

Using Data Science and Machine Learning Techniques to Understand Behavioural Responses to COVID-19 in Kenya

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Introduction

The rate of COVID-19 infections continues to rise in Africa. Estimates show that the number of infections in the region rose from about 2.7 million by the end of 2020 to 4.6 million by May 4, 2021 (Africa CDC 2021a; Africa Centre for Strategic Studies 2021). At the same time, the number of deaths from the disease rose from 65,000 by the end of 2020 to 122,000 by May 4, 2021, representing an increase in case fatality rate from about 2.4% to 2.7% (Africa CDC 2021a; Africa Centre for Strategic Studies 2021). Kenya ranks among the top ten countries in Africa that are affected by the pandemic. The country had registered a total of 160,904 positive cases as of May 4, 2021, up from about 96,000 cases as of December 31, 2020.¹ Although the number of deaths rose from about 1,700 to about 2,800 between end of January 2021 and May 4, 2021, the case fatality rate remained stable at about 1.7% over the same period, which is slightly lower than the average for Africa.²

In response to the spread of COVID-19, governments have promoted adoption of protective behaviours, such as wearing face masks in public places, regular handwashing with soap and running water or use of hand sanitizers, regular sanitization of common surfaces, avoidance of crowded places, contact tracing, screening, quarantine and isolation (de Bruin et al 2020; Girum et al. 2020). More recently, with the availability of vaccines, governments have initiated vaccination, in collaboration with international agencies, as a prevention strategy against COVID-19 infection (WHO 2020). Estimates by the Africa CDC show that as of April 27, 2021, a total of 37.1 million vaccine doses had been supplied in the continent, with slightly less than half (48%) of the doses having been administered (Africa CDC 2021a). Kenya began vaccinations against COVID-19 in early March 2021, by giving priority to health care workers, people with comorbidities, persons aged 50 years or older, and frontline or essential workers such as security personnel and teachers (Africa CDC 2021a). The country received slightly over 1 million vaccine doses out of which 81% had been administered by April 27, 2021 (Africa CDC 2021a).

Studies have shown low adherence to COVID-19 prevention measures in parts of Africa (Amodan et al. 2020; Bante et al. 2021; Ditekemena et al 2021; Shewashinad Yehualashet et al. 2021). Estimates by the Africa CDC further show wide variations in vaccine availability and coverage across the continent. For instance, eight countries had not received any vaccine doses by April 27, 2021 while among those that had received, the quantities varied from about 24,000 doses in Sao Tome and Principe to over 10 million doses in Morocco (Africa CDC 2021a). In addition, a recent study by Africa CDC in 15 African countries found wide variations in willingness to accept COVID-19 vaccines – very low willingness in some settings and very high willingness in others (Africa CDC 2021b). The varied patterns in adherence to COVID-19 prevention measures and willingness to accept COVID-19 vaccines in Africa underscore a need for an in-depth

¹Available at: <https://www.worldometers.info/coronavirus/country/kenya/> [Last accessed: May 5, 2021].

²*ibid.*

understanding of the behavioural responses to the measures in different contexts, which could limit the effectiveness of the interventions in controlling the pandemic in the region.

The Kenya Government has instituted prevention measures similar to those implemented elsewhere in order to contain the spread of COVID-19 disease in the country (McDade et al. 2020). A longitudinal study conducted by the Population Council showed that the proportion of people who perceived themselves to be at risk of COVID-19 infection in the country ranged from 4% to 42% depending on the setting, with no major changes over time (Population Council 2020a; 2020b; 2020c). The research further showed that adoption of protective behaviours ranged from 20% to 96% depending on the setting and the specific behaviour, with improvements in some behaviours, regression in some, and stagnation in others over time (Population Council 2020a; 2020b; 2020c). These patterns are likely to have implications for acceptability of COVID-19 vaccines as the country rolls out vaccinations to the general population. This study will examine the extent to which perceptions about COVID-19 and perceived vulnerability to infection influence adoption of protective behaviours in Kenya, variations across different sub-groups of people, and the implications of current patterns for future risks, needs and opportunities for the control of COVID-19 and similar pandemics.

Data and methods

The study will use data science and machine learning techniques to generate new insights from two existing datasets: 1) a longitudinal COVID-19 knowledge, attitude and practice (KAP) survey conducted in five informal settlements in Nairobi County, and in rural settings in Wajir, Kilifi and Kisumu Counties of Kenya among 3,661 adult women, 1,826 adult men, 2,825 female adolescents, and 1,106 male adolescents; and 2) data from Twitter platform on COVID-19 related messages posted by users in Kenya. Participants in the KAP survey were randomly sampled from ongoing longitudinal cohort studies conducted by the Population Council in the four counties (Abuya et al. 2020; Austrian et al. 2020). These included the Adolescent Girls Initiative-Kenya (AGI-K), NISITU (Nisikilize Tuiengane): Listen to Me, Let's Grow Together, and DREAMS projects (Austrian et al. 2020). Data from Twitter platform will, on the other hand, be purposively identified based on the relevance of the posts to COVID-19.

Results

Based on the literature showing low adherence to COVID-19 prevention measures in some parts of Africa and the wide variations in vaccine availability and coverage, we hypothesise that the extent to which perceptions about COVID-19 and perceived vulnerability to infection influences adoption of protective behaviour varies across sub-groups of people. Given the socio-economic impact of the pandemic, it is likely that those whose livelihoods are most affected may not afford some of the protective materials such as face masks, hand sanitisers or soap for regularly sanitising or washing hands. Thus, regardless of their perceptions about the disease and perceived vulnerability, they are unlikely to adopt protective behaviour. In contrast, those whose livelihoods were least affected may afford the protective materials, and whether they adopt protective behaviour or not will depend on their level of perceived vulnerability to infection and the benefits of adopting such behaviour.

Conclusion

Findings will inform targeted information, education and communication (IEC) as well as prevention programmes (including the roll-out of COVID-19 vaccines) to those most in need who might be overlooked by existing interventions.

References

Abuya, Timothy; Austrian, Karen; Isaac, Adan; Kangwana, Beth; Mbushi, Faith; Muluve, Eva; Mwanga, Daniel; Ngo, Thoi D.; Nzioki, Mercy; Ochako, Rhoune; Pinchoff, Jessie; Tidwell, Ben; White, Corinne, 2020, “Experiences among adults and adolescents during the COVID-19 pandemic from four locations across Kenya.” <https://doi.org/10.7910/DVN/VO7SUO>.

Africa CDC. 2021a. Coronavirus Disease 2019 (COVID-2019): Latest Updates on the COVID-19 Crisis from Africa CDC. Available at: <https://africacdc.org/covid-19/> [Last accessed: May 5, 2021].

Africa CDC. 2021b. *COVID-19 Vaccine Perceptions: a 15-Country Study*. Addis Ababa: Africa CDC.

Africa Centre for Strategic Studies. 2021. Analyzing Africa’s Second Wave of COVID-19. Available at: <https://africacenter.org/spotlight/analyzing-africas-second-wave-of-covid-19/> [Last accessed: May 5, 2021].

Amodan, Bob O., Lilian Bulage, Elizabeth Katana, Alex R. Ario, Joseph N. Siewe Fodjo, Robert Colebunders, and Rhoda K. Wanyenze. 2020. “Level and Determinants of Adherence to COVID-19 Preventive Measures in the First Stage of the Outbreak in Uganda.” *International Journal of Environmental Research and Public Health* 17(8810):1-14; doi:10.3390/ijerph17238810.

Austrian K, L. Pinchoff, J.B. Tidwell, C. White, T. Abuya, B. Kangwana, et al. 2020. COVID-19 related knowledge, attitudes, practices and needs of households in informal settlements in Nairobi, Kenya. [Preprint]. *Bulletin of the World Health Organization*. E-pub: 6 April 2020. doi: <http://dx.doi.org/10.2471/BLT.20.260281>.

Bante, Agegnehu, Abera Mersha, Azene Tesfaye, Behailu Tsegaye, Shitaye Shibiru, Gistane Ayele, and Meseret Girma. 2021. “Adherence with COVID-19 Preventive Measures and Associated Factors Among Residents of Dirashe District, Southern Ethiopia.” *Patient Preference and Adherence* 15:237–249.

de Bruin, Yuri Bruinen, Anne-Sophie Lequarre, Josephine McCourt, Peter Clevestig, Filippo Pigazzani, Maryam Zare Jeddi, Claudio Colosio, and Margarida Goulart. 2020. “Initial impacts of global risk mitigation measures taken during the combatting of the COVID-19 pandemic.” *Safety Science* 128(104773):1-8.

Ditekemena JD, Nkamba DM, Muhindo HM, *et al.* 2021. “Factors associated with adherence to COVID-19 prevention measures in the Democratic Republic of the Congo (DRC): results of an online survey.” *BMJ Open* 11:e043356. doi:10.1136/bmjopen-2020-043356.

Girum, Tadele, Kifle Lentiro, Mulugeta Geremew, Biru Migora, and Sisay Shewamare. 2020. “Global strategies and effectiveness for COVID-19 prevention through contact tracing, screening, quarantine, and isolation: a systematic review.” *Tropical Medicine and Health* 48(91):1-15. doi: <https://doi.org/10.1186/s41182-020-00285-w>.

McDade, K.K., D. Ogira, J. Onyango, J. Ojal, G. Kokwaro, W. Mao, and G. Yamey. 2020. *Kenya’s policy response to COVID-19*. The Center for Policy Impact in Global Health. Policy Report. Available at: <http://centerforpolicyimpact.org/our-work/the-4ds/kenya-policy-response-to-covid-19/> [Last accessed: May 06, 2021].

Population Council. 2020a. *Kenya: COVID-19 Perceptions, Prevention Practices, and Impact: Responses from fourth round of data collection in five Nairobi informal settlements (Kibera, Huruma, Kariobangi, Dandora, and Mathare)*. Nairobi: Population Council.

Population Council. 2020b. *Kilifi, Kenya: Adult COVID-19 Perceptions, Prevention Practices, and Impact. Responses from the first round of adult data collection in Kilifi, Kenya*. Nairobi: Population Council.

Population Council. 2020c. *Kisumu, Kenya: Adult COVID-19 Perceptions, Prevention Practices, and Impact. Responses from the first round of adult data collection in Kisumu, Kenya*. Nairobi: Population Council.

Shewasinad Yehualashet S, Asefa KK, Mekonnen AG, Gameda BN, Shiferaw WS, Aynalem YA, *et al.* 2021. “Predictors of adherence to COVID-19 prevention measure among communities in North Shoa Zone, Ethiopia based on health belief model: A cross-sectional study.” *PLoS ONE* 16(1): e0246006. <https://doi.org/10.1371/journal.pone.0246006>.