Title:

Lung Health in Africa: challenges and opportunities in the context of COVID-19

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The emergence of the coronavirus disease 2019 (COVID-19) in December 2019 caused unprecedented challenges to healthcare worldwide. While at the beginning of the COVID-19 pandemic, it was projected that Africa would suffer a huge pandemic, the reality is that the number of SARS- CoV2 infections and deaths from COVID -19 have not been as large as projected. Africa has currently reported about 4.6 million confirmed cases of SARS-CoV-2 infection against a global total of 190.5 million confirmed infections and 107 000 deaths with against the global total of 4 million deaths from COVID-19, with a contribution of 2.4% and 2.7% of all confirmed SARS-CoV-2 infections and COVID-19 deaths, respectively (1). Reasons for this may include the relatively youthful population of the region, genetic factors, climatic conditions, high exposure to other infectious diseases with development of trained immunity and use of COVID-19 mitigation measures very early in the evolution of the COVID-19 pandemic (2). However, lack of testing for diagnosis or poor access to health care facilities with many deaths outside such facilities may also influence these estimates.

The COVID-19 pandemic has caused global devastation, in high and low- and middle-income countries (LMICs). In Africa and other LMICs, the direct impact including COVID-related illness and deaths, as well as the indirect effect on economies, other health related conditions, education and social services has been overwhelming, and are likely to endure, threatening to shape the future of its population.

This pandemic poses challenges to the wellbeing of both adults and children in Africa which is made more profound by weak health systems, pre-existing poor population health and low socio-economic status pervasive in the continent. Also, high exposure to potentially harmful environmental factors such as tobacco smoke or air pollution may be associated with a greater risk of severe COVID. Further the ability of health systems to deal with increased numbers of people with COVID-related illness and to upscale and widely implement vaccination against SARS-CoV-2 are challenges. However, within these challenges also lies opportunities for the continent to leverage this health crisis to improve the lives of its people. The ability to mitigate this pandemic requires a multi-faceted approach embracing global partnerships and alliances.

Adult lung health in Africa, in the context of COVID-19.

Chronic respiratory diseases (CRD), including asthma and chronic obstructive pulmonary disease (COPD) are common and rising public health concerns in Africa (3, 4). These diseases

were relatively neglected with no public health programs in place for them in most countries in Sub -Saharan Africa (sSA) (5). Consequently, the provision of health care for CRD such as asthma and COPD has been suboptimal even before the COVID-19 pandemic. The pandemic has further compromised the situation and negatively impacted on care and treatment for these diseases. Most guidelines recommend that pulmonary function tests should be limited to the most essential tests when possible for fear of transmission of SARS-CoV-2 (6). This recommendation is likely to constrain efforts that were being made to promote spirometry testing in sSA and will further compromise the diagnosis of CRD in the continent (7).

We hypothesize that in the African setting the COVID-19 pandemic has reduced the number of people diagnosed with asthma, worsening the already existing wide gaps between prevalent cases of asthma and those accessing appropriate care and treatment for their disease for several reasons. These reasons include inadequate services for asthma as health resources are diverted to the COVID-19 response; fear of a diagnosis of COVID -19 and the attendant consequences, including isolation, keeping away from health care facilities for fear of infection with SARS-CoV-2 infection which is perceived by the population as fertile grounds for the transmission of this virus. Patients with asthma exacerbations who arrive at health care facilities may have delayed care for their disease as they are screened and tested for SARS-CoV-2 infection and may be at increased risk of acquiring infection with this virus if they are placed in holding areas where persons suspected to have COVID-19 are isolated as they await their COVID-19 tests results. These interactions have not been studied in the African setting, and we urge African researchers, their partners, and funders to prioritize this area of research to gather the evidence needed to develop robust mitigation measures.

It has been documented that people with chronic respiratory disease are at increased risk of developing severe disease when infected with SARS-CoV-2 (8). Data in the African setting are however sparse and it remains unclear if people with asthma and COPD, especially those with COPD unrelated to tobacco smoking and people with TB-associated chronic lung disease, which are common forms of chronic respiratory disease in Africa, have an elevated risk of severe COVID -19.

Similarly, there is a high burden of HIV-associated disease especially in sSA; HIV-infected people, especially those whose disease is not well controlled with antiretroviral therapy or those with co-morbidities such as diabetes or renal impairment may be at increased risk for developing severe COVID-19 (9). Other underlying illnesses that place people at risk for

developing severe COVID-19 are common in Africa. Cardiovascular disease including hypertension is one of the commonest non-communicable diseases in the African populations (10). Diabetes and obesity are increasingly emerging as important chronic illnesses in African populations (11). Each of these places individuals at increased risk for developing severe COVID-19.

Acute lower respiratory infections (ALRIs) are more common in LMICs with about 70% occurring in South Asia and sSA (12). Pneumonia due to COVID-19 may be difficult to distinguish from bacterial community-acquired pneumonia. The lack of diagnostic tests for SARS-CoV-2 in the early days of the pandemic might have delayed the diagnosis and optimal management of bacterial pneumonia. Avoidance of medical settings by patients might have led to the late diagnosis of pneumonia from other causes and consequent increase in pneumonia related mortality overall.

The COVID-19 outbreak has again brought the weaknesses of health systems in Africa to the fore. In emergency departments of many hospitals across sSA, there is a lack of equipment and commodities, such as pulse oximeters and oxygen, that are critical for the identification and treatment of people with serious lung disease. This situation implies that outcomes for people presenting to these facilities with COVID-19 and other respiratory emergencies, including asthma and COPD exacerbations, are likely to be poor.

Child lung health in Africa in the context of COVID-19.

Respiratory illnesses remain a predominant cause of morbidity and mortality in African children, from both infectious causes and chronic non-communicable disease. As children constitute a third to half of African populations, this comprises a large burden of illness. Pneumonia and tuberculosis (TB) disease remain key challenges for child health, while asthma is the commonest non-communicable disease in children and adolescents. African children have been largely spared from moderate or severe illness with SARS-CoV2 through the COVID-19 pandemic, as has occurred globally, but the indirect effects have substantially impacted on child health.

The incidence and severity of childhood pneumonia has reduced substantially with socio-economic improvement, improved immunization strategies, particularly pneumococcal conjugate vaccine (PCV) and *Haemophilus influenzae* type b conjugate vaccine (HiB) and

better prevention and management of HIV. Nevertheless, pneumonia remains the commonest cause of death in children under 5 years outside the neonatal period, with almost 800,000 deaths in 2018, with more than half of deaths occurring in Africa or South-East Asia (12) (13) .

Childhood TB is common in Africa, and has been reported to contribute up to 20% of the overall caseloads (14), although this is probably an underestimate given the challenges in confirming TB in children and lack of notification of childhood cases. *M tuberculosis* has increasingly been recognized as a pathogen in the context of acute pneumonia in children, comprising a large proportion of cases.

Factors associated with the high burden and severity of respiratory disease in African children also include high exposure to air pollution or tobacco smoke, under resourced health systems and lack of access to effective preventive or management strategies. Further, early life respiratory infection particularly pneumonia or TB may lead to long-term impairment of health, setting a trajectory for the development of CRD through the life course (15).

Asthma is the commonest chronic disease in African children, with an increasing prevalence in both urban and rural settings. While childhood asthma was regarded as rare in Africa, global epidemiological studies have shown that the prevalence in African children is similar or higher than the global average (16). Further, asthma in Africa may be frequently undiagnosed, untreated and be more severe (17). Access to routine health services and follow-up during the pandemic may have compromised care of these children further. HIV-associated chronic lung diseases or bronchiectasis or bronchiolitis obliterans following lower respiratory tract infection or TB are other causes of chronic respiratory illness in African children.

Although children and adolescents constitute a very small proportion of cases of COVID-19 and of COVID-associated mortality in Africa similar to the patterns seen globally, the indirect effects on child health have been substantial. These include disruptions in delivery of essential healthcare services such as immunization, HIV or TB programs, increasing poverty levels, disrupted schooling, lack of access to school feeding schemes and diversion of resources away from maternal and child health to adult COVID responses. With a large informal economic sector with little social protection in Africa, levels of poverty and hunger are increasing at an alarming rate increasing susceptibility of children to severe pneumonia from other pathogens is of concern.

However, the use of non-pharmacologic interventions including universal mask wearing, social distancing and hand hygiene has reduced the incidence of influenza or RSV-related illness, with reductions in number of cases and hospitalization of children. Nevertheless, late presentation with severe disease may occur as families may be reluctant to attend health facilities in the context of COVID-19 or these may be inaccessible. Parental or family loss due to COVID-19 has compounded the effects on child health. While immunization program against COVID-19 have been initiated in many African countries, rollout is slow (18). Greater coverage is urgently needed, to protect populations including children and adolescents, who may be indirectly protected with high coverage of adult population groups.

Tuberculosis and COVID-19 in Africa; What has happened?

Sub- Saharan Africa bears a disproportionate burden of tuberculosis. It is currently estimated that about 14% of the global population of about 7.8 billion people live in sSA, however, in 2019, this region accounted for 25% of all incident cases of TB in the world (19). The drivers of the large burden of TB in the African setting include the concurrent HIV epidemic and rampant poverty. Nearly 75% of all people living with HIV are in sSA (20) and of the 736 million people who lived on less than $1.90 in 2015, 413 Million (56%) lived in sSA (21). The link between poverty and TB has been firmly established and known for nearly a century and it is therefore not surprising that Africa, with a large proportion of people living in extreme poverty suffers a high burden of TB.

An important question that needs to be addressed is the impact that COVID-19 has had on the TB epidemic in the African setting and what may be expected to happen as the COVID-19 pandemic continues to evolve. The first major concern has been the influence of COVID-19 on TB case finding. As a result of both societal fear of a new disease that had been depicted to be highly lethal and the mitigation measures put in place to protect society and the health care system, TB case finding declined significantly. Tuberculosis surveillance data from high TB endemic settings have revealed significant declines in TB notification between 2019 (the pre-COVID era) and 2020 (the COVID era) (22). The decline in TB notification in the African settings has been of the order of about 20% (23, 24). The decline in TB notifications has been attributed to disruption in TB service provision , some of which has been related to closure of facilities that provide TB services and redirection of resources , including human, financial, equipment such as the Xpert platforms and others, to the COVID -19 response to confront a public health threat that was perceived to be more urgent and bigger. Additionally, travel

restrictions and the fear of health facilities, contributed to alterations in population health seeking behavior. The full impact of these developments is not yet known but it has been projected that TB incidence and deaths will rise globally to set the world back by several years in the fight against this age-old disease.

In Sub- Saharan Africa, it has been projected that COVID-19 will lead to economic declines, with shrinkage of the Gross Domestic Product of African countries of up to 1.4% with smaller economies contracting by a margin of up to 7.8% which will increase poverty rates (25). The rise in poverty in Africa because of the COVID-19 pandemic implies a rise in the burden of TB. The second effect of the COVID-19 pandemic is on treatment outcomes. With disruptions in TB service provision and the hurdles occasioned by COVID-19 mitigation measures in accessing health services combined with societal fear of health services, disruptions in TB treatment were expected to become more common. We need to see if this projection will be confirmed as national TB programs carry out cohort analysis of treatment outcomes of persons diagnosed with TB in 2020 and 2021 (in the COVID-19 era) to allow for comparisons to be made with those diagnosed and placed on treatment in the pre-COVID period. Preliminary data from Kenya, Malawi and Zambia suggest that TB treatment outcomes in the COVID -19 era were slightly better than in the pre-COVID -19 era (26)

Thirdly, there have been concerns that persons with current or previous TB may have a worse COVID -19 disease clinical course than those without these conditions. The data so far suggests that this may be so (26), which is extremely worrying for countries in Sub-Saharan Africa with a large burden of TB, highlighting the need to develop robust mechanisms to protect these individuals from acquiring SARS-CoV2 infections and consequently developing severe disease. Prioritizing these people in vaccination programs may be very helpful.

In a continent that is struggling with a myriad of health problems on the background of very weak health systems, the COVID-19 pandemic could not have come at a worse time. The effect of this pandemic on TB are expected to be enormous and will add to woes of a continent that was already been off track with its efforts to achieve the End TB Strategy targets. All is not lost, however, and with concerted efforts including advocacy efforts to ensure African governments allocate sufficient resources to build and sustain robust and resilient health systems, the expected trajectory of the TB epidemic in Africa during and post the COVID-19 pandemic can be re-set to get the African continent to reach the targets of the End TB Strategy.

African governments must address the social determinants of TB. Now is the time to ramp up efforts to lift people out of poverty in Africa. On the other hand, National TB programs, TB researchers in Africa, communities and other stakeholders need to develop, test, and scale up innovations to expand TB case finding in Africa and to ensure all people on treatment for TB are supported throughout their TB journey and beyond. Now is the time to step up the fight against this disease. Africa should not and must not be left behind in the fight against TB, COVID-19 notwithstanding.

Strategies to mitigate the COVID-19 pandemic: where we are & where we need to be.

Mitigation strategies for the COVID-19 pandemic aim to slow the spread of the disease and protect the population, while being cognizant of the need to minimize the impact of these strategies on the wellbeing of the people they aim to protect. Safe hygiene practices, physical distancing and mask wearing are fundamental to any mitigation action and have been adopted globally to curb the spread of SARS-CoV-2. Universal mask wearing has been found to be a highly effective practice that reduces transmission both in experimental models and in real life situations (27, 28). When adhered to, mask wearing also contributes to reduced spread of other respiratory diseases including influenza virus or RSV. However, adherence to mask wearing has varied; being politicized in some parts, unenforced in others or just simply ignored.

Lockdown or mandatory stay at home measures as a mitigation strategy truncates the spread of the virus and protects the health system, but has adverse social, economic, educational and health consequences (29). The adverse economic impacts of COVID-19 related lockdowns have been found to be more profound in the African setting due to high rates of poverty, high reliance on daily wages, and lack of social safety nets (30). Further, reports of increases in gender-based violence during lockdowns in many parts of Africa and non-COVID deaths due to limited access to healthcare services have been documented (31, 32). Therefore, lockdown as a COVID-19 mitigation strategy has not worked well in Africa and in many instances its enforcement has been met with protests and crack downs resulting in further loss of lives. Lockdowns disproportionately affect the poor and widen the already existing inequities within these societies.

Mitigating the pandemic must of necessity include the provision of adequate healthcare services to treat all people with COVID-19, which remains a challenge within Africa's fragile health systems. Inadequate supply of oxygen was a pre-pandemic challenge in many parts of Africa

which has been exacerbated by the pandemic as increased demand for oxygen far outstripped supply. While some efforts have been made to mitigate the deficits in oxygen supply with some African countries such as Nigeria and Malawi having made some strides in improving oxygen supply by establishing new infrastructure for production and delivery, these efforts have not been enough. One major health need in the COVID-19 pandemic is the availability of critical care services including care and treatment of respiratory failure using supportive ventilation. Across sSA availability of critical care beds and associated resources for the provision of care and treatment of critically ill COVID-19 patients is dismal. This calls for the mobilization of resources not only for infrastructural development, but also for capacity building. Trained healthcare workers in this area are limited and task shifting for critical care has proven feasible in Africa and requires further consideration (33).

Vaccination which is considered as one of the most cost-effective strategies for mitigating and containing this pandemic has underscored the global inequities that exist today. While countries such as Canada, United Kingdom and Israel have achieved nearly 70% vaccination rate, Africa is yet to reach the 3% mark targeted by the World Health Organization (WHO) under the COVAX facility as at mid-July, 2021. Indeed, most African countries have vaccinated <1% of the population with one dose of the vaccine.

The decisive and pro-active measures taken by the African Center for Disease Control to mitigate this pandemic which included the Partnership to Accelerate COVID-19 Testing (PACT) and more recently procurement and equitable distribution of donated vaccines through the COVAX facility is commendable. The early development of a continental wide African strategy endorsed by African leaders in the early phases of this pandemic may have contributed to the unexpected low numbers of COVID-19 cases and related deaths in Africa. However, much more needs to be done with regards to vaccine access and widespread effective implementation in Africa. COVAX will receive about 600 million doses of the vaccine which can cover only a third of the African population, implying that countries need to purchase vaccines to meet additional needs. Vaccine availability, affordability and implementation will remain key challenges for the African setting and there is need for the global community to consider additional strategies to scale up vaccine coverage for poorer African countries. Additionally, vaccine hesitancy in the African setting will need to be decisively dealt with to ensure vaccines made available through the various initiatives are taken up by the population in a timely manner. Addressing vaccine hesitancy in high context societies of Africa where key

opinion leaders sway behavior regardless of scientific rationale is an important mitigation strategy that requires public health action. The rapid spread of conspiracy theories through the wide penetration of social media in Africa must be matched by alternative messaging that is grounded in the local realities to enhance vaccine uptake when vaccines become more available.

As rich countries begin to emerge from this pandemic due to confidence in the high rates of vaccination, Africa must not be left behind. The spread of the SARS CoV-2 from China to a global pandemic serves as a lesson and reminder that global health is everyone's business.

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