BMC Infectious Diseases

RESEARCH

Open Access

Implementation of an infection prevention and control response strategy to combat the Sudan Virus Disease outbreak in an urban setting, the Kampala Metropolitan area, Uganda, 2022

S. Judith Nanyondo[1*], Shillah Nakato[1], Janelle Franklin[8], Andrew Kwiringira[1], Marvin Malikisi[1], Maureen Kesande[1], Abdullah Wailagala[1], Rebecca Suubi[1], Dathan M. Byonanebye[1,4], Elizabeth Katwesigye[2], Paul Katongole[4], Juliet Kasule[6], Louis B. Bayo[10], Martin Kasendwa[10], Diriisa Musisi[6], Jennifer Hunter[8], Lisa P. Oakley[8], Cori Dennison[8], Linus Ndegwa[7], Lindsay K. Tompkins[8], Neil Gupta[8], Rony Bahatungire[2], Victoria Willet[9], Amy R. Kolwaite[8], Sarah Zalwango[3], Elizabeth Bancroft[8], Stacey Mearns[5] and Mohammed Lamorde[1,5]

Abstract

Background In October 2022, the Uganda Ministry of Health (MoH) confirmed the first case of a Sudan Virus Disease (SVD) outbreak in the Kampala Metropolitan area (KMA). A multicomponent infection prevention and control (IPC) strategy was implemented to control the spread of *Orthoebolavirus sudanense* (SUDV) in KMA. We describe the deployment of this strategy, its effect on IPC capacities, and the successful control of the SVD outbreak in KMA during the 2022 outbreak.

Methodology The multicomponent IPC strategy included (1) IPC pillar coordination: an IPC task force convened by government and health partner representatives and designated focal persons at the district level (2) Ring IPC: intense and targeted IPC support was developed to provide support to healthcare facilities (HCFs) and communities around each confirmed case, (3) IPC in HCFs: HCFs were assessed using a modified WHO SVD IPC scorecard rapid assessment tool that measured 15 IPC capacity domains, mentorship and IPC supplies were provided to HCFs with low scores on the rapid assessment.

Results A KMA task force was established, and 13 IPC Rings were activated; 790 HCFs were assessed for IPC readiness, and 2,235 healthcare workers (HCWs) were trained. The mean (± standard-deviation) IPC score was 59.2% (± 18.6%) at baseline and increased to 65.5% (± 14.7%) at follow-up after 2 weeks ($p < 0.001$) of support. The mean IPC scores at baseline were lowest for primary HCFs (57%) and private-for-profit HCFs (47.1%). Similar gaps were revealed across all

*Correspondence:
S. Judith Nanyondo
nsjudytah@gmail.com

Full list of author information is available at the end of the article

HCFs, with eight out of 15 (53.3%) IPC capacity areas assessed, resulting in scores < 50% at baseline. At follow-up, only four out of 15 (26.7%) capacity areas (26.7%) were below this threshold.

Conclusion The IPC strategy enhanced the IPC capacities at HCFs and could be adopted for future outbreaks. Leadership commitment and resource allocation to IPC during non-outbreak periods are critical for preparedness, rapid response, and access to safe care.

Keywords Infection prevention and control, Ring IPC, *Orthoebolavirus sudanense*, Sudan Virus Disease, Ebola, Outbreak response, Uganda

Background

On September 20, 2022, Uganda's Ministry of Health (MoH) declared an Sudan Virus Disease (SVD) outbreak caused by the *Orthoebolavirus sudanense* (SUDV), after a case was confirmed at Mubende Regional Referral Hospital in rural central Uganda [1, 2]. Consequently, the outbreak spread to eight additional districts in western and central Uganda (Fig. 1). The outbreak was characterized by two waves, in September 2022 and October 2022. Overall, there were 142 confirmed cases, and 55 confirmed deaths reported nationally, of which 19 cases and seven deaths were reported among healthcare workers (HCW). The MoH declared an end to the outbreak in January 2023 [3]. This was the eighth SVD outbreak recorded in Africa and the fifth in Uganda; other outbreaks of SVD in Uganda occurred in 2000, 2011, and two in 2012 [4]. The most severe outbreak was in 2000, with 425 recorded cases and 224 deaths [4]. During the 2022 SVD outbreak, the overall case-fatality ratio (CFR) was 39%, lower than the 41–100% CFR reported in previous SVD outbreaks [3, 5].

On October 21, 2022, the MoH confirmed the first case of SVD in the Kampala Metropolitan Region (KMA) after a person with confirmed SVD traveled from Mubende to the KMA, approximately 150 km. The MoH classified the KMA as a high-risk region that needed enhanced readiness [6] due to the potential risk of outbreak amplification, high number of healthcare facilities, high mobility, high population density of over 6 million people, and high levels of movement in and out of the area since it hosts the capital city [7]. By the end of the outbreak, 21 cases had been confirmed in KMA with 2 primary cases, 19 secondary cases, and 3 deaths.

Uganda's healthcare system consists of a referral system with tertiary facilities providing highly specialized services, and the low-level facilities providing primary care services (Appendix 1). Patients often receive referrals (including self-referrals) from other districts to KMA for health care, unlike in KMA. At the time of the outbreak, Uganda's health system faced challenges that could have contributed to the outbreak. The National IPC program in Uganda was not yet fully developed, thereby posing significant risks to an already fragile health workforce [8–10]. The IPC program was not institutionalized, or fully implemented, at all levels to ensure the implementation of IPC best practices. Gaps in IPC systems included outdated national guidelines, no standard IPC curriculum, and no IPC indicators for monitoring progress and the effectiveness of national interventions [11]. Additionally, the country had experienced a protracted COVID-19 pandemic that caused exhaustion among HCWs. The country was also experiencing a simultaneous malaria outbreak [12] and has a high prevalence of other diseases. Initial signs and symptoms of these diseases resemble those of the SVD, thereby potentially contributing to a delay in the identification of SVD in patients with early symptoms.

Following confirmation of the outbreak in the KMA, the MoH, supported by partners, developed, and implemented a multi-pillar national IPC strategy to interrupt SUDV transmission, protect HCWs, and ensure the continuity of essential health services. Components of this strategy were also implemented in the epicenter, Mubende andwere adopted from what was done in West Africa and DRC as guided by the technical experts that supported the response. We describe the deployment of this strategy, its effect on IPC capacities, and the successful control of the SVD outbreak in KMA during the 2022 outbreak.

Methods of the IPC response strategy

The strategy consisted of six pillars: (1) IPC pillar coordination, (2) IPC in non-Ebola treatment HCFs, (3) Ring IPC, (4) IPC in Ebola treatment units (ETUs), isolation units and quarantine sites, (5) IPC in the community, and (6) Cross-pillar IPC support. We selected three of the six pillars of the multimodal strategy to describe and evaluate in this paper: IPC pillar coordination, IPC in HCFs, and Ring IPC as these pillars most directly engage non-Ebola HCFs in building their overall outbreak response capacities and performance compared to the other pillars. ETUs were not included in this paper as these are separate, dedicated facilities that are set up and managed by other partners and utilize different assessment tools for capacity enhancement. Additionally, even within IPC in HCFs, pharmacies were not included since these were handled by another partner.

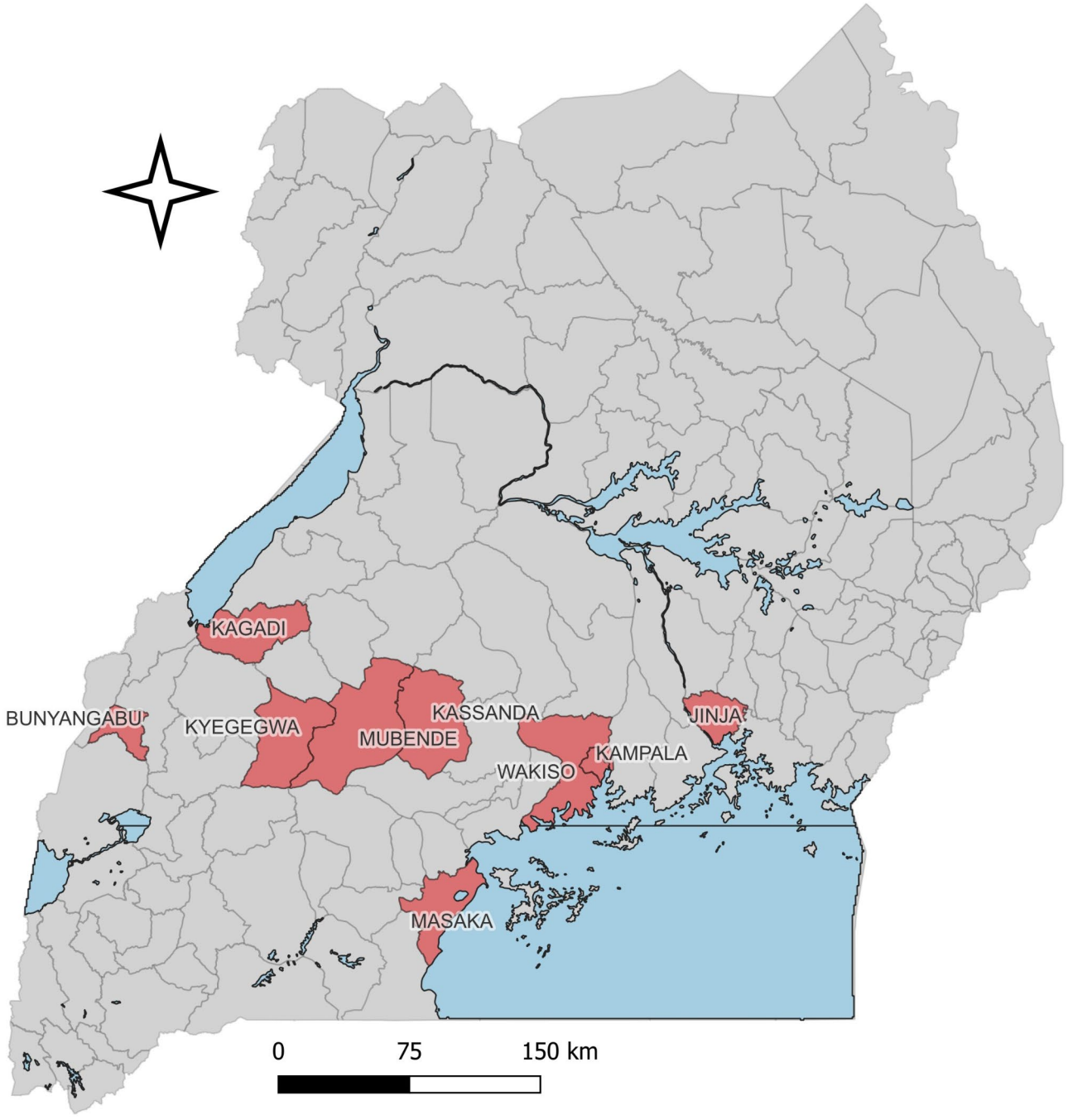

Fig. 1 Eight Districts in Uganda that reported Sudan Virus Disease (SVD) outbreak, 2022

IPC pillar coordination

A KMA IPC response task force was established within the KMA response structure. The task force was composed of local government representatives with both local and international partners including, but not limited to, the Infectious Diseases Institute of Uganda (IDI), World Health Organization (WHO), U.S. Centers for Disease Control and Prevention (CDC), United States Agency for International Development (USAID), FHI 360, Samaritan's Purse and UNICEF.These partners were all allocated different tasks based on the response plan for better coordination and to avoid duplication. The task force was chaired by the Kampala City Council Authority (KCCA) IPC focal person and co-chaired by partners. Other members of the KMA task force included an IPC duty officer designated to coordinate partners and a KMA logistics person responsible for informing the supply chain and the distribution of IPC supplies.

For structural implementation at the district level, each of the three districts in KMA had a designated district IPC focal person. Additionally, for Kampala, each of the five divisions had a designated division IPC focal person. These IPC focal persons worked collaboratively with IPC specialists at IDI or WHO. The task force served as a coordination body to facilitate the planning and implementation of IPC activities, provide IPC guidance, standardize training and implementation tools, and establish mechanisms for resource mobilization and allocation. Communication channels were established and included regular meetings, email updates, and a task force social media platform (WhatsApp group). Daily catch-up meetings were held to monitor progress, allocate tasks, present updates on the key activities undertaken, and share plans for the next day. Meetings were also used to share knowledge, allocate or reallocate resources, manage supply chains, and address shortages. In addition, the challenges and issues experienced by different partners were also discussed to provide solutions.

IPC in HCFs (non-ETUs)

This pillar focused on HCFs without Ebola treatment units (ETUs) (non-ETU HCFs). It aimed to ensure that all non-ETU HCFs had functional screening and holding areas, in-patient surveillance, and notification and referral processes for suspected SUDV. A basic IPC minimum capacity guide was developed and used for implementation at the various levels of HCFs (Appendix 2). A multimodal approach was used to reach all facilities: (1) Weekly webinars were held to rapidly sensitize HCWs with a target of reaching all HCWs. The sessions were facilitated by experts from the MoH and health partners, including IDI. Time was dedicated to respond to participants' questions and to allow them to share their best practices;. (2) The webinars were complemented by the distribution of information, education, and communication (IEC) materials and standard operating procedures (SOPs) with partner support. These were put up in facilities, distributed on WhatsApp platforms, sent by email, and posted on the National MoH website for easy access; and (3) A package of IPC interventions was promoted for prioritized HCFs, which included training the facility IPC focal persons, conducting facility IPC assessments, delivering IPC supplies, onsite mentorship, and in-person supportive supervision. The HCFs initially prioritized included those with the highest volume of public and private facilities in KMA and smaller facilities along the Kampala-Mubende Road, as they were thought to be the most likely to see new SVD patients.

Training materials were adapted from previous outbreaks in Uganda, the Democratic Republic of the Congo (DRC), and West Africa, and these were approved by the MoH as national training materials to be used by all partners. The trainings were scheduled for two days, including one day for didactic learning and another for practical sessions. The topics covered included: an introduction to Ebola and Sudan Virus, personal protective equipment (PPE), sharps safety, hand hygiene, waste management, cleaning and disinfection, screening, isolation, notification, Ring IPC, and an overview of the IPC scorecard rapid assessment tool and mentoring. Participants were given pre-and post-tests to assess their learning and comprehension of the material. The training first targeted the IPC focal persons from the prioritized facilities. The IPC focal persons of the prioritized HCFs were required to implement the basic minimum package (Appendix 2).

An IPC scorecard rapid assessment tool (Appendix 3) was developed to assess IPC readiness, identify gaps, and develop action plans. The tool was adapted from a WHO EVD IPC scorecard rapid assessment [13] and addressed 15 capacity areas that included: leadership in EVD outbreaks, screening capacity, isolation capacity, staff training, hand hygiene, availability of PPE, injection safety, environmental cleaning and disinfection, decontamination of medical equipment, in-patient surveillance and case management, HCW post-exposure management, bed occupancy, hygiene and sanitation, water supply and storage, and waste segregation and waste elimination. The scorecard had a total of 52 indicators. The assessment tool was made available online via the Open Data Kit ODK [14] and was accessible via smartphones to the trained IPC focal persons for real-time data entry. Data could also be collected offline and then automatically uploaded to a secure database at the MoH for analysis. External assessments were performed whenever possible with partner support. When an external assessment was not feasible internal assessments were performed upon training of aseessors on proper assessment performance and the online ODK tool.

Initial facility visits included facility leadership engagement, conducting a baseline IPC assessment, onsite modular training of HCWs on IPC using the IPC training materials, setting up screening and isolation areas, and distribution of relevant supplies, especially non-contact thermometers. The trained IPC focal persons from the prioritized HCFs were tasked to perform a baseline assessment at their own facility and, if they scored above 70% on the training post-test, they were facilitated with a transport refund and tasked to perform the assessment on nearby facilities. After the initial assessment, they were then required to support the HCFs in developing an action plan to address the identified IPC gaps and to continue to visit the HCFs as improvements were being made. Action plans would change depending on the results of the most recent assessments, which reflected immediate gaps. The district and division focal persons,

alongside a WHO or IDI IPC officer, were then tasked to provide oversight of the facility-level activities for the prioritized facilities. After the initial assessment, follow-up assessments were initially planned to be conducted based on the baseline assessment score, specifically daily for HCFs that scored below 50%, two or three times a week for HCFs with scores between 50 and 74%, and once a week for HCFs that scored 75% or higher. However, the initial assessment across all HCFs revealed similar gaps (e.g., screening, triage, staff training, PPE, isolation capacity), and a decision was made by the task force to pause follow-up assessments and instead focus human resources on addressing the gaps before conducting follow-up assessments.

For scale-up of each facility's capacity to recognize and isolate a patient with SVD, we initially targeted two critical areas: (1) screening and establishment of isolation areas near all the entrances at all HCFs, including ensuring IPC supplies such as hand hygiene stations and PPE were procured and distributed to each area and (2) in-patient surveillance in HCFs with in-patient services. Supportive supervision visits by the District or Division focal persons and partners were conducted to follow up on implementation actions. However, due to resource constraints, IPC supplies were only provided to public HCFs, and facility mentorship was not consistently conducted across HCFs due to a strain on the trained human resources available during the active response phase.

Ring IPC

This pillar focused on intensive IPC activities in HCFs and/or communities approximately 500m around where a confirmed case was diagnosed, lived, or had sought care within their infectious period. Following notification of a confirmed case and location by the district/division surveillance focal person, the district/division IPC focal persons would mobilize all necessary logistics through the designated logistics focal person. A trained team of at least seven people, including the district/division surveillance focal person, IPC focal person, risk communication focal person, two hygienists, IDI IPC officer, WHO IPC specialist, and personnel from any other partners as available, moved to the location of the confirmed case. An engagement meeting would first be held with the community leader where the facility/home of the confirmed case was located, and a perimeter of 500 m would be established. All HCFs, schools, homes, markets, and other potential hot spots were mapped within the perimeter and these mapped results informed subsequent Ring IPC activities. For a HCF where the confirmed case was identified or had sought care during their infectious period, decontamination was performed within 24 h (according to the MoH-approved SOP), HCWs were sensitized, supplies based on the SVD IPC kit (Appendix 4) were provided, as available, IPC assessments were conducted, and improvement plans were developed. For HCFs within the 500 m perimeter where no confirmed SVD patient was identified nor patients sought care during their infectious period, only HCW sensitization and IPC supplies were provided. For community locations not visited by an SVD-confirmed patient but within the perimeter, health promotion and sensitization were conducted. Ring activities were tracked using the Ring IPC action tracker.

Analysis of IPC scores at baseline and follow-up assessments

The scorecard had a total of 52 indicators, and the facility performance was measured as a percentage (total number of ''yes" responses over the total possible number of ''yes"). The IPC assessment scores were summarized as means (± standard deviations), while levels of HCFs were summarized as frequencies and percentages. To analyze the impact of the multi-pillar IPC response strategy on the IPC assessment scores, the paired t-test was used to compare the mean score at baseline versus follow-up assessment after 2 weeks, overall, as well as stratified by level and ownership of HCFs and IPC capacity areas. The assumption of normality for the paired t-test was assessed using the visual inspections (histograms) of the differences between baseline and follow-up scores, which indicated that the assumption was met. R software (version 4.0.3) was used for all analyses, and a two-sided p-value of 0.05 was considered as the threshold for statistical significance.

Results

IPC in HCFs

While support was provided by several partners, the results presented here describe the support provided by the IDI and US CDC where we had access to the data. Six webinars were held, each attended by approximately 200 people. MoH-approved IPC IEC materials and SOPs were distributed to 1,465 HCFs (675 in Kampala, 676 in Wakiso, and 114 in Mukono). Overall, 522 IPC facility focal persons were trained, and 2,235 HCWs were directly mentored. The mean score improved from 38.96 pre-test to 53.57 post-test ($p < 0.001$). However, the scores generated by automatic grading may underestimate or overestimate the actual level of knowledge. A validation process was implemented where a subset of responses was manually reviewed to verify the consistency and accuracy of the automated grading. From October 21 to December 9, 2022, 790 HCFs had both a baseline and follow-up assessment (two weeks after baseline); 417 were from Kampala District (52.8%), 214 were from Wakiso District (27.1%), and 159 from Mukono District (20.1%) (Table 1). The distribution of HCFs by level was

Table 1 Key response and infection prevention and control (IPC) indicators from the Sudan Virus Disease outbreak in the Kampala Metropolitan area by district, Uganda, 2022

Indicator	Overall, *N*	Kampala, *n*	Wakiso, *n*	Mukono, *n*
SVD cases and deaths				
Cases	21	18	3	0
Deaths	2	0	0	0
IPC response indicators				
HCFs that received IPC IEC materials and SOPs distributed	1,465	675	676	114
IPC focal persons trained	522	287	134	101
HCWs mentored	2235	1328	517	390
HCFs assessed (baseline and last follow up)	790	417	214	159
HCFs that had an assessment scored > 80% at baseline	204	87	75	42
HCF that had an assessment scored > 80% at follow up	363	155	133	75
Ring IPC teams trained ready to respond	22	20	1	1
IPC Rings activated	13	11	2	0
HCFs supported during Ring IPC	61	59	2	0
Community locations supported during Ring IPC	11	6	5	0

Abbreviations: SVD, Sudan Virus Disease; IEC, information, education, and communication; SOPs, standard operating procedures; HCWs, healthcare workers; HCFs, healthcare facilities

Table 2 Mean infection prevention and control (IPC) assessment scores at baseline and follow-up assessment by level of health care facility, Kampala metropolitan area, Uganda, 2022

HCF Level (*n*)	Baseline Mean (SD)	Follow-up Mean (SD)	*p* value
Hospital (47)	67.2 (11.1)	76.8 (15.2)	0.144
HC IV (100)	62.6 (16.4)	74.5 (13.8)	< 0.001
HC III (264)	61.3 (19.1)	65.8 (16.4)	0.050
HC II (379)	57.4 (18.2)	64.9 (13.9)	< 0.001
All HCFs (790)	59.2 (18.6)	65.5 (14.7)	< 0.001

Abbreviations: SD, standard deviation; HCFs, healthcare facilities; HC, health center

as follows: The highest proportion of facility coverage was in health centers (HC) (39% of all HC II facilities visited, $n = 379$), followed by HC III facilities (27% of all HC III level facilities, $n = 264$). The majority (63%, 612/970) of the covered facilities were private for-profit, while 22% (213) were public.

Of the 790 HCFs with both a baseline and follow-up assessment, 204 HCFs (21%) scored > 80% in the baseline assessment, which increased to 363 (46%) on follow-up (Table 1). There was a significant increase ($p < 0.001$) in the overall mean IPC score from 59.2% (SD = 18.6%) at baseline to 65.5% (SD = 14.7%) at follow-up (Table 2). When stratifying mean IPC scores by level of health facility, the mean IPC scores at baseline were the lowest for HC IIs (57.4%, SD:18.2) and highest for hospitals (67.2%, SD:11.1). In the follow-up assessment, significant improvement from baseline was seen for HC IIs (mean scores increased to 64.9%, SD:13.9, $p < 0.001$) and HC IVs (from 62.6%, SD: 16.4 to 74.5%, SD: 13.8; $p < 0.001$; Table 2).

Table 3 Mean infection prevention and control (IPC) assessment scores of 790 healthcare facilities (HCFs) at baseline and follow-up by HCF ownership, Kampala metropolitan area, Uganda, 2022

HCF ownership	Baseline score Mean (SD*)	Follow up score Mean (SD*)	*p* value
Government	63.9 (13.3)	67.6 (14.9)	0.40
Private not for profit	47.1 (15.6)	65.9 (16.2)	< 0.001
Private-for-profit	58.2 (18.1)	74.1 (17.2)	< 0.001

* SD: Standard deviation

When stratifying mean IPC scores by HCF ownership, scores in government HCFs were higher than private HCFs (Table 3). However, there was significant improvement in mean scores at follow-up ($p < 0.001$), with private not-for-profit increasing to 65.9% (SD: 16.2) and private for-profit increasing to 74.1% (SD: 17.2).

At the baseline assessment, approximately half (8/15) of the IPC assessment capacity areas had scores less than 50% (Fig. 2). As shown in Fig. 2, the highest change was observed in IPC leadership, screening capacity, isolation capacity, and water supply while hand hygiene and PPE had the lowest change.

Ring IPC

Overall, 22 location-based Ring IPC teams were trained to readily support Ring IPC activities. During October 2022, 13 IPC Rings were activated for the 21 cases identified in KMA (some cases were identified within the same Rings). These 13 Rings implemented direct support within the Rings, across a total of 35 HCFs and 11 community locations, including homes and schools(Table 1). For 9 of the IPC Rings, cases were first identified within HCFs requiring decontamination. Seven of the 9 HCFs (78%) were decontaminated within 24 h of case confirmation. Of the 21 cases identified for which Rings were activated, 7 (or 33%) were among HCWs.

Discussion

We successfully developed and deployed a multi-pillar IPC response strategy in an urban setting. Overall, the implementation of the IPC response strategy led to improvement of the IPC assessment scores at supported HCFs, which demonstrates an improvement in knowledge. Compared to previously documented IPC strategies for Ebola outbreaks [15–17] that capitalized on classroom training or Ring IPC alone, which are not independently sufficient for controlling SVD outbreaks in

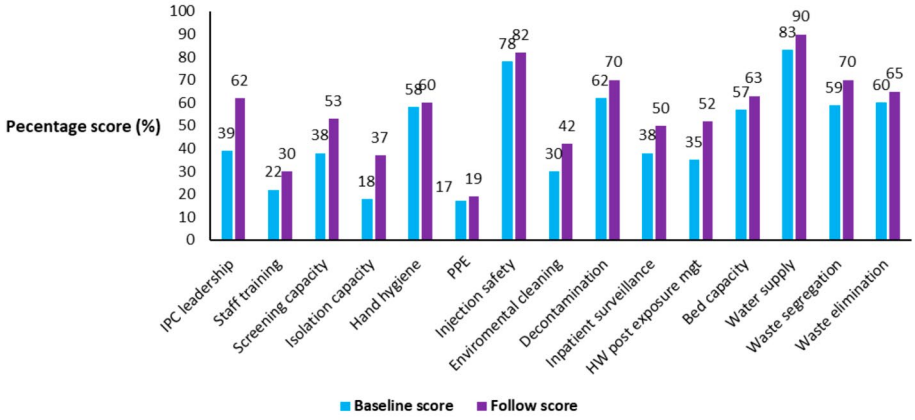

Fig. 2 Healthcare facility infection prevention and control (IPC) scorecard assessment results by capacity area at baseline and at follow up score, Kampala Metropolitan area Uganda, 2022

an urban setting, we deployed a multi-pillar strategy. The response was successfully deployed due to several reasons, including the coordinated and collaborative efforts of a strong partner coalition. Effective coordination helps to avoid fragmentation of assistance, reduce transaction costs, and lessen the administrative and reporting burden on countries [18]. Our IPC coordination strategy created a platform for accountability and timely follow-up of actions; similar benefits were observed in previous outbreaks in Uganda [19]. The IPC scores for HCFs in KMA improved significantly from baseline to follow-up. The WHO recommends the use of a multimodal strategy to improve IPC capacity through system change, training and education, reminders, and monitoring and feedback [20]. The multimodal approach (webinars, IEC materials, training for IPC focal persons in priority facilities, mentorship, and distribution of IPC supplies) utilized in this response greatly supported the scale up of the intervention. While there was a significant improvement in the scores, hand hygiene, environmental cleaning, and PPE showed minimal improvement. This could be explained by several parameters that could not be improved directly and rapidly without government interventions including procurement of PPE and IPC supplies, access to clean water, bed capacity, isolation capacity, and waste elimination. These IPC pillars are some of the cornerstones for effective IPC programs at healthcare facilities [13]. MoH and funding agencies should ensure resources are allocated to IPC, generally and not just during an outbreak, including the (1) consistent and adequate procurement of IPC supplies, e.g., PPE and environmental cleaning and hygiene supplies for HCW and patient safety, (2) sustain access to clean water at all HCFs, (3) provide suitable bed capacity at the HCF level, including isolation capacity, and (4) waste elimination mechanisms like incinerators. Furthermore, the low baseline IPC scores despite the national IPC mentorship program established during the COVID-19 response speaks to the need to develop strategies that can be maintained and institutionalized. It is critical for evidence-based IPC practices to be established and consistently maintained through adequate financial and material support in all HCFs prior to an outbreak, as this allows for quality and safe patient care and the prevention of outbreaks, as well as the rapid detection, response, and containment of infectious diseases of outbreak concern. Allocating sufficient resources to IPC initiatives only after the start of an outbreak results in insufficient IPC practices at healthcare facilities, delays in the control of outbreaks within and across countries, undue risk to HCWs, patients, and caregivers, and a reduction in the overall effectiveness of the response [23]. Minimum IPC core elements must be in place and always maintained, not just in the context of outbreaks, to ensure rapid and comprehensive response efforts and the safety of patients, healthcare workers and the community at large.

In Uganda, approximately 60–70% of the population initially seek health services from the private sector (including private health facilities, and pharmacies) and traditional healers [21] and the KMA is served by mostly private health facilities. However, even with this magnitude of private healthcare seeking, previous efforts to build capacity and provide infrastructure support in the previous disease outbreaks largely focused on public facilities, with an emphasis on the largest HCFs. Since private HCFs comprise the largest number of HCFs in KMA and have the lowest baseline scores, it is imperative to prioritize these HCFs by extending IPC training and using incentives or other regulatory approaches to improve IPC capacities across the spectrum of healthcare facilities regardless of public or private ownership. Additionally, outreach to traditional healers and pharmacies during non-emergency time is critical for relationship building so that they can be a strong source of

effective IPC communication during outbreaks. It would be beneficial for the Ugandan government to establish an inclusive approach to dialogue with the private sector and co-create a policy framework which includes the development of solutions to the challenges of managing outbreaks such as Ebola.

Furthermore, low baseline IPC scores for the lowest level facilities underscore the need to strengthen IPC readiness and response capacities in primary healthcare facilities, as has been emphasized previously [22]. The IPC strategies should, therefore, be adapted to the varying needs across different levels of health facilities, including lower-level HCFs because they serve primary care points for majority of the population [23]. Larger, high-volume HCFs should also remain a main focal point in IPC capacity building since a single case at these HCFs can expose a large patient and HCW population.

While significant improvements were made during the SVD outbreak response, particularly within Ring IPC activities, the outbreak was extremely complex, there were shortages of staff to support the response, and interventions required rapid intervention given the urban setting. It was, therefore, not feasible for all assessments conducted by the mentors to be validated by an external party.

Deployment of the Ring IPC strategy could have helped to interrupt transmission. Ring IPC is most appropriate at the beginning or near the end of an outbreak when specific chains of transmission and when HCFs can be identified [15]. To create a resilient health system that is prepared for future outbreaks, it is critical for governments to develop and institutionalize an IPC program across all levels of the healthcare system, including in private facilities. This program would facilitate the adoption and sustainability of IPC best practices, including prevention of healthcare-associated infections, and serve as a first line of defense against epidemics in the future. While we document the successful scale-up of the multi-pillar IPC response strategy, it is unclear whether this approach is cost-effective or if it can be generalized to other infectious disease outbreaks. We did not also evaluate the role of traditional healers, who are trusted care providers in the community and play a critical role in outbreak amplification. In addition, future research needs to be done to assess the feasibility of implementing this approach in different countries.

Conclusion

During the 2022 SVD outbreak in Uganda, the coordinated multi-pillar response strategy improved response IPC capacities in an urban setting. While these gains were notable, they require expansion to additional levels of the health system and ongoing leadership commitment. As most patients first present at primary public and private HCFs, these HCFs need to be provided due attention to ensure an infection control safety net is sustained across all levels of the health system. Additionally, the importance of leadership commitment to IPC at the national and HCF levels is critical to meaningfully improve and sustain facility and broader country preparedness for future outbreaks. This response strategy provides one path forward for an effective, multi-pillar strategy and could be adapted for use in future outbreaks of Ebola or other high-mortality, highly infectious diseases.

Abbreviations

CDC	US Centers for Disease Control and Prevention
ETU	Ebola treatment unit
FHI 360	Family Health International
HCF	Healthcare facility
HCW	Healthcare worker
IDI	Infectious Diseases Institute
IEC	Information, Education, and Communication
IPC	Infection Prevention and Control
KCCA	Kampala City Council Authority
KMA	Kampala Metropolitan area
MoH	Ministry of Health
PPE	Personal Protective Equipment
SOP	Standard Operating Procedures
SUDV	Orthoebolavirus sudanense
SVD	Sudan Virus Disease
UNICEF	United Nations Children"s Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12879-025-10720-0.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Acknowledgements

We acknowledge Healthcare workers who supported this response, all members of the KMA IPC task force, the Ministry of Health, Uganda, Kampala City Council Authority, Wakiso District Local Government, Mukono District Local Government, US Centers for Disease Control and Prevention, Infectious Diseases Institute, World Health Organization, United States Agency for International Development, FHI 360, UNICEF and Samaritan Purse.

Author contributions

JNS, SN, AW, MK, JK, LBB, MK, DM, JH, LPO, CD, LN, PK, YW, EK, LKT, NGN, JK, AK, RB, SM, EB, SZ, ML contributed to the conception, design, and preparation of the draft manuscript. JNS, AK, MM, and DB participated in the analysis, interpretation, and preparation of the manuscript. All authors read and approved the final manuscript.

Funding

This project was funded by the US Centers for Disease Control and Prevention through the Makerere University Infectious Disease Institute under grant number GH00045. No other funding was obtained for data analysis or the development of this manuscript.

Data availability

Data will be provided once requested.

Declarations

Ethical approval and consent to participate

Deployment of the public health emergency response strategy was approved by the Director General of Health Services as part of the Ebola Response plan. For the evaluation, aggregate data, devoid of unique identifiers, was used. The Data Protection and Privacy Act 2019 (https://ict.go.ug/wp-content/uploads/2019/03/Data-Protection-and-Privacy-Act-2019.pdf) Sect. 7(d) permits data to be collected and processed without obtaining a written informed consent if the data is to be collected and processed for medical purposes. The data presented in this study was collected by Ministry of Health as part of Sudan Ebola outbreak response. The data published in this study complies with all other provisions in the Uganda Data Protection and Privacy Act. Furthermore, the clearance of this work as non-research was obtained from the US CDC under clearance number NCEZID-IICP-9/26/23-260a3. Additionally, given that this work fell under a public health emergency response and was not research, consent was not obtained from public health professionals or patients to implement the strategy.

Consent for publication

Not applicable since an analysis of secondary data was done.

Disclaimer

The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

Competing interests

Funding to support the response activities was received from US CDC.

Author details

[1]Infectious Diseases Institute (IDI), College of Health Sciences, Makerere University, Kampala, Uganda
[2]Ministry of Health (MoH), Kampala, Uganda
[3]Kampala City Council Authority (KCCA), Kampala, Uganda
[4]School of Public Health, Makerere University, Kampala, Uganda
[5]Resolve to Save Lives, New York, USA
[6]US Centers for Disease Control and Prevention (CDC), Kampala, Uganda
[7]US Centers for Disease Control and Prevention (CDC), Nairobi, Kenya
[8]US Centers for Disease Control and Prevention (CDC), Atlanta, USA
[9]World Health Organization (WHO), Geneva, Switzerland
[10]Family Health International (FHI 360), Kampala, Uganda

Received: 13 September 2024 / Accepted: 26 February 2025
Published online: 06 March 2025

References

1. WHO WHO. World Health Organization. Ebola Disease caused by Sudan virus– Uganda. World Health Organisation. 2022 [Available from: https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON410.
2. WHO. Weekly Bulletin on outbreaks and other emergencies. week 39: 19–25 September 2022. 2022 [Available from: https://extranet.who.int/iris/restricted/bitstream/handle/10665/363303/OEW39-1925092022.pdf
3. WHO. World Health Organisation. Uganda declares end of Ebola disease outbreak 2023 [Available from: https://www.afro.who.int/countries/uganda/news/uganda-declares-end-ebola-disease-outbreak
4. Kozlov M. Ebola outbreak in Uganda: how worried are researchers. Nature. 2022;597.
5. Lefebvre A, Fiet C, Belpois-Duchamp C, Tiv M, Astruc K, Glélé LA. Case fatality rates of Ebola virus diseases: a meta-analysis of world health organization data. Méd Mal Infect. 2014;44(9):412–6.
6. MOH. National Ebola response plan. Ministry of Health, Uganda. 2022.
7. Sprecher A. Understanding the key to outbreak Control — Sudan virus disease in Uganda. N Engl J Med. 2022;387(26):2393–5.
8. Organization WH. Health worker Ebola infections in Guinea, Liberia and Sierra Leone: a preliminary report 21 May 2015. World Health Organization; 2015.
9. Wamala JF, Lukwago L, Malimbo M, Nguku P, Yoti Z, Musenero M, et al. Ebola hemorrhagic fever associated with novel virus strain, Uganda, 2007–2008. Emerg Infect Dis. 2010;16(7):1087.
10. Kinsman J. A time of fear: local, National, and international responses to a large Ebola outbreak in Uganda. Globalization Health. 2012;8:1–12.
11. WHO. World Health Organization. Joint External Evaluation of IHR Core Capacities of the Republic of Uganda. 2017. www.who.int/ihr/publications/WHO-WHE-CPI-REP-2017.49/en/ 2017 [.
12. Zalwango MG, Zalwango JF, Kadobera D, Bulage L, Nanziri C, Migisha R, et al. Evaluation of malaria outbreak detection methods, Uganda, 2022. Malar J. 2024;23(1):1–9.
13. Organization WH. Infection prevention and control assessment framework at the facility level. World Health Organization; 2018.
14. Hartung C, Lerer A, Anokwa Y, Tseng C, Brunette W, Borriello G, editors. Open data kit: tools to build information services for developing regions. Proceedings of the 4th ACM/IEEE international conference on information and communication technologies and development; 2010.
15. Nyenswah T, Massaquoi M, Gbanya MZ, Fallah M, Amegashie F, Kenta A, et al. Initiation of a ring approach to infection prevention and control at non-Ebola health care facilities—Liberia, January–February 2015. Morb Mortal Wkly Rep. 2015;64(18):505.
16. Keïta M, Camara AY, Traoré F, Camara ME, Kpanamou A, Camara S, et al. Impact of infection prevention and control training on health facilities during the Ebola virus disease outbreak in Guinea. BMC Public Health. 2018;18:1–7.
17. Oji MO, Haile M, Baller A, Trembley N, Mahmoud N, Gasasira A et al. Implementing infection prevention and control capacity Building strategies within the context of Ebola outbreak in a Hard-to-Reach area of Liberia. Pan Afr Med J. 2018;31(1).
18. Olu OO, Lamunu M, Chimbaru A, Adegboyega A, Conteh I, Nsenga N, et al. Incident management systems are essential for effective coordination of large disease outbreaks: perspectives from the coordination of the Ebola outbreak response in Sierra Leone. Front Public Health. 2016;4:254.
19. Olu O, Usman A, Woldetsadik S, Chamla D, Walker O. Lessons learnt from coordinating emergency health response during humanitarian crises: a case study of implementation of the health cluster in Northern Uganda. Confl Health. 2015;9(1):1–9.
20. WHO. Evidence of hand hygiene as the Building block for infection prevention and control: an extract from the systematic literature reviews undertaken as the background for the WHO guidelines on core components of infection prevention and control programmes at the National and acute health care facility level. World Health Organization; 2017.
21. UBOS. The Uganda National household survey 2016/17. Uganda Burea of Statistics; 2017.
22. Frieden TR, Lee CT, Lamorde M, Nielsen M, McClelland A, Tangcharoensathien V. The road to achieving epidemic-ready primary health care. Lancet Public Health. 2023;8(5):e383–90.
23. Health Mo. Annual Health Sector Performance Report, Uganda 2016.

Publisher's note