MINISTRY OF HEALTH UGANDA

# UNIPH Epidemiological Bulletin

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Quarterly Epidemiological Bulletin of the Uganda National Institute of Public Health, Ministry of Health

## April– June, 2021

Dear Reader,

We take great pleasure in welcoming you to Issue 2, Volume 6 of the Uganda National Institute of Public Health (UNIPH) Quarterly Epidemiological Bulletin.

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 articles including; COVID-19 Rapid antigen test in comparison with Real Time (RT-PCR), trends of key surveillance performance indicators of acute flaccid paralysis, COVID-19 cluster within health facilities and a formal workplace, and ambient air pollution in Kampala.

Should you have any questions or require additional information related to articles in this bulletin please contact us on: iwadunde@musph.ac.ug, nsubugaeddiej@musph.ac.ug, vmasanja@musph.ac.ug OR lbulage@musph.ac.ug

We hope you find this information valuable and we shall appreciate any feedback from you.

Thank you



*Inside this issue:*

## Upcoming Public Health Events, Uganda and Globally, July-September,2021

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**Summary**

*The global public health days are commemorations that call the attention of the public on one public health issue, and offer great potential to raise awareness and understanding about health issues and mobilize support for action, from the local community to the international stage. In the coming quarter, we commemorate the following world health days.*

### World Hepatitis Day July 28

Commemorated on the 28th of July every year, the world hepatitis day aims to bring the world together under a single theme to raise awareness of the global burden of viral hepatitis and to global response. This year 2021, the WHD will be celebrated under the theme "**Hepatitis can't wait**". With aleast one person dying every 30 seconds from a hepatitis related illness – even in the current COVID-19 crisis – we can't wait to act on viral hepatitis.

### World Lung Cancer Awareness Day August 1

Lung cancer continues to be one of the most common cancers worldwide, claiming more lives yearly than breast, colon, and prostate cancers combined. It is estimated that lung cancer accounts for nearly one in five cancer deaths globally.

### World Breastfeeding Week August 1-7

Celebrated every first seven days of August each year, World Breastfeeding Week (WBW) represents a global celebration of breastfeeding efforts including breastfeeding promotion, support, education, research, progressive trends and normalizing breastfeeding as the gold standard of infant nutrition. Celebrated under the theme: **"***Protect Breastfeeding: A Shared Responsibility***"** the 2021 WBW will focus on how breastfeeding contributes to the survival, health and wellbeing of all, and the imperative to protect breastfeeding worldwide.

### World Suicide Prevention Day September 10

Suicide is a growing public health problem worldwide, and among the leading causes of death in young people between 15 and 34 years. Every 40 seconds, someone takes their own life and for every suicide that results in death, there are as many as 40 attempted suicides. (WHO). Annually, the 10th of September has been designated as a way of focusing attention on the problems of suicide worldwide. This year, the world suicide prevention day will be celebrated with a message of hope that aims to empower people with confidence to tackle suicide under the new theme: "*Creating Hope Through Action*".

UPDATES

**The Joint External Evaluation Self-Assessment, Uganda, 14th-28th May, 2021**

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As the world becomes more interconnected, the next public health threat is just a plane away, hence the need to establish and maintain global health security. Uganda was among the first countries to pilot the Global Health Security Agenda (GHSA) in 2013, and joined other member countries in committing to the next phase of the GHSA strategic framework in 2018, termed "GHSA 2024" which calls upon countries to step up sustainable health security by 2024.

The GHSA aims to accelerate compliance to the World Health Organisation's (WHO) International Health Regulations (IHR) (2005) by encouraging all countries to observe a multisectoral, "One Health" approach. To assess the progress towards compliance, WHO designed a Joint External Evaluation (JEE) which became a key component of the IHR's monitoring and evaluation framework.

The JEE is an independent, transparent, objective, and multisectoral assessment, process that enables countries to determine their ability to be prepared for and address infectious disease risks through a coordinated response. It assesses capacities across 19 technical areas to establish a baseline assessment, enabling countries to have a greater understanding of their gaps and weaknesses in health security, so they can focus efforts to improve in these areas.

In 2017, Uganda held its first JEE which assessed the country's capacity to prevent, detect, and rapidly respond to public health emergencies (PHEs). Under the guidance of the office of the prime minister, the National Plan for Health Security (NAPHs) 2019 - 2023 was developed to bridge gaps in health Security identified by JEE and step up capacities.

The JEE is scheduled to take place every after five years, however, between 14th-28th May 2021, Uganda conducted a JEE self-assessment, to assess the progress towards attaining the 2017 JEE recommendations and help the country prioritize activities that can form a one-year operational plan for improving capacity levels before the next JEE is held. The self-assessment workshop was held at the Ministry of Health Public Health Emergency Operation Center (PHEOC) led by the office of the prime minister and Ministry of Health, and facilitated by experts in the 19 technical areas. This was a hybrid multisectoral exercise involving both physical and online participation via zoom, in respect of the COVID-19 Standard Operating Procedures.

The 19 technical areas discussed were grouped into four thematic areas; prevent, Detect, Respond, and other IHR related hazards and point of Entry (PoE). Under the four themes, different topics including immunization, animal health, zoonotic diseases, antimicrobial resistance, risk communication, policy and financing, emergency response, human resources, and laboratory systems among others. To assess the progress, participants were requested to score capacities for each indicator using the revised JEE 2.0 tool and propose activities for improvement. Different actions were identified to form the 2021-2022 operational plan for health security and Uganda's commitments to the GHSA 2024, as will be discussed in the final report..

## The state of ambient air pollution, Kampala City, January-May 2021

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**Summary**

*Outdoor (ambient) air pollution is increasingly associated with non-communicable diseases killing over four million people globally and over 30,000 people nationally annually[1]. Cities in sub Saharan Africa are known to have high pollution levels. We downloaded data from the air quality monitoring network for Kampala Capital City Authority (KCCA) and studied the trends of ambient air pollution. Concentrations of particulate matter (PM) 2.5, the pollutant with the greatest health hazard was largely (65-110 µg/m3) higher than the World Health Organization (WHO) cut off (24 hour mean value of 25 µg/m3) for all the sites during the observation period. Urgent community-based and inclusive initiatives are needed to address the challenge of high pollution levels in Kampala city.*

**Background**

Even to the naked eye, the sky over Kampala city has changed in the recent past, with worsening visibility. One can no longer view the clear hills across the neighborhood. This is due to changes in concentrations of the atmospheric contents that might have led to air pollution. Air pollution is a leading cause of global disease burden, especially in low and middle-income countries[1]. Health conditions associated with air pollution exposure include: respiratory diseases such as chronic obstructive pulmonary disease (COPD), lung cancer, and acute respiratory infections in children, and cardiovascular diseases. In addition, exposure to ambient air pollution increases morbidity and mortality, and is a leading contributor to global disease burden. Given that 91% of the world's population lives in places where air quality exceeds world health organization (WHO) guideline limits (24 hour mean value of 25 µg/m3 for PM2.5) and that at the global level, ambient air pollution leads to about 4.2 million annual deaths, pollution deserves urgent attention. Air pollution disproportionately affects the cities in the developing world where pollution levels are usually higher than the WHO cut off. Moreover, this causes double burden of disease given that communicable diseases are highly prevalent in developing countries.

Although many substances are known to potentially contaminate air, the WHO has identified carbon monoxide (CO), particulate matter (PM), ozone (O3), nitrogen dioxide (NO2), and sulfurdioxide (SO2) as the pollutants with greatest public health importance. The United States (US) National Ambient Air Quality Standard (NAAQS) designates all of the above plus airborne lead (Pb) as criteria pollutants. In order to promote and protect public health, the WHO and the US Environmental Protection Agency (USEPA) have defined guideline limits for the pollutants that should not be exceeded[2]. The WHO limits for PM2.5, the pollutant with the greatest health risks due to its ability to cross lung tissue and enter blood circulation is 25 µg/m3 (24-hour mean) while the limits for the same pollutant set by the USEPA is 35 µg/m3 (24-hour mean). Data on the magnitude of air pollution in African cities is limited, particularly as it relates to Sub-Saharan Africa. The WHO database provides an average PM2.5 value for Africa of 78 µg/m3 annual mean (which is three times the set limit) and may be worse for Sub-Saharan Africa where Kampala city falls. A study conducted in the cities of Kampala and Jinja in 2015

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revealed that the mean concentrations of PM2.5 were 132.1 µg/m3 and11.4 µg/m3, respectively[3]. This mean PM2.5 concentration is 5.3 times the WHO cut-off limits. Another study done in Mpererwe, Kampala city suburb done earlier in 2014 had found similarly very high levels of pollutants[2]. Given that the number of vehicles has been increasing (with worsening idling in jam) coupled with government's policy on industrialization, the concentration of PM2.5 is expected to have increased. We established the spatial variation and trends of ambient air pollution for Kampala city, January – May, 2021.

## Methods

### Study setting

We conducted the study in Kampala city. Kampala, like other fast-growing African cities is affected by high levels of pollution and consequently poor air quality. Kampala city has about 23% of its area fully urbanized, 60% semi-urbanized, and 17% considered rural. The city's day and night population are 3 million and 1.5 million people, respectively. The average annual temperature is 21.9° C and relative humidity ranges from 53–89%. This reflects on the likely extent of human activity that results in air pollutant generation.

### Study design

We used spatial, longitudinal calibrated air quality monitoring data obtained from the 24 air quality monitors deployed across Kampala City by the City Authority, January-May 2021. Monitor readings are calibrated based on the BAM (beta attenuated monitor) station at Nakawa, one of the five KCCA urban division headquarters. These monitors take continuous readings for main pollutants, temperature, and humidity.

Kampala City Council Authority has been monitoring the status of air quality across the city since 2019. The monitors are well situated across the city to represent different land use patterns as well as places prone to idling of cars during rush hour (Figure 1). These are low cost monitors which measure temperature, humidity, and ambient air concentrations of pollutants. These data are then calibrated based on a standard monitor (BAM) before being relayed via the internet for download on a computer. These data can be downloaded at resolution of reading per minute, hour 24 hour or monthly mean. An analytics platform is included for easy data visualization even to a non-technical person. The concentrations of the pollutants are converted into an air quality index, which is color coded on a continuum from green (healthy air) to purple (hazardous air) to guide citizens on choice of timing for different activities such as Exercise.

### Study variables and data analysis

We obtained data on air PM 2.5 and analyzed these using STATA 14. Data was downloaded at a resolution of 24 hours and therefore 24-hour means (daily averages) were used. We established trends of levels

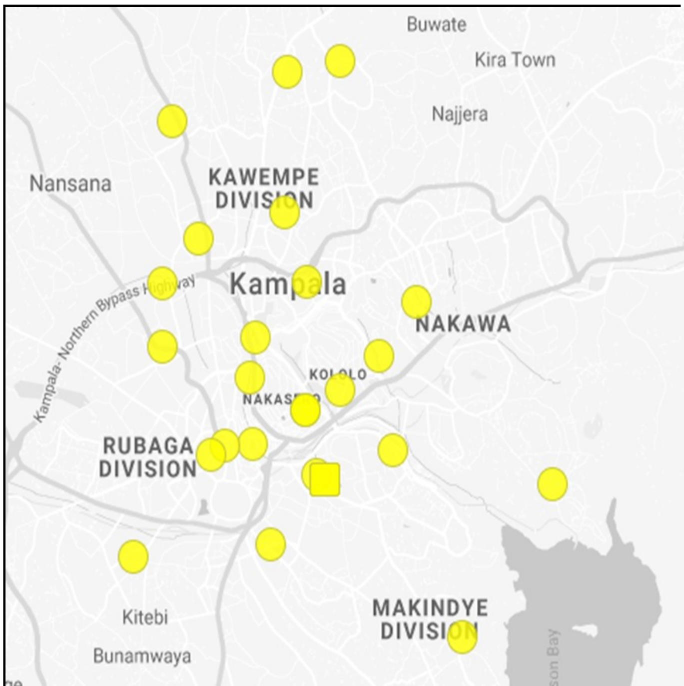


*Figure 1: Location of sites for air pollutant monitors, Kampala city, January-May, 2021*

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of PM2.5 and exceedances (in the past 28 days, the number of days for which the pollution level exceeds the WHO PM2.5 cut off) and displayed the information on graphs against the WHO cut off as reference per site for selected locations. Exceedances were categorized into unhealthy for sensitive groups such as persons with allergic airway conditions like asthma (>40-65 µg/m3), unhealthy for all persons (>65-150 µg/m3), very unhealthy (>150-250 µg/m3), and hazardous (>250-350 µg/m3).

**Ethical considerations**

We did not seek ethical approval for this assessment. The assessment is based on routine air quality monitoring data generated by KCCA. It does not contain any personal identifiers. However, we sought and obtained permission from KCCA to access and use the data to inform air quality improvement interventions in Kampala city.

**Results**

**Mean pollution levels in selected areas, Kampala City, January-May, 2021**

Over all, the pollution levels in Kampala exceed WHO cut offs most of the time. Throughout the study period, the average level of pollution was higher than the WHO cut off (25micrograms/cubic metre) (Figure 2). All sites recorded an average daily value of more than twice the WHO cut off. Sites with less human activity tended to have lower average levels of pollution as compared to city center for instance the pollution levels in Kyanja remained lower than those of Bwaise, a busy city suburb during the whole observation period (Figure 2).

**Mean particulate matter 2.5 exceedances, May 2021**

The mean PM exceedances over the last 28 days (during the month was May) was either unhealthy for sensitive groups or unhealthy with more than 50% of the time registering unhealthy for all city residents in all monitoring sites except Bwaise surbub. In Bwaise, it was over 90% unhealth for all city residents and very unhealthy 10% of the time (Figure 3).

**Trend of mean 24-hour particulate matter 2.5 levels in selected areas, January-May, 2021**

The pollution levels in the green upscale Kampala (civic center) remained lower than for Kyanja residential area with unpaved roads and Bwaise suburb which has many human activities including traffic idling due to jam, manufacturing plants, and some unpaved roads (Figure 4). The levels of PM2.5 remained consistently above the WHO threshold during the observation period except at Kyanja and civic center sites during late April-early May.


Figure 2: Mean pollution levels (daily particulate matter 2.5 mean) for selected sites, Kampala city, March 2021

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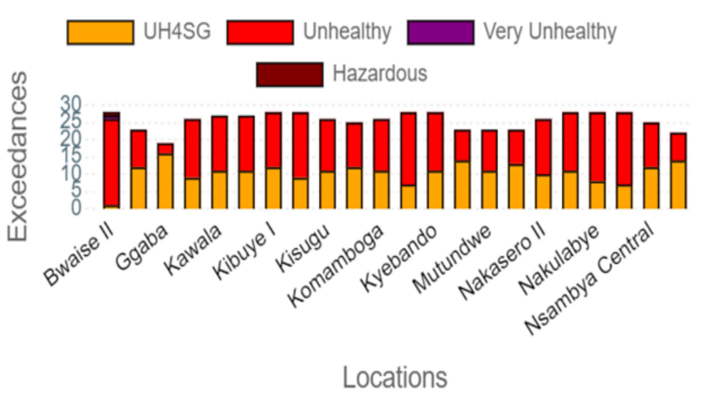


Figure 3: Mean particulate matter 2.5 exceedances, May 2021: *UH4SG=Unhealthy for sensitive group*

Similar to Figure 4 trends, PM2.5 levels remain higher than the WHO threshold most of the time except during April-May rainy season. Sites with busy human activity such as trading centers, areas prone to jam or with manufacturing plants consistently recorded higher pollution levels compared to residential or the leafy upscale Kampala (Figure 5 and 6).

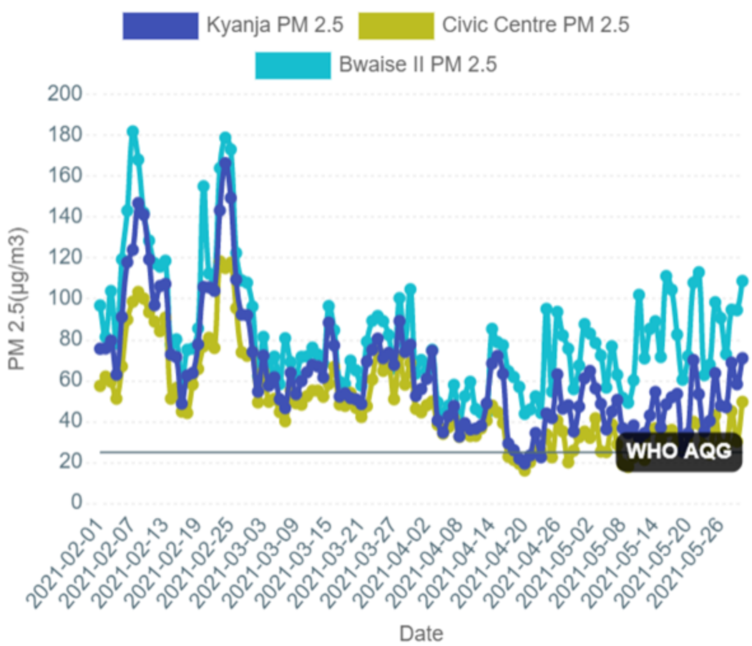


Figure 4: Trend of mean 24-hour particulate matter 2.5 levels in upscale Kampala (civic center) and business city suburb (Bwaise) and residential area (Kyanja), January-May, 2021

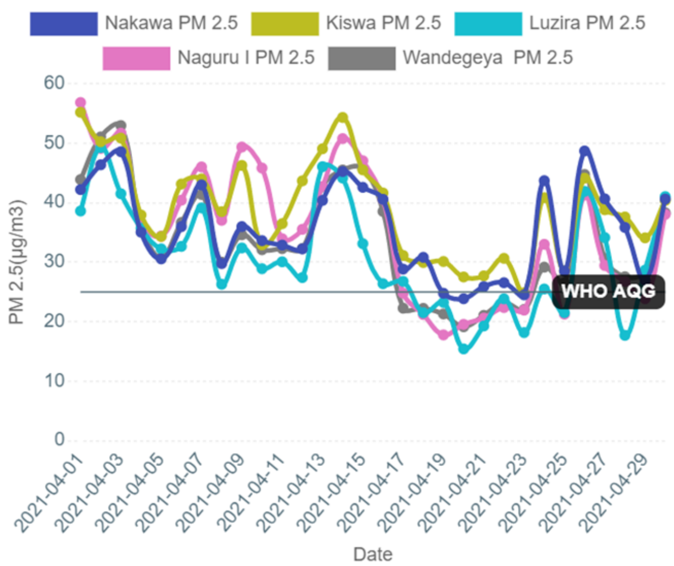


Figure 5: Trend of mean 24-hour particulate matter 2.5 levels for Nakawa, Kiswa, Luzira, Naguru and Wandegeya, April, 2021

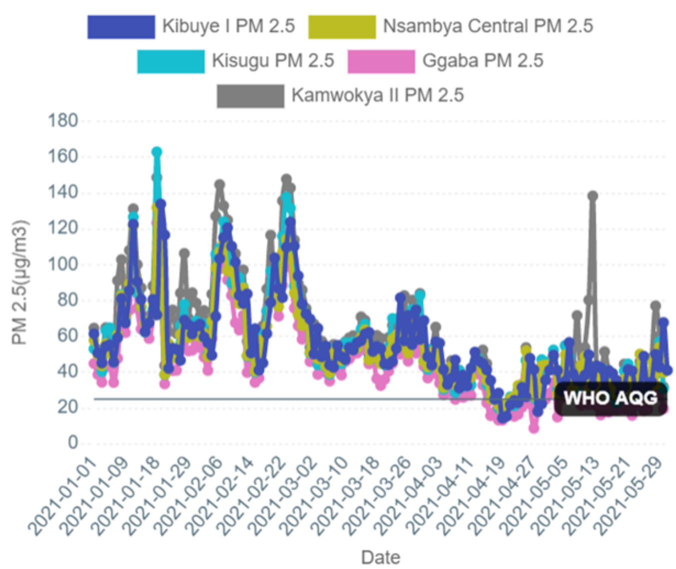


Figure 6: Trend of mean 24 hour mean particulate matter 2.5 levels for Kibuye, Nsambya central, Kisugu, Ggaba, and Kamwokya, January-May, 2021

**Discussion**

Throughout this observation period, the average level of pollution was higher than the WHO cut off (25micrograms/cubic metre), potentially putting the health of city dwellers at stake. The WHO and US Environmental protection agency put standards for

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common air pollutants including ozone, nitrogen oxides, and particulate matter to guide countries and cities. Largely in monitored cities, over 80% exceed the cut offs potentially exposing over 90% of the dwellers to unhealthy air. Ambient (outdoor) air pollution is hazardous as it leads to non-communicable diseases in the cardiorespiratory system.

In Kampala city and most of Africa, particulate matter 2.5 (PM 2.5) with the ability to enter the blood stream is the most hazardous. Due to idling of cars in jam around road junctions, road construction and construction sites generating dust participles, unpaved roads, poor waste disposal through burning that generates fumes, and location of factories/manufacturing plants release pollutants into the atmosphere. These collectively contribute to formation of PM2.5 and PM10 the pollutants of greatest importance. Idling cars also release significant Nitrogen oxides that may also contribute to PM 2.5 if acted upon by environment forms PM2.5. To minimize the effects of pollution on health monitoring of pollutant concentrations, evidence basic interventions and monitoring progress are key.

The city authority has embarked on developing a clean air action that spells out the activities to combat air pollution the city. Some interventions such as paving of roads, non-motorized ways, tree planting, adoption of cleaner energies such as electric transport and cooking, regulation of the construction industry are already underway. Additional steps include the air quality management regulation by national environment management authority which spells out penalties to offenders such as factories emitting beyond the limits.

With such levels of pollution in a densely populated city, it is important that every one is rallied behind addressing the causes. Human-centered designed projects are urgently needed to address obvious health hazard. For instance having low air pollution in the upscale Kampala which also has many trees suggests that planting trees in Kampala may reduce air pollution significantly

## Conclusion

This assessment shows that pollution in Kampala city exceeds the WHO cuts potentially putting the health of city residents at risk. Urgent community centered solutions are needed to collectively address this problem

## Acknowledgement

We appreciate the support from the partners of the air quality monitoring network at KCCA including Airqo, Clarity movement inc, National Environmental management Authority, and US Embassy in Kampala. We are also grateful to the support rendered by the Uganda Public Health fellowship program during the data analysis and writing.

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3. Kirenga, B.J., et al., *The state of ambient air quality in two Ugandan cities: a pilot cross-sectional spatial assessment.* International journal of environmental research and public health, 2015. **12**(7): p. 8075-8091.

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**Rapid SARS-CoV-2 antigen (SD Biosensor) test in comparison with Real Time (RT-PCR) for diagnosis of COVID-19 in a secondary school, Kampala, Uganda: November, 2020**

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**Summary**

*Real time RT-PCR testing is considered the "gold standard" in SARS-CoV-2 detection. It detects RNA that is specific to the virus. The RT-PCR are financially costly, require longer evaluation time, and needs highly professional staff for sample handling. The SD Biosensor's COVID-19 antigen rapid test is cheaper than the RT-PCR, with about 30* ***minutes turnaround time, and*** *demands no expertise of the staff. Following a countrywide lockdown, the government of Uganda opened schools to candidate classes on October 15, 2020 with strict COVID-19 guidelines to follow. A secondary school in Kampala reported a cluster of COVID-19 cases by November 17, 2020, and Ministry of Health recommended the need to conduct testing for COVID-19 among the students, teachers, and support staff at the school. We compared the rapid SARS-COV-2 antigen detection test (SD Biosensor) with real time RT-PCR test as the gold standard for diagnosis of COVID-19 at a secondary school in Kampala, Uganda.*

*Three hundred sixty-one nasopharyngeal samples were obtained from students, teachers, and support staff of the school, by trained laboratory personnel from the MOH, 19th to 22nd, November, 2020.*

*Of the 361 respiratory samples, 141 were positive for real-time RT-PCR test. Only 12 were positive with the rapid SARS-COV-2 antigen test. The sensitivity of the Rapid test was 8.5% and specificity of 100%. With the rapid test, the false negatives were 129 and no false positive. Among the respondents who tested positive with the RT-PCR and negative with the rapid antigen (SD Biosensor) test, majority (94.5%, n=122/129), were asymptomatic at time of sample collection.*

*The rapid antigen SARS-COV-2 test (SD Biosensor) showed incomparable sensitivity (8.5%), however, there was comparable specificity of 100% with the real-time RT-PCR test. We recommended concurrent use of both the real-time RT-PCR and the rapid SD Biosensor test as screening testes especially in a high prevalence area.*

**Introduction**

On January 30, 2020, the World Health Organization (WHO) declared COVID-19 a public health emergency of international concern (1) and testing for COVID-19 has tremendous value to containing the spread of the corona virus, by enhancing detection and isolation of cases (2).

Infection with the virus causing COVID-19 (SARS-CoV-2) is confirmed by the presence of viral RNA detected by molecular testing, usually RT-PCR. Real-time RT-PCR testing is considered the "gold standard" in SARS-CoV-2 detection (3). This test detects RNA (or genetic material) that is specific to the virus and can detect the virus within days of infection, even those who have no symptoms (4). The disadvantages are the financial cost compared to the antigen tests, the longer evaluation time, and the need for highly professional staff for sample handling. Turnaround time is longer, generally in the 2-3 day range but results can be in as little as 24 hours (5). On the other hand, the rapid SARS-CoV-2 antigen (SD Biosensor) test was approved for emer-

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gency use by the World Health Organization (6), and test looks for proteins produced by the SARS-CoV-2 virus. Their advantage is the price, the result within 15 to 30 minutes, and lower demands on the expertise of the staff (7). The disadvantage is that they are not as sensitive (accurate) as the standard RT-PCR test used to accurately identify those infected. In a few days, these people will spread the virus to others, thinking they are healthy. The rapid antigen test reveals patients at the peak of the infection when the body has the highest concentration of these proteins, and considered most accurate in a patient who is having symptoms of COVID-19 (8).

Following a countrywide lockdown, the government of Uganda opened schools to candidate classes on October 15, 2020 with strict COVID-19 guidelines to follow. A secondary school in Kampala reported a cluster of COVID-19 cases by November 17, 2020 and at that time country had only registered the strain from Wuhan. The Ministry of Health (MoH) recommended the need to conduct testing for COVID-19 among the students, teachers and support staff at the school.

There was need to evaluate the performance of rapid SARS-COV-2 antigen tests and compare with the gold standard real time RT-PCT for diagnosis of COVID-19. We determined the sensitivity and specificity of the rapid SARS-COV-2 antigen detection test (SD Biosensor) and compared with real time RT-PCR test as the gold standard for diagnosis of COVID-19 at a secondary school in Kampala, Uganda, so as to inform COVID-19 testing.

## Methods

### Study setting

The study was conducted at secondary school in Kampala, Uganda. The school has both day and boarding sections, however, the study was conducted among the students in the boarding section.

### Study design

We conducted a cross-sectional study, employing quantitative methods of data collection among the students, teachers, and support staff at the secondary school. We defined a confirmed case as laboratory-confirmed SARS-CoV-2 infection identified during November 21-23, 2020 in a student, teacher or support staff at a secondary school in Kampala, Uganda. A suspected case was defined as high temperature (above 37.5˚C) and at least one sign/symptom of respiratory illness in a student, teacher or support staff at a secondary school in Kampala, Uganda.

### Sample size

We considered a sample size of 427 as determined using Kish Leslie (1965) formula.

$$n = \frac{Z^2 PQ}{\partial^2}$$

n=sample size, z= critical value at 95% level of confidence, $\partial$ = margin of error at α=0.05, P= prevalence of COVID-19 is assumed to be 50%, since no study has been identified in Urban settings, Q= (1-P) which is the probability of not finding cases of COVID-19; with a non-response rate of 10%

### Sampling procedure

We used convenient sampling for students, teachers, and support staff. Everyone at the school during testing days was allowed to test for COVID-19, and those willing to test were interviewed.

### Specimen collection and laboratory testing

Samples were taken from students, teachers, and support staff conveniently, from the nasopharynx by the trained laboratory personnel from the MOH. We used the RT-PCR molecular diagnostic test to identify SARS-COV-2, and the rapid antigen Biosensor test for the qualitative detection of specific antigens to SARS-COV-2 present in human nasopharynx. The results for rapid antigen tests were read within 15 to 30 minutes. Feedback with test results from the RT-PCR was given to the clients through the MOH using an emailing platform.

### Ethical consideration

This investigation was conducted as part of the Ministry of Health (MoH) efforts to control the COVID19 pandemic in Uganda. The MoH of Uganda through the of-

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fice of the Director General Health Services gave the directive and approval to conduct this investigation. Additionally, the office of the Associate Director for Science, Centers for Disease Control and Prevention, Uganda, determined that this investigation was not human subjects' research because the primary purpose was to identify, characterize, and control disease in response to a perceived immediate public health threat. Prior to participation, information about the evaluation was provided, including the risks, and benefits of participating. The participants were informed of their right to voluntarily participate or even withdraw their participation at any time without consequences. The potential participant was allowed to ask questions and answers provided after which a verbal consent was obtained.

**Results**

**Sociodemographic characteristics of respondents**

The average age of the respondents was 20 years (Range: 14 -77 years). Males were average, 53%, (n=191/316). The majority, 84%, (n=280/361) were in the 10-20 years age group and the majority, 86%, (n=311/361) of the respondents were students. The students were in senior four, (56%, n=177/361) and senior six classes (44%, n=134/361).

**Sensitivity and specificity of Rapid antigen (SD Biosensor) test**

We tested a total of 361 respondents for COVID-19. The positivity rate was 39.1% (n=141/361). And the positivity of Biosensor as regards the gold standard (RNA PCR) was only 8.5% (Table 1).

The sensitivity, (12/141) of the Bio-Sensor RDT as regards the RT-PCR was 8.5%. The level of discrepancy of in the positivity of the Bio-Sensor RDT against the gold standard RNA PCR, (129/141) was 91.5%. The specificity of the Bio-Sensor RDT as regards the RT-PCR, (220/220) was 100%. The positive predictive value of the Bio -Sensor RDT as regards the RT-PCR, (12/12), was 100%. The negative predictive value of the Bio-Sensor RDT as regards the RT-PCR, (220/349), was 63%.

Among the respondents who tested positive with the RT-PCR and negative with the rapid antigen (SD Biosensor) test, the majority (94.5%, n=122/129), were asymptomatic at the time of sample collection (Figure 1).

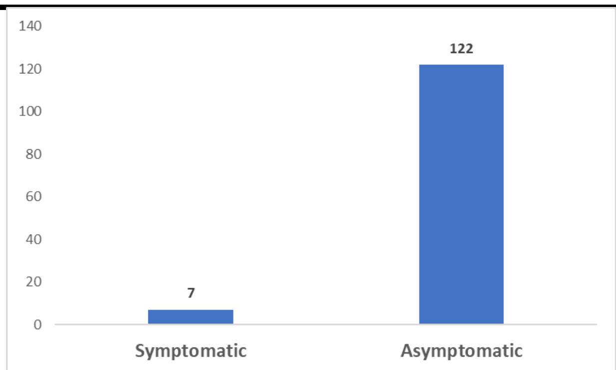


**Figure 1:** ***Symptoms at time of sample collection among respondents who tested positive with RT-PCR and Negative with SD Biosensor RDT for COVID-19 at a secondary school in Kampa-***

**Table 1: Comparison between Biosensor RDT against the gold standard RT- PCR for COVID-19 at a secondary school in Kampala, Uganda, November, 2020.**

| | | RNA PCR | | |
|---|---|---|---|---|
| | | Positive | Negative | **Total** |
| **Bio-Sensor RDT** | Positive | 12 | 0 | **12** |
| | Negative | 129 | 220 | **349** |
| | **Total** | **141** | **220** | **361** |

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**Discussion**

Real time RT-PCR are the gold standard in testing for COVID-19 as it detects the presence of viral RNA (3). It is a very accurate and efficient test. In our study, we compared the RT-PCR with the rapid antigen (SD Biosensor) test using nasopharyngeal swab samples among students, teachers, and support staff at a secondary school in Kampala, Uganda that had reported a cluster of COVID-19 cases.

The rapid antigen test detects proteins produced by the SARS-CoV-2 virus (9). The sensitivity of the rapid antigen test as compared to the gold standard RT-PCR was 8.5%. This low level of sensitivity of a test is likely to have high false negatives (10), and similarly did our study record high (91.5%, n=129/141) false negatives. This low sensitivity could also be explained by the fact that the rapid antigen test detects viral proteins and reveals patients at the peak of the infection when the body has the highest concentration of these proteins. This low sensitivity using the rapid test could also be because the targeted antigen maybe absent on some strains of the SARS-COV-2 virus.

In addition, in the RT-PCR test, the amount of the sample may not matter because it is amplified during the polymerase chain reaction processes (11) and an adequate sample for an antigen rapid test is likely to cause no reaction on the test strip.

Technical errors in reading test results from the rapid antigen test lead to false negatives. Other technical errors include interferences with room temperatures that affect rapid diagnostic test kits (12), amount of diluent used, and the waiting time to read the test results.

Rapid antigen tests are considered most accurate in a patient who is having symptoms of COVID-19 at the time of sample collection (13). Our study showed that among the respondents who tested positive with the RT-PCR and negative with the rapid antigen (SD Biosensor) test, majority 94.5%, were asymptomatic at time of sample collection. The rapid antigen (SD Biosensor) recorded a specificity of 100%, meaning no false positive.

**Conclusion and recommendation**

The rapid antigen SARS-COV-2 test (SD Biosensor) showed incomparable sensitivity of 8.5% with the gold standard RT-PCR, however, the specificity was 100%. We recommended concurrent use of both the RT-PCR and the rapid SD Biosensor test as screening tests especially in a high prevalence area.

**Acknowledgements**

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## Trends of key surveillance performance indicators of acute flaccid paralysis: A descriptive analysis of the surveillance system, Uganda, 2015-2020

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### Summary

*Poliovirus infection causes irreversible paralytic disease, presenting as Acute Flaccid Paralysis (AFP). A sensitive AFP surveillance system is central to the overall polio eradication initiative. We described the Uganda's AFP surveillance performance, 2015-2020, based on the World Health Organization (WHO) recommended epidemiological performance indicators for AFP surveillance.*

*We conducted a retrospective descriptive study using AFP surveillance secondary data submitted to ministry of health and WHO, Uganda office by districts, 2015-2020. Comparisons across the three indicators, including non-polio AFP and stool adequacy rate were made to assess for any relationships therein using trend analysis. We used QGIS to illustrate differences of non-polio AFP and stool adequacy rate across districts.*

*Of 3,605 AFP cases reported and investigated throughout the Country, 3,475 (96%) were true AFP cases. Majority of the true AFP cases (85%) had received the recommended three and above doses of oral polio vaccine. Of the true AFP cases, none of the de-*

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*tected cases were classified as poliomyelitis, but 445 (13%) AFP cases were caused by non-polio enteroviruses (NPEV). The mean non-polio AFP rate generally declined from 3.1 per 100,000 in 2015 to 2.1 per100,000 in 2020. In every year, less than 40% of the districts achieved the non-polio AFP target rate of at least 4 per 100,000 population of children under 15 years of age. The proportion of districts with non-polio AFP rate of at least 4 per 100,000 significantly declined by 43% (OR=2.2; 95% CI: 1.1-4.1) between 2015 and 2020. Nationally, 2020 recorded the least (20%) proportion of districts that met the minimum non-polio AFP target rate of at least 4 per 100,000 children under 15 years of age. The proportion of districts with stool adequacy rate of at least 80% significantly declined by 15% (OR=0.53; 95% CI: 0.30-0.94) between 2015 and 2020. Nationally, 2018 recorded the least (52%) proportion of districts that met the minimum stool adequacy target rate of at least 80%.*

*The worst performance in AFP surveillance was recorded in 2020. There is need for UNEPI and WHO to train health staff, intensity support supervisions, and hold review and feedback meeting with districts..*

**Background**

Poliomyelitis is a disease caused by the wild poliovirus (WPV) [1], and it can cause lifelong paralysis or death. In 200 poliovirus infections, one will present with an irreversible paralytic disease, known as Acute Flaccid Paralysis (AFP) with, 5 to 10% of them will die when their breathing muscles become immobilized [2]. Polio mainly affects children under 5 years of age [3 , 4]. Poliomyelitis has no cure but can be preventable through vaccination. Wild polioviruses are human enteroviruses with three individual and immunologically distinct serotypes 1, 2 and 3; serotypes 2 and 3 have been declared eradicated by WHO in September 2015 and October 2019, respectively [5]. In addition, Poliomyelitis caused by vaccine-derived poliovirus (VDPV) or vaccine-associated paralytic poliomyelitis (VAPP) are also targeted for eradication. VAPP occurs when the live attenuated poliovirus strain in the oral polio vaccine (OPV) changes in the intestines and causes development of symptoms of paralytic polio within the vaccine recipient or a very close contact, but does not spread to cause paralysis in other cases. VDPV rarely occurs when a strain of poliovirus in OPV changes and revert to a form that may be able to cause paralysis in humans and develop the capacity to spread from person to person [6].

The Poliovirus spreads from person to person through contact with faecal matter or droplets from cough or sneeze of an infected person [1, 7]. The Poliovirus enters through the mouth and multiplies in the pharynx and intestines of its human host and consequently replicates in the motor neurons of the anterior horn and brain stem, destroying cells and thus manifesting poliomyelitis. Before the onset of illness (which is usually after 7 to 21 days), the virus is present in the throat for 1 to 2 weeks but remains shaded in the stool for several weeks [8].

The Global Polio Eradication Initiative (GPEI) Polio Endgame Strategy 2019-2023 targets to eradicate the poliovirus worldwide by 2023. The initiative emphasised in goal 1 (Eradication) the following core strategies to interrupt transmission: maintaining AFP surveillance and Environmental surveillance (ES), and providing polio vaccines through supplementary immunization activities (SIA) [9]. A sensitive acute flaccid paralysis (AFP) surveillance system is central to the overall polio eradication initiative [9]. WHO recommends minimum standards for AFP surveillance in a nationwide, case-based syndromic manner with laboratory confirmation of poliovirus from stool specimens. AFP cases are identified, reported and investigated using both active and passive surveillance, and community-based detection methods [1].

All children less than 15 years of age presenting with

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sudden onset of floppy paralysis or muscle weakness affecting either one or two limbs; or any person of any age with paralytic illness if poliomyelitis is suspected by a clinician are categorised as AFP cases [10].

This assessment aims to describe Uganda's AFP surveillance performance from 2015 to 2020 based on the Uganda's ministry of health and WHO recommended epidemiological performance indicators [1] for AFP surveillance. The information generated from this analysis contributes to evidence which guides the implementation of AFP surveillance interventions toward global eradication of polio.

**Methods**

**Study setting**

Uganda is a tropical country located in eastern Africa. The projected population of Uganda was 37,084,566 in 2015; 37,084,566 in 2016; 37,673,800 in 2018; 38,866,300 in 2019 and 41,583,600 in 2020 with a growth rate of 3.3% (UBOS). As of 2020, Uganda had 135 districts all report their AFP surveillance data to the Ministry of Health.

**Study design and data source**

We conducted a retrospective descriptive quantitative study using AFP surveillance secondary data submitted to ministry of health and WHO, Uganda office by districts using case-based reporting from 2015 to 2020.

Uganda adopted the WHO recommended AFP surveillance performance indicator targets, which include: At least 90% of all expected AFP monthly reports received in time; Annualized Non-polio AFP (NPAFP) rate of at least 4 per 100,000 children under 15 years of age; 80% of reported AFP cases investigated within 48hrs At least 80% of cases whose Specimens are arriving at the lab ≤ 3days; At least 80% of cases whose specimens arrive at the lab in "Good condition"; At least 10% of cases whose Specimens NPENT was isolated; At least 80% of cases whose Specimens are collected within 14 days of onset of Paralysis; At least 80% of proportion of cases (6 months-15 years) with OPV3+ immunization status; and At least 80% of stool adequacy rate.

There are two key AFP surveillance performance indicators *[10]* namely . Non-polio AFP Rate of at least 4 per 100,000 children under 15 years of age and stool adequacy rate of at least 80%. Non-polio AFP rate is an indicator of surveillance sensitivity that reduces likelihood of missing WPV cases. Non-polio AFP rate is measured by getting number of non-polio AFP cases under the age of 15 years / population under 15 years of age X 100 000. Stool adequacy rate is percentage of AFP cases with two adequate stools collected at least 24 hours apart within 14 days after onset of paralysis and arriving at the laboratory in good condition (*"Good condition" means that upon arrival within 72 hours: There is ice or a temperature indicator (showing < 8°C) in the container, the specimen volume is adequate (>8 grams) there is no evidence of leakage or desiccation (It is important to fill the case investigation and specimen tracking form).*

**Study variables**

We obtained already downloaded and organized district level annual data from Ministry of health (MOH), Uganda. The data included the following performance variables , total cases investigated, true AFP cases, minimum expected no. of non-polio AFP cases, Non polio AFP rate, proportion of reported AFP cases investigated within 48hrs, proportion of cases whose Specimens are arriving at the lab ≤ 3days, proportion of cases whose sspecimens are arriving at the lab in "Good condition", proportion of cases whose specimens (Non-polio enterovirus (NPENT) was isolated, proportion of cases whose specimens are collected within 14 days of onset, proportion of cases (6 months-15 years) with OPV3+, stool adequacy rate, and surveillance index.

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**Table 1: Acute flaccid paralysis cases and oral polio vaccine coverage ≥3 doses, Uganda, 2015-2020**

| Year | Under 15 population | AFP cases investigated | True AFP cases | Districts with cases of OPV3+ immunization status of at least 80%, n (%) | Average proportion of cases with OPV3+ Immunization status |
|---|---|---|---|---|---|
| 2015 | 18,171,438 | 600 | 570 | 82 (73) | 88% |
| 2016 | 18,171,438 | 713 | 674 | 85 (76) | 90% |
| 2017 | 19,590,376 | 610 | 590 | 59 (51) | 74% |
| 2018 | 19,590,376 | 628 | 606 | 85 (73) | 88% |
| 2019 | 20,210,476 | 595 | 580 | 86 (67) | 84% |
| 2020 | 21,623,472 | 459 | 455 | 103 (76) | 88% |
| **Total** | **117,357,575** | **3,605** | **3,475** | **500 (70)** | **85%** |

**Table 2: Non-polio acute flaccid paralysis rate and trend analysis of proportion of districts with non-polio acute flaccid paralysis rate of at least 4 per 100,000, in Uganda, 2015-2020**

| Years | Non-polio AFP rate per 100,000 (Min-Max) | Districts with non-Polio AFP rate | | Districts with no report of AFP cases -silent, n (%) | Trends analysis, Odds ratio (CI) |
|---|---|---|---|---|---|
| | | at least 4/100000, n (%) | at least 2/100000, n (%) | | |
| 2015 | 3.14 (0.80-28) | 39 (35) | 72 (64) | 0 (0.0) | 1 |
| 2016 | 3.71 (0.0-15) | 40 (36) | 77 (69) | 1 (0.89) | 0.96 (0.54 -1.7) |
| 2017 | 3.01 (0.52-14) | 29 (25) | 81 (70) | 0 (0.0) | 1.57 (0.87-2.8) |
| 2018 | 3.09 (0.52-14) | 31 (27) | 85 (73) | 0 (0.0) | 1.46 (0.80 -2.7) |
| 2019 | 2.87 (0.36-17) | 49 (38) | 86 (67) | 0 (0.0) | 0.88 (0.49-1.6) |
| 2020 | 2.10 (0.0-20) | 27 (20) | 56 (41) | 3 (2.2) | 2.2 (1.1-4.1) |
| **Total** | **2.99 (0.37-18)** | | | **4 (0.52)** | |

### Data analysis

From district level data, some sub regional, and national level variables were generated by getting sums. For example, proportion of districts with non-polio AFP rate of at least 1 per 100,000, 2 per 100,000 and 4 per 100,000 children under 15 years of age; proportion of districts with OPV3 immunization status of at least 80%; proportion of districts with stool adequacy rate of at least 80%; and percentage of districts that reported at least a case in the various groups.

In 2015, there were 112 districts, and this number increased gradually to 135 districts. For place analysis, the population of the districts created later were added to their mother district and given the same surveillance performance achievement.

We calculated proportion of districts with non-polio AFP rate of at least 1 per 100000, 2 per 100000 and 4 per 100000, proportion of districts with oral polio vaccine dose ≥3 (OPV3+) immunization status of at least 80%, proportion of districts with stool adequacy rate of at least 80% and percentage of districts that reported at least a case in the various groups. The analyses were stratified by sub regions, national, and calendar year.

Comparisons across the two indicators, including non-polio AFP and stool adequacy rate were made to assess for any relationships therein using trend analysis in STATA/ SE 14. We used QGIS to illus-

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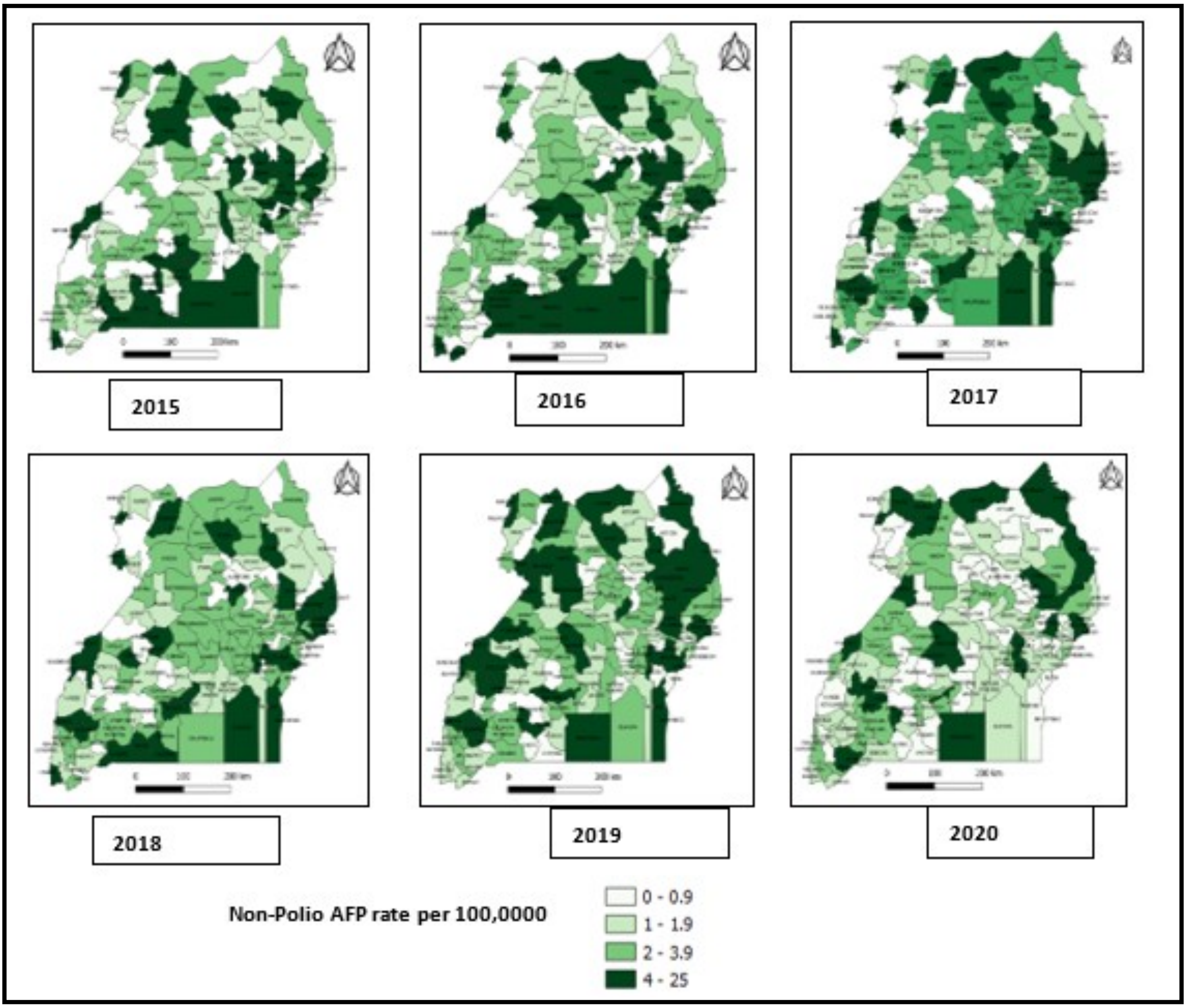


trate differences of NPAFP and stool adequacy rate across districts, sub regions and nationally.

**Results**

**Acute flaccid paralysis cases and oral polio vaccine coverage ≥3 doses, Uganda, 2015-2020**

Between 2015 and 2020, the population of children under 15 years of age increased from 18,171,438 to 21,623,472. During the study period, a total of 3,605 AFP cases were reported and investigated throughout the Country. Of the investigated AFP cases, 3,475 (96%) were true AFP cases (Table 1). Majority of the true AFP cases (85%) had received the recommended ≥3doses of oral polio vaccine. Of the true AFP cases, none were classified as poliomyelitis. Four hundred forty five (13%) AFP cases were caused by non-polio enteroviruses (NPEV).

Non-polio acute flaccid paralysis rate as a surveillance indicator, Uganda, 2015-2020

The mean non-polio AFP rate generally declined from 3.14 per 100,000 in 2015 to 2.1 per100,000 in 2020 (Figure 1). The mean non-polio AFP rate in the study period was 3.0 per 100,000 population of children under 15 years of age. During the study period, year 2016 recorded the largest non-polio AFP target rate of 3.71 whereas in every year, less than 40% of the districts achieved the non-polio AFP target rate of at least 4 per 100,000 population of children under 15

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**Table 4: Oral polio vaccine coverage ≥3 doses (OPV3+), stool adequacy rates and trend analysis of proportion of districts with stool adequacy rate of at least 80%, Uganda, 2015-2020**

| Year | Districts with cases of OPV3+ immunization status of at least 80%, n (%) | Average proportion of cases with OPV3+ Immunization status | Districts with cases of stool adequacy rate of at least 80%, n (%) | Average Stool adequacy rate | Trends analysis, Odds ratio (CI) |
|---|---|---|---|---|---|
| 2015 | 82 (73) | 88% | 76 (68) | 88% | 1 |
| 2016 | 85 (76) | 90% | 69 (62) | 89% | 1.3 (0.76 -2.3) |
| 2017 | 59 (51) | 74% | 77 (66) | 82% | 1.1 (0.61-2.0) |
| 2018 | 85 (73) | 88% | 60 (52) | 88% | 2.0 (1.2 -3.4) |
| 2019 | 86 (67) | 84% | 88 (69) | 90% | 0.96 (0.56-1.7) |
| 2020 | 103 (76) | 88% | 108 (80) | 91% | 0.53 (0.30-0.94) |
| **Total** | **500 (70)** | **85%** | **478 (66)** | **88%** | |

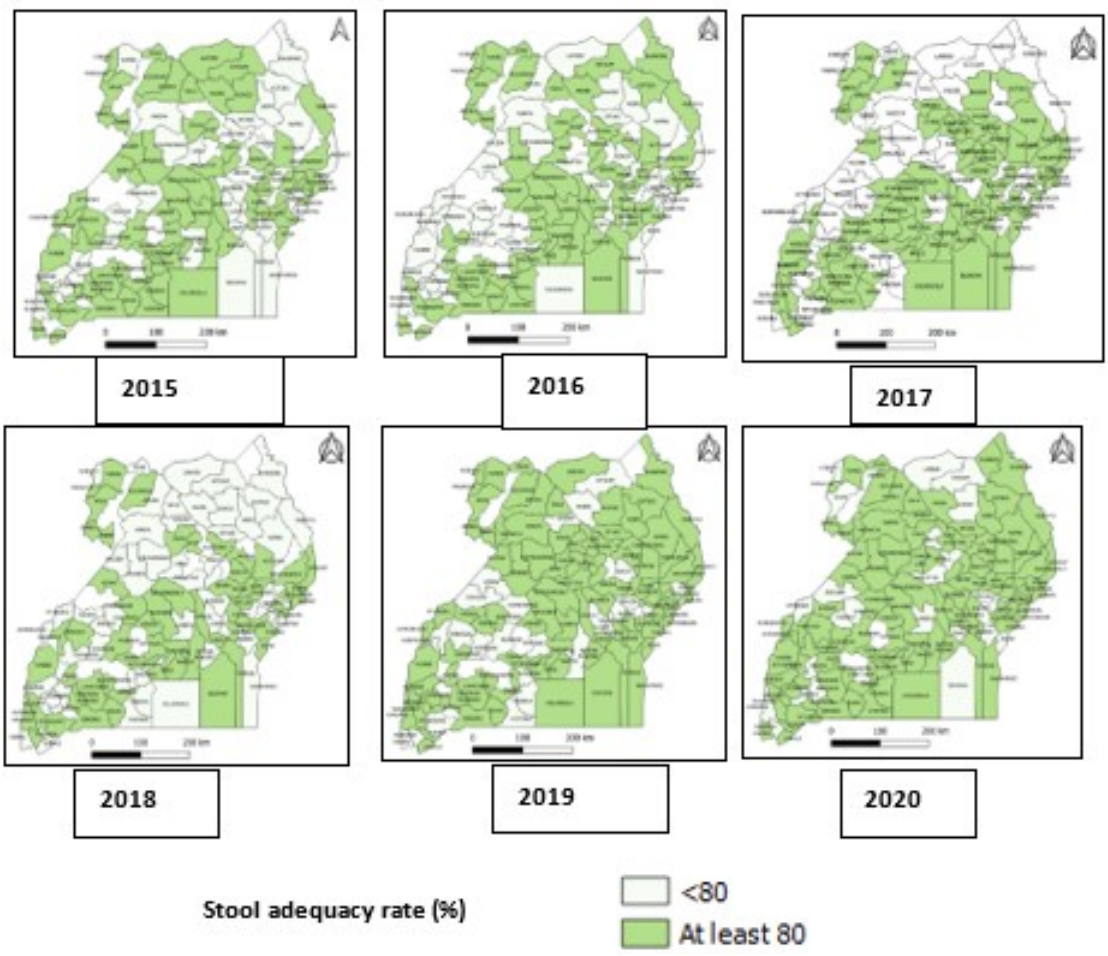


**Figure 2: Distribution of stool adequacy rate by District, Uganda, 2015-2020**

years of age, majority of the districts recorded non-polio AFP target rate of at least 2 per 100,000 population of children under 15 years of age (Table 2).

In the study period, 4 districts did not report any AFP cases (silent district); most (3) of the silent districts were observed in the year 2020 (Table 2). There was an overall decline in proportion of districts with the targeted non-polio AFP rate of at least 4 per 100,000 between year 2015 (at 35%) and 2020 (at 20%). The proportion of districts with non-polio AFP rate of at least 4 per 100,000 significantly declined by 43% (OR=2.2; 95% CI: 1.1-4.1) between 2015 and 2020 (Table 2). Nationally, year 2020 recorded the least (20%) proportion of districts that met the minimum non-polio AFP target rate of at least 4 per 100,000 children

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under 15 years of age. Similarly, year 2020 recorded the least (41%) proportion of districts that achieved non-polio AFP target rate of at least 2 per 100,000 children under 15 years of age (Table 2).

Distribution of Non-polio AFP rate per 100,000 by districts, Uganda, 2015-2020

Most districts did not generally attain the non-polio AFP target rate (4 per 100,000 children <15 years) (Figure 1).

**Stool adequacy rate as a surveillance indicator, Uganda, 2015-2020**

In Uganda, the stool adequacy rate has generally increased from 88% in 2015 to 91% in 2020 (Table 4). The mean stool adequacy rate in the study period was 88%. Throughout the study period, majority of the districts achieved the stool adequacy target rate of at least 80% (Table 4).

There was an overall increase in proportion of districts that met the stool adequacy rate of at least 80% between 2015 and 2020. The proportion of districts with stool adequacy rate of at least 80% significantly increased by 15% (OR=0.53; 95% CI: 0.30-0.94) between 2015 and 2020 (Table 4). Nationally, 2018 recorded the least (52%) proportion of districts that met the minimum stool adequacy target rate of at least 80% (Table 4).

**Distribution of stool adequacy rate by districts, Uganda, 2015-2020**

Most districts had generally not attained the stool adequacy target rate. At district level, the map generally had a bigger number of districts with less than 80% stool adequacy rate in 2015 and reduced as every year passed by, which implied that stool adequacy rate was improving over time in several districts (Figure 2).

**Discussion**

This study aimed at describing the AFP surveillance performance in Uganda from 2015 to 2020, based on the two key recommended performance indicators for AFP surveillance i.e. non-polio AFP and stool adequacy rate. This current study showed that majority of the AFP cases investigated were true AFP cases, and yet majority of them had received three or more (OPV3+) doses of oral polio vaccine. This is similar to the study findings in Ethiopia [11], Kenya [12], and Iran [4]. Whereas polio vaccination coverage of at least 90% yields herd immunity, this assessment indicated that the OPV3+ coverage among AFP cases was lower. It is possible that the OPV3+ coverage stated in this study was underestimated, as this could be affected by recall bias.

Nationally, the non-polio AFP rate significantly declined between 2015 and 2020. This was contrary to many similar studies that showed increase in non-polio AFP rates over the period of assessment [12, 13]. In addition, the country also did not meet the target of 4 per 100,000 children under 15 years as adopted [10]. Significant decline in non-polio AFP rates over the assessment period, and non-attainment of the non-polio AFP target rates indicates that there was decreasing sensitivity of the AFP surveillance system with more likelihood of missing any ongoing transmission of either circulating VDPV or WPV. It is possible that districts are yet to understand this new AFP surveillance indicator of 4 per 100,000 children under 15 years, and thereafter intensifying efforts and resources towards meeting the target is critical. Most of the silent districts were recorded in 2020. Similarly, in 2020, the least proportion of districts met the non-polio AFP target rate of at least 4 per 100,000 children under 15 years of age. Furthermore, there was generally poor performance in meeting the non-polio AFP target rate in 2020 compared to other years. This could be attributed to the fact that COVID-19 interrupted health service delivery in the whole country [13, 14].

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The national stool adequacy rate significantly increased in between 2015 and 2020, with mean stool adequacy rate in the study period being higher than the recommended target of 80%. This finding is in line with a study conducted in Ethiopia [11], some eastern and southern African countries [13], Liberia [15]. There were sub regional variations in terms of stool adequacy. This could be attributed to the good attitude and skill of the health facility staff or district surveillance focal persons. High stool adequacy rates indicate that two enough stool samples reached the laboratory in time in good condition within 72 hours. In this assessment, it likely that the surveillance system will not miss the virus in the stool.

## Limitations

The dataset did not have data on variables such as sex, age, and AFP categorization. This did not allow explicit description of AFP surveillance. For example, we could not the proportion of <5 years fully vaccinated with OPV.

## Conclusion

The majority of the true AFP cases had received three or more (OPV3+) doses of oral polio vaccine. Nationally, there was a significant decline in non-polio AFP rate, and significant increase in stool adequacy rate between 2015 and 2020. The non-polio AFP target rate of 4 per 100,000 children under 15 years was not met by the country, and yet the average stool adequacy target rate of 80% was met. The worst performance in AFP surveillance was recorded in 2020.

There is need for ministry of health and WHO to train health staff, intensity support supervisions, and hold review and feedback meeting with districts.

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## COVID-19 cluster within health facilities in Abim District, October 2020

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***Summary***

*Coronavirus Disease (COVID-19) has been an ongoing epidemic in Uganda since March 2020. As of 8 October, 2020, more than 9,500 cases had been confirmed, with nearly 350 (4%) among health care workers (HCWs). During September 2020, a cluster of COVID-19 cases was identified among health care workers and community members in Abim District, northern Uganda. We investigated to describe the transmission pattern in the cluster and recommend evidence-based prevention and control measures.*

*We defined a case as a laboratory-confirmed SARS-CoV-2 infection in a resident of Abim district during September and October 2020. We identified cases from the hospital records and interviewed case-patients on contact and exposure histories.*

*Abim District in Northern Uganda experienced a COVID-19 cluster of 25 patients with COVID-19. A 35 -year-old expectant female HCW was the index case. She reportedly had no travel history and had no known contact with persons with suspected or confirmed COVID-19. She interacted widely without protective gear with persons at Abim Hospital, Morulem health centre (HC) III, and Aremo village for at least 18 days (September 4-22) while symptomatic. She was hospi-*

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*talised in Abim hospital for this illness but not isolated, testing was not conducted until a week after she presented with symptoms. Results took 11 days to return. Despite her pending COVID-19 test results, the patient was released from the hospital.*

*Most (76%) of the patients in the cluster were HCWs. The most affected facilities were: Morulem HC III (31/100 HCWs infected) where the index case spent two days and Abim hospital (4/100 HCWs infected) where the index case-patient spent seven days while hospitalised. An additional case-patient existed at Morulem HC III around the same time that may have also contributed to the high attack rate there.*

*We recommended strict adherence to guidelines around isolation of patients with COVID-19 related symptoms in Abim hospital, self-isolation of the symptomatic individuals and a training on suspicion and effective isolation of COVID-19 cases for HCWs in Abim District. The Ministry of Health should also decrease the turnaround time for COVID-19 samples to avoid instances of releasing positive case-patients.*

**Introduction**

Coronavirus Disease (COVID-19) is a viral respiratory illness caused by SARS-CoV-2. It causes a range of human respiratory tract infections varying from mild cold to severe respiratory distress syndrome and even death [1].The virus is spread primarily via respiratory droplets during close face-to-face contact [2, 3]. Infection can be spread by asymptomatic, pre-symptomatic, and symptomatic carriers and the medium virus shedding time is around 19 days [4]. The average time from exposure to symptom onset is 5 days, and 98% of people who develop symptoms do so within 12 days [4]. Spread of COVID-19 from patients to healthcare workers (HCW) and between healthcare workers has also been reported [4].

COVID-19 has been an ongoing epidemic in Uganda since March 2020. As of 8 October, 2020, more than 9,500 cases had been confirmed, with nearly 350 (4%) among HCWs[5]. Abim District in Northern Uganda had registered only two cases of COVID-19 since the beginning of the pandemic. On 11 September 2020, Abim hospital medical staff suspected COVID-19 in one of the patients admitted in the hospital. Samples were picked from the patient on 11 September, but did not return positive until 22 September 2020. Following the positive test confirmation, contacts were listed and samples taken for COVID-19 testing. Of these, 25 persons tested COVID-19-positive, of whom 19 were HCW. It was not clear what had caused the cluster and what the missed opportunities were for the prevention of COVID-19 spread among HCW. We described the cluster, its transmission dynamics, and provide evidence-based recommendations to reduce future hospital related COVID-19 clusters.

**Methods**

***Study setting***: The cluster occurred in Abim District, northern Uganda which had a projected 2020 population of approximately 153,000 persons [6]. The district has one hospital and 17 lower-level health facilities. The hospital had 134 staff, while the lower health center IIs and IIIs have an average of seven and 11 staff each, respectively.

***Case definition and finding***: We defined a confirmed case as a positive PCR for SARS-CoV-2 in a resident of Abim District from 4 September to 5 October, 2020. We identified the cases using the district health records and visited Abim Hospital COVID-19 isolation unit to seek verbal consent from case-patients for the phone interviews.

***Investigation:*** We conducted phone interviews with all case-patients in the isolation using a standardized COVID-19 questionnaire modified from the national general case and HCW investigation forms. We asked about contact with suspected or confirmed COVID-19 cases, dates of contact with these persons, presence of

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| Characteristic (N=25) | Freq | Per- |
|---|---|---|
| **Sex** | | |
| Female | 19 | 76 |
| Male | 6 | 24 |
| **Occupation** | | |
| Healthcare worker | 19 | 76 |
| Farmer | 3 | 12 |
| Teacher | 2 | 8 |
| Student | 1 | 4 |
| **Facility with affected staff** | | |
| Abim Hospital | 12 | 63 |
| Morulem HCIII | 5 | 26 |
| Karenga HCIV | 1 | 5 |
| Koya HCII | 1 | 5 |
| **Health care worker cadres affected** | | |
| Midwife | 8 | 42 |
| Nurse | 8 | 42 |
| Records Assistant | 2 | 11 |
| Hospital admin | 1 | 5 |
| **Symptomatic** | **17** | **68** |
| **Contact with suspected/confirmed case-** | **19** | **76** |

***Table 1: Characteristics of the COVID-19 case-patients identified in Abim District, Uganda, October 2020***

| Risk group(N=19) | Case (n) | Estimated population at risk | Attack rate/100 |
|---|---|---|---|
| **Facility** | | | |
| Morulem HC III | 5 | 16 | 31 |
| Koya HC II | 1 | 5 | 20 |
| Abim hospital | 12 | 270 | 4 |
| Karenga HC * | 1 | | |
| **Nurses** | | | |
| Morulem HC III | 2 | 7 | 29 |
| Abim hospital | 5 | 119 | 7 |
| Karenga * | 1 | | |
| **Midwives** | | | |
| Morulem HC III | 2 | 2 | 100 |
| Koya HC II | 1 | 1 | 100 |
| Abim hospital | 5 | 32 | 16 |
| **Abim Hospital Administrator** | 1 | 1 | 100 |
| **Abim Records assistant** | 1 | 2 | 50 |
| **Morulem HC III HIA** | 1 | 1 | 100 |

***Table 2: Attack rates of the COVID-19 infection among HCWs, Abim District, Uganda, October 2020.***

****One of the HCW (from Karenga Health facility) was infected while visiting his family in Aremo village and therefore his facility and cadre AR are not calculated since it was not a work-related exposure.***

***HIA: Health information assistant***

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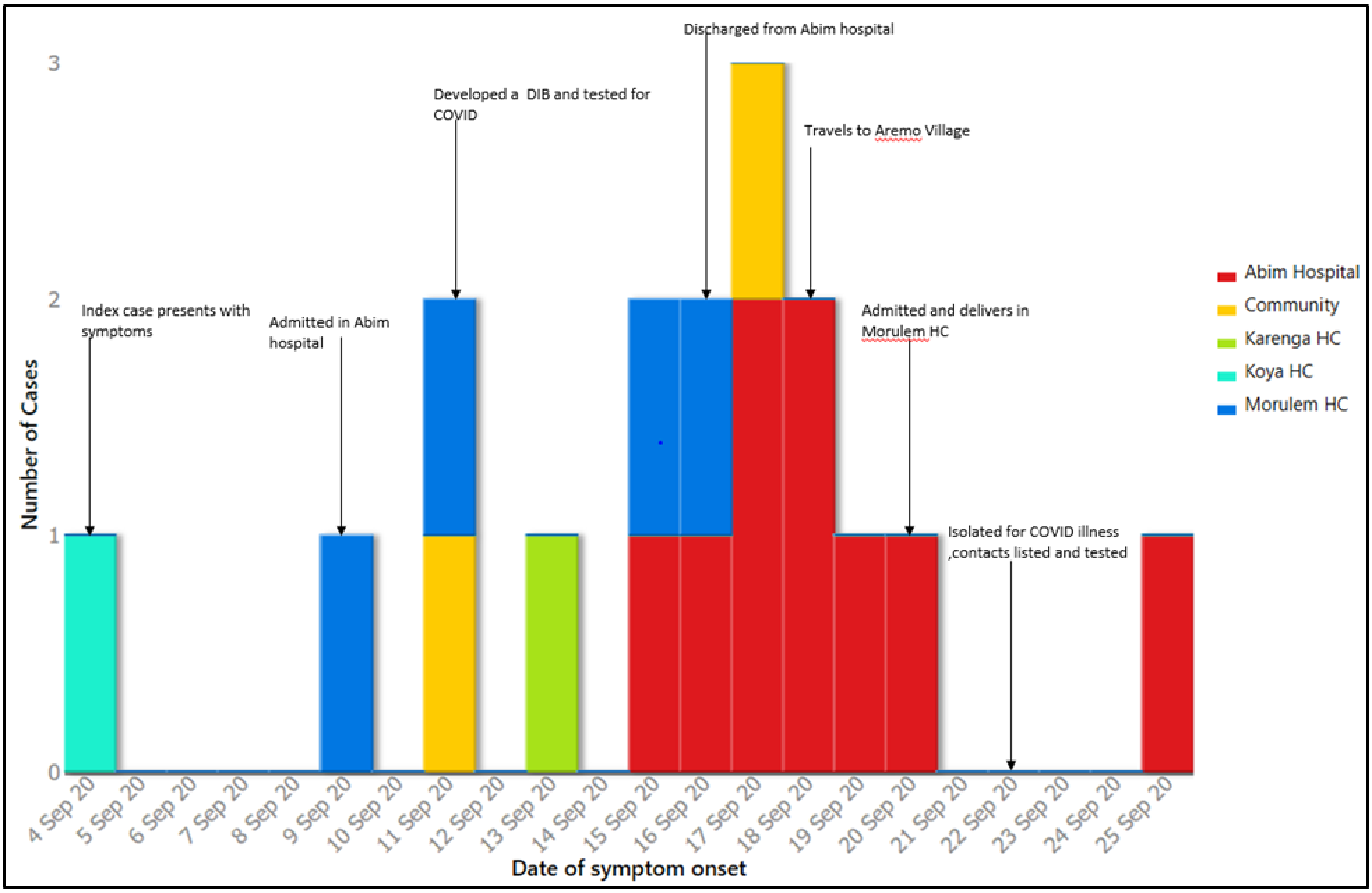


**Figure 1:** ***Distribution of the COVID-19 cases by date of symptom onset in Abim District Uganda, October 2020.***

**Eight additional asymptomatic persons were identified from Morulem(Aremo Village) (5) and Abim (3). Among the asymptomatic from Morulem (Aremo village), four were non HCWs.*

symptoms, dates of symptom onset for the symptomatic, wearing appropriate personal protective equipment (PPE) while handling patients (for HCW), PPE while in the community (for HCW and community members),

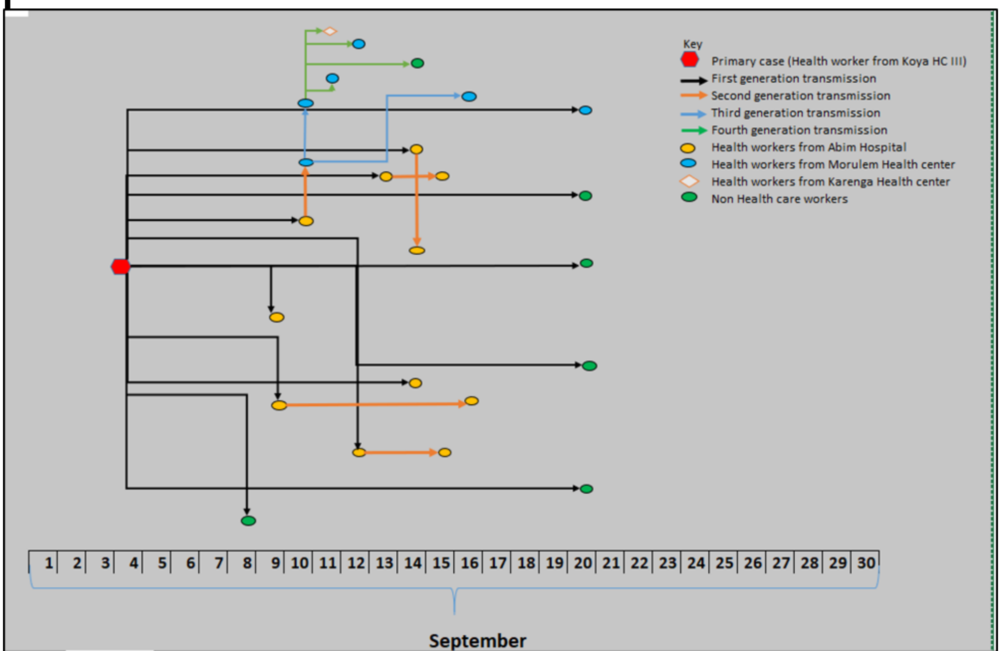


***Figure 2: The transmission tree of the 25 healthcare worker cases in Abim District Uganda, September 2020***

The SARS-CoV-2 infection transmissions in Abim hospital (where she spent seven days) were primarily or secondarily linked to the index case-patient. However, the index case was primarily linked to only one case patient in Morulem HC III (where she later delivered) her baby (Figure 2).

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practices around hand hygiene and social distancing and visits to any social gatherings in the last month before symptom onset or positive test result (for asymptomatic persons).

***Data analysis**:* We described the case-patients by person, place, and time. We constructed transmission chains and used epidemic curves by date of symptom onset to describe the characteristics of the cluster over the investigation period. We calculated attack rates by health facility and by cadre of HCW (for HCW).

***Ethical considerations*:** This investigation was conducted as part of the Ministry of Health (MoH) efforts to control the COVID19 pandemic in Uganda. The MoH of Uganda through the office of the Director General Health Services gave the directive and approval to conduct this investigation. Additionally, the office of the Associate Director for Science, Centers for Disease Control and Prevention, Uganda, determined that this investigation was not human subjects' research because the primary purpose was to identify, characterize, and control disease in response to a perceived immediate public health threat. We sought permission to interview the patients from the District health office. We obtained verbal informed consent from case-persons before the interviews.

## Results

### Index case and sequence of events leading to index case identification

The index case-patient was a 35-year-old female HCW at Koya HC II, one of the lower-level health facilities in Abim District. She reportedly had no travel history and had no known contact with persons with suspected or confirmed COVID-19. On 4 September, she presented to Koya HCII with a dry cough and chest pain. She was 8.5 months pregnant at the time of her onset. She was managed as an outpatient for the cough and treated with antibiotics, but not tested for COVID-19. However, she developed a pneumonia and on 9 September, she was referred to Abim Hospital where she was admitted to the maternity ward. While at the hospital, she was continued on antibiotic treatment despite worsening of her illness. On 11 September, she developed difficulty in breathing, at which point staff suspected COVID-19 and took a sample for testing. Despite not having results, she had improved by 16 September and was discharged, after which she returned to her residence at Koya for two days. On 18 September, she travelled to Aremo village with in Abim District to stay with relatives while waiting to deliver her baby. While there, she interacted socially with the community including fellow HCWs while visiting their homes. On 20 September, she delivered a healthy infant at Morulem HC III (within Aremo village). On 22 September, her test results were returned, confirming her infection with SARS CoV-2. She was isolated the same day at the Abim Hospital; contacts were identified and also tested for COVID-19.

In total, 25 case-patients (including the index case-patient and those who were contacts to the index case-patient) were identified in this cluster. Seventeen (68%) of these were symptomatic,19 (76%) of them were HCWs. Mean age was 34 years (range, 13-56 years) and 19 (76%) were female. Twelve (52%) HCWs had direct contact with the index case-patient. Sixteen (84%) of the 19 HCWs were either nurses or midwives (Table 1).

Morulem HC III was the most affected health facility with an Attack rate 31/100 while midwives were the most affected cadre in Morulem HC III with an AR of 100%.

## Discussion

Twenty-three (92%) of the cases, in the cluster of 25 SARS-CoV-2 infections in Abim District, Uganda during September, 2020 were epidemiologically linked to one infected HCW. The HCW had no known history of contact with a suspected or confirmed COVID-19 patient. She interacted widely without protective gear

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with persons at Abim Hospital, Morulem HC III, and Aremo village for at least 18 days (September 4-22) while symptomatic. While ill, she was hospitalised in the maternity ward in Abim hospital. She was therefore not isolated. Testing was not conducted until a week after she presented with symptoms and results took 11 days to return. Despite her pending COVID-19 test results, the patient was released from the hospital. None of the guidelines in and around isolation of the patient and health care worker interaction with communities while treating COVID-19 patients was adhered to.

Our findings established that the attack rate among the HCWs was 4/100 persons, the affected HCWs were from Abim hospital where the index case-patient spent seven days, Morulem HC III where she spent two days, Koya HC II where the case patient worked and Karenga HC whose case patient had visited His family in Aremo village where Morulem HC III is located. Our epidemiologic assessment demonstrated that the Morulem HC III was most affected and that midwives were the most affected cadre in Morulem HC III. We also demonstrated that there was no epidemiological evidence of transmission from the index case to cases that occurred 9 and 11 September in Morulem health facility.

Morulem HC III had its first case (GP), who reportedly interacted with staff from another health facility (Karenga) during the time they had lost a COVID-19 patient and had active cases. He reported no contact with the index case and no cases were linked to Him in this cluster. We also established one of the midwives in Abim hospital interacted with staff from Morulem HC III after treating the index case-patient during her stay on admission in Abim hospital. This interaction of the midwife probably resulted in spread and subsequent identification of cases in the facility (Morulem HC III) before being identified in Abim where the exposure initially happened. The index case therefore was not the sole source of exposure for all the cases in Morulem HC III and probably this explains the observed attack rate in and around Morulem HC III.

The community members affected in this cluster were mostly relatives to the health care workers, these likely contracted the infection during their social interaction with the infected HCWs. Studies elsewhere have evidenced possibilities of non-nosocomial infection among HCWs. In fact some highlight the possibility of them occurring more often than the work-related acquisitions of COVID-19 [7].

The care taking staff in Abim hospital took almost four days before suspecting COVID-19. During this period, no extra precautional measures were taken while handling the index patient in the health facilities. Studies elsewhere have observed this kind of behaviour among HCWs, this situation may lead to a lack of recognition of the infection while patients are highly contagious [8], resulting in repeated opportunities for infection of unsuspecting HCW. In this investigation, we observed a propagated infection among the midwives since the initial exposure to the index case occurred in maternity ward and the staff reportedly used ordinally cloth masks while handling their patients. This observation was also similar to one in a prospective cohort study of nearly 100,000 HCW and more than 2 million community individuals in the US and the UK showed that frontline healthcare workers had 11.6 times higher risk of COVID-19 disease [9]. The non-medical staff was probably infected due to the fact that these non-front liners are rarely trained on infection control and are therefore less concerned with personal protective equipment use.

The turnaround time for the results was almost ten days which led to the release of the suspected case-patient before her results were confirmed. This then created an opportunity for the index patient to interact and spread the infection wider in the Abim community and other health facilities. At the time of the outbreak, samples

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from the district hospitals were picked by regional vans and delivered to regional referral hospitals. These would then be transported to the testing laboratories by through the hub system. The testing would take an average 24 hours and the test results communicated on wats up and email to the District health officers. This whole process would often take a week or longer, exceeding the time in which the results would be practically useful. However, a lot has changed since then, health facilities are able to screen patients for the SARS-Cov infection using Rapid diagnostic tests, private laboratories have been authorised to test for the Covid infection, and the government has procured testing machines that can produce results within a shorter time. All these efforts are geared towards reducing the time taken between sample collection and receipt of the test results.

**Strengths and Limitations**

The transmission tree was constructed based on history taking of contact with a suspected or confirmed case and also recall of the dates of contact. These might have been inaccurate due to the inability of the participants to recall the exact dates of contact and dates of symptom on set.

The symptoms of COVID-19 are very similar to the ordinally flu symptoms and therefore contact history and symptom onset date in this investigation might have been misrepresented or interpreted. Despite the limitations, the study highlights important behaviours of HCWs that need to be considered while managing COVID-19 infections in the facilities.

**Conclusion**

This COVID-19 cluster in Abim district started with one HCW who was not suspected early and therefore was not effectively isolated. Her COVID-19 test results took long and while waiting for the test results, she interacted with HCWs and community members. During the two weeks of waiting, she was not isolated, was symptomatic and infectious.

We recommend a training on suspicion and effective isolation of COVID-19 cases for HCWs in Abim District. We additionally recommend strict adherence to guidelines around isolation of suspected cases and HCW managing suspected cases. Ministry of Health should consider decreasing the turnaround time for COVID-19 samples.

**Acknowledgements**

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## A cluster of COVID-19 at a formal workplace, Kampala Central, August 2020: description of cases and response measures

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### Summary

*In response to COVID-19, the Ugandan government instituted a lockdown, with multiple strategies including curfews and banning of both private and public transport. On May 5, with minimal community transmission (6%) phased lifting of some of the earlier restrictions commenced. Due to its high rate of infectivity, multiple clusters were seen in Kampala's workplaces. We described confirmed COVID-19 cases among employees of a motor vehicle dealing facility in Kampala city and assessed the implemented control measures.*

*We described case-persons by demographic characteristics, symptoms, role at the facility, distribution of overtime, and documented the response strategies. We also conducted Key Informant interviews with the cases and workplace management, made observations, and generated information on the response strategies. We conducted content analysis to summarise findings from the key informant interviews.*

*All the 85 employees were tested. The overall attack rate (AR) was 12.9/100. Only the males (AR: 14.9/100) were affected, females were not affected. All case-patients were from the mechanics department (AR: 24.4/100), working as motor vehicle mechanics. Eight out of the 11 case-patients (73%) reported symptoms of cough and/or fever.*

*The outbreak ended on August 22, when all the employees had been successfully tested and only those who were asymptomatic with a negative PCR test result for COVID-19 could resume work.*

*A low proportion of the employees at the motor vehicle dealership tested positive for COVID-19 and were predominantly symptomatic. Inspection of the workplace showed that close or prolonged interactions among the employees in the meeting areas including the dining could have resulted in the continued spread of the infection. Widespread transmission of COVID-19 did not seem likely to occur as the management instituted control measures and ensured they were strictly adhered to.*

### Background

COVID-19 was confirmed as a global pandemic on March 11, 2020, and reached Uganda on March 21, 2020(1). In response to this, the Ugandan government instituted a lockdown on March 30, with multiple strategies including curfews and banning of both private and public transport. Six weeks later, on May 5, with minimal community transmission (6%) the government begun phased lifting of some of the earlier restrictions to spur economic growth. Due to its high rate of infectivity, multiple clusters were seen in Kampala's workplaces following the easing of some of the earlier government restrictions. In response to this, we described confirmed COVID-19 cases among employees of a motor vehicle dealing facility in Kampala city and assessed the implemented control measures.

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**Methods**

We conducted a descriptive study using both quantitative and qualitative data collection approaches among a group of 85 employees engaged in motor vehicle mechanics, sales, and administrative duties at the motor vehicle dealing facility, 07th-22nd August 2020. The study was conducted from 07 – 22 August 2020. All employees were tested for COVID-19 following the confirmation of three (3) employees as COVID-19 positive while at the workplace in August 2020. We defined a confirmed case as any staff that had a confirmed PCR positive test for COVID-19 at the motor vehicle dealing facility in August 2020.

Using an interviewer-administered questionnaire we collected data from the confirmed cases on COVID-19 symptom status, sex, age, date, and site of sample collection, date of COVID-19 test confirmation, and the occupation or role at the workplace.

We conducted key informant interviews with the case-persons and workplace management, made observations, and generated information on the response strategies. We described case-persons by demographic characteristics, symptoms, role at the facility, distribution of overtime, and documented the response strategies. We used content analysis to summarise findings from the key informant interviews.

This was a public health emergency and the investigation was part of the national efforts to control COVID19 in Uganda, we did not therefore seek for ethical approval. However, we received a project determination as non-research and clearance from the Centers for Disease Control and Prevention (CDC) to conduct this investigation. Personal identification information was not recorded during the interviews at the workplace.

**Results**

All 85 employees (74 males and 11 females) at the workplace had their samples taken and tested. The overall attack rate (AR) was 12.9/100. Only the males (AR: 14.9/100) were affected, females were not affected. Eight out of the 11 case-patients (73%) reported symptoms of cough and/or fever. All case-patients were from the mechanics department (AR: 24.4/100), working as motor vehicle mechanics. There were no cases from the sales, support, and administrative departments.

The outbreak started on August 07, 2020, almost three months after the government had initiated relaxation of some of the lockdown restrictions in May 2020. The initial cases were three (3) employees, working as motor vehicle mechanics, who presented at work with symptoms of COVID-19 on August 06, 2020. COVID-19 was suspected, while on duty at the motor vehicle dealing facility, the employees sought medical attention, and samples were collected immediately. Following this, samples were collected from all employees (82) at the workplace for fourteen days and 8 additional employees were confirmed positive. All the subsequent cases were close contacts of the initial three cases, working together in the mechanics department. Direct or prolonged close contact was reported among all the case-patients as they shared close contact areas at the workplace including the dinning and meeting rooms where they held conversations near each other. The outbreak ended on August 22, when all the employees had been successfully tested and only those who were asymptomatic with a negative PCR test result for COVID-19 could resume work (Figure 1).

**COVID-19 control strategies at a** motor vehicle dealing **facility, Kampala Central, August 2020**

During the inspection of the workplace and interviews with management, we identified the following control strategies

*Closure of workplace*

The workplace was closed for two weeks, to allow for fumigation and deep cleaning including the vehicles. Only employees with negative PCR COVID-19 test

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results could resume working after the two weeks of closure. The workplace initiated a policy of fumigation of all vehicles accessing the dealership before offering mechanical services with the cost to be split between the customer and the workplace.

*Safe physical distancing in the dining room*

Before testing and identification of the initial cases, the 85 employees were sharing one small dining room, they were subsequently advised to improve the dining spacing and design shifts for taking meals to enable practicing of safe physical distancing.

*Enforcement of standard operating procedures*

A team was set up in the workplace to train the employees on the key basic practices they were required of. This team comprised of the human resources manager, occupational safety manager and the heads of each department including mechanics, sales, administration and support staff. It was also tasked with ensuring compliance to the use of face masks by the employees, hand hygiene, and physical distancing practices. The workplace provided masks for the employees, improved coverage of handwashing stations and provision of hand sanitizers, and put physical markings in workplace areas including the reception and dining room to minimize possibilities of crowding.

**Discussion**

Our investigation demonstrates that workplaces are key sources of COVID-19 infections as all the confirmed cases were close contacts, working together in the same department.

Our findings are in agreement with COVID-19 outbreak events elsewhere, in Ireland, of the 344 outbreaks/clusters reported in 2020, most of them 293 (85%) were from workplaces including commercial premises, construction sites, office-based workplaces, meat/poultry plants, manufacturing plants, other food/beverage plants, defense forces, justice and emergency services and other workplaces(2).

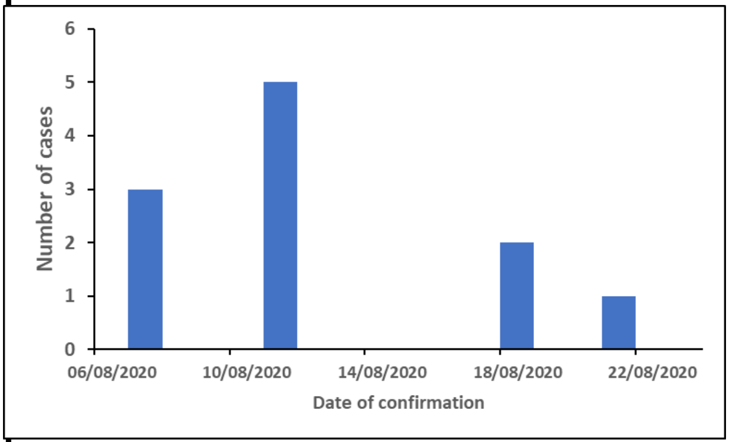


**Figure 1: Epidemic curve showing the number of confirmed COVID-19 cases at a motor vehicle dealing facility, by date of confirmation, Kampala, August 2020**

We found a low positivity rate of COVID-19 as the initial cases did not cause a high volume of secondary cases at the workplace which can be explained by the rapid response strategies undertaken by the management upon identification of the initial cases to cut further transmission amongst the employees. This also implies that workplaces can be made COVID-19 safe if adherence to Standard Operating Procedures is strictly enforced.

All employees who tested positive for COVID-19 were working in the same department and most of them developed symptoms. This could have resulted from multiple unavoidable interactions amongst the employees which increased the risk for propagated transmission within the department. The outbreak of COVID-19 at this workplace was probably due to close or prolonged interactions among employees working in the same department. Close contact was reported in the dining area during mealtime with low compliance with handwashing and use of face masks.

**Limitations**

Given the nature of the study design (a descriptive study), without analytical approaches, we were not able to quantify and relate exposure factors among the employees. However, this study documents control strategies that can be utilised by formal workplaces during

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future similar outbreaks.

**Conclusion**

A low proportion of the employees at the motor vehicle dealership tested positive for COVID-19 and were predominantly symptomatic. Inspection of the workplace showed that close or prolonged interactions among the employees in the meeting areas including the dining could have resulted in the continued spread of the infection. Widespread transmission of COVID-19 did not seem likely to occur as the management instituted control measures and ensured they were strictly adhered to.

**Acknowledgements**

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