

# Evolution of the COVID-19 pandemic over six weeks in four French-speaking countries in West Africa

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## Research article

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# Abstract

## Background

The COVID-19 pandemic is an unprecedented international health crisis with different approaches to the response at country levels. The objective of this study was to analyze the evolution of this pandemic in Guinea, Mali, Senegal, and Burkina Faso over the first six weeks. We hypothesize that there exist significant differences in the incidence of COVID-19 between countries.

## Methods

A cross-sectional study was conducted as part of a collaborative project. Data collection focused on the epidemiological surveillance indicators available in the countries' COVID-19 daily situation reports. Data were entered into a standardized Microsoft Excel spreadsheet which was exported to the STATA 15 software for analysis.

## Results

COVID-19 had a different dynamic in the four countries over the first six weeks. Its incidence in Burkina Faso and Senegal was dropping, while it was increasing slowly in Mali; only in Guinea, it increased rapidly. The analysis of variance revealed that the differences observed in the weekly COVID-19 incidence in the four countries were statistically significant ( $p \leq 0.01$ ). Different screening approaches have been used by the four countries. Guinea ( $n = 4,539$ ) performed more tests compared to Senegal ( $n = 2,961$ ), Burkina Faso ( $n = 2,455$ ) and Mali ( $n = 2,397$ ). The positivity rates were significantly higher in Mali (25.5%) and Burkina Faso (23.7%) than in Guinea (19.0%) and Senegal (9.5%) ( $p \leq 0.0001$ ). Hospitalization rates by country ranged from 32.0–79.6%, with Guinea's hospitalization rate (79.6%) being significantly higher as compared to that of the three other countries ( $p \leq 0.0001$ ). The cure rates were significantly higher in Burkina Faso (61.4%) and Senegal (61.1%) than in Mali (37.3%) and Guinea (19.7%) ( $p \leq 0.0001$ ). The case fatality rate was significantly higher in Burkina Faso (6.5%) than in Mali (5.2%) ( $p \leq 0.001$ ), Guinea (0.7%), and Senegal (0.7%) ( $p \leq 0.0001$ ).

## Conclusion

This study highlighted insights from COVID-19 surveillance data, as a basis for improving response strategies in the four countries. Large-scale screening seems relevant to not only facilitate controlling the disease spread but also reducing case fatality rates by early case detection, prior to the occurrence of complications.

## Background

The novel Coronavirus disease 2019 (COVID-19; caused by the virus SARS-CoV-2) is severely challenging health systems worldwide. The COVID-19 outbreak, which originated in the city of Wuhan in China as cases of pneumonia of unknown cause, was first reported to the WHO on December 31, 2019 [1], and was declared a Public Health Emergency of International Concern on January 30, 2020 when 18 countries were already affected [2, 3]. The epidemic was later declared a pandemic on March 11, 2020, when 118,000 people were infected and 3,400 deaths were recorded in 114 countries [1, 4, 5]. As of May 31, 2020, about six million confirmed cases including 367,166 deaths have been recorded in 216 countries globally [6, 7].

The COVID-19 pandemic further weakens health systems in Africa. Without specific treatment or a vaccine, the health services which suffer from huge gaps in human, material, and financial resources are struggling to adequately care for the infected people [8].

In Africa, the first case of COVID-19 was reported by Egypt on February 15, 2020, after which the pandemic spread to all countries on the continent with 46,829 positive cases as of May 12, 2020 [9]. Among the 21 French-speaking countries in sub-Saharan Africa, Senegal, Burkina Faso, Guinea, and Mali notified their first cases on March 02, 09, 12, and 25, 2020, respectively [10–13] and experienced different trajectories of disease progression, with obvious differences in the epidemiological surveillance indicators between countries. To our knowledge, these differences have not been analyzed. This study aims to fill this gap, focusing on notification data. We compared the evolution of the COVID-19 pandemic in Senegal, Burkina Faso, Guinea, and Mali over the first six weeks of each country's COVID-19 experience. Specifically, it involved comparing the trends of epidemiological surveillance indicators provided by the four countries. We hypothesize that there exist significant differences in the incidence of COVID-19 between countries.

## Methods

### Setting

This study was conducted as part of a collaborative project called “COVID-19 in Francophone Africa” initiated by the “Francophone Africa and Fragility” (AFRAFRA) network, which brings together more than 90 African and international experts [14]. The collaborative project aims to analyze the COVID-19 response in Guinea, Mali, Senegal, and Burkina Faso since fewer efforts are made towards research realization in French-speaking African countries as compared to English-speaking countries, while they face significant public health challenges. This is, among other reasons, because English is the main language of research and French-speaking countries often feel that they are outside the priorities of funders [15].

The four countries border each other. Mali is the largest country (1,241,238,000 m<sup>2</sup>) followed by Burkina Faso (274,200,000 m<sup>2</sup>), Guinea (245,857,000 m<sup>2</sup>), and finally Senegal (196,712,000 m<sup>2</sup>). In terms of population, the four countries have between 12 and 21 million inhabitants (Table 1). The countries' health systems have a similar pyramidal structure with a peripheral, regional, and central level, and a similar healthcare organization in three levels. The first level corresponds to the health district with basic healthcare facilities and a district referral hospital, at the second level there are regional hospitals, and the third level corresponds to the university hospital center for specialized healthcare. These four countries are underdeveloped and COVID-19 appeared in the context of major socio-political crises in Guinea, Mali, and Burkina Faso, although the socio-political situation has been more stable in Senegal. It should be noted that Guinea was the African French-speaking country which bore the greatest burden of the Ebola virus disease between 2014 and 2016, with 3,811 infected cases and 2,543 deaths [16].

### Study design and period

A cross-sectional study was conducted over six weeks since the notification of the first case of COVID-19 in each country (Table 1). The reporting of this study follows international guidelines relating to that of observational studies in epidemiology (STROBE) [17,18].

### Study population and Sampling

An exhaustive sampling was carried out including the four countries' aggregated COVID-19 data for the study periods.

### Variables

The study variables (Table 1) included epidemiological surveillance indicators (number of screening tests, confirmed cases, and hospitalized cases; rates of test positivity, hospitalization, cure, case fatality, and evacuation abroad; and number of contacts (recorded, went out of follow-up, to be traced, untraced, and lost to follow-up)).

### **Definitions:**

*Confirmed case:* is anyone who is symptomatic or not with laboratory confirmation of COVID-19 infection [19].

*Cumulative number of confirmed cases:* is the sum of new and old confirmed cases.

*Positivity rate:* is the ratio between the cumulative number of confirmed cases and the number of tested cases.

*Hospitalization rate:* is the ratio between the number of hospitalized cases and the cumulative number of confirmed cases.

*Cure rate:* is the ratio between the cumulative number of cases cured and the cumulative number of confirmed cases.

*Case fatality rate:* is the ratio between the cumulative number of deaths and the cumulative number of confirmed cases.

*Evacuation rate:* is the ratio between the number of evacuated cases and the cumulative number of confirmed cases.

*Contact:* a person who i) had close contact with a probable or confirmed case within one meter and for more than 15 minutes; ii) had direct physical contact with a probable or confirmed case; iii) provided direct care to a probable or confirmed COVID-19 patient without using appropriate personal protection equipment; iv) has been exposed through other situations (such as classrooms, places of worship, hospital waiting rooms, and public transport) [20].

*Contact lost to follow-up:* is any contact with which the surveillance team has come into contact and who has not been reachable by telephone for three successive days [21].

*Untraced contact:* is any contact that after being recorded has never been traced [21].

### **Data sources and collection**

Data originated from the daily situation reports published online by health authorities in the four countries, as reported by the National Health Security Agency (ANSS) in Guinea (<https://anss-guinee.org/welcome/document>), the Ministry of Health (MoH) and Social Affairs in Mali (<https://coronamali.info/>), the MoH and Social Action in Senegal (<http://www.sante.gouv.sn/Pr%C3%A9sentation/coronavirus-informations-officiel-et-quotidiennes-du-msas>), and the Government of Burkina Faso (<https://www.sig.gov.bf/accueil>).

From these reports, aggregated data were entered into a standardized Microsoft Excel spreadsheet.

### **Data analysis**

Descriptive statistics (sum, means, and proportions) and comparisons were carried out using STATA version 15 software (Stata Corporation, College Station, TX, USA). Weekly trends of new confirmed cases of COVID-19 were described as an epidemiological curve. The proportions of the epidemiological surveillance indicators between the four countries were compared using the two-sample test of proportion using the `Prtesti` command. The means of incident cases of COVID-19 in the four countries were compared using a one-way analysis of variance (ANOVA) where the Bartlett's test was applied. Multiple comparison tests (Bonferroni, Scheffe, and Sidak) were used to verify the validity of the ANOVA result. Significance level was set at 5%.

**Ethical considerations**

The study involved the review of officially released national data and documents; therefore, no ethical review process was undertaken.

**Results**

Table 1 and Table 2 provide a summary of all data for the four countries, and their between-country comparisons.

During the study period, Guinea performed more COVID-19 screening tests (n = 4,539) and identified more cases than the other three countries (Table 1).

[Table 1, HERE SOMEWHERE]

**Positivity, hospitalization, cure, case fatality, and evacuation rates**

The positivity rates recorded in Mali (25.5%) and Burkina Faso (23.7%) were significantly higher than in Guinea (19.0%) and Senegal (9.5%) ( $p \leq 0.0001$ ). The difference in the positivity rate between Mali and Burkina Faso was not statistically significant ( $p = 0.145$ ), but it was between Guinea and Senegal ( $p \leq 0.001$ ). Hospitalization rates by country ranged from 32.0–79.6%, with Guinea’s hospitalization rate (79.6%) being significantly higher as compared to that of the three other countries ( $p \leq 0.0001$ ). Burkina Faso and Senegal recorded similar cure rates (61%) which were significantly higher compared to those in Mali (37.3%) and Guinea (19.7%) ( $p \leq 0.0001$ ). Case fatality rates ranged from 0.7–6.5%. Burkina Faso had the highest case fatality rate (6.5%) which was significantly higher than that of Mali ( $p \leq 0.001$ ), and those in Guinea and Senegal ( $p \leq 0.0001$ ). Mali and Senegal evacuated 8 (1.3%) and 1 (0.4%) COVID-19 patients respectively, for treatment abroad (Table 2).

[Table 2, HERE SOMEWHERE]

**Trends in COVID-19 incidence**

COVID-19 had a different dynamic in the four countries (Fig. 1). In Guinea, its evolution was marked by an exponential rise of incident cases ranging from 2 (week 1) to 424 (week 6). In Mali, the number of new confirmed cases evolved gradually and linearly; it varied between 28 (week 1) and 188 (week 6). As for Burkina Faso, we observed a polynomial incidence of the pandemic, which increased gradually from 15 cases (week 1) to 147 cases (week 3), then decreased to 118 cases (week 4), increased to 151 cases (week 5) and dropped to 66 cases (week 6). In Senegal, we noted a moderate gradual incidence of the pandemic from 4 cases (week 1) to 80 cases (week 5), which decreased to 58 cases (week 6).

The analysis of variance (carried out at 23 degrees of freedom) revealed that the means of incident cases of COVID-19 in the four countries were not identical (significant Bartlett’s test:  $p \leq 0.01$ ). Therefore, the differences observed in the spread of the pandemic in the four countries were statistically significant. This was confirmed by the “post-estimation” where the Bonferroni, Scheffe, and Sidak tests reported differences in proportions of means varying between 39% and 100%.

[FIGURE 1, HERE SOMEWHERE]

**Contact tracing**

In Guinea, during the first six weeks (March 12 to April 18, 2020), 4,872 contacts were recorded, of which 3,613 went out of follow-up after 14 days. Among the remaining contacts (n = 1,241), 1,076 (86.7%) were traced and 165 (13.3%) were untraced. Besides, in the same period, some contacts (n = 55) were lost to follow-up. Data on contact tracing were not detailed in Mali where overall, 2,013 contacts were recorded over the first six weeks of the pandemic. The other two countries (Senegal and Burkina Faso) did not report any data on contact tracing (Table 1).

Table 1

Surveillance indicators over the first six weeks of each country's COVID-19 epidemic in four French-speaking countries in West Africa, 2020

		Senegal	Burkina Faso	Guinea	Mali
	First case (in 2020; date)	March 2	March 9	March 12	March 25
	Six weeks later (in 2020; date)	April 12	April 19	April 22	May 5
Notifications over six weeks	Screening test	2,961	2,455	4,539	2,397
Confirmed cases (cumulative six weeks)	Total	280	581	862	612
	Positivity rate	9.5%	23.7%	19.0%	25.5%
Hospitalized cases	Total	106	186	686	344
	Hospitalization rate	37.9%	32.0%	79.6%	56.2%
Cure	Total	171	357	170	218
	Cure rate	61.1%	61.4%	19.7%	37.3%
Deaths	Total	2	38	6	32
	Case fatality rate	0.7%	6.5%	0.7%	5.2%
Evacuations for treatment abroad	Total	1	0	0	8
	Evacuation rate	0.4%	0.0%	0.0%	1.3%
Contacts	Total recorded	N/A	N/A	4,872	2,013
	Out of follow-up after 14 days	N/A	N/A	3,631	N/A
	To be traced	N/A	N/A	1,241	N/A
	Traced	N/A	N/A	1,076	N/A
	Untraced	N/A	N/A	156	N/A
	Lost to follow-up	N/A	N/A	55	N/A
Country population (in millions)		16 (2019)	21 (2020)	12 (2018)	18 (2016)

N/A = Not Available

Table 2

Comparisons of epidemiological surveillance indicators over the first six weeks of COVID-19 between four French-speaking countries in West Africa, 2020

Indicators	Guinea	Mali		Guinea	Senegal		Guinea	Burkina Faso	
	N = 862	N = 612	p-value	N = 862	N = 280	p-value	N = 862	N = 581	p-value
Positivity rate (%)	19.0	25.5	$\leq 0.0001$	19.0	9.5	$\leq 0.001$	19.0	23.7	$\leq 0.0001$
Hospitalization rate (%)	79.6	56.2	$\leq 0.0001$	79.6	37.9	$\leq 0.0001$	79.6	32.0	$\leq 0.0001$
Cure rate (%)	19.7	37.3	$\leq 0.0001$	19.7	61.1	$\leq 0.0001$	19.7	61.4	$\leq 0.0001$
Case fatality rate (%)	0.7	5.2	$\leq 0.0001$	0.7	0.7	1.000	0.7	6.5	$\leq 0.0001$
Evacuation rate (%)	0.0	1.3	N/A	0.0	0.4	N/A	0.0	0.0	N/A
	Mali	Senegal		Mali	Burkina Faso		Senegal	Burkina Faso	
Positivity rate (%)	25.5	9.5	$\leq 0.0001$	25.5	23.7	0.145	9.5	23.7	$\leq 0.0001$
Hospitalization rate (%)	56.2	37.9	$\leq 0.0001$	56.2	32.0	$\leq 0.0001$	37.9	32.0	0.087
Cure rate (%)	37.3	61.1	$\leq 0.0001$	37.3	61.4	$\leq 0.0001$	61.1	61.4	0.933
Case fatality rate (%)	5.2	0.7	$\leq 0.0001$	5.2	6.5	$\leq 0.001$	0.7	6.5	$\leq 0.0001$
Evacuation rate (%)	1.3	0.4	N/A	1.3	0.0	N/A	0.4	0.0	N/A
N/A = Not Available									

## Discussion

To our knowledge, this study is the first to analyze the evolution of the COVID-19 pandemic in Francophone West Africa. Our hypothesis is confirmed; the incidence of COVID-19 varied significantly by country. Also, our findings show that the evolution of the following epidemiological surveillance indicators: rates of test positivity, hospitalization, cure, case fatality varied significantly by country. However, three indicators (incidence of COVID-19, test positivity rate, and case fatality rate) merit further attention to understand the factors that might explain the differences observed across countries, although there still remain critical unknowns and many uncertainties in COVID-19 [22].

The most striking finding of this study is that the incidence of COVID-19 in Burkina Faso and Senegal was dropping, while it was increasing slowly in Mali despite the high transmissibility of the virus [23, 24], including in asymptomatic or mildly symptomatic carriers [25, 26] and the apparent lack of cross-immunity against related viral infections; however, only in Guinea, it increased rapidly. The trends observed in Burkina Faso, Senegal, and Mali might be due to the early and adequate implementation of containment measures. However, these gains may be reversed if containment measures are lifted without any thorough analysis of the epidemiological situation [27]. This is currently the case for Senegal, where the curfew was relaxed, restrictions on interurban travel lifted, and certain public places (restaurants,

sports halls, movie theaters, etc.) were reopened on June 05, 2020 with 4,155 confirmed cases. As a result, the country quickly found itself more exposed than the other three countries with 5,090 cases declared positive as of June 14, 2020.

Another reason might be that case detection is not picking up cases anymore. One might posit that at the beginning of the epidemic, the virus spread among the “elites, who had traveled from abroad, or who were in direct contact with people who had traveled from abroad”, and these people were picked up by the epidemiological surveillance system put in place. However, after “4–6” weeks, the virus is being spread through community transmission (far away from the elites), and the existing epidemiological surveillance system is unable to capture those cases.

In contrast, the exponential incidence of COVID-19 in Guinea may be linked to delays in implementing public health response measures [28–30]. While the first confirmed case of COVID-19 was notified on March 12, 2020, the state of health emergency was only declared by the Head of State 18 days later (March 30, 2020) when the country already had 22 confirmed cases and community transmission had already started. This state of health emergency notably enabled the quarantine of Conakry by prohibiting movement towards the countryside, the establishment of a night curfew, and the reduction of the number of passengers by motorbike and by vehicle (taxi, minibus, bus) in order to respect physical distancing. Additionally, shortcomings were noticed, for instance with regard to contact tracing, which could have contributed to the swift and increasing dissemination of the disease in the country. Yet, Guinea should be able to use the lessons learned from the management of the 2014–2016 Ebola outbreak to improve control of the current COVID-19 pandemic. South Korea and Singapore were able to speedily contain COVID-19 by taking advantage of lessons learned from the management of previous SARS and MERS outbreaks [31, 32]. Guinea could also build on its experience of community engagement in the Ebola response. Indeed, the involvement of community-based organizations and community leaders in response activities contributed to overcoming community reluctance against response actions, a better observance of prevention and control measures, the improvement of contact tracing, and the referral of suspected cases to the Ebola treatment centers [33]. Such an innovative initiative could be adapted to the response to COVID-19, remaining mindful of the differences between Ebola and COVID-19.

Screening, testing, isolating and treating, and quarantining contacts are essential steps to control the current COVID-19 pandemic [34]. However, different screening approaches have been used by the countries included in this study. Guinea and Senegal performed more tests compared to Burkina Faso and Mali. This could be explained by the fact that Guinea and Senegal used similar screening strategies based on the detection of suspected cases and identification and testing of their close contacts, increasing, therefore, the number of tests performed. This might result in a lower positivity rate as the denominator increases. In contrast, Mali and Burkina Faso reserved the test only for suspected cases resulting in a higher positivity rate among those tested. The strategy of using large-scale tests has been the cornerstone of response strategies against COVID-19 in countries such as South Korea and Singapore [32]. However, this has been impossible till now in West Africa, because of resource constraints, as where the Governments had to rely on local funding. Making the best use of available resources was the guiding principle. Therefore, the four African countries studied gave priority to suspected cases and hospitalized patients which was feasible within their testing capabilities. Indeed, testing only suspected cases may not allow grasping the extent of the disease transmission correctly, since 87.8% of infected individuals remain asymptomatic and likely to spread the disease [25, 26, 35]. This lack of testing capability even occurred in the United States where a similar strategy was used to prioritize specific groups of people [36, 37]. However, given the rapid spread of the pandemic and the growing demand for relief of lockdown and containment measures to preserve the fragile economies, there is a real need to increase screening and testing capabilities in these countries [32]. Since early June 2020, Guinea has been increasing its testing capabilities to 800 tests per day with the availability of rapid tests and the decentralization of testing. Since then, the positivity rate of tests has been decreasing relatively. As the world awaits a potential vaccine to prevent COVID-19, efforts have to focus on



slowing the ongoing community transmission through strengthened epidemiological surveillance and reinforcement of infection prevention and control measures.

Our study reported case fatality rates ranging from 0.7–6.5%. These case fatality rates are similar to those existing in the current literature (0.6–7.2%) [36, 38, 39]. In our context, higher case fatality rates have been observed in Mali and Burkina Faso, linked to severe comorbidities and old age, but also due to the lack of adequate supportive treatment, mainly oxygen therapy. Several studies have already mentioned these factors to be associated with high case fatality rates [38, 40–42]. The different screening strategies could also explain the variation between the case fatality rates in the four countries studied. When access to screening tests is strictly reserved for suspected cases, the positivity rate is high, and often with advanced disease progression, the case fatality rate among all notified cases is invariably high [38]. Consequently, Burkina Faso and Mali have recorded higher case fatality rates than Guinea and Senegal where screening is also intended for contacts (6.5% and 5.2% in Burkina Faso and Mali, respectively vs. 0.7% in Guinea and Senegal).

## Study limitations and strengths

This study has some limitations. First, the analysis conducted was based exclusively on notification data; these are undoubtedly an underestimation of the ongoing community transmission. Second, the study only considered the first six weeks of the pandemic. Some results would likely be different if the study were conducted over a longer period. Third, data on contacts was not reported or detailed by all the study countries; this did not allow critical analyses to be carried out on this tracer epidemiological indicator. Finally, our study was unable to identify further contextual factors influencing COVID-19, due to the emergency context in which it was conducted.

However, despite these limitations, the study has the merit of being original and timely, to allow early lessons learning and improving the response to the current COVID-19 pandemic. The findings of this study provide the basis for additional studies, in particular, to identify country-specific contextual factors relevant to COVID-19. They will enable decision-makers and health authorities to strengthen the COVID-19 response strategies.

## Conclusion

This study provided insights from COVID-19 surveillance data, as a basis for improving response strategies in the four countries. A strategy for mitigation of lifting of the public health response measures is necessary to avoid new peaks or the rebound of the pandemic. Large-scale screening seems relevant to not only facilitate controlling the disease spread but also reducing the case fatality rate by early case detection, prior to the occurrence of complications. It is, therefore, urgent that health authorities in Africa invest in strengthening their health systems in order to better respond to the current pandemic and future health threats.

## Abbreviations

AFRAFR: Francophone Africa and Fragility; ANOVA: Analysis of Variance; COVID-19: Coronavirus Disease of 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; MERS: Middle East Respiratory Syndrome; SARS: Severe Acute Respiratory Syndrome; WHO: World Health Organization

## Declarations

## Availability of data and materials

Data are available from the websites of the health authorities in the four countries that we provided in the data sources and collection sub-section.

### **Ethics approval and consent to participate**

This study involved the review of officially released national data and documents; therefore, no ethical review process was undertaken. The consent to participate was not required.

### **Consent for publication**

Not required.

### **Competing interests**

The authors declare that they have no competing interest.

## **Funding**

This study did not benefit from any funding, although it was conducted as part of a collaborative project aiming at analyzing the response against COVID-19 in Senegal, Burkina Faso, Guinea, and Mali. The research team is still searching for grants.

## **Authors' contributions**

TMM initiated the research idea and designed the data collection tool which has been revised by BAL. Data were collected by TMM (Guinea), BAL (Mali), SB (Burkina Faso), and CLF (Senegal). TMM and FMG analyzed the data and the interpretation was performed by TMM. TMM drafted the manuscript which was critically revised by MAAA, BAL, SB, CLF, AD, and WVD. All authors read and approved the final version of the manuscript before submission to the journal.

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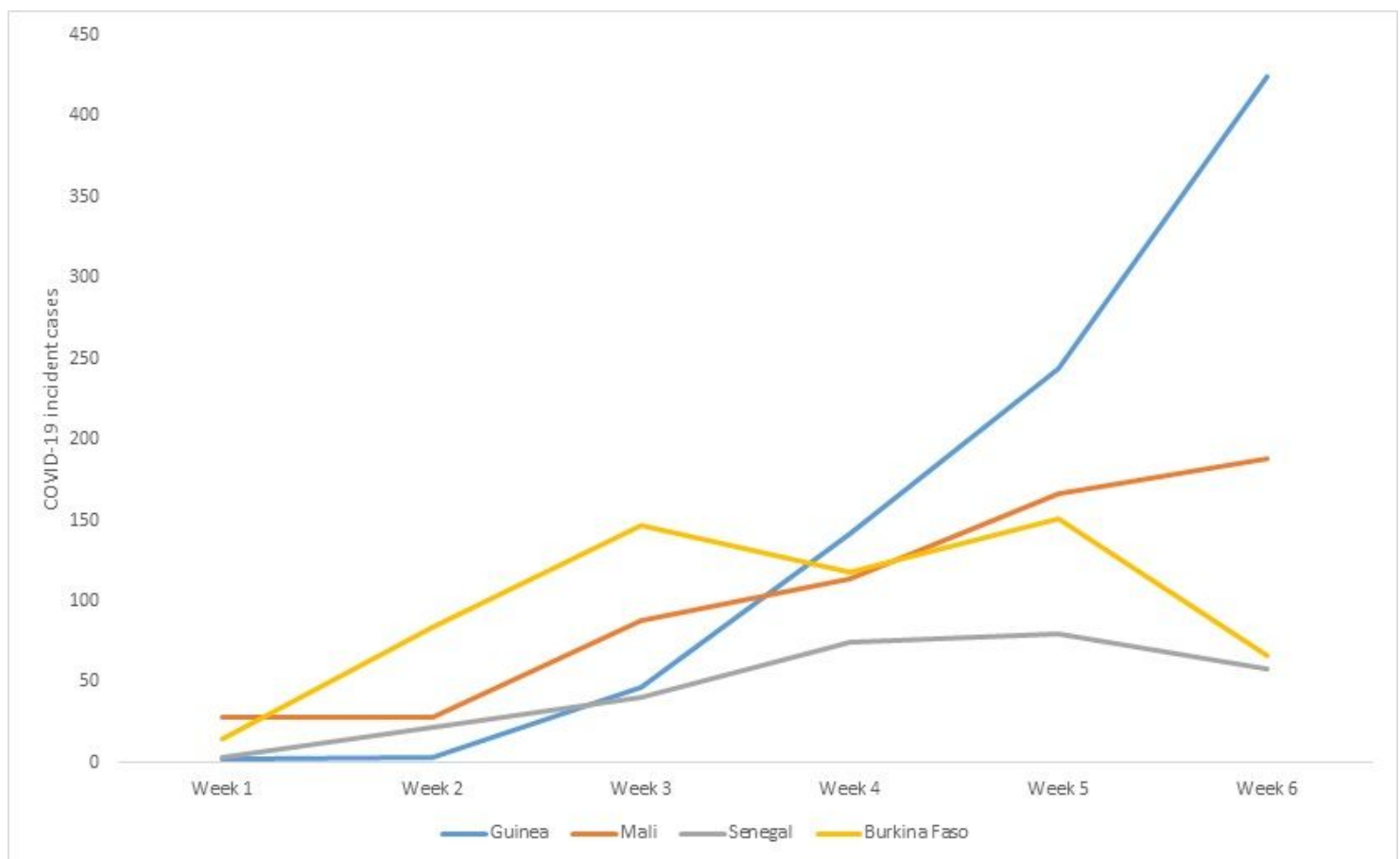
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## Figures



**Figure 1**

Trends in the weekly incidence of COVID-19 over the first six weeks in four French-speaking countries in West Africa, 2020