COVID-19 in Africa: the little we know and the lot we ignore

COVID-19 in Africa: il poco che sappiamo e il molto che ignoriamo

Sandro Colombo, Rino Scuccato, Antonello Fadda, Amelia Jossai Cumbi
About the authors: see p. 422.

«…Things fall apart; the centre cannot hold…»

W.B. Yeats, The Second Coming

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ABSTRACT

COVID has stirred up an information deluge that challenges our capacity to absorb and make sense of data. In this unrelenting flow of information, Africa has been largely off the radar, escaping the attention of the scientific literature and the media. International agencies have been the exception: despite the still low numbers of cases and deaths, they have voiced concerns, often in catastrophic terms, on the health, economic and social impacts of COVID in African countries. These concerns contrast sharply with the optimistic view that Africa may be spared the worst consequences of the pandemic.

This paper provides a snapshot of a crisis in evolution: its features could change as new data become available and our understanding improves. The paper examines the epidemic trends, the health impact, the containment measures and their possible side effects. Africa has a long experience of responding to epidemics: relevant lessons learned are outlined. The picture of the epidemic and its narrative are heterogenous, given the differing vulnerabilities of African countries and the diverse contexts within their borders. The paper, therefore, singles out selected countries as illustrative of specific situations and advocates for a transnational and subnational approach to future analyses.

The virus has shown a strong capacity to adapt; therefore, a response strategy, in order to be effective, needs to be flexible and able to adapt to changes. The paper concludes with the recommendation that affected communities should be engaged in the response, to maintain or build trust. A lesson from the Ebola outbreak of a few years ago was that epidemiologists and community leaders learned, after initial difficulties, how to dialogue and work together.

A summary update of the pandemic has been added, in view of its fast evolution.

Keywords: COVID-19, pandemic, Africa, epidemic curve, models, non-pharmacological interventions

KEY MESSAGES

■ **Sub-Saharan Africa (SSA) resilience to the shocks caused by the pandemic has proved strong; the death toll has been so far limited. However, the overall effects of the economic and health crisis will have a devastating impact, in the absence of a strong humanitarian response.**

■ **The official data underestimate the pandemic in SSA. The scarcity of data reflects the overall low testing capacity, the limited access to health services, their weaknesses, and political constraints.**

■ **National figures hide between and within-country differences; there is a need for transnational and subnational epidemiological studies to better understand the transmission patterns, assess the impacts of the epidemic, and evaluate the effects of containment measures.**

■ **The role of epidemiology, and science at large, as well the importance of basic public health measures have proved their worth in a contest of widespread uncertainty.**

■ **Lessons learned from responses to outbreaks in SSA point to the need to engage communities, build trust, promote local ownership of control measures, and adopt flexible, adaptive strategies through local institutions.**

RIASSUNTO

COVID ha suscitato un diluvio di informazioni che mette alla prova la nostra capacità di assorbire e dare un senso ai dati. In questo flusso inesorabile di informazioni, l'Africa è sfuggita all'attenzione della letteratura scientifica e dei media. Le agenzie internazionali sono state un'eccezione: nonostante il numero ancora basso di casi e morti, hanno espresso preoccupazioni, spesso in termini catastrofici, sull'impatto sanitario economico e sociale di COVID nei paesi africani. Queste preoccupazioni sono in netto contrasto con l'opinione ottimista secondo cui all'Africa potrebbero essere risparmiate le peggiori conseguenze della pandemia.

Questo articolo ha preso una foto istantanea di una crisi in evoluzione: le sue caratteristiche potrebbero cambiare man mano che nuovi dati diventano disponibili e la nostra comprensione migliora. L'articolo esamina le tendenze dell'epidemia nella sua fase iniziale, l'impatto sulla salute, le misure di contenimento e i loro possibili effetti collaterali. Africa ha una lunga esperienza nel rispondere alle epidemie: vengono

delineate le lezioni pertinenti apprese. Il quadro dell'epidemia e la sua narrazione sono eterogenei, date le diverse vulnerabilità dei paesi africani (del subcontinente) e i diversi contesti all'interno dei loro confini. L'articolo individua alcuni paesi come illustrativi di situazioni specifiche e sostiene un approccio transnazionale e subnazionale per le analisi future.

Il virus ha mostrato una forte capacità di adattamento; una strategia di risposta, per essere efficace deve essere flessibile e in grado di adattarsi ai cambiamenti. Il documento si conclude con la raccomandazione che le comunità colpite dall'epidemia dovrebbero essere coinvolte nella risposta, per mantenere o costruire la fiducia. Una lezione dall'epidemia di Ebola di alcuni anni fa è stata che epidemiologi e i leader della comunità hanno imparato, dopo le difficoltà iniziali, a dialogare e lavorare insieme.

È stato aggiunto un aggiornamento della pandemia, in considerazione della sua rapida evoluzione.

Parole chiave: COVID-19, pandemia, Africa, curva epidemica, modelli, interventi non farmacologici

1. COVID IN AFRICA: A SILENT EMERGENCY?

Never has so much been published in so little time on a single topic, than on the COVID pandemic since January 2020. A quick search in the Medline database resulted in 11,468 scientific articles including the virus and/or the pandemic in their titles or abstracts, as of early June. This high number of articles in such a short time reflects the unprecedented 'tsunami' of scientific literature.[1] Out of the total, however, only 173 articles, or 1.5%, mentioned Africa in their title or abstract.

In this article, we provide a snapshot of the epidemic in Sub-Saharan Africa, SSA, (list of countries in annex, table 2), examining its trends and health impact. We discuss the limitations of predictive models, particularly in the initial phase of an epidemic caused by a novel pathogen. We examine the testing performance of countries, the control measures implemented in the region, and their possible side effects, considering the vulnerability of SSA economies and health systems. We examine the lessons learned from recent epidemics on the continent, which may be relevant to the current context.

Journalists, politicians, and pundits of various backgrounds have joined virologists and epidemiologists in discussions on the origin of the virus, its spread, the health and socioeconomic impact, and the control measures to be taken. Concepts like 'flattening the epidemic curve' or 'reducing the basic reproduction number' have become the common currency of television debates and global information networks, thus entering the everyday vocabulary of ordinary citizens. The unrelenting and often conflicting flow of information has, however, resulted in an overload of unfiltered messages, which may have increased anxiety and confusion among the public. SARS Cov-2 has travelled fast, crossing political boundaries. However, the virus has also, paradoxically, multiplied physical and mental barriers between countries.[2] Most politicians in Europe and the United States have not regarded COVID as a pandemic that requires joint efforts and coordination. Instead, most western governments under political pressure have turned inward, uninterested in the fate of other nations.[3] They have mobilised enormous resources for propping up their economies and controlling the epidemic within their countries.

In this noisy information context, the spread of COVID in Africa has occupied a tiny space in the scientific literature, newspaper headlines, and television newscasts, despite the alerts issued by some academic institutions and aid agencies. Part of this neglect could result from the perception that SSA, which has so far reported comparatively fewer cases and deaths than other regions, might be spared the worst of the pandemic impact. But this perception should be challenged. The official numbers underestimate the epidemic-related caseload and mortality in SSA by an unknown factor. Overall, the testing capacity in SSA is low and the coverage of vital statistics systems is weak.[4] The pandemic hit SSA with a delay of two months since the first cases were reported in China. We cannot exclude that some governments have exerted tight controls on COVID statistics for political reasons, such as not wanting to alarm citizens, deflecting criticism on their ineffective action, or using COVID as an excuse to curtail civic liberties or postpone elections.[5] The limited reliability of tests, particularly their less than optimal sensitivity,[6] contributes to the undercounting of cases. Only well-designed sero-surveys can provide an accurate picture of the pandemic, in SSA and elsewhere.[7]

In contrast to the general indifference, apocalyptic prophecies have been voiced by some international agencies. Estimates of the death toll and economic losses are huge, with a substantial decline of foreign direct investment and a collapse of remittance flows.[8] The epidemic could double the number of acutely food-insecure people, of whom half are in Africa.[9] In contrast to the economic crisis of 2008, aid budgets of donor countries are being cut in order to respond to domestic financial needs, resulting in increased inequality in the response to humanitarian crises.[10] Aid agencies have already seen their operations disrupted.[11]

2. HOW WE ANALYSED THIS ISSUE

We undertook a non-systematic literature review in Medline, Google Scholar, and MedRxiv preprints, supplemented by a citation search. We extracted relevant data from various sources: John Hopkins University for the time series of COVID cases and deaths,[12] Worldometer[13] and 'Our 'World in Data' for the tests,[14] and ACAPS for the non-pharmaceutical interventions.[15]

The data analysis focuses on 49 SSA countries and covers the period from 13 March – date of first reported death

within SSA – to 15 May 2020. Cumulative data refer, unless otherwise specified, to the entire period. We collected additional information on diagnostic and treatment capacity, the existence of surveillance systems, and COVID infections among health workers through an e-mail questionnaire that was circulated to a network of colleagues in SSA. We received responses, of variable completeness and quality, from 13 countries. Our study is descriptive. Boxes are included to clarify concepts or illustrate, with short case-studies, complex issues. Additional data are presented in a separate annex. The software Microsoft Excel and OriginLab OriginPro were used for the data analysis.

Our analysis suffers from several data limitations. It reflects, with delay, the very dynamic trends of the pandemic. When data become available, often with delay, they may already be outdated. We decided, therefore, to carry out the analysis of data available until mid-May 2020, aware that the picture and some of our comments might become obsolete by the time the article is published. In order to partially remedy the obsolescence of data analysed, we have included a box with a summary update of the pandemic in SSA as of 31st August, based on few selected indicators.

Data are often published in aggregate, national formats, which hide within-country differences, particularly in the early phase of the epidemic, when cases tend to be concentrated around a limited number of epidemic foci. We have carried out, when disaggregated data were available, a descriptive analysis at the sub-national level. Finally, we did not delve into the clinical and public health aspects of government responses to the epidemic, which would require a separate article, but we limited our discussion to a brief overview of critical strategic issues relevant to the context.

■ SSA resilience to the shocks caused by the pandemic has proved strong; the death toll has been so far limited. However, the overall effects of the economic and health crisis will have a devastating impact, in the absence of a strong humanitarian response.

■ The official data underestimate the pandemic in SSA. The scarcity of data reflects the overall low testing capacity, the limited access to health services, their weaknesses, and political constraints.

■ National figures hide between and within-country differences; there is a need for transnational and subnational epidemiological studies to better understand the transmission patterns, assess the impacts of the epidemic, and evaluate the effects of containment measures.

■ The role of epidemiology, and science at large, as well the importance of basic public health measures have proved their worth in a contest of widespread uncertainty.

■ Lessons learned from responses to outbreaks in SSA point to the need to engage communities, build trust, promote local ownership of control measures, and adopt flexible, adaptive strategies through local institutions.

3. "ALL MODELS ARE WRONG, BUT SOME ARE USEFUL"[16]

Models are used to forecast the size of epidemics, provide insights into the transmission dynamics of the disease, and assess the potential impact of control measures. They can play an important, sometimes unjustified, role in influencing governments' policies on epidemic control.

The predictive value of models has, however, a mixed record. This is not surprising: models are simplified representations of complex biological and social phenomena. Particularly in the early epidemic phases, modellers are confronted with "*limited data, a constantly changing landscape, and a lot of assumptions*"[17]; instances of wrong predictions are therefore not lacking, as the box 1 shows.

Overall, models display a tendency toward worst-case scenarios, which reflect the propensity to err on the side of caution. 'Crying wolf' can also be a deliberate strategy for obtaining the attention of media and politicians.

For decision-making, politicians rely on increasingly com-

BOX 1. "Prediction is very difficult. Especially about the future",[18] or about failed predictions

Pisani tells us how she concocted prevalence estimates of HIV/AIDS in the early days of UNAIDS.[19] She compares the exercise to drawing a picture of Mount Everest, from the base camp, with only the photographs of two rocks and no idea of how high the mountain might be. The statistics were criticised as methodologically flawed and inflated for funding reasons.[20] Later, the findings of Demographic and Health Surveys prompted the agency to drastically lower the estimates.

Avian Influenza appeared in Hong Kong in 1997, raising the concern that the virus might acquire the ability to transmit person-to-person. The newly appointed UN coordinator for avian influenza stated that the deaths from the H5N1 infection could number between five million and 150 million, and warned that a pandemic would be imminent.[21] However, only 455 deaths were reported between 2003 and 2020.[22]

The Ebola epidemic in western Africa produced disparate estimates. Early in 2014, WHO downplayed the size of the epidemic, estimating that the death toll could be no more than a few hundred cases. This position led to a delayed declaration of 'public health emergency of international concern'.[23,24] At the other extreme, the CDC estimated that up to 1.4 million cases might have occurred in Liberia and Sierra Leone, in the absence of a scale-up of interventions and changes in community behaviour.[25] The total number of cases reported at the end of the outbreak was high, at around 25,000; much higher than WHO initial estimates, but substantially lower than the CDC predictions.[26]

plex models, which neither they nor their scientific experts can fully understand.[27] For example, the UK Prime Minister followed one early policy based on one model then announced on 16 March a radical change of the UK-COVID policy.[28] This dramatic reversal followed the release to the government's scientific advisers of a predictive study that attracted much attention and generated a renewed sense of urgency. The study predicted the occurrence of up to 500,000 deaths in the country, in a scenario of uncontrolled spread of the epidemic.[29]

Table A1 in the annex summarises projections of COVID in Africa obtained through mathematical models. Direct comparison of their findings is made impossible by the different time periods and methods utilised.

4. WHAT HAS HAPPENED: THE SPREAD OF THE PANDEMIC IN SSA, ITS IMPACT AND THE CONTROL MEASURES

4.1 THE COVID EPIDEMIC IN SSA

The first COVID case in SSA was reported in Nigeria on 28 February, two months after the first cases were registered in China, and five weeks after WHO confirmed the first cases outside China. In early April, most SSA countries had reported cases. The first death was reported in the Sudan on 13 March, two months after the first known death occurred in China.

By mid-March 12 SSA countries had reported a first case and in the following two weeks a total of 40 countries were affected. A smoother pattern of spread emerges when countries have reported at least 100 cases, a threshold arguably intended to reflect community transmission (figure 1) South Africa, the first country to reach this threshold, was gradually followed by 36 other countries, without a clear chronological or geographical pattern.

The total number of cases for each country is obviously proportional to the time spent in the transmission phase. Despite large individual differences, an average exponential trend may be recognized in this relationship, with a doubling time of 13.6 days, almost the same value found for the curve of cumulative cases of the region (13.5 days). This result may be accidental or may suggest that countries are experiencing different phases of a common pattern of spread of the infection (fig. A2 annex).

SSA reports a much lower caseload and mortality, relative to its population, than other continents. Table 1 shows that SSA, representing 14.6% of the world population, reported only 1.2% of total cases and 0.4% of total deaths. The infection fatality rate (IFR) in SSA is about one third of the global IFR.

Figure 2 compares the epidemic curve of SSA with that of selected non-SSA countries severely affected by COVID. Details of the SSA curve are discussed in further detail in the article.

Within SSA, the distribution of COVID cases is uneven, with three countries (South Africa, Ghana, and Nigeria)
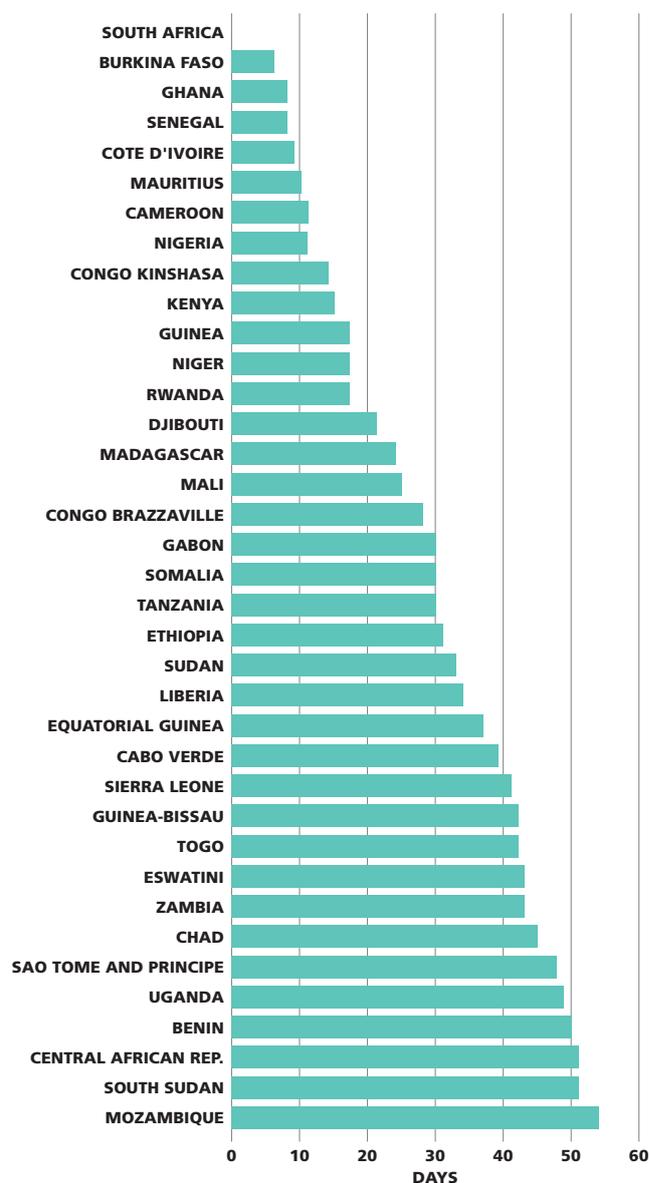
SPREAD OF THE EPIDEMIC ONSET IN SSA COUNTRIES

Figure 1. Spread of the epidemic onset in days since South Africa reported 100 cases.
Figura 1. Giorni da quando il Sudafrica ha segnalato 100 casi.

reporting 47% of total cases and a long tail of countries with low case numbers.

When incidence rates are used, the distribution of countries remains uneven, but their order changes radically, with small and insular countries now at the top of the list. In order to reconcile such differences, a "Risk of Exposition" factor (RoE) was used.[30] The RoE takes into account the country-specific factors that influence people's susceptibility, thus allowing to adjust for different population densities, urbanization, and climate. With this adjustment, Niger and Chad are the countries with the highest incidence, but once again the distribution remains uneven. Deaths, totalling 1,258, show a similarly uneven distribution, with South Africa, Nigeria, Cameroon and the Sudan having

	SSA	WORLD	RATIO SSA / WORLD
No. Cases	52,666	4,542,347	1:86.2
No. Deaths	1,258	307,666	1:244.6
Population	1,137,040,685	7,785,000,000	1:6.8
Incidence rate x10,000 person-months	0.217	1.522	1:70
Mortality rate x 10,000 person-months	0.005	0.103	1:19.9
IFR	2.4%	6.8%	1:2.83

*for the calculation of rates, periods of 64 and 115 days were used, respectively, for SSA and the world

Table 1. Summary of COVID cumulative cases and deaths in SSA and the world (15 May 2020).
Tabella 1. Riepilogo dei casi cumulativi COVID e dei decessi in SSA e nel mondo (15 maggio 2020).

EPIDEMIC CURVES
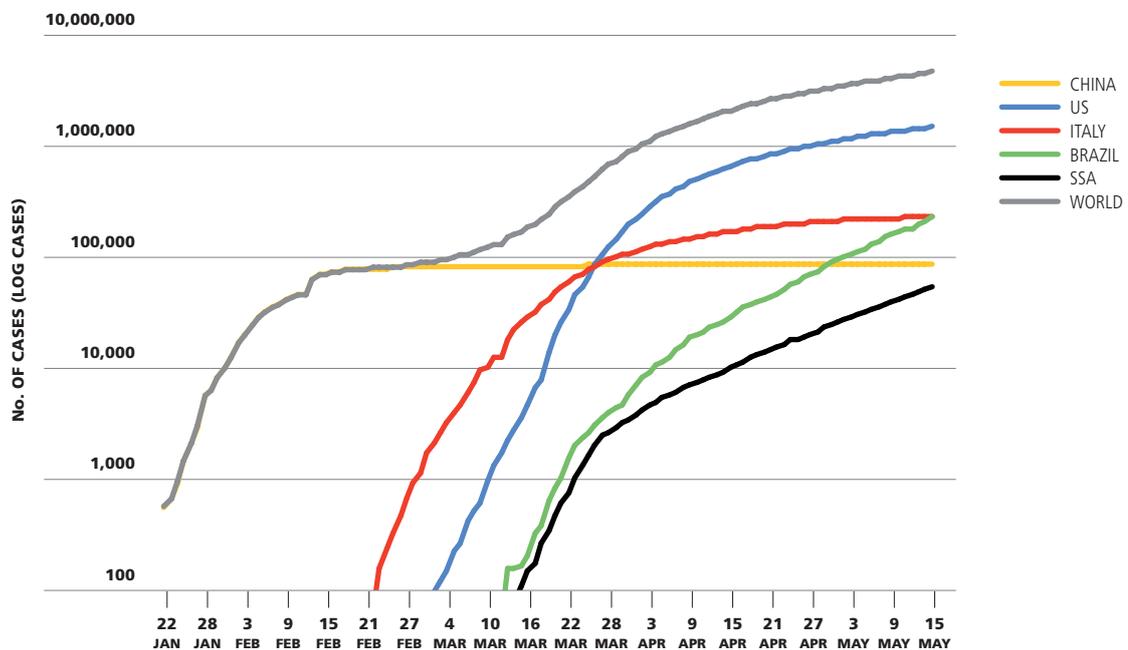
Figure 2. Comparison of epidemic curves: SSA vs a selection of severely affected countries and the world.
Figura 2. Confronto tra le curve epidemiche della SSA, una selezione di Paesi gravemente colpiti, e il mondo.

the highest death tolls and representing 52% of the total. Cases and deaths display a linear association when plotted on a logarithmic scale (r=0.68), an element in favour of the overall internal consistency of data.

The epidemic curve of SSA countries (figure 2) shows an important change in the slope at the end of March. A first phase, of two weeks, characterised by a steep curve, is followed by slower growth. Cases reported after March show a clear exponential growth (r=0.99), with a doubling time of 13.5 days (+ or – 0.1 day) and an average daily increase of cases of 5.3% which remains stable over time – a typical feature of the initial stage of an epidemic. The SSA curve is characterised by a very slow growth rate, but even moderate exponential growth can, over time, produce catastrophic ef-

fects. For example, the present dynamic, in the unlikely hypothesis it continues unchanged, would lead to a hundred-fold increase of cases by mid-August, which would be an unsustainable caseload for SSA health systems and the society at large (see the update box 6 for a reality check).

We analysed the epidemic curves of all SSA countries to better understand the observed uneven distribution of cases and to verify whether the overall curve may be used to draw general conclusions or is, instead, the result of different, possibly conflicting patterns. Since the epidemic started at different times in different countries, we had to align the days on which the countries reached 50 cases (the analysis included only 34 countries that had totalled at least 50 cases). Three patterns emerged: **a.** countries with a sus-

COVID-19 CASES AND DEATHS IN SSA AS OF 15 MAY
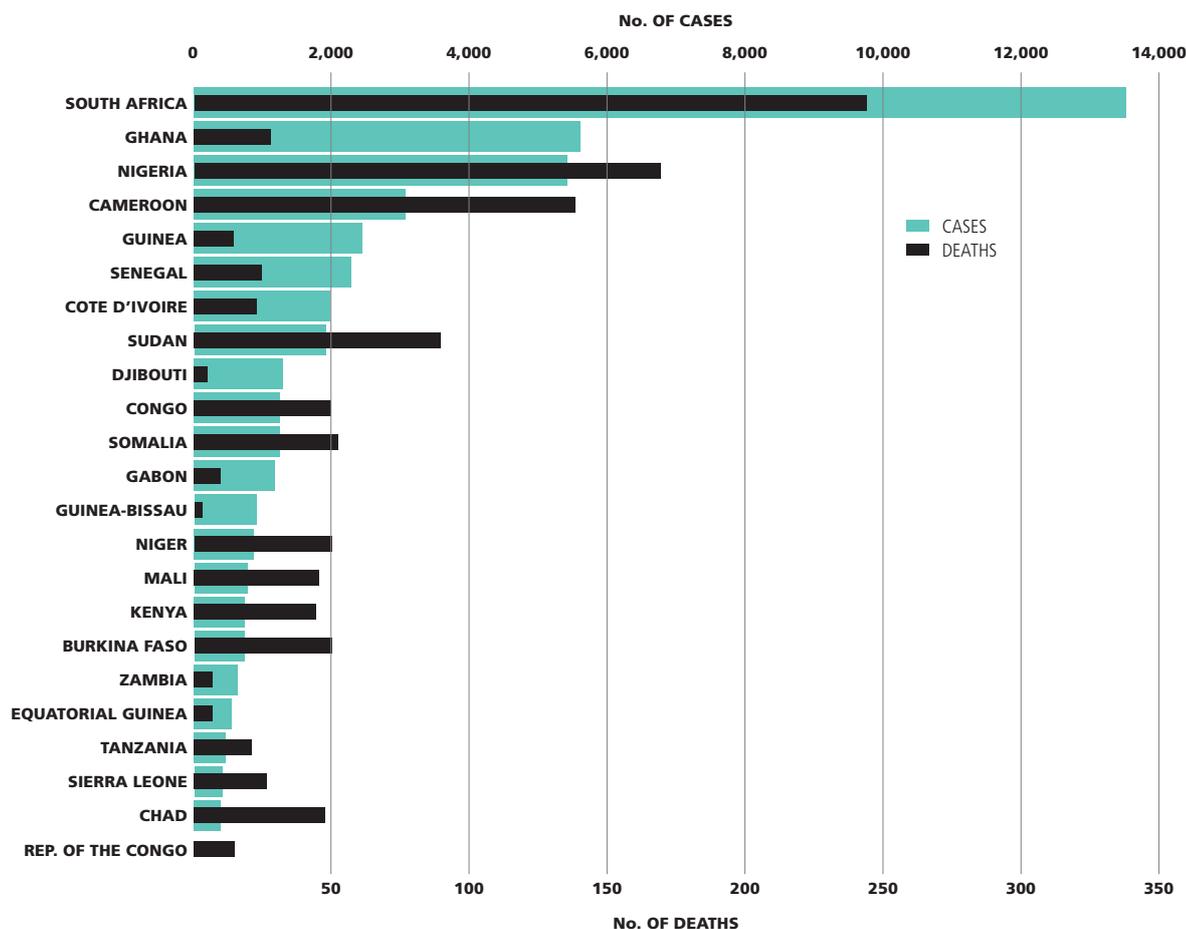
Figure 3. Distribution of cases (green bars) and deaths (black bars) in countries representing 92% of cases and 94% of deaths, with separate axes. The ratio of the two scale ranges (350/14,000) was chosen to approximate the SSA IFR (2.4%), so that green and black bars have equal height if the IFR of a country is the same as the average (2.4%) and differences can be easily appreciated.
Figura 3. Distribuzione dei casi (barre verdi) e dei decessi (barre nere) nei paesi che rappresentano il 92% dei casi e il 94% dei decessi, con assi separati. Il rapporto delle scale (350 / 14.000) è stato scelto per approssimare l'IFR della SSA (2.4%), in questo modo le barre verdi e nere hanno la stessa altezza se l'IFR di un paese è uguale alla media (2.4%) e gli scostamenti possono essere facilmente apprezzati.

tained exponential growth, **b.** countries with a moderate, linear growth, and **c.** countries with a decreasing slope.
The first group includes 20 countries (including South Africa, Ghana and Nigeria) which account for 47% of all cases. The second group includes eight countries, representing 16% of cases and showing individual curves that are consistent with the overall shape of the curve. The third group includes six countries representing 8% of cases and with a curve that could suggest progression beyond the peak of the epidemic. It remains to be confirmed whether the curve represents a real or a spurious trend, or an intermediate phase of the epidemic.

4.2 WITHIN-COUNTRY DIFFERENCES
National figures mask the epidemic pattern within countries. We carried out an analysis of the distribution of cases within individual countries, drawing on national COVID statistical bulletins for the period of end of May to first week of June. Figure 4 shows a high proportion of cases

concentrated in and around capital cities: 95% in Guinea Bissau, 94% in Chad and DR of Congo, 85% in South Sudan, and 83% in Burkina Faso. In Mozambique, the epidemic focus was in the northern Province of Cabo Delgado, where a large foreign gas company operates.

4.3 COVID TESTING
The overall testing capacity in the region has improved from a very low starting point but remains insufficient. Furthermore, the distribution of laboratories within the region is unequal: according to the information we collected, some large countries, such as the DR Congo and South Sudan had only one laboratory each, whereas Kenya had 53, Ethiopia 19 and South Africa 18. Within the countries a large proportion of laboratories – 43% – was concentrated in the capitals. Testing strategies also differed across countries: in our analysis of non-pharmacological interventions in SSA, only 43% of governments had adopted a testing policy. These differences explain why South Africa

and Ghana, with about 10% of the population, accounted for more than half of the tests conducted, whereas the two most populous countries, Nigeria and Ethiopia, had conducted less than 10% of the tests. Nigeria's official policy of 'test, treat, trace and isolate' has been hampered by a lack of equipment and kits.[31] Ethiopia has only recently scaled up testing in response to a surge of cases signalling that community transmission has increased.[32] In Eastern Africa, Kenya and Rwanda reported few cases in comparison with the number of tests performed, which might suggest,

with due caution, a lower transmission rate of the virus. Countries with successful strategies, such as South Korea and Germany have tested more than 1% of the population, a level probably unrealistic for many African countries. Table 2 shows the number of tests performed in relation to the number required, in order to reach a more modest level of 0.6 % test coverage in selected countries. The gap is particularly large in Nigeria and Ethiopia. It is worth noting the inverse relationship between testing rate and positivity rate, which suggests that, over time, confirmed cases repre-

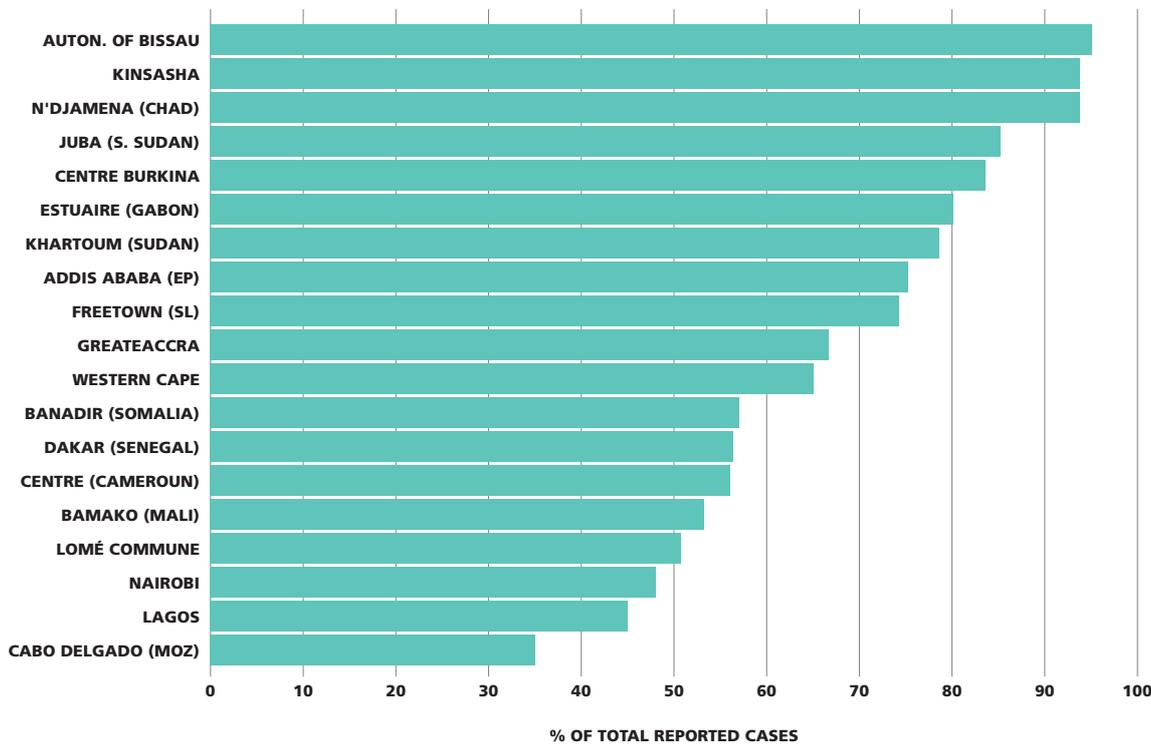**AREAS WITH CASES INSIDE SELECTED SSA COUNTRIES**

Figure 4. Areas with a high percentage of cases inside selected SSA countries
Figura 4. Aree con un'alta percentuale di casi situate all'interno di alcuni paesi della SSA

COUNTRIES	POPULATION	No. COVID-19 CONFIRMED CASES	COVID-19 TESTS REPORTED BY 18 MAY	POSITIVITY RATE	TESTING RATE X 10,000 PEOPLE	TESTS REQUIRED TO REACH 0.6% OF THE POPULATION
South Africa	59,308,690	17,200	488,609	3.5%	82.4	-132,757
Ghana	31,072,940	5,918	180,567	3.3%	58.1	5,871
Uganda	45,741,007	260	75,228	0.3%	16.4	199,218
Kenya	53,771,296	2,153	18,608	2.1%	3.5	304,020
Nigeria	206,139,589	6,175	35,345	17.5%	1.7	1,201,493
Ethiopia	114,963,588	365	62,300	0.6%	5.4	627,482
DR of Congo	89,561,403	1,629	4,493	31.9%	0.5	532,875

Adapted from Lancet[33] and BBC[34] Data source: Worldometer, authors'calculations

Table 2. COVID testing needs in selected SSA countries (as of 15 May 2020)
Tabella 2. Fabbisogno di test per COVID in alcuni paesi della SSA (al 15 maggio 2020)
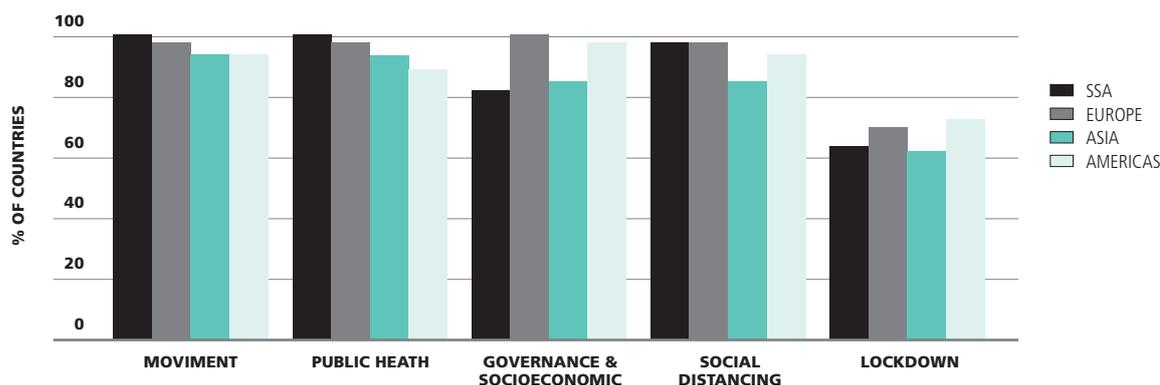
Source: ACAPS, 2020[36]

Figure 5. Countries with Government measures in response to COVID, by main categories, Region or Continent.
Figura 5. Paesi con misure governative in risposta al COVID, per categorie principali, regione o continente.

sent more robustly the total infected cases. The table refers to mid-May, to allow inter-country comparisons; since then testing in SA has increased substantially, as shown in box 3.

4.4 THE HEALTH IMPACT OF THE EPIDEMIC AMONG HEALTH WORKERS

According to WHO, as of mid-May, 1,810 health workers (about 4% of all positive cases) had been infected with COVID in 31 SSA countries, with two outliers: Liberia 18.6% and Niger 18.7%.[35] This proportion is lower than that observed in some European countries such as Spain and Italy, but it must be interpreted in the context of a general shortage of health staff in the region and the early phase of the epidemic, with a still relatively low risk of infection among personnel, due to limited caseloads in hospitals. All the respondents to the questionnaire claimed that the PPE was insufficient.

4.5 NON-PHARMACOLOGICAL INTERVENTIONS (NPIs)

NPIs adopted in SSA were compared with the corresponding measures in other continents. The aggregated data mask variations among individual countries, which can be large, and do not allow assessment of the effectiveness of their implementation, which depends on the different enforcement capacities of the governments. The graph in figure 5 shows a comparison of the distribution of government measures since February 2020.

The data reveal that SSA policies are overall in line with those of other continents, except for policies related to governance and socioeconomic support, which reflect the lower income of the region. We analysed the distribution of specific government measures and found that a higher proportion of SSA countries have adopted policies of curfews, health screening and school closure, as compared with other continents. The opposite occurs for the existence of a testing policy, which is lower in the region and probably reflects the weaker laboratory infrastructure and procurement of tests and reagents of SSA countries.

South Africa is a special case, in terms of reported cases and deaths, testing capacity and implementation of strict measures, as illustrated in box 2.

5. COMMENTS

5.1 POOR NUMBERS

The issue is not only the paucity and low quality of COVID-related data in SSA, but the fact that their degree of inaccuracy cannot be assessed easily. As a result, policymakers often have to make decisions in the dark. The causes of this state of affairs, not unique to the region but particularly serious there, are only partially attributable to lack of technical accuracy: there are no short-term solutions to improve official statistics.

Meanwhile, epidemiological studies are needed to better understand the transmission patterns, assess the health and overall impacts of the epidemic, and evaluate the effects of containment measures. Standardised methods for crisis settings are available: for estimating mortality and nutritional status, for needs assessments, and for real-time evaluations of emergency response.[45-47] They can provide, at low cost, results within a few weeks. Scientific research on COVID is gearing up, boosted by huge investments. The pharmaceutical industry and the researchers are racing to find effective treatments and vaccines: by mid-April, 300 clinical trials were ongoing or in preparation,[48] and, as of June, 100 candidate vaccines were in development.[49] It should not be difficult to obtain funding for epidemiological studies in SSA; this should be promoted now, in order to gain insights into the epidemic that can quickly be translated into action.

5.2 THE SIZE OF THE PANDEMIC

As of 15 May, SSA, with 14.6 % of the world population, has reported only 1.2% of total COVID cases and 0.4% of deaths (see table 1). Several hypotheses have been advanced to explain these huge discrepancies, in addition to under-reporting and limited testing capacity. The possibil-

BOX 2. South Africa: Never claim success too early

After former president Thabo Mbeki's poor response to the HIV crisis in the early 2000s, RSA needed a success story and COVID offered an opportunity. RSA, the second-largest economy in Africa, contrasts in many ways with the other SSA countries. It is an upper middle-income country that also has high levels of poverty and inequality.[37,38]

RSA was the third country in SSA to notify an index case in early March,[39,40] and has since then registered a rapid increase of cases. In comparison, most other countries in the region have displayed a much slower growth. As of the end of May, RSA reported about 34,000 cumulative cases and 700 deaths, tripling the caseload of the second highest country, Nigeria, which has a population three times greater. Various factors may explain these differences. RSA implemented a strong initial response. It quickly expanded its testing capacity, establishing a network of decentralized laboratories and mobile testing units. It has performed, as of early June, more than 700,000 tests. It has deployed several thousand community health care workers to screen people for COVID symptoms and track the contacts of infected persons. RSA's impressive testing capacity is, however, being overwhelmed by a huge backlog of tests to be performed.[41-43]

It has implemented a draconian lockdown, including bans on tobacco and alcohol, in an early phase of the epidemic, when only a few hundred cases and no deaths had occurred. The lockdown has exacerbated economic hardship; it has been imposed through heavy military force, which has been criticised for the use of violence. The government has introduced social protection measures, such as the distribution of food aid to mitigate the impacts of the epidemic and the lockdown. This has resulted, however, in long queues of people with inadequate physical distancing.

The initial praise for the impact of restriction measures has been replaced by doubt about their impact on the rate of transmission.[44] The recent lifting of restrictions has coincided with an important surge of cases – nearly 15,000 – in the Western Cape, highlighting that transmission continues and that early success can be quickly reversed

THE REPUBLIC OF SOUTH AFRICA (SA)

POPULATION
59,308,690

DENSITY
46,754/KM^2
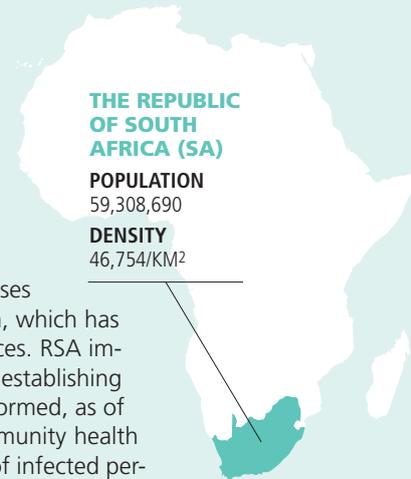
BOX 3. Rwanda and Burundi. Neighbour, but different countries

Similarities might be expected between these two tiny, neighbouring, and densely populated East African countries. Yet, the trajectory of the epidemic shows striking contrasts rooted in the difference between the two health systems as well as in political reasons. Health system performance has followed diverging paths, with Rwanda achieving much better health indicators than its neighbor.[58] In Rwanda, the epidemic started on 14 March and grew steadily afterwards, reaching 287 cases as of mid-May. Burundi reported its first cases on 31 March. The growth was slow and peaked on 2 May with 15 cases, then stopped. The measures put in place by the two governments were quite different. Rwanda, in addition to border control, tight movement restrictions, and the obligation to wear masks, adopted an aggressive testing policy and a social protection scheme. Burundi enforced limitations to access from abroad but allowed public gatherings and free movement within the country while adopting an insignificant testing policy. Health officers and foreign observers suggested that the downplaying of the COVID crisis by the Burundian Government was led by its dictator's political agenda: presidential elections were scheduled to take place on 20 May and the ruling party was determined to win at any cost.

RWANDA
POPULATION
12,912,035
DENSITY
490/km^2

BURUNDI
POPULATION
11,845,443
DENSITY
426/km^2
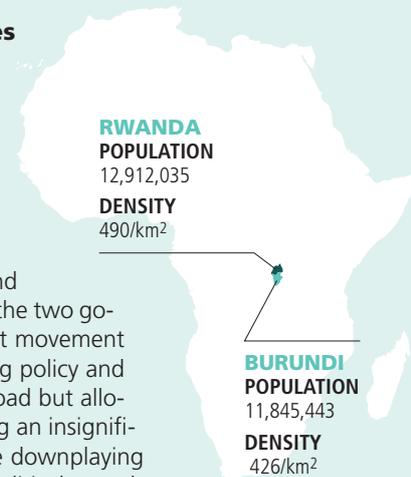
ity of genomic diversity with different transmissibility has been ruled out.[50] The limited air traffic from and to SSA could explain the delay in the start of the epidemic, and the travel restrictions quickly implemented may have slowed the seeding of the epidemic. The younger age distribution in SSA, as compared to western countries, is likely to have played a major role in reducing the number of clinical cases and the severity of infections. In SSA, the elderly tra-

ditionally live at home, usually within extended families, and often in rural areas rather than cities. This contrasts with the situation in much of Europe, where care homes have proven to be important foci of infection. The reduction in the already low utilisation of health services, due to the fear of contagion from health workers, may partly explain the low detection of COVID.[51] The evidence for a possible role of warm and humid climate in reducing the

transmission is inconclusive.[52] It has been suggested that people with underlying conditions, such as tuberculosis, might have increased resistance to the virus, thanks to the previously triggered immune response.[53] It has been hypothesised that the BCG vaccination might protect against the virus, by boosting immune mechanisms.[54] Last but not least, containment policies have been implemented early by governments, sometimes, as in South Africa, with stricter measures than those adopted in western countries. It is too early to judge, however, if these measures have been effective in reducing or slowing transmission.

Other factors could act in the opposite sense, favouring transmission of the virus and increasing the severity of COVID: the high population density in the slums of mega-cities, the large average household size, and the pre-existing burden of disease.

It has been suggested that the epidemic in SSA is in an early phase; WHO claims that its trajectory could be characterised by a flatter, longer epidemic curve than that of other continents, with some transmission hotspots.[55]

Available morbidity and mortality data contrast, with much lower figures, with the predictions from models. The large discrepancies between figures are likely, however, to converge, as diagnostic and tracing capacities increase and models are adjusted downward over time, with more robust parameters and more realistic assumptions. The snapshot we have provided is, therefore provisional, and can change, in accordance with the behaviour of the virus and the adaptive and varied responses of countries to the epidemic.

5.3 THE PICTURE IS NOT UNIFORM

A large variety of epidemic patterns and government testing policies clearly emerges among countries, due to the differing demographic, economic and cultural factors, settlement patterns, and detection capacities.[56] Aggregated data somewhat obscure this variation. Figure 4 shows that "the disease has largely affected urban populations, with most rural communities relatively unaffected or only reporting sporadic cases."[57] Analysis of these data can help to identify the spread of the pandemic and guide in developing targeted containment measures.

SARS-CoV-2 travels fast, crossing political boundaries. Limiting the analysis to only national perspectives would be a mistake, especially after borders are re-opened, when strong trans-border links, and flows of people and commodities, are considered. Box 3 shows the striking differences between two neighbouring countries, which have common features, but contrasting policies and politics.

Further inquiries into COVID in SSA should focus on clusters of countries with substantial cross-border traffic: for example, the Horn of Africa, where the historical links between Djibouti, Eritrea, Ethiopia and Somalia are strong, or western Africa, including Côte d'Ivoire, Guinea Conakry, Sierra Leone, and Liberia. It is likely that substantial variation also occurs at sub-national levels, but

data and time constraints did not allow such analysis at this time. A full picture of the epidemic requires both a wide-angle lens, to assess regional and sub-regional levels, and a macro lens to study local patterns.

5.4 THE EPIDEMIC CURVE.

The epidemic curve (fig. 2) shows a clear change in the slope at the end of March. It seems reasonable to interpret the curve as representing two patterns of transmission. The former, steeper part of the curve, representing comparatively few infections, probably reflects the importation of cases from abroad and the initial seeding of cases. It has been documented that wealthier, more mobile sections of the population have been the early index cases of COVID in some SSA countries, importing the epidemic from Europe.[59,60] The second, flatter part of the curve might reflect the end of the short-lived spark of the epidemic and the transition to community transmission when containment measures were implemented and surveillance systems were put in place.

5.5 COVID TESTING

The differences in the numbers of confirmed COVID across SSA, presented in the previous section, may in part be explained by the differential testing capacities of countries (see table 2). The expansion of testing capacity in SSA has been impressive. As of early February, only two laboratories in South Africa and Senegal could perform COVID testing, serving as referral centres for the rest of the countries in the region.[61] One month later, laboratories in 43 African countries could already do COVID testing.[62]

Overall, however, weak laboratory infrastructure, insufficient equipment, scarcity of trained human resources and irregular supply of reagents remain important hurdles for further scale-up of testing capacity in the region. An important bottleneck is the procurement of test kits. According to the Africa CDC, 15 million COVID kits are needed in Africa, in large excess to the current financial capacity.[63] The international competition in the global market for procurement of essential medical supplies, the constraints to the expansion of production of reagents and other consumables, and the complex logistic supply chains, are additional major challenges. The risk of test kit 'nationalism',[64] analogous to that feared for the future distribution of vaccines, cannot be ruled out: "Even where there is enough money, many African health authorities are unable to obtain the supplies needed".[33]

5.6 THE OVERALL IMPACT OF THE PANDEMIC IN SSA IS SEVERE

The secondary impacts of the epidemic may be even more severe that its direct effects on health, as occurred in the western Africa Ebola epidemic of 2014-15.[65] An increase in non-COVID related, indirect morbidity and mortality can result from various causes. Most health resources and efforts shift to the response to the epidemic, at the ex-

BOX 4. Excess mortality

Data on COVID infections are unreliable, in SSA and elsewhere. Mortality data, which should suffer less from underreporting, are not exempt from problems. The two common mortality indicators – number of deaths and IFR – are difficult to interpret, due to underreporting and, for the latter, for the underestimation of mild cases in populations with very young people: in the absence of systematic testing, the IFR cannot be estimated. (note: The Case Fatality Ratio (CFR) is the number of deaths divided by the number of confirmed cases; the Infection Fatality ratio (IFR) is the number of deaths divided by the total number of cases, confirmed and presumed. High numbers of mild or asymptomatic cases, mean that the IFR is likely to be lower than the CFR).

An analysis of the deaths in excess to the average of previous years in 14 Western countries has shown that the death toll during the first months of 2020 could be 60% higher than the official COVID-19 count.[66] All-cause mortality can, therefore, be a better metric to quantify the whole burden of the epidemic, when statistics become available.

'Mortality displacement' or 'harvesting' refers to the initial increase in mortality among the most vulnerable people with pre-existing conditions, as a result of heatwaves, epidemics, famine, etc.[67]. The subsequent, compensatory dip in mortality may be offset by secondary non-COVID-related deaths, due to the breakdown of health services, reduced service utilisation and the additional health problems caused by the crisis and government interventions.

Excess mortality therefore represents a combination of the direct effects of COVID-19 and its indirect effects on the health and livelihood of people, including the unintended 'collateral damage' of containment measures.

pense of essential health care. Health spending is diverted to the epidemic control, at the expense of other health needs. Health workers get infected; several die. Patients may abstain from using health services because of fear of contagion, movement restrictions or impoverishment.[51] Delayed diagnoses of life-threatening conditions, such as cancers, and neglect of chronic diseases, increases mortality. Medical supplies chains are disrupted, a critical factor in the context of the high dependence of the continent on imported pharmaceutical products.

The coverage of essential maternal and child health services is reduced.[68] Routine programmes, such as immunisation, TB, malaria, and HIV/AIDS control are suspended, with far-reaching consequences in terms of a future surge of diseases.[69,70] Mental health problems linked to the crisis and malnutrition related to the reduced living standards are likely to increase.

The worldwide economic impact of the epidemic is already evident, with a projected global output fall of 3% in 2020.[71] Prospects for Africa are bleak, with the collapse of the oil price, the crash of major African exports such as textiles, the breakdown of food trade, and the halt in tourism. Remittances, aid, and foreign investment are foreseen to decline dramatically. With the fall of tax revenues, the governments' reduced fiscal space will make it difficult, or impossible, to provide economic stimuli and social safety nets.[72] The likely outcomes will be increased poverty, socioeconomic inequalities, hunger, missed education opportunities, and political instability.

The overall consequences of severe crises outlast the immediate health impact, especially when societal vulnerabilities are high. Guinea, Sierra Leone and Liberia are cases in point: these countries were still recovering from the devastating Ebola outbreak of few years ago when COVID hit their fragile economies and weak health systems. Even in the optimistic scenario of Africa being spared the most severe consequences of the pandemic experienced by other parts of the world, the economic and social effects will be grave and lasting in SSA, and in the rest of the world.

5.7 THE CONTAINMENT MEASURES: HOW EFFECTIVE AND AT WHAT COST?

The non-pharmacological interventions (NPIs) that have been widely adopted around the world, as some form of movement restrictions, have become the norm in most SSA countries (see fig.5). The spectacular fall in the spread of the epidemic in China as a consequence of a lockdown has been the main argument for this policy to become a one-size-fits-all universal measure, at the expense of the classical public health approach of testing-tracing-isolating.[73]

The positive effects of these measures, however, are not necessarily transferable to low income countries that do not have the financial capacity to counterbalance the negative consequences of long lockdown periods, nor the capacity to enforce strict containment measures countrywide. The different SSA context raises questions about the societal cost and the potential side-effects of the measures.[56] In fact, the structure of the labour market in SSA is characterised by high levels of unemployment and underemployment, while the coverage of social safety nets is insufficient. Cultural, psychological and emotional factors related to the lockdown cannot be dismissed as secondary concerns in societies where disruption of traditional networks and community groups can further exacerbate the levels of stress and anxiety of individuals.

There are no estimates of the human cost of containment measures, except those indirectly captured by excess mortality estimations (see box 4). The ideal 'policy equipoise' – the mix of interventions that might minimise the death toll from both the epidemic and the response to it- is difficult to achieve. African governments are struggling to find a trade-off between the strict measures imposed and the

livelihood of their citizens: for example, Kenya is implementing a cash transfer programme, Rwanda, South Africa, and Uganda are supporting destitute households with food aid, and Nigeria has introduced tax relief measures.[74] A model of the effect of different response strategies in Africa suggests that self-isolation of symptomatic persons and physical distancing help to mitigate the epidemic, and shielding of high-risk individuals can reduce health service demand and mortality.[75] But these measures, to be effective, require high uptake and need to be accompanied by adequate surveillance systems, high testing coverage, stringent infection control measures and strong supportive services, all of which may be difficult to achieve in many African contexts.

Rapid expansion and strengthening of health services capacity, particularly of large hospitals, seem unfeasible for many SSA countries, given the critical gaps in resources, as shown in assessments of critical care preparedness.[76] Response strategies should, therefore, focus on PHC for basic medical care, supported by strong public health systems for surveillance, contact-tracing, health information and promotion activities. However, fragmentation is a common feature of service provision in most low-income countries, where vertical disease-control programmes are the preferred channels of external funding, at the expense of PHC and public health interventions.[77]

Home isolation of mild cases may be difficult, even impossible, in many African contexts. The replication of the 'Fangcang Shelter Hospitals' is being considered by some SSA countries. It consists of the conversion of public venues into temporary hospitals, to provide basic medical care and food to mild COVID cases, and implies low investment and running costs.[78] The model mirrors, on a larger scale, the community health facilities used for the triage and isolation of Ebola Virus Disease in Western Africa (see box 5).

Many African countries have a long experience of epidemic control that needs to be put to good use, avoiding unrealistic high-tech solutions or strict lockdown approaches imported from rich countries with severe side effects. Non-resource-intensive solutions have been implemented by some countries, such as simplified triage strategies in Uganda, the introduction of rapid diagnostic tests in Senegal, and health information and promotion campaigns in Nigeria.[79]

5.8 "IF YOU'VE SEEN ONE PANDEMIC, YOU'VE SEEN ... ONE PANDEMIC"[80]

Despite the diversity of contexts and the differences in epidemic patterns, the experience of response to previous outbreaks should be assessed and the relevant lessons, if any, should be learned and adapted to the current situation, to avoid repeating past mistakes (see box 5). But recognising the differences between this and previous epidemics is also important. The COVID pandemic presents new aspects, such as the severe impacts on the global economy and unprecedented measures intended to limit social interactions. There are also similarities, notably the increased mortality and the pressure on health services.

African countries have shown strong resilience to epidemics.[86] Early in 2000, many analysts forecasted that HIV/AIDS was posing risks of social meltdown, widespread collapse of African states, and a surge in armed conflicts. Despite the deaths of million adults, leaving behind countless destitute families and orphans, the high HIV/AIDS prevalence and the regression of life expectancy, the initial pessimistic predictions proved unfounded. Governments, on the whole, managed to absorb the crisis, their institutions kept functioning despite the loss of human capital, and communities proved resilient to the shock.[87]

6. CONCLUSIONS

In this article, we have taken a snapshot of a crisis in evolution. The data seem to point to a lesser health impact of the epidemic in SSA in comparison to Asia, the Americas and Europe, but caution is in order: the crisis is evolving rapidly and the picture could change within a short period. Current data should not invite complacency.

The region is already hard hit by the economic crisis which, combined with the health impact and the effects of the strict containment measures, will have devastating consequences, particularly in a context of international economic recession. International solidarity risks being a chimera:

BOX 5. Lessons learned from the Ebola outbreak

The Ebola outbreak in western Africa in 2014-15 offers important lessons. Initial poor understanding by humanitarian workers of local burial practices created distrust among local communities and caused their refusal to report cases of the disease, with consequent increased transmission.[81] The insufficient attention paid by humanitarians to frontline health responders, district managers, and local authorities was also recognised as a mistake.[82] Sierra Leone implemented an effective contact tracing system and established small Community Care Centres for triage and isolation of patients, which were well accepted by locals for their locations close to where cases occurred.[83] Communities also organised their own quarantines, aware that self-isolation was in their interest, and quickly adopted good hygiene practices.[84]

In Liberia, a large donor investment was made to build Ebola Treatment Units, but this intervention came late, after the epidemic curve had peaked. Much of the decline in case numbers was attributed to behavior change within local communities, rather than to international efforts.[85]

BOX 6. How the pandemic has evolved since May: a summary update as of 31 August

Since May 15th COVID cases in SSA have increased twentyfold and deaths seventeen-fold. Cumulative COVID cases -1,033,514- represent 4% of the global caseload and deaths – 21,475 – 2.5% of the global death toll. The IFR – 2.5% – has remained stable. Despite the substantial increase the epidemic curve has started to flatten by mid-July, consistently with the trend remarked in other parts of the world. Since August, the total number of confirmed daily cases has been dropping.

South Africa, with 5% of the SSA population, is now contributing to two-thirds of SSA COVID cases and deaths. It is unclear if this pattern reflects its strong testing capacity, or more complex ecological factors are implied, or both explanations hold. The country ranks now sixth worldwide for the number of cases and is approaching the most severely hit European and American countries for the mortality rate. The second most affected country, Nigeria, ranks 50th, with a significantly lower caseload and death toll.

The ranking of countries has significantly altered. Only Ghana maintains its position, while Ethiopia, Kenya, Zambia, and Madagascar are emerging. Some countries, even with large populations, like RDC, report very few cases; others, such as Niger, Burkina Faso, Tanzania have almost stopped reporting.

rich countries, grappling with their domestic problems, are not likely to deliver the same level of aid as in the past.

The picture is not homogeneous: COVID is affecting individual SSA countries differently, and distinctively from other regions and continents. The diverse data quality can only partly explain these differences: "epidemic diseases are not random events that afflict societies capriciously and without warning. On the contrary, every society produces its own specific vulnerabilities".[88]

COVID has challenged and subverted many common misconceptions, such as portraying Africa as the reservoir of disease. During the Ebola outbreak of 2014-15, Europe and the US feared the introduction of cases from West Africa, and Africans were internationally stigmatised.[89] Now the situation has reversed, with African countries seeking to protect themselves from COVID cases imported from Western and Asian countries.[90]

The virus has shown a strong capacity to adapt, undergoing evolutionary changes in its genetic material, which enabled it to eventually infect humans and then spread from person to person.[91,86] In order to respond to it, effective response strategies should be "designed and intended to adapt to change",[92] for example, relaxing some interventions and maintaining others, as new evidence becomes available, or modulating the response to the different contexts. In this unfamiliar and fluid territory, rigid blueprints cannot work: as in Deng Xiaoping's famous saying, one should "cross the river by feeling the stones" 模着石头过河.[93]

Finally, the epidemic has unveiled, probably as never before, the importance of epidemiology, and science at large, in informing decision-making, particularly when uncertainty poses serious dilemmas to politicians. The importance of simple hygiene and preventive measures has also been highlighted.

However, the stereotype of the office-based epidemiologist, removed from both politicians and affected communities, and using technical jargon, not easily understood by both audiences, is not very far from reality. COVID shows the importance of effective communication between policy makers, politicians, the scientific community and the public, as well as the need to engage the affected communities, to build trust. As Richards, an anthropologist who worked in Sierra Leone during the Ebola outbreak observed: "It is striking how rapidly communities learnt to think like epidemiologists, and epidemiologists to think like communities".[84]

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About the authors

The authors worked together in Mozambique in the 1980', during the war, and remained friends since then. They have a cumulative working experience in Africa of more than a century, which says it all about their age.

Amélia started working in the public health system of Mozambique, both at the rural and national levels. She then moved to the Swiss Cooperation and did some consultancy work in Nepal, Chad, Benin, and Ethiopia. Her areas of work are health planning and financing, health services evaluation, and post-disaster recovery. She is a polyglot (struggling now with Mandarin), plays guitar, and has a green thumb.

Antonello recently retired from the ISS, where he was in charge of the Assessment and Quality of Biomedical Technology, managing projects in the field of retinal diseases. His work abroad included 4 years in Mozambique and short missions in Egypt, Liberia, Jordan, Palestine, Venezuela, China, and Mongolia. His areas of work were medical equipment, hospitals, and biosafety laboratories. He sails in the Mediterranean on his boat Mizar (a star in the Ursa Major).

Rino, a neurologist by training, started working as a bush doctor in Mozambique in the late 1970s. His interests gradually shifted to public health, namely to the training of medical assistants, health program formulation and evaluation. He worked for several agencies, both multilateral and bilateral and NGOs, in Mozambique and Angola. Since he returned to Italy, he retrained in neurology and worked, before retiring, in outpatient clinics. He is a music lover, particularly of Bach, and has become a cyclist, after discovering the electric bike.

Sandro started his career as an epidemiologist in Torino. He moved to Mozambique in the mid-1980s and, worked for multilateral agencies and NGOs in Afghanistan, DR of Congo, Liberia, Somalia, Sudan, Iraq, Syria, Uganda, Palestine, Haiti, and Sierra Leone. His areas of work included health systems analysis in conflicts and information management in emergencies. Since retirement, he lives in Madrid with his dog Gaia (Nataly to join soon) and cats Coco and Zazie. He is a compulsive reader, piling up many more books than he would be able to read even in a second life.