Modelling the Impact of COVID-19 Responses on HIV, TB and Malaria: Imperial College Report

The global focus on COVID-19 could turn the clock back on developing countries’ efforts to stem the spread of HIV/AIDS, tuberculosis (TB), and malaria, resulting in hundreds of thousands of additional deaths globally, according to a recent report from Imperial College London (published 1 May 2020). But these impacts will likely be uneven, depending on the extent and duration of COVID-19 public health measures in different countries. Ensuring the continuing availability of key medicines and equipment will be critical to mitigating outbreaks of HIV, TB and malaria in the near term. Our near region will likely not be impacted as heavily as parts of Africa (given the lower burden of these diseases in the Indo-Pacific), but any spike in these diseases could reverse hard-won gains of the past several decades and significantly slow progress to disease elimination.

HIV, TB, malaria deaths set to rise as world turns attention to COVID-19

On 1 May 2020, public research university Imperial College London published the results of a modelling study into the potential impacts of COVID-19 interventions, particularly lockdowns and social distancing, on HIV, TB, and malaria in low- and middle-income countries (LMICs). The study assessed four COVID-19 intervention scenarios (see Box 1, p.5), outlining how different strategies for combating COVID-19 could have different impacts on these other diseases. But the researchers behind the study also cautioned that their results should be interpreted with caution as, for now, the scenarios depicted were all hypothetical. As with all modelling studies, results should be considered to outline a range of possibilities, not projections. Infectious disease modelling is one of several types of information that can inform decision making in public health.

The paper admits that policymakers will face an extraordinarily difficult task in balancing the obvious urgent imperative of mitigating the spread of COVID-19 with the ongoing threat of HIV, TB and malaria outbreaks. Underscoring this challenge, the paper notes that under worst-case scenarios — where there health systems are placed under extreme strain due to COVID-19 — deaths from HIV, TB and malaria could rise by as much as 10%, 20% and 36% respectively over five years.

Other modelling reports from the WHO, the HIV Modelling Consortium and the Stop TB Partnership examining the impacts of COVID-19 responses on HIV, TB and malaria separately, largely align with the findings of the Imperial College report. Though there are variations in the models used, all suggest an overall trajectory of an increasing number of cases and deaths caused by these diseases as health systems pivot to focus on COVID-19. The WHO estimates that an additional 500,000 people could die from HIV-related illnesses in Sub-Saharan Africa from 2020 to 2021 if access to HIV treatment is disrupted. A similar number could also die from malaria in those countries in the same time period. Likewise, Stop TB Partnership estimates that an additional 1.4 million people across the globe could die from TB, with the number of cases turning the clock on anti-TB efforts back five to eight years.

There has yet to be any similar modelling focusing just on the Indo-Pacific, but the trends from the Imperial College study and others are indicative of the challenges the region will face. The burden of these three diseases is not as heavy in our near region as it is in Africa — which is the focus of many of these studies — but countries in Southeast Asia and the Pacific nonetheless have high rates of TB, including its drug-resistant form. There is also a risk that efforts towards achieving malaria elimination in Asia, to which Australia has a long-standing commitment, could come under threat and suffer reversals.
HIV cases rise under ‘suppression-lift’ strategy, patients struggle to access medication

According to the Imperial College study, HIV-linked cases and deaths in LMICs will rise if access to antiretroviral therapies are disrupted as a result of COVID-19 mitigation efforts. The study projected that the largest number of HIV-related deaths would occur under a 'suppression-lift' scenario, where lockdowns are implemented and health resources diverted to combating COVID-19 over a short two-month period. This would result in greater difficulties for HIV patients in accessing treatment and for new patients seeking initial care. But the impacts of this disruption to health services would likely only be felt in the following year with potential spikes in deaths due to interrupted access to medicine (in the case of existing HIV patients) and new cases not receiving early enough intervention.

A longer term, year-long 'well-managed' suppression effort against COVID-19, meanwhile, would result in less disruption to services and thus reduce the number of additional deaths due to HIV. A 'well managed' suppression effort would include implementing lockdowns and social distancing over a twelve-month period while also carefully ensuring patients' ongoing access to HIV medication, either through managing flows of patients to clinics or implanting other methods for regular distribution such as multi-month dispensing or delivery services. Social distancing measures would also likely reduce the likelihood of at-risk individuals engaging in unprotected sex with new partners.

Still, across all scenarios, there is generally an increase in HIV cases and deaths some time after the COVID-19 pandemic is brought under control, owing to the time lag in some HIV cases progressing beyond treatment. The report highlights that the impact of any disruptions could be felt for decades to come.

Figure 1: Excess deaths per million population due to HIV during 2020 (dark green and dark orange) and 2021-2024 (light green and light orange) under each scenario for the COVID-19 epidemic.

**Sharp rise in malaria cases in 2020 before dropping off in later years**

The Imperial College model suggests that malaria outbreaks are likely in LMICs in the near-term as a result of health services being diverted to stemming the spread of COVID-19. Just as condoms and antiretrovirals are a key part of preventing infections and deaths in HIV sufferers, insecticide-treated bed nets and medicine are critical in preventing malaria infections. Breaks in these services could result in sharp spikes in deaths, owing to malaria's acute nature — death can follow quickly after
infection, rather than the drawn-out suffering of HIV or TB. Such breaks in health services are already taking place in some countries: campaigns to distribute bed nets — which usually require residents to gather at centralised areas, such as hospitals or clinics — are being cancelled due to social distancing measures in response to COVID-19.

The impact of these disruptions will vary depending on whether LMICs are at the beginning or end of malaria transmission seasons. If bed nets and treatment are unavailable as a transmission season kicks off, this will likely result in malaria outbreaks that could quickly claim thousands of lives. But where this equipment and treatment is made available, particularly during a ‘well-managed’ COVID-19 suppression effort or at the beginning of a transmission season, outbreaks could be prevented or brought under control. The Imperial College model predicts a return to declining death rates due to malaria after 2020, but this is based on the model’s underlying assumption that health services will return to normal next year — which is not guaranteed.

Figure 2: Excess deaths per million population due to malaria during 2020 (dark green and dark orange) and 2021–2024 (light green and light orange) under each scenario for the COVID-19 epidemic.

Extended lockdowns most likely to push TB cases up

Disruptions to TB treatment are also expected to result in a larger number of deaths but the main cause of this spike would be the duration of anti-COVID-19 efforts, not their intensity. While lockdowns are in place, existing TB patients may be unable — or unwilling — to access treatment in hospitals and clinics due to social distancing requirements. New cases would also likely go undiagnosed — there could be more such cases as some people have prolonged household exposure to infectious TB. In this way, the modelling predicts that longer lockdown interventions will result in more TB cases and deaths, and a longer period required to bring them back down to pre-COVID-19 levels.

Shorter-term lockdowns — such as in a suppression-lift scenario — would still place extreme pressure on health systems, draw resources away from fighting TB and lead to a spike in cases and deaths. But their shorter timeframe would enable treatment and prevention programs to resume more quickly.

So, while longer (albeit well-managed) COVID-19 interventions would likely result in fewer additional HIV and malaria cases, these kinds of interventions could lead to additional TB cases and deaths over a much longer period.
Figure 3: Excess deaths per million population due to TB during 2020 (dark green and dark orange) and 2021-2024 (light green and light orange), under each scenario for the COVID-19 epidemic.

Access to critical services, medication key to mitigating spike in cases, deaths

The Imperial College report highlights that maintaining critical services will be key to mitigating outbreaks of HIV, TB and malaria and reducing the overall impact of COVID-19 in the near term:

For HIV, this means ensuring persons on ART can continue to access medicine even in periods of highest health system demand (e.g. multi-month scripting, dispensing away from health facilities); for TB this means providing routes for persons to continue to seek care and be diagnosed despite interventions that promote social distancing; and for malaria it means prioritising preventative measures and ensuring [insecticide nets] and prophylactic treatments such as mass drug distribution are conducted at scale as soon as possible.

Other modelling studies also largely echo the recommendations made by Imperial College, emphasising the need to reduce health service disruptions for these diseases as much as possible. The WHO has already issued guidance on tailoring malaria interventions during the COVID-19 pandemic, including adapting insecticide net distribution in accordance with social distancing requirements. Stop TB has also recommended implementing rapid recovery strategies, such as ramping up active case finding and contact tracing, once COVID-19 lockdowns are lifted. Echoing the Imperial College report, the WHO and UNAIDS have also emphasised the importance of ensuring ongoing access to antiretrovirals, including through multi-month dispensing of medication, and maintaining prevention services such as voluntary male circumcision programs.

Unknown unknowns

There are still other factors that could further exacerbate a resurgence of these diseases during the COVID-19 pandemic. First, it is unclear how long the COVID-19 pandemic will last — in some LMICs the effects of the virus thus far have been relatively limited, leading some to suspect that future waves may hit LMICs harder. So, while the models presented in this study focus on a one-year timeframe for combating COVID-19, some countries may face a much more protracted campaign.

Second, the modelling has not taken account of longer-term resourcing issues, which could impact the availability of medicine, equipment and staff. The report notes that while disruptions of supply chains have not yet occurred on a large scale, extended lockdowns could impact international trade routes and drive up the price of medication — there are some early indications that TB drug supplies are already being affected. COVID-19 illness among health service staff could also lead to shortages of
expertise during periods when demand for treatment is high, adding to the burden of hospitals trying to juggle their COVID-19 response with other health priorities.

Third, the HIV, TB and malaria models have not yet taken into account additional strains on the health system from each of these diseases in concert. Thus far, the model has considered the impact of COVID-19 responses on each of these diseases separately, but there may be combined effects. For example, the report highlights initial views — still yet to be supported by clear evidence — that prevalence of TB in a particular LMIC could lead to more COVID-19 cases, due to the former’s impact on patients’ respiratory system. If this kind of scenario comes to pass, this could have a force multiplier effect on cases and deaths caused by COVID-19 as well as HIV, TB and malaria.

Box 1: Model Methodology

The Imperial College London report modelled the potential impacts of COVID-19 mitigation efforts on HIV, malaria and TB based on four broad scenarios:

- **No action**: there is no substantial intervention against COVID-19 (hypothetical only).
- **Mitigation**: interventions reducing the virus' reproduction rate by 45% are used for six months.
- **Suppression-lift**: interventions reducing the virus' reproduction rate by 75% are used for two months.
- **Suppression**: interventions reducing the virus' reproduction rate by 75% are used for one year.
  - Well-managed Suppression: interventions take place for a year but the level of their disruption to health services is the same as a Mitigation or Suppression-lift scenario.
  - Unmanaged Suppression: interventions take place for a year and the level of disruption to health services grows throughout that time.

At the end of each of these timeframes it was assumed that a vaccine or other treatment will be available in order to bring COVID-19 under control and that health services will resume more or less immediately after the pandemic has subsided.

**Figure 4**: The impact of the COVID-19 epidemic under each epidemic scenario in respect of (A) Cumulative deaths due to COVID-19 per million population, and (B) The ratio of the number of COVID-19 patients requiring non-critical care in hospital to the total hospital capacity. In panel (B) the dashed lines indicate the threshold which are used to delineate periods of ‘High’ (50%) and ‘Extremely High’ (100%) Health-System Demand.
To represent the burden on health systems in terms of pre-existing caseloads and capability, Imperial College researchers used Sub-Saharan African and South American countries as case studies:

- High Impact: South Africa (HIV and TB); non-descript West African country (malaria).
- Moderate Impact: Malawi (HIV); Brazil (TB); non-descript East African country (malaria).

The model assumes that the spread of COVID-19 will take place in LMICs as it has in other countries, though it notes that, to date, the spread has been limited in many LMICs.

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i 'The potential impact of health service disruptions on the burden of malaria: a modelling analysis for countries in sub-Saharan Africa' (WHO, 23 April 2020)

ii 'Predicted impact of the COVID-19 pandemic on global tuberculosis deaths in 2020' (WHO, 4 May)

iii 'Potential effects of disruption to HIV programmes in sub-Saharan Africa caused by COVID-19: results from multiple mathematical models' (HIV Modelling Consortium, 11 May 2020)

iv 'The Potential Impact of the COVID-19 Response on Tuberculosis in High-Burden Countries: A Modelling Analysis' (Stop TB Partnership, 1 May)

v 'Tailoring malaria interventions in the COVID-19 response' (WHO, 9 April 2020)