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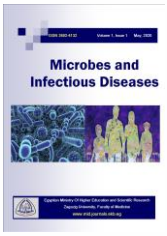

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Review article

A review of the impact of COVID-19 pandemic on malaria control in Africa

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ABSTRACT

Background: The COVID-19 pandemic has affected many scientific and technical institutions globally, resulting in lower productivity in a number of fields and programs. As the COVID-19 pandemic spreads rapidly around the globe, there is an urgent need to aggressively tackle the novel coronavirus while ensuring that other killer diseases, such as malaria, are not neglected. Although many malaria-endemic African nations have shown remarkable resilience and adaptivity in the face of previous global health threats, they nevertheless face the unprecedented challenge of COVID-19 with a comparatively lower health-care system capacity and a higher baseline level of malaria burden. Recognition of the threat posed to malaria control by COVID-19 has been widespread, and there is an urgent need to properly contextualize these threats amid rapidly evolving global health priorities. Doing so will require granular information with which to compare the relative threats posed by the spatially varying deterioration of malaria interventions. In this article, we discuss the impact of COVID-19 pandemic on malaria control in Africa. In this review, different literatures were consulted from Web of Science, Pubmed, AJOL etc., using Google search engine, and findings from these studies were put together in an attempt to provide evidence for a diverse impact of the COVID 19 pandemic on malaria. There is the need to further investigate the public health consequences of COVID 19 pandemic on malaria burden.

Introduction

A novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was found in patients with severe pneumonia in Wuhan, China, at the end of 2019 [1]. SARS-CoV-2 spread throughout the world and was the cause of the infectious coronavirus disease 2019 (COVID-19). The COVID-19 pandemic was the most sustained, disruptive, and lethal infectious disease outbreak since the influenza pandemic of 1918 [2]. It was initially predicted that Africa would be the worst affected region by the COVID-19 pandemic because of its weak health systems, prevailing poverty and the high burden of other infectious diseases. Overall, the epidemiology of COVID-19 in Africa remains puzzling [3]. By 14 June, 2021, there were about 3.6 million COVID-19 cases and 89,000 deaths reported from the entire continent, and most of these were from its northern and southern regions [4]. Potential explanations for such a situation are incomplete data due to much lower testing capacities, a significantly younger population, overall lower population mobility, cross-reactive immunity or immunomodulation due to high prevalence of other

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infectious agents, and effects of public health responses [5].

The reduction in the incidence, severity, and fatality of SARS-COV-2 observed in Africa has been associated with several factors, despite the risks associated with economic and health systems vulnerabilities, including limited testing and surveillance capabilities [6].

Malaria is a mosquito-borne infectious disease, which has long been a nightmare for countries in sub-Saharan Africa. As of March 12, 2020, several malaria-endemic regions in Africa had reported a few imported COVID-19 cases, which led to serious public health emergencies. As the COVID-19 pandemic spread in Africa, it became a challenging task to maintain core malaria control services while protecting health workers against COVID-19 transmission [6]. As a consequence, malaria control services were disrupted in many malaria-endemic regions in sub-Saharan Africa, among which insecticide-treated net (ITN) campaigns have been considered as the most important measure for malaria intervention and control across Africa in the last two decades [7]. However, as of March 2020, there were reports of the suspension of insecticide-treated net campaigns in several African countries due to concerns around exposure to COVID-19. An integrative literature review has shown that the COVID-19 pandemic may have a great socio-economic impact on global poverty [8, 9]. According to the World Health Organization, there is an urgent need to aggressively tackle the COVID-19 pandemic while ensuring that other diseases, such as malaria, are not neglected. Serious concerns have been raised in the scientific community regarding the potentially detrimental public health consequences of COVID-19 control measures on non-COVID-19 diseases, in particular, human immunodeficiency virus (HIV) /acquired immunodeficiency syndrome (AIDS), tuberculosis (TB), and malaria. These are highly endemic across Africa, and they remain major causes of death and suffering on the continent, and some of them are more fatal than COVID-19 [10,11]. These might be worsened by the disruption of the international system affecting the supply of essential medical products, as well as reduced capacity of patients to support direct and indirect medical costs, reduced inclination of patients (including those presenting symptoms overlapping with those of the new pandemic) to seek care at a formal health facility due to COVID-19 related fears, and clinical parallels and potential interactions between COVID-19 and these diseases [12].

Recognition of the threat posed to malaria control by COVID-19 has been widespread, and there is an urgent need to properly contextualise these threats amid rapidly evolving global health priorities. Doing so will require granular information with which to compare the relative threats posed by the spatially varying deterioration of malaria interventions. In this article, we discuss the impact of COVID-19 pandemic on malaria control in Africa.

Epidemiologic data from African countries

A small study from Sierra Leone reported a significantly lower number of malaria outpatient visits in one health facility during the March/April 2020 lockdown period compared to the same period in 2019 [13]. In addition, preliminary national data from Uganda point to a reduction of malaria cases diagnosed in health facilities during the first quarter of 2020 compared to the same period in 2019 [14]. Another study from Uganda reported a 54% decrease in visits for malaria treatment of febrile children; visits for antenatal care declined by 26%, restricting the delivery of intermittent preventive malaria treatment in pregnancy (IPTp) [15]. In the Democratic Republic of the Congo (DRC), lower attendance to health facilities for malaria treatment ranged from 20 to 90%, depending on local lockdown measures [16]. In contrast, a study from one rural district in Zimbabwe reported a large increase in malaria cases in 2020 compared to previous years, which was associated with delayed IRS in 2020 [17]. These findings were confirmed by national data from Zimbabwe, which compared the number of malaria cases and deaths in 2020 with those in previous years; in 2020, there was a large excess of reported malaria cases and deaths [18]. Moreover, national data from Zambia showed an increase of malaria cases between August 2019 and June 2020; however, no data from control periods were provided [19].

Impact of the pandemic on malaria programmes

About three quarters of malaria-affected countries reported disruptions of malaria services and programmes [20]. Re-allocation of funds from other disease control programmes to the control of COVID-19 was common and posed great problems for malaria control [21]. Ongoing malaria programmes (e.g., Indoor Residual Spraying with insecticide (IRS), Insecticide Treated Net (ITN)

interventions) needed to be adapted to the restrictions associated with COVID-19 control measures, which requires additional financial resources [22]. Programmes for vulnerable populations living in remote areas were particularly at risk as they strongly depended on logistics and external financing [24]. Disrupted ITN programmes led to increased malaria transmission as 80% of the nets are distributed through mass campaigns [23]. IRS campaigns faced many challenges as they required direct household contact [24].

Model based impact of COVID-19 on malaria

In their study, **Weiss et al.** [25] predicted in their worst-case scenario (75% fewer anti-malarial drugs and ITNs) and for the year 2020 that in sub-Saharan African countries, malaria cases would increase by 22% (from 215 to 262 million) and malaria deaths by 99% (from 386,000 to 769,000); the lower access to anti-malarial treatment had a larger effect than reduced ITN distribution. These estimates mirror those by the WHO, but the authors described the effects of nine different scenarios compared to the effects of three scenarios by **Weiss et al.** [2]. A further analysis by WHO predicted up to 100,000 additional deaths in 2020 with a 50% lower access to anti-malarials [25]. However, all these authors emphasized that the projected effects on malaria services and mortality are highly uncertain because these estimates are heavily dependent on how countries respond to the COVID-19 pandemic. Regarding the relative burden of COVID-19 in Africa, one study concluded that the excess disability-adjusted life years (DALYs) lost by malaria due to COVID-19 may exceed those directly lost due to COVID-19 [14].

The impact of viral co-infections on malaria

There is limited data addressing whether co-infection with COVID-19 affects the immune response and susceptibility to malaria and vice versa [26]. Previous studies, for example, have addressed the effects of virus co-infection on malaria pathogenesis in endemic areas. They showed that the presence of viral infections such as influenza, parainfluenza, adenovirus, coronavirus, rhinovirus repressed the *P. falciparum* burden in peripheral blood and elevated patients' haemoglobin levels, thus improved their anaemia [27]. Moreover, the presence of viral respiratory tract infection was highest in children not infected with malaria, and as the parasite levels increased during *Plasmodium* infection, the viral infection decreased [28]. Others showed that chikungunya virus (CHIKV) infections prevented *Plasmodium*-induced neuropathology in mice [29]. Conversely, prior exposure to *Plasmodium* suppressed CHIKV tissue viral load and suppressed CHIKV-induced joint pathology in mice [29]. Overall, the impact of malaria and respiratory viruses co-infection on host susceptibility and pathogenicity remains unclear. However, it was suggested that the immunomodulatory and immune-evasion capabilities of *Plasmodium* might play critical roles in altering virus clearance and viruses-induced pathology [30]. These findings could be applied to improve COVID-19 management in regions with malaria co-endemicity, leaving a gap for future studies.

In contrast, there are concerns that malaria co-infection may compromise the pre-existing vaccine response. Previous studies, for example, showed that *P. chaubaudi* [31] and *P. yoelii* [32] infections reduced pre-existing influenza-specific antibodies and increased susceptibility to influenza in mice. *P. yoelii* infection also led to an accelerated loss of pre-existing vaccine-specific IgG (tetanus, measles and hepatitis B) in Malian children [32]. Given the urgent need for developing a vaccine for COVID-19, these studies and others highlight the importance of addressing the impact of malaria on the up-coming COVID-19- vaccine-specific antibodies.

Misdiagnosis and mistreatment

Since most low- and middle- income countries could not be able to afford large-scale diagnostic tools, clinical case definition or presumptive diagnosis of COVID-19 was prioritized [33]. This might affect malaria control efforts because of the overlap symptoms for COVID-19 and malaria, such as fever, difficulty in breathing, headaches, and body pain [34]. Symptoms of malaria usually arise 10–15 days after the bite of female *Anopheles*. Severe malaria infection is usually associated with multi-organ failure in adults and respiratory distress in children, presenting what is commonly seen in COVID-19 infected patients [34]. As a result, patients with fever may get tested for malaria and sent home due to a negative result when they may, in fact, have COVID-19 infection and vice versa . There are also laboratory-confirmed cases of both asymptomatic malaria and COVID-19 infected individuals. This increased the possibility that both asymptomatic patients can transmit the infection through their respective modes [35]. A

single case of COVID-19 has the potential to transmit up to 3.58 susceptible individuals [36]. In contrast, malaria has the potential to cause further community infections which in turn continues to be a significant source of illness and deaths globally. Consequently, undetected malaria and COVID-19 cases may pose an immediate health challenge to the individual and public health consequences for the community. Laboratory investigation is the definitive way to diagnose infectious diseases. Thus, it is highly recommended to include malaria RDT in routine diagnosis for COVID-19 in malaria-endemic areas to eliminate the misdiagnosis between malaria and COVID-19 and subsequently mistreatment of co-infections. Patients' travel and medical history should also be considered when screening for COVID-19 in low-income malaria-endemic areas were large scale diagnostic tools are limited.

Challenges of achieving malaria elimination in 2030

Malaria control largely depends on the mass distribution of long-lasting insecticide-treated nets (LLINs), seasonal malaria chemoprevention (SMC) and indoor residual spraying of insecticide (IRS) across communities and households. Together with slide-based diagnosis, RDTs, case management delivered through trained health staff and increasing awareness have led to significant success in reducing malaria burden over the years [37]. Understanding the effect of the concentrated campaigns against malaria is vital to inform future control planning during the COVID-19 crisis. Therefore, the WHO stressed that all routine malaria prevention and control activities should not be hampered and be continued to the extent possible as they tackle the COVID-19 pandemic. However, implementing these preventive activities house-to-house was harder due to the current health and economic crisis. It was substantially scaled back owing to a shortage of budget and the requirement of different intervention delivery. For example, a modeling analysis by the WHO predicted a >20% rise in malaria morbidity and >50% mortality in sub-Saharan Africa during the COVID-19 pandemic as a result of 75% reduction in routine malaria control measures including ITN distribution and shortage of anti-malarial drugs [38].

A study suggested that in Nigeria alone, interrupting malaria control management such as delaying LLIN campaigns for 6 months could result in 81,000 additional deaths. Other indirect effects of the COVID-19 pandemic, particularly those that impacted people's lives and well-being, such as increased malnutrition, poverty, and social instability, may further influence malaria burden. Thus, it is debatable whether the WHO strategy, in close alignment with the Roll Back Malaria Partnership's Action and Investment to defeat malaria 2016–2030, can reach their goal of eliminating and eradicating malaria in at least ten countries by 2020 and 35 countries by 2030. Therefore, the WHO released guide-lines for malaria control in areas affected by COVID-19 [39]. The guidelines include the continuation of all the routine malaria control measures while adhering to COVID-19 local personal and physical distancing guidelines established by the authorities. These measures will require an arrangement with all relevant national COVID-19 stakeholders and partners to minimize the risk of substantial additional mortality [39].

Synoptic overview of the main challenges of malaria control amidst COVID-19 pandemic

The COVID-19 epidemic, particularly in Africa, threatened malaria control in numerous ways. First, already-fragile health-system capacity was overwhelmed, this led to a decrease in access to primary care for routine case management and the availability of hospitalisation for severe malaria. Second, delivery of malaria control across the continent relies on a substantial workforce distributed across multiple sectors, including front-line health workers, health-system administrators, and logistics and field personnel orchestrating community-based intervention delivery [2]. Widespread absenteeism due to illness, restrictions on movement, or diversion to the COVID-19 response means that this workforce was critically disrupted. Third, supply chains that allow malaria control commodities such as drugs, bed-nets, rapid diagnostic test kits, and insecticide to be manufactured, procured, and delivered internationally and within Africa was jeopardised by movement restrictions. Fourth, malaria control relies heavily on the decision making of patients and their families, including choosing to leave their homes to seek care for febrile children and receiving ITNs delivered at antenatal clinics or schools. Decisions such as these were affected by additional illness, risk perception, or movement restrictions, all of which jeopardise the provision and use of key malaria interventions [2]. Data from population-

based studies showed that the COVID-19 pandemic negatively impacted the access to, and cost of, health services relevant for HIV, TB, and malaria control on the continent.

Conclusion

The findings from this review provide information about the impact of COVID-19 pandemic on malaria control in Africa. Some of these impacts include the disruption of ongoing malaria programmes such as IRS and distribution of insecticide treated nets, diversion of funds meant for other ongoing disease prevention programmes to focus on COVID-19, under-reporting of malaria cases due to restriction of movement and lockdown. The disruption of the international system affecting the supply of essential medical products, as well as reduced capacity of patients to support direct and indirect medical costs, reduced inclination of patients (including those presenting symptoms overlapping with those of the new pandemic) to seek care at a formal health facility due to COVID-19 related fears, and clinical parallels and potential interactions between COVID-19 and malaria.

Conflict of interest

The authors declared any conflict of interest.

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