



REVIEW ARTICLE

# Pandemic COVID-19 and Endemic Neglected Tropical Diseases: Friends or Foes?

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## Abstract

The COVID-19 pandemic, caused by the SARS-CoV-2, is the most serious global health calamity since the 2<sup>nd</sup> World War. The COVID-19 pandemic threatens public health systems worldwide, both in developed and developing countries. In the present report we discuss various effects of the pandemic on the status of neglected tropical diseases (NTDs). COVID-19 will be a public health issue for an extended period. COVID-19 presented several challenges and opportunities for NTD prevention and control. Significant alterations include impact of the pandemic on preventive/control measures and poverty-related plans, service failures and injury to health workers, delayed treatment of NTDs, health service funding, and worsening poverty in marginalized societies. Additionally, the COVID-19 pandemic necessitated school and university closures on public education and research institutes. Furthermore, the COVID-19 pandemic has also provided opportunities, such as improving health literacy, changing approaches to NTD treatments, restructuring the health system and emergency responses, and enhancing science communication.

**Key words:** neglected tropical diseases, COVID-19 pandemic, post-COVID-19 challenges

## INTRODUCTION

The COVID-19 pandemic is considered the greatest global humanitarian crisis since World War II. While specific therapeutic strategies (i.e., pharmacologic and nutritional regimens) are being discovered and gradually emerging [1,2], COVID-19 is causing widespread socio-economic, psychological, and profound life-long impacts on society. Hence, protective measures are of great importance for preventing illness.

With the global outbreak of COVID-19, diverse quarantine plans have been applied in different countries to mitigate

and prevent the pandemic. Indeed, many individuals and vulnerable populations have been confronted with difficulty in accessing care [3], which may lead to a health crisis. COVID-19 has affected human life worldwide. We believe, however, that COVID-19 presents severe threats and valuable opportunities to global health, particularly neglected tropical diseases (NTDs). As summarized in Fig 1, we have attempted to demonstrate post-COVID-19 challenges and opportunities for NTD-endemic regions worldwide, which has become a major issue after the pandemic.

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Received: June 19 2023

Revised: July 8 2023

Accepted: September 27 2023

Published Online: November 18 2023

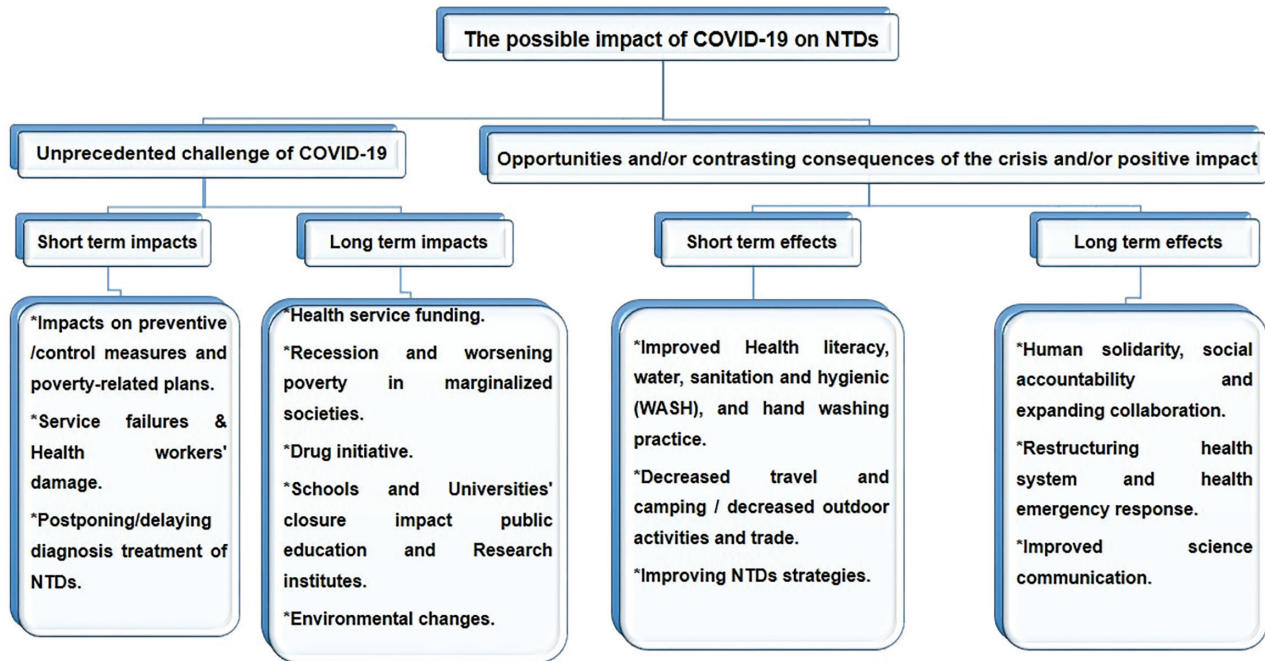


FIGURE 1 | Graphical presentation of the possible post-COVID-19 challenges and opportunities for NTD-endemic regions.

## UNPRECEDENTED CHALLENGE OF COVID-19

### Short term impact

#### ***Impact on preventive /control measures and poverty-related plans***

The principal focus of health systems on COVID-19 will lead to a lack of sufficient attention to patients affected by other diseases and likely lead to a loss of opportunities for several patients with underlying diseases, including NTDs. The pandemic reduced positive healthcare-seeking behaviors due to social distancing, fear, and anxiety about COVID-19 (i.e., socio-psychological impact). Logistical challenges and difficulties in providing safe locations for donning health services unavoidably forced health authorities to dedicate many areas in the hospitals or healthcare systems to COVID patients; however, these decisions provided the coverage necessary for admission of COVID-19 patients. It should be noted that some basic necessary vaccination efforts for children were delayed in 24 countries during the COVID-19 pandemic [4]. Mitigating the challenges of providing sustainable water resources is of great importance for NTDs (soil-transmitted helminths, schistosomiasis, and trachoma). Accessibility of sanitation and hygiene for all by 2030 as an essential part of the Sustainable Development Goals (SDGs-6), especially for marginalized societies and resource-poor communities, can be affected by the crisis [5,6] with severe consequences for the prospect of NTD control.

Functional personal protection equipment (PPE [hand hygiene facilities, prevention supplies, alcohol-based hand rub, and hygienic masks]) may not be available for many communities, especially resource-poor populations. An estimated 4.5 billion people still lack global access to safe

water and safely-managed sanitation. Furthermore, providing basic sanitation is progressing very slowly in 90 countries, representing a lack of universal coverage by 2030 [7].

Poverty alleviation strategies in a competitive manner by intersectoral action in municipalities and local governments affect poverty-associated NTDs. Focusing on the COVID-19 pandemic delayed these activities, thus trapping marginalized societies in endless cycles of poverty and NTDs. Therefore, the international community, global organizations, and governments should steer this global response and manage the continuation of NTD interventions, especially poverty-associated NTDs. The optimal programming of activity resumption and rescheduling of intervention for deprived patients (e.g., NTDs) will be indispensable during the outbreak and in the post-crisis period.

#### ***Service failures & healthcare worker injury***

Occupational risks have been reported for healthcare workers who are at high risk due to increased contact with individuals in health centers, patients, and suspected COVID-19. Therefore, healthcare providers with pre-existing risks (old age and underlying medical conditions) might be replaced by other health personnel who are not at high risk for completing their duties in national health services wherever possible [8]. This process may affect the health care given to non-COVID-19 patients. The COVID-19 pandemic imposed severe psychological effects on healthcare professionals (e.g., women and front-line workers) [9]. In contrast, elective surgeries have had dramatic restrictions significant cancellations of elective

surgical or increased elective surgery waiting times (as much as one-third) during the COVID-19 crisis; however, the rate of elective surgery has increased by one-fifth after quarantine [10,11].

### ***Postponing/delaying diagnosis treatment of NTDs***

It is interesting to note that during this critical period of the global epidemic, the World Health Organization [12] supported vital interventions, such as diagnosis, therapeutic, and care measures for NTD patients presenting to healthcare centers, as well as necessary vector control measures. The WHO suggested postponing mass treatment campaigns, systematic screening for active cases, and community-based surveys for NTDs [13]. A global reduction in the global poverty-related NTDs has been achieved through international activities since 2000, leading to dramatic gains associated with disability from NTDs and vaccine-preventable childhood diseases, as well as relieving NTD-related disability adjusted life years (DALYs) [14,15]. The development of rapid diagnostic tools for COVID-19 is associated with the deprioritization of the development requirement for NTD diagnostics (rapid diagnostic tests [RDTs] and molecular tests) via reduction of funding, human resources, and clinical trials [16].

The entire emphasis of health systems on COVID-19 may cause the re-emergence of NTDs (e.g., ascariasis, cystic echinococcosis and other soil-transmitted helminths, leishmaniasis, dengue fever, American trypanosomiasis, typhoid, and paratyphoid fevers). NTDs are widespread in tropical and subtropical conditions in 149 countries or among the poor in technologically sophisticated nations, affecting greater than one billion people and developing economies yearly [17]. According to the Global Burden of Disease Study in 2016, substantial declines in the global disease burden associated with NTDs have been reported, as demonstrated in DALYs of seven NTDs targeted through integrated mass drug administration (MDA) from 2006–2016. The WHO estimates showed that at least one essential NTD drug has been delivered to approximately 1.024 billion people from the Rapid-Impact Package for NTDs, indicating that 62.3 % of the population requires treatment worldwide [14,18].

Concerns have risen in the Americas, where 30,000–45,000 people (0.3 % of the 300,000 individuals in the United States) have been estimated to be at risk for COVID-19 complications, including Chagas-related cardiomyopathy, because they have heart problems associated with Chagas disease, thus essential care should be available within the healthcare system during the pandemic [19]. There will always be deprived patients and vulnerable populations requiring supportive measures not only for such a pandemic, but also for other diseases during the pandemic, such as NTDs. The optimal programming of activity resumption and rescheduling of intervention for deprived NTD patients will be indispensable during the outbreak and in the post-crisis period. Without appropriate measures, the pandemic can have a devastating impact

on NTDs and the achievements of the previous programs in the long term [16].

Re-planning should be adapted to the new coronavirus-hit regions on planned approaches (diagnosis, interventions, and care measures) and other non-COVID-19 emergencies. Up-to-date, evidence-based guidelines are clearly needed to support healthcare centers during and after the outbreak to manage not only the pandemic, but also to provide health services for deprived NTD patients referred to healthcare centers.

### **Long term impact**

#### ***Health service funding***

It has been projected that the NTD budget will decrease in 2021 due to financial challenges or budget diversion towards control of the COVID-19 pandemic [16]. Issues related to funding the WHO can fully affect all global health programs and therapeutic approaches, not only for disaster management funds, but also for the WHO plans for other diseases, such as NTDs and tickborne diseases (TBDs). It is noteworthy that health emergency responses and developing health strategies during and after a pandemic should be universally coordinated under the support of UN agencies and organizations. The COVID-19 experience demonstrated that countries require special economic revitalization packages due to global recession. A need for a managed economy with a role for government intervention during recessions existed in many countries as a reality against the commodification of healthcare. Development of health system infrastructures (more prominent among hospitals) has historically received more investments than preventive strategies, which has impacted NTD control activities [20]. Aid package allocation for strengthening health systems may reduce global mortality and disability in terms of NTDs and TBDs during the post-crisis period of COVID-19. Financial and administrative support is needed from governments to deal with the crisis in collaboration with decision-makers and key stakeholders [21]. For example, India released \$23 billion for weaker sections affected by COVID-19 [22], and the USA dedicated a \$2.9 million aid package for India [23].

#### ***Recession and worsening poverty in marginalized societies***

Poverty has emerged as the most important structural and social determinant for many NTDs, especially during the global recession, which resulted in economic inequity (e.g., decreased production on livelihoods and food security, and the inability to pay for health services) and catastrophic health problems. Regarding the 10/90 Gap, high-priority tools for neglected infections of poverty are indispensable (e.g., active surveillance and treatment, drugs, diagnosis, and prevention efforts) [24]. Postponements and cancellations of poverty alleviation programs have negative short- and long-term consequences on NTD control programs, especially in marginalized societies. In contrast, loss of labor capability or loss of labor for individuals, and costly

treatment of some NTDs can lead to poverty (e.g., leishmaniasis, lymphatic filariasis, and dengue fever) [25–27].

### **Drug initiative**

The Drugs for Neglected Diseases initiative (DNDi) is involved in improving research and development (R&D) capacity and delivering preclinical candidates for developing therapeutic strategies for malaria, visceral and cutaneous leishmaniasis, filaria, sleeping sickness, hepatitis C, and pediatric HIV/AIDS in a collaborative manner with the WHO/TDR program in developing countries. DNDi is committed to continuing the treatment of individuals participating in clinical studies during the pandemic [28] and the WHO has attempted to provide guidance for resuming NTD activities [29]; however, this drug initiative effort is affected by the new pandemic in most countries as the world has been closely focusing on COVID-19 [30,31].

### **School and university closures impact public education and research institutes**

Approximately 1.3 billion learners were affected due to school closures in response to the pandemic, impacting approximately 98.5% of the world's student population, according to UNICEF [32]. In light of rising concerns during the outbreak, educational institutions postponed campus events, such as research and workshops, while migrating to online courses [33]. This change did not compensate for the postponement of medical research and practical training, especially education and training involving NTDs. Widespread school closures may be disproportionately associated with labor shortages due to child-care obligations, healthcare absenteeism, and reduced support for healthcare system services.

### **Environmental changes**

Part of the United Nations Environment Program is to address global efforts to prevent biodiversity loss, promote economic recovery programs, and prohibit the illegal wildlife trade [34]. Nonetheless, the planned land management scheme is being postponed by the COVID-19 crisis. Many countries are under partial or total lockdown due to the COVID-19 pandemic, affecting mass gatherings and all social and cultural activities. The COVID-19 crisis showed contrasting consequences in the short term, including industrial waste emission, decreased greenhouse gases and tiny suspended particles, reduced use of fossil fuels, recovered ecosystems, and pollution in tourist spots [35] without long-term significance because reduced emissions are unlikely to affect carbon dioxide globally in the long term. Global anthropogenic changes, including progressive deforestations, are associated with compromising some ecologic niches or changing the habitats, the distribution of wildlife and vectors, as well as the proximity of populations with wildlife, bat-borne viral diseases, vector-borne diseases (VBDs), and NTDs, which affect vulnerability and exposure levels.

Furthermore, anthropogenic changes are relatively neglected as a challenge to the future of humanity [36]. Bats are vectors or suspected vectors or reservoirs for many zoonotic infections, including several filoviruses [37] and COVID-19 (e.g., if having a role in the onset of COVID-19). A wide variety of societal inputs (political, structural, social, cultural, and economic) can be linked to infectious disease risks or NTD-associated hazards (vulnerability and exposure levels), [6] as wildlife trade may be associated with the COVID-19 pandemic and China banned the trading and consumption of many wild animals because of potential risks for emerging new infections. Therefore, management of the environment is of great importance for developing appropriate strategies and preventing future outbreaks as the cornerstone of veterinary medicine under a collaborative transdisciplinary “One Health” approach. Veterinary medicine can provide environmental health and sustainable measures for wildlife management (illegal wildlife trade and animal markets) to prevent some of the effects of future pandemics.

## **OPPORTUNITIES AND/OR CONTRASTING CONSEQUENCES OF THE CRISIS AND/OR POSITIVE IMPACT**

### **Short-term effects**

#### ***Improved health literacy, water, sanitation, and hygiene (WASH), and hand-washing practices***

Increased sanitation and hygiene during COVID-19 outbreak played a key role in reducing transmission of COVID-19, and as a result blocking the transmission of several infectious diseases, including trachoma and protozoan pathogens transmitted via the fecal-oral route, e.g., giardiasis and amebiasis, echinococcosis, and soil-transmitted helminthiasis, in the short term.

#### ***Decreased travel and camping, decreased outdoor activities, and trade***

A considerable decline in domestic and international travel and outdoor activities (e.g., outdoor recreational activities and tourism) occurred during the new pandemic. The pandemic dramatically decreased global travel to tropical and subtropical regions (tourist destinations). In contrast, populations at risk of contracting NTDs that rely on outdoor activity (e.g., agricultural farming) may face a decreased risk for NTDs and arthropod-borne diseases.

#### ***Improving NTD strategies***

The COVID-19 pandemic may also reveal opportunities to strengthen specific components of strategies to control NTDs, e.g., increasing passive screening capacity using RDTs [16] and the use of advanced or innovative technology (telemedicine, smartphone apps, remote monitoring, and short message service-based systems) that can be potentially applied for tracking cases and reporting tests or diagnostic findings.

## Long term effects

### ***Human solidarity, social accountability, and expanding collaboration***

The COVID-19 pandemic revealed that our health depends on each other. In many coronavirus hardest-hit countries, a strong level of community solidarity and social accountability has been raised in response to the socio-economic effects of the pandemic and a shift occurred from self-protection to altruism (human solidarity). Societies were involved in providing humanitarian aid, and the increasing morals of the frontline health providers in social media resulted in expanding collaborative actions around the world. The pandemic has united health staff as valued team members for providing health services. This is a step forward for collective efforts against COVID-19, as a lesson learned for considering the prevention and treatment of other infectious diseases, including NTDs, in unified collaborations.

### ***Restructuring the health system and health emergency response***

Among the lessons learned from the COVID-19 pandemic was the insufficient preparedness for infectious epidemics, even in upper-income countries. This finding revealed the need for restructuring health systems and combining efforts across multiple diseases where different aspects should be addressed, including considering transparency, holistic response plans, expert advice, deploying tech-based solutions, launching new schemes (improvement of hospital information system and risk assessment), supporting scientific plans, cutting-edge technology-based strategies (e.g., artificial intelligence and mobile devices for disease screening), optimizing current interventions, and aid packages and integrating other related platforms into the health system. Current strategies can be optimized for preventing multiple diseases by considering prevention and healthcare delivery for improving management of different illnesses, such as NTDs.

Imperative emergency management in a critical situation is of great importance in the healthcare system. In this regard, risk assessment of other diseases (modeling), health transition, advanced technology, or innovative technology linked to medicine (e.g., 5G, artificial intelligence, telemedicine, remote monitoring, and interactive services) can potentially be applied to disease epidemics [38–41]. The COVID-19 pandemic has led to the rapid expansion of the use of telemedicine for urgent care and non-urgent care visits [42]. There are also concrete post-COVID-19 interventions (e.g. revitalizing economies with funds allocated by various major league stakeholders) where NTDs have already been piggybacked. The COVID-19 pandemic has created opportunities for the NTD community through concrete projects, which were launched as a result of the pandemic to leverage some of the current economic development initiatives aimed at improving the global economy and mitigating the pandemic. The funding scheme for strengthening health systems, the integrated surveillance–response, laboratory and

diagnostic capacity, and improving WASH will contribute to development of strong public health capacity and may be directly helpful in NTD control [21,43].

### ***Improved science communication***

The profound significance of health communication has been documented in the COVID-19 pandemic mitigation. This atmosphere could enhance appropriate scientific health communication for controlling NTDs in endemic countries. Neglected disease communication should be implicated to provide updated evidence-based information for the public. Bad science and misinformation are other serious issues that must be considered to decrease the public's panic and prevent “infodemics.” Accountable, socially responsible mass media, and social networks are central to health communication and controlling the dissemination of false information.

## CONCLUSION

In this current review we have tried to discuss what might be affected by the current pandemic regarding NTDs. What is clear is that it is too early to judge what effects COVID-19 may have on the NTDs. Undoubtedly, COVID-19 will be with us for an extended period. The pandemic will have short- and long-term consequences on NTD-endemic societies around the globe. Lack of attention to NTDs can cause an irreparable burden on the vulnerable population in the world. COVID-19 has presented several challenges and opportunities for NTD prevention and control. Key challenges include the impact of the pandemic on preventive/control measures and poverty-related plans, service failures, health worker injuries, postponing/delaying treatment of NTDs, health service funding, recession and worsening poverty in marginalized societies, drug initiatives, the impact of school and university closures on public education and research institutes, and the environment and veterinary medicine. Further, the opportunities or contrasting consequences of the pandemic include health literacy, WASH, and hand-washing practices, decreased travel and camping/outdoor activities, changing approach to NTD treatments, human solidarity, social accountability and expanding collaboration, restructuring health system and health emergency response, and improved science communication. Therefore, a collaborative transdisciplinary “One Health” approach is needed as a milestone across countries and sectors for maintaining continuity of care services, control, and poverty alleviation programs.

## ACKNOWLEDGEMENTS

This study was supported by grants from The National Key Research and Development Program of China (2021YFC2600202) and the Science and Technology Development Planning Project of Jilin Province (20220101294JC and 20220508052RC).

## CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

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