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Dear Reader,

With great pleasure, we welcome you to Issue 4, Volume 6 of the Uganda National Institute of Public Health (UNIPH) Quarterly Epidemiological Bulletin (UQEB).

We aim to inform the district, national, and global stakeholders on disease outbreak investigations, public health surveillance, and interventions undertaken in detecting, preventing, and responding to public health events in Uganda.

In this issue, we present a variety of policy briefs: Re-classifying Anthrax as a public good disease; Reduce missed measles vaccination opportunities to save our children; Improving access to integrated community case management (iCCM) services for malaria in the community; Dying rabid—adopting compulsory mass dog vaccination to reduce human deaths from dog rabies in Uganda; the magic bullet - using interpersonal communication to increase consistent bed net use in Uganda. Other articles include; Ownership and use of Long-lasting Insecticidal Nets and Factors Associated, Immediately after a Mass Distribution Campaign in Uganda: a Cross-sectional Survey of Fourteen districts, Malaria Outbreak facilitated by agricultural activities, residing near water logged areas and participating in late night campaign activities: Nabitende Subcounty, Iganga District, December 2020- February 2021 and, Counting deaths in Uganda: history, challenges, and what is currently being done amidst COVID-19 Pandemic.

Should you have any questions or require additional information related to policy briefs and articles in this bulletin please contact us on: atuhaire@musph.ac.ug, rnampeera@musph.ac.ug, akwiringira@musph.ac.ug, or lbulage@musph.ac.ug. We hope you find this information valuable and we appreciate any feedback from you.

Thank you

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UPCOMING EVENTS

Upcoming Public Health Events, Nationally and Globally, January -March, 2022 Author: Andrew Kwiringira

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Summary

The numerous international days, weeks and months are observed globally in the field of health to raise awareness of specific health matters of public health concern.

The following global and national health awareness days will be celebrated in the next quarter January-March, 2022.

World Leprosy Day, January 27

Everyday nearly 600 more people are diagnosed with and start treatment for leprosy. World Leprosy Day (WLD) is celebrated on the last Sunday of January. This international day is an opportunity to celebrate people who have experienced leprosy, raise awareness of the disease, and call for an end to leprosy-related stigma and discrimination. The "United for Dignity" campaign calls for unity in honoring the dignity of people who have experienced leprosy. The campaign honors the lived experiences of individuals who have experienced leprosy by: sharing their empowering stories and advocating for mental well-being and the right to a dignified life free from disease-related stigma.

World Cancer Day, February 02

An estimated 19.3 million new cancer cases and almost 10.0 million cancer deaths occurred in 2020. According to the World Health Organization (WHO), if the incidence of cancer continues to grow at the reported rate, the number of deaths worldwide from cancer will increase to more than 16.3 million by 2040. The theme of this year is '**Close the Care Gap'** and is about understanding and recognising the inequities in cancer care around the globe. This is
the year to question the status quo and help reduce stigma; to listen to the perspectives of the people living with cancer and their communities and let those lived experiences guide our thoughts and actions.

World TB Day, March 24

Tuberculosis is the 13th leading cause of death and the second leading infectious killer after COVID-19 (above HIV/AIDS). In 2020, an estimated 10 million people fell ill and 1.5 million people died from TB tuberculosis (TB) worldwide in 2020. World TB Day, falling on **March 24th** each year, is designed to build public awareness that tuberculosis today remains an epidemic in much of the world, causing the deaths of nearly one-and-a-half million people each year, mostly in developing countries. The theme of this year's World TB Day is **'The clock is ticking.'** The time is now for national TB programs in high burden countries to urgently expand efforts and commit to carry out a mix of cost-effective, sustainable interventions.

Policy brief:

Improving access to Integrated Community Case Management (ICCM) services for malaria in the community.

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Key Messages

Malaria remains the leading cause of under 5 morbidity and mortality in Uganda. In 2020, there were 3,832 deaths due to malaria among children under 5 years.

Facilitating the Village Health Teams (VHTs) to report and restock antimalarials monthly will increase the number of malaria episodes management within 24 hours from the current 1.9 to 3.6 million at the cost of $2.11 per additional malaria episode managed.

Problem Statement

Malaria is the leading cause of morbidity and mortality affecting 90-95% of the population in Uganda [1]. About 58,000 total deaths due to malaria were reported in the District Health Information System (DHIS2) in 2020. Nearly 7 in 100 (about 3,800) of these deaths were among children under 5 years of age [2]. About 4 in 10 of the suspected malaria cases among children under 5 do not access confirmatory diagnosis and receive effective treatment on the same day due to poor access to care in the community [3].
The World Health Organization introduced integrated Community Case Management of Malaria (iCCM) as a proven strategy to improve access to timely malaria treatment at the community level. Selected community members (Village Health Teams, or VHTs) are trained and equipped to treat malaria and other childhood illnesses at community level before these cases be-

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come severe and necessitate a health facility visit [4]. The 2020 iCCM comprehensive survey conducted by PACE indicates that since its inception in Uganda in 2010, iCCM had been rolled out to 120/135 districts. However, 62% of the VHTs had experienced stockout of Malaria commodities [artemisinin-based combination therapy (ACT) and malaria rapid diagnostic testing kits (mRDT)] in the last six months prior to the study [5].

Multiple system factors are responsible for commodity stockout at VHT level, including low motivation to collect commodities from the facility, delayed quarterly supervisions and facilitation, commodity stockout in some facilities, competing priorities and voluntary nature of VHT work [5]. However, our phone consultations with the district malaria focal persons and VHTs in 15 selected districts implementing iCCM indicated that VHTs are provided quarterly transport and lunch facilitation to attend a reporting and commodity restocking meeting at the health facility. Whereas VHTs can restock iCCM commodities at any time during the quarter, it was reported that majority wait for the quarterly facilitation even when they have stockout due to transport challenges. It was further reported that VHT with commodity stocks are seen to be active and motivated to treat children towards the period for the quarterly facilitation to generate data to report during the meeting but focus on other priorities thereafter. Additionally, quarterly facilitation affects reporting frequency and use of data for planning and forecasting malaria commodity needs. It further affects the frequency of interaction between supervisors (health workers) and VHTs to review performance and provide guidance. For these reasons quarterly facilitation is a key system factor resulting in stockout at VHT level. With frequent stock out at VHT level, the overall goal of iCCM will not be achieved.

Policy Options

To reduce childhood morbidity and mortality due to malaria by providing timely access to treatment in the community, we considered the question of whether the current quarterly facilitation schedule should be changed to monthly facilitation.

POLICY OPTION 1:

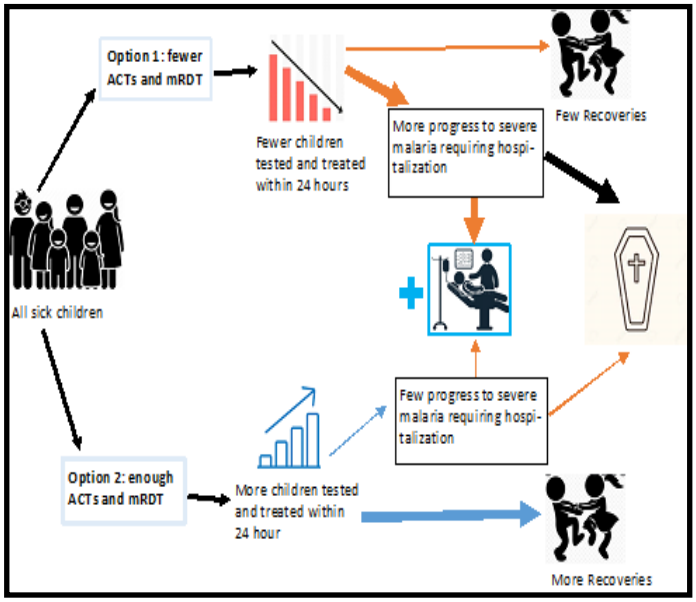
Maintain status quo (maintain quarterly transport and lunch facilitation of VHT to attend a reporting, a review and a commodity restocking meeting)

Meetings are currently organized quarterly at the health facility nearest to the VHT. During the meeting, VHTs report on progress of their work, and health workers review reports and registers for correctness, completeness and accuracy. VHTs are replenished with ACTs and mRDTs and other items such as job aids. During the quarter VHTs can go to the health facility at any time to replenish their stocks, but the majority face a challenge of transport costs.

Therefore, the three months period for replenishment of stock leads to stockout of malaria commodities at VHT level resulting in missed opportunities for children under 5 years getting timely malaria treatment in the community as per the purpose of ICCM. With delayed access to malaria treatment, uncomplicated malaria cases progress to severe/complicated malaria that require health facility visits or admissions resulting in increased treatment cost and under 5 deaths.

POLICY OPTION 2

Change to monthly transport and lunch facilitation of VHT to attend a reporting, review and commodity restocking meeting



This policy would provide facilitation of VHTs with a transport refund to reach the nearest health facility to submit their reports, discuss their challenges with health workers and replenish their ACT and mRDT stocks for the management of malaria in children under 5 years monthly. With this option, the current facilitation of about $10 per quarter will be distributed monthly to create an incentive that attracts the VHTs to the health facility monthly to report and replenish commodities. This option increases the frequency of VHT accountability, improves oversight by supervisors and improves timely availability of data for forecasting iCCM commodity needs to minimize stockouts at VHT level.

With reduced commodity stock outs at VHT level, VHTs will be able to provide timely malaria testing and treatment to most of the uncomplicated cases before progression to complicated malaria. Facilities will be decongested, with fewer complicated malaria cases needing outpatient care or admission. This will eventually lead to reduction in mortality due to malaria among children under 5 years of age.

ANALYSIS OF POLICY OPTIONS

Assuming a population projection of 41 million in 2020 [6] with

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approximately 17.7% (7,257,000) under-5 children [7] and 3 episodes per child under 5 per year, we modelled an estimated 18.2 million cases of malaria each year.

There are about 65,000 active VHTs implementing iCCM [8]. Assuming the number of suspected malaria cases that are tested, confirmed and treated by VHTs is directly related to commodity stocks at VHT level, holding other contextual factors constant, we estimate that moving from quarterly to monthly facilitation will increase the proportion of VHTs with adequate commodity stocks from the current 38% to 58%. This will result in an estimated 1.7 million additional episodes of uncomplicated malaria managed by the VHTs at USD 2.11 per additional uncomplicated case managed.

Recommendations and next steps

The 'monthly reporting and restocking meetings' option is economically favorable relative to the quarterly reporting meetings' option. Thus, 'monthly reporting and restocking, policy option represents good value for money for community malaria management. Our analysis does not take into account the potential cost savings from treating malaria cases in the community rather than in health facilities, which would further increase the economic value of this intervention.

Table 1: Summary of effectiveness, and operational and political feasibility

Outcome indicator	Option 1: Quarterly reporting and commodity restocking	Option 2: Monthly reporting and commodity restocking
Uncomplicated episodes managed	1,960,465	3,611,383
Total VHT program	$4,145,226	$7,635,943
Additional uncomplicated episodes managed	-	1,650,918
Incremental Cost	-	$3,490,717
Incremental cost per uncomplicated episode managed	-	$2.11
Political feasibility	High	Moderate
Operational feasibility	High	High

Politically, monthly facilitation is moderately feasible; this is because monthly facilitation is a strategy for enhancing an already acceptable iCCM model. However, this may meet resistance by some stakeholders, due to an additional effort caused by the increased frequency of funds disbursement and additional time committed to organizing reporting meetings. We plan to map the stakeholders directly implementing iCCM and share with them the incremental benefits of monthly facilitation of VHTs with minimal additional costs. Operationally, monthly facilitation is highly feasible, because there are existing structures implementing quarterly facilitation as well as dedicated resources.

Our cost-effectiveness analysis was modeled with several assumptions. There was no literature demonstrating cost effectiveness of option 2 over option 1. There is a need to conduct a monthly evaluation of this policy to monitor the performance of this model in the initial phase. Nonetheless, there is evidence of Ethiopia and Burkina Faso implementing monthly facilitation of community health workers (VHTs in Uganda) with success [9].

Next steps

A formal communication about the policy change to key stakeholders and the effective date will be circulated. The ministry of health will convene a meeting with Key ICCM implementing partners, (TASO, UNICEF, Save the Children, Malaria consortium and MoH) to discuss facilitation mechanisms and adjust VHT quarterly reporting tools to monthly and provide them in adequate quantities. Mechanisms such as utilizing monthly data to forecast commodity requirements will be developed to ensure availability of ACTs and RDTs at health facilities to handle additional malaria episodes under monthly reporting meetings. Changing from quarterly to monthly reporting and replenishment will enable us to treat an additional 1.65 million episodes of uncomplicated malaria at community level before they progress to a severe state and possible death. This will cost us additional USD 3,490,716.74 in terms of VHT program cost but will be cost-effective or potentially even cost-saving when considering the costs averted by treating cases in the community before they reach health facilities.

Acknowledgement

We appreciate the Uganda National Institute Public Health for the technical support during the development of the policy brief. We also appreciate Vital Strategies and CDC Foundation for conducting the training and the technical support offered. We acknowledge the Malaria Control Programme, Ministry of Health for giving us access to data and relevant information on malaria to support and justify the policy options. We also acknowledge the District Local Governments, Kumi, Soroti, Katakwi, Lira Dokolo, Bukedea, and Ngora for providing information on the existing gaps on the current policy to support the

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formulation of the problem statement of the policy brief.

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Policy brief

Re-classifying Anthrax as a Public Good Disease

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Key Messages

Anthrax is an acute infection with a very high case fatality rate ranging from 25-80%.

In 2018 alone, 3 districts accounted for a total of 186 human cases and 721 animal deaths.

Government loses an average of 140 USD in the management of one anthrax case.

WHO recommends 80% anthrax vaccination for effective control; however, less than 6% of animals are vaccinated in Uganda.

Re-classification of anthrax from private to public can eliminate anthrax.

Problem Statement

Anthrax is a zoonotic disease, caused by a bacteria transmitted to humans through handling or eating meat from infected animal carcasses or by breathing in spores[1]. Anthrax among livestock presents as a severe infection with a high death rate. About 3-8 people with severe infection die[1,2]. Uganda has had continuous and recurring outbreaks of anthrax since 1968, with an average of 3 to 5 investigated outbreaks per-year[3]. In 2018 alone, Kween, Kiruhura and Arua districts accounted for a total of 186 human cases and 721 animal deaths. Due to increasing cases, the government loses approximately $140 per person in management of complex anthrax cases in humans. Limited vaccination coverage is one of the most important contributing factors to re-occurrence of anthrax outbreaks in Uganda. Currently the vaccination coverage for anthrax in Uganda is estimated at 0-6%, Falling short of the WHO recommendation for 80% coverage[4].

Uganda is vulnerable to zoonotic diseases due to its unique biological diversity, and population increase which is associated with encroachment of game parks and reserves, which facilitates close contact between humans and animals (domestic and wild) across the country. The population's heavy engagement in agriculture indicates increased interaction between livestock and humans, which is a ground for transmission of anthrax. Moreover, over 80% of Uganda's population is engaged in agriculture with 58% of these individuals involved in livestock farming. Uganda has an estimated 14.3 million cattle, 15.7 million goats, 4.3 million sheep, and 4 million pigs, which generates a lot of income to the farmers, and revenue to the government – the livestock sector contributes to 1.54% to Uganda's Gross Domestic Product.

Currently, anthrax is classified as a "private good disease" which means that the management and control of anthrax in Uganda is done by farmers. Unlike other diseases like foot and mouth disease, Contagious bovine pleuropneumonia (CBPP) and Rabies which are state-controlled diseases. Reclassifying anthrax as a public good disease will ensure state control and management of anthrax, thus may reduce the frequency of outbreaks reported among animals and humans across the country. Therefore, the main objective of this policy brief is to highlight the benefits of reclassifying anthrax as a public good disease, which is critical to the prevention and control of future anthrax outbreaks in Uganda.

Policy Options

Policy Option 1: [Maintain status-quo]

Under this policy, Currently Anthrax is classified as a "private disease" this means that farmers are responsible for treatment and disposal of animals affected by anthrax, Farmers can go ahead treat the animals, and Vaccinate but not through a MAAIF or MOH affiliated program.

Policy Option 2: [Anthrax to be reclassified as a public good disease:] - (100% vaccination)

Under this policy, Government to fund anthrax vaccination and its administration / community sensitization, Procurement and delivery of vaccines and carcass disinfectants to households, administration of vaccines to livestock and Post exposure prophylaxis

Policy Option 3: [Compulsory vaccination of 80%

Under this policy, Government to fund 80% of the anthrax vac-

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cination, its administration / community sensitization, procurement and delivery of vaccines and carcass disinfectants to households and Post exposure prophylaxis

Methods

We used a decision analysis approach. We used country reports, and Uganda-specific governmental reports to obtain data to inform our assumptions, where we couldn't find enough literature or country level data, where no documented data were available, we used informed guesses. We constructed a decision tree to compare different options for reclassifying Anthrax as a public good disease. We calculated incremental cost effectiveness ratios (ICERs) expressed as US$ per additional in the low and high transmission scenarios

We conducted sensitivity analysis for the Animals if infected.

Cost-effectiveness analysis for the three policy options, Uganda 2021

S/n	Outcome	Policy Option 1 Status-Quo	Policy Option 2 100% Vaccination	Policy Option 3 80% Vaccination
1	Animal Cases	22,460,483	47,101	581,681
2	Animal Deaths	2,246,048	4,4710	9,420
3	Human Infections	4,492,097	9,420	116,336
4	Increment effect (Human Deaths)	49,413	104	1,280
5	Total costs for each intervention (US$)	-	23,299,236	21,429,977
6	ICER cost/case averted*	-	473	445
7	Political Feasibility	Feasible	Feasible	Feasible
8	Operational Feasibility	High	Moderate	High

Results:

**ICER: Incremental cost-effectiveness ratio, ICER = (Costs 2 -Costs 1)/(Effectiveness2-Effectiveness1).*

At a prevalence of 0.13% for Anthrax infection among the livestock, a total of 22,460,483 for Option 1, 47,101 for Option 2 and 581,681 for Option 3 infected animals would be identified in one Horizon ,through this program we would expect 2,246,048 infected animals die from Anthrax to be to be for Option 1,4,4710 for Option 2 and 9,420 for Option 3. A total of 4,492,097 infected Human Infections would be identified for Option 1, 9,420 for Option 2 and 116,336 for Option 3. However, implementation costs for these interventions would cost Option 2 ($22.3 million USD) an ICER of $473 per case averted, for Option 3 and an ICER of $445 per case averted ($21.4 million USD) for Option 3

Anthrax Infection prevalence had a major impact on the ICER, at high prevalence of animals infected Option 3 is still cost effective, i.e. the ICER/cases averted is lower than when compared to Option 2.

Conclusion

While compared to Option 1, status quo Both vaccination Options 2 (%100 vaccination) and Option 3(80% vaccination), indicate better alternatives to control of Anthrax from animals to humans, over a ten-year period. However, implementation costs for these interventions would cost Option 2 ($22.3 million USD) an ICER of $473 per case averted, for Option 3 and an ICER of $445 per case averted ($21.4 million USD) for Option 3, making Option3 Cheaper this is also reflected in sensitivity figure above for High and Low transmission scenario

Recommendation

Overall the 80% vaccination of all animals is the most effective approach to eliminating Anthrax.

Acknowledgments

We appreciate the CDC- Bloomberg Data for Health Initiative for funding and supporting the Policy development. We also appreciate the Ministry of Agricultural Animals and Fisheries, National Animal Disease Diagnostics and Epidemiology Centre for giving access to data from the animal surveillance platform on anthrax, and the Uganda National Institute of Public Health and Ministry of Health Uganda, and the National One health Platform for giving us access to some of the data used to develop this policy brief. We also appreciate the technical support rendered to use by all the institutions highlighted in this section.

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Policy brief

Improving national measles vaccination coverage among children under five in Uganda

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5th Jan 2022

Key Messages

Measles is Uganda's most frequent disease outbreak in the past two decades.
Measles vaccination coverage across the country remains low, below the target of 95% despite vaccines being offered for free and this is attributed to the Missed Opportunities for Vaccination (MOV) by the health system.
Introducing the MOV policy will increase vaccination coverage from 80% to 96% and consequently reduce the number of confirmed measles cases by 65%.

Problem Statement

Measles is a highly infectious disease that can lead to severe illness, lifelong complications and death, particularly in Under-fives (1). An effective and accessible vaccination programme against measles exists globally and is offered free of charge in Uganda. However, measles remains a major cause of vaccine preventable diseases. Measles outbreak has been ranked the most frequent disease outbreak (24%) in Uganda over the past two decades.

In the last three years, nearly two thirds of the 135 districts in the country have reported measles outbreaks with hospitalizations and deaths. Uganda identified more than twice as many confirmed measles cases between 2018 – 2020 (1,461) compared to 2013 – 2015 (581) when there were national measles vaccination campaigns.
One of the factors causing the low measles vaccination coverage is Missed Opportunities for Vaccination (MOVs). MOVs refers to any contact with health services by a child under five years who is eligible for measles vaccination, that does not result in the child receiving the vaccine dose (2).
MOVs include absence of routine screening for vaccination status or records by health workers, requiring caregivers to present cards or records to health facilities regardless of presenting complaints, poor record keeping, not opening a multidose vial for a small number of persons to avoid vaccine wastage and unfavorable vaccination schedule at the health facilities such as vaccines being given only once a week. A policy focusing on the reduction of MOVs would enhance compulsory screening for vaccination status and therefore reach more children. Studies conducted in Nepal (3) and Kayunga District in Central Uganda showed that compulsory screening for vaccination status in children under-five increased vaccination coverage from 50% to 91% and 75% to 96% respectively (4). Although the measles vaccination program in the country is targeted for children under five years old, with eligibility at nine months of age, the level of measles vaccination coverage across the country remains low, below the target of 95%.

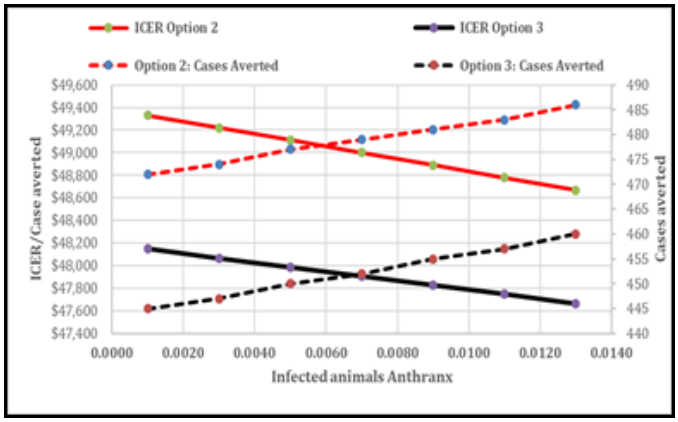

Figure 1; Showing Sensitivity - Variation in ICER by infection prevalence

Policy Options

We evaluated two measles vaccination strategies to observe their effect on the number of measles cases alongside the effect on the level of vaccination coverage.

Option 1
What: status quo
How: One dose of vaccination for measles through routine immunization at 9months alongside, vaccination of any child under-five years of age who is identified as not vaccinated, plus mop-up vaccination starting at 6months in case of an outbreak in a given area and mass vaccination campaign every three years depending on availability of resources and stakeholder engagements.
Challenge: Coverage is less than the target of 95% over the past decade (5).

Option 2
What: Compulsory screening of vaccination status for all children under- five
How: Compulsory screening of vaccination status for all children under-five through routine health service delivery regardless of their presenting complaints. This will be done alongside health education of parents or caretakers through community outreaches, and at the health facilities coupled with encouraging them to carry and present evidence of vaccination (home based vaccination records). The health facilities will be encouraged to increase the number of days when measles vaccination is offered (≥3 days a week). If a client has no card, but recalls vaccination status, they will be encouraged to come with it on the next visit; if client recalls vaccination status, but has lost their card, their status can be confirmed using the health facility vaccination record; if client has no card and does not

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recall vaccination status, they will be vaccinated and given a vaccination card.

Why: enhancing compulsory screening for vaccination status has resulted in increased vaccination coverage from a study in Nepal and a pilot study in Kayunga district (3,4).

Figure 1. IgM confirmed measles cases in Uganda, 2013 - 2020

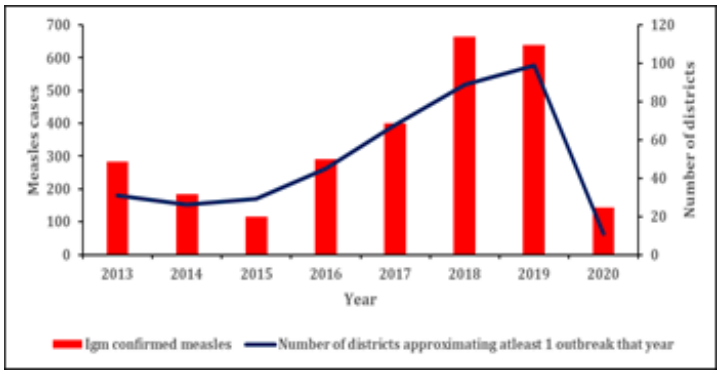
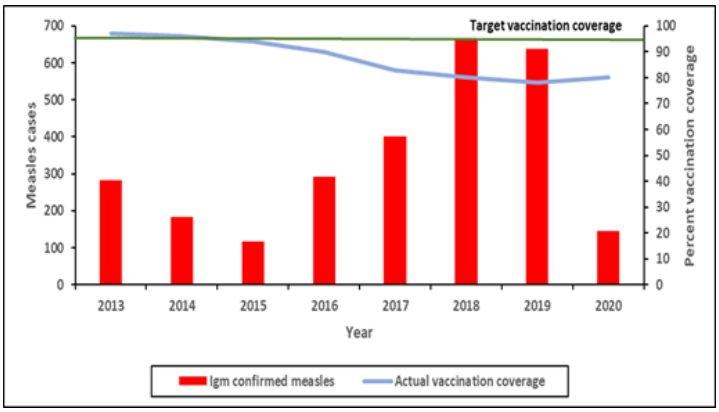


Figure 2. measles vaccination coverage in Uganda, 2008 –



2019, Source: WHO and UNICEF estimates of immunization coverage for measles, Uganda (GAVI)

Economic analysis

A comparative economic analysis was performed from the provider's perspective to assess the value for money of Compulsory screening of vaccination status for all children under- five (option 2) relative to the status quo (policy option 1). Policy option 2 was economically favorable with incremental cost-effectiveness ratio (ICER) of US$0.92 (UGX 3,312) per case averted, relative to policy option 1 (Table 1). The ICER is not sensitive to changes in the effectiveness of the intervention and related variable costs.

Table 1: incremental cost-effectiveness

Outcome indicator	Option 1: Status Quo (UNEPI)	Option 2: Compulsory Screening
Target population reached	8,823,606	8,823,606
Total cases	1,800,016	510,357
Total costs	$10,251,951.91	$11,440,534.03
Incremental number of cases	-	-1,289,659
Incremental cost	-	$1,188,582.12
Incremental cost per case averted	-	-$0.92
Political feasibility	High	Moderate
Operational feasibility	High	High

Recommendations and next steps

Adopting the MOV policy will improve measles vaccination coverage and reduce missed opportunities for vaccination among under-fives. To achieve this, there is a need to develop policy strategy guidelines, train health workers, conduct community engagement and build partnerships. The strategy has been piloted at Kangulumira Health Centre IV in Kayunga district and has successfully shown results comparable to those seen in other countries that have adopted the policy including Nepal and India. Therefore, it is a feasible option. Thus, adopting the policy of compulsory screening for measles vaccination status and improving measles vaccination coverage among under-fives, will subsequently reduce the number of confirmed measles cases in Uganda.

We recommend development of guidelines based on this strategy.

Acknowledgement

We appreciate the support of the Zambian-based mentors – Kutha Banda and Lawrence Mwenge, as well as our mentor from the CDC Foundation – Abidemi Fasanmi, who supported the team in every step of developing this policy brief including the economic analysis. Appreciation goes out to Kangulumira Health Centre IV in Kayunga District where a pilot study was conducted and generated the data for which this policy brief is based. We acknowledge the technical support of the CDC Foundation, Uganda Public Health Fellowship Program, Ministry of Health, and Makerere University School of Public Health. We thank the CDC-foundation for supporting the Uganda Public Health Fellowship Program activities and guiding the team to develop this policy brief.

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Policy brief

The magic bullet: using interpersonal communication to increase consistent bed net use in Uganda

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Key Messages

Uganda has the 3rd highest malaria burden globally and contributes 3% of total malaria cases in the world.

59% of people consistently use bed nets compared to the Ministry of Health target of 90%.

Currently, Uganda utilizes mass media which reaches only 52% of Ugandans with messages of utilization of bed nets.

Using community-led interpersonal communication could potentially increase the proportion of people reached with messages of utilization of bed nets from 52% to 100% and consequently increase bed net use to 90%.

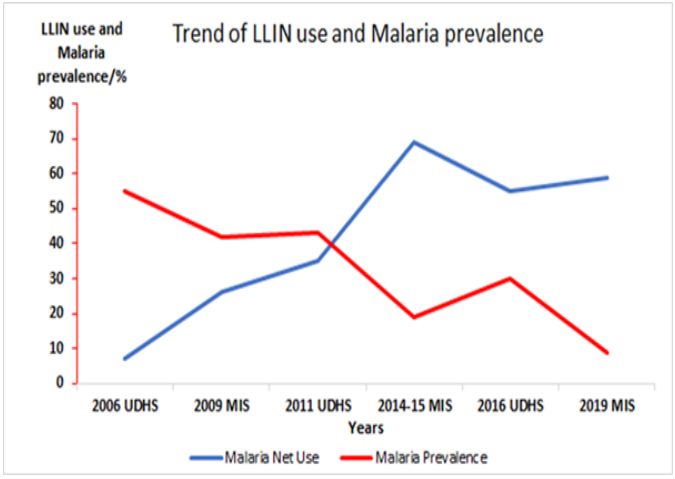
Problem Statement

In 2019 alone, Uganda registered about twelve million cases of malaria thirteen thousand (13,000) of which resulted in deaths [1]. Furthermore, 3 out of 10 pregnancies were exposed to malaria infection. The World Health Organization (WHO) estimates that the use of long-lasting insecticidal nets (LLINs) alone can prevent up to 69% of malaria cases. Uganda has a target of at least 90% of the target population consistently using LLINs by 2025. The Ministry of Health (MoH) conducted mass LLIN use campaigns in 2009, 2013, 2017 [2] and 2020.

Evidence shows that despite these efforts, less than 8 out of 10 people own a LLIN. Out of these, only 6 out of 10 use LLIN, a figure lower than the national target of 9 out of 10 people using LLINs daily. As of 2019, bed net usage stood at 59% compared to the MoH target of 90% [2-4].

Figure 1 shows trends of LLIN use over a 13-year period and the relationship with prevalence of malaria. In fact, 41% of the population remains at risk of acquiring malaria at any point in time as result of the non-use of LLINs. This may result in 281/1,000 cases of malaria and 9 in 100,000 deaths per year due to malaria.

Figure 1: Trend of LLIN use and Malaria Prevalence



Messaging for LLIN use is conventionally done through broadcasting over mass media (Radio, TV, flyers/posters, and billboards) which are able to reach many people at once, and health facility-based interpersonal communication (IPC), also known as one on one communication where health workers are able to speak to people that seek healthcare. This has resulted in 59% of the intended national population using LLINs against [2] the MoH national target of 90%[5]. The possible explanation for this gap is that the mass media approach is not accessible by all at-risk populations. For instance, as of 2019, 84 % of the population had access to radio while only 34% could access television and of the 74% population who had access to phones, only 17% could access the internet. At present, 16% of the population reached with messages through interpersonal communication use bed nets[2]. Those who heard messages through interpersonal communication believe that one-on-one communication easily influenced them to use bed nets because it gave an opportunity to seek clarity on the use of bed nets and often eliminated the issue of language barrier.

Community-led interpersonal communication involves direct communication between one person and another; this form of communication has been shown to overcome challenges associated with use of mass media because it allows each person participating in the discussion to seek clarity on any information

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they have not understood. Some studies have shown a notable increase in LLIN use following messaging through IPC (1,2)

Policy Options

Status quo

What: Messaging for Communication of LLIN mosquito net use happens through mass media and by health care workers at health facilities for visiting patients

How: National Malaria Control Division (NMCD) LLINs distribution campaign is conducted simultaneously with messaging for uptake and use via mass media such as TVs, Radio, Mobile vans, newspapers. This is augmented by health workers who conduct health education to patients when they visit the facility to seek health care.

Problem: Mass media is not accessible by all at-risk populations especially the rural and low-income earners who constitute the majority of the at-risk population. In addition, there is a language barrier, limited opportunity to seek clarity, unfavorable time of broadcast, and exclusion of people who may not visit the health facilities to seek care. Despite mass media interventions, 59% of the population only (about 6 out 10 people) sleep under mosquito nets.

Feasibility: **High:** This strategy requires a lot of funds, transport, and human resources. Its implementation is dependent on donor funding with budgetary constraints.

Community-led interpersonal communication

What: Conduct population-wide community-led interpersonal communication to reach 100% of the population with beneficial messages that will influence consistent and daily LLIN use, care and regular repair.

Why: Increased population reach with impactful and influential messages requires community-led interpersonal communication. In our model, Village Health Teams (VHTs) in addition to community champion mothers, influential shop attendants, and opinion leaders trained in interpersonal communication would increase LLINs use. For example, in the study conducted in Nakasongola district, Uganda[6], the proportion of under-five children who used LLIN the previous night increased from 51% to 74.7% and from 24% to 78% among pregnant women[6]

Feasibility: **High:** This strategy builds on the government's efforts to eliminate malaria by the year 2030. The IPC model allows one on one direct engagement between the interpersonal communicator and the targeted individuals and has high influence to cause the desired change. It will require an operational legal framework, training, and placement of more trained community interpersonal communicators.

Economic Evaluation Results

We conducted an economic evaluation of two policy options to ascertain which is the most cost-effective strategy to reach the population with malaria messages in Uganda. The results are as shown in the table below.

Variable	Status Quo	Reinforcing community-led interpersonal communication for increased population reach and influence LLIN use, care, and repair
Expected no of target population reached	Varies depending on media used; difficult to assess	Population-wide (100%)
Number of Malaria cases	2,377,000.0	2,242,000
Expected no. of Malaria Cases averted per year		135,000
Expected total cost ($)	2,472,019.2	1,082,474.6
Incremental Costs		(1,389,544.6)
Cost/life saved ($)		10.3
Political feasibility	High	High
Operational feasibility	High	High

Table 1: Summary of effectiveness, and operational and political feasibility

The results indicate that the communication intervention strategy based on simulated health impact to improve the use of LLIN use is community-led interpersonal communication. This strategy reduces the proportion of new malaria infections by 6% for a period of 1 year. On the other hand, this intervention has a lower cost compared to the status quo. Overall, community-led interpersonal communication is very cost-effective as it costs $10.3 to avert an additional case of Malaria.

Recommendations

We, therefore, recommend reinforcing **community-led interpersonal communication** as the most impactful, cost-effective, and feasible option to increase consistent bed net use in Uganda. We recommend substitution of the current messaging via mass media with community-led interpersonal communication strategy as a key medium for malaria messaging for the Ministry of Health of Uganda. This should involve using Village

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Health Teams (VHTs) in addition to community champion mothers, influential shop attendants, and opinion leaders to ensure increased population reach with impactful and influential messages through interpersonal communication.

Acknowledgement

We thank the Uganda Public Health Fellowship Program, particularly the team that investigated an upsurge in malaria cases in Nwoya District in 2018, which revealed that applying integrated malaria prevention methods was associated with reduced malaria transmission and illness, upon which this policy brief is based. We also appreciate the MoH National Malaria Control Division for continued efforts towards reducing malaria incidence in the country, and the entire team that worked towards formulating this policy brief.

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Policy brief

Dying Rabid: Adopting Compulsory Mass Dog Vaccination To Reduce Human Deaths From Dog Rabies In Uganda

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An average of 14,865 dog bites and 36 rabies deaths were registered annually in Uganda from 2015-2020.

Only 10% of the dogs are vaccinated

Key messages

Globally canine rabies causes approximately 59,000 human deaths per year.

An average of 14,865 dog bites and 36 rabies deaths were registered annually in Uganda from 2015-2020.

Over 90% of the rabies cases are transmitted via domestic dog bites.

Despite PEP being almost 100% effective, only 2 out of 10 dog bite victims access it.

WHO recommends 70% dog vaccination for effective rabies control, however only 10% of domestic dogs in Uganda are currently vaccinated.

Making vaccination of dogs compulsory while targeting a 25% semi-annual vaccination coverage would reduce rabies cases by 94% within 10 years.

Introduction

Human Rabies is a global public health concern accounting for an estimated 59,000 human deaths annually 95% of which occur in Africa and Asia [1, 2].

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Every year we experience rabies from all regions of the country causing an estimated 14,865 dog bites and 36 rabies deaths/ year [3]. These numbers could be higher since this disease is severely underreported [2].

Death as a result of rabies is nearly 100% once symptoms such as anxiety, confusion and hyperactivity set in. This makes rabies infection one of the most deadly of all infectious diseases. Although treatment of rabies immediately after a dog bite using post exposure prophylaxis (PEP) is 100% effective. This PEP is very expensive and only 2 out of 10 dog bite victims can access it [4].

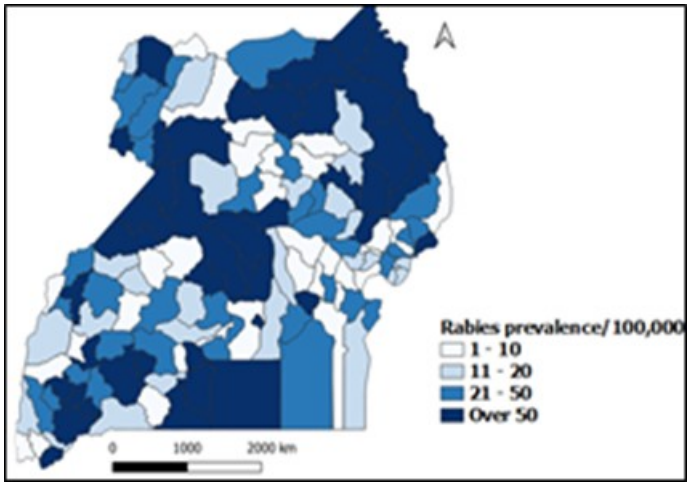

Fig 1: Dog bites (suspected rabies) prevalence in Uganda

Vaccination of domestic dogs can eliminate rabies illness among humans since nine out of ten rabies cases are caused by bites from domesticated dogs [5-8]. Although dog vaccination against rabies is compulsory in Uganda (WHO REF), most dog owners never present their dogs for vaccination resulting into the 10% dog vaccination coverage.

WHO recommends 70% dog vaccination coverage sustained for 7 years for effective rabies control, however only 10% of the domestic dogs in Uganda are currently vaccinated. against rabies [9, 10]. Compulsory vaccination of dogs in Uganda would increase the coverage and subsequently reduce rabies deaths.

Problem Statement

Rabies is endemic in Uganda and significantly affects public health with an average of 14,865 dog bites and 36 deaths/year [3]. These surveillance figures are underestimated due to poor surveillance systems [2, 5].

Transmission of rabies infection as a result of dog bites still occurs in Uganda due to the low dog vaccination coverage (10%) [10].

Nine out of ten dog bites and subsequent rabies deaths occur in children under 15 years, causing a huge loss in terms of years lost to productivity [1, 2, 11]. Death due to rabies can be prevented by treatment using a post exposure prophylaxis (PEP) before the rabies symptoms set in. Even though PEP for rabies bite is almost 100% effective, the treatment is expensive. A complete PEP treatment ranges between UgSh 360,000 and 1,150,000 (USD100 to 300) [4, 11]. In addition, rabies PEP is time intensive, it must be received within 24 hours after a rabies dog bite, and it is not always available in Uganda [11]. Studies in the region have estimated that out of ten dog bite victims, only two receive rabies PEP [4].

In comparison to the PEP, dog vaccination has proven to be a more

Rabies control interventions

	Option 1		Option 2		Option 3	
Vaccination options	10% vaccination of all dogs (Status Quo),		Annual vaccination of 70% of all dogs		Semi-annual vaccination of 25% of dogs	
Transmission scenario	Low	High	Low	High	Low	High
Number of Rabid dogs	431,447	1,062,293	10,621	18,309	33,878	60,229
Human deaths due to Rabies	2,465	6,135	60	104	182	324
Cost per Human death averted	NA	NA	9,751	3,417	7,070	2,437
Cost per DALY averted	NA	NA	978	354	747	263
Political feasibility	Feasible	Feasible	Feasible	Feasible	Feasible	Feasible
Operational feasibility	Feasible	Feasible	Weakly feasible	Weakly feasible	Feasible	Feasible

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affordable and effective strategy for preventing rabies associated illnesses/ disabilities and death [2, 12].WHO recommends 70% vaccination coverage of the dog population sustained for three to seven years to control and eliminate dog rabies, however, in Uganda the vaccination coverage is at 10% [9].

There is need to educate the public on the dangers of rabies plus the importance of dog vaccination against rabies to ensure that government efforts are taken seriously.

Policy options

In order to prevent and eliminate the ongoing rabies associated disabilities and deaths, there is a need to increase the dog vaccination coverage from 10% which is the status quo (option 1). The subsequent sections present the possible vaccination options.

Option 1 (status quo);

Maintain status quo of ten percent (10%) dog vaccination coverage and administer PEP treatment to 21% of the dog bite victims.

This is the current practice and would require no extra resources in terms of carrying out social mobilization and enforcement. There is currently no penalty to dog owners who do not vaccinate their dogs. Feasibility is high since it is the current practice and would require no additional resources or enforcement.

Option 2:

Annual vaccination of 70% of dogs and administering PEP to 21% of the dog bite victims.

WHO has recommended 70% dog vaccination coverage sustained over three to seven years to control or eliminate rabies infections. However, the Sustainable Development Goal targets elimination of rabies by 2030.

Feasible but subject to availability of extra resources and law enforcement. However, this option will be carried out using the existing schedules/work plans of the veterinary staff or technicians.

Option 3:

Biannual Vaccination of 25% of dogs and administering PEP to 21% of the dog bite victims.

This option addresses the high population turnover among dog populations in Uganda and would require minimal enforcement.

The targeted vaccination coverage is achievable. However this option will require vaccinating twice in a year which might negatively affect the existing schedules/work plans of the veterinary staff or technicians, this proposed approach is highly feasible.

Results

We conducted an economic evaluation of three policy options to prevent and eliminate rabies in Uganda for a period of ten years. The results are as shown in the table below.

The results of the model are based on three different dog rabies vaccination options: 10% vaccination of all dogs (Status Quo), annual vaccination of 70% of all dogs, and semi-annual vaccination of 25% of dogs. We included, for each vaccination option, two dog rabies transmission scenarios: low (1.2 dogs infected per infectious dog) and high (1.7 dogs infected per infectious dog).

Low Transmission Scenario

With 10% of dog vaccination, over 10 years there would be a total of approximately 430,000 rabid dogs and 6,135 human deaths. Annually vaccinating 70% of dogs results in 10-year reductions of 99% in rabid dogs, approximately and 2,405 human deaths averted. In addition, 70% annual vaccinations result in a cost-effectiveness ratio of $978 per DALY averted.

On the other hand, Bi-annual vaccination of 25% of dogs' results in 10-year reductions of 92% in rabid dogs, and approximately 2,283 human deaths averted, and $747 per DALY averted. Both the annual vaccination of 70% of dogs and 25% biannual vaccination eliminated dog rabies by the 4th year of implementation of both vaccination strategies.

High Transmission Scenario

With 10% of dog vaccination, over 10 years there would be a total of approximately 1,060,000 rabid dogs and 6,135 deaths. Annually vaccinating 70% of dogs results in 10-year reductions of 99% in rabid dogs, approximately and 6,030 human deaths averted. In addition, 70% annual vaccinations result in a cost-effectiveness ratio of and $354 per DALY averted.

On the other hand, bi-annual vaccination of 25% of dogs results in 10-year reductions of 94% in rabid dogs, and approximately 5,810 human deaths averted, $263 per DALY averted.

Conclusion

Using the WHO Cost Effectiveness threshold (Uganda GDP Per Capita of 810 these results indicate that the 25% bi-annual vaccination is very cost effective in comparison to the status quo. On the other hand, the 70% vaccination is very cost effective under a high transmission scenario and moderately cost effective in the low transmission scenario. However, the 25% bi-annual vaccination strategy is more cost effective as it has a lower cost per DALY averted in both low and high transmission scenarios.

Recommendations

We recommend that the Ministry of Agriculture adopts the 25% semi-annual dog vaccination approach as it is the most cost-effective approach to eliminating human rabies in Uganda; this is politically and operationally feasible.

The government should educate the public on the dangers of rabies plus the importance of dog vaccination against rabies to ensure public cooperation.

Currently vaccination of dogs in Uganda is carried out once a year using the static vaccination points, the program is not compulsory dog owners present their animals for vaccination at will. The proposed option will require vaccinating twice in a year, it therefore necessitates adjustments in the existing schedules/ work plans of the veterinary staff or technicians. It also requires some enforcement

Resources for mobilization and procurement of vaccines and accessories will be required. Political buy-in to support the mobi-

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lization of communities and lobbying of resources required for the implementation of the proposed strategy should also be considered.

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Ownership and Use of Long-lasting Insecticidal Nets and Factors Associated, Immediately after a Mass Distribution Campaign in Uganda: a Cross-sectional Survey of Fourteen districts

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Summary

Background: *Uganda conducted its third mass Long-Lasting Insecticide-treated Nets (LLIN) distribution campaign in 2021. The target of the campaign was to ensure that 100% households own at least 1 LLIN per 2 persons, and to achieve 85% use of distributed LLINs. We assessed LLIN ownership, use, and associated factors 3 months after the campaign.*

Methods: *We conducted a cross-sectional household survey in 14 districts during 13-30 April 2021. Households were selected using multistage sampling. Outcomes were household LLIN ownership (at least one LLIN), adequate LLIN coverage (at least one LLIN per 2 residents), and LLIN use (residents slept under LLIN the previous night). Modified Poisson regression was used to assess associations between exposures and outcomes.*

Results: *In total, 5,529 households with 27,585 residents and 15,426 LLINs were included in the analysis. Overall, 95% of households owned ≥ 1 LLIN, 64% of households owned ≥1 LLIN per 2 persons in household, and 69% of residents slept under an LLIN the previous night. Factors associated with LLIN ownership included believing that LLINs are protective against malaria (aPR=1.13; 95% CI=1.04-1.24). Reported use of mosquito repellents was negatively associated with ownership of LLINs (aPR=0.96; 95% CI=0.95-0.98). The prevalence of LLIN use was 9% higher among persons who had LLINs 3-12 months old (aPR=1.09; 95% CI=1.06-1.11) and 10% higher among LLINs 13-24 months old (aPR=1.10; 95% CI=1.06-1.14), than those who had LLINs <3 months old. Of 3,859*

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LLINs not used for sleeping the previous night, 3,250 (84%) were <3 months old. Among these 3,250, 41% were not used because owners were using old LLINs, 16% were not used because of lack of space for hanging them, 11% were not used because of fear for chemicals in the net, 5% were not used because of dislike of smell of the nets, and 27% were not used because of other reasons.

Conclusion: *Three months after the mass campaign, LLIN ownership and use both remained well below targets. The government should distribute more LLINs to supplement on recent mass distribution campaign and behavior change communication should be conducted before distribution of LLINs to counter misconceptions about new LLINs.*

Introduction

Over the past 20 years, the scale-up of malaria control efforts has led to marked reductions in morbidity and mortality (1, 2). An estimated 663 million malaria cases were averted by malaria control interventions ; nearly 70% of these were attributed to use of long-lasting insecticide treated nets (LLINs) between 2000 and 2015(1). However, global progress has slowed in recent years, particularly in sub-Saharan Africa, which accounted for 94% of the world's 219 million cases in 2019 (2). In Uganda, malaria accounts for 30-50% of outpatient visits at health facilities, 15-20% of all hospital admissions, and up to 20% of all hospital deaths and 27.2% of inpatient deaths among children under five years of age

Long-lasting insecticide treated nets are one of the core interventions recommended by the World Health Organization to reduce malaria transmission and prevent malaria in high-risk communities (3). Long-lasting insecticide treated nets have been shown to reduce malaria incidence among children under five years and pregnant women by up to 50 percent and all-cause mortality in children by about 20 percent(4). Since 2013, the government of Uganda has conducted 3 mass LLIN distribution campaigns to achieve universal LLIN coverage and to reduce inequality in ownership of LLINs between poor and wealth households. The most recent LLIN mass campaign was conducted in 2020/2021 and 27 million LLINs were distributed nationwide (5).

Despite LLINs mass campaigns, malaria burden remains high in Uganda. The Malaria Indicator Survey conducted in Uganda in 2018/19 (2018 MIS) showed that 54% households own at least one LLIN for 2 people and 59% of the population use the LLINs for sleeping. At individual level, factors influencing LLIN use have been reported to include age of the LLIN and beliefs and risk perceptions (6). Studies have also documented barriers to LLIN use, including lack of sufficient space to hang the net, lack of enough nets for a household, discomfort with the net material, and others; however, different settings have unique and dynamic barriers to LLIN use and may require unique strategies (7). We conducted a survey 3 months after the 2020/2021 mass distribution campaign to estimate LLIN ownership, use, and identify barriers to LLIN use in 14 districts in Uganda to inform programming of future mass distribution campaigns.

Methods

Study design and setting

We conducted a cross-sectional household survey in 14 districts (Buikwe, Buyende, Dokolo, Iganga, Jinja, Kagadi, Kaliro, Kayunga, Kibaale, Kyegegwa, Lamwo, Luuka, Mayuge, Mukono) in Uganda between 13-30 April 2021 (Figure 1). These districts were chosen because they received LLINs in the last phase of mass distribution campaign preceding the survey.

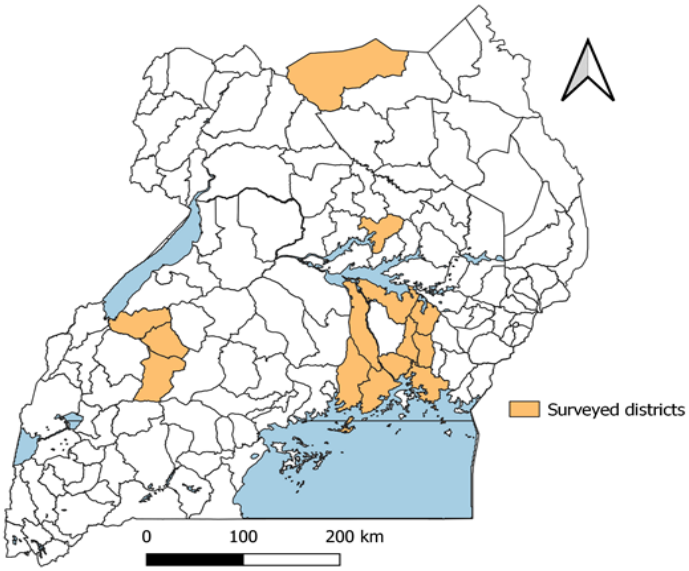

Figure 1: Map of Uganda showing the location of the 14 districts surveyed in the study

Sample size and sampling

Sample size for each district was 412 households. We calculated sample size for precision based on an estimated 84% of households having at least one LLIN in every district (8), 95% confidence, an error of +/- 5%, and a design effect of 2. We selected households for survey using multistage sampling.

Study outcomes

The primary outcomes were the percentage of households with at least one LLIN, percentage of households that achieved universal coverage of LLINs (defined as one LLIN for every two persons who stay in the household), and percentage of the household population that slept under an LLIN previous night before the survey.

Data collection

Study team members visited households and interviewed the head of household or one of his or her adult dependants. If no appropriate respondent was found at the house, the team scheduled another visit later that day. At least three attempts were made to reach a respondent before dropping the house-

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hold without replacing it. The household questionnaire included a household member roster, questions about the mosquito net(s) owned by households and usable, whether the net(s) had been used the previous night by each member of the household, and participant's beliefs about LLINs. We also examined the LLINs for texture.

Data analysis

Household and household member characteristics, estimation of LLIN ownership and use are presented as percentages. We conducted multivariate analysis using modified Poisson regression and the measure of association was prevalence ratios (PRs) and 95% confidence intervals. PRs were used instead of odds ratios (ORs) because the prevalence of both LLIN ownership and LLIN use was more than 10%. P-values of <0.05 showed statistically significant associations between the outcomes and the independent variables. We considered independent variables with p-values ≤ 0.1 at bivariate analysis for the multivariable model.

Ethical consideration

Permission to conduct the survey was sought from Ministry of Health and administrative clearance was sought from District Health Officers. The survey protocol was reviewed and approved by Centers for Disease Control and Prevention, Atlanta, Georgia, USA (CDC) Associate Director for Science as non-research. The data collected did not have personal identifiers. During data collection and analysis, unique identifiers were used, and data were only accessible to the analysis team. During reporting, no identifiers were used.

Results

Household and household member characteristics

A total of 5,529 households and 27,584 household members were included in the survey. Mean household size was 5 persons (range, 1-25), 4220 (15.3%) of household members were <5 years of age, 13,241(48%) were males and 14,344(52%) were females. We found a total of 15,426 nets in these households. Of these, 12,260 (79.5%) nets were distributed in 2020/21 through the government mass distribution mechanism (Table 1).

Long-lasting insecticide treated nets ownership in fourteen districts immediately after a mass distribution campaign in Uganda

Overall, 5,293 (95.7%) households owned at least 1 LLIN. A total of 3,557 (64.4%) households had at least one LLIN for every 2 persons in the household (achieved universal coverage of LLINs). The median number of LLINs in the household was 3.

Long-lasting insecticide treated nets use in fourteen districts immediately after a mass distribution campaign in Uganda

Among 27,434 household members, 18,954 (68.7%) slept under an LLIN the previous night before the survey. Overall, 11,466 (74.3%) of 15,426 existing LLINs in the households were used the night before the survey. Of 3,859 LLINs not used for sleeping the previous night, 3,250 (84%) were <3 months old. Among these 3,250,1333 (41%) were not used because owners were using old LLINs, 520 (16%) were not used because of lack of space for hanging them, 358 (11%) were not used because of fear for chemicals in the net, 163(5%) were not used because of dislike of smell of the nets and 878(27%) were not used because of other reasons.

Table 1: Characteristics of long-lasting insecticide treated nets immediately after a mass distribution campaign in Uganda (n=15,426 LLINs)

Variable	Frequency (n)	Percentage (%)
LLIN texture		
Polyester	6,189	40.1
Polyethylene	2,542	15.4
Polyester and polyethylene	4,866	31.5
Not sure	1,829	13.0
LLIN source		
Mass distribution 2020/21	12,260	79.5
Mass distribution 2017	2,201	14.3
Bought the LLIN	505	3.3
ANC	271	1.8
Others	90	0.6
Unknown	99	0.6
LLIN age		
New (<3 months)	11,101	71.9
3-12 months	1,583	10.3
>12-24 months	398	2.6
>24 months	2,195	14.2
Unknown	149	1.0

Factors associated with household ownership of long-lasting insecticide treated nets in fourteen districts immediately after a mass distribution campaign in Uganda

The prevalence of household LLIN ownership was 2% higher among households with high wealth index compared to households with a low wealth index (aPR=1.02; 95% CI=1.01-1.04). The prevalence of household LLIN ownership was 4% lower among households where respondents reported using mosquito repellants compared to households where respondents reported not using repellants (aPR=0.96; 95% CI=0.95-0.98). The prevalence of household LLIN ownership was 13% higher among households where respondents believed LLIN would protect them from malaria compared to households where respondents did not believe LLINs would protect them from

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malaria (aPR=1.13; 95% CI=1.04-1.24) (Table 2).

Table 2: Factors associated with household ownership of long-lasting insecticide treated nets immediately after a mass distribution campaign in Uganda

Variable	LLIN ownership		Unadjusted PR (95% C.I)	Adjusted PR* (95% C.I)
	Yes	No		
Wealth index				
Low	1,805	98	1.00	1.00
Medium	1,704	71	1.01 (0.99- 1.02)	1.01 (0.99- 1.03)
High	1,769	65	1.01 (1.00- 1.03)	1.02 (1.01- 1.04)
Repellent use				
No	4,345	161	1.00	1.00
Yes	947	75	0.96 (0.94-0.98)	0.96 (0.95- 0.98)
Nets protect from malaria				
No	76	13	1.00	1.00
Yes	5,125	174	1.13 (1.03- 1.23)	1.13 (1.04- 1.24)
Not sure	92	49	0.76 (0.66- 0.89)	0.77 (0.66- 0.89)
Malaria serious condition				
No	119	18	1.00	
Yes	5,174	218	1.10 (1.03- 1.18)	

Factors associated with use of long-lasting insecticide treated nets in fourteen districts, immediately after a mass distribution campaign in Uganda

The prevalence of LLIN use was 9% higher among LLINs 3-12 months old compared to LLINs <3 months old (aPR=1.09; 95% CI=1.06–1.11). The prevalence of LLIN use was 10% higher among LLINs 13-24 months old compared to LLINs less than 3 months old (aPR=1.10; 95% CI=1.06-1.14). The prevalence of using LLINs with polyester material was 4% lower compared to the prevalence of use of LLINs with polyethylene material (aPR=0.96; 95% CI=0.94-0.97). Participants who reported that LLINs were hanged on their bed or sleeping space were 6.3 times more likely to use the net compared to those who reported that nets were not hanged (aPR=6.29; 95% CI=5.83-6.78) (Table 3).

Table 3: Factors associated with use of long-lasting insecticide treated nets immediately after a mass distribution campaign in Uganda

Variable	LLIN Utilisation		Unadjusted PR (95% C.I)	Adjusted PR* (95% C.I)
	Yes	No		
Age of net (Months)				
3-12	7,814	3,250	1.00	1.00
>12- 24	1,428	153	1.27 (1.25- 1.30)	1.09 (1.06- 1.11)
> 24	364	34	1.29 (1.25- 1.34)	1.10 (1.06- 1.14)
Unknown	1,797	387	1.17 (1.14- 1.19)	1.02 (0.99- 1.05)
	63	35	0.91 (0.78- 1.06)	1.06 (0.98- 1.15)
Net texture				
Polyethylene	2,150	387	1.00	1.00
Polyester	4,658	1,521	0.89 (0.87- 0.91)	0.96 (0.94- 0.97)
Both polyester and polyethylene	3, 283	1,564	0.79 (0.78- 0.82)	0.97 (0.95- 0.98)
Not sure	1,375	387	0.92 (0.89- 0.95)	0.92 (0.89- 0.95)
Source of				
Mass distribution 2017	1,827	365	1.00	1.00
Mass distribution 2021	8,843	3,360	0.87 (0.85- 0.89)	0.98 (0.95- 1.01)
ANC	233	38	1.03 (0.98- 1.09)	0.97 (0.94- 1.01)
Bought	450	55	1.07 (1.03- 1.11)	0.98 (0.96- 1.01)
Other	113	41	0.88 (0.79- 0.97)	0.92 (0.86- 0.99)
Net hanging over bed				
No	614	3,468	1.00	1.00
Yes	10,852	391	6.42 (5.97- 6.90)	6.29 (5.83- 6.78)
Net condition				
No holes	9,563	3,476	1.00	
One or few holes	1,328	119	1.25 (1.23- 1.27)	
Many holes	553	224	0.97 (0.93- 1.02)	
Unknown	22	40	0.48 (0.35- 0.68)	

Discussion

Overall, 95% of households owned ≥ 1 LLIN, 64% of households owned ≥1 LLIN per 2 persons in household, and 69% of residents slept under an LLIN the previous night. The percentage of households that achieved universal coverage (at least one net for every

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two persons who stayed in the household last night) increased from 54% reported in UMIS 2018/19 to 64% in 2021, after a mass distribution of LLINs.This estimate still falls short of the NMCP target of 100% (5). Nonetheless, this is an indication of an improvement towards the right direction to fulfillment of this target.

A successful mass campaign is measured by the household population that uses the LLINs for sleeping to prevent malaria(5). There was an increase in the proportion of the population that slept under an LLIN the previous night from 59% reported in UMIS 2018/19 to 69% in 2021, after a mass distribution campaign. This achievement also falls short of the NMCP target of having 85% of the population using an LLIN (5).

Malaria disproportionately affects the poor and addressing inequalities has been the cornerstone of malaria control efforts. The distribution of LLINs also shifted from targeted distribution to mass distribution to increase equity of ownership of LLINs. Our findings show that Inequality in LLIN ownership between households with low and high wealth index was minimal. The minimal inequality observed in this study could be due to improved coverage on LLINs. A study evaluated the change in equity in ownership of LLINs in 19 sub-Saharan African countries and concluded that equity of net ownership had improved in 13 countries including Uganda after mass distribution of LLINs(11). An evaluation conducted in Tanzania demonstrated that increasing the price of LLINs significantly reduces both demand and ownership (12).

The prevalence of LLIN ownership was lower among households where respondents reported using mosquito repellants. Respondents who had repellants possibly believed that repellants were protective enough and that could explain why they were not owning LLINs. The prevalence of LLIN ownership was higher among households where respondents believed LLIN would protect them from malaria. The health belief model illustrates that if individuals believe that net use and treatment would be beneficial in either reducing their susceptibility to malaria or alleviating it severity, they are likely to act to reduce their risks (13).

Participants preferred to use old LLINs compared to new ones. This study discovered phobia for chemicals as one of the factors responsible for non-use of new LLINs. The fear of harm from chemicals used in LLINs was also reported in Western Kenya(14). Some respondents feared perceived danger and harm associated with coming in contact with chemicals or insecticide used in LLINs, and therefore, chose not to use the nets but hang them out for several days for medicines to wear off. This could be an indication of behavioral change gaps in this setting. Community sensitizations should be prioritised in future campaigns to demystify these LLINs myths.

Participants preferred to use polyethylene material compared to the polyester material. Our findings observe a different trend compared to findings from India that showered polyester LLINs were preferred to polyethylene(15). However, this was a qualitative study that did not assess actual use. Acceptability reported may not necessarily translate to actual use. The source of LLIN was not associated with LLIN use. The results of this study contradict the data from a previous study conducted in Budondo subcounty in Uganda, that showed that bed nets that were bought were more likely to be used and used adequately than those obtained free from mass distribution campaign (16). This study was conducted on a small setting compared to our study, and different settings may have unique and dynamic enablers to use of LLINs.

Limitations

This study has several limitations. First, self-report was used to assess LLIN use, which could have underestimated or overestimated the actual use of LLINs. More so, reported use of LLINs the previous night before the survey only captures a cross-section of use at one night in time and thus provides a somewhat unclear indication of regular use. Although this is the recommended approach to measuring LLIN use(9), meta-analysis showed that self-reported measures overestimate LLIN adherence by 13% relative to objective measures(17), suggesting that the true proportion of the population who slept under LLIN the previous night could be lower than our estimates. Second, the ability to understand why individuals choose to use nets or not is limited by the quantitative nature of the questionnaire. Further exploration using qualitative research methods would be required to better understand local perceptions and why they are hesitant to take up new LLINs.

Public Health Action

We conducted community sensitization to demystify LLINs myths. We also conducted community sensitization on maintenance of LLINs and we volunteered to hang up nets in households were LLINs were available.

Conclusion

Long-lasting insecticide treated nets universal coverage (at least 1 LLIN for 2 people) was 36% short of 100% national target. Population that slept under LLIN night proceeding the survey was 16% short of 85% national target. Inequality in LLIN ownership between households with low and high wealth index was minimal. Ownership of LLINs was low when respondents used mosquito repellants. Participants reported misconceptions about new LLINs.

The government should distribute LLINs to achieve a target of ≥1 LLIN for 2 people in the household. We recommend that NMCP/stakeholders should design and conduct targeted behaviour change communication immediate after mass campaign to counter misconceptions about new LLINs. We further recommend that behavior change communication messages should advise communities to use mosquito repellants as adjuvants to malaria protection. We also recommend a more in-

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depth analysis of LLIN campaign messages to determine whether the methods of dissemination and messages being disseminated are accepted, consider norms and, are consistent with common local practices.

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Malaria Outbreak facilitated by agricultural activities, residing near water logged areas and participating in late night campaign activities: Nabitende Subcounty, Iganga District, December 2020 - February 2021

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Summary

Background: *Despite implementation of prevention measures, malaria remains the leading cause of illness and death in Uganda. In Feb 2021, Ministry of Health-Uganda identified an upsurge in malaria cases in Iganga District, Eastern Uganda, and thus necessitated epidemic response and control. We investigated this outbreak to establish the scope and magnitude of the outbreak, possible exposures and to make public health recommendations.*

Methods: *We defined a malaria case as a positive malaria test result using mRDT or microscopy in a resident of Iganga District from 1 May 2020 to 28 Feb 2021. We identified cases by reviewing medical records in all health facilities in the affected sub county. We conducted a case-control study. We defined a case-household as a household with at least one self-reported and/or confirmed (by patient book) resident with malaria for the period of 1 May 2020 to 28 Feb 2021 in Nabitende sub-county*

Results: *Nabitende subcounty had 6,620 cases with an Attack rate (AR)=20/100. Females were the most affected with an AR=21% (3462/16600) compared to the males with an AR=11% (1796/16900). The mean age of cases line-listed was 17 years with a range of 0-96 years. Age-group that contributed high numbers was 0-5 years that accounted for 53.7%. Malaria in Nabitende subcounty had a Case Fatality Rate of 0.05%. Participating in recent political campaigns in late nights (OR=1.6; 95%CI=1-2.5), residing near waterlogged places (OR=2.5; 95%CI=1.4-4.4), and having a household located <500m from a swamp (OR=2.3(CI=1.4-3.8) were strongly associated with this outbreak. Also, the distance of households (<500m) to the rice and sugarcane fields during the outbreak was associated with malaria disease [rice; OR=2.2, CI (1.2-4.2), Sugarcane; OR=1.67, CI (1.03-2.7)]*

Conclusion: *This outbreak was triggered by favourable breeding sites within the community among which include: waterlogged places, distance from rice farms, and the household being near the swamp and it was also facilitated by participating in political campaigns late in the nights. We recommend increased coverage of mosquito nets and larviciding the water-logged areas.*

Introduction

Despite wide implementation of malaria prevention measures such as indoor residue spraying, Long-lasting insecticide treated nets, and mass distribution campaigns, Uganda has the 3rd highest burden of malaria cases globally, accounting for 5% of all the world's cases with 38.8 million malaria cases (1), (2).

In February 2021, Ministry of Health (MOH) identified an upsurge in malaria cases in Iganga District, Eastern Uganda, exceeding expected limits (compared with malaria normal channels) (Figure 1). Using data extracted from the District Health Information System (DHIS2) and Subcounty populations, we calculated attack rates per subcounty. Calculated attack rates showed that Nabitende subcounty was the most affected with an AR of 14/100 compared to other sub counties. We thus conducted an investigation in Nabitende subcounty to determine the magnitude of the problem, identify risk factors for transmission, and recommend evidence-based control measures.

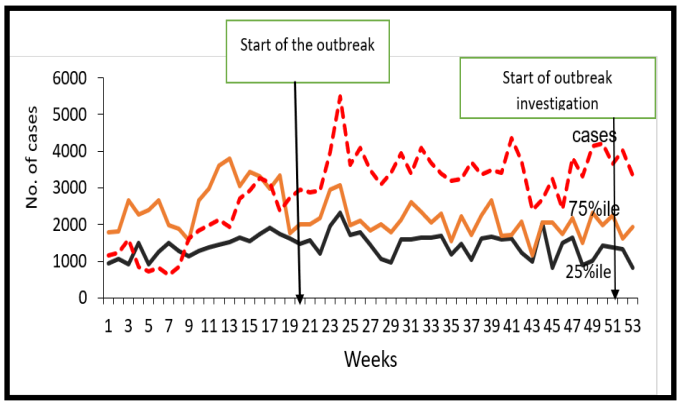

Figure 1: Malaria normal channel for Iganga District from 1st March 2020 – 28th Feb 2021 (53 weeks)

Methods

Outbreak setting

The Investigation was conducted in Iganga District. Iganga District is located in the Eastern part of the country. It has a population of 10,836500 with an annual population change of 3%. Iganga experiences a warm, muggy, and cloudy weather through the year. Over the course of the year, the temperature typically varies from 62°F to 86°F and is rarely below 60°F or above 93°F. The wetter season lasts 8.2 months, from March 16 to November 23, with a greater than 54% chance of a given day being a wet day. The month with the most wet days in Iganga is April, with an average of 22.9 days.

The drier season lasts 3.8 months, from November 23 to March 16 (3).

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Case definition and Finding

We defined a confirmed case as a positive malaria test result using mRDT or microscopy in a resident of Iganga District from 1 May 2020 to 28 Feb 2021. Using the case definition, we systematically abstracted case-patient information on age, sex, village, subcounty, date of onset of fever, diagnostic test done and the test result from all the health facilities in Nabitende subcounty (the most affected subcounty).

Descriptive Epidemiology

We described the identified cases by date of admission and constructed an epidemic curve. We abstracted rainfall data from the National Aeronautics and Space Administration (NASA) (4) and examined rainfall patterns for the same period by superimposing the line graph on the epidemic curve to compare the number of cases by admission to rainfall patterns over the same period. We also calculated the attack rates by sex, village and parish of residence. We did not calculate attack rates by age-group because of failure to obtain the population breakdown by age.

Hypothesis generation

To identify possible contributors to the malaria outbreak, we conveniently sampled and conducted key informant interviews with 18 community members, seven health facility in-charges, and nine community leaders in the most affected subcounty.

Environmental assessments

We walked through the most affected villages to find out whether there were environmental and human factors that may have facilitated the upsurge in malaria cases during the outbreak period.

Case-control study

To test the hypotheses developed based on descriptive epidemiology, we conducted unmatched case-control study in the five most affected villages. We defined a case-household as a household with at least one self-reported and/or confirmed (by patient medical book) resident with malaria for the period of 1 May 2020 to 28 Feb 2021 in Nabitende sub-county. Self-reported cases had to describe drugs prescribed to be considered. Control households were those in which none of the household members had suffered from malaria in the period of 1 May 2020-28 Feb 2021. We interviewed one case or control per case- or control-household.

Each case or control was asked about ownership of mosquito nets, where they obtained the mosquito nets, if they participated in late night campaigns, wearing of long-sleeved clothes in the evening, treatment and completion of doses, if they slept under the mosquito nets the previous night, residing near water logged places, staying near the swamp and which agricultural field they were involved in and any human activity in the swamp. We collected data using Kobocollect and exported them to Epi Info 7.2.2.0 software for analysis. We calculated frequencies and proportions for categorical variables, and means and medians for continuous variables. We analysed outcome variables against possible exposures. For the case-control study, we developed case-control sets for analysis and obtained Mantel–Haenszel odds ratios. The magnitude of association was calculated with odds ratios at 95% confidence interval

Results

Descriptive epidemiology

We identified 6,620 cases in Nabitende subcounty leading to an attack rate (AR)=20/100 and 3 deaths (case fatality rate=15/10000).

Females were the most affected with an AR=20% (3,462/16,600) compared to the males with an AR=11% (1,796/16,900). The mean age of cases was 17 years with a range of 5 months to 96 years. Age-group that contributed the highest number of cases was 0-5 years that accounted for 53.7%. In Nabitende sub-county, three parishes of Kasambika parish, Bugono parish, and Itanda parish were the most affected **(Table 1).**

Table 1: Attack rates by parish, Nabitende Subcounty, Iganga District, December 2020 to February 2021

Parish	Frequency	Population	Attack rate/100
Kasambika	1,247	5,113	24
Itanda	1,385	6,164	23
Bugono	646	3,398	19
Ituba	1,123	7,635	15
Nabitende	565	6,222	9
Naluko	293	4,519	6

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In these three parishes, Kasambika, Buweira , and Bugono, villages were most affected with an AR more than 14/100 persons (figure 2). As a result, we focused our case control study in these areas.

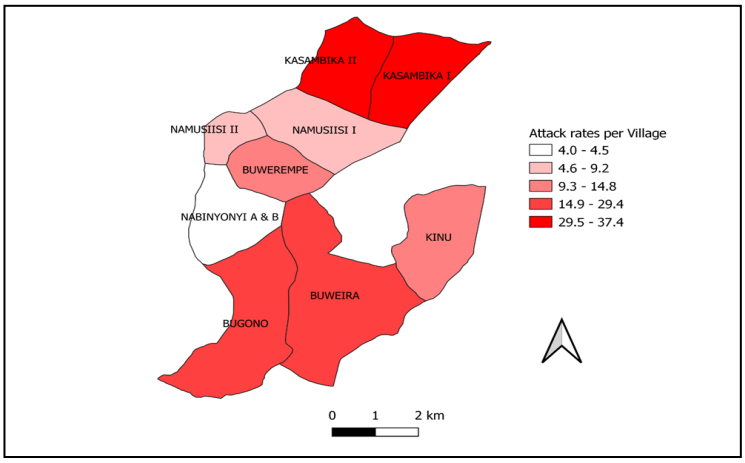

Figure 2 : Villages most affected with malaria in the severely affected three parishes of Nabitende subcounty, Iganga District, December 2021- February 2021

There was no distinct relationship between rainfall and the number of malaria cases recorded (Figure 3).

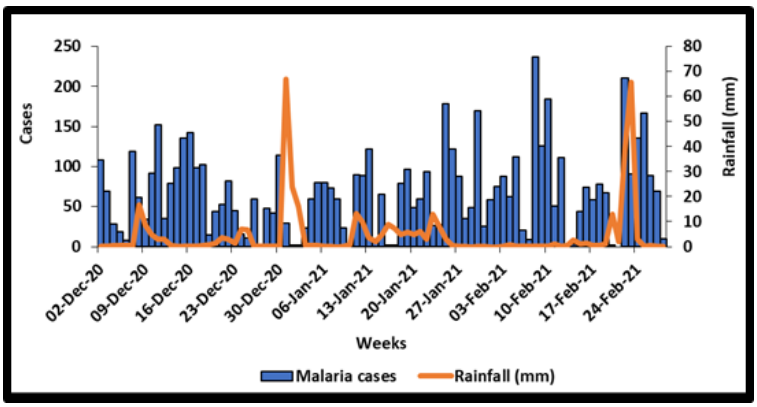

Figure 3: Periodic peaks of rain in Nabitende sub county (December 2020-Feb 2021)

Hypothesis generation findings

During our walks through the villages, we observed most households were located in very close proximity to farm fields (sugar cane plantations, sweet potato plantations, rice farms, banana plantations). Interviews with 14 household heads indicated that 5 households had changed had their proximity to the farm fields in recent months, suggesting this as a possible factor associated with the outbreak. During home visits, we identified holes in houses where mosquitoes could pass through, even if the door was closed. These holes were located in the space between the wall and the roof. We also identified trenches in rice fields that contained standing water, in which mosquito larvae were found. Water containers around homes as well as harvesting pots/ containers were also found to contain mosquito larvae. During the discussion with the community members, we learned that there had been a recent policy change on the sales of sugarcane to the factories. This effectively reduced the price and demand for sugar and made it substantially less profitable for farmers. As a result, many farmers had changed from sugarcane planting to rice planting. We considered this as a possible factor associated with the outbreak, since rice fields much more often hold standing water compared with sugarcane fields.

Among other exposure factors, we inquired about drug stock-outs, which might facilitate outbreaks by allowing people to go untreated for their malaria infection, health facilities in-charges confirmed that they had no antimalarial stock-outs in health centres between May 2020-Feb2021. We also inquired about staying outside houses in late night hours, community members reported that they had participated in recently concluded elections. Due to the COVID-19 outbreak, campaigns were not supposed to be conducted in person. To reduce the chance of detection, activities were instead conducted in the evenings and late-night hours. The election activities involved moving from door to door to solicit votes and also holding late-hour meetings. This increased the risk of people being exposed to mosquitos (describe how it works).

Participating in recent political campaigns (OR=1.6; 95%CI=1-2.5), residing near water logged places (OR=2.5; 95%CI=1.4-4.4), and having a household located <500m from a swamp (OR=2.3(CI=1.4-3.8) were strongly associated with this malaria outbreak. Also, distance of households (<500m) to the rice and sugarcane fields during the outbreak was associated with malaria disease [rice; OR=2.2, CI (1.2-4.2), Sugarcane; OR=1.67, CI (1.03-2.7)] (Table 2).

Table 2: Factors associated with malaria infection, Nabitende subcounty, Iganga District, December 2021- February 2021

Exposure	% cases exposed	% controls exposed	OR	CI
Political campaigns in late hours	68.8	31.2	1.6	1-2.5
Water logging	70.6	29.3	2.5	1.4-4.4
Household close to the swamp (<500m)	66.4	33.6	2.3	1.4-3.8
Rice(<500m)	48.0	15	2.5	1.2-4.2
Sugarcane(<500m)	168	90	1.7	1.0-2.7
Ownership of mosquito nets	64.4	35.6	1.4	0.9-2.1
Water holding containers outside household	65	35	1.6	0.8-3.3
Open spaces on the house	64.1	35.9	1.3	0.8-2.0
Completion of antimalaria drugs	78.7	21.3	1.5	0.4-4.9
Changed occupation	55.7	44.3	0.7	0.4-1.3
Human activity in the swamp	72.9	27.1	1.7	0.2-2.0

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Discussion

Malaria has remained a big challenge in Uganda regardless of all the interventions implemented. Our findings indicated that the Malaria outbreak in Iganga had occurred six months before with Nabitende sub-county being the most affected, three parishes of Kasambika, Itanda and Bugono were the most affected. In these parishes, five villages: Kasambika, Buweira , and Bugono were more affected with an attack rate of more than 14/100 population. Participating in political campaigns late at night, residing near water logged places (within <500M), having household close to the swamp and having rice and or sugar farm field within 500m to the households were strongly associated with the outbreak.

People residing in households near waterlogged places were more likely to suffer from malaria. Waterlogged places tend to act as the breeding sites for the mosquitos. These findings are in agreement with a study done in Kyotera District identified waterlogging as significant factor associated the outbreak at the time (5). It is also in agreement with the study done by Godfrey N. who established that there was a strong association between staying near water logged areas and suffering from Malaria in a study done in northern Uganda (6)

Distance less than 500m from the household was also found to be significantly associated with malaria infection. Rice fields provide suitable breeding sites/places for anopheles mosquitos. While in the field, we saw trenches in the rice fields and these are dug by the owners of these rice fields to retain water in their farms. These later turn into breeding sites and since most of the rice farms were in a distance of <500m from households, mosquitos can fly and feast on people.

Households close to the swamps (<500m) were also associated with this malaria outbreak in Nabitende sub-county. These findings are similar to those of a study done by Baymot who found out that people living near swamps were more likely to be infected with malaria compared to those who stayed far (7). This is due to the presence of breeding sites in the swamps coupled with the fact that mosquitoes can fly up to a distance of 500m (8).

Study limitations

The controls used in our investigation were not tested. It is therefore possible that some of them might have been asymptomatic at the time of our investigation or at a certain point during the period considered for the investigation. Being asymptomatic controls might have led to an underestimation of the outcomes and associations in our study. Additionally, our study was only conducted in one subcounty, and cannot therefore be generalized to the entire district. It is also possible that some of the cases were tested and treated more than once in a healthy facility or at different health facilities because of non-adherence to treatment or reinfection. Testing and being treated more than once might have led to an overestimation of the magnitude of the outbreak.

Conclusion

This Malaria outbreak in Nabitende Sub-county was facilitated by proximity of households to mosquito breeding sites, that is, swamps, and agricultural fields (rice, sugarcane and banana). The change in agricultural practice, from sugarcane to rice farming might have also facilitated the outbreak.

We recommended to the officials of Iganga District to strengthen their surveillance system by using Malaria Early Warning System and larviciding breeding sites (water logged places) in the area.

Public health actions

We implemented some immediate control measures in the affected communities and homesteads, and these included: Draining of pots and containers that were found to have stagnant water; we conducted health education about the importance of eliminating active and potential breeding sites for mosquitoes around homes; Emphasizing the need for proper and consistent use of treated mosquito nets; Sensitization of the community members and leaders on malaria and its prevention by using simple cost-effective strategies like wearing long sleeve clothes in evenings, closing windows and doors early, repurposing of old/damaged nets into curtains

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Counting deaths in Uganda: history, challenges, and what is currently being done amidst COVID-19 Pandemic

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Summary

Background and methods: The COVID-19 pandemic has led to a dramatic loss of human life and has been an unprecedented challenge to public health service delivery. One challenge has been identifying COVID-19-specific mortality in Uganda because of limited testing capacity. In addition, the disruption of societal and health systems caused by the epidemic contributes to deaths from other causes. All-cause mortality surveillance before, during and after a pandemic can help in understanding the true impact of COVID-19 on mortality. The Uganda Rapid Mortality Surveillance Project commenced from November, 2020 to-date to strengthen mortality surveillance at both health facility and community level. Rapid mortality surveillance (RMS) Informs decision makers about the full magnitude of the health consequences of pandemics with a focus on excess mortality. It enables real-time capturing and processing mortality data to enable monitoring of mortality trends to monitor population health and public health measures and contributes to the Civil Registration and Vital Statistics (CRVS) system strengthening efforts in order to ensure maximum benefit from routine data systems for policy and development. We conducted a descriptive analysis of the prospectively reported deaths in the RMS project database by age, sex, place and date of death to inform planning and interventions. Results: By the 31st August, 2021, preliminary findings showed that 8,513 deaths had been reported from 1st January to 31st August 2021 from both health facility and community level. Of these,61% (5,209/8,513) were health facility reported and 39% (3,304/8,513) were community reported deaths. Of the 5,209-health facility reported deaths, 94% (4,896/5,209) had died from natural causes, 55% (2,850/5,209) were males, 25% (1,319/5,209) were in the age-group of 0-9 years. Majority of health facility reported deaths were reported by Fort portal RRH 14% (723/5,209) and Hoima RRH 14% (713/5,209). A COVID-19 test was done on 19% (993/5,209) of the health facility reported deaths. Of the 993 health facility reported deaths that underwent a COVID-19 test, 69% (687/993) had a positive test by either PCR or Rapid Diagnostic Test. Among those that underwent COVID-19 test, the test positivity rate was 65% or higher for age-groups 30 years and above. For the 3,304 community reported deaths, 83% (2,753/3,304) had died from natural causes, 43% (1,437/3,304) were males, 73% (2,417/3,304) had died from home and 27% (885/3,304) had died from health facilities. COVID-19 test was done on 6.7% (223/3,304) of the community reported deaths. Of the 223 community reported deaths that underwent a COVID-19 test, 51% (114/223) had a positive test by either PCR or Rapid Diagnostic Test. Conclusion: The project has succeeded in strengthening collection of real time mortality data at both health facility and community level. We recommend further collection of prospective data that will help to target, prioritize, monitor the effectiveness of prevention and response strategies for COVID-19 and other diseases in Uganda.

Background

Approximately half of all deaths in the world go unrecorded; thus, health policy decisions are often based on inadequate information(1). In Uganda, most deaths in health facilities go unreported to the National Identification and Registration Authority (NIRA), and an even smaller proportion of deaths in the community are reported(2). According to World Bank estimates, the crude death rate in Uganda was 6.5 deaths per thousand in 2018(3). There are few data about the causes of death by age, sex, date of death, place of death, and place of usual residence at either the health facility or community level(4). The COVID-19 pandemic has led to a dramatic loss of human life and has been an unprecedented challenge to public health service delivery(5). One challenge has been identifying COVID-19-specific mortality in Uganda because of limited testing capacity(6). Furthermore, the disruption of societal and health systems caused by the epidemic contributes to deaths from other causes(6, 7). All-cause mortality surveillance before and during the pandemic can help in understanding the true impact of COVID-19 on mor-

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tality, thus predicting the mortality of any other pandemic. Rapid mortality surveillance is a system for generating daily or weekly counts of all-cause mortality by age, sex, date of death, place of death, and place of usual residence. Rapid mortality surveillance helps to count both deaths that have occurred at health facilities and in the community to provide accurate, timely, and reliable mortality data(8). Mortality surveillance helps identify the leading cause(s) and circumstances of deaths to guide immediate and future prevention strategies. Counting of deaths in Uganda has been conducted for a few conditions/diseases, such as maternal mortality; the practice has been restricted mainly to health facilities(9). Most importantly, the mortality data have not been aggregated into one system for easy monitoring and to establish cause-specific mortality rates.

The Uganda Rapid Mortality Surveillance (RMS) project, which commenced on 1st November 2020 will contribute to the reduction in the mortality surveillance related challenges Uganda is currently facing. The project is being implemented by two key implementers, the Ministry of Health (Uganda National Institute of Public Health [UNIPH] & Division of Health Information) and the National Identification and Registration Authority (NIRA). The key funders of the project include the Government of Uganda, Africa Centers for Disease Control and Prevention, CDC Foundation and Bloomberg Philanthropies Data for Health Initiative. The project is aimed at establishing a rapid mortality surveillance system that captures at health facility and community levels daily and weekly counts of all-cause mortality by age, sex, date of death, place of death, and place of usual residence to establish the impact of COVID-19 by evaluating excess mortality attributable to the pandemic. At health facility level, the project is being implemented at the 15 Regional Referral Hospitals (RRH) in the country putting into consideration regional representation that include: Arua, Gulu, Lira, Soroti, Moroto, Mbale, Jinja, Masaka, Hoima, Mubende, Fort portal, Mbarara, Kabale, Naguru and Entebbe. One medical records officer was trained from each RRH hence a total of 15 trained focal persons. The Regional Referral Hospital Focal Persons collect data on death events that have occurred within their respective RRHs and those brought in dead (BID)/dead on arrival (DOA) using a standard health facility based hard copy line list that is filled and updated on a daily basis. The line lists are remitted daily to the rapid mortality surveillance project coordinator and senior epidemiologist by email. The data sources used include: outpatients registers, inpatient registers, theatre registers, mortuary registers, death review reports and death notification reports.

At community level, the project is being implemented in 5 Ministry of Health regions that had registered the highest COVID-19 cases in the first wave of the pandemic in Uganda and these include: Lira, Kampala metropolitan, Masaka, Gulu, and Mbale. From each of these regions, 3 most affected districts were purposively selected making a total of 15 first phase districts that include: Kayunga, Mukono, Wakiso, Lira, Dokolo, Oyam, Gulu, Amuru, Kitgum, Masaka, Kyotera, Rakai, Mbale, Tororo, and Kapchorwa. Thirty Parish Village Health Team (VHT) coordinators were trained from each of the 15 Districts hence a total of 450 trained VHT coordinators. One district VHT coordinator was trained from each of the 15 districts making a total of 15 trained District VHT coordinators. Trained Parish (VHT) Coordinators collect data on any death alert in their areas of jurisdiction and enter in the standard community line list. The data source used include: next of Kin or immediate caretakers of the deceased. Data is remitted as a short death notification message to the mobile tracking (mTrac) system of the Ministry of Health (MoH). Hard copies of the line list are picked by the District VHT Coordinators and submitted to the rapid mortality surveillance project coordinator and senior epidemiologist on a quarterly basis.

Baseline mortality data collection is also on going at both Regional Referral Hospitals and in the 15 first phase districts for 3 years (1st Jan 2018 – 31st Dec 2020). Data from the baseline assessment will be used to compute expected deaths. In addition to the data collection activities, the project central team conduct monthly review meetings with RRH focal persons and District VHT coordinators to highlight and make a way forward to the challenges faced during the data collection process at both RRHs and community level. On a weekly basis, analysis and dissemination of mortality data is done every Tuesday during weekly technical meetings. On a monthly basis, findings from the analysis are presented during the National Task force meetings to inform actions. We conducted a descriptive analysis of the prospectively reported deaths by age, sex, place and date of death to inform planning and interventions.

Methods

We conducted a descriptive analysis of the prospectively reported deaths captured in the rapid mortality surveillance data base from November, 2020 to 31 August, 2021. We described the deaths by age, sex, place and date of death. Frequencies and percentages were computed. We sought permission for using the data from the rapid mortality surveillance project management which owns the data. Data was kept in confidential and was only accessed and analyzed by the project staff.

Results

Over all, by the 31st August, 2021, the preliminary findings show that 8,513 deaths had been reported from 1st January 2021 to 31st August 2021 at both health facility and community levels. Of these, 61% (5,209/8,513) were health facility reported deaths and 39% (3,304/8,513) were community reported.

Of the 5,209 health facility reported deaths, 94% (4,896/5,209) had died from natural causes, 55% (2,850/5,209) were males, 25% (1,319/5,209) were in the age-group of 0-9 years, followed by 11% (555/5,209) in the age group of 30-39 years while 8.4% (436/5,209) were in the age-group of 80+. (Table 1)

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Table 1: Distribution of reported deaths, Uganda, January 2020-August 2021,

Variable	All reported deaths at RRHs N = 5,209	Had a COVID-19 test		COVID-19 test result (n=993)		
		Yes n (%)	No n (%)	Positive n (%)	Negative n (%)	Results not yet received n (%)
Sex						
Male	2,850 (55)	524 (19)	2,326 (83)	370 (71)	108 (21)	46 (9)
Female	2,301 (44)	468 (20)	1,833 (80)	316 (68)	91 (19)	61 (13)
Not recorded	58 (1)	1 (2)	57 (98)	1 (100)	0 (0)	0 (0)
Age group						
0-9	1,319 (25)	52 (4)	1,267 (96)	11 (21)	9 (17)	32 (62)
10-19	281 (5)	31 (11)	250 (89)	12 (39)	15 (48)	4 (13)
20-29	478 (9)	60 (13)	421 (88)	29 (48)	21 (35)	9 (15)
30-39	555 (11)	81 (15)	474 (85)	53 (65)	19 (23)	9 (11)
40-49	500 (10)	112 (22)	388 (78)	77 (69)	25 (22)	10 (9)
50-59	534 (10)	143 (27)	391 (73)	107 (75)	27 (19)	9 (6)
60-69	494 (9)	161 (33)	333 (67)	124 (77)	23 (14)	14 (9)
70-79	453 (9)	171 (38)	282 (62)	132 (77)	31 (18)	8 (5)
80+	436 (8)	127 (29)	309 (71)	126 (99)	1 (1)	0 (0)
Not recorded	159 (3)	55 (35)	104 (65)	17 (31)	3 (5)	35 (64)

Majority of health facility reported deaths were reported by Fort portal RRH 14% (723/5,209) and Hoima RRH 14% (713/5,209) (Table 2). A COVID-19 test was done on 19% (993/5,209) of the health facility reported deaths. Of the 993 health facility reported deaths that underwent a COVID-19 test, 69% (687/993) had a positive test by either PCR or Rapid Diagnostic Test and the test positivity rate was 65% or more among age groups 30 years and above (Table 1).

Table 2: Showing distribution of reported deaths at Regional Referral Hospitals

Regional Referral Hospitals	Frequency	Percent
Entebbe	91	1.7
Moroto	94	1.8
Naguru	129	2.5
Jinja	190	3.6
Kabale	213	4.1
Gulu	229	4.4
Mbarara	321	6.2
Masaka	357	6.9
Mbale	363	7.0
Mubende	378	7.3
Arua	400	7.7
Soroti	469	9.0
Lira	539	10.3
Hoima	713	13.7
Fort portal	723	13.9
Total	5,209	100

For the 3,304 community reported deaths, 83% (2,753/3,304) had died from natural causes, 43% (1,437/3,304) were males, 73% (2,417/3,304) had died from home and 27% (885/3,304) had died from health facilities. COVID-19 test was done on 6.7% (223/3,304) of the community reported deaths. Of the 223 community reported deaths that underwent a COVID-19 test, 51% (114/223) had a positive test by either PCR or Rapid Diagnostic Test.

Discussion

We found that most of the deaths occurred at health facilities than in the community. Majority of the deceased both at health facility and community level died from natural causes and were males. Age group 0-9 years particularly, neonates was most affected among the health facility reported deaths while age group 80+ was most affected among the community reported deaths. The positivity rate among those who underwent a COVID-19 test at both health facility and community level was high and increased by age.

This analysis revealed that most of the reported deaths occurred at a health facility as compared to those that occurred at home. This may be explained by the fact that regional referral hospitals are high volume health facilities and have a catchment area of 2 million people(10). Most patients admitted in health facilities had severe COVID-19 and required specialized medical services such intensive care unit (ICU) which were not readily available. However, we our findings are in contrast to a study conducted in Burkina Faso, Ethiopia, and Nigeria that found barriers to healthcare access due to the pandemic(11). Our findings suggest that even though essential health services have been disrupted by the pandemic, people are still going to regional referral hospitals to seek care.

Secondly, majority of the deceased both at health facility and community level died from natural causes. This is expected for deaths that occur in the community because in most cases there is no medical examination or history taken(1, 12). However, for deaths that occurred at health facilities, it shows a lack of coding of the specific causes or factors contributing to death as prescribed by the International Classification of Diseases 11th revision (ICD-11)(13). Therefore, there's a need to scale up training and implementation of the ICD-11 module and certification of deaths at health facilities in Uganda that will directly feed into death registration information collected for civil registration and vital statistics by NIRA.

Thirdly, the age group 0-9 years, particularly neonates contributed the highest proportion of deaths at RRHs. This is expected because it is in line with 2019 estimates by United Nations Inter-agency group for child mortality estimation which show that Uganda still has high neonatal (20/1000), infant (33/1000) and

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under-five (45/1000) mortality rates per 1,000 live births(14). As expected, the mortality rate for the age group 5-9 years was a bit lower, estimated at 8.6 per 1000 children aged 5(14).

Additionally, the positivity rate among those who underwent a COVID-19 test at both health facility and community level was high at more than 50%. This may be explained by the increase in testing volume as COVID-19 RDT kits became widely available in April 2021(15). This finding also shows the high burden of COVID-19 at both health facility and community level at the time. It provides evidence of widespread community transmission of COVID-19. This supports expansion of COVID-19 testing services to all those that need it and as well help with attribution of cause of death to COVID-19.

Lastly, for those who died at RRHs, the test positivity rate increased with age. Those who were 30 years and above had test positivity rates higher than 60%. This finding helps to highlight the nature of the COVID-19 pandemic in Uganda at the time. It is supported by results from other studies that found higher infection rates in older age-groups which in turn lead to higher chances of having comorbidities and worse outcomes like death(16-18).

With these findings, the Rapid Mortality Surveillance project has met it's main objective which is to provide real time evidence-based information on overall mortality within the context of COVID-19 pandemic in Uganda. The RMS project data will help to give estimates of the number of deaths in excess of those expected in the absence of the SARS-CoV-2 epidemic that are highly correlated with the confirmed number of COVID-19 deaths over time(19). The project has succeeded in strengthening collection of real time mortality data at both health facility and community level.

Limitations

Despite the achievements, we were an unable to calculate the excess mortality caused by COVID-19 because we did not have complete mortality data before the pandemic. Baseline data collection is still ongoing and once complete expected deaths will be computed and compared with the observed deaths. We are also cognizant of the fact that the community level data is currently being collected from 30 districts representing only 5 regions whereas the data at health facility level is being collected from all the 15 regions in the country. This may limit the representativeness of the community level data.

Conclusion

The project has succeeded in strengthening collection of real time mortality data at both health facility and community level. Most of the reported deaths occurred at a health facility as compared to those that occurred at home. Majority of deaths at both health facility and community level were due to natural causes and were males. Age group 0-9 years specifically, neonates was most affected among health facility reported deaths while age group 80+ was most affected among community reported deaths. The positivity rate among those who underwent a COVID-19 test at both health facility and community level was higher than 50% and for health facility deaths, it increased by age.

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