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***Policy Brief***

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# The Nature and Magnitude of the COVID-19 Outbreak in South Sudan

## Summary

*This analysis uses laboratory data to examine the COVID-19 infections in South Sudan. Preliminary findings point to the underlying concerns. First, the COVID-19 preventive measures instituted in March are ineffective, with at least 100 new cases of the virus likely to be recorded daily in the coming weeks or even days. Second, the effect of the virus varies by both age and sex of patients. At greater risk of infections are the elderly and women. Third, running nose and weakness are the most notable symptoms for the COVID-19 illness in South Sudan. Lastly, the borders seem to no longer pose a significant health threat to South Sudan. There are policy options to reverse this petrifying onslaught of the virus, including widening testing coverage, adopting lifestyle and behavioral changes, and insulating low-risk populations. But mass testing and the promotion of lifestyle and behavioral changes in a country, where literacy rates are extraordinarily low, demand heavy investments in the health sector and health education/campaigns.*

## 1 Introduction

The COVID-19 pandemic stands as one of the most policy galvanizing health crises of the 21st century. It first hit the Chinese province of Wuhan in December 2019, before rapidly spreading globally. The World Health Organization[1] estimates a global infection at 5.6 million people and over 350,000 fatalities to date. The African continent has the lowest number of globally confirmed cases, standing at roughly 80,000[2] and registering less than 4% in related deaths.

Broadly, the international community acted quickly, with both advanced and developing countries adopting swift and targeted measures to contain the virus and mitigate its other impacts. But the nature, level, and effectiveness of such response plans depend on the country's context.

As of May 26, 2020, South Sudan has confirmed 816 COVID-19 cases, 8 deaths, and 6 recoveries. The death rate, which represents 1% of the confirmed cases, is within the global average (2.5 – 10%)[3]. Nonetheless, recent updates from the High-Level Taskforce suggest a heightening rate of infection in the population. To understand the nature and magnitude of

[1] https://covid19.who.int
[2] https://www.africanews.com/2020/05/19/coronavirus-in-africa-breakdown-of-infected-virus-free-countries/
[3] https://ourworldindata.org/mortality-risk-covid#the-current-case-fatality-rate-of-covid-19

such risk, this analysis uses surveillance data to offer insights into the COVID-19 pandemic in South Sudan, both at national and subnational levels.

This brief uses the COVID-19 laboratory (lab) tests data administered at the South Sudan's National Health Lab between April 2 and May 20, 2020. From over 3,000 tests performed and documented thus far, a sample of 2,216 (74%) with complete records is used. A vast majority of the samples (97.7%) come from Central and Eastern Equatoria states, indicating the Ministry of Health's attendant level of capability to monitor the virus nationally. Obviously, the numbers are skewed in favor of Central and Eastern Equatoria because of Juba (CE), the nation's capital, and Nimule (EE), a border town connecting South Sudan to East Africa.

Information obtained includes demographic features and occupation of patients, alert type, location, and the test results. The first part of the brief maps the short-term risk of the COVID-19 pandemic in the country, subsequently projecting the infection frontier over a span of 30 days, from May 6 through June 6, 2020. The second part of the brief evaluates the manifestation of the normed COVID-19 risk factors and clinical symptoms in the South Sudanese context. The last section concludes with policy implications and discussion.

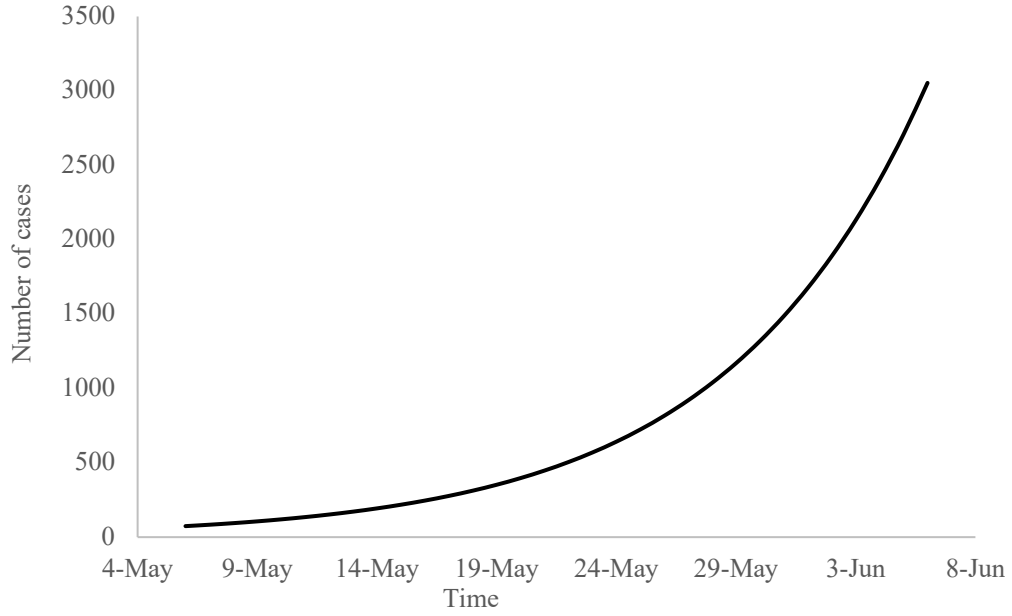
## 2 The infection outlook

From April 2 to May 20, 2020, South Sudan recorded 481 cases of COVID-19, averaging a little over 8 new cases per day. If the outbreak is spread across the population, the present number of infections translates to 160 cases per 1000 population, distributed as 92 among men and 172 among women. At the subnational level, the estimated infection outlook is 571 per 1000 population in Abyei, 500 in Jonglei, 120 in Central Equatoria, and 33 in Eastern Equatoria.

Distributed exponentially[4], South Sudan's infection rate is estimated at 12% per day. Because the present measures to prevent the spread of the virus in the country are evidently ineffective, the infection is expected to follow a natural distribution—exponential. Based on this estimate, the number of confirmed infections per day since the monitoring of the outbreak began would be expected to peak at 96, with a true daily record of new cases bounding between 61 and 131 on a 95% confidence scale. If the present infection trajectory holds into the future, the total number of confirmed cases in South Sudan would be 3,054 by June 6, 2020, for example (see Fig. 1).

[4] https://www.forbes.com/sites/startswithabang/2020/03/17/why-exponential-growth-is-so-scary-for-the-covid-19-coronavirus/#205636b24e9b

Fig. 1. COVID-19 projected infection frontier in South Sudan, May 6 - June 6, 2020




Source: Data are from South Sudan's National Health Lab.

The infections in South Sudan are doubly reproduced in under a week. Specifically, the present sample indicates that the number of confirmed cases doubles every 6.11 days. This is encouraging because things could actually get worse. With evidently more infected cases roaming public spots in the country as confirmed by the Ministry of Health and law enforcement agencies, this time could significantly shrink. Alternatively stated, the number of new infections could spiral out of control if the situation continues unmitigated. This was the case in China in the early days of the outbreak, with the doubling time rapidly dropping to just 1.4 days in Hunan and 3.1 days in Xinjiang provinces (Muniz-Rodriguez et al 2020). This experience was also reflected elsewhere in late March and early April. In New York, for example, the doubling time stood at 2 days in late March and about a week in early April[5].

## 3 Infection risk factors

Yang et al (2020) analyze the prevalence of clinical symptoms among COVID-19 infected individuals and find fever (91.3%), cough (67.7%), and fatigue (51.0%) to be the most prevalent. However, analysis of the lab samples indicates that a vast majority of COVID-19 patients in South Sudan are asymptomatic. The normed/standard clinical symptoms are manifested in the minority of cases: shortness of breath (5%), cough (13%), chills/fever (8.8%), running nose (10%), and malaise/fatigue (8.8%). Overall, at least 90% of infections in South Sudan are asymptomatic. These results are consistent with experiences elsewhere, according to WHO. Accordingly, 80% of the confirmed cases are either mild or asymptomatic (WHO 2020).

[5] https://www.japanmacroadvisors.com/page/category/economic-indicators/covid19-related/covid19-days-for-deaths-to-double/

The risk of infection is unequally distributed. Three groups are considered to be at a high-risk of both COVID-19 infection and death. These include the elderly (those over 60 years), those with pre-existing health conditions (comorbidity), and men. Notable pre-existing health conditions, according to many studies, are cardiovascular diseases, diabetes, chronic respiratory complications, hypertension, and cancer, all of which increase the risk of death. Similarly, obesity and smoking elevate the COVID-19 risk (Jordan et al 2020). The encouraging news is that South Sudan is relatively young; less than 5% of its population is 60 years or older, according to the 2008 national census[6]. Although little remains understood about the prevalence of non-communicable diseases (NCDs) in South Sudan, Luka (2015) notes based on 'anecdotal evidence' an increase in cases of cardiovascular incidents associated with hypertensive disorders, diabetes, and cancers. Luka finds that cases of stroke, breast or cervical cancer, and amputation owing to 'uncontrolled diabetes' are becoming more common in South Sudan.

A recent multivariable analysis that uses data from China finds the increasing odds of in-hospital death among the elderly (Zhou et al 2020). Jin et al (2020) also find that 'older age and a high number of comorbidities are associated with higher severity and mortality in patients with both COVID-19 and SARS.' Likewise, according to Lighter and colleagues (2020), being under 60 years with a BMI ranging from 30 to 34 is associated with a likelihood of being admitted to acute and critical care, compared to those with a BMI lower than 30. This reveals that a younger person who is experiencing other health complications faces as much risk as the elderly. Of the COVID-19 patients Zhou and colleagues investigated, 48% suffered comorbidity, marked by a high prevalence of hypertension (30%), diabetes (19%), and coronary heart disease (8%).

More generally, men and women seem to respond differently to the effects of COVID-19. Available evidence suggests that men are more likely to die of the virus than women, owing presumably to the biological and lifestyle factors (Wenham et al 2020; Walter & McGregor 2020; University of Oxford 2020). Biological factors lead to sex differentiated susceptibility to illness. For example, men are more prone to acute health problems, partly explaining why women live a little longer than men (Vlassoff 2007). There is also a sex difference in lifestyle or health behavior. Men smoke and consume alcoholic beverages more than women (Wingard 1984). Men are equally less likely to report illness. Summarily, while men and women experience similar odds of COVID-19 infection, men are disproportionately exposed to the severest of outcomes, including death (Jin et al 2020).

Drawing from above, we examine in Table 1 below whether age and sex are indeed predictive of COVID-19 infection in South Sudan. Further, an extended model nets out likely age and sex differences associated with symptom manifestations.

Men constitute 84.5% of the samples investigated at the National Health Lab. The average age for the examined cases is only 35.68 years (+/-0.56), distributed as 36.5 (+/-0.58) for men and 31.4 (+/-1.67) for women, respectively. A sensitivity analysis evaluating the assumption of no sex difference in age shows that women are actually more youthful than men, which implies greater protection for the group. The most vulnerable age group, 60 years and older (14.45%), is evidently yet unintentionally underrepresented in the country's effort to detect, identify, and isolate those carrying the virus.

[6] https://microdata.worldbank.org/index.php/catalog/1631.

Table 1 presents results for three integrated regression models. Model 1 evaluates the association between demographic features (age and sex) and COVID-19 infection. Age does not appear to have any significant impact or influence on infections, the dependent variable of our interest. According to this model, being a woman is the most predictive element of COVID-19 infection. Women, compared to men, are about 120% (2.117 - 1) more likely to be diagnosed with COVID-19. Model 2 retains age and sex variables but also incorporates clinical symptoms reported by the patients (i.e., those related to COVID-19 and others—headaches, sore throat, sneezing, among others). It also controls for the history of international/regional travel, a marker of exposure. If age and sex do indeed matter in the acquisition of and recovery from COVID-19, then the underlying clinical symptoms would manifest according to these two factors.

As Model 1 illuminates, Model 2 equally indicates that being older by just a year results in zero odds of getting infected with COVID-19 (1 – 1=0). Clearly, controlling for the clinical symptoms lowers the odds of infection among women by about half of the effect noted in Model 1. The incidence of clinical symptoms ranges from 6.8% for shortness of breath to 12.8% for cough among women and 3% for weakness and 7.8% for cough among men. This sex difference is also reflected in unrelated symptoms; 26.7% of women report other symptoms, compared to 23.4% among men. Nevertheless, unlike men, women are 64% more likely to be COVID-19 positive.

Except for cough, the rest of the symptoms are revealing of COVID-19 infection (see Model 2). The symptoms with the most consequential outcomes are running nose (odds = 208%) and weakness (odds = 278%), both statistically significant at 95% or higher confidence levels. Presence of other clinical symptoms is apparently good news. Those who report presence of other symptoms are 78% less likely to be COVID-19 positive. This implies that people are actually worried, essentially reporting to the health authorities when they feel unwell. This presents a timely opportunity for the country to detect, identify, and isolate asymptomatic cases.

History of international/regional travel is also found to be negatively related to the possibility of contracting COVID-19. Patients with a recent history of travel are 86% less likely to contract COVID-19. This finding is not surprising. It implies that the global screening system for COVID-19 is working. This might also be indicative of the protective effect of higher socioeconomic status. People with the means to travel regionally and internationally tend to be financially better off than those who do not, insulating themselves from infections. It equally reflects the damaging role of local policy laxities—South Sudan's measures around social distancing seem grossly ineffective.

Table 1. COVID-19 risk factors and symptoms (odds ratios)

| | (1) Model | (2) Model | (3) Model |
|---|---|---|---|
| Age (in single years) | 1.003 | 1.009 | |
| | (0.005) | (0.007) | |
| Sex (ref = Man) | | | |
| Woman | 2.117*** | 1.637** | 1.658** |
| | (0.361) | (0.365) | (0.360) |
| Having cough (ref=No) | | | |
| Yes | | 0.781 | 0.767 |
| | | (0.379) | (0.367) |
| Shortness of breath (ref=No) | | | |
| Yes | | 1.288 | 1.195 |
| | | (0.698) | (0.646) |

| | | | |
|---|---|---|---|
| Having chills/fever (ref = No) | | | |
| Yes | | 1.287 | 1.159 |
| | | (0.616) | (0.546) |
| Running nose (ref = No) | | | |
| Yes | | 3.084** | 3.255*** |
| | | (1.383) | (1.439) |
| Weakness/malaise (ref = No) | | | |
| Yes | | 3.781*** | 4.305*** |
| | | (1.869) | (2.098) |
| History of travel (ref = No) | | | |
| Yes | | 0.141*** | 0.133*** |
| | | (0.065) | (0.061) |
| Presence of other symptoms (ref = No) | | | |
| Yes | | 0.220*** | 0.224*** |
| | | (0.082) | (0.082) |
| Age groups (ref = < 59) | | | |
| Age 60+ | | | 1.395 |
| | | | (0.388) |
| Constant | 0.090*** | 0.066*** | 0.087*** |
| | (0.019) | (0.018) | (0.010) |
| N | 2103 | 1933 | 2029 |
| Pseudo $R^2$ | 0.013 | 0.093 | 0.096 |

Standard errors are in parenthesis
*** *p<0.01, ** p<0.05, * p<0.1*

Finally, Model 3, while keeping other variables in their original form, reconstructs the patient's age into a binary variable. The patients are then grouped as follows: those ≤ 59 and those ≥60 years. This enables us to assess the proposition that, like everywhere else globally, those who are 60 years or older have an elevated risk of contracting COVID-19 in South Sudan. The inclusion of age as a binary variable in the model changes the magnitude of our initial estimates but not in a significant way—the statistical importance of the results is retained. Lastly, based on the sign of our estimate, we confirm that those who are 60+ are indeed more likely to contract COVID-19, with old age increasing the risk by 40%. Although the estimate is not statistically significant, this could possibly be attributed to selection factors, such as self-reporting, geographical coverage, and the stigma fears. Results could also be spurious due to missing, key variables.

# 4 Policy implications and discussion

This brief has analyzed the risk factors associated with COVID-19 infections in South Sudan. Analysis of samples investigated at the National Health Lab reveals interesting insights and points to important policy lessons.

South Sudan responded to the outbreak of COVID-19 in March, immediately introducing two control measures. These include social distancing, which mainly encompasses reduction in social interactions, and closure of international borders to curtail cross-border transmission of the virus. Nonetheless, COVID-19 infections continue to rise at an unprecedented rate in the country. To this end, the confirmed COVID-19 related deaths in South Sudan stand at 8 as of May 26, 2020 and the number of confirmed cases stands at 816 and rising. Of the two major policy interventions, social distancing is probably the most unsuccessful, as evidence indicates that most members of the general public defy this policy measure.

Because the clinical samples submitted to the National Health Lab come predominantly from relatively younger people, using age in single years as a predictor of COVID-19 infection seems to bias the estimate, both in terms of effect size and significance. As expected, the effect size changes when age is dichotomized—aged ≤ 59 & ≥ 60 years. Thus, people who are 60 years and older are 40% more likely to contract COVID-19, compared with those in the younger age group.

Contrary to most experiences elsewhere, South Sudanese women have the highest risk of contracting COVID-19. This effect does not change, even when other factors are controlled for. What really accounts for this difference is not clear, but socio-cultural and socioeconomic factors, which place women at a disadvantage in the country, could be at play. For instance, most South Sudanese women are relegated to traditional roles (restraining their access to gainful employment or learning opportunities), have the highest incidents of illiteracy and poverty, and infrequently participate in the country's policy and political processes (Awolich & Tiitmamer 2020).

The symptoms to watch out for in determining whether someone is possibly infected with COVID-19 are running nose and weakness. Other clinical symptoms are compelling people to seek medical attention, leading to early detection of both COVID-19 and other health problems. Finally, the borders seem to no longer pose a significant health risk to South Sudan. Our results indicate that the COVID-19 global screening system is possibly shielding South Sudan. This gives the government and partners room to focus most of their attention on social distancing policy, probably the most failed prevention instrument.

From recent lab results, it seems the outbreak is spiraling out of control. Nonetheless, there are options for the country to adopt. One of the possible means of reversing this trend is by widening testing capabilities. This leads to early detection, identification, and isolation of cases. But isolation only works if the public cooperates with health professionals and law enforcement agencies. Another major improvement could come from lifestyle changes. These changes entail practicing social distancing, washing hands, sanitizing, and wearing facemasks more frequently. Still, these lifestyle measures are effective if they are widely understood and implemented. To have these measures widely understood, the country needs to embark upon mass campaigns to educate the public about the significance of hand washing, wearing facemasks, and social distancing in containing the virus. These measures are also proven to be effective in less crowded spaces, the most complex predicament facing urban South Sudan. An average South Sudan household houses 6.7 people, according to the 2008 census. This is slightly higher for the urban households, increasing residential congestion.

Studies have shown that a lockdown as a preventive measure is tenable for a relatively short period, giving authorities room to plan and respond. It is unsustainable economically, especially in a poor and cash-ridden economy like South Sudan. A complete lockdown could actually be more damaging—could result in excess mortality related to food insecurity and other diseases. The government could insulate low-risk populations (rural, which are sparsely spread). This entails severing population movements between low- and high-risk populations (urban/town, which are tightly concentrated and economically active) for at least two weeks. In particular, the government ought to promptly terminate the enduring practice of transporting bodies to the villages, reducing the risk of spreading the virus to the rural populations. Moreover, funeral rites should be attended by no more than ten people, with law enforcement agencies empowered to implement this rule. And because such rule is

hardly observed in the country, at least 57% of those who attended the funeral rite of Late Edward Lino in Abyei, contracted the virus. And so, the axiom 'better late than never' goes.

These results ought to be cautiously interpreted. This is because South Sudan's testing capacity when these data were acquired was still very inadequate. The National Health Lab was using a single machine to test about 100 samples a day. The Ministry of Health recently acquired 3 more efficient testing equipment, leading to more tests being performed daily at the moment. Therefore, the current estimates are highly likely to under-estimate the severity (i.e., nature and magnitude) of COVID-19 infections in the country. Lastly, the current statistical projections are derived using a constant rate of change under the assumption of unconstrained conditions. Therefore, the picture this analysis paints is insightful and unrealistic at the same time, since many of the variables under investigation are subject to change due to the fluidity of the situation. What is certain is that the situation is indeed petrifying.

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