Health services & systems

Impact on HIV, TB and malaria could last several years

Jewell BL et al. Potential effects of disruption to HIV programmes in sub-Saharan Africa caused by COVID-19: results from multiple mathematical models. University College London preprint, May 2020.

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A synthesis of five different studies that model the effect of a three- or six-month interruption of HIV services across sub-Saharan Africa finds that excess deaths due to HIV – in other words those in addition to the usual number of HIV deaths – may be in the order of 550,000. As the current annual HIV-related death toll is around 470,000 (in 25 million people living with HIV in the region), there may therefore be around a million deaths, equating to a 2.2-fold rise in HIV mortality, during the COVID-19 pandemic.

The World Health Organization (WHO) and UNAIDS, which convened the group of modelling experts issued a press release accompanying the modelling synthesis, which warned that people would continue to die from the disruption for at least another five years, with an average annual excess in deaths of 40% over that period.
Dr Tedros Adhanom Ghebreyesus, WHO Director-General, said: “The terrible prospect of half a million more people in Africa dying of AIDS-related illnesses is like stepping back into history”.

Glossary

malaria

mathematical models

voluntary male medical circumcision (VMMC)

mother-to-child transmission (MTCT)

stigma

In addition to the five-model synthesis, in its press release, WHO and UNAIDS refer to a more sophisticated model, developed by Imperial College London, that models the impact COVID-19 itself, HIV, TB and malaria may have in the next year and the next five years. This models what would happen to deaths from all four infections under five different scenarios for the containment of COVID-19.
This finds that disruption to the health services due both to planned reduction in services and unplanned increases in demand could give rise to several million excess deaths due to HIV and TB, in particular, over the next five years – but that doing nothing to contain COVID-19 would involve the deaths of even more people.

The WHO/UNAIDS five-model synthesis

Anecdotally, the COVID-19 lockdown has already been impacting on other health services in different African countries, with 13% of respondents in one South African survey saying they had lost access to regular medication that they needed. A rapid HIV-specific assessment from Zimbabwe found that 19% of people with HIV were unable to get antiretroviral therapy (ART) refills.

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It is important to state that the assumptions that have been fed into the five models that went into the synthesis are very much worst-case scenarios. In particular, they assume a *total* interruption in the supply of ART to all people with HIV for a three- or six-month period. The modellers themselves acknowledge this is unlikely to be what will actually happen.
“Our results are intended to convey where the greatest vulnerabilities are amongst the various services which form part of HIV programmes and should not be taken as a prediction that disruption will be as extensive as this,” they say.

“In reality a disruption to a smaller subset of the population is likely. We did not consider disruptions of services to key populations such as sex workers or men who

have sex with men, but given the levels of stigma these could represent populations who are particularly vulnerable to disruptions."

More news from Sub-Saharan Africa

The five-model synthesis combines findings from five existing mathematical models of the impact of HIV diagnosis, prevention, care and treatment on the HIV epidemic in sub-Saharan Africa. It investigates what happens if a three- or six-month suspension of ART and of other HIV healthcare measures happens due to the COVID-19 epidemic.

The models are the Goals Model developed by Avenir Health for UNAIDS' Fast Track strategy; the Optima Model developed by the Kirby Institute in Australia; a so-called HIV Synthesis model developed by University College London to measure the impact of various HIV interventions, most recently PrEP in South Africa; a model developed by Imperial College London, based on the South African epidemic, most recently to estimate the impact on the HIV epidemic of injectable contraceptives in women; and a model called EMOD developed by the US Institute for Disease Modelling, based initially on the HIV epidemic in South Africa, but that can be used to model any infectious disease.
The details of the individual models do not matter so much in this particular case, as they came to broadly similar findings. Two – HIV Synthesis and EMOD – are 'individual stochastic' models that apply differing inputs to a group of virtual 'individuals' in a computer programme and see how an epidemic affects them over time. The other three are population-level models that predict what happens to large groups of people. They did not all incorporate the same factors in their models; for instance, only one, the HIV Synthesis model, includes the possible impact of transmitted drug resistance, while the Imperial College model does not include the impact of changes in the prevention of mother-to-child transmission.

The upshot of the projected disruption of services due to COVID-19 is that nearly all of the impact on HIV mortality and on new HIV cases (incidence) is due to the projected interruption of ART, rather than the interruption of other services.

For instance, the impact of just a three-month interruption of the supply of ART to every person diagnosed with HIV in the 13 countries studied – mainly in the countries stretching from Kenya to South Africa in eastern and southern Africa, though also including Nigeria, Cameroon and Côte d'Ivoire in west Africa – was a rise in annual mortality during 2021 ranging from 35% (in the Optima model) to 131% (in the EMOD model).

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A six-month interruption produced much more serious increases in the 2021 death rate ranging from a near-doubling of the death rate (87% increase) in the Optima model to a near-tripling (180% increase) in the HIV Synthesis model.

Rises in the rate of *new* HIV infections in 2021 (annual incidence) were more modest in three models – 10%, 11% and 17% in the Goals, Optima and Imperial models for a three-month ART interruption. The EMOD model produced a much larger incidence rise of 172%; this outlier appears to be driven by an input that an interruption in the ART supply would increase the HIV risk of each individual sex act by 54%, due to people developing detectable viral loads.
The models also predict smaller contributions to HIV mortality due to other factors. For instance, two predict that suspending programmes to prevent mother-to-child transmission for six months would raise HIV mortality by 10-12% and incidence by a similar amount. An additional 7% or 16% of deaths would be added not due to a lack of ART, but due to opportunistic infections and illnesses not being treated by health systems overstretched by COVID-19.

A six-month interruption in the condom supply is projected to lead to incidence increases of 10% to 28% in different models. The disruption of other services, such as voluntary male medical circumcision and HIV testing, had a much lesser impact on incidence.

The main reason for the increased mortality remains lack of treatment, and this means that excess deaths vary widely from country to country.

Countries that have relatively low prevalence and/or a relatively low proportion of people with HIV on ART have less to lose, in terms of the lives they have managed to preserve due to HIV treatment in the last few years. Even somewhere like Nigeria, however, would see death rates, on average, double in the next year if ART were to be interrupted for six months, with its 2019 death toll of 53,000 increasing by anything from 50% to 128%, according to the model used.

But a country like Botswana, which due to its smaller population and wide ART coverage despite high prevalence, had only 4800 HIV deaths last year, would see them increase by anything from 6100 (a 127% increase) to 19,350 (a 400% or nearly fivefold increase).

The HIV, TB and malaria model: COVID-19 impact could last five years

A more sophisticated model, which also covers the impact on TB and malaria, has also been issued by Imperial College London. This measures the impact of five different COVID-19 containment scenarios on HIV, TB and malaria services and deaths. It measures both deaths that are due directly to the services being withdrawn or reduced, such as starting people on ART or PrEP, and those that are due to the health system being overwhelmed by COVID-19, such as a proportion of people stopping ART.

Unlike the five models in the WHO/UNAIDS synthesis, this does not assume the complete stopping of any of these vital services, but rather reductions, such as new or existing ART being reduced by 25% or 50%, and supposes that as a result between 2% and 10% of people with HIV per month become virally unsuppressed.

It then assumes five different scenarios for the way COVID-19 is handled in the region:

- **No action**, other than a voluntary reduction in social contact. This, it is assumed, would cut the R_0 or reproduction number of COVID-19 (the average number of people each person goes on to infect) by 20%.
- **Mitigation** for six months, which includes moderate social distancing and some restrictions on travel and working and would reduce the R_0 by 45%.
- **Suppression then lift**, which supposes two months of complete lockdown but then a return to 'no action'. This would reduce the R_0 by 75% for those two months but only 20% thereafter.
- **Well-managed suppression**, which supposes indefinite lockdown (till a COVID-19 vaccine or effective treatment is found) and a reduction in R_0 by 75%, but no unmanageable increase in demand on health services.
- **Unmanaged suppression**, which also supposes indefinite lockdown and the same 75% reduction in R_0, but periods of extreme demand on the health system so that 50% or even 100% of all available resources are diverted to COVID-19.
  In the 'no action', 'mitigation' or 'suppression then lift' scenarios, it is notable that although HIV, TB and malaria deaths would increase, the number of COVID-19 deaths would be greater.

Deaths in 2020 due to HIV for the first three scenarios would be 161, 21 and 45 deaths per million population in a high-burden country such as South Africa, with approximately half the death rate in a moderate-burden country such as Malawi. But they would be exceeded by COVID-19 death rates of around 6000, 4400 and 6000 per

million. As there are just over one billion people in sub-Saharan Africa, the latter figures imply over four to over six million COVID-19 deaths in the region as a whole.

In the last two 'suppression' scenarios, however, COVID-19 deaths in 2020 would be considerably reduced – to fewer than deaths due to HIV, due to greatly reduced transmission – but there would still be an increase in HIV deaths in high-burden countries, of 11 and 42 deaths per million population, in the ‘well managed’ and ‘unmanaged’ scenarios respectively.

At its peak, HIV mortality would increase by 50-80% (depending on the country) in the no-action and suppression-then-lift scenarios; with a 30-40% increase in the unmanaged suppression scenario; a 16-20% increase in the mitigation scenario; and a 7% increase in the managed suppression scenario. However, the duration, as well as the magnitude, of peaks would vary.

However, in HIV and TB especially, the price of managing COVID-19 would largely come later, as deaths due to reductions in treatment and prevention, which would not have happened without COVID-19, accumulate in the following five years. During the years 2020-2024, estimated extra HIV deaths (on top of those already expected) would be as follows in high-burden countries, under the five different scenarios:

- No action: 596 per million.
- Mitigation: 160 per million.
- Suppression then lift: 612 per million.
- Well-managed suppression: 69 per million.
- Unmanaged suppression: 421 per million.

Note that the worst strategy of all is a brief period of lockdown, because all this does is to delay the impact of peak COVID-19 infection to a later time period where both global prevalence and the impact on health services are already worse. Note also, however, that even in the worst-case scenarios, the total number of excess HIV deaths due to COVID-19 is nowhere near the millions who would die of COVID-19 in any but the two suppression scenarios.

"Even in the worst-case scenario, deaths from HIV, TB and malaria would not total more than 60% of the deaths due to COVID-19 in the first three scenarios."

The impact on TB is similar to that on HIV in terms of extra deaths, but skewed even more towards the following years as deaths accumulate due to untreated TB and onward transmission. There would actually be more TB deaths if COVID-19 was suppressed

rather than if nothing was done, due to declines in services. Approximate extra deaths in the ‘mitigation’, ‘well-managed suppression’ and ‘unmanaged suppression’ scenarios would, in the 2020-2024 period, be 362, 784 and 987 per million respectively in high-burden countries.

The opposite is the case with malaria; here the impact is rather less predictable as malaria is a seasonal illness, and it depends whether COVID's impact on health services happens during the high season or the low season. More deaths are due to reductions in prevention measures such as the distribution of bed nets than reductions in treatment.

This means most extra deaths – in the order of 2000 per million in all scenarios except ‘well-managed suppression’ – would be concentrated during the peak of a COVID-19 epidemic if resources such as bed nets and combination prevention for malaria were unavailable. In fact malaria deaths would be lower during the next few years, because many children aged 0-5, who are by far the most vulnerable group, would already have died, except in the 'well-managed suppression' scenario, which would see no extra deaths during the peak of the COVID-19 epidemic, but a slight rise in infections in the following three years.

It is difficult to add up the impact of the extra deaths from the three diseases as they overlap, especially in the cases of HIV and TB. However, even in a worst-case imaginary scenario where there is no overlap between the three diseases and in a country which has the maximum existing death toll in the region for all three diseases, the deaths would not total more than 60% of the deaths due to COVID-19 in the first three scenarios.

The lesson of these models taken together would appear to be then, that preventing as many cases of COVID-19 as possible would save more lives than failing to prevent it; but that if services for HIV, TB and malaria can be preserved, millions of extra deaths due to these diseases over the next five years can also be averted.