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Marburg Virus Disease in Rwanda, 2024 – Public Health and Clinical Responses

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Abstract

Background: On September 27, 2024, Rwanda reported an outbreak of Marburg virus disease (MVD), after a cluster of viral hemorrhagic fever was detected at 2 urban hospitals.

Methods: We report key epidemiology, clinical manifestations, treatment, and overall response to the outbreak. We performed a retrospective epidemiologic and clinical analysis of data compiled across all pillars of the outbreak response. We conducted a case series analysis to characterize clinical features, disease progression, and outcomes of patients receiving supportive care and investigational therapeutics.

Results: Of 6,340 suspect cases tested, 66 laboratory confirmed cases of MVD were identified, of whom 51 (77%) were healthcare workers. The median (interquartile range) estimated incubation period was 10 (8-13) days, and symptom onset occurred a median of 2 (1-3) days prior to hospital admission. Epidemiologic investigations were highly suggestive of a zoonotic origin of the outbreak through identification of an index case exposed to Egyptian fruit bats at a mining site. The case fatality proportion was 22.7% (15 of 66). Remdesivir and the monoclonal antibody MBP091 were utilized under expanded access and clinical trial protocols. Additionally, 1,710 frontline workers and high-risk contacts received the ChAd3-MARV vaccine under emergency use authorization and a Phase 2 clinical trial.

Conclusions: Implementation of containment measures, advanced supportive care, and access to investigational countermeasures likely contributed to reduced MVD mortality. Enhancing surveillance, improving infection prevention and control in healthcare settings, and ensuring timely deployment of medical countermeasures are critical for mitigating the impact of future filovirus outbreaks.

The first outbreak of Marburg virus disease (MVD) reported in Rwanda was declared on September 27, 2024.[1] The outbreak was identified after a cluster of severe febrile illnesses occurred in the capital city of Kigali, home to 1.7 million inhabitants. Within 1 week, MVD affected over 20 healthcare workers at two tertiary care hospitals in Kigali. Government agencies and their partners promptly implemented comprehensive response measures, including establishment of a national MVD treatment unit, introduction of investigational therapies and vaccines, enhanced surveillance, contact tracing and public awareness campaigns.[2]

Marburg virus, a member of the family *Filoviridae*, which also includes the Ebola virus, was first discovered during an outbreak in 1967 that affected laboratory personnel in two European countries.[3,4] MVD is zoonotic infection transmitted to humans from fruit bats (*Rousettus aegyptiacus*), the natural reservoir.[5] Human-to-human transmission can occur through direct contact with bodily fluids of infected individuals.[6] MVD has an incubation period ranging from 2 to 21 days, though most reported cases have symptom onset between 5 and 10 days after exposure.[7] The clinical presentation variably includes fever, gastrointestinal symptoms, coagulopathy, and multi-organ failure.[8]

MVD outbreaks have historically originated from spillover events in remote areas before potentially spreading to populated regions.[9,10] Large outbreaks have occurred in the Democratic Republic of the Congo from 1998 to 2000 (154 cases, case fatality proportion (CFP) 93%),[11] and in Angola from 2004–2005 (252 cases, CFP 90%).[9] Uganda experienced multiple outbreaks between 2007 and 2017.[12]

Unlike previous MVD outbreaks, which occurred in remote settings, the 2024 Rwanda outbreak emerged in two large hospitals in the capital Kigali. This setting presented distinct challenges, including nosocomial transmission and healthcare workforce strain, but also enabled the deployment of advanced clinical interventions. In this report, we describe the epidemiology, clinical presentations, treatment strategies, and overall public health response to the outbreak.

METHODS

Study Design and Data Sources

To provide a comprehensive account of the outbreak, we conducted an integrated analysis using both prospectively and retrospectively collected data. These included epidemiologic surveillance, clinical case, and laboratory records. We characterized the outbreak's transmission dynamics over time and conducted a complete clinical case review of all laboratory-confirmed MVD cases.

Testing and treatment data were captured in the District Health Information System-2 (DHIS-2), the comprehensive public health database maintained by the Ministry of Health for collecting routine case-level data. Clinical data were documented in the electronic medical

records of hospitals where MVD patients received care, or in paper-based bedside charts at the National Treatment Center. From these sources, a team of physicians systematically extracted data elements for the case series analysis, which were linked by patient identifiers with MVD case records in the DHIS-2 system.

Laboratory Testing

Specimens from patients suspected of having MVD were tested for viral RNA at the Rwanda National Reference Laboratory (laboratory assays are described in the Supplementary Appendix). Whole-genome sequencing was performed on Marburg virus-positive specimens to characterize the outbreak lineage, assess genetic variation, and infer transmission dynamics, as described elsewhere.[13]

Data Management and Analysis

To ensure data accuracy and completeness, we implemented a standardized approach to case documentation, integrating manual abstraction from patient charts with automated data extraction from electronic health systems. Exploratory and descriptive analyses were conducted using R software (version 4.4.2; R Foundation for Statistical Computing) and Python (version 3.12.8; Python Software Foundation). The Rwanda National Ethics Committee provided the approval (No.121/RNEC/2024) for this work.

RESULTS

Outbreak Detection and Early Response

On September 25, clinicians at an academic, tertiary care hospital in Kigali (Hospital 1) notified officials at the Rwanda Biomedical Center of a cluster of severe febrile illnesses among patients admitted to the intensive care unit (ICU). The patients presented with rapidly progressive fever, headache and gastrointestinal symptoms, followed by multiple organ failure and death within 48 hours of admission. Within 2 days, numerous healthcare workers at Hospital 1 developed similar symptoms. Testing for viral hemorrhagic fevers was obtained for several clinical and post-mortem specimens at National Reference Laboratory. Positive results for Marburg virus via RT-PCR were confirmed and a coordinated national emergency response plan was activated on September 27. A National Treatment Center was established the same day in a temporary mobile hospital near Kigali. Patients were later transferred to a permanent facility on October 5, which included ICU capabilities and separate isolation areas.

Marburg virus RT-PCR testing was recommended for all patients presenting for care at any health facility in Rwanda who met the standardized case definition for Suspected Cases (**Table S1** in the Supplementary Appendix). Protocols for symptom screening, triage, and isolation of suspected cases were shared with all health facilities. Rapid response teams were deployed to assist local staff with key response actions, in accordance with World Health

Organization guidance.[14] Dedicated medical transport teams were established to transport patients to an isolation facility while awaiting their test result. Contact tracing efforts rapidly expanded, with 1,497 contacts identified and monitored, including family members, hospital staff, and other patients who had potential exposure.

Rwanda's Community Health Worker program[15] conducted systematic weekly screenings across all 30 districts, reaching 1,288,205 households and 4,793,212 individuals (37% of the population) to provide MVD information. Community Health Workers identified 24 suspect cases out of the contact list, all of whom tested negative by RT-PCR. Laboratory testing capacity was expanded on October 1 to include RT-PCR testing at 5 regional laboratory hubs, which were able to provide test results with a turnaround time of less than 12 hours. A national mortality surveillance system was established, mandating MVD testing for all community deaths during the outbreak. This effort resulted in screening of 240 decedents, all of whom tested negative, consistent with transmission remaining within identified chains.

Figure 1 illustrates the epidemic curve for the outbreak, showing the date of symptom onset for all laboratory confirmed cases, and the major milestones in the public health response. From September 27 until November 8, a total of 6,340 individuals were tested for Marburg virus, of whom 66 were confirmed positive, yielding an overall test positivity proportion of 1.0%. The majority of cases (75.8%) and deaths (80%) occurred within the first two weeks after the outbreak was reported (Figure S1 in the Supplementary Appendix). Of the 66 confirmed MVD cases, 51 (77.3%) occurred in healthcare workers.

Public Health Investigations

To determine the source of the outbreak, a team of clinicians and epidemiologists conducted a retrospective chart review of 120 patients admitted to the ICU at Hospital 1 between July 1 and September 25. This review began in the second week of the outbreak, after initial investigations of the first two identified cases (C000 and C001) found no evidence of direct zoonotic exposure or prior contact with symptomatic individuals. Investigators systematically reviewed records of ICU patients with temperature greater than 38°C and at least one additional feature suggestive of viral hemorrhagic fever.

The retrospective review identified one case highly suspicious for undiagnosed MVD: a 25-year-old female patient transferred to Hospital 1 on August 26 after undergoing a Cesarean delivery at a district hospital. She developed fever, bleeding, elevated transaminases, and thrombocytopenia after delivery, prompting transfer to Hospital 1 with presumptive diagnosis of HELLP syndrome. On arrival, she had acute kidney injury, coagulopathy, and respiratory distress. Despite resuscitation efforts, she died within 24 hours of ICU admission on August 27. Viral hemorrhagic fever was not considered as a diagnosis at the time of her death, and no specimens were retained for subsequent testing. Admission records revealed that the first patient with confirmed MVD (C000), a 37 year-man hospitalized for diabetic ketoacidosis, was admitted to the ICU bed adjacent to hers shortly after her death.

Epidemiological investigation linked the deceased woman to her husband, a 27-year-old miner working in a rural mining site with a tunnel inhabited by Egyptian fruit bats. The miner described experiencing an illness with fever, headache, and fatigue in early August 2024 but recovered without seeking medical care. He reported that his wife developed similar symptoms in mid-August shortly after delivery, and their infant also died of an unexplained febrile illness one week after birth. Serologic testing of the husband revealed a high-titer Marburg virus-specific IgG antibody (1:6400) with no detectable IgM, suggesting past infection. Investigators concluded that he was likely the primary case resulting from zoonotic spillover, with subsequent transmission to his wife and newborn. Case C000 was likely exposed to the virus via contaminated surfaces while receiving care in the ICU of Hospital 1.

Integration of contact tracing data with field investigations of probable pre-outbreak cases enabled a comprehensive characterization of transmission networks during the outbreak (**Figure 2**). Three prominent transmission clusters were identified. The first cluster involved patients and staff at Hospital 1 who were most likely exposed to Case C000 and/or Case 001, a health care aide who provided direct care to C000 during his illness. The second cluster emerged at Hospital 2, where Case 002—a physician involved in resuscitation attempts for C000—later worked in patient care areas, facilitating additional transmission. The third cluster primarily consisted of family members and other close contacts of Case C000, many of whom visited him in the hospital before the outbreak was recognized.

A single case identified on October 24 (C064) was not linked to any of the three clusters. This patient, a miner who worked in the same tunnel as the index case, was suspected to represent a second direct zoonotic spillover event, but confirmation by viral sequencing was precluded by a high RT-PCR cycle threshold (Ct). Serologic testing of 137 miners who worked in the same tunnel identified 14 additional individuals with detectable Marburg virus-specific IgG antibodies, suggesting unrecognized spillover events and potential subclinical infections within the mining community.

Clinical Management of Confirmed MVD Cases

Among the 66 confirmed cases, the median age was 31.5 years, and 21 (31.8%) were female. The median (interquartile range) estimated incubation period was 10 (8-13) days, and symptom onset occurred a median of 2 (1-3) days prior to hospital admission. Fifteen patients died, a case fatality proportion (CFP) of 22.7%. Over 48% of patients with Ct value less than 25 (higher viral load) died, compared to 5% of patients with Ct greater than or equal to 25. Other demographic and clinical characteristics are shown in **Table 2**.

The most reported symptoms at presentation included fever (95.4%), fatigue (87.9%), and gastrointestinal symptoms such as nausea, vomiting, or diarrhea (81.8%). Hemorrhagic manifestations, such as epistaxis, gingival bleeding, or gastrointestinal hemorrhage, occurred in 42.4% of cases. Neurologic symptoms, such as confusion or altered mental status, were reported in 16.7% of cases. The full spectrum of clinical symptoms is detailed in **Table S2** of the Supplementary Appendix.

Baseline laboratory testing commonly showed elevation of hepatic enzymes, electrolyte disturbances, and thrombocytopenia, which typically worsened during the course of hospitalization. Approximately one-third of patients had serum aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels greater than three times the normal upper limits, and nearly 70% of cases developed this level of transaminitis during hospitalization. Hyponatremia (88%), hypokalemia (39%), and hypoglycemia (30%) were the most frequently observed electrolyte disturbances. Additional laboratory findings are summarized in **Table S3** of the Supplementary Appendix.

Supportive care included resuscitation with crystalloid fluids and close monitoring of volume status. Patients with hemorrhagic complications received transfusions of packed red blood cells platelets and fresh frozen plasma. Empiric broad-spectrum antibiotics and antifungal therapy were administered in cases of suspected secondary bacterial or fungal infections.

Clinical management of cases incorporated two investigational therapeutics: Remdesivir, a nucleotide analog prodrug that inhibits viral RNA polymerase, and MBP091, a monoclonal antibody targeting the Marburg virus glycoprotein. Given the absence of approved antiviral treatments for MVD, these therapies were obtained through emergency procurement from international sources and deployed under an expanded access protocol approved by the Rwanda National Ethics Committee and the Rwanda Food and Drug Authority. IRB approvals were expedited, allowing Remdesivir administration to begin on September 30, and MBP091 infusions to commence on October 5. Written informed consent was obtained from all patients who received an investigational treatment.

Remdesivir was administered intravenously to 52 patients, including all critically ill individuals requiring supplemental oxygen or organ support. Rwanda also provided remdesivir as post exposure prophylaxis (PEP) for over 150 healthcare workers. MBP091 was given to 10 patients: 6 received MBP091 under the expanded access protocol and 4 received it after enrolling in a randomized clinical trial coordinated by the World Health Organization.[16] No immediate drug-related adverse events were identified for either therapy. A description of patient outcomes stratified by clinical characteristics and treatment exposures is provided in **Table 3.**

Nine patients developed respiratory failure necessitating intubation and mechanical ventilation, primarily due to acute lung injury, refractory shock, or progressive metabolic acidosis. Two of nine intubated patients were successfully extubated and discharged, while the remaining 7 died. Hemodialysis was initiated in two patients with severe acute kidney injury and multiorgan failure, both of whom died. A summary of clinical complications encountered during the management of hospitalized patients and interventions received is provided in **Table S3** of the Supplementary Appendix.

Vaccination in the Outbreak Response

While no vaccines for MVD have been licensed, several candidates are in clinical development and have been prioritized by the World Health Organization for emergency deployment in outbreak settings. When the outbreak was declared, the Government of Rwanda rapidly mobilized efforts to introduce the ChAd3-MARV vaccine developed by the Sabin Vaccine Institute (SVI), which had demonstrated a safety profile in Phase 1 trials.[17] In coordination with U.S. Biomedical Advanced Research and Development Authority (BARDA) and the Coalition for Epidemic Preparedness Innovations (CEPI), 700 doses were shipped to Rwanda on October 5, 2024. Concurrently, Rwanda FDA and the Rwanda National Ethics Committee expedited regulatory approvals, authorizing emergency use on October 2 and October 7, respectively. The first frontline healthcare worker provided informed consent and received the vaccine on October 10, just 13 days after the outbreak was declared.

By the end of October 2024, a total of 1,710 high-risk contacts were vaccinated, with administration prioritized for healthcare workers, burial teams, and laboratory personnel. In addition to emergency deployment, Rwanda initiated a Phase 2 clinical trial to assess safety and immunogenicity under a modified WHO Solidarity CORE protocol, adapting the study design to optimize protection of critical healthcare personnel.[18] The first patient was enrolled on October 15, and no serious vaccine-related adverse events were reported during the emergency rollout.

Outbreak Containment

Following the rapid implementation of multi-sectoral, comprehensive response activities, the outbreak trajectory shifted by the third week of response (**Figure S1** of the Supplementary Appendix). An outpatient clinic dedicated to monitoring and psychosocial support for recovered patients opened on October 23. The final patient was discharged from the treatment center on November 11, 2024. On December 20, no new confirmed cases had been reported for over two incubation periods, signaling that transmission had been successfully interrupted, and the outbreak was declared over.

DISCUSSION

This MVD outbreak in Rwanda represents the first documented occurrence of the virus in the country and emergence in a densely populated urban setting. Unlike past MVD outbreaks, which have been marked by high case fatality and delayed detection in remote regions, this outbreak saw the rapid initiation of a multi-sectoral response, likely contributing to a lower CFP (22.7%). Although direct comparisons across outbreaks are limited by differences in surveillance, healthcare capacity, and diagnostic access, this experience underscores the potential impact of early case identification, aggressive supportive care, and access to investigational treatments in mitigating MVD mortality.

In this outbreak, nosocomial transmission accounted for 77% of cases, underscoring the need to strengthen infection prevention and control measures in VHF-endemic healthcare settings,

especially during resuscitation of critically ill patients. A unique challenge in this setting was that many of the affected healthcare workers were caring for critically ill colleagues, often under stressful conditions.[19,20] Studies of previous filovirus outbreaks suggest that familiarity with infected patients, high emotional burden, and emergency clinical interventions may contribute to lapses in infection prevention and control measures.[21] Improved capacity for testing and earlier consideration of MVD in the differential diagnosis of severe febrile illness are also necessary, particularly in high-risk regions where VHF may initially present unrecognized and mimic other endemic febrile illnesses such as malaria.

While access to advanced supportive care contributed to improved survival in this cohort, investigational treatments may have also played a role. Formal efficacy assessment of these interventions is not possible outside of a clinical trial. Among those treated with remdesivir (n=52), 3 (5.8%) died, compared to 12 of 14 (85.7%) who did not receive it. For MBP091, 2 of 10 (10%) patients died, while 13 of 56 (23.2%) untreated died. As neither treatment was given in a randomized fashion, other factors may be contributing to the lower mortality observed. This outbreak further demonstrated that organ support interventions, including dialysis and vasopressor therapy, can be administered safely for filovirus infections with proper infection prevention and control measures in place, and should be standard of care in future outbreaks.

The deployment of the ChAd3-MARV vaccine within 13 days of outbreak declaration, alongside a concurrent Phase 2 clinical trial, demonstrates that investigational vaccines can be integrated into outbreak response. Although vaccine impact on transmission was not directly assessed, the prioritization of frontline workers for emergency vaccination under an adapted WHO Solidarity CORE protocol provides an important model for future filovirus outbreaks.

The multisectoral public health investigation and response employed during the Rwanda MVD outbreak highlights the importance of One Health approach to strengthening future pandemic preparedness, prevention, and response activities.[22] Integrating surveillance systems, supported with genomic analysis, can strengthen capacity for the earlier detection of MVD among humans, animals, and the environment.[13]

Averting high mortality in future filovirus outbreaks will require faster recognition of viral hemorrhagic fevers through a multidisciplinary One Health approach, strengthening infection prevention and control measures to prevent nosocomial spread, timely supportive and intensive care, and psychosocial support for patients, families and staff. Further, sustainable investments in clinical trial infrastructure and vaccine stockpiling will be essential to ensuring that investigational countermeasures can be deployed swiftly when outbreaks emerge. These efforts will be critical to reducing morbidity and mortality from future filovirus outbreaks and strengthening global health security against emerging pathogens.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

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Figure Legends

Figure 1. Timeline of MVD cases by date of symptom onset and key response activities

Figure 2. Transmission clusters linked to probable index case*

* “Index” = Probable index case exposed to Egyptian fruit bats at a mining site;

** “Contact” = Household contact (spouse) of probable index case, representing first probable MVD case admitted to Hospital 1.

TABLES

Table 1: Demographic characteristics and test results of MVD suspect cases

Characteristic	Demographic characteristics	Marburg Virus Positivity rate	
		Negative	Positive
	N	N (%)	N (%)
Overall	6340	6,274 (98.96%)	66 (1.04%)
Age			
<10 years	386 (6.3%)	385 (99.7%)	1 (0.3%)
10-19 years	776 (13%)	775 (99.9%)	1 (0.1%)
20-29 years	1,890 (31%)	1,870 (98.9%)	20 (1.1%)
30-39 years	1,444 (23%)	1,414 (97.9%)	30 (2.1%)
40-49 years	828 (13%)	817 (98.7%)	11 (1.3%)
50+ years	835 (14%)	832 (99.6%)	3 (0.4%)
Sex			
Female	2,931 (47%)	2,910 (99.3%)	21 (0.7%)
Male	3,304 (53%)	3,259 (98.6%)	45 (1.4%)
Patient occupation			
Health care worker	246 (7.1%)	196 (79.7%)	50 (20.3%)
Non health care worker	3,234 (93%)	3,218 (99.5%)	16 (0.5%)
Province			
Eastern Province	657 (11%)	656 (99.8%)	1 (0.2%)
Kigali City	4,018 (65%)	3,960 (98.6%)	58 (1.4%)
Northern Province	545 (8.8%)	545 (100%)	0 (0%)
Southern Province	533 (8.6%)	527 (98.9%)	6 (1.1%)
Western Province	415 (6.7%)	414 (99.8%)	1 (0.2%)
Week of outbreak			
Week 1 (23–29 Sept)	157 (2.5%)	130 (82.8%)	27 (17.2%)
Week 2 (30 Sept–6 Oct)	1,401 (22%)	1,376 (98.2%)	25 (1.8%)
Week 3 (7–13 Oct)	988 (16%)	979 (99.1%)	9 (0.9%)
Week 4 (14–21Oct)	949 (15%)	948 (99.9%)	1 (0.1%)
Week 5 (22–29 Oct)	709 (11%)	705 (99.4%)	4 (0.6%)
Week 6 (30 Oct–6 Nov)	1,383 (22%)	1,383 (100%)	0 (0%)
Week 7 (7–14 Nov)	604 (9.5%)	604 (100%)	0 (0%)
Week 8 (15–22 Nov)	147 (2.3%)	147 (100%)	0 (0%)

Table 2. Characteristics of patients with laboratory-confirmed MVD, by treatment outcome

		Outcome	
Characteristic	**Total**	**Recovered**	**Died**
Overall	66	51 (77.3%)	15 (22.7%)
Age			
Under 35 Yrs	40 (60.6%)	31 (77,5%)	9 (22.5%)
Above 35 Yrs	26 (39.4%)	20 (76.9%)	6 (23.1%)
Sex			
Female	21 (31.8%)	15 (71.4%)	6 (28.6%)
Male	45 (68.2%)	36 (80%)	9 (20%)
Hospitalization days			
< 7 days	27 (40.9%)	15 (55.6%)	12 (44.4%)
7+ days	39 (59.1%)	36 (92.3%)	3 (7.7%)
Patient occupation			
Healthcare worker	51 (77.3%)	40 (78.3%)	11(21.6%)
Non health care worker	15 (22.7%)	11(73.3%)	4 (26.7%)
Province			
Kigali City	57 (86.4%)	45 (78.9%)	12(21.1%)
Other Provinces	9 (13.6%)	6 (66.7%)	3 (33.3%)
Initial RT- PCR Ct value – Median (IQR)	25.8 (IQR)	26.5 (21.5 – 28.7)	19.4 (16.3 – 23)
Initial RT-PCR Ct value group			
< 25	27 (40.9%)	14 (51.8%)	13 (48.2%)
25+	39 (59.1%)	37 (94.9%)	2 (5.1%)
Days from first known contact to symptom onset – Median (IQR)	10 (8 – 13)	10 (7 – 12)	9 (7 – 11)
Days from symptom onset to hospital admission – Median (IQR)	2 (1 – 3)	1 (1 – 3)	3 (3 – 5)
Days from MVD diagnosis to first negative RT-PCR test – Median (IQR)		10.7 (7 – 13)	
Days from hospitalization to discharge for patients who recovered – Median (IQR)		12 (9 – 15)	
Days from hospitalization to death for patients who died – Median (IQR)			5 (3 – 6)

*Abbreviations: RT-PCR= reverse transcriptase polymerase chain reaction; Ct=cycle threshold; IQR=interquartile range,

Table 3. Complications and clinical interventions among patients hospitalized for MVD

	Recovered (N= 51)	Died (N=15)
	No. of patients (%)	
Complications		
Encephalopathy (N, %)	4 (7.8%)	11 (73.3%)
Hypoxia, SpO2 < 90% (N, %)	7 (13.7%)	13 (86.7%)
Hypercapnic respiratory failure (N, %)	2 (3.9%)	3 (20%)
Hypotension, SBP < 90 mmHg (N, %)	6 (11.8%)	10 (53.3%)
Acute kidney injury		
KDIGO Stage 1 (N, %)	7 (13.7%)	7 (46.7%)
KDIGO Stage 2 (N, %)	2 (3.9%)	7 (46.7%)
KDIGO Stage 3 (N, %)	1 (2%)	8 (53.3%)
Coinfections		
Malaria test requested	25 (49%)	9 (60%)
Malaria test reported positive	3 (12%)	1 (6.7%)
Bloodstream infection	12 (23.5%)	4 (26.7%)
Urinary tract infection	0 (0%)	0 (0%)
Hospital-acquired pneumonia	1 (2%)	1 (6.7%)
Radiographic findings		
Pulmonary infiltrate, lobar	1 (2%)	0 (0%)
Pulmonary infiltrate, multi-focal	2 (3.9%)	2 (13.3%)
Pleural effusion	2 (3.9%)	5 (33.3%)
Supportive care interventions		
Supplemental oxygen	7 (13.7%)	13 (86.7%)
Non-invasive ventilation	0 (0%)	1 (6.7%)
Endotracheal intubation	2 (3.9%)	7 (86.7%)
Central venous catheter placement	3 (5.9%)	4 (26.7%)
Intravenous fluid therapy	48 (94.1%)	13 (86.7%)
Urinary catheterization	6 (11.8%)	12 (80%)
Vasopressors	1 (2%)	4 (26.7%)
Hemodialysis	0 (0%)	2 (13.3%)
Antibiotics	41 (80.4%)	11 (73.3%)
Antimalarials	3 (5.9%)	1 (6.7%)
Packed Red Blood Cells transfusion	3 (5.9%)	3 (20%)
Platelets transfusion	3 (5.9%)	3 (20%)
Fresh frozen plasma transfusion	2 (3.9%)	3 (20%)
Cryoprecipitate transfusion	1 (2%)	1 (6.7%)
Disease-specific treatments		
Remdesivir	49 (96.1%)	3 (20%)
MBP091	8 (15.7%)	2 (13.3%)

*Abbreviations: SpO2=Blood oxygen saturation; KDIGO=Kidney Disease Improving Global Outcomes