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Dear Reader,

Welcome to Issue One of the Third Volume of the Uganda National Institute Public Health (UNIPH) Quarterly Epidemiological Bulletin.

This bulletin aims 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 the country.

In this issue, we present reports on the investigation of the cholera outbreak in Hoima District; the malaria epidemic in Kisoro District; mumps in a children home in Wakiso District; and deaths due to consumption of food laced with a poisonous chemical in Sironko District. Also in the issue are three policy briefs, namely: Combating Resistance to Insecticides; Alternative Approaches in Sustaining the Relevance of Vector Control Strategies; and Increase vaccination against meningococcal meningitis to areas outside the meningitis belt.

In case you would like to access original references used in this issue, feel free to contact us at: **dokethwangu@musph.ac.ug** **OR** **dkadobera@musph.ac.ug**

We will appreciate any feedback regarding the content and general outlook of this issue and look forward to hearing from you. We hope this will be both an informative and enjoyable reading to you.

Thank You

Inside this issue:

THE UGANDA PUBLIC HEALTH FELLOWSHIP PROGRAM CONDUCTS THE SECOND GRADUATION CEREMONY

By Doreen Birungi

The Uganda Public Health Fellowship Program graduated another cohort of Field Epidemiologists in January 2018. This was the second cohort of fellows trained in field epidemiology through an intensive 2-year in-service training. The nine graduands were awarded in a colorful ceremony hosted at Golf Course Hotel, Kampala on 24 January, 2018. The ceremony was attended by Uganda Ministry of Health officials, CDC Country Director and staff, the World Health Organization Country Representative, staff from Makerere University, USAID and District Health Officers.

The guest of Honor, Prof. David Sserwadda appreciated the achievements by the graduands and urged them to use the capabilities gained during the two-year training to benefit Uganda and the African continent. Fellows were appreciated for providing high quality outputs at their respective host sites and improving Uganda's capacity to respond to numerous disease outbreaks. Prompt response to threats that affect safety and health of people is vital thus, the need to develop robust capacity in the health system. He urged fellows to demonstrate high levels of professionalism as they provided health service in various fields.

During the ceremony, the graduands presented their defense using some of their projects highlighting evidence-based and policy-relevant recommendations for some of the public health challenges faced in Uganda. Projects under taken by fellows ranged from evaluation of surveillance systems in refugee settlements, responding to public health emergencies, projects on HIV, and public health interventions aimed at improving quality of service delivery.

The certificate award ceremony was graced by the Dean of School of Public Health Makerere University, Assoc Prof Rhoda Wanyenze, who appreciated Ministry of Health for integrating the program with an overall aim of enhancing capacity in disease control and prevention. The Director General Health Services, Ministry of Health stressed the need of embracing the One Health approach in handling public health challenges.

PHFP-secretariat, Ministry of Health officials, AFENET ED and Fellows (graduands) pose for a photo after the ceremony

Upcoming Events

World Health Day: April 7, 2018

This is the global health awareness day, first observed on Apr 7, 1948. The aim of this day is to spread awareness on health and well-being. This year's theme is 'Universal Health Coverage: Everyone, everywhere'

World Malaria Day: April 25, 2018

The world commemorates this day as a sign of commitment made in 2007 (when the day was established) to rid the world of malaria. In Uganda, this day shall be commemorated in a yet-to-be-communicated venue. The theme this year is 'Ready to beat malaria!"

World No Tobacco Day: April 31, 2018

This day is observed annually to highlight health and other risks associated with tobacco use, and advocating for effective policies to reduce tobacco consumption. The focus of this year's WNTD is 'Tobacco and heart disease'.

The Field Epidemiology Training Program (FETP) International Night: April 17-18, 2018; Atlanta, GA, USA

This event is co-sponsored by TEPHINET and CDC. At this year's international night, PHFP will present the following abstracts: Food Poisoning Caused by Poisonous Cassava Flour: Kasese District, September 2017' by Dr. Phoebe Alitubeera and 'Outbreak of Gastrointestinal Anthrax following Consumption of Beef of Suspicious Origin–Isingiro District, Uganda, 2017' by Dr. Miriam Nakanwagi.

Good luck, fellows in your presentations!

THE WORLD TUBERCULOSIS DAY CELEBRATIONS IN ARUA DISTRICT

By Dr. Freda Loy Aceng

Tuberculosis (TB) is as old as mankind and continues to haunt man despite advances in diagnosis and management of the disease. Globally, TB is one of the major ten causes of death. In 2016, 10.4 million people had TB disease and 1.7 million died. More than 95% of TB deaths were in low & middle income countries. According to the 2015 Uganda National TB prevalence survey, the incidence of TB was at 201/100,000 population for all TB cases & prevalence was 253/100,000 population.

Each year, World TB Day is commemorated on March 24 to raise public awareness about the devastating health, social and economic consequences of TB & step up efforts to end the global TB epidemic. The date marks the day in 1882 when Dr. Robert Koch announced that he had discovered the bacterium that causes TB, and thus opened the way towards diagnosing and curing the disease. The theme of World TB Day 2018 "Wanted: Leaders for a TB-free world" focuses on building commitment to end TB, not only at the political level with Heads of State and Ministers of Health, but at all levels of leadership, and across partnerships and stakeholders. All can be leaders of efforts to end TB in their work or terrain. In Uganda, the national event for the World TB Day was hosted at the Boma Grounds in Arua District in the West Nile region of Uganda. The theme was 'Leaders for a TB-free Uganda' and the slogan was 'Act to End TB today'. Arua District was chosen because it has one of the largest numbers of TB case notifications in the country. Activities were also going on in various areas around the country including in Kampala. The Guest of Honor for this event was the State Minister for Health-General Duties. The Minister asked for commitment from all leaders in order to end TB in Uganda. She also launched the enhanced pediatric TB formulations and short course regimen at Arua Regional Referral Hospital. In attendance were several other stakeholders such as implementing partners and district leaders.

The Program Manager, NTLP and Minister of State for Health inspecting stalls during the commemoration

CLOSE-DOWN OF THE SECOND UNIVERSAL COVERAGE CAMPAIGN FOR LONG LASTING INSECTICIDAL NOSQUITO NETS (LLINS)

By Denis Okethwangu

President Museveni (with hat), Ambassador Malac (2nd right) and Hon. Opendi (left) give out a mosquito net to a beneficiary in Sheema District during the function

The universal coverage campaign (UCC) for long lasting insecticidal mosquito nets (LLINs) came to a close on the 17 March 2018. The year-long campaign was led by the Ugandan Ministry of Health with support from Global Fund; the UK's Department for International Development (DfID) through UNICEF; the US Agency for International Development/President's Malaria Initiative (USAID/PMI); and Against Malaria Foundation (AMF) among other funders. This was the 2nd campaign after the first, conducted in 2014. It is envisaged that, with these campaigns, LLIN ownership will significantly increase to protect at least 85% of the Ugandan population.

The close down of this campaign was marked by a colourful function in Sheema District. The function was graced by the President of Uganda, who personally gave out a mosquito net each to four persons in the district. Other dignitaries that attended this function were the US Ambassador, government officials, and heads of partner organisations. This function was designed to coincide **with** Wave 4b of the campaign targeting Mbarara, Sheema, Kasese, Kagadi and Bundibugyo districts.

The campaign was run in seven waves to cover the entire country. Wave 1 conducted in February 2017 covered Northern Uganda districts, including West Nile. Wave 2 in April 2017 covered most Eastern Uganda districts. Wave 3 covered the remaining Eastern and a few Western Uganda districts, and was conducted in May 2017. Wave 4a conducted in June 2017 covered most other Western Uganda districts. Wave 5, in November 2017, covered Central Uganda districts except Wakiso & Kampala Districts, which were covered in Wave 6 in Jan & Feb 2018 respectively. Wave 4b was the last wave of the campaign. By the end of Wave 5, the coverage target of 85% had been exceeded, and was at 90%. According to the National Malaria Control Program, >24 million nets had been distributed to over 38 million people in 109 districts in 7,000 parishes in over 54,000 villages.

CHOLERA OUTBREAK IN KYANGWALI REFUGEE SETTLEMENT IN HOIMA, UGANDA, 2018

Fred Monje[1], Kenneth Bainomugisha[1], Daniel Kadobera[1], and Benon Kwesiga[1]
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SUMMARY

On 15 February 2018, Uganda Ministry of Health (MoH) was notified of 3 suspected cholera deaths in Kyangwali refugee settlement, Hoima District, Western Uganda. Following the alert, the MOH confirmed Vibrio cholerae by culture and declared a cholera outbreak on 23 February 2018. On 24 February, 2018, we conducted an investigation to determine the scope of cholera outbreak; identify possible exposures; and recommend evidence-based control measures. The case fatality rate was 2.2% and Kyangwali sub-county was the most affected with attack rate of 16/1,000 case-patients. We conducted a frequency-matched case-control study and found that stream water was associated with cholera outbreak. We recommended increased access to safe water in all affected communities.

INTRODUCTION

Cholera is a preventable acute diarrhoeal disease caused by infection of the intestine with the bacterium *Vibrio cholerae* serogroup O1 or O139. Cholera is usually transmitted through consumption of water or food contaminated by feaces bearing the cholera causing organism. About 20% of those who are infected develop acute, watery diarrhoea and 10–20% of these individuals develop severe watery diarrhoea. The incubation period is very short (2 hours to 5 days) and thus the number of cases can rise quickly. If these patients are not promptly and adequately treated, the loss of such large amounts of fluid and salts can lead to severe dehydration and death within hours (Pande *et al.,* 2018, Ali *et al.,* 2017).

On 15 February 2018, Uganda Ministry of Health was notified of 3 suspected cholera deaths in Kyangwali refugee settlement, Hoima District. The signs and symptoms presented before death were vomiting, fever and acute watery diarrhea. 70% (7/10) of stool samples from the patients tested positive for *Vibrio cholerae* by culture. We conducted an investigation to determine the scope of cholera outbreak; identify possible exposures; and recommend evidence-based control measures.

METHODS

We defined a community case as onset of watery diarrhoea in a person in Hoima District since 1 February, 2018; suspected case as onset of watery diarrhoea in a person aged ≥2 years in the Hoima District since 1 February, 2018; a confirmed case had *Vibrio cholerae* serogroup O1 or O139 isolated by culture from the stool sample. We found cases by vising affected communities, reviewing and updating line lists at cholera treatment centres. We conducted a descriptive epidemiology by person, place and time. We then conducted a case control study where we compared exposure factors among cases and controls. We interviewed case-persons about their water sources. We also conducted environmental assessment of the refugee settlement regarding water sources, and sanitation, and tested water samples for pathogen identification.

RESULTS

Person: We line listed 1,625 case-patients, with a case fatality rate of 2.2% (36/1625) as of 12 March 2018. The attack rates per 1000 persons by sex in Maratatu village in Kyangwali sub-county were 1.9 for males and 2.2 for females. The age-specific attack rates (/1000) for 0-9 years was 1.5; 10-19 years was 2.5; 20-39 years was 0.86; 40-59 years was 6.3; and >60 years was 0.21.

Place: The attack rate per sub-county was 16 per 1000 persons in Kyangwali; 4 in Kabwoya and 1 in Buseruka (see figure 1).

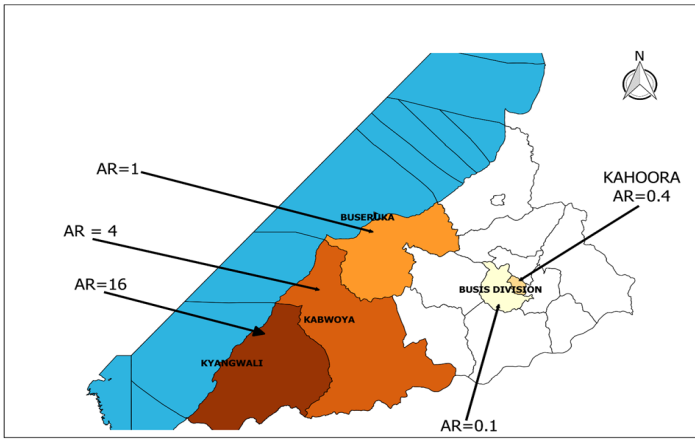

Figure 1: Map of Hoima showing attack rates (/1000) of cholera per sub-county

Time:

The first case-patient occurred on 11th February, 2018 and progressed to a peak on 17th February, 2018 before declining down to a minimum on day 20th. Thereafter, the case-patients picked up until another peak on 22nd and later declined to its minimum on day, 23rd. Other peaks were observed on day 25th and day, 28th as shown on the epi-curve.

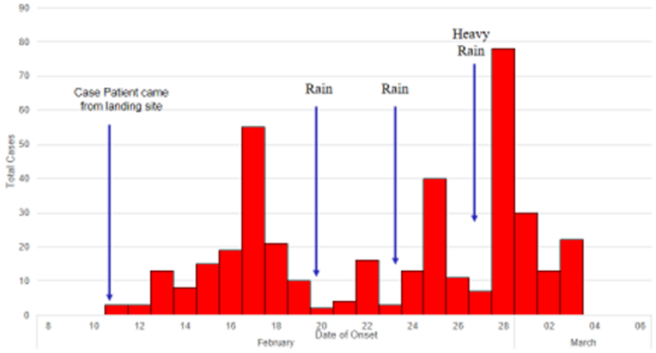

Figure 2: Continuous common source outbreak in Maratatu, Kyangwali sub-county

The epidemic curve indicates a continuous common source outbreak sustained by rains that washed fecal matter into the stream water.

Environmental assessment: There was evidence of open defecation near the stream water during environmental assessment in Maratatu (Figure 3). Stream water testing revealed presence of faecal coliforms.

In hypothesis generation, we considered the known facts about the outbreak such as mode of transmission of cholera, the incubation period, case-patients, the areas most affected, the duration of the outbreak and the pattern of

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the outbreak. On conducting hypothesis generation interviews of 14 case-patients in Maratu B and C, we found out that 71% (10/14) case-patients drank stream water.

Case control study: In a case control study, 63% (46/73) case-households drank stream water compared to 43% (46/107) control-households (matched odds ratio [MOR] = 2.5; CI: 1.2 - 4.9). 1.4% (1/73) case-households drank spring water compared to 13% (14/107) control-households (matched odds ratio [MOR] = 0.13; CI: 0.016 – 1.).

DISCUSSION

The cholera outbreak we investigated was the fifth such outbreak in Hoima District and the third in Kyangwali Sub-county since 2012. As of 12 March, 2018, 1625 case-patients had been identified with 36 deaths (CFR=2.2%). Our epidemiologic and laboratory investigation and environmental assessment revealed that the outbreak was caused by drinking contaminated stream water. The influx of refugees on 5 February, 2018 from the neighboring Democratic Republic of Congo (DRC) constrained water and latrine resource utilization in Kyangwali Sub-county. Consequently, open defecation was evident along the stream and easily washed by the rains thereby intermittently contaminating the water source. This rendered stream water unsafe for direct drinking.

Cholera outbreaks had occurred multiple times in Hoima District since 2012. Our findings could shed light on why cholera outbreaks repeatedly occurred in this fishing community and provide evidence based solutions. The first case-person was a refugee from DRC (where a cholera outbreak was reportedly ongoing) suggesting that he might have contracted the disease from DRC. After cholera was introduced into the refugee community, open defecation, unsafe drinking water, poor hygiene, and rains likely aided the spread of cholera in the refugee community. In previous outbreaks, unsafe water and cross-border activities were also listed as possible exposures. These risk factors still exist in the area; hence new outbreaks could again occur in the future if they are not attended to. After the first refugee case was confirmed, the refugees have continued coming to Uganda thereby posing further threats. During this outbreak, even though cholera outbreaks were occurring on both sides of the border, there was no information exchange between Uganda and DRC geared towards joint control efforts of the Outbreak. Enhanced coordination from both countries is necessary for future preparedness, early detection, and response to disease outbreaks along the albertine border districts.

CONCLUSIONS AND RECOMMENDATIONS

Our investigation revealed that the refugee influx might have introduced cholera into the Kyangwali refugee community. Consequently, drinking unsafe stream water (not treated or boiled) contaminated by feaces that was washed by the rains, aided transmission of Cholera, resulting into a prolonged cholera outbreak. We recommended to the district and ministry of health to increase access to safe water supply in all affected communities. We also conducted health education of the communities to effect behavioral change towards latrine usage.

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MALARIA OUTBREAK IN KISORO DISTRICT, JANUARY 2018

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SUMMARY

Malaria is a febrile illness liable for high morbidity and mortality worldwide. Analysis of DHIS2 data revealed an upsurge in malaria cases in Kisoro District in December 2017 and January 2018. We investigated this outbreak to determine its extent, identify risk factors, and recommend control and prevention measures. We reviewed health records from June, 2017 to January, 2018 in all health facilities in the 2 most affected sub-counties. In a case-control study we compared potential exposures between 145 case-persons and 145 asymptomatic controls matched by age and village. We carried out an entomological and environmental assessment in affected sub counties. Persons older than 5 years of age were the most affected. 22% (32/145) of case-persons and 15% (21/145) of control-persons reported not sleeping under a mosquito net (OR_{M-H}=4; 95%CI=1.2-1.3) in Chibumba village; 89% (129/145) of case-persons and 73% (106/145) of control-persons were bitten by mosquitoes before bed time OR_{M-H}=2.9; 95%CI=1.6-5.7). Anopheles gambiae sensu lato was the dominant identified species. We recommend increased sensitization and further entomological investigations to ascertain vector bionomics.

INTRODUCTION

Despite significant progress in scaling up malaria control interventions, malaria remains one of the most important global health challenges accounting for high morbidity and mortality. Malaria is highly endemic in about 95% of Uganda and is the leading cause of attendance at health facilities [8]. Transmission is unstable and epidemic-prone in extreme south-western areas around Rwenzori mountains, Mt. Elgon in the east and areas extending above 1,800 meters in altitude. Kisoro is one of the highland areas in Uganda with a low malaria prevalence of 12% [8]. A detailed investigation and understanding of the factors impacting increase in Malaria cases in Kisoro was crucial to improve well targeted malaria control strategies.

Methods:

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We defined a confirmed case as any positive malaria test result from mRDT or microscopy from 1st June, 2017 to 27 January, 2018 in a resident or visitor of Kisoro District. We systematically searched for malaria cases by reviewing health records in all health facilities in the 2 most affected sub-counties of Kanaba and Murora. In a case-control study we compared potential exposures between 145 case-persons and 145 asymptomatic controls matched by age and village. We carried out an entomological and environmental assessment of the affected sub counties.

RESULTS

We line listed 2,720 malaria case-patients with a median age of 19 years (IQR 10-30).

Person characteristics

Age Group	Frequency	Population	AR/1000
<5	317	7,692	41
5-18	1023	15,383	67
>18	1380	19,657	70
Total	2720	42,732	100

Table 1: Distribution of cases by age group

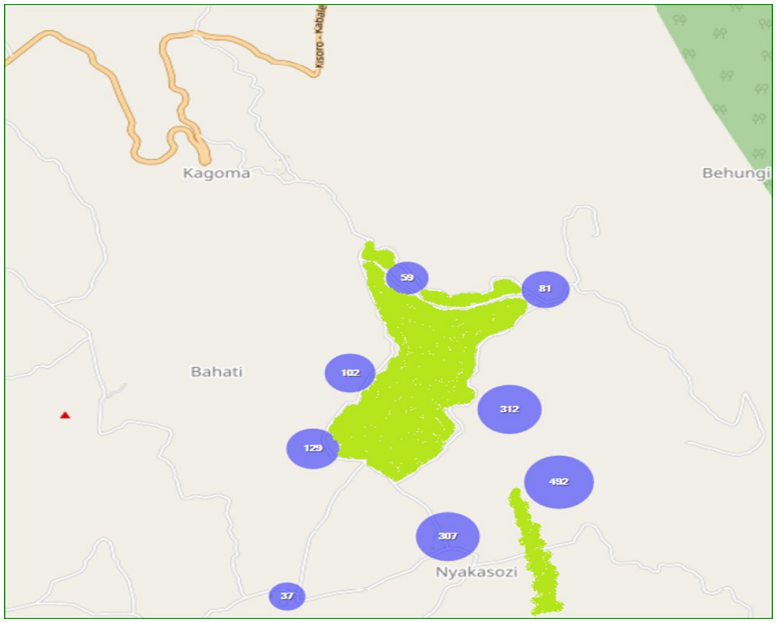
Persons older than 18 years old were most affected, closely followed by those between 5 and 18 years old.

Sub county	Parishes	Cases	Population	Attack Rate/1000
Kanaba	Kagezi	832	8,619	97
	Muhindura	159	10,148	16
Murora	Chahafi	485	13,149	37
	Chibumba	1211	10,816	112

Place characteristics

Table 2: Distribution by Parish

Chibumba Parish had the highest attack rate per 1000 population (112), followed by Kagezi (97), Chahafi (37) and Muhindura (16) parishes (Table 2). In Kagezi, Butoke had the highest attack rate (329/1000 population) followed by Mukaka and Kooga villages with 156 and 146 respectively. In Chibumba Parish, two



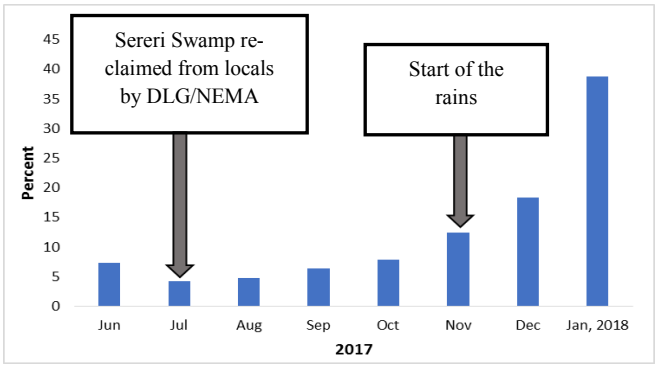
villages; Chibumba (337/1000) and Mpundu (314/1000) were the most affected.

Figure 1: Location of affected villages around Sereri and Mpundu Swamps

Mpundu, Chibumba, Butoke, Mukaka and Kooga villages around Sereri swamp contributed 60% of all the confirmed cases in the 2 most affected sub-counties.

Time characteristics

There was a marked increase in the number of malaria cases in December and January (Figure 3). There has been continuous transmission since September 2017 and is bound to continue if transmission is not broken. The epicurve is indicative of a continuous common source



pattern with waves of transmissions that have kept increasing since November 2017.

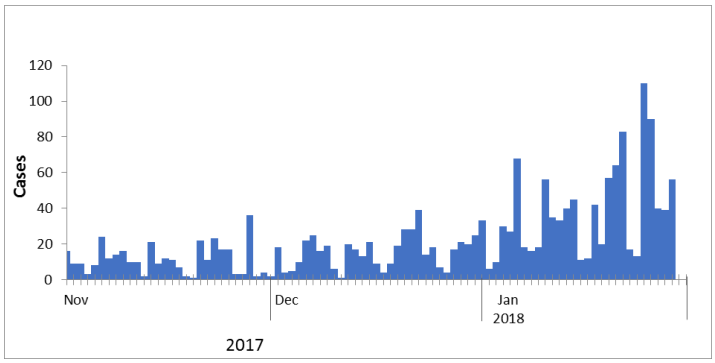


Figure 2: Distribution of cases by month

Figure 3: Epidemic curve showing cases in the most affected months of November, December 2017 and January 2018.

Environmental and entomological assessment: The villages in these sub-counties with high malaria transmission; Mpundu, Chibumba, Kooga, Butoke, Mukaka are located on hills around the Chibumba-Sereri wetland. This swamp an extensive lowland into which run off water from the hilly villages affected by the outbreak drains. Communities have encroached on the wetland to carry out farming and brick activities thus creating suitable breeding sites of malaria (Appendix 1). Stagnant water in brick pits and garden trenches in the swamp were the major breeding sites of *Anopheles*. Temporary breeding sites which depended on continuous rains were roadside pools and tyre-tracks on feeder roads. *Anopheles gambiae sensu lato* was the only vector identified from the Pyrethrum Spray Catches (PSC). Low adult catches were observed by the assessment.

Case control results: Not sleeping under a mosquito net and mosquito bites before bed time were significantly associated to malaria infection. The odds for malaria infection were 3 times higher if the person was bitten by mosquitoes before bed time (OR_{M-H}: 2.9, CI: 1.6 – 5.7) and 4 times higher if one was not sleeping under a mosquito net (OR_{M-H}: 4, CI: 1.2 – 1.3) in Chibumba village.

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Table 3: Exposure status among cases and controls

Exposure	No. of participants		% Exposed		OR_{M-H} (95% CI)
	Cases (n=145)	Controls (n=145)	Cases	Controls	
Not using mosquito net	32	21	22	15	1.7 (0.94 – 3.06)
Chibumba village	14	05	39	14	3.9 (1.2-13)
Mosquito nets before bed time	129	106	89	73	2.9 (1.6 – 5.7)
History of sick in household	86	73	59	50	1.4 (0.91 – 2.3)
Entering bed after 9:00pm	109	113	76	78	0.91 (0.52– 1.6)
Travel history	8	6	5.5	4.1	1.4 (0.45 – 4.3)
Wearing long clothes	38	39	26	27	0.96 (0.57 – 1.6)
Outdoor activities	56	69	39	48	0.69 (0.43 – 1.2)

DISCUSSION

This investigation revealed that there is continuous transmission of malaria in Kisoro District which peaked in late 2017 and early 2018. High malaria transmission is evident among villages of Mpundu, Chibumba, Kooga, Butoke, Mukaka located at the slopes of hills around the Chibumba-Sereri wetland. It's propagated by favorable vector breeding sites located within the affected sub-counties due to human activity in the swamp specifically brick making and agriculture. These provide favorable breeding sites for the anopheles mosquito whose population has steadily increased in the affected areas over time. Homes in the affected sub-counties receive returnees for the Christmas holidays from early November till end of December, many of which are from high malaria endemic areas in Uganda. These easily provide the source for malaria parasites for the anopheles mosquito to transmit. In other areas of Uganda where *Anopheles gambiae* is largely endophilic, the low adult catches by PSC suggests few mosquitoes rest indoors perhaps due to hot conditions facilitated by iron sheet roofs for the houses. This points to the possibility of changes in vectors behaviors, mutation or , changes in the known vector dynamics of biting humans.

CONCLUSION AND RECOMMENDATIONS

To ascertain the true vector feeding and resting behavior detailed bionomic studies have to be conducted using different adult collection methods. Conducting molecular characterization of the *An. gambiae s.l* is key. Community mass action to fill such small pools could be used by environmental health officers through initiating and promoting participation of area residents. Larviciding can be effective in the garden trench pools.

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COMBATING RESISTANCE TO INSECTICIDES: ALTERNATIVE APPROACHES IN SUSTAINING THE RELEVANCE OF VECTOR CONTROL STRATEGIES—A POLICY BRIEF

By Denis Okethwangu[1], Benon Kwesiga[1], Stephen Kabwama[1], and Myers Lugemwa[2]

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SUMMARY

Resistance to insecticides by malaria vectors is an emerging threat in malaria-endemic countries that threatens gains so far achieved in control of the epidemic. The effectiveness of vector control strategies are largely dependent on the potency of the chemicals used. Evidence from the analysis of data from the insecticide resistance database, managed by the Uganda National Malaria Control Program, suggests resistance to pyrethroid chemicals; and partial or total resistance to carbamates. The recommendation of the World Health Organization is to use only chemicals in the pyrethroid class in the impregnation of mosquito nets. Resistance to pyrethroids therefore may compromise the effectiveness of this strategy for malaria control.

Uganda registered dramatic reduction in the malaria burden between 2000 and 2015. There has however, been a reversal in the trend in recent years, with malaria cases rising above the 2015 levels. Consequently, there has been a massive scale-up of vector control strategies. A second mosquito net distribution campaign targeting all households in the country was conducted in 2017, following the first campaign which was implemented in 2013/4. This was envisaged to achieve a target mosquito net coverage of 85%, and consequently further reduce the prevalence of malaria in the country. Indoor Residual Spraying (IRS) has also been implemented in high burden districts in Northern and Eastern Uganda.

The role of insecticide resistance in the reversal of gains in malaria control in Uganda has not been widely explored, yet cannot be dismissed. In order to curtail, the further spread of insecticide resistance, we suggest the roll out of mosquito nets treated with insecticides enhanced with Piperonyl Butoxide (PBO), a synthetic synergist. Organic alternatives to pyrethroids like pyrethrum, which has been demonstrated to be effective, may also be considered.

BACKGROUND

Malaria remains the leading cause of mortality and morbidity

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in the world. In 2015, it was reported that some 214 million cases of malaria had occurred globally, with over 440,000 deaths. The World Health Organization reports that sub-Saharan Africa bears a disproportionate burden of this disease, with 90% of childhood deaths due to malaria occurring in this region (2,3). Over the last decade, however, significant progress has been made in the fight against malaria. The African Leaders Malaria Alliance (ALMA), a platform that brings together leaders in the continent, recently recognized five African countries which decreased malaria prevalence by over 50% from the year 2000 to 2015 (1). Despite these efforts in malaria reduction, there has been an increase in malaria cases in recent years (4). This increase may have been due to a number of factors, including insecticide resistance.

This relative success has been achieved through the application of two major vector control strategies, namely Indoor Residual Spraying (IRS) and the use of Insecticide Treated mosquito nets (ITNs). The application of IRS, and the use of ITNs are the mainstay of vector control in most malaria-endemic countries (5). In Uganda, IRS has a long history dating back to the 1950s. However, in recent years, it has mostly been used in 25 districts in Northern and Eastern Uganda. In these districts, IRS has been used in combination with ITNs, which are widely available countrywide (3). Uganda has just completed the second universal coverage campaign (UCC) for ITNs (Ministry of Health, Uganda). The first one was implemented in 2013/4 (6). In these campaigns, all households in the country are targeted for mosquito net distribution. The target is for a universal coverage of 85% nationwide. Mosquito nets are also given out routinely in health facilities to pregnant women attending antenatal care (ANC) and to children during EPI vaccination. Mosquito nets are also made available through the private sector, where anyone who can afford can buy for themselves. The UCC and routinely provided mosquito nets are free of charge. Both IRS and ITNs are insecticide-based strategies; meaning that they are as effective as the chemicals employed in their implementation.

Currently, the World Health Organization (WHO) recommends only pyrethroids for use in the impregnation of mosquito nets (7). However, four classes of chemicals are approved for use in IRS, including pyrethroids, organophosphates, carbamates and organochlorines (8). Currently, the coverage of IRS in Uganda is limited to less than 20% of the entire country; ITNs on the other hand have been distributed widely, with coverage rates of over 75% (3,9).

EXTENT OF THE PROBLEM

Recent evidence abounds on the extent of insecticide resistance in Uganda. Analysis of data from the Uganda national insecticide resistance database showed that the malaria vector has developed significant resistance to chemicals in the pyrethroid and organochlorine classes. We analyzed insecticide resistance data from five sentinel sites collected from 2011-2015. We used the WHO criteria of classifying resistance, which states thus; less than 90% mortality rates within a specified period indicated resistance. Malaria vector mortality rates greater than 90% but less than 97% suggested partial or possible resistance. Mortality rates greater than 97% indicated vector susceptibility to the insecticide. In Apac, Hoima, Tororo, Wakiso and Kanungu Districts, anopheline mosquitoes were resistant, or partially resistant to both permethrin and deltamethrin. Both these chemicals belong to the pyrethroid class. There was evidence of resistance to more chemicals in the pyrethroid class. In these districts, resistance to Dichloro-diphenyl trichloroethane (DDT), an organochlorine, was also demonstrated. Moderate resistance was also demonstrated to bendiocarb, a carbamate. There was resistance to propoxur, another carbamate, in Wakiso and Tororo Districts. Only the organophosphates were potent against malaria vectors in all sentinel sites selected.

Vector control strategies have made a vital contribution in reducing the malaria epidemic to current levels. The effectiveness of IRS has been widely documented; however, it is expensive and therefore less widely used, except in high transmission areas for the rapid reduction of the prevalence of malaria. Various studies have also demonstrated the effectiveness of mosquito nets in reducing childhood morbidity and mortality. With the current UCC coverage rates, the ITN is the most available malaria control intervention. However, the emergence of resistance to insecticides used in the impregnation of ITNs means that mosquito nets can no longer be relied upon to protect its users against malaria.

POLICY CRITIQUE

Presently, the WHO Pesticide Evaluation Scheme (WHOPES) recommends three LLINs for public sector procurement; namely, Olyset Net®, PermaNet®, and Interceptor®. These LLINs are all impregnated with varying concentrations of pyrethroid chemicals. The Olyset Net® has 2% permethrin, while PermaNet® is impregnated with deltamethrin. Interceptor® on the other hand has alpha-cypermethrin, another chemical in the pyrethroid class (10). Mosquito nets provide a physical barrier, limiting access by mosquito vectors and thus providing protection to the human being from malaria. Pyrethroid insecticides further have an excito-repellant effect providing protection against malaria to the individual. Often, these chemicals kill mosquito vectors that come in contact with them. The emergence of insecticide resistance therefore calls for the need for creative alternatives to enhance protection against malaria using mosquito nets. Though the use of pyrethroids is not as common in indoor residual spraying (IRS), this demonstrated resistance compromises pyrethroids as the chemical of choice.

POLICY ALTERNATIVES

Piperonyl Butoxide (PBO) is a synthetic synergist that helps to enhance the performance of LLINs by increasing the sus-

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ceptibility of malaria vectors to pyrethroid chemicals (11). The mode of action of PBO, among others, is inhibiting the activity of enzymes in mosquitoes, and the incorporation of the synergist has been demonstrated to restore the efficacy of pyrethroids where there is widespread pyrethroid resistance (12). Bendiocarb, against which resistance by malaria vectors has been demonstrated in Tororo and Wakiso Districts may not be effective when used for IRS in these districts. Pirimiphos methyl, an organophosphate, may be used as an alternative. In the last round of IRS in the fourteen Northern and Eastern Uganda districts, pirimiphos methyl was indeed used. The WHO recommends rotation of insecticides as one of strategies to delay or manage resistance by malaria vectors (7). These strategies need to be incorporated in the Ministry of Health policy documents to clearly guide procurement and choice of insecticides for IRS.

POLICY RECOMMENDATIONS

In view of the above, it is recommended that the mosquito nets encouraged for use should be those impregnated with pyrethroids enhanced with PBOs. Currently, there is a mix of mosquito nets with different chemicals used. With the private sector largely unregulated, there is a real danger of non-ITNs offered for sale to Ugandans. According to the Malaria Indicator Survey conducted in 2014, there was a similar number of people with any type of mosquito net as there were with ITNs, including LLIN (13).

Alternatives to pyrethroids may be considered for use in mosquito nets. Organic compounds like pyrethrum have been demonstrated to work as well as pyrethroids. Pilot studies have suggested that it is an alternative to pyrethroids with considerable advantages, including lower resistance ratios, repellency, good knock down effect and blood-feeding inhibition against pyrethroid resistant mosquito vectors (14).

CONCLUSION

The universal coverage campaign for mosquito nets and other channels of distribution have made the vector control intervention more available for use. A significant contributor to the successes in malaria control in Uganda, it is now threatened by the emergence of insecticide resistance by malaria vectors. Incorporation of PBO-enhanced mosquito nets shall restore the relevance of ITNs in vector control. Pyrethrum may yet be another alternative to pyrethroids with lasting results. Lastly, the strategies outlined by WHO in the global plan for insecticide resistance management to delay or manage resistance need to be incorporated in our vector control policies.

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CLUSTER OF DEATHS DUE TO CONSUMPTION OF QUINALPHOS IN SIRONKO DISTRICT, UGANDA- NOVEMBER 2017

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SUMMARY

Quinalphos is an organophosphate chemical chiefly used as a pesticide. It is ranked moderately hazardous in the World Health Organization's acute hazard ranking and its use is either banned or restricted in most nations. We describe a case of alleged intentional poisoning of four members of the same household in Sironko District, Uganda. All the four case-persons developed similar symptoms of stomach ache, vomiting, neck pain and perceived fever (all temperatures recorded in the health facilities were within normal ranges). They all developed symptoms on the same day (9 November 2017) and almost at the same time (onset time for 3 case-persons was 9am and 1 case-person 7pm), and three died within 24 hrs. All the 4 case-persons shared a usual meal with 4 others at 9pm on 8th November 2017 however, the 4 that got ill ate 5 rice balls earlier in the day at 2pm. The severity of symptoms was dependant on the quantity of rice balls eaten. Eight chicken that died ate pieces of rice that fell down during sharing. The only survivor tested positive for quinalphos. This cluster of illness and deaths most likely was caused by consumption of rice balls laced with Quinalphos. We recommended police investigation as triple homicide, and stricter control of pesticides in the district and countrywide.

BACKGROUND

Quinalphos is an organophosphate chemical chiefly used as a pesticide. It is a reddish brown liquid and is ranked moderately hazardous in the World Health Organization's (WHO) acute hazard ranking. The use of quinalphos is either banned or restricted in most nations [1]. Acute pesticide poisoning accounts for significant morbidity and mortality worldwide, especially in developing countries [2]. The WHO estimates three million cases of pesticide poisoning occurring every year resulting in an excess of 250,000 deaths, temporary or permanent disability [3]. And yet pesticides are produced in an unregulated manner and sold by unregistered vendors on the streets and in market places in Sub-Saharan Africa [4]. We describe a case of alleged intentional poisoning of four members of the same household in Sironko District, Uganda.

Case presentations: At 14:00hours, on the 8th November, an eight-year old child (SP) of primary two level came neck home from school with five rice balls (locally called bolingo). The school is approximately 400 metres away. The rice balls (RB) were shared among the children and their grandmother [NB (9-year old)-2 RB, SP (8-year old)-1RB, NP (6-year old) -1/2RB, AW (58-year old)-1 ½RB]. Pieces of the RB fell down as the grandmother shared them. 8/10 chicken that were being reared by the grandfather ate the pieces that fell down. On the same day at 21:00 hours, the family of 8 shared a meal of sweet potatoes, yams, and egg plants and drunk water from a common pot.

On 9th November, as the family awoke at 6:00hours, eight chicken (4 adults and 4 chicks) were found dead. And by 0900hrs the three children (NB, SP and NP) had started developing symptoms.

NB developed stomach-ache, neck pain, fever (self-reported), vomiting and convulsion. She was taken to a clinic A and referred to Hospital B but the mother preferred to take her to her father who stays in the next district. While there, she was taken to clinic C and given normal saline, dexamethasone and hydrocortisone & referred again to Hospital B but died on the same day on her way to hospital at 5pm.

SP developed stomach-ache, neck pain, confusion, convulsion, perceived fever, general body weakness, nasal bleeding, headache and vomiting. She was taken to clinic D and died at 3:15am on 10th November. Only a malaria test (result: negative) and Haemoglobin (Hb: 10g/dl) was done.

AW collapsed at 19:00hours, and taken to clinic E. Other symptoms included neck pain, stomach-ache, chest pain, general weakness, and loss of consciousness. Tests that were run included; Temperature (35.8), malaria (negative), typhoid (negative), brucella (negative), Random blood sugar (100.3mg/dl: ranges 72-108mg/dl), Blood pressure (100/70mmHg). She was managed with diclofenac, normal saline, ceftriazone plus quinine and died at 11:00hours on 10 November.

NP developed vomiting and stomach-ache. She was taken to a drug shop for first aid however medication given could not be traced for. A blood sample was collected and taken to the Government Analytical Laboratories (GAL) for toxicology analysis. Quinalphos was qualitatively detected in her blood by Liquid Chromatography-Mass Spectrometry Triple quadruple (LC-MS/MS). She recovered and is well.

DISCUSSION AND CONCLUSIONS

Organophosphate compounds are possibly the most widely used insecticides in the world [5]. While Uganda is a signatory to several conventions and agreements related to the management of chemicals, the national implementation of the principles of these agreements are not excellent [6]. The easy access to these hazardous products might result in serious health threats [7]. Diagnosis of mild to moderate organophosphate poisoning is frequently difficult [8, 9], as was the case with the case-persons described above, since symptoms are non-specific and mimic other common disorders.

The acute toxicity of organophosphates is due to the inhibition of the enzyme acetylcholinesterase by phosphorylation, resulting in an accumulation of acetylcholine at postganglionic parasympathetic nerve endings (muscarinic receptors), parasympathetic ganglia (nicotinic receptors) and neuromuscular junctions (nicotinic receptors). All the organo-

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phosphates inhibit both red cell acetyl cholinesterase and plasma cholinesterase and this provides the basis for biological monitoring of toxicity [10].

Early symptoms of acute exposure to organophosphates are non-specific but lead to more characteristic features. In mild to moderate poisoning there may be headache, blurred vision, miosis, excessive salivation, nausea, vomiting, lacrimation, sweating, wheezing and lethargy. Severe poisoning may cause coma, convulsions, respiratory muscle paralysis, bradycadia and hypotension [10, 11]. The four case-persons described in this paper presented with similar symptoms.

The first step in management of acute poisoning is to maintain a clear airway and ensure adequate ventilation, after which atropine should be given until atropinization is achieved. Pralidoxime (a specific cholinesterase reactivator) should also be started within four hours of exposure [10]. Supportive measures include oxygen support, intravenous fluids, and maintaining electrolyte balance [12]. None of the case-persons in this paper received ideal care and management of poisoning. First, there was a delay in seeking care from a health facility. Secondly, the case-persons were taken to clinics probably because of financial implications or access. These clinics possibly do not have health workers who are experienced enough, so the illness was not diagnosed as poisoning and symptoms were managed as any other infection. A review of literature showed that many patients recover if they report to a health facility within a short time following exposure to organophosphates, whether orally or through inhalation, followed by a correct diagnosis using patient history and correct clinical management [4, 7, 11-14]. The mismanagement of this poisoning led to loss of lives of the three case-persons. The one case-person who survived was probably because of the low dose that she ate.

Organophosphate poisoning in this case occurred because these pesticides are easily accessed in the open market from unregistered vendors with no strict regulation of their use. Additionally, was a lack of recognition of the clinical features of organophosphate poisoning by the attending health workers at the health care facilities. As a result, institution of appropriate care and management of poisoning was not done. We recommended police to take on this investigation as triple homicide. Also there should be strict control in the handling of pesticides in the district and country.

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RE-ENFORCING TETANUS TOXOID CONTAINING VACCINE BOOSTER DOSES AMONG MALES — A POLICY BRIEF

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SUMMARY

Tetanus is a nervous system disorder characterized by muscle spasms caused by toxin producing anaerobe Clostridium tetani found in the soil. The efforts worldwide towards the goal of elimination of maternal and neonatal tetanus has reduced tetanus incidence and mortality in those groups through vaccination during pregnancy and clean delivery and cord-care practices. However, adolescent and adult men seem to have been largely missed by vaccination programmes, as implementation of the World Health Organisation (WHO) recommended fourth to sixth doses of tetanus vaccine to adolescents and adults has been limited.

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Investigation into tetanus cases identified through voluntary medical male circumcision programmes and an analysis of available global data highlighted a gender gap in tetanus morbidity that excessively affects men. Uganda provides a 3-dose primary series of penta-valent vaccine containing tetanus toxoid (TT) to infant boys and girls through routine immunization services at 6, 10, and 14 weeks of age. Furthermore, Uganda is one of many countries in the African Region that does not yet offer six shots of tetanus vaccine to everybody. About 80% of infants in Uganda get the first three tetanus vaccine shots, and women are additionally offered the vaccine during pregnancy for protection of mothers and newborns during birth; but older children and men do not get the booster shots. Although Uganda validated the elimination of maternal and neonatal tetanus (MNTE) in 2011 it reports one of the highest rates of Non-neonatal tetanus (Non-NT) in the world. National and district surveillance staff report weekly, verify and investigate cases of NT using a standard case-investigation form as part of Uganda case-based surveillance system while Non-NT is not. A cross-sectional descriptive analysis of tetanus data from 2012-2016 indicated an incidence of 10/100,000 population with Non-NT contributing the highest proportion[1]. More so, an evaluation of the Tetanus surveillance system revealed 3665 (85%) of the cases as males. We recommend a national policy regarding introduction of tetanus toxoid containing vaccine (TT) booster doses into routine immunization program for both sexes with much emphasis to the males to provide equitable tetanus protection throughout the life-course.

BACKGROUND

Tetanus is a nervous system disorder characterized by muscle spasms caused by toxin producing anaerobe *Clostridium Tetani* found in the soil. Tetanus can be life-threatening without treatment with approximately 10-20 percent of the case patients being fatalities [2]. Persons that suffer from tetanus are managed as medical emergencies that require treatment in a modern hospital with intensive care equipment. Fortunately, tetanus is preventable through the use of a vaccine. However this vaccine is not protective for a lifetime, but booster doses are needed to ensure immunity [2]. Because of the easy availability of the vaccine, tetanus is rare in the United States and more common in other countries that don't yet have strong immunization programs like Sub-saharan Africa.

Through the Expanded Program on Immunization, a 3-dose primary series of penta-valent vaccine containing tetanus toxoid (TT) is provided to infants through routine immunization services at 6, 10, and 14 weeks of age [3]. Uganda does not provide the 3 WHO recommended booster doses of TT at ages 12–23 months, 4–7 years, and 9–15 years. To prevent and maintain maternal and neonatal tetanus elimination (MNTE), up to five doses of TT are provided to women of reproductive age (WRA) [3]. While neonatal tetanus (NT) is reported as a notifiable disease with a standard case definition through the Integrated Disease Surveillance and Response (IDSR) weekly system, Non-NT is not. National and district surveillance staff verify and investigate cases of NT using a standard case-investigation form as part of a case-based surveillance system while Non-NT is not.

EXTENT OF THE PROBLEM

Mortality attributed to tetanus is an important public health concern. In developing countries, tetanus is the major cause of death in newborns, and it may still cause death among adults in developed countries as well [4]. Tetanus is completely preventable by active or passive immunization, the best form being active immunization with tetanus toxoid. Similar to most low- and middle-income countries, the underlying tetanus burden in Uganda may be higher than published as Non-NT tetanus is not reportable on weekly basis as a priority condition [1].

Uganda provides a 3-dose primary series of penta-valent vaccine containing tetanus toxoid (TT) to infant boys and girls through routine immunization services at 6, 10, and 14 weeks of age [3].

Investigation into tetanus cases identified through voluntary medical male circumcision programmes and an analysis of available global data highlighted a gender gap in tetanus morbidity that excessively affects men [5]. The occurrence of tetanus following voluntary medical male circumcision was rare with fewer cases reported from programmes that have conducted safe procedures. Although Uganda validated MNTE in 2011, the country reports one of the highest rates of non-neonatal tetanus globally [1, 5].

Furthermore, Uganda is one of many countries in the African Region that does not yet offer six shots of tetanus vaccine to everybody. About 80% of infants in Uganda get the first three tetanus vaccine shots, and women are additionally offered the vaccine during pregnancy for protection of mothers and newborns during birth; but older children and men do not get the booster shots [3].

A cross-sectional descriptive analysis of surveillance tetanus data from 2012-2016 indicated an annual incidence of 10/100,000 population with Non-NT contributing the highest proportion. High mortalities over 50% were noted among the males. More so, an evaluation of the Tetanus surveillance system in Uganda revealed 3665 (85%) of the cases as males. Morbidity and mortality ascribed to tetanus still remains high despite being preventable using affordable and accessible public health measures.

Passive immunization with human tetanus globulin (TIG) shortens the course of tetanus and may lessen its severity. A dose of 500 U may be as effective, Therapeutic TIG (3,000-6,000 units as 1 dose) is also recommended for generalized tetanus. Other treatment measures include ventilator support, high calorie nutritional support and pharmacological agents that treat muscle spasms, rigidity, tetanic seizures and infections. However modern facilities offering such services are very expensive and unaffordable to most of the rural population in Uganda. Several deaths can be averted if the males are given TT during the course of adolescence age to maturity.

CRITIQUE OF CURRENT POLICY

A 3-dose primary series of penta-valent (TT) is provided to infants through routine immunization services in Uganda at 6, 10, and 14 weeks of age [3]. Uganda does not provide the 3 WHO-recommended booster doses of TT at ages 12–23 months, 4–7 years, and 9–15 years. To prevent and maintain MNTE, up to five doses of TT are provided to WRA [3]. There are no opportunities for males to receive TT during their childhood as they grow to maturity. The efforts worldwide towards the goal of elimination of maternal and neonatal tetanus has reduced tetanus incidence and mortality in those groups through vaccination during pregnancy and clean delivery and cord-care practices. However, adolescent and adult men seem to have been largely missed by vaccination programmes, as implementation of the WHO-recommended fourth to sixth doses of tetanus vaccine to adolescents and adults has been limited [6]. Some studies have documented few tetanus cases reported by voluntary medical male circumcision programmes with a known his-

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tory of tetanus vaccination[5]. Less attention, however, has been given to the immunization of males after infancy. This could also probably explain the high morbidity and mortality rates due to Non-NT reported among the males.

CONCLUSION

Eradicating tetanus is very possible and achievable in our communities using cost effective public health measures like vaccinations and therefore it is regarded as one of the simplest and most cost effective way to reduce mortality rates attributed to tetanus.

RECOMMENDATIONS

The government needs to re-focus the implementation of (National Immunization Policy, 2009) and also scale up TT vaccination for male children and adults. Additionally, there is need for male adult vaccination programs to educate the community on health education on the importance and benefits of TT in order to increase its acceptance, appreciation and utilization.

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MUMPS OUTBREAK IN A CHILDREN'S HOME, WAKISO DISTRICT, AUGUST 2017

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SUMMARY

On the 28 July 2017, Public Health Emergency Operations Centre, Uganda received an alert of 12 suspected cases of mumps among children in a Children's Home with a school in Wakiso District. We investigated to verify the existence of the outbreak, determine the scope, identify exposure factors, and recommend control interventions. We defined a suspected case as acute onset of swollen/ painful salivary glands in a person living in Wakiso District from 1 June-15 September 2017. We identified cases through medical record review at the school clinic; controls were asymptomatic children at the school. We administered a questionnaire to the children, teachers, and parents about children's exposures and hygienic behaviors. We identified 25 case-persons. Overall attack rate (AR) among children <10 years was 21%. The AR was highest in nursery class (64%) and primary 1 (46%) and lowest in preparatory (6.3%) and primary 2 class (4.6%). Both nursery and primary 1 classes had 5-6 children per table, while preparatory and primary 2 classes had 2-3 children per table. Being in primary 1 [(OR=9.6(95% CI; 2.7-34.2)] and close interaction with a sick child [OR=15.5 (95% CI; 3.4-70.1)] were associated with mumps infection at the children's home. This was a mumps outbreak that affected children in lower primary classes at the children's home. Crowding in the classroom and late diagnosis may have contributed to the outbreak. We recommended vaccination of all asymptomatic children <10 years, isolation of symptomatic children for 5 days after symptom onset, and reducing the number of pupils per table in classes where possible. The Uganda Ministry of Health should consider including MMR vaccine in routine vaccination schedules.

BACKGROUND

Mumps is an acute viral illness transmitted by respiratory droplets and saliva[1]. The incubation period ranges from 12-25 days but parotitis typically develops 16-18 days[2]. In the absence of vaccination, mumps is epidemic with peaks after every 2-5 years [3]. Vaccination of Mumps in Uganda is not available in Public Health Facilities. In recent years, increasing outbreaks of Mumps infection have been reported in Sub-Saharan Africa, the most affected countries in 2016 were Kenya, Ghana and Rwanda[4]. Several upsurges of mumps have occurred in Uganda but were neither reported nor investigated. On the 28 July 2017, Ministry of Health was alerted of 12 suspected cases of Mumps from a children's home in Wakiso District. We investigated the epidemiologic characteristics, risk factors for the transmission and developed recommendations to control future outbreaks.

METHODS

We defined a suspected case as acute onset of swollen/painful salivary glands in a person living in Wakiso District from 1st June 2017 onward and a confirmed case as any suspected case with positive IgM mumps result. We actively searched for cases in the school, children homes and reviewed health facility records. We collected blood samples for laboratory confirmation of the outbreak and inspected classrooms and children homes for sitting arrangement in class, sleeping arrangement at home and personal hygiene facilities. We carried out descriptive analysis and an unmatched case control study in which we randomly selected 3 asymptomatic school controls for each case identified using stratified sampling giving a total of 25 cases and 87controls.

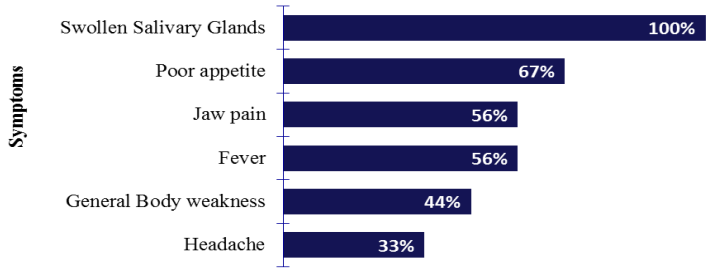
RESULTS

Descriptive Epidemiology

We identified 25 suspected cases persons. Of the cases, 24% (6/25) were confirmed with positive IgM for mumps. No deaths occurred.

The clinical presentations were consistent with mumps with all cases reporting parotitis

Figure 1: Clinical presentation of cases



Time Characteristics

The first case was identified on 28 June 2017 and the epidemic peaked in August 2017

Figure 2: Distribution of cases by time of onset in children's home

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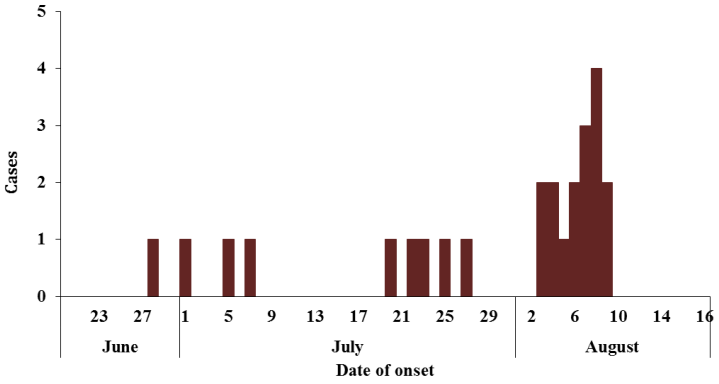

Place Characteristics

Overall, the attack rate for mumps at the children's home was 21%. The attack rate was highest in nursery class (64%) and lowest in primary 2 class (4.6%).

Table1: Attack rates by class

Table 2: Number of pupils per table in class

Class	Cases	Population	AR (%)
Nursery	9	14	64
Preparatory	1	16	6.3
Primary1	12	26	46
Primary2	3	65	4.6
Total	25	121	21

Class	#Children/table
Nursery	5
Preparatory	2
Primary1	6
Primary2	3

Primary 1 had 6 pupils sharing a table while nursery had 5 pupils per table

Persons Characteristics

Table 3: Attack rates by age in children's home Y, Wakiso District Uganda: Jun-Aug 2017

The median age was 6 years (Range 3-10). The age group ≤4 years was the most affected with AR of 62%.

Age (Years)	Cases	Population	AR (%)
≤4	8	13	62
5-7	6	45	13
8-10	11	59	19
>10	0	4	0
Total	25	121	21

Table 4: Attack rates by sex in children's home Y, Wakiso District Uganda: Jun-Aug 2017

The girls had a higher AR (26%) compared to the boys(16%).

Sex	Cases	Population	AR (%)
Boys	10	64	16
Girls	15	57	26
Total	25	121	21

Case management

Patients with fever were managed on Paracetamol and Vitamin A while patients with extensive swelling were given Prednisolone.

Vaccine effectiveness and coverage

Vaccine Effectiveness was calculated as thus:

$VE = (1 - OR_{MH}) \times 100$

We found that the vaccine effectiveness was 100%. Cumulatively, 24% (73/310) of all children in this school had been vaccinated against mumps between 2013 and 2017. By March , vaccination coverage was 13% among children from Nursery to P2 classes. MMR vaccine in this school is only given in single dose to children going for trips abroad.

Table 5: Vaccination coverage by class in children's home Y, June to August 2017

Case Control Study

	Vaccinated			
Class	Yes	No	Total	Coverage (%)
P2	14	38	52	27
P1	0	27	27	0.0
Preparatory	0	2	2	0.0
Nursery	1	30	31	3.0
Total	15	97	112	13

We found that the age groups 6-7 and ≤5 years old were significantly associated with development of mumps. Being in primary 1 and nursery classes, and having close contact with a child sick with mumps were also significantly associated with the disease. Other kinds of contact, such as sharing of bed and room with other children, touching eyes, nose, and mouth, sucking fingers and licking pencils and rubbers from the case-patient, played no role during this outbreak

Table 6: Risk factors for mumps outbreak in children's home Y, from June to August 2017

Characteristics	Case-patients % (n=25)	Controls % (n=87)	OR(95% CI)
Age			
≥8	53	53	1
6-7	26	26	4.4(1.4-14)
≤5	21	21	4.6(1.4-16)
Sex			
Male	47	14	1
Female	54	56	1.1(0.4-2.7)
School class			
Primary 2	16	55	1
Primary 1	48	17	9.6(2.7-34)
Preparatory	8	0	1
Nursery	28	28	3.5(0.9-13)
Vaccination status			
Yes	0	17	-
No	100	83	1
Contact with sick child			
Yes	92	43	16(3.4-70)
No	7.7	57	1

Environmental Risk factors for Mumps

We found that children in nursery and primary 1 classes are , there were 2 or 3 children on a table of a similar size as those in the allocated a table for every 5 or 6 children. In preparatory and primary 2 classes other classes. We found that there were

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washing facilities available for the children to use after using the toilet. These hand-washing facilities are situated just outside the classrooms.

DISCUSSION

Our study shows that talking, sneezing and playing with the index case-patient at close range at Children's home, Y led to this outbreak. This outbreak was further facilitated by transmission inside the classrooms due to close sitting arrangement of 5-6 pupils per table in Nursery and primary1 class. This was comparable with a study done in Kansas, which showed that relatively closed architectural design of school A and the intersection of many short corridors encouraged a complicated flow pattern of students between classes bringing many students in contact with one another and may have increased the level of respiratory contact among students(1). Conversely, other kinds of contact, such as sharing of bed and room with other children, touching eyes, nose, and mouth, sucking fingers, and licking pencils and rubbers from the case-patient played no role during this outbreak. Other studies also found that crowded, institutionalized setting such as a school and children's home play a big role in mumps transmission [5]. The most affected class was P1 class, which is bordered by P2. This proximity could have facilitated transmission through contact with children in P2. However, transmission in P2 was the lowest because of high vaccination coverage of MMR. Hygiene practices in the classrooms and homes were good. All classrooms and homes had hand washing facilities and soap. The classes were well ventilated and clean. Hand washing practices were not significantly associated with the outbreak. This could have been due to the fact both cases and controls had similar access to hand washing facilities. Children's home Y, and Wakiso District was not yet able to contain the current infection and later on prevent new infections from happening. This was observed in Outpatient Clinic that was the treatment centre for Mumps. This clinic had remained with only 2 doses of MMR vaccine which was not enough to vaccinate the whole school children.

CONCLUSION

The Mumps outbreak has affected children in lower primary classes. Results of the case-control study showed that the virus spread by droplet transmission when sick pupils were talking with their fellow pupils. Additionally, the affected classrooms had between 5-6 children sitting on one table in class. Children's home Y, does not have enough MMR vaccines to manage the outbreak. The findings of our investigation highlight the importance of preventing droplet transmission during an outbreak and early recognition of mumps clinical characteristics.

RECOMMENDATION

We recommended vaccination of all asymptomatic children <10 years in WCH, isolation of symptomatic children for 5 days after symptom onset, and reducing the number of pupils per table in classes where possible. The Uganda Ministry of Health should consider including MMR vaccine in routine vaccination schedules.

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INCREASE VACCINATION AGAINST MENINGOCOCCAL MENINGITIS TO AREAS OUTSIDE THE MENINGITIS BELT: LESSONS FROM A CLUSTER OF MENINGITIS IN BUNYANGABU– A POLICY BRIEF

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SUMMARY:

Meningococcal meningitis occurs globally but the highest burden is in the Meningitis belt of Sub-Saharan Africa. Some parts of Northern and Western Uganda are found in the meningitis belt. The disease is transmitted from person to person through infected air droplets. Infants and young children are particularly at risk, especially in crowded areas. The disease is preventable through vaccination.

In Uganda, there was mass vaccination of children and young adults in the regions covered by the meningitis belt in January 2017. However, in November 2017, there were 2 clusters of meningitis in Bunyangabu district, with 3 deaths of children. In one case-patient, meningococcal meningitis was confirmed. Bunyangabu district does not lie in the meningitis belt.

This means that meningococcal meningitis can spread and cause morbidity and mortality in areas that lie outside the meningitis belt. Therefore vaccination of all children in Uganda against meningococcal meningitis would go a long way in averting illness and deaths.

INTRODUCTION

Meningococcal meningitis occurs worldwide but the highest burden of the disease is in the meningitis belt of sub-Saharan Africa, stretching from Senegal to Ethiopia. The meningitis belt refers to those regions in Sub-Saharan Africa that are susceptible to outbreaks of meningococcal meningitis partly because of the physical environment that is conducive for the proliferation of the bacteria. Some parts of Uganda are found in this belt; that is the Northern and a small portion of the Western parts. Meningococcal meningitis can occur as sporadic cases,

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small clusters as well as enormous epidemics. Overcrowding is a particular risk factor for this infection. It mainly affects infants, preschoolers and the young adults. Meningococcal meningitis is caused by bacteria, *Neisseria meningitides*. Transmission is from person to person through infected air droplets, saliva or respiratory secretions. The bacteria attack the meninges - the thin lining surrounding the brain and spinal cord. The symptoms typically consist of: sudden onset of headache, fever, stiff neck, convulsions, sensitivity to light and vomiting. More than 10% of the affected persons develop severe complications such as brain damage, blindness and hearing impairment even when treated. Failure to get treatment results into deaths of up to 50% of those that develop symptoms. Diagnosis of meningococcal meningitis is made on clinical and laboratory examination. Cerebrospinal fluid (CSF) got from a lumbar puncture of a patient with meningococcal meningitis is examined for evidence of meningococcal bacteria. (1). The disease is preventable through vaccination and therefore maintaining high vaccination coverage can go a long way towards elimination of meningococcal epidemics in Africa.

Uganda has a comprehensive immunization program that has achieved reasonable routine immunization coverage of infants. According to the 2016 Uganda Health Demographic Survey (2), 55% of children aged 12-23 months received all basic vaccinations. However, the meningococcal vaccine is not among the vaccines offered in the routine immunization and so is not accounted for in these statistics. In the past, because Northern Uganda and a few parts of Western Uganda lie in the meningitis belt, there was a preventive immunization campaign focusing on the greater Northern Uganda and parts of western Uganda between 19 and 24 January 2017. While this is applaudable, environmental changes such as longer dry seasons, low humidity and dusty conditions may allow for the meningitis belt to extend to areas where it previously did not exist.

On 13th November 2017, the Uganda Ministry of Health through the Public Health Emergency Operations Centre was notified of an unknown illness with two sudden deaths in Bunyangabu District. The case-patients presented with fever, convulsions, loss of consciousness, neck stiffness and headache which were consistent with meningitis.

APPROACHES AND RESULTS

We defined a suspected case as onset of fever and neck stiffness and any of the following: convulsions, loss of consciousness, headache, vomiting, and nausea in a resident of Kabonero or Kateebwa sub-counties, Bunyangabu District from 1-30 September, 2017. A confirmed case was a suspected case with laboratory confirmation of meningitis. We conducted active community case finding in affected sub-counties & reviewed medical records at drug shops and clinics where case-patients had been admitted during our data collection. We also conducted an environmental assessment in the communities where the case-patients dwelt and schools & churches that the case-patients attended.

We identified a total of 5 case-patients with a mean age of 4 years. The first case-patient was on 30th September 2017 and the other on 18th October 2017. Case-patients peaked on 28th October 2017 and declined to 0 thereafter. Three of the 5 case-patients died, giving a case fatality rate of 60%. The average time from development of symptoms to death was 2 days. There were two clusters of cases in two sub-counties. One cluster in Kabonero sub-county had 3 cases from and the other in Kateebwa sub-county had 2 cases. All case-patients that died originated from Kabonero sub-county and all were closely related. The two from Kateebwa sub-county that survived were siblings.

There was no established epidemiological link between the two clusters because the children from the respective clusters had not attended the same school, health facility, or social gathering. The parents to these children had not similarly interacted.

All case-patients presented with neck stiffness and fever while 80% presented with vomiting and 60% had convulsions and loss of consciousness. Only one case patient had a lumbar puncture and CSF analysis done. *Neisseria meningitidis* was isolated. However, the strain causing the outbreak was not identified and the samples had been destroyed at the time of the outbreak investigation. All the patients were treated from the neighboring Kabarole District. There was sensitization of health workers in the affected and surrounding districts on the possible outbreak of meningitis and the need to have enhanced surveillance so as to identify more cases. Immediate family members of the cases were offered a dose of intravenous ceftriaxone as chemical prophylaxis.

CONTEXT AND IMPORTANCE OF THE PROBLEM

Although Bunyangabu District does not lie in the meningitis belt, we found a confirmed case of meningococcal meningitis. There was minimal district preparedness in handling these clusters of infections and this catastrophe can occur in any other district of Uganda that is not in the meningitis belt. This experience shows that the other districts may similarly be inadequately prepared to handle meningococcal meningitis clusters or outbreaks.

CRITIQUE OF POLICY OPTIONS

Currently, the Uganda National Expanded Program on Immunization (UNEPI) has no policy on meningococcal meningitis immunization. However, according to PATH, an international organization that generates data for introduction of new vaccines, the MenAfriVac® vaccine is expected to have been given to all the eligible population in the meningitis belt and therefore protect almost the entire population of the belt (3). If this is done, it will be a step in the right direction in averting deaths and disability due to meningococcal meningitis. However, it is important to know that a cluster of cases has been found outside the belt. This implies that there is another population at risk that should be considered when during vaccination drives.

POLICY ALTERNATIVES

The alternative is to introduce vaccination against *Neisseria meningitidis* in the routine vaccination of infants. In the investigation we carried out in Bunyangabu District, all the affected were children and it is envisaged that had these been vaccinated, the deaths and morbidity would have been averted. In addition, other districts that do not lie in the meningitis belt should be supported so that there is timely identification of case-patients and hence mitigation of outbreak spread.

POLICY RECOMMENDATIONS

It is recommended that the vaccination of the children against meningococcal meningitis is carried out in a phased manner in Uganda. Initially, in the regions within the meningitis belt, and then in the districts surrounding the regions that are in the meningitis belt since there is a risk of spread by travel and congregation of people from the belt to neighbouring districts for trade and cultural ceremonies. The vaccination there after can be spread to cover the entire country. However, all districts' surveillance systems should be supported so that outbreaks are recognized early and averted.

IMPLICATIONS AND RECOMMENDATIONS

There is evidence that Uganda's immunization program has achieved tremendous success in reducing morbidity and mortality due to immunizable diseases. For example, since introduction of Hib vaccine in 2002, the number of meningitis cases due to *Haemophilus Influenza* type b (Hib) declined by 95% at sentinel sites for Hib surveillance (4). This underscores the impact vaccination would have on averting morbidity and mortality due to meningococcal meningitis.

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