Forecasting the impact of Omicron sub-variant BA.2/4 in Kenya

Key points

- Genomic surveillance data shows that the Omicron sub-variants BA.2 and BA.4 have been introduced in Kenya.
- We used an existing SARS-CoV-2 mathematical model to forecast hospital and ICU bed occupancy and deaths due to the Omicron sub-variants BA.2/4, assuming community transmission from late April 2022. Our time frame for forecasting is medium term (until mid-October).
- Fully vaccinated uptake was assumed to increase to 49% among over 18s by mid October 2022, and to prioritise the elderly.
- Predictions assumed a range of immune evasion for Omicron subvariants BA.2/4 (low 10%, high 25%) relative to protection against infection by the original Omicron subvariant BA.1. Vaccine effectiveness against disease was assumed to be identical to the original Omicron variant.
- The model predicts a range of outcomes depending on the relative transmission advantage of subvariants BA.2/4 versus the original Omicron variant. At low transmission advantage (10% immune evasion), we project very little detected COVID-19 severe disease over our forecasting window. At high transmission advantage (25% immune evasion), we project a shallow wave of severe disease (June – September 2022, peaking in late-July-Early August 2022).
- The increase in transmission due to these sub-variants is hence unlikely to result in an increase in health care demand. The predictions support the maintenance of current government advisory on COVID-19 measures.

Introduction

Genomic surveillance has reported the introduction of the Omicron sub-variants BA.2 and BA.4 in Kenya and it is highly likely that sustained transmission is already occurring. These sub-variants have transmission advantage relative to original Omicron subvariant [1]. However, there is no evidence of increased severity of disease associated with a BA.2/4 infection episode compared to the original Omicron variant [1], which was associated with lower rates of disease per infection compared to the Delta variant [2]. Moreover, the importance of "hybrid" immunity, that is immunity induced by a combination of natural infection with SARS-CoV-2 and vaccination, in settings with high levels of population exposure to natural SARS-CoV-2 infection (e.g. Kenya) has been increasingly emphasised [3]. We modelled the transmission of the BA.2 & BA.4 sub-variants to forecast hospital and ICU bed occupancy and deaths under the assumption that that transmission of BA.2/4 subvariants became established in Kenya at the end of April 2022.

Methods

We previously described the multiple waves of SARS-CoV-2 in Kenya with a mechanistic transmission model fitted to reported cases, multiple seroprevalence surveys, reported deaths, and reported occupancy in intensive care units (ICUs) and general wards due to COVID-19 disease [4]. We also accounted for population immunity due to natural infection, vaccination and hybrid protection from both natural infection and vaccination [4]. Here we extend that model using reported incidence of deaths and ICU/general ward occupancy data through the December 2021 – February 2022 wave of COVID-19 in Kenya (Figures 1-3) to capture the reduction in risk per infection with the original Omicron variant compared to Delta variant evident in Kenya. We use this inference to make projections on possible up-coming waves of COVID-19 in Kenya driven by the BA.2/4 subvariants.

Our key assumptions are:

- BA.2/4 Omicron subvariants have similar disease risk per infection as the original Omicron variant.
- The transmission advantage of BA.2/4 subvariants is due to immune escape, with the relative advantage of BA.2/4 compared to the original Omicron variant among previously infected people being in a range of 10%-25% (chosen to be consistent with a ~10-13% daily transmission advantage [1]).
- The proportion of fully vaccinated adults in Kenya continues growing and reaches 49% in mid-October 2022.

Results

1. Recent changes in reported case rates in Kenya

Until May 2022, daily rates of reported cases have been decreasing in 2022, with a daily decrease in cases 2.3% between 1st March – 15th April 2022. In May 2022 the rate of reported cases began increasing again, with a likelihood that this is caused by the introduction of Omicron subvariants BA.2/4, daily increase in cases 8.6% 5th May – 3rd June 2022 (doubling time 8.4 days). This indicates that the daily transmission advantage of BA.2/4 is approximately 10.9% in the Kenyan context, broadly consistent with a 10%-25% transmission advantage due to immunity evasion in a highly exposed population. Because precise case numbers are highly contingent on availability of tests, rate of seeking tests and changes in testing strategy we do not project precise case numbers.

2. Hospital bed occupancy due to Omicron sub-variants BA.2/4

Projections for hospitalisations are shown in Figure 1. We found that the original Omicron variant had 50% less risk of causing severe disease requiring non-critical care at a hospital/health facility compared to Delta variant, other factors such as previous exposure, age, vaccine status etc being kept constant. Different forecasts are given following Omicron introduction under assumptions of 10% (blue lines), 15% (red lines), 20% (green lines) and 25% (red lines) immune evasion for BA.2/4 subvariants compared to original Omicron subvariants.

The extremes of estimates are (a) around 380 hospital bed occupancy (~0.75 per 100,000 Kenyans) across Kenya at peak around mid-August with a total of 3600 – 3700 admissions between 1st May 2022 and 1st November 2022 (purple line), versus (b) extended low level rate of hospitalisation with 1000-1500 admissions between 1st May and 1st November (blue line).

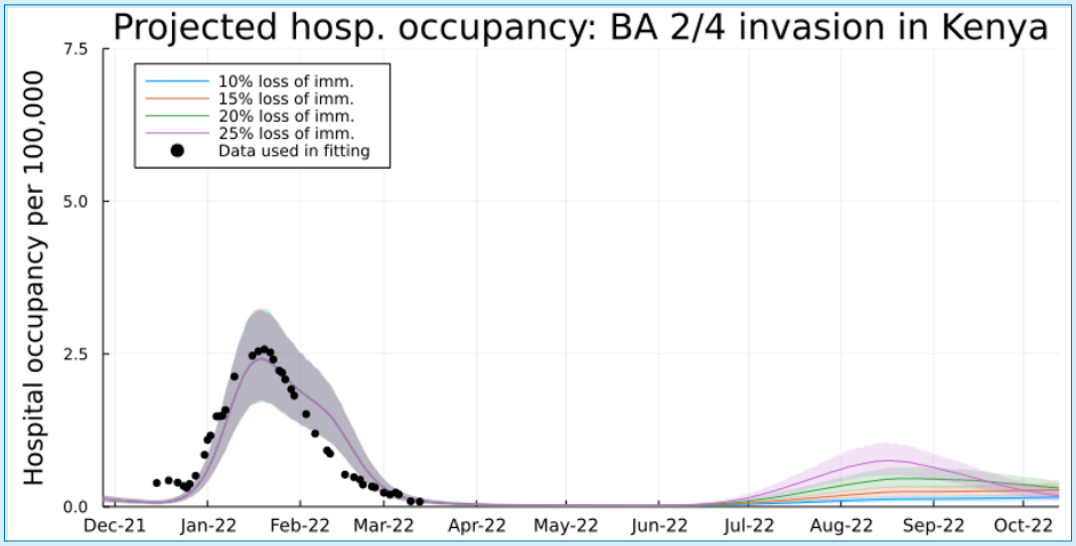

Figure 1. Model forecasts of daily hospital bed occupancy following introduction of the Omicron sub-variant BA.2/4 cumulative for all counties in Kenya. Forecasts assume a range of immune evasion (10-25%). The model is fit to the number of beds occupied during the Omicron variant wave (black dots), and projections are made for different levels of transmission advantage of Omicron BA.2/4 subvariants over original Omicron subvariant.

3. ICU bed occupancy due to the Omicron sub-variant BA.2/4

Patterns for ICU beds occupied follow that of all hospitalisations. We found that the original Omicron variant had 70% less risk of causing critical disease requiring care at an ICU compared to the Delta variant, other factors such as previous exposure, age, vaccine status etc being kept constant. In all scenarios both the peak and cumulative numbers of cases needing critical care is low (less than 10 Kenyans occupying ICU at peak and less than 200 cumulative critical cases between 1st May 2022 and 1st November 2022) (Figure 2).

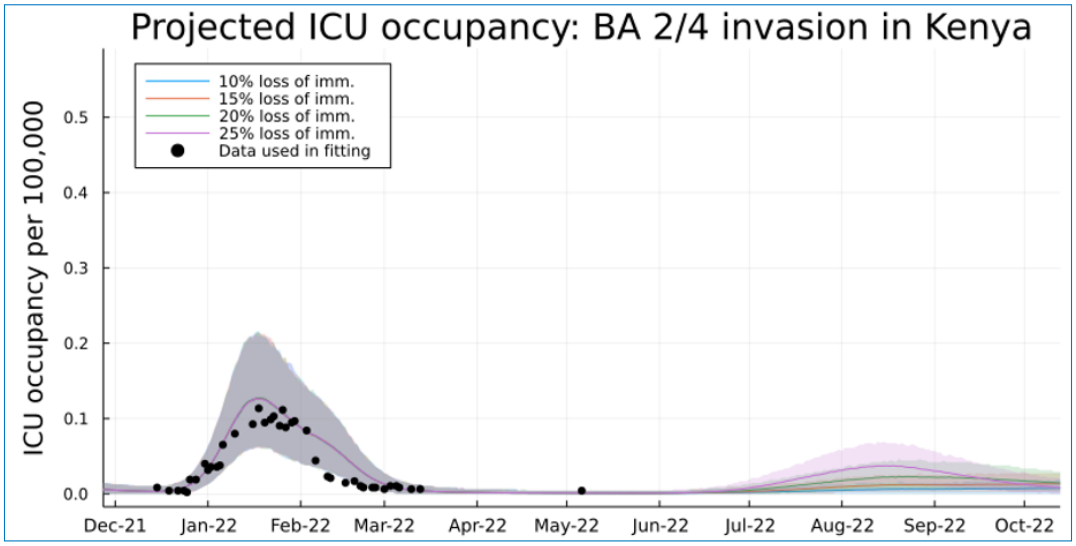

Figure 2. Model forecasts of daily ICU occupancy following introduction of the Omicron sub-variants BA.2/4 cumulative for all counties in Kenya. Forecasts assume a range of immune evasion (10-25%). The model is fit to the number of ICU beds occupied during the Omicron variant wave (black dots), and projections are made for different levels of transmission advantage of Omicron BA.2/4 subvariants over original Omicron subvariants.

Deaths due to the Omicron sub-variant BA.2/4

Patterns of deaths follow that of hospitalisations and ICU cases. However, it should be noted that we are reporting incidence of deaths which we project as peaking before the hospitalizations because of backlog effects. We found that the original Omicron variant had 70% less risk of causing death compared to Delta variant, other factors such as previous exposure, age, vaccine status etc being kept constant. In all scenarios both the peak and cumulative numbers of deaths are low (less than 10 reported deaths at peak and less than 180 deaths between 1st May 2022 and 1st November 2022) (Figure 3).

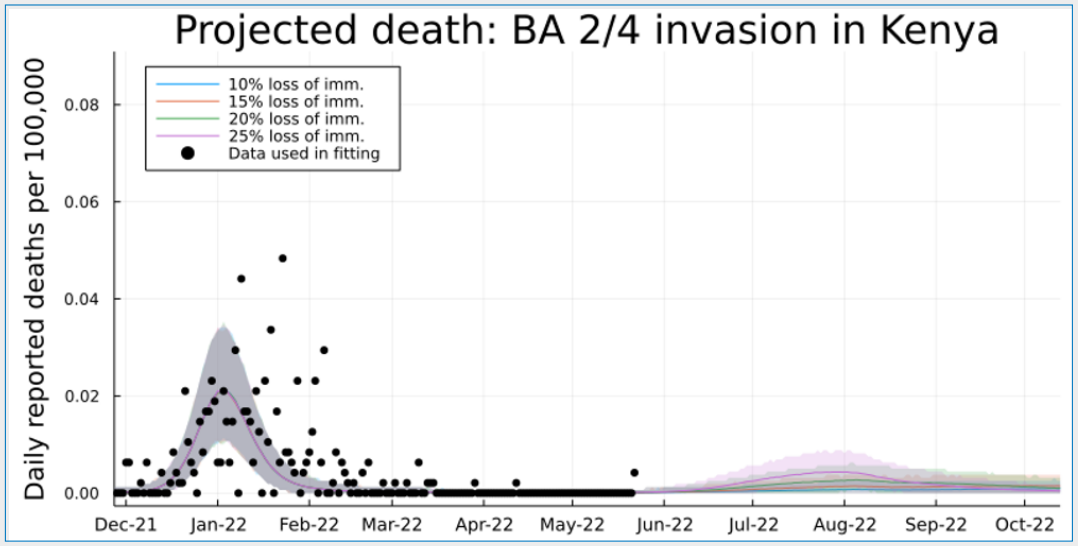

Figure 3. legend. Model forecasts of daily deaths following introduction of the Omicron sub-variant BA.2/4 cumulative for all counties in Kenya. Forecasts assume a range of immune evasion (10-25%). The model is fit to the number of daily reported deaths during the Omicron variant wave (black dots), and projections are made for different levels of transmission advantage of Omicron BA.2/4 subvariants over original Omicron subvariant.

Interpretation

Our model predicts that the impact of the introduction of Omicron sub-variants BA.2/4 to the Kenyan population will likely range from very little detected COVID-19 severe disease and deaths to a shallow wave with low numbers of severe cases and deaths. The increase in transmission due to these sub-variants is hence unlikely to result in an increase in health care demand. The predictions support the maintenance of current government advisory on COVID-19 measures.

References

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