Malaria, HIV, and TB in Uganda: epidemiology, disease control, and interventions

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Question

What is the evidence on epidemiology (including demographic and geographic inequalities) and disease control challenges of malaria, HIV and TB; and on the effectiveness of interventions aimed at preventing, detecting and treating these diseases in Uganda?

Contents

1. Summary

There was a wealth of information on Malaria, tuberculosis (TB), and HIV in Uganda which was not possible to cover entirely within the scope of this review. This report includes the latest data from the World Health Observatory and draws on research published since 2016 identified in the top results of a rapid keyword search.

Malaria

Epidemiology:

- 26 percent of the population have malaria
- 8,600,724 estimated cases
- 14,390 estimated deaths

Uganda accounts for 5 percent of the global burden of malaria. Incidence peaks during June and July and is lowest in February-March. Rates are highest in Acholi region and lowest in Kegezi region. Other regions recording higher incidence rates are West Nile, Karamoja, East Central - Busoga, and Teso. Prevalence is higher in rural areas.

Risk factors identified include lower socioeconomic status, lower education levels, house construction variables, and an occupation in farming. Within children between 0-59 months prevalence increases with age.

Mass Action Against Malaria was launched in 2018 by the president of Uganda. It aims to re-orient values towards malaria, increase commitment to accountability, support scaling up of interventions, and communicate a sense of urgency around the situation.

Intervention evidence on prevention in Uganda:

- Indoor residual spraying and insecticide treated nets are found to be effective in reducing risk (Ssempiira et al., 2017; Kigozi et al., 2020b; Roberts & Matthews, 2016; Tukei et al., 2017; Maziarz et al., 2017; Rek et al. 2020).
- Health system readiness affects malaria outcomes (Ssempiira et al., 2018a).
- One study suggests strengthening environmental factors for prevention (Musoke et al., 2018). This includes managing breeding grounds for mosquitos and improving structural housing conditions.

Barriers to the use of ITNs include heat and low-perceived risk. Resistance to insecticides is also a growing concern.

Evidence on treatment interventions:

- Management with artemisinin-based combination therapy (ACT) and vector control are found to be effective (Ssempiira et al., 2018b).
- A study finds a combination of IRS and chemoprevention administered promptly to be highly effective.

TB

Epidemiology:

- Incidence is 196 per 100,000 population per year
- 16 per 100,000 HIV-negative people die per year of TB
- There are 90,000 incident TB cases.

There is an upward trend in case numbers of TB. The Karamoja region has the highest national incidence. There is low drug resistance in this area.

Treatment coverage nationally was 68 percent in 2020. And overall effective treatment coverage 46.8 percent. There is a 78 percent success rate in treating patients for multi-drug resistant TB (MDR-TB).

Risk factors for mortality include co-infection with HIV, non-adherence to treatment, and low education (Kizito et al. 2021). Challenges to treating TB include poor treatment adherence and delayed treatment (Okethwangu et al., 2019; Hassard et al., 2017). Directly observed treatment strategies to improve adherence are recommended.

The Uganda National TB and Leprosy Programme (NTLP) under the government department of National Disease Control is responsible for planning. The management structure functions at national, regional and district levels. The NTLP sets out standards and operational guidelines, conducts training, manages drug procurement and distribution, supervises technical support, coordinates partners and activities, and communicates advocacy. It is also responsible for monitoring and evaluation. A national guidelines for Tuberculosis Infection Control in Health Care Facilities, Congregate Settings and Households outlines control measures, healthcare management roles, and protective equipment needs. It advises on how to control in congregative settings; and how to reduce transmission in households.

Increased access to treatment services is required along with quality of service improvements. Health facilities are found to lack rapid TB diagnosis testing, have long testing turnaround times, and have limited services for MDR-TB (Oyediran et al., 2020). Gaps in knowledge among patients has also been identified.

Data on treatment outcomes is limited. The use of data is found to be important for facilities in Uganda to make decisions, for design, continuous quality improvement, capacity building, and prioritisation of better people management (Izudi et al., 2019).

Interventions to improve case identification so that treatment is delivered sooner involve targeting, systems strengthening, systematic screening amongst vulnerable groups, and improved adherence to guidelines. Outcomes from digital interventions to improve adherence were mixed.

HIV

Epidemiology:

- Prevalence of HIV among adults aged 15 to 49 is 5.4%.

- The trend in prevalence is steadily reducing from 8.1% in 2000.
- An estimated 1.4 million people in Uganda are living with HIV.
- There are 1.4 new infections per 1,000 uninfected population per year.
- There were 22,000 deaths due to HIV in the year of latest available data.

HIV is higher among urban residents. It is highest in the Central, South-West, and Mid-North regions of the country. Prevalence is known to be much higher in the fishing community. Women are more likely to be living with HIV than men. A study found 33 percent of sex workers to be carrying the virus (Hladik et al., 2017).

Other risk factors:

- Socioeconomic status
- Education
- Alcohol use (leading to risky sexual behaviour)
- Migrants are higher risk than non-migrants

An estimated 90 percent of people living with HIV are receiving antiretrovirals (ARVs). There are 3,365 health facilities across the country which provide testing and counselling. Less than half of males and females have comprehensive correct knowledge about the virus.

Government planning to accelerate the prevention of HIV aims to shift from emergency vertical programming to epidemic control and long-term development programming (Uganda AIDS Commission, 2018). There is also a planned shift from centralised programming to decentralised local responses. To address vulnerability, risks, exposure and to improve mitigation the plan outlines a shift from intervention-specific programming to systems approaches. The plan will be implemented using a multisectoral response with a wide range of stakeholders.

Intervention evidence:

- Combination interventions of ART and male circumcision are found to be successful in a number of studies (Grabowski et al, 2017; Kagaayi et al., 2019).
- One study suggests removing CD4 count thresholds for ART initiation (McCreesh et al., 2017).
- Home-based testing uncovered more cases than testing at community mobilisation events in one study (Bogart et al., 2016).
- Distribution of testing kits through peer distribution had promising uptake in fishing communities (Choko et al., 2018).
- Challenges to integrated care include lack of staff, gaps in knowledge of service providers, limited space, and shortage of critical supplies.
- A study finds women with disabilities were less likely to receive HIV testing and counselling services (Zandam et al., 2022). Of a sample of 10,073 women between 15 and 49 who had a live birth in the past 5 years, 68.2 percent of women without disabilities received a test result compared to 61.4 percent of women with disabilities.

- Greater efforts are needed to ensure that people living with disabilities have equal access to testing and counselling (Zandam et al., 2022); and need to be included in education outreach (Schenk et al., 2017).

It is challenging to improve treatment adherence and testing in fishing communities as they are highly mobile and have transport issues (Musumari et al., 2021; Kuteesa et al., 2019). Stigma reduction and social support are important in these communities and required clinic visits should be reduced if possible (Sileo et al., 2019b).

Co-infection

30 percent of HIV deaths are caused by TB (Uganda AIDS Commission, 2017). There are 65 cases of TB in 100,000 HIV cases. Highest numbers of this co-infection are found around Lake Victoria and in northern Uganda.

One study found 27 percent of HIV patients co-infected with malaria. Malaria was more prevalent in patients not using ART. Risk of co-infection is reduced with malaria prevention methods (nets and spraying), use of cotrimoxazole prophylaxis, and education on the risk of HIV-malaria interaction.

The government have published a strategic plan to reduce barriers to HIV, TB and malaria services.

2. Malaria

Incidence

Latest from the Global Health observatory:[1]

- Incidence of malaria (per 1,000 population at risk): 262.7
- Estimated number of Malaria cases: 8,600,724
- Estimated number of Malaria deaths: 14,390
- Malaria – number of reported confirmed cases in a year – 11,667,831

Uganda accounts for five percent of the global burden of Malaria and is the third highest in the world in terms of number of cases (WHO, 2020). It has the eighth highest levels of death. Trends show a decrease in cases and deaths between 2016 and 2019 of 7.2 and 9.5 percent respectively.

Geographical and environmental

A study looking at spatial-temporal patterns of malaria incidence between 2015 and 2019 using data from 3446 health facilities finds strong seasonality (Kigozi et al., 2020a). The highest peaks were experienced June-July and the lowest February-March. Mean monthly regional incidence rates were highest in Acholi region (Northern) and lowest in Kegezi region (South-western). Other regions recording higher incidence rates are West Nile, Karamoja, East Central - Busoga, and Teso. High burden and risk districts were identified within these regions - Lamwo of Acholi,

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[1] https://www.who.int/data/gho/data/indicators/indicators-index accessed 4.2.22. Data from between 2017 and 2020.

Moyo of West Nile, Kaabong of Karamoja, Namayingo of East Central - Busoga, and Katakwi of Teso region.

Maps of district-level malaria risk can be found in an epidemiological profile produced by the National Malaria Control Programme, KEMRI-Wellcome Research Trust and LSHTM (2018).[2] The profile also includes geospatially-represented long-lasting insecticidal nets (LLIN) and indoor residual spraying (IRS) coverage maps.

Malaria is higher in rural areas (Ssempiira et al., 2017). Land cover of crops, followed by forest, leads to higher prevalence than other land cover types.

A study comparing rates of paediatric (age 0-14) malaria hospitalisation found variance of malaria parasite exposure levels at five different sites: Jinja, Mubende, Kabale, Tororo, and Apac (Mpimbaza et al., 2020). There was a correlation between incidence rate and *Plasmodium falciparum*[3] prevalence in school children although findings were not statistically significant. All sites except Kabale had a concentration of under 5 years admitted to hospital (74 percent). Case numbers were highest in Apac followed by Jinja, Tororo, and Mubende. Cases in Kabale were very low.

Risk factors

- Prevalence increases with age between 0 and 59 months (Ssempiira et al., 2017; Roberts & Matthews, 2016; Wanzira et al., 2017).
- Socioeconomic status, low income, low wealth, and food insecurity correlate with higher rates of infection (Ssempiira et al., 2017; Degarege et al, 2019; Tusting et al., 2016; Maziarz et al., 2017).
- Lower prevalence is found with higher education levels of parents (Ssempiira et al., 2017; Degarege et al, 2019; Tusting et al., 2016).
- House construction variables such as main floor material, main wall material and availability of electricity are found to correlate with malaria prevalence (Degarege et al, 2019; Roberts & Matthews, 2016; Musoke et al., 2018).
- A study of 4,930 children using 2014 Malaria Indicator Survey data found increasing malaria parasite prevalence with increasing severity of anaemia (Wanzira et al., 2017).

Having an occupation in farming increases malaria risk (Degarege et al, 2019).

Gender was not found to be a factor in a study in northern Uganda (Maziarz et al., 2017).

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[2] https://web-archive.lshtm.ac.uk/www.linkmalaria.org/sites/link/files/content/country/profiles/Malaria%20LINK%20profile%20Uganda-final-4-9.pdf

[3] Estimated to cause 98%

Mass Action Against Malaria Intervention

Mass Action Against Malaria was launched in April 2018 by the president (WHO, 2020). It is targeted widely at high-level state leadership, parliamentarians, government civil servants, religious and cultural leaders, media personnel, private sector, district health teams, health facilities, schoolteachers, community leaders, and households and the public at large.

It aims to:

- re-orient values towards malaria prevention as a public health action to save lives
- increase commitment to accountability for the fight against malaria
- support the scaling up of interventions against malaria
- create a sense of urgency around the situation

There has been widespread dissemination and development of a handbook (WHO, 2019). It supported incorporation of malaria in the National Development Plan and the Health Sector Development Plan (WHO, 2020). It achieved establishment of the Uganda Parliamentary Forum for Malaria (UPFM). District task forces have been established for operational intervention and information dissemination. Sustained funding is needed to ensure high impact. Accountability at national level requires capacity building.

Intervention evidence

Prevention - bed nets and residual spraying

Rek et al. (2020) found non-adherence to use of long-lasting insecticide-treated bed net (LLIN) strongly associated with increased odds of getting malaria. Barriers to use included heat and low-perceived risk of malaria. Children exposed to fewer mosquitos were less likely to use LLINs. Behaviour change strategies are recommended to ensure consistent use even when transmission risk has been reduced.

A study analysed national data from 2014-15 to assess intervention effects on the distribution of malaria prevalence in children under 5 in Uganda (Ssempiira et al., 2017). Indoor Residual Spraying (IRS) and Insecticide Treated Nets (ITN) ownership were found to have significant protective effect on malaria prevalence although effects varied. "The varying effects of the interventions calls for selective implementation of control tools suitable to regional ecological settings" (p2). No effect was observed for Artemisinin Combination-based Therapies (ACTs).

A study using outpatient surveillance data from four health facilities in Uganda estimated the impact of control interventions on the age distribution of malaria over a 10-year period (Kigozi et al., 2020b). All sites distributed LLINs on a large scale and two sites incorporated indoor residual spraying of insecticide (IRS). In all sites the proportion of malaria cases in under 5's decreased significantly.

Factors related to risk of malaria in a study of 4,939 children found IRS to significantly reduce a child's risk (Roberts & Matthews, 2016). A large study in northern Uganda found a decreasing trend in malaria morbidity following IRS (Tukei et al., 2017). Malaria prevalence was found to be

lower where IRS was being used in Burkitt lymphoma-endemic areas of northern Uganda (Maziarz et al., 2017).

With success shown in LLIN and IRS use in a study of Walukuba, Kihihi and Nagongera authors suggest prioritising interventions targeting outdoor biting (Mawejje et al., 2021).

A study of prevention practice in a rural community in Wakiso district suggests that it is not necessary to increase coverage of ITNs and IRS but rather to support and strengthen with environmental management (breeding grounds for mosquitos) and improving structural housing conditions (Musoke et al., 2018).

Resistance to insecticides is a growing concern (National Malaria Control Programme, KEMRI-Wellcome Research Trust and LSHTM, 2018).

Management

A study on health system readiness found an association between severe malaria outcomes (Ssempiira et al., 2018a). Management with artemisinin-based combination therapy (ACT) and vector control interventions were found to be effective in a study using District Health Information from 2013 to 2016 (Ssempiira et al., 2018b).

A pooled analysis of measures in the high-transmission area of Tororo showed that a combination of IRS and chemoprevention, and prompt effective treatment of symptomatic malaria to be highly effective (Kamya et al, 2020).

3. Tuberculosis (TB)

Incidence

Latest from the Global Health observatory:[4]

- Incidence of tuberculosis (per 100 000 population per year) – 196
- Deaths due to tuberculosis among HIV-negative people (per 100 000 population) – 16
- Number of deaths due to tuberculosis, excluding HIV – 7,400
- Number of incident tuberculosis cases – 90,000
- Number of incident tuberculosis cases in children aged 0 -14 – 12,000
- Number of incident tuberculosis cases, (HIV-positive cases) – 30,000
- Confirmed cases of RR-/MDR/-TB – 470
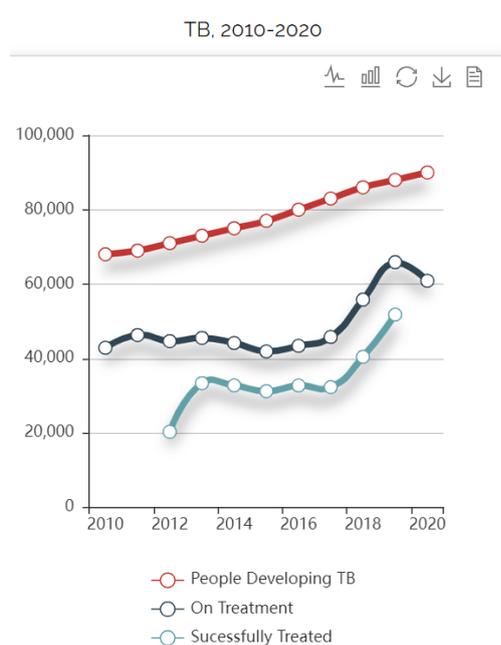- New cases tested for RR-/MDR-TB (%) – 63

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[4] https://www.who.int/data/gho/data/indicators/indicators-index accessed 4.2.22. Most data from 2020. Some from 2017.

Uganda is one of the 30 countries with the highest burden of TB (Oyediran et al., 2020).

Figure1 shows an upward trend in numbers of people developing TB.

Figure 1: TB trends in Uganda

Source: https://www.stoptb.org/static_pages/UGA_Dashboard.html. Original source WHO, 2021. Reproduced with permission from WHO.

Regional

Karamoja has the highest national TB incidence but low drug resistant TB (DRTB) prevalence (Simbwa et al., 2021). Previous treatment and drug stockouts were associated with the DRTB that was identified. Regular supply of anti TB medications and health education is recommended to stem the burden of TB amongst this nomadic population.

TB treatment data

Latest from the Global Health observatory:[5]

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[5] https://www.who.int/data/gho/data/indicators/indicators-index accessed 4.2.22. Data from between 2017 and 2020.

- Tuberculosis treatment coverage (%) – 68
- Tuberculosis effective treatment coverage (%) – 46.8
- Cases started on MDR-TB treatment – 456
- HIV-positive TB patients on ART (antiretroviral therapy) (%) – 97
- Treatment success rate for patients treated for MDR-TB (%) – 78
- Treatment success rate: HIV-positive TB cases (%) – 81
- Treatment success rate: new TB cases (%) – 82
- Treatment success rate: previously treated TB cases (%) – 74
- Treatment success rate: XDR-TB cases (%) – 44

TB barriers to prevention and treatment

Risk factors for mortality among patients with MDR-TB identified in a study in Uganda include co-infection with HIV, non-adherence to treatment, and having no education (Kizito et al. 2021).

A Multidrug-resistant tuberculosis outbreak in the Arua District was associated with poor treatment adherence and delayed treatment (Okethwangu et al., 2019). The study authors recommend strengthening directly-observed treatment strategies. There was also a need to increase access to treatment services including increasing the number of beds in the MDR-TB ward.

A study of 201 patients in Kampala looked at treatment adherence issues (Hassard et al., 2017). 26% were found to be non-adherent. Patients' perception of 'not needing a treatment observer' and perception that 'TB patients being rejected' were associated with non-adherence.

National programme and guidelines

The Uganda National TB and Leprosy Programme (NTLP) is a program under the department of the National Disease Control in the Ministry of Health.[6] The unit is responsible for planning; setting out standards and operational guidelines; conducting training; managing drug procurement and distribution; supervising technical support; coordinating partners and activities; communicating advocacy; and monitoring and evaluation. The management structure functions at national, regional and district levels. TB services are integrated in the general health care system. The overall approach to TB control in the country is aligned to the Stop TB Partnership and the Global Plan to Stop TB.

A National Guidelines is available for Tuberculosis Infection Control in Health Care Facilities, Congregate Settings and Households (The Republic of Uganda Ministry of Health, 2017). It outlines control measures (administrative and environmental), healthcare facility management roles, personal protective equipment, how to control in congregative settings; and how to reduce transmission in households.

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[6] https://www.health.go.ug/programs/tb-leprosy-control-program/ accessed 14.2.22

TB services

A quality of services assessment looked at health facility structure, service delivery process, and service delivery outcomes across 2,016 facilities (Oyediran et al., 2020). Performance was good on the availability of drugs/medicines, HIV services, pediatric TB screening and treatment services, and provider training and behaviours. Gaps highlighted were unavailability of rapid TB diagnosis testing, long testing turnaround times, and limited services for DR-TB. There are also gaps in knowledge and understanding of TB among patients, health-seeking behaviour of symptomatic patients, supportive services for TB patients on treatment, and data on treatment outcomes. Stigma and discrimination are also found.

Interviews with health services in Uganda found that treatment success was associated with facilities using data to make decisions and for design, continuous quality improvement, capacity building, and prioritisation of better people management (Izudi et al., 2019).

A qualitative study identified inadequate knowledge of basic standards of TB diagnosis, treatment, and control among health workers in the districts of Mukono and Wakiso in Uganda (Buregyeya et al., 2016). Improved training is strongly recommended.

To mitigate MDR-TB mortality, research recommends increased provision of social support, particularly for the elderly (Kizito et al. 2021). As well as supporting treatment adherence and early detection.

TB intervention

A study explored patient perception of a digital adherence intervention which used mobile phones to monitor medication and send reminders in the Mbarara region (Musiimenta et al., 2019). Participants thought the intervention would be useful but there was some concern about whether they would see SMS messages on time. A study of a low-cost digital adherence technology called 99DOTS was found to be ineffective in improving treatment outcomes in a stepped-wedge cluster-randomized trial in 18 facilities across Uganda (Cattamanchi et al., 2021).

A trial using a mobile health intervention for contact investigation was found to be more direct and efficient but was complex and lacked adaptability (Meyer et al., 2020). There was also loss of trust among end users and lack of effective feedback systems.

Surveillance

Interventions to improve case identification help to prevent issues of undiagnosed prevalence and help patients get treatment sooner. An intervention was assessed in Northern Uganda which combined quality improvement with facility-led active case finding (Karamagi et al. 2018). The intervention involved targeting, systems strengthening, systematic screening amongst vulnerable groups, and improved adherence to guidelines.

Surveillance and treatment success was found to be low in a review of ten clinics in eastern Uganda (Izudi et al., 2020). The authors urge that TB programmes should strengthen MDR/RR-TB surveillance and especially target those with treatment failure.

A number of papers reference data from the Uganda National Tuberculosis Reference Laboratory (NTRL).[7] It received accreditation from the WHO in 2013. It provides data quality control, technical assistance, training and diagnostic services.

Diagnosis of TB among adolescents is challenging as they do not disclose health information (Muttamba et al., 2021). Adolescent's awareness of TB and associated risk factors was relatively high. Health workers have a misconception that adolescents are at low risk.

4. HIV

Incidence

Latest from the Global Health observatory:[8]

- Prevalence of HIV among adults aged 15 to 49 – 5.4%.
- Prevalence trend: 6.3% in 2015; 6.8% in 2010; 7.1 % in 2005; and 8.1% 2000.
- Estimated number of people (all ages) living with HIV – 1,400,000
- New HIV infections (per 1,000 uninfected population) – 1.24
- Number of new HIV infections – 48,000 (in 2019)
- Number of deaths due to HIV/AIDS – 22,000

Regional

HIV is higher among urban residents (7.1%) than rural residents (5.5%) (Uganda AIDS Commission, 2018). Prevalence is highest in the Central, South-West, and Mid-North regions of the country. It is lowest in the West Nile, and North-east regions.

An assessment in the Kasensero fishing community in the Rakai district in south-western Uganda found HIV prevalence of 25.1% (Mafigiri et al., 2017). In neighbouring communities prevalence was 11% in Gwanda, and 3.9% in Kyebe. Prevalence was higher in landing site communities. Another study of ten fishing communities around Lake Victoria measured prevalence among 13–24-year-olds finding 10.8% of the 630 participants to be positive (Nanyonjo et al., 2020). Kamali et al. (2016) found those in fishing communities to have 6.04 per 100 person years at risk compared to 0.56 person years at risk for the general population cohort.

Gender

Gender disaggregated data in the Kasensero study found markedly higher prevalence in women, 26%, compared to 12% in men. The Nanjojo et al. (2020) study found females to be 3.5% more likely to be infected as men.

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[7] https://ntrl.or.ug/who-we-are/ accessed 28.2.22

[8] https://www.who.int/data/gho/data/indicators/indicators-index accessed 4.2.22. Data from between 2017 and 2020.

Sex workers

In a sample of 942 female sex workers in Kampala, 33 percent were found to have HIV (Hladik et al., 2017).

Risk factors

- A study found higher socio-economic status (SES) correlated with lower incidence of HIV in a sample of 8,622 individuals in rural Uganda found (Santelli et al., 2021). The gap between incidence in higher and lower SES has widened over time.
- Education were factors in communities around Lake Victoria (Nanjojo et al., 2020)
- Alcohol use is associated with risky sexual behaviour and higher risk of contracting HIV (Kiene et al., 2019a). It is also an issue for ARV adherence (Sileo et al., 2019a)
- Higher incidence in women and in fishing communities as described above.
- Migrants were found to have higher prevalence than non-migrants in a study in the Rakai District (Olawore et al., 2018). The high-risk period is within the first two years of migration.
- Infection among female sex workers has been associated with low levels of schooling, having no other work, never having tested for HIV, self-reported genital ulcers or sores, and testing positive for another sexually transmitted infections (Hladik et al., 2017).

Treatment data

ARV:

- Estimated antiretroviral therapy coverage among people living with HIV (%) – 90
- Estimated number of pregnant women living with HIV needing antiretrovirals for preventing mother-to-child transmission based on WHO methods – 90,941
- Number of pregnant women living with HIV who received antiretrovirals for preventing mother-to-child transmission – 90,941

Testing, counselling, knowledge:

- HIV testing and counselling facilities – 3365 (number of health facilities which provide testing and counselling)
- Reported number of tests performed where results were received by a person – 8,445,382 (2018)
- Population aged 15-24 years with comprehensive correct knowledge of HIV/AIDS (%) – (2007-2013) 40 male and 38 female

Government plan

The government published a road map in November 2018 for the acceleration of HIV prevention in Uganda aiming at zero new infections (Uganda AIDS Commission, 2018). It outlines three strategic shifts.

1) Shift from emergency vertical programming to epidemic control and long-term development programming. This is set to be achieved by attaining critical coverage of the current HIV prevention interventions. The bottleneck is diagnosing the estimated 312,000 individuals who do not know they have the disease. They also plan to select critical interventions to move to epidemic control. These include finding HIV positive people not yet tested and getting them treated and retained in care, focusing on hard to reach and at-risk populations, expanding proven prevention programmes, increasing programme impact, and increasing efficiency and effectiveness. They also plan to consciously implement a full dose of combination HIV prevention interventions. Biomedical interventions include focus on condom use, ARV-based prevention, voluntary medical male circumcision, elimination of mother-to-child transmission, testing, and counselling. Interventions for social and behaviour change include behaviour change communication for minimising sexual risk behaviours, improving care seeking, and stigma reduction.

2) Shift from centralised programming to decentralised responses grounded on the local epidemic. Action plans to utilize data and local epidemiology to target geographical prevalence and disease burden in local governments for more effective targeting. Focus will also be on specific populations and high-risk age groups that have been missed in programming, and on getting them on treatment and retaining them in care. Evidence-informed data will be used for men and women by age group, partners and families of positive cases, HIV-exposed infants, adolescents, orphans, and sexual minorities. In this regard the road map plans to improve data quality and reporting. Key populations will be mapped geographically and interventions targeted to those hotspots, urban authorities and districts.

3) Shift from intervention-specific programming to systems approaches to address vulnerability, risks, exposure and impact mitigation. This involves enhancing economic opportunities for girls, increasing secondary school completion for girls, addressing HIV awareness among young people, programming to respond to cross-generational sex, age-appropriate programming for young women and girls, reducing stigma, addressing alcohol abuse, fighting for gender equality, elimination of gender-based violence, and promoting the reduction of multiple concurrent partnerships.

The road map outlines four key strategic actions:

1) Integration within local government development programming.
2) Integration along the human life cycle.
3) Leveraging local resources and sustainable financing.
4) Leveraging other key sectors for the HIV prevention revolution.

The plan will be implemented using a multisectoral response with a wide range of stakeholders.

There are existing mechanisms for information which will be for monitoring and evaluation.

Intervention evidence

Combination strategy

A large-scale study of data from 30 communities across Rakai, Uganda, assessed trends in the incidence of HIV with the combination of ART scale-up and medical male circumcision (Grabowski et al, 2017). Data were collected from 33,937 study participants between 1999 and 2016. HIV was found to decline significantly with the scale up of the interventions.

A survey in four hyperendemic fishing communities on Lake Victoria found combination interventions led to declines in incidence in women and men (Kagaayi et al., 2019).

A number of intervention combinations were modelled by researchers to assess effectiveness in Uganda (McCreesh et al., 2017). Results suggest that the CD4[9] threshold should be removed. This is where patients are only given ART when they reach a specific count of CD4 cells per microlitre. The most effective option was 'Universal Test, Treat, and Keep' (UTTK) which involves increased testing, no CD4 threshold for ART initiation, improved retention on ART, improved linkages to care, and improved pre-ART care.

Challenges in mobile fishing communities

A scoping review found 32 papers and 2 reports describing HIV in fishing communities in Uganda but a lack of evidence in terms of what works in prevention or improving ART adherence (Musumari et al., 2021). A feasibility study identified challenges to monitoring longitudinal trials in a highly mobile fishing community (Kuteesa et al., 2019).

Transport issues such as irregular services and boats in poor condition are an issue for fisherfolk in accessing HIV services (Tumwine et al., 2019; Bogart et al., 2016). To improve adherence in communities in Lake Victoria a cross-sectional study suggests care models need to integrate stigma reduction and social support (Sileo et al., 2019b). And if possible, reduce number of clinic visits needed.

Addressing alcohol use

A study assessed an intervention which used commitment savings to reduce alcohol use and therefore reduce risky sexual behaviour (Kiene et al., 2019b). The intervention showed moderate effectiveness and was more effective for men than women.

Promotion

A promotion programme delivered by community health workers was assessed in Rakai (Chang et al., 2021). The intervention was based on theory[10] and informed by motivational interviewing. The counselling strategy to promote engagement in HIV treatment and prevention services was

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[9] white blood cells that fight infection https://medlineplus.gov/lab-tests/cd4-lymphocyte-count/

[10] situated Information, Motivation, and Behaviour Skills

mobile phone application-supported. The intervention was found to improve HIV care and ARV coverage. It did not improve coverage of male circumcision or HIV viral suppression.

Testing

A study compared home-based testing and testing at community mobilisation events in Lake Victoria fishing communities (Bogart et al., 2016). Home-based testing was found to uncover more cases but had lower linkage to care. A small pilot study distributed self-testing kits through peer networks and had high uptake (Choko et al., 2018).

Integrated care challenges

A study in the Katakwi and Mubende districts found challenges in integrating HIV with antenatal and post-natal services (Ahumuza et al., 2016). There was a lack of staff, gaps in knowledge of service providers, limited space, and shortage of critical supplies.

Disability

A study finds women with disabilities were less likely to receive HIV testing and counselling services (Zandam et al., 2022). Of a sample of 10,073 women between 15 and 49 who had a live birth in the past 5 years, 68.2 percent of women without disabilities received a test result compared to 61.4 percent of women with disabilities.

Qualitative research in Uganda finds that people living with disabilities are more sexually active than is the common assumption (Schenk et al., 2017). Knowledge on HIV among people with disabilities was limited with impediments to accessing information and services. Education outreach is recommended.

5. Co-infection

Co-infection of TB and HIV is of the greatest concern amongst the combination of these diseases. TB is the leading cause of death for individuals with HIV (Uganda AIDS Commission, 2017). 30 percent of HIV deaths are from TB.

World Health Observatory data on HIV and TB coinfection:

- Incidence of tuberculosis (per 100 000 population) (HIV-positive cases) – 65
- Number of incident tuberculosis cases, (HIV-positive cases) – 30,000
- TB patients with known HIV status (%) – 100
- HIV-positive TB patients on ART (antiretroviral therapy) (%) - 97 (2020)

Aturinde et al. (2019) find that although TB and HIV are highly correlated, they show relatively different spatial patterns. Hotspot clusters were found around Lake Victoria and in northern Uganda. Possibly explained by the presence of refugees and internally displaced. Cold spots in eastern Uganda and Kasese could be explained by low HIV in communities which practice the circumcision tradition.

Factors associated with HIV-malaria co-infection include non-in-door residual spraying, poor perception on the health risk of HIV-malaria co-infections, non-use of insecticidal treated bed nets, non-use of cotrimoxazole prophylaxis, and not having received health education on the risk of HIV-malaria interaction (Yibeltal et al., 2020).

A study of HIV infected individuals attending hospital in Kano found 27 percent also infected with malaria (Jegede et al., 2017). Co-infection was higher among non-ART patients. And lower among treated bed net users.

A study found low co-infection of malaria at a TB treatment centre in Mulago Hospital, Kampala, 2.2 percent overall (Baluku et al., 2019). 5 percent of participants with rifampicin resistance also had malaria. 3 of the 363 participants had HIV, malaria, and TB, 0.8 percent.

Intervention

In December 2019 the national government published a strategic plan to reduce human rights related barriers to HIV, TB and malaria services (The Republic of Uganda, 2019). It was based on a baseline survey and developed by a multi-sectoral Technical Working group through the Ministry of Health. It aims to address stigma and discrimination in communities and healthcare settings; gender inequality and gender-based violence; punitive practices, policies, and laws preventing access; and social marginalisation. It also aims to increase knowledge on rights and responsibilities for health. It aims for a public health response to remove equity barriers that are comprehensive, sustainable, and well-coordinated. It includes a monitoring and evaluation framework. It will be financed by national disease programmes through domestic and external sources.

6. References

Ahumuza, S. E., Rujumba, J., Nkoyooyo, A., Byaruhanga, R., & Wanyenze, R. K. (2016). Challenges encountered in providing integrated HIV, antenatal and postnatal care services: a case study of Katakwi and Mubende districts in Uganda. *Reproductive health*, *13*(1), 1-9. https://reproductive-health-journal.biomedcentral.com/articles/10.1186/s12978-016-0162-8

Aturinde, A., Farnaghi, M., Pilesjö, P., & Mansourian, A. (2019). Spatial analysis of HIV-TB co-clustering in Uganda. *BMC infectious diseases*, *19*(1), 1-10. https://link.springer.com/article/10.1186/s12879-019-4246-2

Baluku, J. B., Nassozi, S., Gyagenda, B., Namanda, M., Andia-Biraro, I., Worodria, W., & Byakika-Kibwika, P. (2019). Prevalence of malaria and TB coinfection at a national tuberculosis treatment centre in Uganda. *Journal of tropical medicine*, *2019*. https://www.hindawi.com/journals/jtm/2019/3741294/

Bogart, L. M., Wagner, G. J., Musoke, W., Naigino, R., Linnemayr, S., Maistrellis, E., ... & Wanyenze, R. K. (2017). A comparison of home-based versus outreach event-based community HIV testing in Ugandan fisherfolk communities. *AIDS and Behavior*, *21*(2), 547-560. https://link.springer.com/article/10.1007/s10461-016-1629-x

Bogart, L. M., Naigino, R., Maistrellis, E., Wagner, G. J., Musoke, W., Mukasa, B., ... & Wanyenze, R. K. (2016). Barriers to linkage to HIV care in Ugandan fisherfolk communities: a qualitative analysis. *AIDS and Behavior*, *20*(10), 2464-2476. https://link.springer.com/article/10.1007/s10461-016-1331-z

Buregyeya, E., Kasasa, S., & Mitchell, E. M. (2016). Tuberculosis infection control knowledge and attitudes among health workers in Uganda: a cross-sectional study. *BMC Infectious Diseases*, *16*(1), 1-10. https://link.springer.com/article/10.1186/s12879-016-1740-7

Cattamanchi, A., Crowder, R., Kityamuwesi, A., Kiwanuka, N., Lamunu, M., Namale, C., ... & Katamba, A. (2021). Digital adherence technology for tuberculosis treatment supervision: A stepped-wedge cluster-randomized trial in Uganda. *PLoS medicine*, *18*(5), e1003628. https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1003628

Chang, L. W., Mbabali, I., Hutton, H., Amico, K. R., Kong, X., Mulamba, J., ... & Nakigozi, G. (2021). Novel community health worker strategy for HIV service engagement in a hyperendemic community in Rakai, Uganda: A pragmatic, cluster-randomized trial. *PLoS medicine*, *18*(1), e1003475. https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1003475

Choko, A. T., Nanfuka, M., Birungi, J., Taasi, G., Kisembo, P., & Helleringer, S. (2018). A pilot trial of the peer-based distribution of HIV self-test kits among fishermen in Bulisa, Uganda. *PloS one*, *13*(11), e0208191. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0208191

Degarege, A., Fennie, K., Degarege, D., Chennupati, S., & Madhivanan, P. (2019). Improving socioeconomic status may reduce the burden of malaria in sub Saharan Africa: A systematic review and meta-analysis. *PloS one*, *14*(1), e0211205. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0211205

Grabowski, M. K., Serwadda, D. M., Gray, R. H., Nakigozi, G., Kigozi, G., Kagaayi, J., ... & Chang, L. W. (2017). HIV prevention efforts and incidence of HIV in Uganda. *New England Journal of Medicine*, *377*(22), 2154-2166. https://www.nejm.org/doi/full/10.1056/nejmoa1702150

Hassard, S., Ronald, A., & Angella, K. (2017). Patient attitudes towards community-based tuberculosis DOT and adherence to treatment in an urban setting; Kampala, Uganda. *Pan African Medical Journal*, *27*(1). https://www.ajol.info/index.php/pamj/article/view/159852

Hladik, W., Baughman, A. L., Serwadda, D., Tappero, J. W., Kwezi, R., Nakato, N. D., & Barker, J. (2017). Burden and characteristics of HIV infection among female sex workers in Kampala, Uganda–a respondent-driven sampling survey. *BMC public health*, *17*(1), 1-12. https://link.springer.com/article/10.1186/s12889-017-4428-z

Izudi, J., Tamwesigire, I. K., & Bajunirwe, F. (2020). Surveillance for multi-drug and rifampicin resistant tuberculosis and treatment outcomes among previously treated persons with tuberculosis in the era of GeneXpert in rural eastern Uganda. *Journal of clinical tuberculosis and other mycobacterial diseases*, *19*, 100153.

Izudi, J., Tamwesigire, I., & Bajunirwe, F. (2019). Explaining the successes and failures of tuberculosis treatment programs; a tale of two regions in rural eastern Uganda. *BMC health services research*, *19*(1), 1-10. https://link.springer.com/article/10.1186/s12913-019-4834-2

Jegede, F. E., Oyeyi, T. I., Abdulrahman, S. A., Mbah, H. A., Badru, T., Agbakwuru, C., & Adedokun, O. (2017). Effect of HIV and malaria parasites co-infection on immune-hematological profiles among patients attending anti-retroviral treatment (ART) clinic in Infectious Disease Hospital Kano, Nigeria. *PLoS One*, *12*(3), e0174233. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0174233

Kagaayi, J., Chang, L. W., Ssempijja, V., Grabowski, M. K., Ssekubugu, R., Nakigozi, G., ... & Reynolds, S. J. (2019). Impact of combination HIV interventions on HIV incidence in hyperendemic fishing communities in Uganda: a prospective cohort study. *The lancet HIV*, *6*(10), e680-e687. https://www.sciencedirect.com/science/article/abs/pii/S2352301819301900

Kamali, A., Nsubuga, R. N., Ruzagira, E., Bahemuka, U., Asiki, G., Price, M. A., ... & Fast, P. (2016). Heterogeneity of HIV incidence: a comparative analysis between fishing communities and in a neighbouring rural general population, Uganda, and implications for HIV control. *Sexually transmitted infections*, *92*(6), 447-454. https://sti.bmj.com/content/92/6/447

Kamya, M. R., Kakuru, A., Muhindo, M., Arinaitwe, E., Nankabirwa, J. I., Rek, J., ... & Dorsey, G. (2020). The impact of control interventions on malaria burden in young children in a historically high-transmission district of Uganda: a pooled analysis of cohort studies from 2007 to 2018. The American journal of tropical medicine and hygiene, 103(2), 785. https://www.ajtmh.org/view/journals/tpmd/103/2/article-p785.xml

Kiene, S. M., Sileo, K. M., Dove, M., & Kintu, M. (2019a). Hazardous alcohol consumption and alcohol-related problems are associated with unknown and HIV-positive status in fishing communities in Uganda. *AIDS care*, *31*(4), 451-459. https://www.tandfonline.com/doi/abs/10.1080/09540121.2018.1497135

Kiene, S. M., Ediau, M., Schmarje, K. A., Kintu, M., & Tumwesigye, N. M. (2019b). Exploring the potential of savings-led economic strengthening HIV interventions among high-risk economically vulnerable fishing communities in Uganda: associations between use of commitment savings, sexual risk behavior, and problematic alcohol use. *AIDS and behavior*, *23*(9), 2347-2360. https://link.springer.com/article/10.1007/s10461-019-02475-y

Kigozi, S. P., Kigozi, R. N., Sebuguzi, C. M., Cano, J., Rutazaana, D., Opigo, J., Bousema, T., Yeka, A., Gasasira, A., Sartorius, B. & Pullan, R. L. (2020a). Spatial-temporal patterns of malaria incidence in Uganda using HMIS data from 2015 to 2019. *BMC public health*, *20*(1), 1-14. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-10007-w

Kigozi, S. P., Kigozi, R. N., Epstein, A., Mpimbaza, A., Sserwanga, A., Yeka, A., ... & Rodriguez-Barraquer, I. (2020b). Rapid shifts in the age-specific burden of malaria following successful control interventions in four regions of Uganda. *Malaria journal*, *19*(1), 1-12. https://researchonline.lshtm.ac.uk/id/eprint/4656519/1/Rapid%20shifts%20in%20the%20age-specific%20burden%20of%20malaria%20following%20successful%20control%20interventions%20in%20four%20regions%20of%20Uganda.pdf

Kizito, E., Musaazi, J., Mutesasira, K., Twinomugisha, F., Namwanje, H., Kiyemba, T., ... & Zawedde-Muyanja, S. (2021). Risk factors for mortality among patients diagnosed with multi-drug resistant tuberculosis in Uganda-a case-control study. *BMC infectious diseases*, *21*(1), 1-7. https://link.springer.com/article/10.1186/s12879-021-05967-2

Kuteesa, M. O., Weiss, H. A., Abaasa, A., Nash, S., Nsubuga, R. N., Newton, R., ... & Kamali, A. (2019). Feasibility of conducting HIV combination prevention interventions in fishing communities in Uganda: a pilot cluster randomised trial. *PloS one*, *14*(3), e0210719. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0210719

Mafigiri, R., Matovu, J. K., Makumbi, F. E., Ndyanabo, A., Nabukalu, D., Sakor, M., ... & Wanyenze, R. K. (2017). HIV prevalence and uptake of HIV/AIDS services among youths (15–24 Years) in fishing and neighboring communities of Kasensero, Rakai District, South Western Uganda. *BMC public health*, *17*(1), 1-10. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-017-4166-2

Mawejje, H. D., Kilama, M., Kigozi, S. P., Musiime, A. K., Kamya, M., Lines, J., ... & Staedke, S. G. (2021). Impact of seasonality and malaria control interventions on Anopheles density and species composition from three areas of Uganda with differing malaria endemicity. *Malaria journal*, *20*(1), 1-13. https://link.springer.com/article/10.1186/s12936-021-03675-5

Maziarz, M., Kinyera, T., Otim, I., Kagwa, P., Nabalende, H., Legason, I. D., ... & Mbulaiteye, S. M. (2017). Age and geographic patterns of Plasmodium falciparum malaria infection in a representative sample of children living in Burkitt lymphoma-endemic areas of northern Uganda. *Malaria journal*, *16*(1), 1-14. https://malariajournal.biomedcentral.com/articles/10.1186/s12936-017-1778-z

McCreesh, N., Andrianakis, I., Nsubuga, R. N., Strong, M., Vernon, I., McKinley, T. J., ... & White, R. G. (2017). Universal test, treat, and keep: improving ART retention is key in cost-effective HIV control in Uganda. *BMC infectious diseases*, *17*(1), 1-11. https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-017-2420-y

Meyer, A. J., Armstrong-Hough, M., Babirye, D., Mark, D., Turimumahoro, P., Ayakaka, I., ... & Davis, J. L. (2020). Implementing mHealth interventions in a resource-constrained setting: case study from Uganda. *JMIR mHealth and uHealth*, *8*(7), e19552. https://mhealth.jmir.org/2020/7/e19552

Mpimbaza, A., Walemwa, R., Kapisi, J., Sserwanga, A., Namuganga, J. F., Kisambira, Y., Tagoola, A., Nanteza, J.F., Rutazaana, D., Staedke, S.G. and Dorsey (2020). The age-specific incidence of hospitalized paediatric malaria in Uganda. *BMC infectious diseases*, *20*(1), 1-12. https://bmcinfectdis.biomedcentral.com/track/pdf/10.1186/s12879-020-05215-z.pdf

Musiimenta, A., Tumuhimbise, W., Mugaba, A. T., Muzoora, C., Armstrong-Hough, M., Bangsberg, D., ... & Haberer, J. E. (2019). Digital monitoring technologies could enhance tuberculosis medication adherence in Uganda: Mixed methods study. *Journal of clinical tuberculosis and other mycobacterial diseases*, *17*, 100119. https://www.sciencedirect.com/science/article/pii/S2405579419300191

Musoke, D., Miiro, G., Ndejjo, R., Karani, G., Morris, K., Kasasa, S., ... & Musoke, M. B. (2018). Malaria prevention practices and associated environmental risk factors in a rural community in Wakiso district, Uganda. PLoS One, 13(10), e0205210. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0205210

Musumari, P. M., Techasrivichien, T., Srithanaviboonchai, K., Wanyenze, R. K., Matovu, J. K., Poudyal, H., ... & Kihara, M. (2021). HIV epidemic in fishing communities in Uganda: A scoping

review. *PloS one*, *16*(4), e0249465.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0249465

Muttamba, W., Bbuye, M., Baluku, J. B., Kyaligonza, S., Nalunjogi, J., Kimuli, I., & Kirenga, B. (2021). Perceptions of Adolescents and Health Workers Towards Adolescents' TB Diagnosis in Central Uganda: A Cross-Sectional Qualitative Study. Risk Management and Healthcare Policy, 14, 4823. https://pubmed.ncbi.nlm.nih.gov/34876864/

Nanyonjo, G., Asiki, G., Ssetaala, A., Nakaweesa, T., Wambuzi, M., Nanvubya, A., ... & Kiwanuka, N. (2020). Prevalence and correlates of HIV infection among adolescents and young people living in fishing populations along Lake Victoria Fishing Communities in Uganda. *The Pan African Medical Journal*, *37*. https://www.panafrican-med-journal.com/content/article/37/208/full/

National Malaria Control Programme, KEMRI-Wellcome Research Trust and LSHTM (2018). Uganda: A Profile of Malaria Control and Epidemiology. Uganda Ministry of Health. https://web-archive.lshtm.ac.uk/www.linkmalaria.org/sites/link/files/content/country/profiles/Malaria%20LINK%20profile%20Uganda-final-4-9.pdf

Okethwangu, D., Birungi, D., Biribawa, C., Kwesiga, B., Turyahabwe, S., Ario, A. R., & Zhu, B. P. (2019). Multidrug-resistant tuberculosis outbreak associated with poor treatment adherence and delayed treatment: Arua District, Uganda, 2013–2017. BMC infectious diseases, 19(1), 1-10. https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-019-4014-3

Oyediran, K., Kirenga, B., Turyahabwe, S., Davis, N., Chauffour, J., Muttamba, W., Muzoora, A., & Muyinda, H. (2020). Quality of Tuberculosis Services Assessment in Uganda: Report. Chapel Hill, NC, USA: MEASURE Evaluation, University of North Carolina. https://www.measureevaluation.org/resources/publications/tr-20-398/at_download/document

Rek, J., Musiime, A., Zedi, M., Otto, G., Kyagamba, P., Asiimwe Rwatooro, J., ... & Krezanoski, P. J. (2020). Non-adherence to long-lasting insecticide treated bednet use following successful malaria control in Tororo, Uganda. *PloS one*, *15*(12), e0243303. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0243303

Santelli, J. S., Chen, I., Makumbi, F., Wei, Y., Nalugoda, F., Lutalo, T., ... & Serwadda, D. (2021). Household wealth and HIV incidence over time, rural Uganda, 1994–2018. *AIDS (London, England)*, *35*(11), 1835. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8373447/

Schenk, K. D., Tun, W., Sheehy, M., Okal, J., Kuffour, E., Moono, G., ... & Leclerc-Madlala, S. (2020). "Even the fowl has feelings": access to HIV information and services among persons with disabilities in Ghana, Uganda, and Zambia. Disability and Rehabilitation, 42(3), 335-348. https://www.tandfonline.com/doi/full/10.1080/09638288.2018.1498138

Sileo, K. M., Kizito, W., Wanyenze, R. K., Chemusto, H., Reed, E., Stockman, J. K., ... & Kiene, S. M. (2019a). Substance use and its effect on antiretroviral treatment adherence among male fisherfolk living with HIV/AIDS in Uganda. *PloS one*, *14*(6), e0216892. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0216892

Sileo, K. M., Wanyenze, R. K., Kizito, W., Reed, E., Brodine, S. K., Chemusto, H., ... & Kiene, S. M. (2019b). Multi-level determinants of clinic attendance and antiretroviral treatment adherence

among fishermen living with HIV/AIDS in communities on Lake Victoria, Uganda. *AIDS and Behavior*, *23*(2), 406-417. https://link.springer.com/article/10.1007/s10461-018-2207-1

Simbwa, B. N., Katamba, A., Katana, E. B., Laker, E. A., Nabatanzi, S., Sendaula, E., ... & Worodria, W. (2021). The burden of drug resistant tuberculosis in a predominantly nomadic population in Uganda: a mixed methods study. *BMC Infectious Diseases*, *21*(1), 1-11. https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-021-06675-7

Ssempiira, J., Kasirye, I., Kissa, J., Nambuusi, B., Mukooyo, E., Opigo, J., ... & Vounatsou, P. (2018a). Measuring health facility readiness and its effects on severe malaria outcomes in Uganda. *Scientific reports*, *8*(1), 1-11. https://www.nature.com/articles/s41598-018-36249-8

Ssempiira, J., Kissa, J., Nambuusi, B., Kyozira, C., Rutazaana, D., Mukooyo, E., ... & Vounatsou, P. (2018b). The effect of case management and vector-control interventions on space–time patterns of malaria incidence in Uganda. *Malaria journal*, *17*(1), 1-11.

Ssempiira, J., Nambuusi, B., Kissa, J., Agaba, B., Makumbi, F., Kasasa, S., & Vounatsou, P. (2017). Geostatistical modelling of malaria indicator survey data to assess the effects of interventions on the geographical distribution of malaria prevalence in children less than 5 years in Uganda. *PLoS One*, *12*(4), e0174948. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0174948

The Republic of Uganda (2019). National Strategic Plan to Reduce Human Rights Related Barriers to HIV, TB and Malaria Services: Uganda 2020-2024. https://www.theglobalfund.org/media/9768/crg_humanrightsuganda2020-2024_plan_en.pdf

The Republic of Uganda Ministry of Health (2017). A National Guidelines is available for Tuberculosis Infection Control in Health Care Facilities, Congregate Settings and Households. https://www.who.int/hiv/pub/guidelines/uganda_hiv_tb.pdf

Tukei, B. B., Beke, A., & Lamadrid-Figueroa, H. (2017). Assessing the effect of indoor residual spraying (IRS) on malaria morbidity in Northern Uganda: a before and after study. *Malaria journal*, *16*(1), 1-9. https://link.springer.com/article/10.1186/s12936-016-1652-4

Uganda AIDS Commission (2018). Acceleration of HIV Prevention in Uganda: A Road Map Towards Zero New Infections by 2030: Theme, Towards Sustainability, Ownership and Resilient HIV Prevention Systems. The Government of Uganda. http://library.health.go.ug/download/file/fid/2159

Uganda AIDS Commission (2017). Uganda HIV/AIDS country progress report July 2016-June 2017. Kampala: Uganda AIDS Commission, Ministry of Health, Republic of Uganda. https://www.ecoi.net/en/document/1441187.html

Wanzira, H., Katamba, H., Okullo, A. E., Agaba, B., Kasule, M., & Rubahika, D. (2017). Factors associated with malaria parasitaemia among children under 5 years in Uganda: a secondary data analysis of the 2014 Malaria Indicator Survey dataset. *Malaria journal*, *16*(1), 1-9. https://malariajournal.biomedcentral.com/articles/10.1186/s12936-017-1847-3

WHO (2020). *World Malaria Report 2020.* Geneva: World Health Organisation (WHO). https://www.who.int/publications/i/item/9789240015791

WHO (2019). Mass Action for a Malaria Free Uganda, Handbook for Leaders.
https://www.afro.who.int/sites/default/files/2020-
11/Mass%20Action%20for%20a%20Malaria%20Free%20Uganda%20-
%20Handbook%20for%20Leaders.pdf

Yibeltal, T., Abitew, D. B., Melese, A. B., & Mulu, Y. (2020). Determinants of HIV-malaria co-
infection among people living with HIV on anti-retroviral therapy in Northeast Ethiopia:
unmatched case control study. *Tropical Medicine and Health*, *48*(1), 1-8.
https://tropmedhealth.biomedcentral.com/articles/10.1186/s41182-020-00286-9

Zandam, H., Akobirshoev, I., Nandakumar, A., & Mitra, M. (2021). Utilization of HIV testing and
counselling services by women with disabilities during antenatal care in Uganda: analysis of
2016 demographic and health survey. BMC public health, 21(1), 1-7.
https://link.springer.com/article/10.1186/s12889-021-12045-4

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