

# The 7<sup>th</sup> Uganda National Field Epidemiology Conference

‘Fighting at the Frontline – Field Epidemiology Fellows at the helm of the COVID-19 response’



## ABSTRACT BOOK



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## COVID-19 INVESTIGATIONS

### COVID-19 outbreak at a quarantine prison, Central Uganda, September 2020

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**Background:** During September-October 2020, an outbreak of COVID-19 occurred at Masaka Ssaza, a COVID-19 quarantine prison (holding center for newly-sentenced persons before transit to their host prison) in Central Uganda. We investigated to identify factors associated with introduction and spread of infection in Masaka Ssaza prison.

**Methods:** We defined a case as PCR-confirmed SARS-CoV-2 infection in a prisoner/staff at Masaka Ssaza prison during September-October 2020. A control was defined as a prisoner or staff at Masaka Ssaza with a negative test during the same timeframe. We reviewed prison medical records to identify case-patients and interviewed prison staff to understand possible avenues of introduction of infection and opportunities for spread. We conducted a case-control study interviewing prisoners and staff to determine factors associated with spread of the infection. Logistic regression was used to assess factors associated with infection.

**Results:** The index case was Inmate A, a 33-year-old male who entered the prison on September 16, 2020. On September 23, Inmate A learned that a colleague with whom he had close contact before imprisonment had died of COVID-19. He immediately reported this to prison authorities, prompting mass RT-PCR testing of all 254 prisoners at the prison on September 30, revealing three cases, including Inmate A. Additional follow-up testing of 251 prisoners confirmed 98 cases on October 15. On October 29, testing of 153 prisoners confirmed one case. The overall attack rate was 40/100. Ward-specific prisoner density ranged from 0.3-2.1 prisoners/m<sup>2</sup> and prisoners were observed to congest at ward entrances and at mealtimes. Face mask ownership among case-patients was 35%. Using a face mask all the time was protective (aOR= 0.03; 95% CI 0.01-0.09). Residing in Ward 6 was associated with increased odds of infection (aOR=7.4; 95% CI 1.6-3.4).

**Conclusion:** COVID-19 was likely introduced into Masaka Ssaza prison by an infected incoming prisoner. The outbreak may have been amplified by congestion in wards and at mealtimes and low use of preventive measures. Importantly, consistent use of face masks was protective. Unrestricted access to handwashing facilities, facemask use, and strict adherence to 'do not enter another ward' rules could mitigate risk of future outbreaks.

**Key words:** COVID-19, Quarantine prison, Uganda

## Investigation of a COVID-19 Outbreak at a Regional Prison, Northern Uganda, September 2020

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**Background:** Despite implementing measures to prevent introduction of COVID-19 in prisons, a COVID-19 outbreak occurred at Moroto Prison, northern Uganda in September 2020. We investigated factors associated with the introduction and spread of COVID-19 in the prison.

**Methods:** A case was PCR-confirmed SARS-CoV-2 infection in a prisoner/staff at Moroto Prison during August–September 2020. We reviewed prison medical records to identify case-patients and interviewed prison and hospital staff to understand possible infection mechanisms for the index case-patient and opportunities for spread. In a retrospective cohort study, we interviewed all prisoners and available staff to identify risk factors. Data were analyzed using log-binomial regression.

**Results:** On September 1, 2020, a recently-hospitalized prisoner with unrecognized SARS-CoV-2 infection was admitted to Moroto Prison quarantine. He had become infected while sharing a hospital ward with a subsequently-diagnosed COVID-19 patient. A sample taken from the hospitalized prisoner on August 20 tested positive on September 3. Mass reactive testing at the prison on September 6, 14, and 15 revealed infection among 202/692 prisoners and 8/90 staff (overall attack rate=27%). One prison staff and one prisoner who cared for the sick prisoner while at the hospital re-entered the main prison without quarantining. Both tested positive on September 6. Food and cleaning service providers also regularly transited between quarantine and unrestricted prison areas. Using facemasks >50% of the time (adjusted risk ratio [aRR]=0.26; 95%CI: 0.13–0.54), or in combination with handwashing after touching surfaces (aRR=0.25; 95%CI: 0.14–0.46) were protective. Prisoners recently transferring from other facilities to Moroto Prison had an increased risk of infection (aRR=1.50; 95%CI: 1.02–2.22).

**Conclusions:** COVID-19 was likely introduced into Moroto Prison quarantine by a prisoner with hospital-acquired infection and delayed test results, and/or by caretakers who were not quarantined after hospital exposures. The outbreak may have amplified via shared food/cleaning service providers who transited between quarantined and non-quarantined prisoners. Facemasks and handwashing were protective. Reduced test turnaround time for the hospitalized prisoner could have averted this outbreak. Testing incoming prisoners for SARS-CoV-2 before quarantine, providing unrestricted soap/water for handwashing, and universal facemask use in prisons could mitigate risk of future outbreaks.

## **Epidemiological Assessment of COVID-19 Cluster among Attendees of a Church Activity in Omoro District, Northern Uganda, October 2020**

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**Background:** On 2 October 2020, a cluster of COVID-19 infections was reported in Omoro District in northern Uganda. Despite government directives banning public gatherings, many infected persons had reportedly attended a farewell party at Church X on 5 September. We investigated to determine infection source, understand outbreak magnitude, and identify risk factors to inform COVID-19 control measures.

**Methods:** We defined a case as a positive PCR for SARS-CoV-2 virus in a respiratory sample from an Omoro District resident, taken from 4 September-5 October 2020. We reviewed records to make a line list and interviewed the index case-patient, church farewell party attendees, and several community members to ascertain possible exposures. We conducted a retrospective cohort study among 62 farewell party attendees.

**Results:** Among 23 case-patients (74% male; median age 36 years), 21 (91%) had exposure to a single index case-patient (Case A) before their illness onsets. Fifteen attended the farewell party (party attack rate=24%) and six lived in Case A's village (different from the church village). Case A had onset on 23 August. Case A had no travel history but had multiple traveller contacts through work. Case A was a highly active Church X member, attended multiple Church X services in August and attended the farewell party while ill. A second case-patient, Case B, had onset on 1 September. Case B was also an active Church X member, frequently interacted with Case A, and attended the farewell party. All other case-patients associated with the party had onsets from 8-29 September. Close contact with Cases A (RR=2.4; 95% CI=1.1-5.8) or B (RR=2.6; 95% CI; 1.2-6.7) at the farewell party was associated with infection.

**Conclusion:** A social event at a church and lack of adherence to government directives provided an opportunity for spread of COVID-19 to at least 13 persons. We suggested improved adherence to national guidelines and government directives for COVID-19.

## **A Cluster of SARS-COV-2 Infections among Workers in a Factory making Personal Protective Equipment, Central Uganda, 2020**

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**Introduction:** In September 2020, a cluster of SARS-COV-2 infections was reported among workers at a factory in Uganda making personal protective equipment. The factory (Factory X) had already introduced COVID-19 risk reduction measures for all employees, including mandatory mask-wearing and hand sanitizing at all entry points. We investigated the cluster to determine exposures associated with transmission and inform evidence-based control measures.

**Methods:** We defined a case as positive RT-PCR test for SARS-COV-2 in a Factory X worker during August-September 2020. We conducted a case-control study using a randomly-selected subset of case-patients. A control was a Factory X worker with a negative RT-PCR test for COVID-19 during August-September 2020, selected randomly from Factory X departments with cases. Case-patients and controls were interviewed using a standardized questionnaire and asked about possible exposures. We analysed data using logistic regression to obtain an adjusted odds ratio (AOR) with confidence interval (CI). We interviewed facility staff on preventive measures and conducted an observational assessment for ventilation and crowding.

**Results:** Among 163 case-patients (factory attack rate=11%), none died. The index case-patient was a 27-year-old employee with infection confirmation on August 10. In the case-control study with 75 cases and 75 controls, lack of self-reported mask use (AOR=14, 95% CI 2.4-76), and working in the engineering (AOR=5.9, 95% CI 2.3-16) or old garments (AOR=2.4, 95% CI 1.1-5.5) departments were associated with infection. Engineering and old garments departments lacked windows, while other departments all had open windows. We observed workers on production lines spaced closely together.

**Conclusions:** This SARS-COV-2 cluster was associated with inadequate mask use and poor ventilation, likely exacerbated by congestion. We recommended enforcement of factory risk reduction measures including mask use, increased spacing on production lines (for example, reducing the number of people on each line by implementing shift work), and provision of adequate windows and doors in all departments.

## **Investigation of a COVID-19 Cluster at Achwa Hydroelectric Power Plant, Pader District, Uganda- October 2020**

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**Background:** Achwa Hydroelectric Power Plant (AHPP) in Pader District, Uganda introduced multiple measures starting in April 2020 to reduce the risk of COVID-19 introduction and spread. These included testing of visitors and returnees to the plant for COVID-19 on arrival, enforcement of regular hand washing, face mask use and social distancing. Despite these measures, on October 3, 2020, a cluster of COVID-19 cases was reported at AHPP. We investigated to identify factors facilitating spread of COVID-19 and recommend control measures.

**Methods:** A confirmed case was a positive RT-PCR for SARS-CoV-2 in a person who lived, worked at, or visited AHPP from August 1-October 5, 2020. We reviewed routine COVID-19 test results from medical records at AHPP and actively searched for cases to develop the line list. We performed environmental assessment and conducted a retrospective cohort study to identify risk factors for transmission.

**Results:** We identified 105 case-persons residing in 6 work camps at AHPP (overall attack rate (AR)=20%); mean age was 32 years (range, 18-60 years). The index case-person delivered supplies to the plant from Kampala and left after his sample had been taken on August 10; his positive test result was returned on August 17. The second case-patient was a plant employee who had travelled to Gulu City 10 days before his sample was collected on August 18 and tested positive on August 25. One camp, Alnour camp, was both the most congested, with all workers sharing a single dining area, and the most affected (AR=61%) of the 6 camps. Risk was higher among persons sleeping >2 per room (aRR=1.7, 95%CI=1.5-4.1) than those who slept  $\leq$ 2 per room.

**Conclusion:** Long test turnaround time for the index case and crowded employee sleeping and living conditions facilitated the spread of COVID-19 at AHPP. We recommended decongesting sleeping areas at the station and continued surveillance for early detection and management of infections.

**Keywords:** COVID-19, Power plant, Pader District, Uganda

## Health Care Worker COVID-19 Cluster in Abim District in Uganda during September-October 2020

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**Background:** As of 8 October, 2020, over 9,500 COVID-19 cases had been confirmed in Uganda, of which 4% were among healthcare workers (HCW). In September 2020, a cluster of COVID-19 cases were identified among HCW in Abim District. We investigated to identify transmission patterns and recommend evidence-based prevention and control measures.

**Methods:** We defined a case as a laboratory-confirmed SARS-CoV-2 infection in a resident of Abim District during September-October 2020. We identified case-patients from Facility A records and conducted phone interviews with case-patients to collect data on sociodemographic, clinical history, contact history, and occupational status. We assessed the case-patients' exposure history.

**Results:** Twenty-five case-patients were identified; 19 (76%) were HCWs and six (34%) were community contacts of the infected HCWs. The index case (Patient X) was a 35-year-old staff member at Facility B in Abim District who was 34 weeks pregnant at her illness onset (4 September). She was admitted to Facility A for a respiratory illness from 9-16 September (not isolated), received COVID-19 testing on 11 September, and received positive results on 22 September after her discharge. From the 17-18 September, she interacted with Abim community members. During 19-20 September, she was admitted at Facility C (not isolated) for delivery. During 3-20 September, 39 HCWs from Facility B, Facility A, and Facility C were in contact with Patient X. All had samples taken on 23 September; 18 tested positive for COVID-19. Ten (55%) of the infected HCWs offered direct care to Patient X during 9-20 September. Attack rates among HCW were 31% (5/16) at Facility C and 4% (12/270) at Facility A.

**Conclusions:** A COVID-19 cluster among HCWs and their community contacts resulted from delays in early testing, failure to isolate a possible COVID-19 patient, and a long result turnaround time (TAT). Since that time, the country has adopted rapid COVID-19 diagnostic tests, which have reduced the TAT. Training of HCWs on recently-launched guidelines about continuity of essential health services, COVID-19 guidelines and strict adherence to these guidelines could have averted this outbreak.

## COVID-19 MANAGEMENT

### Trends of Key Surveillance Performance Indicators of Acute Flaccid Paralysis, Uganda, 2015 - 2020

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**Background:** Poliomyelitis is caused by poliovirus and can cause lifelong paralysis, presenting as acute flaccid paralysis (AFP). A sensitive AFP surveillance system, in which AFP cases are evaluated to determine if they are true AFP or non-polio AFP (NPAFP), is key for tracking polio eradication. We describe Uganda's AFP surveillance performance by district from 2015-2020, based on WHO recommended indicators.

**Methods:** We performed a descriptive analysis of national AFP surveillance data from 2015-2020. We evaluated proportion of AFP cases reported that were true AFP and changes in NPAFP and stool adequacy (SA) rate. NPAFP rate was defined as NPAFP cases/100,000 population <15 years (targeted at  $\geq 4/100,000$ ). SA rate was the percentage of AFP cases with 2 adequate stool samples collected  $\geq 24$  hours apart  $\leq 14$  days after onset of paralysis and arriving at the laboratory in good condition.

**Results:** Of 3,605 AFP cases investigated countrywide, 3,475 (96%) were true AFP cases. Between 97-100% of districts reported each year. Overall, the mean NPAFP rate declined (3.1/100,000 in 2015 and 2.1/100,000 in 2020). Less than 40% of districts met the NPAFP target rate in all years. The proportion of districts with NPAFP rate  $\geq 4/100,000$  declined from 35% to 20% from 2015-2020 (OR=0.47; 95% CI: 0.26-0.83). Only 66% of districts achieved the SA target of  $\geq 80\%$ . The proportion of districts with SA rate  $\geq 80\%$  significantly increased from 68% to 80% from 2015-2020 (OR=1.9; 95% CI: 1.1-3.4).

**Conclusion:** SA rates were adequate and improved over time, and most districts reported AFP cases. However, there was a decline in NPAFP rate from 2015-2020 and few districts achieved the target rate. The suboptimal AFP surveillance system performance leaves the country at risk of missing ongoing poliovirus transmission. We recommend health worker training on active AFP searches, intensified supportive supervision, and periodic review meetings with districts to assess AFP surveillance performance.



## Readiness of Health Facilities to Manage COVID-19 in Uganda, June 2021

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**Background:** The COVID-19 pandemic has overwhelmed the capacity of health facilities globally, emphasizing the need for adequate preparedness. In Uganda, regional referral hospitals (RRH) managed COVID-19 patients, while lower-level health facilities screened, isolated, managed uncomplicated cases, and referred complicated cases to RRH. The first wave of COVID-19 in Uganda peaked in late 2020, uncovering challenges with facility readiness. In mid-2021, we assessed readiness of health facilities in Uganda to manage a second wave of COVID-19.

**Methods:** We assessed 17 RRH and 71 lower-level health facilities from all subregions of Uganda during June 2021. In each of the facilities, we interviewed the director about challenges faced during the first COVID-19 wave. We inspected COVID-19 treatment units (CTUs) and other facility service delivery points using a WHO observational checklist with items about infection prevention, equipment, medicines, personal protective equipment (PPE) and CTU surge capacity. We used the "ReadyScore" criteria to classify level of preparedness as >80% ('better prepared'), 40–80% ('work to do'), and <40% ('not ready'). Readiness was assessed at levels tailored to the specific facility level.

**Results:** All 17 RRH assessed were managing COVID-19 patients at the time of the visit. Of these, 15 (88%) were in the "work to do" category, and two (12%) were "better prepared". Thirteen (82%) had an inadequate supply of essential medicines and 12 (71%) had inadequate oxygen; 11 (65%) needed but lacked space to expand CTUs. None of the 71 lower-level health facilities had COVID-19 patients admitted at the time of the visit. Fifty-five (77%) of these were "not ready" and 16 (23%) were in the "work to do" category. Almost all 70 (99%) lacked medicines, 64 (90%) lacked PPE, and 53 (75%) lacked an emergency plan for COVID-19.

**Conclusions:** Few health facilities were ready to manage a second wave of COVID-19 in Uganda during June 2021. The largest gaps were in essential medicines, PPE, oxygen, and space for CTU expansion. Adequate preparedness for future waves of COVID-19 requires additional support and action in Uganda.

**Keywords:** COVID-19, Preparedness, Second wave, Health facilities, Uganda

## **Use of a Toll-free Call Center for COVID-19 Response and Continuity of Essential Services During Lockdown, Greater Kampala, Uganda, 2020**

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**Background:** Establishment of a call center during public health emergencies is essential in reducing unnecessary calls to emergency telephone systems and providing relevant information to the public. Following the introduction of COVID-19 in Uganda on March 21, 2020, a total lockdown was initiated on March 30, 2020 and lifted in stages through June 30, 2020. On March 25, 2020 a toll-free call center with two hotlines was set up at Kampala Capital City Authority to respond to public concerns about COVID-19 and the lockdown. Call-related data were entered into a database. We documented the set-up and use of the call center and key concerns raised by the public during COVID-19 lockdown.

**Methods:** We abstracted data on incoming calls between March 25-June 30, 2020 from the database. We summarized the call data into categories and conducted descriptive analysis of public concerns raised during different phases of the lockdown.

**Results:** Of 10,167 calls made, 6,578 (65%) were about health services access, 1,565 (15.4%) about other social services access, and 1,375 (14%) about COVID-19 concerns. Among the 6,578 calls about access to health services, 2,152 (33%) were requests for ambulances for non-COVID-19 emergencies, 1,155 (18%) were about persons stranded at health facilities, and 1,004 (15%) were about mothers in labor. Among the 1,565 calls about other social services, 1,184 (76%) were requests for food and relief items and 158 (13%) were about price hikes for basic goods. Fifty-three percent of the 1,375 calls about COVID-19 response were seeking disease-related information and 360 (26%) were reporting suspected cases. There were no calls about COVID-19 emergencies.

**Conclusion:** The toll-free call center was used by the public during the COVID-19 response. Calls indicated gaps in health and social services delivery during the COVID 19 lockdown. Continuity of essential services amidst a public health emergency -related lockdown should be planned accordingly.

**Key words:** call center, hotline, Uganda, COVID-19

## **Factors associated with testing positive for COVID-19 among students, teachers and support staff in a secondary school, Kampala, Uganda: November, 2020**

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### **Abstract**

**Background:** Following school closures in Uganda in March 2020 in response to COVID-19, the government reopened schools to candidate classes on October 15, 2020 with strict COVID-19 guidelines. On October 27, 2020, Secondary School X in Kampala, Uganda reported their first case of COVID-19. By November 17, 2020, 32 confirmed cases were reported in the school. We set out to determine the outbreak extent and factors associated with COVID-19 infection in the school.

**Methods:** We conducted a cross-sectional study employing quantitative methods of data collection. We used an interviewer-administered questionnaire to collect demographic and COVID-19 risk factor information from all students, teachers, and support staff at the school on potential risk factors. Nasopharyngeal samples were taken from the interviewees and tested using RT-PCR to identify SARS-COV-2 infection. We conducted logistic regression to identify factors associated with infection.

**Results:** Among 361 interview respondents: 76% were students, 10% were support staff, and 4% were staff. One-hundred and ten (30.5%) respondents tested positive over the 3-day study period; students had the highest attack rate (32.5%; 101/311). Among all respondents, 328 (90%) were asymptomatic at sample collection. The attack rate among those who reported participating in gatherings at school was 45% (81/180); those reporting spending time in shared areas also had a 45% (74/166) attack rate. Among those who reported attending gatherings, 229 (88%) mentioned the Catholic chapel at the school, while 188 (78%) who reported exposure to shared areas said it occurred in the dining hall. Being a support staff (AOR: 3.1, 95%CI: 1.2-8.5) and being in Senior Four class (AOR: 1.8, 95%CI: 1.1-3.1) were associated with testing positive for COVID-19.

**Conclusion and Recommendations:** There was widespread COVID-19 at Secondary School X in Kampala during November 2020. Being a support staff or a student of Senior Four class were associated with testing positive for COVID-19. We recommended intensifying daily screening, testing and isolation of symptomatic cases and their contacts, discouraging gatherings, and introducing shifts at the dining halls. We set up an isolation and treatment center at the school to treat mild and moderate COVID-19 cases.

**Keywords:** COVID-19, School

# **Individual and Household Risk Factors for Covid-19 Infection in Households of Infected Persons in Home-Based Care in Western Uganda, 2020**

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## **Background**

During November 2020, an increase in COVID-19 cases was reported among household members of patients in home-based care (HBC) in western Uganda. We identified factors associated with COVID-19 infections among these household members.

## **Methods**

We conducted a cohort and case-control study. A primary case was defined as a confirmed SARS-CoV-2 infection in a person in HBC in Kasese or Kabarole Districts, Uganda, during November 2020; a secondary case was a household member with confirmed infection during the same time period. The case-control study was designed to identify structural and primary case risk factors for secondary cases among household members of persons in HBC. Case-households had a primary and at least one secondary case; control-households had a primary but no secondary cases. We used logistic regression to calculate odds ratios. The cohort study comprised all household members of case-households, to identify individual factors associated with secondary infection and generalised linear regression to calculate risk ratios.

## **Results**

Among 137 households with primary cases in the study area, 78 (57%) were case-households and 59 (43%) were control-households. Case-households were larger than control-households (mean: 5.8 vs 4.3 members,  $p < 0.0001$ ). Compared to the son or daughter of the primary case, maids and extended family members had a 2.0-fold higher risk of infection.  $\geq 1$  household member per room (OR=4.3, 95%CI 2.0-9.6), and a coughing primary case-patient (aOR=8.0, 95%CI 2.1-30.5) increased odds of case-household status. Any interaction with the primary case (vs. none) patient (RR=1.6, 95%CI 1.2-2.2), and self-described lack of knowledge about HBC (RR=1.5, 95%CI 1.2-1.8) increased individual risk, while access to alcohol-based hand rub reduced risk (RR=0.5, 95%CI 0.6-0.8).

## **Conclusion:**

Household crowding and coughing primary cases were associated with increased risk for secondary COVID-19 cases in HBC households. Individual behavioural and clinical factors increased individual risk. Decisions about how and when to isolate patients in HBC should be made with these factors in mind.

## **Comparative Epidemiologic Analysis of COVID-19 Patients during the First and Second Waves of COVID-19 in Uganda**

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**Introduction:** Uganda has had two major waves of COVID-19, the first in late 2020 and the second in mid-2021. In March 2021, the country began offering Astra-Zeneca COVID-19 vaccine. In late April 2021, the country entered a larger, second wave caused primarily by the SARS-CoV-2 Delta variant. Anecdotal reports suggested that younger persons were more prone to develop severe disease during the second wave than the first. We compared epidemiologic characteristics of hospitalized (HP) and non-hospitalized COVID-19 patients (NHP) during the two major COVID-19 waves in Uganda.

**Methods:** We defined ‘Wave 1’ as November-December 2020, and ‘Wave 2’ as April-June 2021. At each of two major Kampala hospitals, we collected medical records data for 100 randomly-selected HP during Wave 1 and 100 during Wave 2. We retrieved contact information for randomly-selected, PCR-confirmed NHP (200 for each wave) from laboratory records and interviewed them by phone. Demographic, clinical, and self-reported vaccination data were collected from patients or next-of-kin.

**Results:** A higher proportion of HP in Wave 2 than Wave 1 were female (46% vs. 27%,  $p=0.0001$ ), and more HP in Wave 2 than Wave 1 had severe disease or died (65% vs. 31%,  $p<0.0001$ ). NHP in Wave 2 were younger than those in Wave 1 (median age 27 vs. 35 years,  $p=0.08$ ). Median age of HP was significantly older than NHP in Wave 2 (median age 47 vs. 27 years,  $p<0.0001$ ) but not Wave 1 (median age 42 vs. 35 years,  $p=0.15$ ). Increasing age was associated with hospitalization in both waves, but the association was stronger in Wave 2 than Wave 1 ( $p<0.0001$ ). No patients were fully vaccinated.

**Conclusion:** Demographic and epidemiologic characteristics of hospitalized and non-hospitalized patients between and within Waves 1 and 2 of the pandemic in Uganda differed. Different variants of COVID-19 should be studied independently.

**Key words:** COVID-19, Delta, Waves, Hospitalized, Epidemiology, Uganda

# **Patterns of TB case notification and treatment outcomes in the context of COVID-19 pandemic: analysis of the national surveillance data for January 2019-June 2021**

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**Background:** TB case notification and outcomes monitoring are critical for TB control, but can both be disturbed by interruptions to normal health system functioning. The first major wave of COVID-19 in Uganda occurred during August-December 2020. The government-imposed lockdown measures during March-June 2020 during which residents were required to stay at home. Kampala was particularly affected by lockdown. We investigated trends and distribution of TB case notification rates (CNR) and treatment success rates (TSR) during January 2019-June 2021 to determine the association with COVID-19 cases and lockdown.

**Methods:** We extracted and analysed TB case notification data and treatment outcomes for January 2019-June 2021 from the District Health Information System. We computed the TB CNR per 100,000 population. Treatment success was defined as the proportion of patients initiated on TB treatment that successfully completed treatment or cured. We described the quarterly trends and distribution of TB CNR and TSR pre and during COVID-19. We defined time periods by year (2019, 2020, or 2021) and quarter (Q).

**Results:** The overall TB CNR was 165/100,000; TSR was 79.4%. CNR ranged from 133/100,000 (2020Q2) to 190/100,000 (2021Q2). CNR declined by 22% from 2020Q1 to 2020Q2, concurrent with the lockdown and rising COVID-19 cases. This decline was primarily driven by Kampala district for which the CNR declined sharply from 426/100,000 (2020Q1) to 265/100,000 (2020Q2). In contrast to districts outside of Kampala, in which CNR increased from 166/100,000 to 188/100,000 over the study period, Kampala's CNR declined consistently over the study period from 511/100,000 to 329/100,000. TSR increased by 1.6% (95%CI 1.3-1.9%) on average each quarter ( $p < 0.0001$ ).

**Conclusion:** CNR appeared to be impacted by the initial lockdown but recovered quickly. However, this decline was heavily driven by declines in CNR in Kampala district. Kampala district CNR trends are not reflective of the rest of the country during 2019-2021 and should be examined separately. TSR increased over time but was still below the 90% target. There may be a need to focus continuity of TB care interventions in the future in areas heavily affected by lockdowns.

**Keywords:** TB case Notification, Treatment success rates, Trends, Uganda

## Assessment of Adverse Events Following COVID-19 Immunization in Greater Kampala, Uganda, June, 2021

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**Background:** Tracking of adverse events following immunization (AEFIs) is important for evaluating vaccine safety. During March 2021, Uganda began COVID-19 vaccination using the Astra-Zeneca vaccine. We assessed AEFIs in Greater Kampala, Uganda to track the safety of the new vaccine.

**Methods:** We used vaccination registers to identify persons who received  $\geq 1$  dose of the AstraZeneca COVID-19 vaccine during March 10-April 30, 2021. AEFIs were defined as an untoward medical occurrence after immunization (not necessarily causally related to the vaccine). Serious AEFIs were defined as any event considered life-threatening or resulting in hospitalization. We extracted telephone contacts for a systematic random sample of vaccinated individuals and conducted phone interviews with those who consented to collect data on demographics and details of AEFIs where they occurred.

**Results:** Among 374 subjects interviewed, mean age was 41 years (IQR=28-54); 176 (47%) were female. Of these, 235 (63%) received only one dose and 139 (37%) received two doses. In total, 516 AEFIs occurred in 286 (77%) individuals, including in 255 (68%) individuals after the first dose and in 45 (32%) individuals after the second. The most common AEFIs were redness/pain/itching at the injection site (34%) and headache (32%). In total, 35 vaccination events (6.8%) resulted in medical care-seeking and six (1.2%) were classified as serious, involving vomiting/diarrhea (3), headache (2), and difficulty in breathing (1). Persons aged 20-50 years (AOR:3.6, 95% CI: 2.2-6.2) were more likely to develop AEFIs than those aged  $\geq 50$  years.

**Conclusion:** Most individuals experienced  $\geq 1$  AEFI. Serious AEFIs occurred after approximately one in 100 vaccination events. Younger age (<50 years) was associated with AEFIs. We recommend prospective studies to fully understand adverse events following AstraZeneca COVID-19 vaccination in Uganda.

**Key words:** Assessment, COVID-19, Adverse events, Greater Kampala, Uganda

## MALARIA

### Investigation of Malaria Outbreak in Nabitende Subcounty, Iganga District, Uganda, March 2021

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**Background:** Despite well-described prevention measures, malaria remains the leading cause of illness and death in Uganda. In February 2021, the Uganda Ministry of Health (MOH) identified an upsurge in malaria cases in Iganga District, Eastern Uganda, exceeding expected limits (compared with malaria normal channels). We investigated to establish the scope of the outbreak, identify possible exposures, and generate public health recommendations.

**Methods:** We defined a case as a positive malaria test result using mRDT or microscopy in a resident of Nabitende sub-county from 1 May 2020-28 Feb 2021. We reviewed outpatient health records in all six health facilities within Nabitende subcounty. We conducted a case-control study. Case-households were households with  $\geq 1$  self-reported and/or confirmed resident with malaria during 1 May 2020-28 Feb 2021 in Nabitende sub-county. Control households were those in which no household member had malaria during 1 May 2020-28 Feb 2021. We interviewed one case or control per case or control-household. Data were analyzed using Epi-Info. Descriptive analysis was done and logistic regression was done to establish the relationship between risk factors identified and malaria upsurge.

**Results:** Among 6,620 cases, 2,222 (34%) were males and median age was 17 years (range, 0-96 years). Residing near waterlogged places (OR=2.5; 95% CI=1.4-4.4), and living <500m from a swamp (OR=2.3; 95% CI=1.4-3.8) were associated with infection. Residing <500m from rice (OR=2.2; 95% CI=1.2-4.2), sugarcane (OR=1.7; 95% CI=1.0-2.7), and banana fields (OR=3.5; 95% CI=1.3-9.5) were associated with infection.

**Conclusion and Recommendations:** This outbreak was facilitated by proximity to mosquito breeding sites. We recommended the strengthening of Iganga District surveillance system by using Malaria Early Warning System and that community leaders and village health teams be actively involved in sensitizing the community in proper and consistent use of insecticide-treated mosquito nets.

**Key words:** Investigation, Malaria, Outbreak, Iganga, Uganda



## Characteristics of Malaria Deaths in Eight Selected Districts in Uganda January 2020 to May 2021

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**Introduction:** In Uganda, malaria accounts for 30-50% of outpatient visits, 35% of hospital admissions, and 13% of hospital deaths. However, the characteristics of persons who die of malaria in Uganda are not well-described. We investigated the characteristics of malaria deaths in high-malaria-burden districts to inform programming for targeted interventions.

**Methods:** Cases were defined as death of a hospitalized person with a positive microscopy or rapid diagnostic test for malaria from 1 January 2020-30 May 2021. We used District Health Information System 2 malaria death data to identify districts with the highest case rates in Uganda during this period. We selected 8 high-burden districts from various areas of the country (Agago, Apac, Kitgum, Napak, Nebbi, Iganga, Kakumiro, and Kikuube) and visited all Health Centers (HC) III, HC IV, and general hospitals to abstract data on cases at the facilities. We abstracted data on age, sex, health facility name and level, district, diagnosis, date of admission, and date of death. Mortality rates (MR) were computed using deaths (cases) as numerators and district populations as denominators. We analyzed the data by demographic and geographic characteristics.

**Results:** Among 273 cases, 157 (58%) were male; median age was 5 years (IQR: 2-13). The overall MR was 11/100,000. Children <5 years had a higher MR than persons ≥5 years old (25.6 vs 7.1/100,000). Agago district had the highest mortality rate (35/100,000) followed by Nebbi District (20/100,000) and Napak district (18/100,000); all three are in the northern area of the country. Most malaria deaths occurred during June-August.

**Conclusion:** Children <5 years experienced malaria death rates four times higher than older age groups. The highest malaria death rates occurred in northern Ugandan districts. Malaria prevention measures and appropriate clinical management should be heightened amongst children <5 years in these districts.

**Key words:** Malaria, Mortality, Rates, Characterisation, Uganda

## **Compliance to Malaria test, treat and track policy among health workers in selected districts in Uganda, 2020**

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**Background:** In 2012, Uganda Ministry of Health adopted a malaria ‘test, treat and track’ (TTT) policy to improve clinical management of malaria. According to TTT policy, (i) all suspected malaria cases should be assessed for fever with a thermometer; (ii) all should be subjected to a malaria Rapid Diagnostic Test or microscopy; (iii) all positives should be treated with antimalarials, reported, and tracked; and (iv) <5% of negatives should be treated. All healthcare workers (HCW) should also be trained on TTT in the past year. We assessed HCW adherence to the TTT policy to guide its implementation.

**Methods:** We conducted a cross-sectional survey in 29 districts purposively selected from 15 regions in Uganda, 2019-2020. All 14 regional referral hospitals and 126 public, private, and private not-for-profit health facilities were randomly selected across all levels of healthcare. We reviewed malaria data from HMIS and interviewed 360 outpatient department HCW about TTT policy-specific practices.

**Results:** Among 360 HCW interviewed, 55% were nurses, 35% clinical officers, 7% medical officers, and 3% other medical personnel. The mean proportion of patients across facilities with positive tests that were treated with Artemisinin Combination Therapy (ACT) was 96%, higher than the national target of 95%. The mean proportion of negatives that were treated with ACT was 10%, higher than national threshold of 5%. Nearly all (99%) HCW reported using fever to identify suspect malaria cases; 80% used a thermometer to assess fever. All HCW had training on TTT, but only 47% were trained in the last year. Only 2% of HCW had ever treated a patient without testing.

**Conclusion:** Healthcare workers had good adherence to malaria TTT policy in 2019-2020. However, only half had been trained in the past year, 20% failed to use thermometers to assess for fever, and more negatives were treated than specified in the policy. MoH should consider instituting regular refresher trainings for TTT and providing thermometers for proper assessment of suspected malaria patients.

**Key words:** Malaria test, treat and track policy, Adherence, Healthcare worker, Uganda

## Ownership and Use of Long-lasting Insecticide-treated Nets after a Mass Distribution Campaign in 14 Districts, Uganda, 2021

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

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

**Results:** In total, 5,529 households with 27,435 residents and 15,426 LLINs were included in the analysis. Overall, 95% of households owned  $\geq 1$  LLIN, 64% of households owned  $\geq 1$  LLIN per 2 persons in household, and 69% of residents slept under an LLIN the previous night. Factors associated with LLIN ownership included believing that LLINs are protective against malaria (aPR=1.13; 95% CI=1.04-1.24). Reported use of mosquito repellents was negatively associated with ownership of LLINs (aPR=0.96; 95% CI=0.95-0.98). The prevalence of LLIN use was 9% higher among persons who had LLINs 3-12 months old (aPR=1.09; 95% CI=1.06-1.11) and 10% higher among LLINs 13-24 months old (aPR=1.10; 95% CI=1.06-1.14), than those who had LLINs <3 months old. Of 3,859 LLINs not used for sleeping the previous night, 3,250 (84%) were <3 months old. Among these 3,250, 41% were not used because owners were using old LLINs, 16% were not used because of lack of space for hanging them, 11% were not used because of fear for chemicals in the net, 5% were not used because of dislike of smell of the nets, and 27% were not used because of other reasons.

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

**Keywords:** Malaria, Long-lasting insecticidal treated

## ZOONOSES

### Suspected Anthrax Outbreak Associated with Handling and Consuming Cow Meat in Kapchorwa District, Uganda, April 2021

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**Background:** During 2018-2020, Kween District in Eastern Uganda faced annual anthrax outbreaks during April-May. On 24 April 2021, the neighbouring district of Kapchorwa reported suspected human anthrax cases following the sudden death of a cow on 14 April from suspected anthrax. We investigated the outbreak to establish scope and exposures and recommend evidenced-based control measures.

**Methods:** A suspected cutaneous anthrax case was acute onset of skin vesicles, lesions, or eschars plus  $\geq 2$  cutaneous symptoms plus regional lymphadenopathy. Suspected gastrointestinal anthrax was acute onset of  $\geq 2$  of abdominal pain, vomiting, diarrhoea, or sore throat; all were in residents of Kapchorwa District during April 2021. We conducted a retrospective cohort study among all residents in households receiving or having contact with the meat of the dead cow. We collected demographic, clinical, and exposure history data and calculated risk ratios (RR) to identify exposure factors. We collected skin blister exudates from suspected case-patients for real-time polymerase chain reaction (rtPCR) tests.

**Results:** Among 215 cohort members, 24 (12%) were suspected cases, including 5 cutaneous, 19 gastrointestinal, and 1 both. None was laboratory-confirmed due to non-viable samples. Butchering (RR=46, 95%CI 9.3–226), skinning (RR=55, 95%CI 11–262), and removing internal organs from the cow carcass (RR=39, 95%CI 7.7–198) were associated with suspected cutaneous anthrax. Consuming boiled, fried, and/or roasted meat was not associated with gastrointestinal anthrax.

**Conclusion:** This was the fourth anthrax outbreak associated with handling and/or eating meat from cattle that died suddenly in eastern Uganda in four years. Health education targeting socio-behavioral factors associated with handling meat from animals that die suddenly needs to be intensified among butchers. Laboratory capacity to collect viable samples needs to be enhanced for prompt diagnosis and action.

## Rift Valley Fever Outbreak in Kiruhura District, Uganda June 2021

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**Background:** Rift valley fever (RVF) is an endemic viral zoonosis in Uganda. Sporadic outbreaks have been reported to occur in the cattle corridor. On May 14, 2021, a 19-year-old female from Kasaana Village, Kiruhura District died; testing by **reverse transcription polymerase chain reaction (RT-PCR)** was positive for RVF. We investigated to determine the magnitude of the outbreak, source of infection, and recommend evidence-based control measures.

**Methods:** A confirmed case was defined as detection of RVF virus nucleic acid by RT-PCR or serum IgM antibodies by enzyme-linked immunosorbent assay (ELISA) in a resident of/visitor to Kasaana Village from April 24-June 24, 2021. We tested blood samples from 25 persons (3 with RVF symptoms, 2 neighbors of the index case, and 20 randomly-selected villagers) using RT-PCR or ELISA, and 57 livestock (33 randomly-selected cows and 24 goats from 4 village farms reporting any animals with RVF symptoms) by ELISA. We collected data on demographics, history of RVF symptoms, and animal-related activities. We characterized cases epidemiologically.

**Results:** We identified 6 confirmed case-patients in Kasaana village (2 RT-PCR-positive, 4 IgM-positive). One died (case fatality rate=17%). Four (67%) were female; median age was 23 years (range, 19–42 years). All cases kept cows and goats. Two case-patients reported headache, fever, and hematemesis. The index case-patient, who milked cows on her family farm, had hemorrhagic symptoms consistent with RVF starting 1 week before death. She presented to six health facilities during that week but was only diagnosed after death. Three (9%) cows and five (21%) goats were IgM-seropositive for RVF.

**Conclusion:** This RVF outbreak likely resulted from contact with infected animal products. Earlier diagnosis might have prevented the index case-patient's death. We conducted health education among Kasaana villagers, and recommended training of health workers at facilities within the region to emphasize the importance of early diagnosis of haemorrhagic fevers.

**Key words:** Rift Valley Fever, Zoonosis, Uganda

## **Assessment of preparedness of border districts to respond to plague in West Nile region**

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**Background:** Ituri Province in Democratic Republic of Congo (DRC) is a hotspot for plague, with cases sometimes crossing into Uganda. In 2021, at least 117 cases were reported in Ituri Province. We evaluated the risk of plague importation into West Nile region of Uganda and assessed the level of preparedness to respond.

**Methods:** We used the Population Connectivity Across Borders (POPCAB) toolkit to assess risk of plague in 6 West Nile districts and one city. We categorized risk in districts based on previous cases, volume of cross-border movements, and proximity to the outbreak epicenter. We assessed types of travellers coming from DRC to Uganda, identified commonly-used routes, reasons for travel, and places frequently visited through key informant interviews and focus group discussions (FGDs) with district health teams, political leaders, border health staff, boda-boda riders, market traders, and business communities. We assessed districts' preparedness to respond using an adapted WHO checklist and Readyscore criteria (scores <40% = 'not prepared'). We assessed 47 health facilities in West Nile for response readiness in terms of healthcare worker training, availability of standard operating procedures, and training of village health teams, and created composite scores using principal component analysis. Scores <2 were 'not ready', 2-3.9 was 'partially prepared,' and 4-5 was 'prepared'.

**Results:** Two districts (Arua and Zombo) in West Nile were in the highest-risk category for plague importation. All districts scored as 'not prepared', although Zombo and Arua scored higher (both 39%) than other districts. Of 47 health facilities assessed, only 10 had staff who had been trained in plague-related activities. Twenty-one health facilities were 'not ready' and no facility was 'prepared'.

**Conclusion:** No districts were prepared to respond to potential plague importation. The risk is high, especially in Arua and Zombo Districts. No health facility was ready to respond to a potential plague case. Arua and Zombo Districts should be prioritized for preparedness activities for a potential plague outbreak.

**Key words:** Plague, Cross border, preparedness and readiness, Uganda

## **SURVEILLANCE DATA ANALYSIS**

### **TB treatment outcomes among TB/HIV coinfecting patients being treated in Kampala Metropolitan region, Uganda, 2018-2020**

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**Background:** There are 1.4 million persons infected with HIV in Uganda and 40% of those are coinfecting with TB. WHO targets  $\geq 90\%$  TB/HIV treatment success by 2025. However, the TB treatment outcomes of TB/HIV co-infected patients need to be optimized. We described the epidemiological characteristics and treatment outcomes of co-infected patients during 2018-2020.

**Methods:** We conducted a retrospective cross-sectional study in all TB-infected patients  $\geq 15$  years of age who tested positive for HIV and were initiated on TB/HIV co-treatment between 2018-2020 in six districts of Kampala metropolitan in Uganda. We considered at least one hospital with the highest volume of HIV patients. We abstracted demographics and treatment outcomes from TB and HIV registers. TB treatment success was defined as patients who were cured or those who completed 6 months' treatment as per the WHO guidelines. We described the patients' characteristics and treatment outcomes.

**Results:** Of the 317 TB/HIV patients on co-treatment during the study period, 202 (64%) were male and 136 (43%) were aged 25-34 years. In total, 265 (84%) had treatment success between 2018-2020, including 44% who completed treatment and 40% who were cured. Among the 44 (14%) who had unsuccessful treatment, 29 (65%) died, 9 (3%) were lost to follow-up, 7 (2%) failed treatment and 7 (2%) were not evaluated.

**Conclusion:** The TB treatment success rate was very close to the national TB treatment success target of 85%. We recommended continued evaluation to identify factors associated with TB treatment failure.

**Keywords:** Tuberculosis, HIV, Co-treatment, Test, Treat, Outcomes, Uganda

## Trends of cervical cancer in Uganda 2017–2020

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**Background:** Cervical cancer is the commonest cancer and the leading cause of cancer-related deaths among women in Uganda. The Ministry of Health (MoH) in Uganda has adopted many strategies to address the problem of cervical cancer, including screening in government health facilities providing family planning services, and initiating human papillomavirus vaccination for girls in 2015. However, it is unknown if these strategies are having an impact. We describe the spatial and temporal trends of cervical cancer among women attending health facilities in Uganda.

**Methods:** We extracted surveillance data for cases of newly-diagnosed cancer of the cervix per month during 2017-2020 for each district, region, and the country. Incidence of cervical cancer was calculated using the population projections according to Uganda Bureau of Statistics for the total female population as the denominator for the country, region, or district. The significance of the trends over time was calculated using logistic regression.

**Results:** Nationwide, there was a decrease from 1,798 new cases in 2017 to 963 new cases in 2020. The incidence decreased 40% from 9.4/100,000 in 2017 to 4.6/100,000 in 2020 ( $p < 0.001$ ). The Northern region had the highest incidence overall (9.2/100,000) and the Central region had the lowest incidence (6.3/100,000). Despite the incidence being generally low in 2020, Amolatar District still reported an extremely high incidence (73/100,000).

**Conclusion:** There was a decrease in the incidence of cervical cancer in Uganda from 2017 to 2020. The Northern region had the highest incidence, including a district with incidence more than ten times higher than the national average during that year. We recommend strengthening of the strategies of cervical cancer prevention to continue the decline in cases, especially in Northern Uganda. Further investigations are needed to understand the reasons for the high incidence in Amolatar District in 2020.

**Keywords:** Cervical cancer, Trend, Uganda



## **Trends and spatial distribution of neonatal sepsis in Uganda, 2016-2020**

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### **Background:**

Neonatal sepsis can be caused by an infection acquired perinatally (early-onset sepsis, or EOS, occurring at 0-7 days postpartum) or by organisms in the hospital or community (late-onset sepsis, or LOS, occurring 8-28 days postpartum). Neonatal sepsis is the third-leading cause of newborn deaths in Uganda. We described trends and spatial distribution of neonatal sepsis in Uganda from 2016 to 2020.

### **Methods:**

We performed descriptive analysis of routinely-reported surveillance data on in-patient neonatal sepsis from the electronic District Health Information System from 2016-2020. We calculated EOS and LOS incidence rates overall and for national, regional, and district levels as number of cases per 1,000 live births. We determined significance of national and regional trends using logistic regression in Epi-info. We interpreted odds ratios as the average change in incidence per 1,000 live births per year and analysed the geographic distribution of sepsis.

### **Results:**

During 2016-2020, 95,983 neonatal sepsis cases were reported, including 71,262 (74.2%) EOS and 24,721 (25.8%) LOS. Average national incidences were 12.9/1,000 (EOS) and 4.5/1,000 (LOS). Overall, sepsis increased in Central (OR: 1.5, CI: 1.4-1.6) and Northern (OR: 1.2, CI: 1.2-1.3) regions but decreased in Eastern (OR: 0.6, CI: 0.6-0.6) and Western (OR: 0.7, CI: 0.7-0.7) regions over the time period of interest. While EOS followed a similar trend to overall sepsis rates, LOS decreased in Eastern, Northern and Western regions, and increased in Central region. Districts that consistently reported incidence rates >45/1,000 were distributed in Eastern (Kapchorwa and Mbale), Western (Mbarara and Hoima), and Northern (Gulu) Uganda.

### **Conclusion and Recommendations:**

We found mixed trends by region in neonatal sepsis from 2016-2020. Most sepsis cases were EOS. The Uganda Ministry of Health should strengthen screening of pregnant women for infection, administration of prophylactic antibiotics to high-risk mothers intra-partum and provision of postnatal care services at all health facilities.

**Key words:** Neonatal sepsis, Early-onset sepsis, Late-onset sepsis, Uganda

## Trends and distribution of birth asphyxia in Uganda, 2017-2020

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**Background:** During 2018-2020, nearly half of all neonatal deaths in Uganda were due to birth asphyxia. In 2016, Ministry of Health integrated the Helping Babies Breathe (HBB) initiative, an evidence-based educational program to teach birth attendants about neonatal resuscitation techniques into the health system to improve management of birth asphyxia. We described the trends and distribution of birth asphyxia in Uganda during 2017–2020.

**Methods:** We analysed birth asphyxia surveillance data in Uganda from January 2017–December 2020 using secondary data obtained from the District Health Information System (DHIS2). We downloaded, merged, and summarized these data in Microsoft Excel sheets. We calculated incidence rates of birth asphyxia per 1,000 deliveries at district, regional, and national levels. We used logistic regression to determine significance of trends.

**Results:** The overall average national annual incidence of birth asphyxia increased by 4.5% from 2017 to 2020 (OR=1.05; 95%CI=1.04-1.05, p=0.001), concurrent with a decline in reporting rates from 73% to 46% during the same period. The Northern and Eastern Region had a significant increase of 6% (OR=1.06; 95%CI=1.05-1.07, p=0.001) and 5% (OR=1.05; 95%CI=1.03-1.05, p=0.001) over the study period, respectively. The districts with highest incidence were Bundibugyo, Iganga, and Mubende with persistent rates of >60 cases of birth asphyxia/1,000 deliveries. The least affected district was Kazo District, with 3 cases of birth asphyxia/1,000 deliveries).

**Conclusion:** The incidence of birth asphyxia increased nationally from 2017-2020, even with declines in reporting. There is a need to emphasize consistent reporting of birth asphyxia to ensure useful surveillance data. We also recommend continuous capacity building in managing birth asphyxia, with emphasis on the most affected districts.

**Key words:** Trends, distribution, birth asphyxia, Uganda

## Measles Outbreak in Semuto Subcounty, Nakaseke District, Uganda, June-August 2021

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**Background:** Despite a nationwide measles-rubella vaccination campaign conducted in late 2019 in Uganda, two measles-rubella outbreaks occurred in Semuto Subcounty during 2020 and 2021. We investigated the second outbreak (measles), occurring in August 2021, to determine its scope, assess factors associated with transmission, estimate vaccine coverage and effectiveness, and recommend evidence-based control measures.

**Methods:** We defined a probable case as acute onset of fever and generalized maculopapular skin-rash with  $\geq 1$  clinically compatible symptom in a resident of Semuto Subcounty, Nakaseke District from 1 June-August 31, 2021. A confirmed case was a probable case with measles-specific IgM-positivity. We used medical records to identify cases and snowballing to identify additional cases. We conducted a 1:4 case-control study to assess factors associated with transmission. A control was a randomly-sampled person aged 6 months-9 years (same age as case-persons) without signs/symptoms of measles from 1 June-August 31, 2021 residing in the same village as the case. We stratified by parish, calculated vaccination coverage and vaccine-effectiveness.

**Results:** We identified 30 case-persons (3 confirmed); 47% were female. Attack rates increased with age; children aged 5-9 years were the most affected (AR=10.4/1,000). Twenty-two (73%) of 30 case-persons and 117 (96%) of 122 control-persons had received measles vaccine (OR<sub>MH</sub>=0.13, 95% CI=0.037-0.43). Eighteen (60%) case-persons and 12 (10%) control-persons interacted with a symptomatic person (OR<sub>MH</sub>=15, 95% CI=5.7-40) while 21 (70%) case-persons and 46 (38%) control-persons played away from home (OR<sub>MH</sub>=4.2, 95% CI=1.7-11) during their exposure period. Vaccination coverage was 97% for all persons aged 9 months-9 years; vaccine-effectiveness was 86% (95% CI: 45-96%).

**Conclusions:** Measles vaccination was protective among persons in Semuto Subcounty. Infection rates increased with age. Meeting symptomatic persons and playing away from home were associated with measles infection in this outbreak. An in-depth investigation into measles-rubella vaccination activities in Semuto Subcounty and mass community re-vaccination for children 6 months to 9 years of age might be warranted.

**Key words:** Measles, Disease outbreaks, Risk factors, Vaccine coverage, Case control studies, Uganda