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January–March, 2022

Dear Reader,

We take great pleasure in welcoming you to Issue 1, Volume 7 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; Readiness of Health Facilities to Manage COVID-19, Uganda Measles Outbreak in Nakaseke District, Weekly Surveillance Data Reporting on Epidemic prone Diseases, District Leader Community Dialogue Meetings Improved Willingness to Receive COVID-19 Vaccines in Western Uganda, Trends and Geospatial Distribution of Stillbirths in Uganda

Should you have any questions or require additional information related to any article in this bulletin please contact us on: pmwine@musph.ac.ug, smigamba@musph.ac.ug, pnakamya@musph.ac.ug, hnansikombi@musph.ac.ug, OR lbulage@musph.ac.ug

Inside this issue:

UPDATES

Building a resilient public health workforce across all levels of the health sector

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In order to effectively prevent, detect, and respond to public health emergencies in a timely manner, health workers across all levels of the public health system need to be equipped with the right set of skills and competencies. With continued emergence of new diseases and re- emergence of known ones, field epidemiology is becoming more and more relevant in public health. The World Health Organization set a target for countries to have at least one trained field epidemiologist per 200,000 population. Uganda is currently working towards fulfilling the target.

FETP-Intermediate is a supervised, on-the-job, competency-based training and service (workforce development) program to improve field epidemiologic capacity at the regional level. It builds trainees competencies in surveillance, data analysis and interpretation, outbreak investigation, scientific communication, and mentorship. The 9-month part-time training program involves residential trainings interspersed with on-job field projects during which participants return to work stations and conduct job-relevant projects to concretize what they have learned.

On 31st August 2021, Uganda officially launched the intermediate-level field epidemiology training program (FETP-Intermediate). This completed the CDC-funded FETP pyramid model in the country, which already had the national-level FETP-Advanced and district-level FETP- Frontline programs in place. The pioneer cohort of the program included data managers, M&E specialists, medical officers, and community health specialists from Fort Portal, Kabale, Naguru, Entebbe Regional Referral Hospitals and the Uganda Ministry of Health headquarters.

On 31st March, 2022, in a colorful event at the Mansion Hotel in Jinja City, the first FETP- Intermediate cohort in Uganda graduated the 17 members of the pioneer cohort. During the event, graduates shared part of the work they had done during the training period and their experiences with the audience. The event was attended by officials from the Ministry of Health, the regional referral hospitals where the graduates work, African Field Epidemiology Network (AFENET), the Makerere University Monitoring and Evaluation Technical Support (METS) Program, the Uganda National Institute of Public Health and was officiated by Her Excellency the United States Ambassador to Uganda.

In their remarks, the delegates, atop the congratulatory messages, challenged the graduates to utilize the competencies gained to address key public health concerns including non- communicable diseases that are on the rise, and to publish their findings widely to inform policy and interventions. Graduates will now return to their workplaces to continue with their work while putting in practice what they have learned.

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Some of the delegates at the event L-R: Sandra Nabatanzi-CDC, Mr. Paul Mbaka-MoH, Dr. Alex R. Ario-UNIPH, Dr. Moses Mwanga-MoH, Dr. Emmanuel Batiibwe-Naguru RH, HE. Natalie Brown, US Ambassador to Uganda, Dr. Ben Masiira-AFENET, Dr. Sophie Namasopo-Kabale RRH, Ms. Evelyn Akello-METS, Dr. Benon Kwesiga-UNIPH

The graduates enjoying a selfie moment with the chief guest, HE. Natalie Brown, US Ambassador to Uganda and the FETP-Intermediate Resident Advisor, Miss Doreen Gonahasa

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The 6th graduation ceremony of the Uganda Public Health Fellowship Program

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The Uganda Public Health Fellowship program has successfully graduated a total of 65 Advanced Field Epidemiology Training Program fellows since 2015. In January 2022, 13 fellows were awarded for completing the a two-year-in-service training program. This was the 6th cohort of fellows, who took on the course from 2020 to 2021.

The fellows were of mixed backgrounds, including Medicine, Laboratory, Veterinary Medicine, Radiography, Biostatistics, and Environmental Health. During their course, they supported different Ministry of Health departments. The sites of attachment included: Uganda National Expanded program on Immunization, National TB and Leprosy Program, AIDS Control Program, Infectious Diseases Institute, National Malaria Control Program, Non-Communicable Diseases Division, Vector Control Division, National Animal Disease Diagnostic and Epidemiology Centre, Maternal and Reproductive Health, and the Uganda Cancer Institute. They were engaged in various activities involving responding to disease emergencies, projects implementation, surveillance data analysis, and dissemination of findings through various means including abstract presentations at national and international conferences and manuscript writing.

We congratulate the 13 fellows upon the completion of the program and wish them the best in their future career path.

The Graduates and the Chief Guest H.E Natalie Brown, US Ambassador to Uganda

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Upcoming Health Events

Stella Martha Migamba, Uganda Public Health Fellowship Program Fellow, Cohort 2021

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World Malaria Day

Every year on 25 April, Uganda joins the rest of the malaria endemic countries in commemorating the World Malaria Day. The Ministry of Health through its National Malaria Control Division conducts several activities on this day, including a scientific conference in which developments in malaria research are presented to key malaria stakeholders. The scientific conference will be held on 21-22 April, 2022.

Child Days Plus (CDP) are held in April and November of each year in Uganda since 2004. Activities during CDP months include vitamin A supplementation for children from 6 to 59 months of age and deworming of children from 1 to 14 years of age.

World Immunization Week

World Immunization Week is celebrated each year in the last week of April with aims to promote the use of vaccines to protect the population against disease.

World No Tobacco Day

World No Tobacco day is on 31 May. This yearly celebration informs the public on the dangers of using tobacco, the business practices of tobacco companies, what the World Health Organization is doing to fight the tobacco epidemic, and what people around the world can do to claim their right to health and healthy living and to protect future generations.

World Blood Donor Day

World Blood Donor day is celebrated on 14 June each year. Activities aim at raising awareness about the need for safe blood and blood products and to appreciate voluntary, unpaid blood donors for their life-saving gifts of blood. A blood service that gives patients access to safe blood and blood products in sufficient quantity is a key component of an effective health system.

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

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Summary

***Background:** During 2020-2021, multiple waves of COVID-19 overwhelmed the capacity of health facilities globally, emphasizing the need to enhance facility readiness. In Uganda, regional referral hospitals (RRHs) managed severe COVID-19 patients, while lower-level health facilities screened, isolated, and managed mild cases. The first wave of COVID-19 in Uganda peaked in late 2020 and demonstrated challenges with facility readiness to manage large numbers of cases. The second wave began in May 2021. In June 2021, we assessed the readiness of health facilities in Uganda to manage the second wave of COVID-19.*

***Methods:** We assessed 88 health facilities. We purposively included all 17 referral health facilities in the country, all of which were managing COVID-19 patients, and 71 lower-level health facilities from all regions of Uganda. We used multistage sampling to randomly select the lower-level health facilities. In each of the facilities, we interviewed health facility heads about challenges faced during the first COVID-19 wave. We inspected COVID-19 treatment units (CTUs) at the referral hospitals and other facility service delivery points using the World Health Organization (WHO) observation checklist for capacity in infection prevention, medicines, personal protective equipment (PPE), and CTU surge capacity. We used the "ReadyScore" criteria to classify readiness levels as >80% ('better prepared'), 40–80% ('work to do'), and <40% ('not ready'). We tailored facility readiness assessments to the specific health facility level being evaluated.*

Results: The overall median (interquartile range; IQR) readiness score for all health facilities was 39% (IQR: 29.6, 50.8%). The median (IQR) readiness score in referral facilities was 63.4% (IQR: 56.3, 74.6%) while in lower-level facilities it was 32% (IQR: 23.7, 37.3%). *All 17 referral facilities assessed were managing COVID-19 patients at the time of our visit. Of these, two (12%) were 'ready' and 15 (88%) were in the "work to do" category. In relation to the number of COVID-19 patients admitted, 13 (82%) had an inadequate supply of essential medicines and 12 (71%) had insufficient oxygen; 11 (65%) needed but lacked space to expand CTUs to admit more COVID-19 patients in case of the surge. None of the 71 lower-level health facilities had COVID-19 patients isolated at the time of the visit. Sixteen (23%) of these facilities were in the "work to do" category and 55 (77%) were "not ready". Seventy (99%) lacked medicines, 64 (90%) lacked PPE, and 53 (75%) lacked an emergency plan for COVID-19.*

***Conclusion**: Few health facilities were ready to manage the second wave of COVID-19 in Uganda during June 2021. The most significant gaps were in essential medicines, PPE, oxygen, and space for CTU expansion. Study results were used by the Ministry of Health to set up additional COVID-19 wards in hospitals and deliver medicines and PPE to all referral hospitals. Adequate readiness for future waves of COVID-19 requires additional support and action in Uganda.*

Introduction

Ensuring the readiness of health facilities to respond to public health needs during emergencies is essential to effective epidemic management (1). Readiness is defined as a combination of the presence of appropriate infrastructure/amenities, basic supplies/equipment, standard precautions, laboratory tests, medicines and commodities, and trained health professionals (2). However, even countries with highly-resourced health care systems faced challenges with adequate readiness during the COVID-19 pandemic (3,4).

In February 2020, the World Health Organization (WHO) released a COVID-19 strategic response preparedness plan, meant to guide

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health facilities preparing for COVID-19 outbreaks (4). The key pillars of the plan included coordination, risk communication, infection prevention and control, logistics and medicines, ensuring continuity of other health services, and planning for surge capacity (1). In line with these pillars, Uganda's Ministry of Health (MoH) equipped regional referral hospitals (RRHs) with trained health care workers and COVID-19 treatment units, and provided extra supplies of medicines and personal protective equipment at the beginning of the pandemic (5). Lower-level health facility health workers were trained to screen, identify, and manage mild cases and to refer severe COVID-19 cases to referral health facilities.

At the beginning of the pandemic, Uganda registered few COVID-19 cases, most among travelers and theirs contacts (6). However, community transmissions led to a rapid increase in cases starting in August 2020, which peaked around December 2020; 32,000 confirmed cases and 238 deaths were recorded in Uganda by the end of the first wave (7). During the peak of the first wave, health facilities faced major challenges in providing adequate care for COVID-19 patients, including having appropriate health facility infrastructure such as oxygen cylinders and patient beds, having sufficient trained health care workers, and having sufficient personal protective equipment (8). After a respite between waves of a few months, the second wave of COVID-19 began in May 2021 (7).

The second wave of COVID-19 in Uganda was driven primarily by the SARS-CoV-2 Delta variant, which was at the same time causing massive outbreaks in many other countries, including neighboring Kenya (9). Despite efforts to improve health facility readiness after the first wave, including installation of ICU beds and ventilators at the Mulago National referral Hospital and some regional referral hospitals, it was not clear how ready health facilities were for the second wave (10). We assessed the health facility readiness to manage the second wave of COVID-19 in Uganda and identified areas for improvement to strengthen capacity for future waves of COVID-19 cases.

Methods

Study setting

As of November, 2018, Uganda had a total of 6,937 health facilities, including public, private not-for-profit and private facilities (11). Of these, 3,133 (45%) were public health facilities, which provide free health care to the general population with support from the government and partners. Public health facilities are classified (from most basic to most advanced) into Health Centers Level One (HCI) through Four (HCIV), general hospitals, regional referral hospitals (RRH), and national referral hospitals (NRH). At the start of the COVID-19 pandemic, the MoH established COVID-19 treatment units (CTUs) in all 17 RRH in Uganda. These CTUs were equipped with oxygen cylinders, beds, medicines for managing COVID-19 (such as azithromycin), and new and existing health care workers were trained to manage patients. In addition, personal protective equipment appropriate for COVID-19 was distributed to facilities. A single advanced-level CTU with advanced life support machines was set up at Mulago National Referral Hospital (MNRH) to provide care to the most critically ill COVID-19 patients.

Site selection and sample size consideration

Health facilities: We purposively selected all 17 referral health facilities including three national referral hospitals (NRH) and 14 regional referral hospitals (RRH). We selected 71 lower-level health facilities using multistage sampling. First, we randomly divided the country into seven subregions and selected two districts from each: one with and the other without a referral health facility. From each district, we listed all the heath facilities and randomly selected one general hospital (GH), one health centre IV (HC IV), two health centre III (HC III), and two health centre II (HC II).

Health care workers: We interviewed the head of each health facility or CTU visited about COVID-19 response challenges in their health facilities.

Study variables and data collection

We interviewed heads of health facilities using a structured questionnaire. We obtained information on their experiences with the first and the start of the second waves of COVID-19 as well as the challenges they faced with case management. We inspected the CTUs and other service delivery points in the health facility using a readiness assessment tool developed by Centers for Disease Control and Prevention (CDC) for Non-US health care settings revised to suite Uganda's situa-

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tion (12). We assessed facility-level response co-ordination by checking for documentation of health facility meeting minutes on COVID-19 response, availability of an emergency response plan, communication systems in place necessary for coordination and reporting of COVID-19 cases to the MoH. We checked for availability of appropriate Personal Protective Equipment (PPE), medicines for management of COVID-19 and compared the counts to the average monthly consumption of individual health facilities. In addition to these we observed for oxygen equipment (cylinders, masks) and space for CTU expansion in case of a surge of COVID-19 patients for the referral health facilities. We checked for documentation on training and mentorship of health facility staff on COVID-19 and standard operating procedures for infection prevention. We also observed service delivery points, checked for infection prevention measures and the presence and functioning of triaging systems. Both the questionnaire and the checklist were in an electronic form prepared using *Kobo Toolbox* (13).

Data analysis

We imported clean data into EpiInfo version 7 for analysis. We determined a facility's level of readiness using Resolve to Save Lives' "ReadyScore" criteria (14). These criteria were developed to determine if health facilities in the country had the capacity to prevent, stop or control any epidemic. The individual facility percentage scores were categorized as not ready (<40%), work to do (40-80%), and ready (>80%) based on the "Ready Score" criteria. The classification of readiness of the health facilities was specific to the level of the health facility. We considered 59 questions for the lower level health facilities related to coordination, communication, reporting, supplies, training, triage, and evaluation of COVID-19 suspects. In addition to these questions, for referral health facilities, we assessed provision of care, monitoring of health care workers and inpatients, and preparation for a surge of COVID-19 cases to make a total of 71 questions. We coded "Yes" responses "one" and "No" as "zero". We computed the percentage score for each health facility. We used QGIS software to map the geographical distribution of the health facilities visited.

Ethical considerations

This was a public health emergency and the Ministry of Health (MoH) gave the directive to evaluate for readiness of health facilities to manage the second wave of COVID-19 in the country. However, we also sought permission from the district health officials and heads of the health facilities. We obtained verbal consent from respondents before interviews and inspections of various health facility service delivery points. During data collection, respondents were assigned unique identifiers instead of names to protect their confidentiality. Also, a non-research determination form was submitted to US CDC for clearance before the commencement of the assessment as a requirement. The Office of the Associate Director for Science, U.S. Centers for Disease Control and Prevention, determined that this activity was in response to a public health emergency with the primary intent of public health practice (epidemic disease control activity). It was determined therefore to not be human subjects research.

This work was funded by the Cooperative Agreement-Provision of Comprehensive HIV/AIDS services and Developing National Capacity to manage HIV/AIDS Programs in the Republic of Uganda under the President's Emergency Plan for AIDS Relief (Cooperative Agreement number)

Results

Characteristics of assessed health facilities

The 88 health facilities assessed were widely distributed across the country (Figure 1). At the time of the assessment, all 17 referral health facilities were managing COVID-19 patients and no lower-level health facilities had COVID-19 patients isolated.

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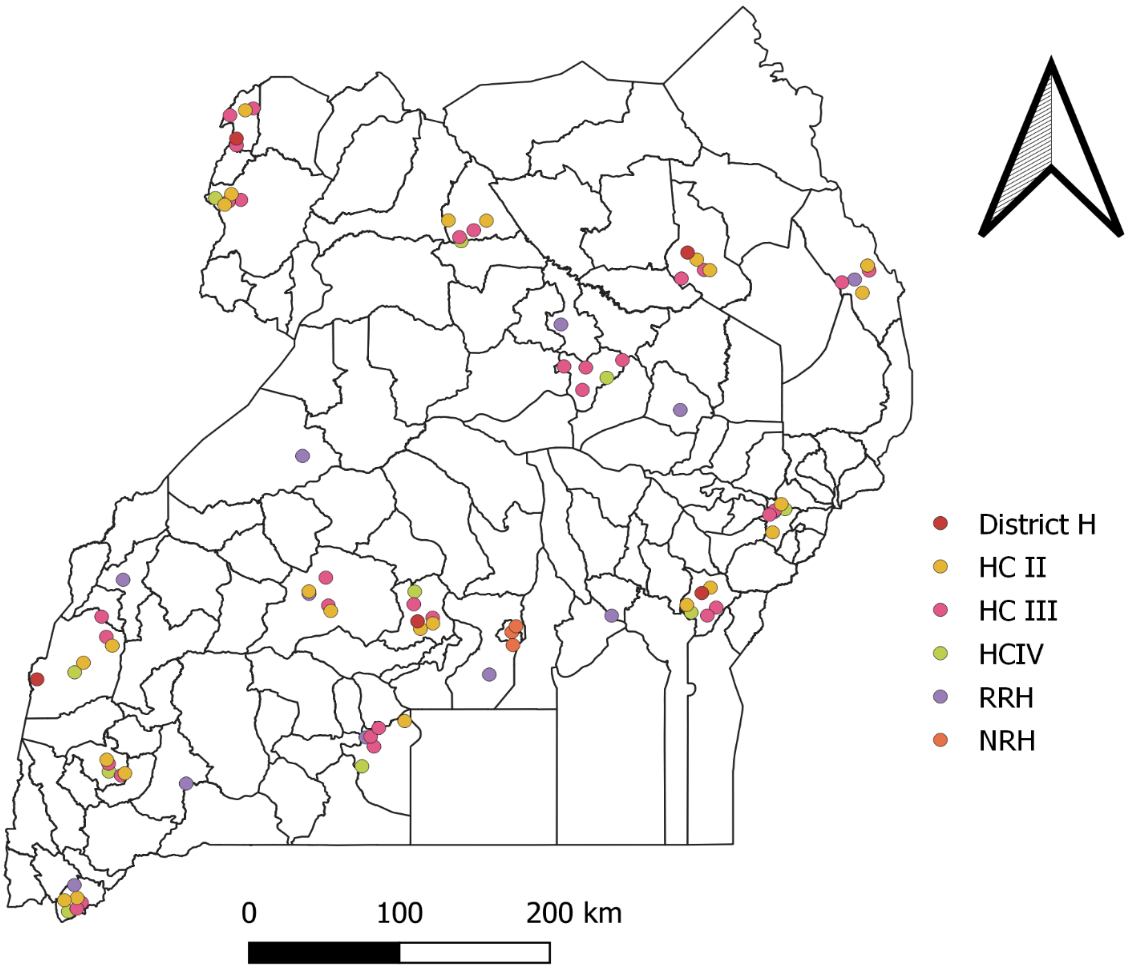

Figure 1: Location of health facilities evaluated for COVID-19 readiness, Uganda, June 2021

****HC- Health Centre **RRH-Regional Referral Hospital ***NRH-National Referral Hospital***

Health facility readiness scores

The overall median (interquartile range; IQR) readiness score for all health facilities was 39% (IQR: 29.6, 50.8%). The median (IQR) readiness score in referral facilities was 63.4% (IQR: 56.3, 74.6%) while in lower-level facilities it was 32% (IQR: 23.7, 37.3%). Of the 17 referral facilities, only two (12%), both regional referral hospitals, were "better prepared", while 15 (88%) were in the "work to do" category. Fifty-five (77%) lower-level health facilities were in the "not ready" category (Table 1).

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Table 1: Health facility readiness to manage the second wave of COVID-19 based on Resolve to Save Lives "ReadyScore" criteria, Uganda, June 2021

Level of Health facility (n)	"Not ready" (n, %)	"Work to do" (n, %)	"Ready" (n, %)
National Referral Hospitals (n=3)	0	3 (100)	0
Regional Referral Hospital (n=14)	0	12 (86)	2 (14)
General Hospital (n=5)	1 (20)	4 (80)	0
Health Center IV (n=10)	5 (50)	5 (50)	0
Health Centre III (n=32)	28 (87)	4 (13)	0
Health Center II (n=24)	21 (88)	3 (12)	0

The health facility readiness decreased with decreasing level of the facility (Figure 2).

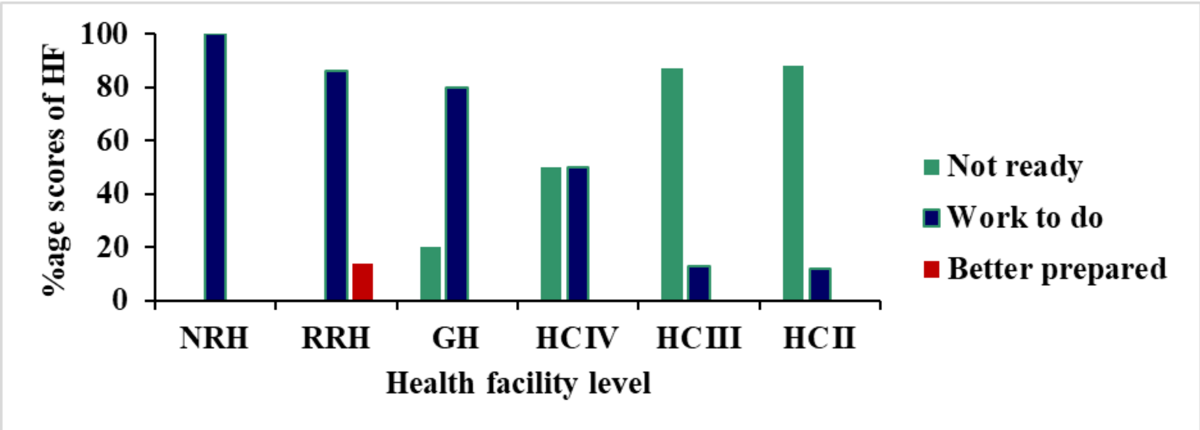

Figure 2: Health facility readiness to manage COVID-19 cases during the second wave in Uganda, June 2021

NRH-National Referral Hospital **RRH- Regional referral hospital * GH- General Hospital ****HC-Health center*

Coordination, reporting, and preparation for the surge

Referral health facilities scored well in the coordination component of the assessment, with 100% having an IPC focal person and 82% having an emergency response plan describing the arrangement, responsibilities, and activities to enable the hospital to function adequately in the COVID-19 response. Most of referral health facility heads/CTU heads (14; 82%) knew their maximum capacity in the event of a surge of COVID-19 cases. However, 11 (65%) reported that they needed but lacked additional space to accommodate the expanding numbers of COVID-19 patients, and 12 (71%) did not include in their plans the option to stop non-essential services in case of overwhelming surge of COVID-19 cases (Table 2).

Comparatively, lower-level health facilities were poorly prepared. Fifty-three (75%) lower-level health facilities lacked emergency plans for COVID-19. Communication and reporting were poor in lower-level health facilities; 29 (41%) lacked personnel designated to report suspected or confirmed cases of COVID-19 (Table 2).

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Training and triage

All 17 referral health facilities, health workers had received training to recognize COVID-19 symptoms. However, at 26 (37%) lower-level health facilities, reported the health workers did not receive COVID-19 training. Triage for respiratory patients was lacking in most lower level health facilities and some referral health facilities; 57 (80%) of the lower-level health facilities and 8 (47%) of the referral facilities lacked a physical barrier to separate health workers and patients during patient review. More so, respiratory (coughing) areas to isolate patients with acute respiratory symptoms were missing in 54 (76%) of lower-level health facilities and 2 (29%) of referral hospitals (Table 3).

Table 2: Comparison of coordination, communication, and reporting systems among health facilities admitting and those not admitting COVID-19 cases during the second wave of COVID-19, Uganda, June 2021

	Referral HF (n=17)		Lower level HF (n=71)	
Response pillar	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
Coordination				
Facility has an IPC focal person in place	17 (100)	0 (0)	63 (89)	8 (11)
The facility has an emergency response plan for COVID-19	14 (82)	3 (18)	18 (25)	53 (75)
The facility has an emergency committee that meets weekly	13 (76)	4 (24)	12 (15)	59 (83)
IPC team participates in emergency committee meetings	17 (100)	0 (0)	17(24)	54 (76)
Communication and reporting				
Focal person(s) to receive reports of suspected or confirmed COVID-19 cases	17 (100)	0 (0)	42 (59)	29 (41)
A phone number to report suspected or confirmed COVID-19 cases	16 (93)	1 (6)	55 (77)	16 (23)
Health facility understands reporting levels of suspected or confirmed COVID-19 cases	16 (93)	1 (6)	57 (80)	14 (20)
A Referral system for suspected or confirmed COVID-19 for treatment is known.	17 (100)	0 (0)	56 (79)	15 (21)
Preparation for the Surge in CTU				
The facility knows its maximum capacity	14 (82)	3 (18)	NA	NA
The facility has developed a plan to stop non-essential services	5 (29)	12 (71)	NA	NA
The facility has identified additional space to expand the number of COVID-19 patients.	11 (65)	6 (35)	NA	NA
The facility has developed a plan to move non-critical patients.	12 (71)	5 (29)	NA	NA
The facility has estimated consumption rates for critical supplies.	11 (65)	6 (35)	NA	NA

***CTU -COVID-19 Treatment Unit ** IPC-Infection Prevention Control**

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Table 3: Comparison of training and triage systems among health facilities admitting and not admitting COVID-19 cases during the second wave of COVID-19, Uganda, June 2021

	Referral HF (n=17)		Lower Level HF (n=71)	
Variable	**Yes (%)**	**No (%)**	**Yes (%)**	**No (%)**
Training				
All HCWs were trained to recognize COVID-19 symptoms.	17(100)	0 (0)	45 (63)	26 (37)
HCWs managing COVID-19 trained in transmission-based precautions	16 (94)	1 (6)	NA	NA
Cleaners trained in cleaning CTU/Isolation units	14 (82)	3 (18)	NA	NA
Triage and evaluation of suspected COVID-19 cases				
Available alternative ways to seek care for patients with respiratory symptoms.	10 (59)	7 (41)	14 (20)	57 (80)
Directions (signs) patients with respiratory symptoms	8 (47)	9 (53)	9 (13)	62 (87)
A physical barrier is in place between staff and patients	9 (53)	8 (47)	14 (20)	57 (80)
A separate "respiratory waiting area")	12 (71)	5 (29)	17 (24)	54 (76)
Benches, chairs, or other seating in the respiratory waiting area are separate by at least 1 meter	12 (71)	5 (29)	15 (21)	56 (79)
Functional hand hygiene available near the registration desk and respiratory waiting area	17 (100)	0 (0)	50 (70)	21 (30)
Dedicated toilets are available for patients in the respiratory waiting area	4 (24)	13 (76)	6 (8)	65 (92)
A separate room for conducting physical evaluations of other patients	11 (65)	6 (35)	10 (14)	61 (86)
COVID-19 triage forms and flow charts available	9 (53)	8 (47)	12 (17)	59 (83)
Access to PPE by HCW during patient examination	13(76)	4(24)	24 (34)	47 (66)
Plans for the safe transfer of patients with suspected or confirmed COVID-19 identified	13 (76)	4 (24)	36 (50)	35 (49)
The facility has increased staff dedicated to triage for COVID-19	7 (41)	10 (59)	6 (8)	65 (92)
A separate temporary structure to for patients with fever and respiratory symptoms	11 (64)	6 (35)	4 (6)	67 (94)

***HCW-Health Care Workers *** Personal Protective Equipment**

Medicines and personal protective equipment supply

More referral health facility heads/CTU heads (16; 94%) knew how to estimate the critical PPE supply consumption rate than heads at lower-level health facilities (46; 65%).In relation to the number of COVID-19 patients admitted at the time of assessment, most referral health facilities (13; 82%) lacked essential medicines, (9;53%) lacked adequate PPE appropriate for COVID-19, and (12;71%) did not have oxygen supply and cylinders. Among lower-level facilities, all but one (70; 99%), lacked medicines and most (64; 90%) had inadequate PPE supplies (Table 4).

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Table 4: Comparison of availability of essential medicines and personal protective equipment among health facilities managing COVID-19 patients and those not managing COVID-19 during the second wave of COVID-19, Uganda, June 2021

	Referral HF (n=17)		Lower Level HF (n=71)	
Variable	**Yes (%)**	**No (%)**	**Yes(%)**	**No (%)**
Essential medicines				
Adequate medicines for the management of COVID-19	3 (18)	13 (82)	1 (1)	70 (99)
Vitamin C	6 (35)	11 (65)	6 (8)	65 (92)
Zinc	4 (23)	13 (76)	8 (11)	63 (89)
Azithromycin	2 (12)	15 (88)	0 (0)	71 (100)
Dexamethasone	3 (18)	14 (82)	6 (8)	65 (92)
Clexane	2 (12)	15 (88)	NA	
Ramdesivir	0 (00)	1(100)	NA	
Isolation spaces/ Isolation Units	16 (94)	1 (6)	9 (13)	62 (87)
HDU/ICU	13 (76)	4 (24)	NA	
Adequate Oxygen Supply	5 (29)	12 (71)	NA	
PPE supplies				
Consumption rate (per week) for critical supplies estimated	16 (94)	1 (6)	46 (65)	25 (35)
Monthly inventory of PPE supply at least once a month	16 (94)	1 (6)	45 (63)	26 (37)
Available focal person to manage critical IPC supplies	17 (17)	0 (0)	59 (83)	12 (17)
Facility leadership knows how to request additional supplies	17(100)	0 (0)	56 (79)	15 (21)
Inventory of PPE supplies in the past seven days	9 (53)	8 (47)	14 (20)	57 (80)
Adequate medicines for the management of COVID-19	8 (47)	9 (53)	6 (8)	65 (90)
The facility has the following PPE supplies in stock				
Gowns	12 (71)	5 (29)	4 (6)	67 (94)
Aprons	13 (76)	4 (24)	4 (6)	67 (94)
Eye protection (face shields or goggles)	13 (76)	4 (23)	5 (7)	66 (93)
Surgical Face masks	5 (29)	12(71)	12 (17)	59 (83)
N 95, or equivalent respirators	10 (59)	7 (41)	11 (15)	60 (84)
Alcohol-based hand rub	12 (71)	5 (29)	10 (14)	61 (86)
Soap	9 (53)	8 (47)	35 (49)	36 (51)
Buckets	8 (47)	9 (53)	5 (7)	66 (93)
Hospital-grade disinfectants (Sodium hypochlorite)	10 (59)	7 (41)	7 (10)	64 (90)

***PPE-Personal Protective Equipment ** ICU-Intensive Care Unit *** HDU-High Dependence Unit**

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Discussion

Early in the second wave of COVID-19 in Uganda, the readiness of most health facilities to manage cases was poor. Triage systems and supplies of medicines, personal protective equipment, and oxygen appropriate for management of COVID-19 were all lacking. Few referral facilities were able to expand their capacity for more COVID-19 patients in the event of a surge.

In addition, the overall median readiness scores for health facilities was 39%; this was below the recommended target of 80% for a health facility's readiness score. This could have been due to low perception of the new wave of COVID-19 by most health facilities and relaxing of infection prevention measures after the first wave.

The readiness median scores were much lower (32%) in the lower-level health facilities than referral health facilities (63%). In addition, readiness declined with decreasing health facility level among lower-level health facilities. Also, despite the preparation in referral hospitals, at the beginning of the pandemic to manage COVID-19, only two regional referral health facilities were found to be ready to manage COVID-19 (9,10,11). The assessment was conducted at a time when the second wave had picked momentum, and these results show that referral health facilities were not ready for the second wave. Therefore, health facilities needed more support from Uganda's Government and relevant bodies to improve their readiness to handle surges of COVID-19 cases, especially during acute phases of the pandemic.

This could have been due to low perceived risk of COVID-19 among the lower level health facilities, since they are located in rural areas compared to referral health facilities which are majorly located in urban area. Readiness of lower level health facilities is critical in controlling COVID-19 outbreaks especially community spread by supporting screening and management of mild cases. This would help in decongesting the referral health facilities hence the need for more support to lower level health facilities in Uganda.

We established poor triaging systems in all health facilities. Efficient triage of patients with COVID-19 at all levels of health facilities helps in planning, allocation of resources, case management as well as prevention of COVID-19 infections among health care workers and other patients (15). WHO recommends all health facilities to have triaging stations irrespective of the level of health facility(16). A good triage system involves: screening of all patient for COVID-19 symptoms, isolation of patients with symptoms, ensuring infection prevention measures like strict wearing of mask, maintaining one-meter distance among others, to limit transmission of COVID-19 (15). A triage system is fairly inexpensive and reliable to screen and separate patients and is effective at preventing spread of COVID-19 with in the health facilities (17). Inadequate triage of patients increases the risk of exposure to COVID-19 among health care workers and the patients and can quickly become the source of infections to communities due to free interactions (18). Therefore, there is need to improve triage systems in all levels of health to prevent spread of COVID-19 with in the health facilities.

A considerable proportion of health facilities admitting COVID-19 patients lacked extra space for admitting more COVID-19 patients in case of a surge. A surge of COVID-19 cases could quickly overwhelm a health facility resulting in a lack of space in the planned hospitals initially. A similar incident occurred towards the end of the first wave; various hospitals lacked space to isolate and manage COVID-19 cases in the designated health facilities resulting into the MoH adopting the home-based care strategy to manage non-severe COVID-19 (8). However, this had consequences since most Ugandan families lack adequate space or rooms to serve the purpose, increasing the risk of infections among family members. According to WHO, 80% of COVID-19 cases are mild and can be manage as out patients' cases (15). However, some of these may progress and develop severe symptoms which may necessitate hospitalization. Due to lack of monitoring and inadequate patient knowledge on when to report to the hospital, community deaths are likely to occur (19). From the results of all-cause mortality rapid surveillance, 51% of the reported community deaths had tested positive for COVID-19 between January to August 2021(20).

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Inadequate supply of drugs and personal protective equipment to manage the number of existing patients was also a significant challenge. Drug shortage became a major challenge globally during the COVID-19 pandemic including high income countries (21). Countries attribute this inadequacy in essential supplies to the rapid increase in demand for personal protective equipment and drugs, resulting in early stock outs (22). Before the COVID-19 pandemic, the Uganda health care system was already weak due to an insufficient supply chain system and a constrained budget (23). Referral health facilities in Uganda rely on a Push inventory control system to receive supplies and drugs from the national medical stores (NMS). The disadvantage with this system is inaccuracies in the forecast; consumption can be unpredictable and vary depending on the season. Health facilities do not request their projected supplies hence a possible reason for early stock outs, which burden them (24). If personal protective equipment is inadequate during the COVID-19 outbreak, health workers are likely to get exposed to COVID-19 infections, which puts them at risk of severe disease and death (25). Several countries registered a high number of COVID-19 infections among health care workers due to shortages in personal protective equipment (26). Furthermore, when health workers get COVID 19, they are likely to be the source of infections to the patients, families, and communities where they live (27).

In addition, inadequate oxygen supply to manage COVID-19 patients, especially in the COVID-19 treatment units, could result in early disease progression and massive deaths like in one of the national referral hospitals in Uganda (25). The shortage of oxygen supply became a big challenge in several countries, including India, which experienced the worst second wave of COVID 19 (28). These shortages have been due to increased demand and high consumption of oxygen by the COVID-19 patients. Oxygen therapy is crucial for COVID-19 patient survival (28, 29) and according to WHO, they require three times more oxygen than other patients.

Study limitations

were some limitations in the assessment. We could have interfaced some bias due to participant social desirability to perform better for some responses. In addition, the date of assessment of hospital readiness was not uniform among the surveyed health facilities making it impossible to assess the true variability of readiness among hospitals.

Conclusion

Ensuring the readiness of health facilities is vital in controlling the COVID-19 pandemic. Most health facilities managing COVID-19 patients were in the "work to do", and those not admitting COVID-19 were in the "not ready" categories. Furthermore, health facilities were under-equipped with essential drugs, PPEs, and oxygen and could not expand to accommodate more COVID-19 patients. We presented our findings to the MoH, and the incident management team utilized them to support the health facilities in the response. The National Medical Stores made an emergency supply of medicines and personal protective equipment to the under-equipped referral hospitals. Also, an isolation ward was created at Kiruddu National Referral Hospital to separate COVID-19 patients from those with other medical conditions. Infection prevention and control were strengthened and respiratory areas were created in health facilities across the country.

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Investigation of a Measles Outbreak, Semuto Subcounty, Nakaseke District, Uganda, June–August 2021

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Summary

Background: *On 25 August 2021, a measles outbreak was reported in Semuto Subcounty, Nakaseke District. We investigated the outbreak to determine the scope, assess factors associated with transmission, estimate vaccine coverage, and effectiveness, and recommend evidence-based control measures.*

Methods: *A probable case was an acute onset of fever and generalized maculopapular skin rash with ≥1 cough, cold, or red eyes in a resident of Semuto Subcounty from 1 June–August 31, 2021. A confirmed case was a probable case with a positive blood test for measles-specific IgM. We reviewed medical records to identify cases and snowballed to identify additional community cases. We conducted a 1:4 unmatched case control study.*

Results: *We identified 30 case-persons, overall subcounty attack rate [AR]=3.2/1,000, with zero deaths. Attack rates increased with age; children aged 5-9 years were the most affected (AR=5.0/1,000). Twenty-two (73%) case-persons and 117 (96%) control persons had received measles vaccine (OR_{MH}=0.13, 95% CI=0.037-0.43). Eighteen (60%) case-persons and 12 (10%) control persons interacted with a symptomatic person (OR_{MH}=15, 95% CI=5.7-41),*

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while 21 (70%) case-persons and 46 (38%) control persons played away from home (OR_{MH} =4.2, 95% CI=1.7-11) during their exposure period. Vaccination coverage was 97% (95% CI: 92-99%); vaccine effectiveness was 86% (95% CI: 45–96%).

Conclusions: *Contact with symptomatic persons and playing away from home facilitated measles transmission in this outbreak. Measles vaccination was protective against measles infection. We recommended mass community revaccination for children 6 months to 9 years of age in Semuto Subcounty to capture pockets of unvaccinated children and parents to isolate children with measles-like symptoms.*

Introduction

Measles is one of the top five causes of vaccine -preventable morbidity and mortality worldwide (1). Major measles epidemics occurred almost every 2-3 years globally, causing an estimated 2.6 million deaths each year before measles vaccinations were introduced in 1963 (2). More than 140,000 people, who were mostly children aged less than 5 years, died from measles in 2018 despite the availability of a safe and effective vaccine (2).

In Uganda, measles vaccination coverage improved from 73% in 2010 to 95% in 2020 (3). Despite this coverage, Uganda has recorded frequent measles outbreaks in the past decade (2010 to 2020). In the past three years (2018 to 2020), measles outbreaks alone (4) affected 89 (66%) districts in Uganda (Public Health Emergency Compendium Reports, Uganda Public Health Emergency Operations Centre, unpublished data).

Measles is a notifiable disease in Uganda. Measles surveillance is case-based as part of the National Integrated Disease Surveillance and Response System (5). When a measles case is suspected, a case investigation form is completed, and blood samples are submitted to the Uganda Virus Research Institute (UVRI) for laboratory confirmation (5). On 25 August 2021, the Ministry of Health (MoH) was notified of three blood samples that tested positive for measles-specific IgM in the Semuto Subcounty. We investigated the measles outbreak to determine the scope, assess factors associated with transmission, estimate vaccine coverage and effectiveness, and recommend evidence-based control measures.

Methods

Outbreak area

Nakaseke District is located in the central region of Uganda. Semuto Subcounty is located in the south of Nakaseke District. Semuto Subcounty has 4 health centers (HCs), two of which are government-owned (Kalege HC II and Kikandwa HC II), and the other two are privately owned (Kirema HC III and Bukatira HC II). All 4 health facilities provide only outpatient care services, including immunization. These HCs primarily receive vaccines from the Nakaseke District vaccine store and at times from other HCs in the district. The administrative measles vaccination coverage in Nakaseke District from January–August 2021 was 79%, which was more than the expected 66%, while the administrative measles vaccination coverage in Semuto Subcounty from January–August 2021 was 24%, which was below the expected 66% (District Health Information System version 2 (DHIS2), Nakaseke District, 2021, unpublished data) (6).

Case definition and finding

We defined a suspected case as acute onset of fever with at least one of the following: cough, cold, red eyes, or a generalized maculopapular skin rash in a resident of Semuto Subcounty from 1–June to 31–August 2021. A probable case was a suspected case with a generalized maculopapular skin rash and at least one of the following: cough, cold or red eyes. A confirmed case was a suspected or probable case with a positive measles-specific IgM test. We reviewed outpatient medical records in all 4 health facilities in Semuto Subcounty. We line listed all the suspected measles cases. We interviewed the suspected cases to document a detailed clinical history and reclassify them as either probable or not. We used the snowballing approach to search for additional cases from the community. Using an electronic standardized case investigation form, we collected data on the case-person's demographics, clinical information, vaccination status, and exposure history. Laboratory confirmation was conducted by the Uganda National Expanded Program on Immunization (UNEPI) Laboratory at UVRI using the recommended World Health Organization (WHO) procedures (7).

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Descriptive epidemiology

We computed measles attack rates [AR] by person and place using the Uganda Bureau of Standards (UBOS) 2021 projected population of children in Semuto Subcounty as the denominator (6). We constructed an epidemic curve to assess the time distribution of measles cases.

Hypothesis generation

We conducted 11 hypothesis-generating interviews using a standardized measles case investigation form. We asked the case-persons' caretakers about potential risk factors for measles transmission within the 21 days before symptom onset, including attending social gatherings, attending worship places, visiting health facilities, vitamin A supplementation in the six months before symptom onset, vaccination status before symptom onset evidenced by child health cards or through caretakers' recall, and confirmed by word of mouth, play site, visiting water collection points, attending medical camps, congestion levels in the household, being in contact with a symptomatic patient, and having received a visitor in the household. We generated hypotheses about exposures based on findings from the descriptive epidemiology analysis and hypothesis-generation interviews.

Case control investigation

We conducted an unmatched case control investigation in the 3 affected parishes (Segalye, Kirema, and Kikandwa) of the Semuto Subcounty to test the hypothesis. We investigated children aged 6 months to 9 years because all cases were in this age range. We interviewed the caregivers and administered an electronic questionnaire to the guardians or caregivers since all the case-persons were minors. We considered only probable or confirmed measles cases for the case–control. We recruited all 30 case-persons we identified, 3 of which were confirmed. We defined a control as any person aged 6 months to 9 years without signs and symptoms of measles from 1 June to 31 August 2021 residing in the three affected parishes of Semuto Subcounty. We selected cases and controls at a ratio of 1:4. We used simple random sampling to select controls from the same village as cases. Our sampling frames were the village health team (VHT) household lists. We used Epi Info 7.2.4.0 for analysis. To assess factors associated with measles infection, we stratified by parish and obtained Adjusted Mantel-Haenszel Odds Ratios (OR_{MH}) (8, 9) and their corresponding 95% confidence intervals (CIs) (10). We also merged all the variables that dealt with meeting symptomatic persons (met a symptomatic person at a water point, shared home with a symptomatic person, met a symptomatic person at a health facility) and came up with a new variable about meeting a symptomatic person generally.

Vaccination coverage (VC) and vaccine effectiveness (VE)

We estimated the one-dose VC by using the percentage of controls that had a history of measles vaccination in our case control investigation. We calculated the measles VE using the formula $VE = 1 - OR_{MH}$ (11), where OR_{MH} was the protective Mantel–Haenszel odds ratio associated with having been vaccinated with at least one dose of the measles vaccine estimated from the case control investigation.

Ethical considerations

The Ministry of Health of Uganda gave the directive and approval to investigate this outbreak. In agreement with the International Guidelines for Ethical Review of Epidemiological Studies by the Council for International Organizations of Medical Sciences (1991) and the Office of the Associate Director for Science, CDC/Uganda, it was determined that this activity was not human subject research and that its primary intent was public health practice or disease control activity (specifically, epidemic or endemic disease control activity). Verbal informed consent was obtained from the participants before the start of each interview. Parental/legal guardian verbal informed consent was obtained on behalf of all the children before the start of each interview since they were aged less than 10 years.

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Results

Descriptive epidemiology

We identified 30 case-persons (27 probable and 3 confirmed cases) and no deaths. The overall subcounty attack rate [AR] was 3.2/1000. The most affected parish was Segalye (AR=9.5/1,000), followed by Kikandwa (AR=7.4/1,000) and Kirema (AR=3.0/1,000). The age range of the case-persons was 6 months to 9 years. The most affected age group was 5-9 years (AR=5.0/1,000), followed by 1-4 years (AR=2.6/1,000). The attack rate was similar between males (3.3/1,000) and females (3.2/1,000).

All (100%) cases presented with a history of fever, a generalized rash, and red eyes. Twenty-seven (90%) had a history of cough and cold. Ten (33%) had pneumonia, 8 (27%) had oral and throat sores, and 2 (6.7%) had otitis media as complications of measles.

The epidemic curve (Figure 1) showed a propagated measles outbreak. The outbreak lasted 88 days. On 2 June 2021, the index case of the outbreak was identified in the Kirema Parish of Semuto Subcounty. The outbreak was not suspected until 28 July 2021, when health workers in Kalege Health Center II received reports of children with measles-like symptoms in the community. The outbreak was confirmed on 25 August 2021. Investigations started on 29 August 2021. The last case occurred between 25 and 28 August 2021.

Hypothesis generation findings

Of the 11 case-persons, 8 (73%) had visited a water collection point during the exposure period, 3 (27%) did not receive vitamin A supplementation in the six months preceding the infection, 3 (27%) played in the neighborhood, and 2 (18%) were not vaccinated. None of the case-persons reported having the other exposures. We, therefore, considered a visit to a water collection point, vitamin A supplementation, playing in the neighborhood, vaccination status, and visiting a health facility as the likely drivers for this outbreak.

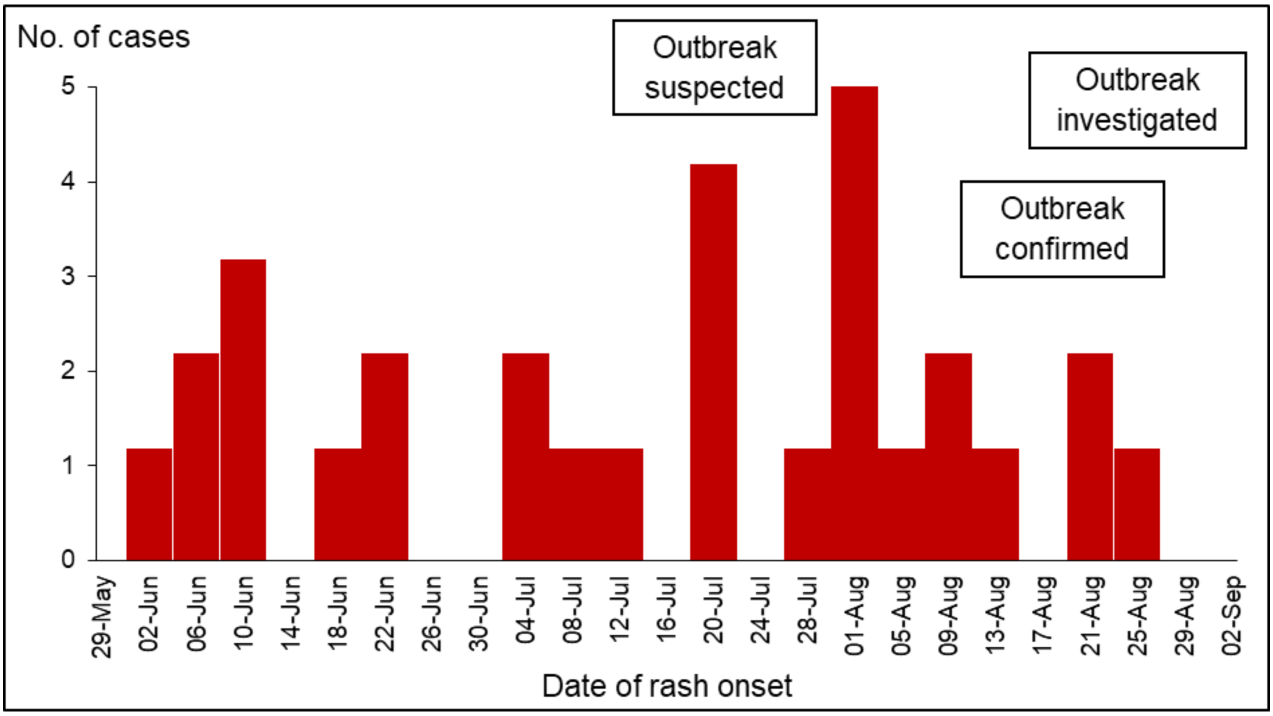

Figure 1: Distribution of measles cases by date of earliest rash onset, Semuto Subcounty, Nakaseke District, Uganda, June–August 2021

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Table 1: Factors associated with the measles outbreak, Semuto Subcounty, Nakaseke District, Uganda, June–August 2021

Risk factor	Cases %(n)	Controls %(n)	OR_{MH} (95% CI)
Measles vaccination	73 (30)	96 (122)	0.13 (0.037-0.43) *
Received vitamin A in last 6 months	50 (30)	45 (29)	2.5 (0.77-7.9)
Visited health facility	20 (26)	17 (121)	1.3 (0.47-3.6)
Travel to a different area during the exposure period	3.3 (30)	7.4 (122)	0.44 (0.052-3.6)
Longline at a health facility	33 (30)	27 (122)	1.4 (0.59-3.3)
Visit water collection point	73 (30)	67 (122)	1.4 (0.55-3.3)
Played at a water collection point	50 (30)	56 (121)	0.8 (0.35-1.8)
Long lines at a water collection point	33 (6)	25 (20)	1.7 (0.21-14)
Met a symptomatic person at a water point	30 (30)	10 (120)	4.4 (1.6-12) *
Shared home with a symptomatic person	57 (30)	0 (122)	Undefined **
Met a symptomatic person at a health facility	0 (6)	20 (20)	Undefined **
Generally, met a symptomatic person	60 (30)	10 (120)	15 (5.7-41) *
Played away from home	70 (30)	38 (122)	4.2 (1.7-11) *

* Significant association at p value <0.05
** Undefined due to having "0" in some cells

Case control study findings

Twenty-two (73%) case-persons and 117 (96%) control persons were vaccinated (OR_{MH} =0.13, 95% CI: 0.037-0.43). Nine (30%) case-persons and 12 (10%) control persons met a symptomatic person at a water collection point (OR_{MH} =4.4, 95% CI: 1.6-12). Eighteen (60%) case-persons and 12 (10%) control persons met a symptomatic person generally (OR_{MH} =15, 95% CI: 5.7-41). Twenty-one (70%) case-persons and 46 (38%) control persons played away from home (OR_{MH} =4.2, 95% CI: 1.7-11). The other exposures assessed in the case control were not significantly associated with measles infection (Table 1).

Among control persons aged ≥9 months to 9 years, we estimated vaccination coverage to be 97% (95% CI: 92-99%). We estimated VE=86% (95% CI: 45–96%) among 22 (79%) case-persons compared to 116 (97%) control persons with a history of measles vaccination (OR_{MH} =0.14; 95% CI: 0.037–0.55).

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Discussion

Our investigation showed that this community outbreak was mild and affected only 3 parishes in the Semuto Subcounty. Older children aged 5 -9 years were the most affected. Measles infection was lower among vaccinated children. The outbreak was propagated by children playing away from home and meeting symptomatic measles case-persons. The high vaccination coverage and suboptimal vaccine effectiveness may have reduced community susceptibility to infection.

Measles infection increased with an increase in age. A shift in the age distribution of measles cases toward older age groups has also been described in other countries (12). The findings in this investigation could be due to waning immunity (13) and the accumulation of the susceptible population as the children grow older. The waning immunity with age may have increased the susceptibility of the older children to measles infections. This can be avoided in the future by introducing a second dose of the measles-rubella vaccine for older children into the national routine immunization schedule (14). Contrary to the findings in this outbreak, an investigation of a measles outbreak in the Somali Region of Ethiopia showed that the younger age group <1 year was the most affected compared to all other age groups (15). This could be due to the difference in vaccination coverage in the two regions at the time of the outbreaks. The current outbreak occurred in an area with high vaccination coverage, whereas the outbreak in the Somali Region occurred in an area with very low vaccination coverage of the <1-year-olds (15).

This investigation showed that the history of being vaccinated with the measles vaccine was protective against measles virus infection. This is in line with findings from other measles outbreak investigations conducted in Ethiopia that found that being vaccinated with the measles vaccine was protective against measles (16). Other investigations conducted in Uganda and China also noted that not being vaccinated against measles was a risk factor for measles infection (17, 18). The current outbreak mainly occurred among pockets of unvaccinated children. These unvaccinated children exposed some of the vaccinated children to measles infection. The findings in this investigation are expected because measles vaccination is the best approach for preventing measles infections and outbreaks (2). The measles vaccine confers immunity to the person who has been vaccinated, and the WHO recommends at least 2 doses of measles vaccine to be administered at 9 and between 15–18 months of age (19). One can also get immunity through being infected with measles, but it comes with severe complications (2).

Children who met with symptomatic measles case-persons while at the water collection points were more likely to contract measles than those who did not meet any symptomatic measles case-persons at the water collection point. This finding is similar to findings in another outbreak investigation, where measles was associated with the congregation of children at water collection points (18). This is not surprising since measles is an airborne disease (1, 2). In this community, similar to most African settings, women are the default caretakers for children (18). These women usually move with children as they collect water for domestic use. The older children aged more than 5 years at times go without adults. For adults, water collection points are meeting points where they converse with each other. As the children wait for the adults to fill up the water collecting containers and finish their conversations, they mingle and play with other children. If one of the children is symptomatic and in the infectious phase, this facilitates transmission of measles to the other children, as was demonstrated in several other studies (18). Contrary to the findings in our investigation, visiting water collection points was protective in another outbreak investigation (20), which was due to it being a sign of healthy children and therefore a lower chance of visiting a pediatric ward in a hospital, which was the source and site of the outbreak at the time.

During this outbreak, playing away from home and meeting a symptomatic person were generally strongly associated with measles infection. These findings agree with results from several other studies (18), which demonstrated that congregation settings facilitate measles transmission. As children move away from their homes to other places to play with other children, their chances of getting in contact with an infected measles person increase. This is not

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surprising since measles is a highly contagious airborne infection that is transmitted from an infected person to a noninfected person via the respiratory route or through direct contact with the infected person (2).

This was a mild measles outbreak with vaccine coverage and vaccine effectiveness falling in the recommended ranges (2). Other studies have also shown that measles outbreaks can occur in communities with >95% vaccine coverage and with documented vaccine effectiveness of >85% (21). However, most previous investigations have shown that measles outbreaks are primarily due to low vaccine coverage of <95%, low vaccine effectiveness of <85%, or both (15), which is understandable due to the existence of a susceptible population and lack of herd immunity. The vaccination coverage and vaccine effectiveness in this investigation could explain the small size and limited spread of this outbreak (22). The findings in this investigation are also consistent with reports that when measles occurs in immunized individuals, the illness is less severe (23). This is also predictable since the measles vaccine is not 100% effective (21). Uganda currently administers a one-dose measles-rubella-containing vaccine to children at 9 months as part of the routine vaccination schedule (24). Measles outbreaks still occur even in countries with high vaccination coverage of the two-dose measles vaccine because a susceptible population still accumulates fairly swiftly (21). Therefore, it is not surprising that measles outbreaks still occur in Uganda.

Study limitations

This investigation had some limitations. The lack of a sufficient sample size rendered it impossible to conduct a more detailed analysis (multivariate regression analysis) to control for confounding. Vaccination status was based on caretakers' recall, which might have led to recall bias leading to an overestimation of vaccine effectiveness and vaccination coverage. In this investigation, we assumed that the controls were representative of the general population and used the proportion of controls vaccinated to estimate vaccination coverage instead of the standard WHO community survey method. This result might have overestimated the vaccination coverage. Additionally, we could not triangulate with the administrative coverage, since vaccination records in some of the health facilities were not up to date, hence, the low administrative coverage compared to the calculated vaccination coverage. We did not ascertain the history of measles infection outside our exposure and outbreak period as a source of measles immunity among the controls, which could have confounded the calculation of vaccine effectiveness.

Conclusion

We concluded that contact with symptomatic children either at home or at a water collection point and playing away from home were associated with this measles outbreak. Measles vaccination was protective against measles infection. The vaccination coverage and vaccine effectiveness could not explain the occurrence of this outbreak.

We recommended that the Nakaseke District Health team conduct a mass community measles revaccination campaign for all children 6 months to 9 years in Semuto Subcounty to capture pockets of unvaccinated children in the area and act as the booster dose for those who might have received only one dose. Parents and guardians to isolate children with measles-like symptoms. Children who had not received the measles-rubella vaccines were referred to the nearby health facilities, where they received their vaccines.

Acknowledgement

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Weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020–2021

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Summary

Background: *Disease surveillance provides vital data for disease prevention and control programs. Incomplete and untimely data are common challenges in planning, monitoring, and evaluation of health sector performance, and health service delivery in many African settings. We described the completeness and timeliness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020-2021.*

Methods: *We abstracted data on completeness and timeliness of weekly reporting on epidemic prone diseases from 136 districts of Uganda from the District Health Information System version2 (DHIS2) platform. Timeliness is the proportion of all expected weekly reports from 136 districts of Uganda that were submitted to DHIS2 by 12:00pm of the Monday of the following week. Completeness is the proportion of all expected weekly reports from 136 districts of Uganda that were completely filled and submitted to DHIS2 by 12:00pm of the Wednesday of the following week. We determined the proportions and trends of completeness and timeliness of reporting at national level by year, health regions, and district.*

Results: *National average of reporting timeliness and completeness was 49% and 75% in 2021 while in 2020, it was 44% and 70% respectively. Both weekly completeness and timeliness of reporting increased in 2021 by 5% when compared to 2020. Eight of the 15 health regions achieved the target for completeness at 80%; Lango Region attained the highest (93%) in 2020, and Karamoja Region attained 96% in 2021. None of the regions achieved the target for timeliness at 80% in both 2020 and 2021. Kampala District attained the lowest in completeness of reporting:38% and 32% in 2020 and 2021 respectively, registering a 6% decrease. Kampala District still attained the lowest in timeliness of reporting (19%) in the both 2020 and 2021.*

Conclusion: *Weekly reporting on epidemic prone diseases became more complete over time, but timeliness of reporting is still poor. Further investigations to identify particular bottlenecks to reporting completeness and timeliness of surveillance data are needed to address the variations at both district and regional levels.*

Background

Uganda is a low-income country that continues to experience disease outbreaks caused by emerging and re-emerging diseases such as cholera, typhoid, COVID-19, and viral haemorrhagic fevers [1, 2]. Infectious disease outbreaks if not detected and reported early can rapidly spread and result in high morbidity and mortality [3]. To curb the effects of disease outbreaks, effective public health surveillance systems are needed to provide timely and accurate information leading to early detection of potential outbreaks and containing them in the local areas [2, 4].

The key strategy for implementing public health surveillance in African countries is the Integrated Disease Surveillance and Response (IDSR) strategy which was launched by WHO Afro in 1998 [5, 6]. One of the main goals of IDSR implementation is to monitor disease and public health event trends in order to ensure that any unusual disease patterns such as outbreaks are detected quickly, investigated, and responded to within the shortest time [6, 7].

The IDSR system in Uganda refers to reportable priority diseases as per the third edition of IDSR Technical Guidelines launched in 2021. The diseases are categorized as follows: diseases targeted for elimination, epidemic prone diseases, diseases of public health importance, and public health events of international concern under IHR 2005 [8]. These priority diseases have varying reporting timelines and requirements. Surveillance data on these diseases is reported as immediate, weekly, monthly or quarterly reports. Reports on epidemic prone diseases must be sent weekly [2].

Diseases, conditions or events that must be reported weekly are 20 as follows: Acute Flaccid Paralysis (AFP), Acute haemorrhagic fever syndrome (Ebola, Marburg, Lassa Fever, Crimean-Congo), Acute Jaundice, Adverse events follow-

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ing immunization (AEFI), Anthrax, Cholera, Dengue fever, Diarrhoea with blood (Shigella), Guinea Worm Disease (Dracunculiasis), Malaria, Malnutrition in under 5 years, Measles, Meningococcal Meningitis, Maternal death, Neonatal death, Neonatal tetanus, Plague, Rift Valley Fever, Severe Acute Respiratory Illness (SARI) clusters, Rabies, Typhoid, Yellow fever, and laboratory confirmed multidrug and extremely drug resistant Tuberculosis [6, 8].

In Uganda, disease surveillance information is reported in a hierarchical order from the communities through the 136 districts to the national health system. At each level of the health system, as data are transferred from one level to another, problems of completeness, timeliness, and data quality may be incurred leading to unreliable information for planning, monitoring, and health service delivery [9]. To combat such challenges, surveillance systems need to be periodically assessed on key indicators such as completeness and timeliness of reporting to ensure that the objectives of surveillance are being met. For this reason, IDSR performance is often evaluated on completeness of reporting (proportion of districts submitting completely filled reports and timeliness of reporting (proportion of districts submitting reports on time) through the District Health Information System version 2 (DHIS2) [5, 10]. The DHIS2 automatically determines the number of reports submitted against the number expected to estimate completeness (by midday every Wednesday). It also indicates the number of reports which are submitted on time (by midday every Monday) [8].

After several years of IDSR implementation in Uganda, assessment of its performance was conducted in 2016 and revealed improvements in both timeliness (40 to 68%) and completeness (56 to 78%) of reporting at national level since 2012 when the second edition of IDSR was launched [1]. This assessment was conducted in only a few selected districts using district data. Furthermore, given the challenges posed by the COVID-19 pandemic to public health surveillance and response, it is important to document the performance of key surveillance indicators amidst the COVID-19 pandemic. However, DHIS2 data on completeness and timeliness of reporting was available starting from 2020. We described the timeliness and completeness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020 to 2021.

Methods

Study setting

Uganda is made up of fifteen health administrative regions which are further divided into 136 districts and health facilities. Health service delivery is organised in tiers; from Health Centre (HC) I, HC II, HC III, HC IV, general hospital, regional referral hospital, and national referral hospital. Operationally, HC I are Village Health Teams (VHTs) that provide referral services to the higher levels.

Data source and disease surveillance reporting procedures

Surveillance data on completeness and timeliness of reporting on epidemic prone diseases is stored on the DHIS2. The DHIS2 is an open-source web-based platform maintained at the national level by the Ministry of Health (MoH). The software is used for reporting, analysing, and disseminating health data as part of the Health Management Information System (HMIS). Disease surveillance reporting in Uganda follows a hierarchical order from community level to the national level of the health system through the DHIS2. At the community level, surveillance activities are conducted by community volunteers (village health teams) who are trained using simple case definitions and report their observations to the periphery health facilities. Then at the health facility level, the data are differentiated including information from outpatient, in-patient, consulting room and laboratory registers into daily summary sheets and IDSR reporting forms. The data are then sent to the district health office (DHO) as immediate, weekly, monthly or quarterly reports. The reports are received at the DHO by the biostatisticians who enter the data into the electronic DHIS2, which has the capability to automatically aggregate the information, reported from the periphery health facilities into district level data. The aggregated data sent from the district to the regional level using the DHIS2 are merged into regional and national level datasets. The periphery, district, and regional levels have specified times for reports submission. The DHIS2 system automatically determines the number of reports submitted against the number expected to estimate timeliness (by midday every Monday). It also indicates the number of complete reports (by midday every Wednesday) [8].

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Study variables, data abstraction, and analysis

We analysed data on completeness and timeliness of weekly reporting of epidemic prone diseases from all the 136 districts of Uganda reporting through the DHIS2. Timeliness is the proportion of all expected weekly reports from all 136 districts of Uganda that were submitted to DHIS2 by 12:00pm of the Monday of the following week. Completeness is the proportion of all expected weekly reports from 136 districts of Uganda that were completely filled and submitted to DHIS2 by 12:00pm of the Wednesday of the following week. We determined the overall proportions and trends of completeness and timeliness of reporting at national level by year, health regions, and district.

Ethical considerations

We used routine surveillance data reported by districts to the MoH for this analysis. The data is aggregated with no identifying information. The US Centres for Disease Control and Prevention (CDC) provided non-research determination for this analysis. We also sought and obtained permission from MoH to use the data.

Results

National completeness and timeliness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020 –2021

Trend of timeliness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020 –2021

Data on timeliness of reporting was recorded beginning epidemiological week four of 2020 with 23% timeliness of reporting. The national timeliness of reporting was below the 80% target throughout 2020 and 2021 (Figure 1). The national timeliness of reporting was 49% in 2021 compared to 44% in 2020, indicating a 5% increase over the two-year period.

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Trend of completeness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020 –2021

The national completeness of reporting was 14% in epidemiological week one of 2020, increased over time and reached the 80% target at epidemiological week 22 of 2020 though dropped at week 43 and remained below the target until the end of 2021 (Figure 1). The national completeness of reporting was 75% in 2021 compared to 70% in 2020, indicating a 5% increase over the two-year period.

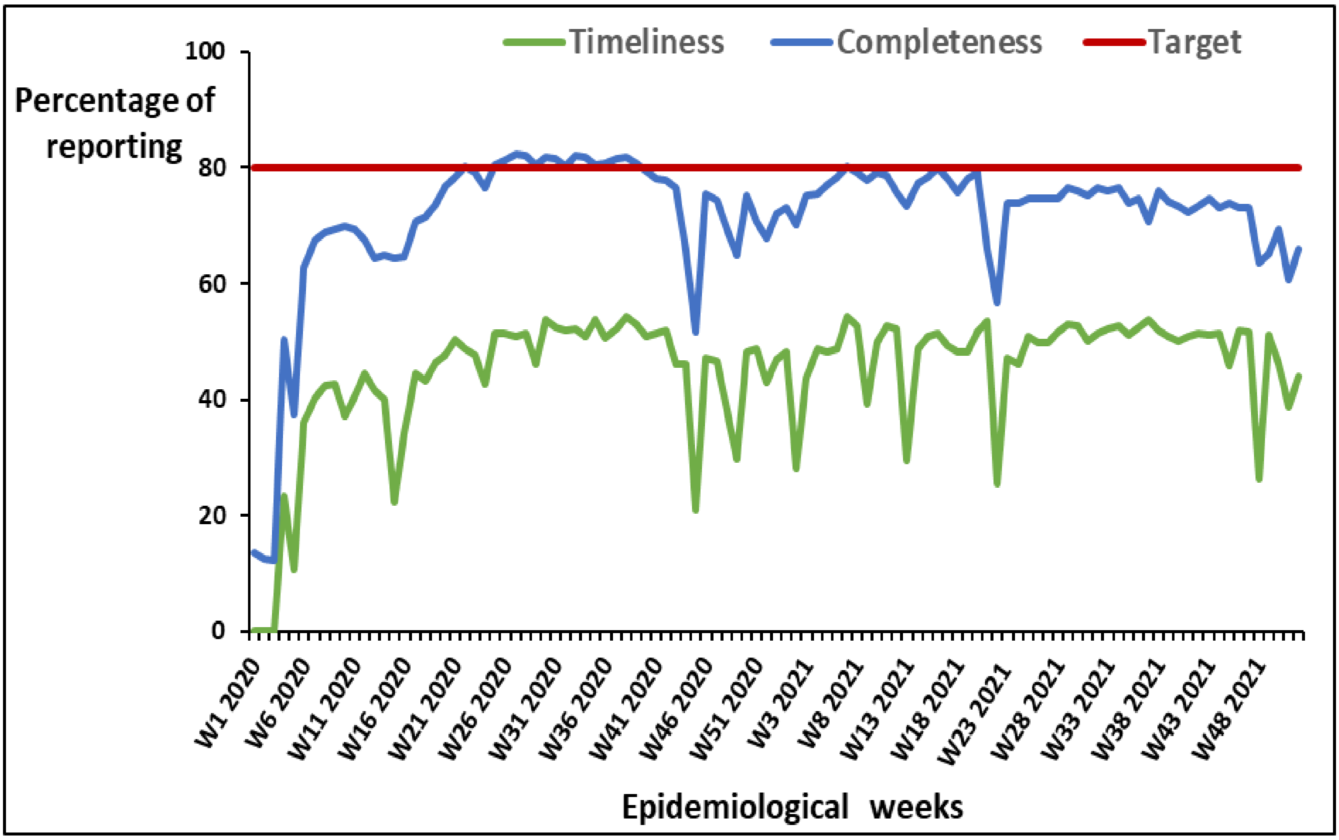

Figure 1: Completeness and timeliness of weekly surveillance data reporting on epidemic prone diseases, Uganda, 2020 –2021

Completeness and timeliness of weekly surveillance data reporting on epidemic prone diseases by health region, Uganda, 2020 –2021

Timeliness of weekly surveillance data reporting on epidemic prone diseases by health region, Uganda, 2020 –2021

None of the 15 health regions achieved the national target for timeliness of reporting at 80%. However, there was a notable increase in timeliness of reporting across all health regions except Kampala Region which also attained the lowest in timeliness of reporting (19%) in both 2020 and 2021 (Figure 2).

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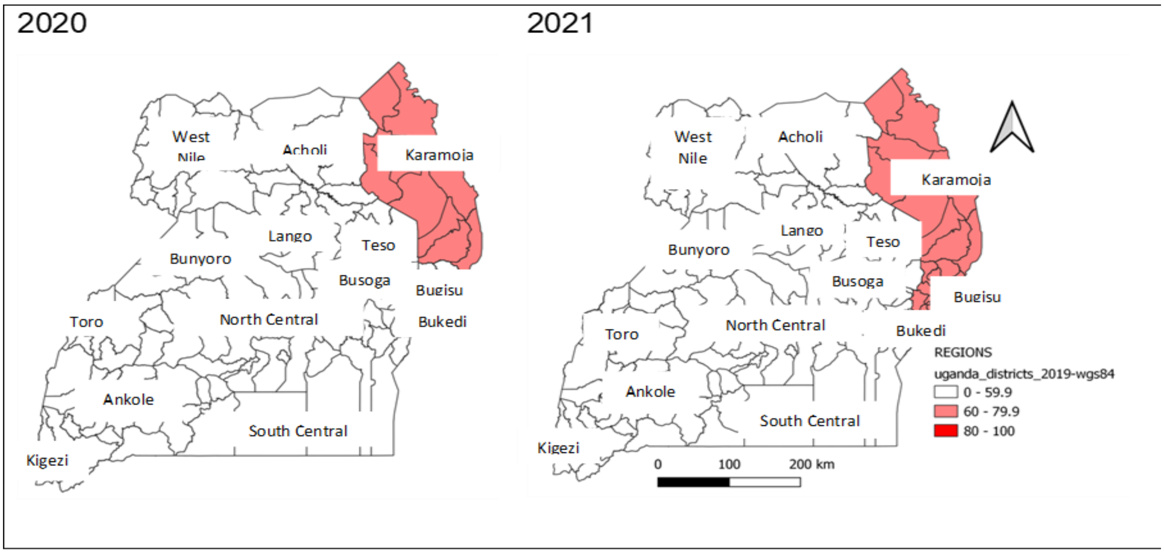

Figure 2: Timeliness of weekly surveillance data reporting on epidemic prone diseases by health region, Uganda, 2020 –2021

Completeness of weekly surveillance data reporting on epidemic prone diseases by health region, Uganda, 2020 –2021

Of the 15 health regions, eight achieved the target for completeness of reporting at 80%; Karamoja and Lango Regions attained the highest 96% and 93% in 2021 and 2020 respectively. Unlike other regions registering improvement in completeness of reporting from 2020 to 2021, Kampala Region attained the lowest and registered a 6% decrease: 38% and 32% in 2020 and 2021 respectively (Figure 3).

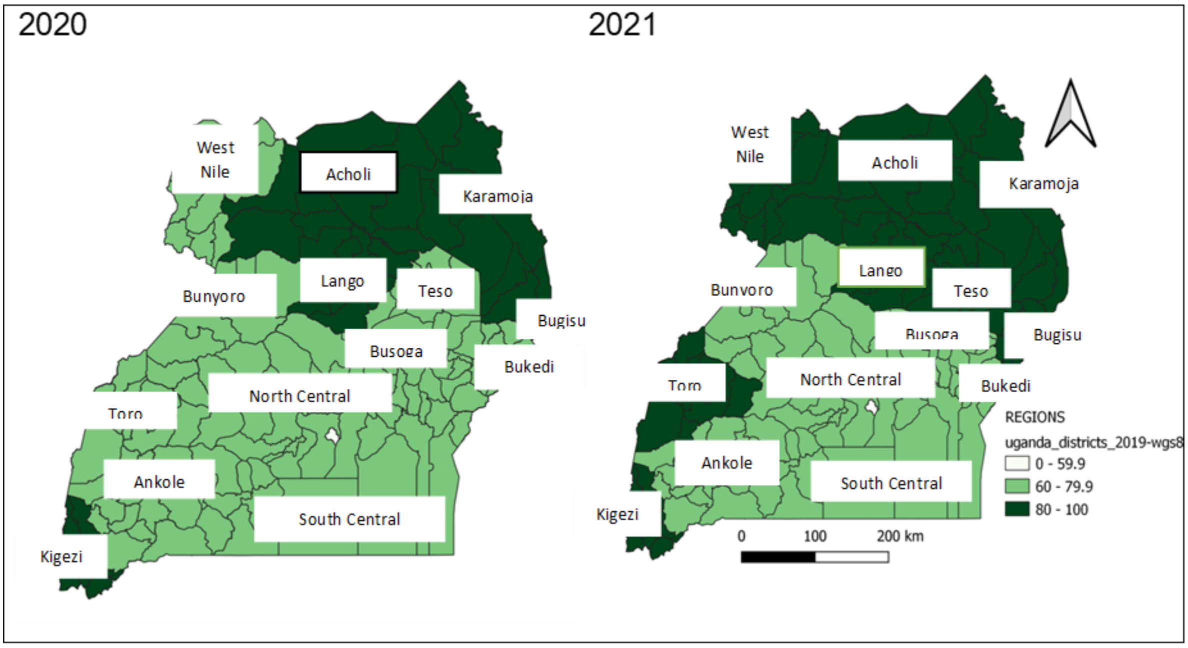

Figure 3: Completeness of weekly surveillance data reporting on epidemic prone diseases by health region, Uganda, 2020 –2021

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Timeliness of reporting weekly surveillance data reporting on epidemic prone diseases by district, Uganda, 2020 –2021

Timeliness of reporting was poor throughout 2020 and 2021, below 60% in many of the districts. Only Kibuku District attained the 80% target for timeliness of reporting in 2020 (81%). In 2021, nine districts improved and attained target for reporting timeliness: Buyende (88%), Isingiro (84%), Kibuku (83%), Rakai (82%), Nwoya (98), Lira (80%), Kalangala (86%), Kyotera (86%), and Kaabong (82%) (Figure 4).

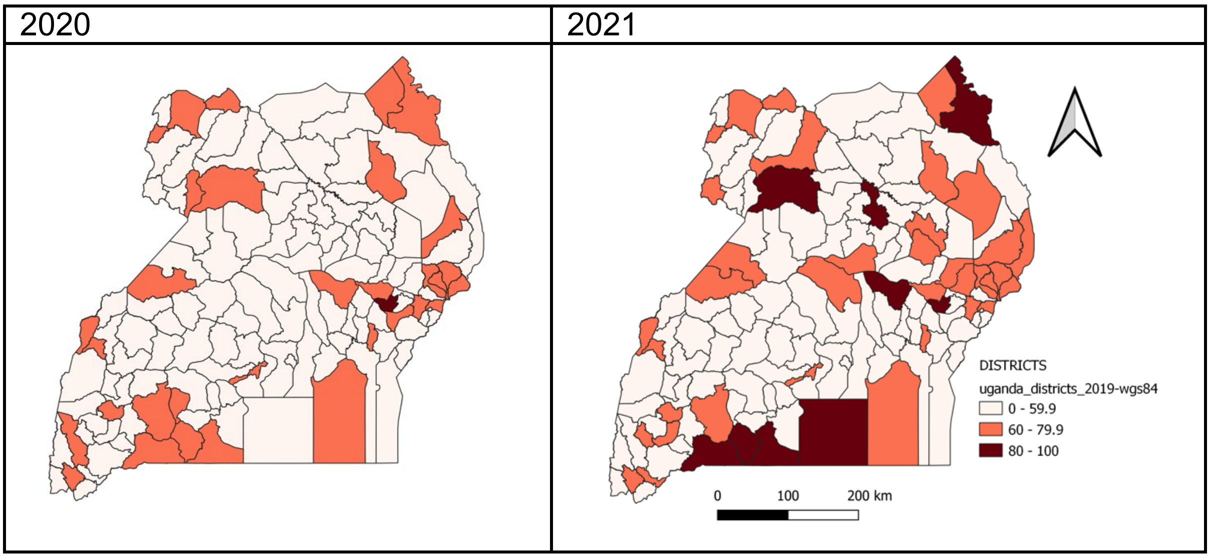

Figure 4: Timeliness of weekly surveillance data reporting on epidemic prone diseases by district, Uganda, 2020–2021

Completeness of weekly surveillance data reporting on epidemic prone diseases by health district, Uganda, 2020 –2021

Majority of the districts achieved the 80% target of completeness of reporting in 2020 and improvements continued to be seen in 2021. All districts in Karamoja Region attained and maintained the 80% target of completeness throughout 2020 and 2021. Districts of Kampala, Busoga Region (Bugiri, Jinja), and South-central Region (Bukomansimbi, Masaka, Kassanda, Wakiso), and Rwampara continued to perform poorly with less than 60% completeness of reporting throughout 2020 and 2021 (Figure 5).

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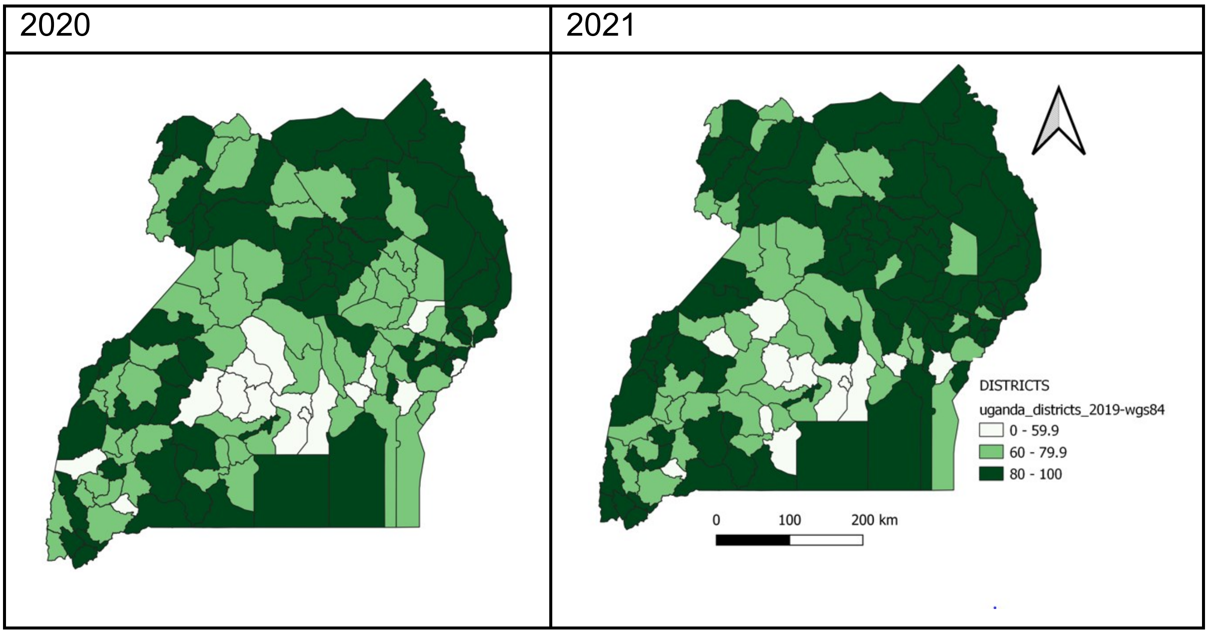

Figure 5: Completeness of weekly surveillance data reporting on epidemic prone diseases by district, Uganda, 2020–2021

Discussion

This study addresses an important aspect of public health surveillance systems in Sub-Saharan Africa (SSA). Our findings indicate improvements in surveillance data reporting both at regional and national levels, which supports similar findings from SSA of progress in reporting completeness and timeliness associated with either IDSR system or DHIS2 implementation [2, 11, 12]. In spite of the observed improvements, the overall reporting completeness and timeliness remains insufficient below the 80% target, and varies greatly by health regions and district.

Although Kiberu et al. argued that challenges of data reporting seem to have been resolved through the use of DHIS instead of paper-based forms in Uganda, this may have worked for a few districts. The increases in both completeness and timeliness of reporting are likely due to the internet-based reporting and continuous reminders of reports submission through personal mobile phones as it has been reported from other countries [13, 14]. In addition, the ongoing COVID-19 pandemic might have increased biostatisticians' and surveillance focal persons' alertness and understanding of the need for surveillance data reporting, thus the improvement in reporting completeness and timeliness as reported by similar studies [15, 16]. However, our findings don't fully support this since data before the pandemic are not available for us to understand the impact of the pandemic on surveillance data reporting. On the other hand, the poor reporting rates in some districts might have been influenced by poor motivation, network and internet challenges, which have potential for error introduction thus affecting data accuracy [17].

The findings further revealed low and varied levels in the reporting timeliness at districts and regional levels. This is in line with previous studies which reported that low timeliness is still common at all levels of health services [12, 18]. The possibility of missing outbreaks and delays in public health response such as contact tracing due to untimely and incomplete reporting appears to be a real challenge in the Uganda health system. Continued training of disease surveillance and health information officers in addition to routine validation of data reports by biostatisticians can help improve completeness, timeliness and data quality of reporting. In the long term, plans should be initiated to scale up data entering into DHIS2 by the periphery health system such as health centres, clinics, to address issues of completeness and timeliness.

Our study should be interpreted based on the following limitations. Firstly, the findings were based on a short duration since data were only available in DHIS2 from 2020; the data only covered the

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COVID-19 pandemic period. We couldn't therefore describe reporting before and during the pandemic to establish its effect on surveillance data reporting. Secondly, common challenges with internet data transmission in all parts of Uganda might have introduced some data errors resulting in bias in our findings.

Conclusion

Timeliness and completeness of weekly epidemic prone disease surveillance reporting through DHIS2 improved over time. However, despite these improvements, timeliness of reporting still remains poor below target in most of the districts and all health regions. Continuous support supervision, mentorship and additional system/infrastructure enhancements, including internet connectivity, may be required to further enhance surveillance data reporting. Further investigations to identify particular bottlenecks to reporting completeness and timeliness of surveillance data are needed to address the variations at district and regional levels.

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District Leader Community Dialogue Meetings Improved Willingness to Receive COVID-19 Vaccines in Western Uganda, May 2021: A Pre-Post Study

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Summary

Background: *Widespread COVID-19 vaccine uptake is necessary for epidemic control. A February 2021 study in Uganda suggested that public uptake would follow uptake among leaders. In May 2021, Baylor Uganda convened and led community dialogue meetings with district leaders from Western Uganda to promote vaccine uptake among leaders. We assessed the effect of the meetings on willingness towards COVID-19 vaccine uptake.*

Methods: *All departmental district leaders, including health, education, security, engineering, and finance of the 17 districts in Western Uganda, were invited to the meetings, which lasted approximately four hours. Scripts were used, and the same topics were discussed in all meetings. Leaders completed self-administered questionnaires before and after the meetings. We used a five-point Likert scale to assess willingness to receive the vaccine. We analyzed the findings using Wilcoxon's signed-rank test.*

Results: *Among 268 attendees, 164 (61%) completed the pre- and post-meeting assessments; 48 (18%) had already been vaccinated, and 56 (21%) declined due to time constraints. Among the 164, the median scores for willingness to receive the vaccine changed from three (neutral) pre-meeting to five (strong willingness) post-meeting ($p<0.0005$).*

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Conclusion: *Dialogue meetings led to district leaders' increased willingness to receive the COVID-19 vaccine. The information dissemination, interactive discussions, and the influence of trusted health experts may have led to the changes observed post-meeting. Broader use of such meetings with community leaders could reduce COVID-19 vaccine hesitancy and increase uptake.*

Introduction

The Uganda Ministry of Health (MOH) began the deployment of vaccination against SARS-CoV-2 in March 2021. Vaccination was offered to prioritized subpopulations, which included health workers, teachers, adults with comorbidities, and the elderly (1). With the lack of a proven effective treatment against COVID-19 at the time, the vaccine was an essential additional measure to the existing standard operating procedures (e.g., use face masks, hand washing, and social distancing) to prevent COVID-19 spread (2-4). Widespread vaccine uptake is necessary for epidemic control (5). However, polls conducted worldwide showed that many people expressed hesitancy about receiving the COVID-19 vaccine (6). As a result, there was a need to identify behavior change methods that could effectively lead to increased COVID-19 vaccine uptake (2, 7). Community dialogue meetings are one method that can promote awareness and behavior change.

Uganda has faced a low level of uptake of new vaccines, such as the Human Papilloma Virus, which targeted girls aged 9–14 years in Uganda beginning in 2015 (8). Even after its use in the country for six years, its coverage was still low, partly due to negative media reporting (9) and the poor public attitude towards the vaccine, such as the perceived feeling that the vaccine had severe side effects (8). Even vaccines used in the country for a long time, such as the Diphtheria, Pertussis, and Tetanus-Hepatitis b-Hemophilus influenza type b (DPT-Hep-Hib) vaccines, still faced challenges with uptake due to misconceptions (9). Additionally, there was public distrust about the new vaccines due to a feeling that Africans were being used as "experimental specimens" (9).

As of May 1, 2021, the cumulative number of COVID-19 cases in Uganda stood at 41,975 cases, 13 months after Uganda reported its first case (10, 11). We suspected that due to the few cases at the time, many did not take COVID-19 seriously, which affected their perception and attitudes towards receiving the COVID-19 vaccines. These negative attitudes contributed to COVID-19 vaccine hesitancy at the time, with only 354,736 eligible people vaccinated as of May 1, 2021, nearly two months after COVID-19 vaccination was introduced in Uganda, despite the availability of free COVID-19 vaccines (12). A February 2021 study in Uganda suggested that public uptake of COVID-19 vaccines would follow the uptake of vaccines among leaders (13). In May 2021, community dialogue meetings were held with Baylor Uganda and district leaders from Western Uganda as a way of reducing COVID-19 vaccine hesitancy and promoting the uptake of COVID-19 vaccines among district leaders and their communities. However, it was not known whether these meetings would change participants' attitudes about COVID-19 vaccination. Therefore, we assessed the effects of the meetings on district leaders' COVID-19 risk perception, COVID-19 vaccine concerns, perceived vaccine benefits, perceived vaccine access, and willingness to receive the vaccine.

Methods

Study setting

We conducted the evaluation in 17 districts of Western Uganda (Figure 1). Of the 41,975 COVID-19 cases reported nationally by May 1, 2021, 2,305 (6%) were reported in 17 districts—1,430 (3%) from the Tooro Region (Bundibugyo, Bunyangabu, Kabarole, Kamwenge, Kasese, Kitagwenda, Kyegegwa, Kyenjojo, and Ntoroko districts) and 875 (2%) from the Bunyoro Region (Buliisa, Hoima, Kagadi, Kakumiro, Kibale, Kikube, Kiryandongo, and Masindi districts) (11). Despite the availability of free COVID-19 vaccines at the time, the 17 districts had low vaccine uptake, with only 20,358 (25%) vaccinated out of a total of 81,430 eligible people who were supposed to have been vaccinated by May 1, 2021 (12).

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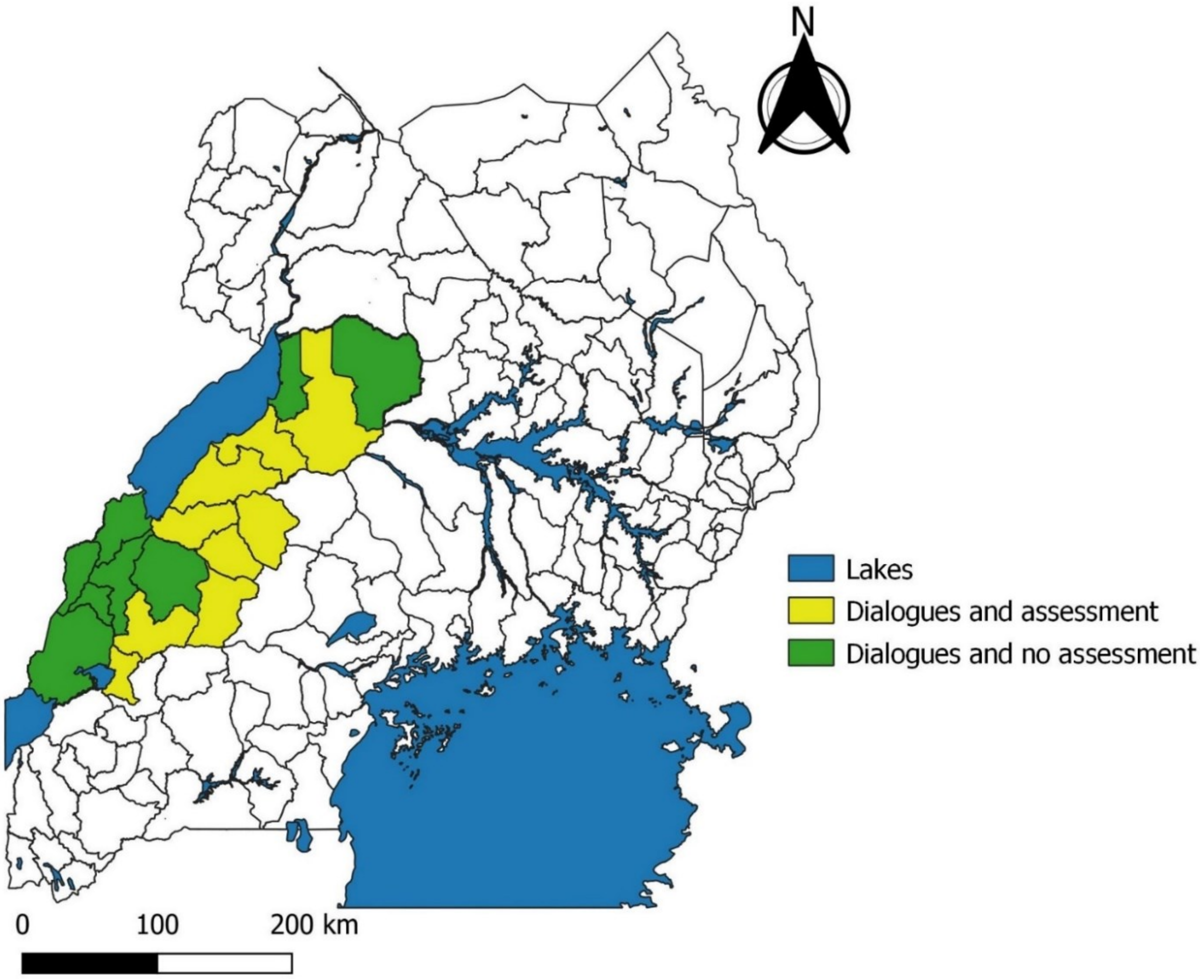

Figure 1: Districts of Western Uganda where community dialogue meetings on district leaders' willingness to receive the COVID-19 vaccine were conducted, May 2021

Study design

We conducted a pre-post evaluation study, through which we assessed district leaders' willingness to receive the COVID-19 vaccine before and after the community dialogue meetings conducted by Baylor Uganda in May 2021. Scripts were used to lead the dialogues, and the same topics were discussed at all meetings.

Community dialogue description

Community dialogue is a forum that brings together people from different sections of society and creates an opportunity for exchanging ideas, information, and perspectives, clarifying viewpoints, and developing solutions to issues of interest to society (14-16). District leaders were invited because it was demonstrated in several studies that they can play vital roles in supporting or opposing health service utilization through the mobilization of community members (17-19). Dialogue participants included political, technical, cultural, and religious leaders. The political leaders consisted of the District Local Council V (LC V) chairpersons, secretaries

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for health, councilors, and Resident District Commissioners (RDCs). Technical district leaders included Chief Administrative Officers (CAOs) and district heads of departments such as health, education, planning, production, works, administration, human resources, and finance. District religious leaders from all prevalent faiths in Uganda—including but not limited to Catholics, Anglicans, and Muslims—and cultural leaders were also invited.

One community dialogue meeting was held in each of the 17 districts, and 14–21 district leaders from each district participated in the meetings. The number of district leaders who participated in the dialogue meetings depended on their availability at the time of the meetings. A total of 268 district leaders from nine districts participated in the meetings and were invited to participate in the evaluation assessment (Figure 1). On average, each meeting lasted approximately four hours.

After arrival and registration, participants completed the pre-meeting assessment questionnaire, followed by opening prayers, self-introductions, brief remarks by Baylor Uganda staff, and opening remarks by District Health Officers (DHOs). Meetings were chaired by District Health Educators (DHEs) who made brief presentations on frequently asked questions about COVID-19 vaccines. Among the issues that the DHEs talked about were general COVID-19 information (what it is, signs and symptoms, who is at risk, how one can be protected from contracting it), the types and availability of different COVID-19 vaccines in circulation, how the vaccines work, how they were developed, and why they were developed in a short time.

The DHEs also talked about COVID-19 vaccines in Uganda—which type are given to Ugandans, why, who is eligible to receive those vaccines, and why they are eligible. Other topics included vaccine availability, administration, safety, effectiveness, common side effects, risks of serious reactions, and how to deal with them.

After their presentations, DHEs allowed participants to ask questions, raise points of concern, and answer each other from their different views of understanding. This was under the guidance of DHEs and other technical professionals, such as DHOs and Assistant DHOs, who were present in the meetings. After issues and concerns about the vaccines were discussed to every participant's satisfaction, DHEs summarized key messages and closed the meetings.

Closing activities included the development of an action plan on how each participant would disseminate the information they received from the meeting to the community to promote vaccine uptake. Each leader was invited to complete the same evaluation questionnaire that was administered at the beginning of the meeting.

Questionnaire

The self-administered questionnaire consisted of information on sociodemographic factors and willingness to receive a COVID-19 vaccine. For the five-point Likert scale questions, participants indicated 1 strongly disagree, 2 disagree, 3 neither disagree nor agree, 4 agree, or 5 strongly agree.

The assessment was performed based on three of the most prominent health behavior theory constructs—the health belief model (20), the theory of planned behavior (21), and the extended parallel process model (22). We used these theories to assess COVID-19 risk perception, vaccine concerns, perceived vaccine benefits, perceived vaccine access, and willingness to receive a COVID-19 vaccine.

Study variables

In the questionnaire, we asked about sociodemographic factors, including highest education level attained, presence of children younger than five years old at home, presence of elderly 60 years or older at home, and district of work. We asked four questions on willingness to receive a COVID-19 vaccine. We constructed a composite score by summing scores from the four questions.

Data analysis

We analyzed the data using STATA version 14.0. We described sociodemographic factors using frequencies and percentages. Likert scale data were ordinal and not normally distributed when tested for normality using the Shapiro–Wilk tests, so we used the non-parametric Wilcoxon signed-rank test to assess differences between pre- and post-dialogue scores for each question (23, 24).

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We used Wilcoxon's signed-rank test instead of the sign test because it has more statistical power (25). Wilcoxon's signed-rank test ranks the degree of change between the paired scores in addition to considering the degree of change measured by the sign test, providing more information for analysis (25).

To calculate the magnitude of the effect of the community dialogue meetings on willingness to receive the COVID-19 vaccines, we used Cliff's delta measure (Cliff's dominance measure), which is the accepted measure of effect size for the Wilcoxon signed-rank test (26, 27), to calculate the effect sizes (*r*) of the changes (28). It is obtained by subtracting the ratio of the negative rank-sum to the total rank-sum from that of the positive rank-sum to the total rank-sum (29, 30). The effect size ranges from 0 to 1, with 0 indicating that the groups are statistically equal and 1 implying that one group significantly dominates (29, 30). We graded the effect size as small effect (r=0.1-0.3), medium effect (r=0.4-0.5), and large effect (r=0.6-1.0) for both positive and negative changes (28).

As part of the analysis, we reported median frequencies, percentages, and first and third quartiles, which we used to calculate interquartile ranges (IQRs) for both pre- and post-meeting assessments. We defined significance as $p \leq 0.05$. We also performed logistic regression to assess whether COVID-19 vaccine willingness was associated with the presence of children younger than five years old or elderly persons 60 years or older at home.

Ethical considerations

This assessment was in response to a public health emergency. The Ministry of Health gave the directive and approval to evaluate the effect of the dialogue meetings on the leader's willingness and intention to receive COVID-19 vaccines. The Office of the Associate Director for Science, CDC/Uganda, also determined that this activity was not human subject research. Its primary intent was public health practice and epidemic disease control. Written informed consent was sought from the respondents. All respondents were informed that their participation was voluntary and that their refusal would not result in any negative consequences. To protect the confidentiality of the respondents, each was assigned a unique identifier.

Results

Final evaluation sample size

Among the 268 community dialogue meeting attendees, 164 (61%) filled out both pre- and post-meeting assessments. Forty-eight (18%) who had already been vaccinated and 56 (21%) who completed only the pre-meeting assessment due to time constraints were excluded from the analysis.

Sociodemographic characteristics of community dialogue participants

In total, 150 (92%) of the 164 district leaders who participated in the study had attained either a tertiary or university education; the rest had attained secondary or primary education. Most (118, 72%) were men. The districts with the highest numbers of participants were Kikube (21, 13%), Kibale (20, 12%), and Hoima (20, 12%); Kyegegwa had the fewest participants (14, 8.0%) (Table 1).

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Table 1: Sociodemographic characteristics of community dialogue participants, Western Uganda, May 2021 (N=164)

Variable	Frequency (n)	Percent (%)
Education		
Primary	2	1
Secondary	12	7
Tertiary/University	150	92
Having children <5 years old in the household		
No	56	34
Yes	108	66
Having elderly ≥60 years old in the household		
No	114	70
Yes	50	30
Sex		
Female	46	28
Male	118	72
A frontline worker during COVID-19 response*		
No	48	29
Yes	116	71
Districts		
Hoima	20	12
Kagadi	18	11
Kakumiro	16	10
Kamwenge	16	10
Kibaale	20	12
Kikuube	21	13
Kitagwenda	18	11
Kyegegwa	14	8
Masindi	21	13

*A frontline worker who worked during the COVID-19 response, e.g., a health worker and a COVID-19 district task force member

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Willingness to receive the COVID-19 vaccine
Before the meetings, 114 (70%) district leaders neither agreed nor disagreed (median: 3, IQR: 3,3) that they were willing to receive the COVID-19 vaccines. After the meetings, 158 (96%) leaders strongly agreed (median: 5; IQR: 5,5) that they were willing to receive the vaccine. This change was statistically significant (p<0.0005, r=0.995) (Table 2, Figure 2).

Table 2: Effect of community dialogue meetings on district leaders' willingness to receive the COVID-19 vaccine, Western Uganda, May 2021 (N=164)

Variable	Pre-dialogue assessment			Post-dialogue assessment			*p*-value	Effect Size (*r*)
	Median			Median				
	n	%	IQR	n	%	(IQR)		
Willingness to receive COVID-19 vaccines	**114**	**70**	**3 (3,3)**	**158**	**96**	**5 (5,5)**	**<0.0005***	**0.995**
I am thinking of getting the vaccine	107	65	3 (3,4)	158	96	5 (5,5)	<0.0005*	1.000
I am prepared to receive the vaccine	114	70	3 (3,3)	158	96	5 (5,5)	<0.001*	1.000
I will get vaccinated if a health worker offers me the vaccine	122	74	3 (3,3)	157	96	5 (5,5)	<0.0005*	0.993
I will get vaccinated for COVID-19	122	74	3 (3,3)	160	98	5 (5,5)	<0.0005*	0.996

Median IQR of 1=strongly disagree, 2=disagree, 3=neither disagree nor agree, 4=agree, or 5=strongly agree. * Significant association at p-value < 0.05

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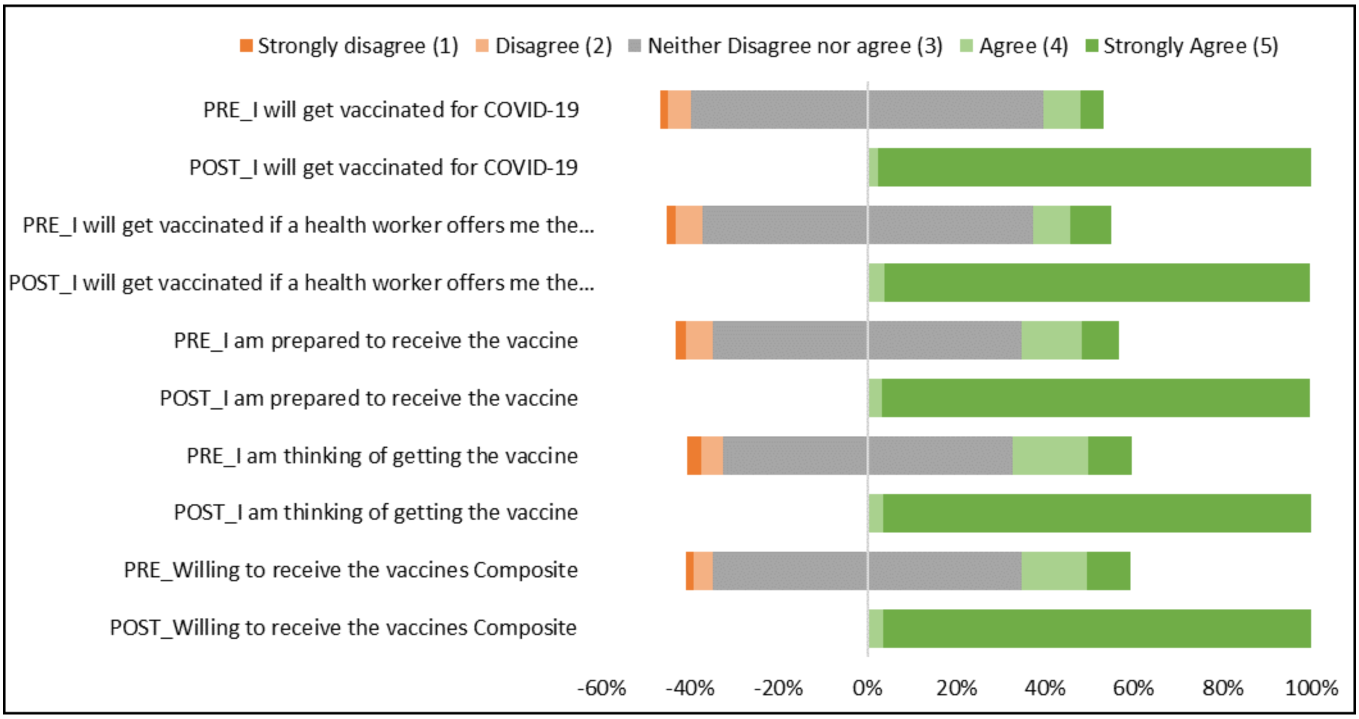

Figure 2: Summary of the effect of community dialogue meetings on district leaders' willingness to receive the COVID-19 vaccine, Western Uganda, May (N=164)

Discussion

Based on 164 district leaders completing pre- and post-meeting questionnaires, community dialogue meetings led to increased willingness and intention to receive COVID-19 vaccines. District leaders' willingness to receive the COVID-19 vaccines increased after the meetings as they were provided with information on the safety and side effects of the vaccines. Information dissemination, interactive discussion (individual questions and concerns being answered or addressed to the satisfaction of the participants), and the personal influence of trust in experts instead of mere risk communication materials led to the changes we observed in post-meeting assessments. The discursive nature of the meetings among the leaders themselves and between the leaders and facilitators might have led to an improvement in their willingness to receive the COVID-19 vaccines. It was shown that learning environments that provide learners with more understanding, richer and more realistic contexts, and dialogic dimensions can be persuasive and lead to eventual behavior change (31). As leaders learned more information, they asked more questions, which, when answered, might have led to improvement in their willingness to receive the vaccine. Our findings are in line with Bandura's argument that the type of learning environment and teaching method can improve the self-efficacy of individuals (32). Similar findings were also reported by Fenci and Scheel, who found that a question-and-answer format of learning can create a positive climate that engages participants, thereby leading to improved self-efficacy towards adopting a given behavior (33).

During these meetings, district medical experts supported the uptake of the vaccines and explained and answered the questions raised by the meeting participants to their satisfaction. Since these medical experts are trusted and have at times been involved in the treatment of the district leaders, this might have influenced the changes in willingness to receive the vaccine observed after the meetings. Findings from this study are consistent with findings from other stud-

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ies that showed that trust in experts improved acceptance of vaccines and reduced anti-vaccination sentiments and that effective policymaking depended on trust in the experts (34, 35).

The improvements in district leaders' willingness and intention to receive the COVID-19 vaccines may have been due to peer influence. If leaders influence each other, this implies that leaders will also be more likely than risk communication materials alone to influence other community members. Targeted community health education with the opportunity for discussion can be a vital tool to improve attitudes towards the COVID-19 vaccine. This is consistent with several studies that found community health education to be one of the most effective methods of increasing community willingness to receive vaccines (36-38).

Study limitations

Although we report changes in participants' willingness to receive the COVID-19 vaccines, we do not know if the theoretical changes eventually led to vaccine uptake. District leaders may have overreported their willingness to receive the COVID-19 vaccine after the meeting due to social desirability. Participants could provide proof of vaccination, but that is beyond the scope of the dialogues.

Conclusion

The 17 community leader dialogue meetings reported here led to district leaders' increased willingness to receive the COVID-19 vaccine. These improvements might influence public uptake of the COVID-19 vaccines if leaders get vaccinated and publicly share their vaccination status and what they learned during dialogue meetings. The information dissemination, interactive discussions, and the influence of trusted health experts may have led to the changes observed after the meetings. Broader use of such meetings with community leaders could reduce COVID-19 vaccine hesitancy and increase uptake. We recommend the broader use of such meetings to bring together health authorities and other community leaders as a way of reducing COVID-19 vaccine hesitancy and increasing uptake. Scaling up community dialogue meetings in the form of public town hall meetings to involve community members might also have the same effect.

Acknowledgements

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Trends and geospatial distribution of stillbirths in Uganda, 2014-2020

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Summary

Introduction: *Uganda is among the countries with the highest burden of stillbirths globally. In 2014, Uganda adopted the World Health Organization (WHO) Every Newborn Action Plan (ENAP), which targets <10 per 1,000 deliveries by 2035. Despite the burden of stillbirths in Uganda, little is known about the trends of burden since ENAP was introduced.* We assessed the distribution, temporal, and spatial trends of stillbirths, Uganda, 2014-2020, to guide control interventions.

Methods: *We obtained and analysed still births surveillance data from the District Health Information System, 2014–2020. A stillbirth was defined as death of a foetus >28 weeks of pregnancy or weighing >1000g before or during birth reported to health facility. We calculated annual incidence rates of stillbirths per 1,000 deliveries at district, regional, and national levels. We used logistic regression to determine significance of trends.*

Results: *The overall national annual incidence of stillbirths decreased from 24/1,000 deliveries in 2014 to 17/1,000 deliveries in 2020. During the same time period, reporting rates declined from 71% in 2014 to 46% in 2020. The central region continuously had the highest incidence rate for the past 5 years despite the largest decline (OR=0.79; CI=0.77-0.83, P<0.001) while the eastern region had the smallest decline (OR=0.59; CI=0.57-0.61, P<0.001). Districts with persistently high annual incidence rates of stillbirths (>30/1000) included Mubende, Kalangala, Hoima, and Nebbi. There was no difference in the reporting rates of the most- vs least-affected districts.*

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Conclusion: Even with suboptimal reporting, the incidence of stillbirths remained far above the national target. Specific areas in the country appear to have particularly high stillbirth rates. We recommend continuous capacity building in managing pregnant women with emphasis on the most affected districts, and investigation into the reasons for low reporting.

Background

Still birth is when a baby dies after 28 weeks of pregnancy, or more than 1000g but before or during birth. Still births are classified into macerated or fresh still births depending on when they occur [1]. Macerated still birth is the intrauterine death of a foetus before the onset of labour where the foetus has showed degenerative changes while fresh stillbirth is the intrauterine death of a foetus during labour or delivery [1]. With quality health care throughout pregnancy and childbirth, most stillbirths are preventable; over 40 percent are fresh still births and can be avoided with improved quality of care during childbirth including routine monitoring and timely access to emergency obstetric care when required [1].

Still births are a growing public health concern. The United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME) released its first-ever global stillbirth estimates in 2020, which revealed that the ratio of the number of stillbirths to number of under-five deaths has increased from 0.77 in 2000 to 0.82 in 2019, globally [2]. The global estimate of still births is 2 million babies yearly, with three out of 4 stillbirths occurring in Sub-Saharan Africa (SSA) or Southern Asia[2]. In SSA, stillbirth rate stands at 21.7 per 1,000 total births. Stillbirths are often underreported, so it is possible that even these numbers are underestimated [1, 3, 4].

In low- and middle-income settings, maternal conditions associated with stillbirth include hypertension, diabetes, maternal infection (e.g. syphilis, malaria, HIV), maternal undernutrition, obesity, and smoking [6].- Other factors which significantly contribute to stillbirths include: foetal asphyxia, trauma, prolonged labour, congenital infections and foetal distress [7, 8].

With quality health care throughout pregnancy and childbirth, most stillbirths are preventable. In Uganda, the rate of stillbirths in 2015 was 21/1,000 live births. Also, a study in a hospital in the North showed the stillbirth rate at 20 deaths per 1000 deliveries [9]. Government of Uganda has ensured that there are health facilities within every 5km radius to help mothers easily access healthcare [10], it has also provided free antenatal care services where mama-kits are distributed to help mother and their unborn babies during delivery [11]. Public health facilities also provide folic acid and iron supplementation, prevention of malaria through providing intermittent preventive treatment and distribution of treated mosquito nets, and improved detection and management of syphilis to pregnant women to improve on pregnancy outcomes [12, 13].

In 2014, the World Health Organisation developed an action plan to prevent stillbirths. This plan, called the Every Newborn Action Plan (ENAP), was adopted by Uganda and targets a reduction in stillbirth rates to <10 per 1000 total births by 2035 [14, 15]. The plan involves supporting government leadership and providing guidance on how to strengthen newborn health components in existing health sector plans and strategies, especially those that relate to reproductive, maternal, and child health. However, there are few data on stillbirth rates in Uganda. Therefore, we assessed the distribution, temporal, and spatial trends of stillbirths in Uganda, 2014-2020, to guide control interventions.

Methods

Study setting

We conducted a countrywide study. Uganda is found in East Africa. The population of the country was approximately 47 million people in 2021 and has a fertility rate of 4.7 births per woman in 2020 [16]. Uganda is divided into health administrative regions which are further subdivided into health sub-districts geographically. The health service delivery is

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organised in levels from the lowest; Health Centre (HCI), HCII, HCIII, HCIV, general hospital, regional referral hospital, and national referral hospital which is the highest.

Study design and data source
We conducted a descriptive analysis of still-births surveillance data reported through the electronic District Health Information System (DHIS2), a computer-based national health information system. According to the DHIS2, a stillbirth is the death of a foetus weighing >1000g or >28 weeks of pregnancy, either before or during birth. Data on stillbirths is routinely generated at registered health facilities (all public health facilities plus most private health facilities), aggregated at district level, and then forwarded to the national database. This data is then utilized by authorised Ministry of Health officials and other stakeholders for analysis to obtain meaningful information.

Study variables and data analysis
We abstracted data using pivot tables in DHIS2 on still-births as well as total deliveries in the health facilities from January 2014 to December 2020. We obtained data on fresh still births, macerated stillbirths, and total deliveries. The data from DHIS2 was downloaded, merged and summarized in Microsoft Excel sheets.

Data on fresh and macerated stillbirths was summed to obtain the total still births. We calculated incidence rates for still births by country and disaggregated by region, district, and year. We calculated the annual incidence rates by dividing the total number of still-births by the total deliveries in health facilities, multiplied by 1,000 in Uganda between 2014 and 2020. We obtained a mean annual incidence rate by summing the annual incidence rate divided by seven. The incidence rates were presented on a trend line graph. Total still-births were disintegrated into Fresh stillbirths (FSB) and Macerated stillbirths (MSB). We calculated the proportion of fresh still births out of the total stillbirths. Incidence rate of FSB was equal to number of FSB divided by total deliveries, multiplied by 1000 while incidence rate of MSB was equal to number of MSB divided by total deliveries, multiplied by 1000. The reporting rates were automatically generated by the DHIS2.

We then imported data into Epi info version 7 to do logistics regression analysis so as to determine the significance of the trends. We drew choropleth maps using Quantum Geographic Information System (QGIS) to show the distribution of incidence rates of still-births at the national level in the different districts.

Ethical considerations
The Ministry of Health of Uganda through the office of the Director General Health Services gave approval to access data from the DHIS-2. We stored the abstracted data set in a password protected computer and only shared it with the investigation team. In addition, the office of the Associate Director for Science, U.S. Centers for Disease Control and Prevention, determined that this study was not a human subjects research with the primary intent of improving use of data to guide public health planning and practice.

Results

Trend of annual incidence rate of still-births, Uganda, 2014-2020
The Incidence rate of still births per 1000 deliveries as recorded by health facilities in Uganda from 2014 to 2020 showed a decline. The mean annual incidence rate over the years was 20 still births per 1000 deliveries. The highest annual incidence over the seven years was recorded in 2014, while the lowest was in 2020. The incidence reduced from 24 stillbirths in 2014, to 20 stillbirths in 2015, and then increased to 22 still births in 2016. The following years of 2017-2020 had an annual decline in stillbirths from 21 to 17 per 1000 deliveries **(Figure 1).** The reporting rates ranged from 71% to 74% for the period 2014 to 2019; then had a steep decline to 46% in 2020.

The incidence of stillbirths decreased by 6.9% from 2014 to 2020 and the decreasing trend was statistically significant. (OR=0.69; CI=0.67 – 0.70, P<0.001).

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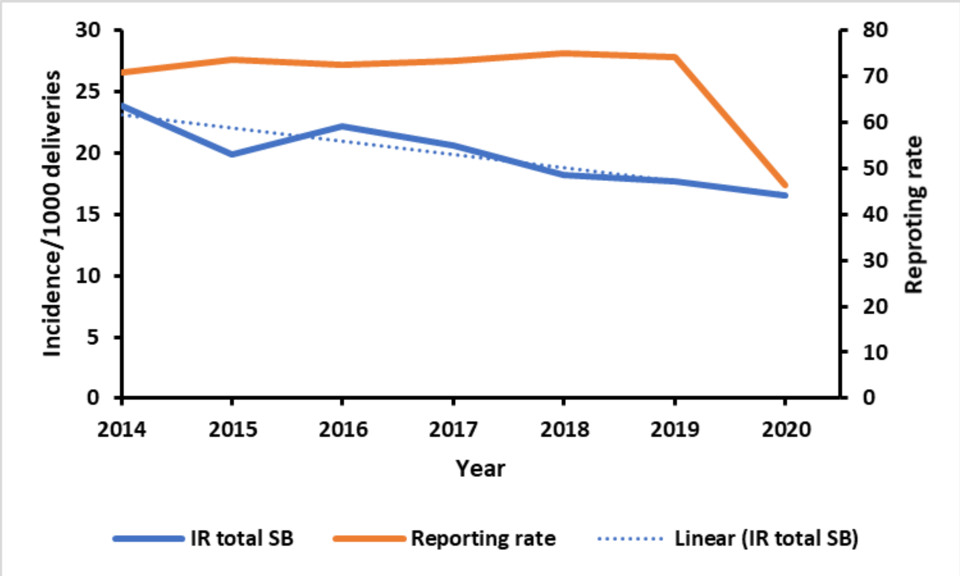

Figure 1: Trend of annual incidence of stillbirths per 1,000 total deliveries, Uganda, 2014-2020

Over the study period, the incidence rate of fresh stillbirths was slightly more than that of macerated stillbirths. In 2014, the incidence of FSB appeared much higher than that of MSB and over the following years the difference narrowed down **(Figure 2).**

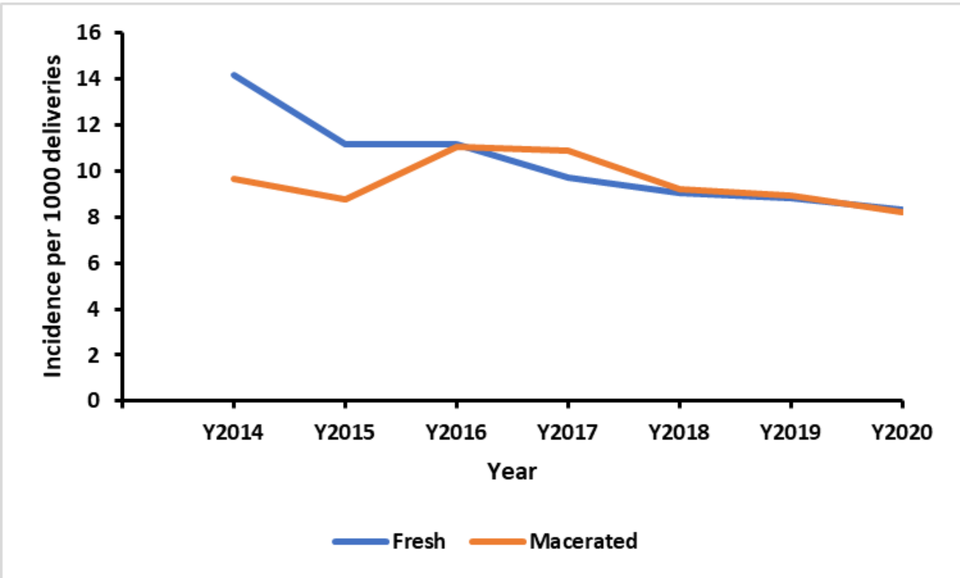

Figure 2: Incidences of fresh and macerated stillbirths in Uganda, 2014-2020

Temporal trends of still-births incidence, regional level, Uganda, 2014-2020

We observed a statistically significant decrease in the incidence rates of still-births per 1,000 deliveries in all the regions of Uganda **(Figure 3 and Table 1)**. Between 2014 and 2020, the central

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and western regions registered the highest mean annual incidence rate of 22 still-births per 1,000 deliveries while Northern and Eastern regions registered the lowest mean incidence rate of 18 per 1,000 deliveries**.** The central region had a steep decline in incidence in 2015 and then a rise in 2016, this was followed with a shallow decline in the subsequent years until 2020 **(Figure 3).**

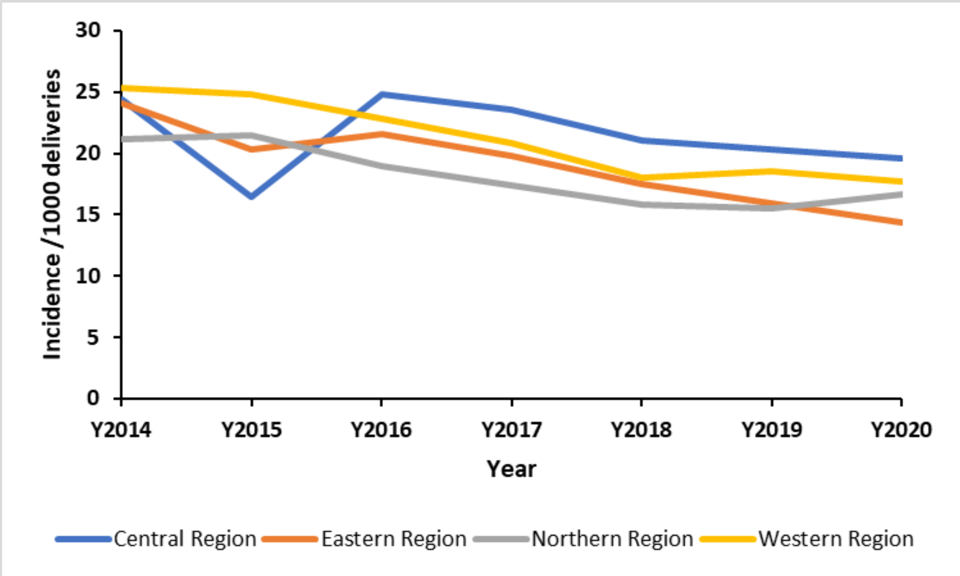

Figure 3: incidence rate of stillbirths, regional level, 2014-2020

Table 1: Significance of the trends of incidence of still-births, regional level, Uganda, 2017-2020

Region	Odds Ratio	95% CI	P-Value
Central Region 2014/2020	0.79	0.77 - 0.83	<0.001
Eastern Region 2014/2020	0.59	0.57 - 0.61	<0.001
Northern Region 2014/2020	0.78	0.75 - 0.81	<0.001
Western region 2014/2020	0.69	0.66 - 0.72	<0.001

Distribution of still-births incidence, district level, Uganda, 2014-2020

Most of the districts in Uganda had an incidence above the target -10 stillbirths per 1000 deliveries. Generally, there was a minimal decrease in the distribution of stillbirths from 2014 to 2020. About 20 districts registered over 30 stillbirths per 1000 deliveries in 2014 and 2015, this number reduced in 2016. In 2017, about 10 districts had over 30 stillbirths per 1000 deliveries. There were less than 10 districts with over 30 stillbirths in 2019 and 2020. The districts with persistently high incidence of >30 still births per 1000 deliveries included: Mubende, Kalangala, Hoima, and Nebbi

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(**Figure 4**).

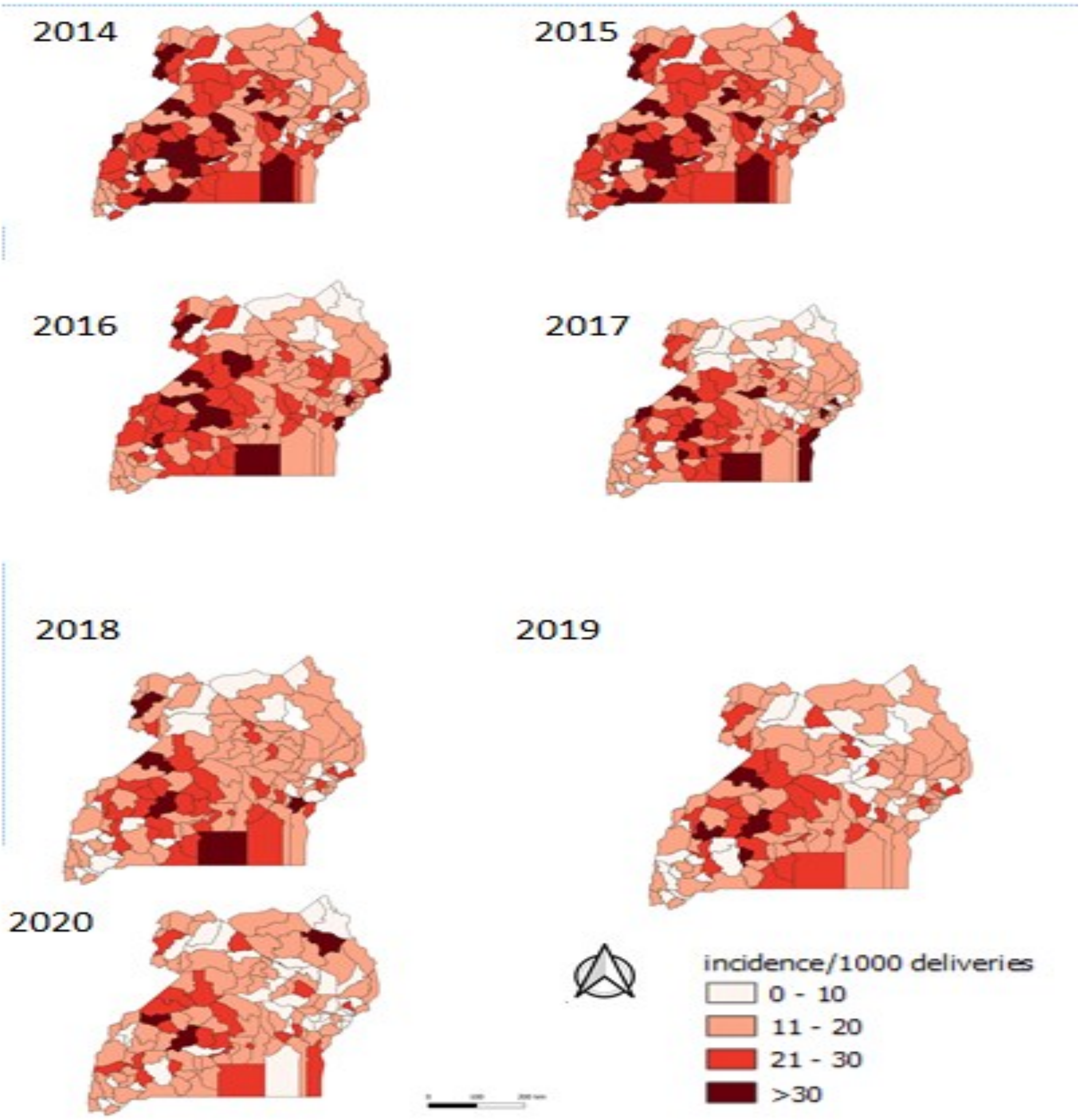

Figure 4: Still-births incidence by districts, Uganda, 2014-2020

Discussion

We assessed the distribution, temporal, and spatial trends of stillbirths in Uganda, 2014-2020. The highest annual incidence over the seven years was recorded in 2014, while the lowest was in 2020. Over the study period, the mean still birth rate was 20 still births per 1000 deliveries. Reporting on stillbirths was less than the target for the national target of 80% throughout the study period with 2020 being the worst year. There was a significant decrease in the incidence rate of stillbirths from 2014 to 2020 in Uganda at national and at regional level. This is similar to what has been recorded at the global level where there has been a reduction in stillbirth rate from 2000 to 2019, estimated at 2.3% despite the fact that still births are increasingly concentrated in Sub-

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Saharan Africa [17, 18].

The highest recorded incidence among the seven years happened in 2014. This is the year ENAP was initiated in Uganda. Through the ENAP initiative health workers across the country were trained in managing deliveries and danger signs of pregnant women. Some of the factors attributed to these deaths included: delay of the mother to seek help from a professional health worker, absence of critical human resource and equipment in health facilities. The causes of deaths included respiratory distress syndrome, birth asphyxia, prematurity and syphilis [19]. By 2019, countries such as South Sudan, Democratic Republic of Congo, Chad, Guinea, and Somalia had more than 25 still births per 1000 deliveries while Uganda had 18 stillbirths per 1000 deliveries[17]..

The incidence of fresh stillbirths was more than that of macerated still births. Similarly, a study in a peri-urban district in Ghana revealed higher fresh stillbirths which was associated with mothers with a parity of 1.6 ± 1.9 compared to mothers with macerated stillbirths who had a parity of 2.54 ± 2.7 [8]. Fresh stillbirths are associated with gaps in care during labor and at delivery while macerated stillbirths are often associated with insults in utero during the antenatal period [21, 22]. Key effective interventions to reduce stillbirths include basic and comprehensive emergency obstetric care. [12].

The rates of reporting on still births were below the target (80%) for each of the years and this affected the representation of the actual burden of still births. The year 2020 had the lowest recorded stillbirths with the lowest reporting rate. The low reporting rate shows that in 2020 the stillbirths could have been an under-estimate due to the challenges in maternal and child health services delivery caused by the response to the COVID 19 pandemic. This could be attributed to the restrictions of movement of people and vehicles which caused a decrease in services delivered to women as well as delays in seeking care [23-25].

Many stillbirths are potentially preventable and the most common cause is placental insufficiency, followed by maternal medical disorders, hypertensive conditions, and spontaneous preterm birth [26, 27].

Study limitations

We utilized secondary data, which is limited in terms of variables to compressively assess the stillbirth challenge in Uganda. The rate of reporting in the system was less than 80% for all years; this limited us from getting the full representation of the incidence of still births in Uganda. It is possible that, the estimates we are reporting are an under estimate.

Conclusion

Stillbirths incidence rate in Uganda still remains far above the national target for ENAP goals. Specific districts appear to have particularly high still birth rates over the study period. We recommend continuous capacity building in managing pregnant women with emphasis on the most affected districts, and investigation into the reasons for low reporting.

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