18% and 2.5% of the population having received at least one dose of the vaccine in Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda respectively as of 12th August 2021. Flattening the curve will require a significant percentage of the population to be immunized. In particular, we recommend that countries with a high (above 1) epidemiological trend measure of the disease such as Kenya (8.52), Burundi (2.84), Uganda (2.34), and Tanzania (2.57) increase the vaccine coverage required to establish herd immunity against COVID-19 and strictly enforce interventions.

Implications for policy

Our study demonstrates the effectiveness of the enforced non-pharmaceutical interventions to contain the pandemic. The study suggests stringent implementation of intervention policies including enforcement of lockdowns and curfews, wearing facemasks, long-term surveillance, and COVID-19 vaccine roll-out. Increasing vaccine coverage would increase herd immunity and therefore epidemiological trend measure of the disease, thus reducing the infections significantly. The country's

[5] https://github.com/CSSEGISandData/COVID-19.
[6] https://github.com/lilywang1988/eSIR.
[7] Basic reproductive number (R_0) (https://github.com/lilywang1988/eSIR)

disparities in the interventions across the EAC's quest for close collaboration between regional governments, the scientific community, and health care providers effectively reduce the spread of COVID-19.

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