ZNPHI
ZAMBIA NATIONAL
PUBLIC HEALTH INSTITUTE

THE HEALTH PRESS

Published by the Zambia National Public Health Institute | Quarter 1, 2025

IN THIS ISSUE

About the HEALTH PRESS

The Health Press is an open-access and peer-reviewed public health bulletin published by Zambia National Public Health Institute (ZNPHI). It was founded with the mission of offering a forum for the exchange and dissemination of health-related research and knowledge in Zambia and around the world. Its goals include spreading information on Zambia's public health security status and guide policy direction on health security in the country. The issue of the Health Press typically includes a research article, outbreak investigation, field notes and epidemiological bulletin. A new issue is published quarterly online and can be accessed at https://thp.znphi.co.zm/index.php/thehealthpress.

Publisher: Zambia National Public Health Institute
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Email: healthpress@znphi.co.zm
Website:https://thp.znphi.co.zm/index.php/thehealthpress

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ISSN: 2520-4378

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FOREWORD

Dear Readers,
I am pleased to present the first issue of Health Press Zambia for 2025.

In the first quarter of the year, Zambia faced two major public health threats cholera and Mpox both linked to cross border transmission. Cholera was first reported in Nakonde, a border town with Tanzania, followed by cases in Chililabombwe, bordering the Democratic Republic of Congo, with no direct epidemiological link. These incidents underscore the vulnerability of border communities and the critical need for strengthened regional collaboration in disease surveillance and response.

This issue features an editorial on the evolving state of health financing amid growing uncertainty around external support. It explores the potential impact of declining donor funding on public health security in Africa and emphasizes the urgency of domestic resource mobilization, regional solidarity, and the adoption of innovative financing mechanisms.

We also highlight two outbreak investigations on Mpox. The first involved an in transit truck driver identified as the index case. The second investigated Zambia's first reported Mpox related death, involving a 7 month old infant. These reports offer valuable insights into transmission dynamics and risk factors for an outbreak still affecting multiple countries across the continent.

Additionally, this issue presents two original research articles: one on the detection of Salivirus genotype A2 in wastewater for the first time in Zambia, and another assessing the management of public health emergencies in 2024 using the 7-1-7 performance framework. As we continue building a healthier and more resilient Zambia, I hope the evidence and insights shared here help inform public health action and reinforce national health security.

Prof. Roma Chilengi

Editor in Chief - Health Press Zambia

Director General - Zambia National Public Health Institute

SPEAK OUT

The State and Future of Health Financing amid Uncertainty in External Funding

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Cite this Article: *Nonde, S., Shempela, D.M and Chilengi, R. (2025). Speak out: The State and Future of Health Financing amid Uncertainty in External Funding. The Health Press 09(1): 3-6.*

The global health landscape is facing unprecedented uncertainty, particularly in external funding. As donor priorities shift and funding landscapes evolve, it's crucial for countries to reassess their health financing strategies and build resilient systems. For several decades, external funding and assistance have played a critical role in financing lifesaving health interventions across Africa, (and other distressed countries in the developing world) helping to avert millions of deaths. Since 1990, such support has contributed to a 50% reduction in under-five mortality, largely by improving access to vaccines and expanding immunization coverage. Additionally, foreign aid through initiatives like PEPFAR currently supports 20 million people living with HIV including over 500,000 children in 55 countries, most of them in Africa to receive life-saving antiretroviral treatment.[1]

However, recent shifts in the global health financing landscape threaten to reverse these gains. The United States Government's recent decision to withdraw from the World Health Organization, along with executive orders to review foreign aid spending will potentially reshape global health financing. As the world's leading donor, any significant reduction in U.S. external aid certainly will send shockwaves throughout the global health ecosystem.

It is important to note, however, that development assistance for global health was already on the decline even before the United States' executive orders. In recent years, official development aid to Africa has gradually decreased. Globally, health funding dropped from around $84 billion in 2021—driven largely by the COVID-19 response—to about $66.4 billion in 2023, only slightly above pre-pandemic levels. During the same period, while U.S. funding remained relatively stable, contributions from other countries fell sharply from $64.9 billion in 2021 to $44 billion in 2023 (See figures 1 and 2).[1]

The decline in external funding is expected to create significant gaps in health financing, placing already fragile health systems under immense strain. This financial downturn comes at a time when disease outbreaks are on the rise. Since 2022, the Africa CDC has recorded a 40% increase in public health emergencies on the continent.[2]

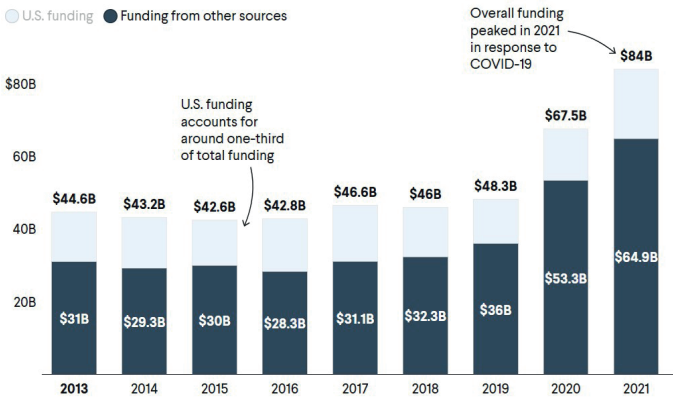

Figure 1 Total global health funding and funding from other countries except the United States from 2013 - 2023.[3]

Figure 2 Total global health funding against funding from the United States from 2013 - 2023.3

Within the same period, two Public Health Emergencies of International Concern (PHEICs) have been declared both linked to the high transmission of Mpox. The recent emergence of Marburg virus in East and Central Africa is raising concerns about the resurgence of viral hemorrhagic fevers. Africa's dependence on imported medical products such as drugs.2 Diagnostics and vaccines, is another major cause for concern. For instance, Africa manufactures less than 1% of the global vaccine stockpile yet consumes 12% of global vaccines. Africa's high dependence on imported health commodities, without corresponding domestic capacity or sustainable financing mechanisms, poses a significant vulnerability that must be urgently addressed.
Although the full extent of how disruptions to external funding will impact health systems remains uncertain, reductions in support for HIV programmes are expected to have devastating consequences, if left unaddressed. UNAIDS estimates that if PEPFAR were halted, an additional 6.3 million AIDS-related deaths could occur.1
Zambia, like many other countries, would experience a seismic shock to its health system if external funding were to decline significantly. The country remains heavily dependent on donor support. In 2022, both the Zambian government and external donors each accounted for 41.4% of total health expenditure. The remaining funding came from social health insurance (6.3%), out-of-pocket payments (9.7%), private health insurance (0.1%), and other NGO sources (1.1%).3

An opportunity to rethink health financing:

While the prospect of declining external support may seem daunting, it also presents an opportunity to rethink how we finance health and sustain public health security. Rather than viewing this as a setback, we can use it as a catalyst to build more resilient and sustainable health financing. To attain this, we must think of the adjustments needed to turn what only appears as a challenge into an opportunity. The following are key actions we can consider as we move a new path forward:

1. Leverage global and regional collaborations:

We must embrace multilateralism and partnerships, especially in the face of rising unilateral decision-making. Infectious diseases do not recognize national borders, and their health and economic impacts often spill over into neighbouring countries and regions. This makes cross-country collaboration and strong multilateral engagement not just beneficial, but essential. During the COVID-19 pandemic, multilateral agreements on vaccine access were instrumental in mitigating global disparities.4 One such forward-looking initiative is the proposed WHO Pandemic Agreement, which seeks to strengthen global preparedness and response to future pandemics of similar magnitude. The Pandemic Agreement will also prioritise sharing of information between countries including genomic sequencing of pathogen.4 Similarly, the Africa CDC is championing the establishment of the Africa Epidemics Fund a pooled resource to support emergency preparedness and rapid response. It is also proposing innovative mechanisms such as regional solidarity levies, including an airline tax, to mobilize additional funding.2 Countries across the continent should rally behind such initiatives; and indeed, pick up cues and domesticate some of the practical options. For example, a $50 additional levy of flights could result in $50 million when a million persons fly.

2. Prioritise high impact, evidence informed interventions:

Now more than ever, it is crucial that public health spending is guided by the best available evidence. This entails building local expertise in health financing to inform resource allocation and support difficult trade-off decisions when resources are limited. It also calls for strengthening and, where necessary, establishing health economics, research, and policy units that can bridge the gap between evidence and policymaking.[5] This should transcend across all levels. At point of implementation, officers should ensure programmes undertaken represent value to all stakeholders. This for Zambia must include reduction of unnecessary "workshop meetings", and reduction of travel to only essential trips.

3. Exploring new and innovative financing models:

It is abundantly clear that countries must increasingly tap into domestic resources to sustain and advance public health security, particularly in the wake of a steep decline in external support. Strengthening domestic commitment is vital to protect health systems from the unpredictability of international funding. While increasing government health expenditure is necessary, bridging the full gap left by diminishing donor support may not be immediately feasible. Government's commitment to serving external debt and other competing social services and programmes make this increasingly unlikely. Nonetheless, a country like Zambia whose fiscal imperatives are presently being re-aligned and gaining unprecedented traction with a promise of real economic gains, there are opportunities. Could a

proportion of the Constituency Development Fund be considered specifically to support health care for the elderly and poor? Can manufacturers of non-degradable waste such as plastic bottles and carry bags the clog the drainages causing strain on the sanitation be levied to contribute to control of resultant waterborne diseases? More direct levies on tobacco and alcoholic beverages could contribute to infrastructure and commodities for care of cancer and other chronic diseases. And indeed, gains expected from revamping the copper production, and we are on our way towards the target 3 million metric tons a year, could already be structured with a direct feed into health care.

In fact, according to the World Health Organization, debt remains a major constraint on healthcare spending in many countries.4 Thus, as Zambia works her way out of unsustainable debt through the restructured program, opportunities exist for health care improvement. Indeed, we must also shift our attention to new and innovative financing models, such as public-private partnerships and collaborations with philanthropic organizations. The goal should be to leverage the private sector's comparative advantages while attracting long-term investment in infrastructure development, local vaccine manufacturing, digital health, and enhanced logistics systems.

Let's work together to build a more sustainable and equitable health financing system, ensuring that everyone has access to quality healthcare, regardless of their circumstances.

References

1. Africa CDC. (2025) Africa's plan to fill health funding gaps amidst declining coffers.Available at: https://africacdc.org/news-item/africas-plan-to-fill-health-funding-gaps-amidst-declining-coffers/ (Accessed: 2 May 2025).

2. Ammar, W., Baggoley, C., Harvey, F., Haque, Y.A., Konyndyk, J., Jee, Y., Sow, S., Sy, E.A. and Tam, T., 2025. Finalising the WHO Pandemic Agreement for a safer future.The Lancet, 405(10487), pp.1339-1340.

3. Clinton Health Access Initiative (2025) Building local health financing expertise. Available at: https://www.clintonhealthaccess.org/research/local-health-workforce-global-health-funding-collapses/ (Accessed: 2 May 2025)

4. Human Rights Watch. (2025) New data exposes global healthcare funding inequalities: World Health Day a clarion call to improve public health funding. Available at: https://www.hrw.org/news/2025/04/10/new-data-exposes-global-healthcare-funding-inequalities (Accessed: 2 May 2025).

5. Krugman, A. (2025) A "Defining Moment" for Global Health Funding. Think Global Health. Available at: https://www.thinkglobalhealth.org/article/defining-moment-global-health-funding (Accessed: 2 May 2025).

RESEARCH ARTICLE

Molecular detection and Phylogenetic Characterisation of Salivirus genotype A2 in Wastewater from Zambia's Copperbelt and Eastern Provinces

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Cite this article: *Shempela, D.M., Sikalima, J., Muleya, W., Daka, V., Kasanga, A., Sandala, D., Chipango, C., Mutinta, C., Mudenda, S., Mkandawire, E., Siwila, J., Mwenda, M., Sinyange, N., Simulundu, E., Sichinga, K., Saasa, N., & Chilengi, R. (2025). Molecular detection and phylogenetic characterisation of Salivirus genotype A2 in wastewater from Zambia's Copperbelt and Eastern Provinces. Health Press, 09(1): 7-20.*

Abstract

Salivirus (SalV), a member of the Picornaviridae family, is a novel virus associated with acute gastroenteritis. In Zambia, its prevalence and genetic diversity remain uncharacterized. We analyzed 87 raw wastewater samples from 12 sites in the Copperbelt and Eastern Provinces using next-generation sequencing. SalV was detected in 43.7% of samples, with 42.1% yielding full-length open reading frames.

Phylogenetic analysis revealed that all sequences belonged to genotype A2, closely related to human-derived strains. SalV sequences from both provinces belonged to genotype A2, and were closely related to a previous strains detected in humans.

To our knowledge, this is the first report of Salivirus genotype A2 detection in raw wastewater in Zambia highlighting the need for environmental surveillance to monitor enteric pathogens.

Keywords: Salivirus, wastewater surveillance, phylogenetic analysis

Introduction

Salivirus, formerly klassevirus, (family Picornaviridae), was first detected in pediatric gastroenteritis samples in 2009 (1). The Picornaviridae comprises 12 genera of human and animal non-enveloped viruses including enterovirus, Aichivirus, Parechovirus, Cosavirus, and Saffold virus. The genus Salivirus (SalV) has a single species; Salivirus A that has 2 genotypes, Salivirus A1 and Salivirus A2 (2). Salivirus has a linear genome whose open reading frame encodes for three structural proteins (VP0, VP1, and VP3) (3). Since its first identification, SalV has been detected in river water, sewage (4), humans (5)and primates (3). SalV has also been detected in stool (6) or sewage (7) and respiratory (8) specimens. SaIV has beein implicated in cases of acute gastroenteritis (8,9).

In Africa, SalV has been reported in children in Tunisia and Nigeria (10). There is evidence suggesting that some cases of enteric infection may arise from unrecognized causative agents that may include SalV. The virus has been associated with instances of acute gastroenteritis (11) (2) (12) (13). Studies have not yet demonstrated the significance of Salivirus in altering the course of clinical disease, however, the continued association of SalV with clinical disease has raised concern about its role in these conditions (14).

Diarrhea is a common cause of morbidity and mortality in Zambia. There are many factors that affect the outcomes of diarrheal cases especially in children under

5 years. An understanding of the causative complex of organisms and environmental factors can significantly improve the outcome of cases. These factors include age, immunity, as well as co-infecting organisms (15). It is therefore important that as many factors at play are identified and appropriate measures taken. One such source of identifying co-infecting organisms is wastewater.

This abundance of many potential pathogens in wastewater necessitates the need to understand their public health significance. In this study, we investigated the presence of important SaIV in raw, untreated sewage influent on the Copperbelt and Eastern provinces of Zambia.

Methods

2.1 Sample collection and Viral Concentration

A total of 87 raw wastewater samples were collected from various sites in the Copperbelt (Ndola, Kitwe, Luanshya) and Eastern (Chipata) Province of Zambia (Fig. 1). Sampling was conducted at the same time of the day in all sites according to guidelines issued by the water utility companies. A composite-grab wastewater sample was collected at 15-30-minute intervals and aliquoted into sterile pre-set sampling bottles. Samples were assigned a unique ID with information such as sampling location, volume, temperature, pH, time and date, recorded for each sample. The samples were transported at 4°C in a mobile refrigerator to the laboratory for processing as previously described [17]. The Bag-mediated filtration system (BMFS) was used to concentrate the samples following collection while Skimmed milk flocculation and Polyethylene glycol (PEG)/Sodium chloride precipitation were used following transportation to the laboratory.

2.2 Total RNA Assay measurement and quantification

Viral RNA was extracted from concentrated samples using the MagMAX viral isolation kit (Applied Biosystems, Foster City, CA) on Kingfisher Flex 96 Deepwell magnetic particle processor (Thermo-Fisher Scientific, USA) according to manufacturer's instructions. Briefly, 200 µL of concentrated sample was mixed with 265 µL of lysis/binding solution, followed by addition of 20 µL of bead-mix. The mixture was incubated, supernatant discarded and the remaining beads washed twice with wash buffer. Samples were eluted in 50 µL of elution buffer and stored at -80 °C until further processing. RNA was quantified using Qubit fluorometer while RNA integrity was measured by the TapeStation 4200 with a High Sensitivity RNA Screen Tape (Agilent Technologies, Santa Clara, CA).

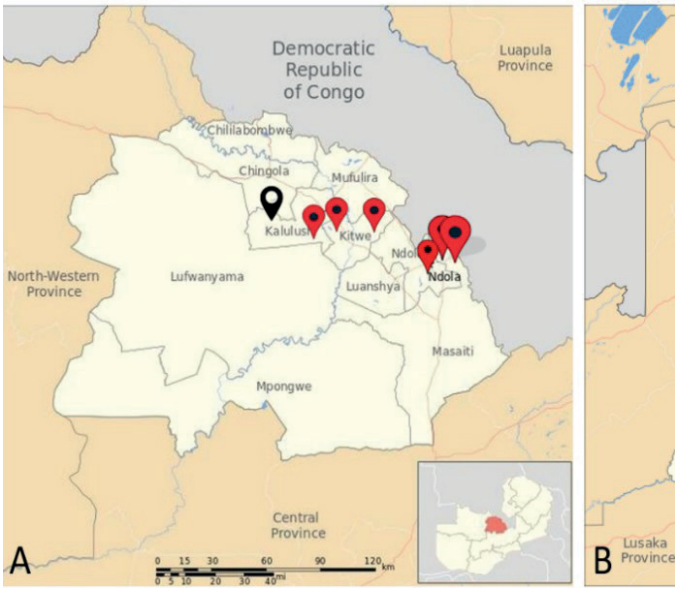

Figure 1. Map showing sampling sites for (A) Copperbelt and (B) Eastern Provinces of Zambia. The red pins with black circles represent eight sampling sites with nine and seven collections while the black pin with a light-yellow circle represent one site with one collection (16).

2.3. cDNA synthesis and Next-Generation Sequencing

cDNA synthesis and Library preparation were performed using the Respiratory Virus Oligo Panel v2 kit following the Illumina RNA Prep with Enrichment kits, which leverage bead-linked transposomes technology paired with fast enrichment (Illumina, San Diego, CA, USA). The automated Hamilton microlab 96 was used during sample processing and amplification was done on the ABI 7500 fast and the Quant studio 7. Synthesized DNA was quantified using a Qubit 4 fluorometer while DNA libraries were assessed on the TapeStation Agillant 4200. Library normalization was performed using the Qubit fluorometric quantification (ThermoFisher Scientific, Waltham, MA, USA). The starting concentration of 4nM pooled was prepared. For genomic sequencing, a 2nM pool (30µl) was used for loading in the Illumina NextSeq 2000 HT instrument through a P300 cycle cartridge loaded with a P2 flow cell. A customized version of the DRAGEN software was used for cluster generation using a pool of primer cocktail.

Sequence processing, assembly, and analysis for viral and variant detection was carried out using the customized DRAGEN Microbiology cloud-based analysis software. Generated Fast Q files were also analysed using a high computational local server (Linux) for in-house computation and verification.

2.4. Data analysis

Demographic data were entered into Microsoft Excel version 2016. The prevalence of Salivirus in wastewater was presented as proportions. The sequences were cleaned and used blastn to determine the identity. The Evolutionary analyses of Salivirus full coding, VP1 and 3D regions were conducted in MEGA7 [3].

2.5. Phylogenetic analysis

Phylogenetic analyses were performed using nucleotide sequences according to the neighbor-joining method and subjected to bootstrap analysis with 1000 replicates to determine the reliability values at each internal node. Evolutionary trees were constructed using the MEGA software.

Results

3.1 Detection of Salivirus

Of the 87 samples, SalV was detected in 38/87 (37.9%) collections. Salivirus was detected in all four districts of Ndola, Kitwe, Luanshya and Chipata. Salivirus was consistently detected at most sites (11/12) throughout the collection period. The virus was not detected at Old Kanini WWTP. The virus was also detected at two once off sites at Ndeke SP (Copperbelt Province) and Gondar Barrack SP and Tecoma WWTP (Eastern Province).

3.2. Molecular characterization of Salivirus

Out of a total of 87 collections from 12 wastewater sites, Salivirus was amplified and detected in 11/12 (91.7%) locations. Out of a total of 87 samples obtained during weekly collections, SalV genome was detected in 38/87 (43.7%). Out of the successfully sequenced samples, 16/38 (42.1%) yielded full coding regions (Table 2). The SalV sequences obtained in this study have been deposited in the GenBank database and assigned accession numbers PP943387-PP943402 (Table 2). The full genome of SalV was used for evolutionary analysis (Figure 1). The Phylogenetic analysis of the 16 SalV sequences for the full CDS (Figure 2), VP1 (Figure 3) and 3D regions (Figure 4) showed similar characteristics for the Zambia cluster. The Zambian viruses aggregated into a single cluster within the A2 genotype separate from other previously reported sequenced from within and outside Africa. There was no segregation according to province.

Discussion

We detected the presence of SalV in wastewater at several sites in the Copperbelt and Eastern provinces of Zambia. The study reveals the presence and abundance of SalV in raw wastewater during the 10-week study period. The presence of the virus suggests that the virus is discharged into the wastewater of the respective communities of the four towns under investigation.

Diarrhea is one of the leading causes of child death especially in young children under 5 years in Zambia.

No.	Site	Town	Province	1	2	3	4	5	6	7	8	9	10	No.	Positives
1	Chipata Motel	Chipata	Eastern	+										8	1/8
2	Gondar Barracks SP	Chipata	Eastern								+			1	1/1
3	Chipata Motel SP	Chipata	Eastern						+	+				8	2/8
4	Chipata Motel PH	Chipata	Eastern	+					+	+				8	2/8
5	Chambishi SP	Kitwe	Copperbelt	+	+	+	+	+	+					10	6/10
6	Mindolo SP	Kitwe	Copperbelt	+	+	+	+		+		+		+	10	7/10
7	Tecoma WWTP	Luanshya	Copperbelt	+										1	1/1
8	New Kanini WWTP	Ndola	Copperbelt	+	+		+		+		+	+	+	10	7/10
9	Ndeke SP	Ndola	Copperbelt										+	1	1/1
10	Nkana East WWTP	Ndola	Copperbelt	+	+		+	+			+			10	5/10
11	Lubuto WWTP	Ndola	Copperbelt	+	+	+		+			+			10	5/10
12	Old Kanini WWTP	Ndola	Copperbelt											10	0/10
														87	38/87

These infections include Rotavirus (17) , Norovirus (18), Adenovirus, Salmonella, and Giardia (19). The existence of multiple agents in co-single infections makes determination of the contribution to the overall disease manifestation of each organism difficult. The finding of the current study showed for the first time that SaIV is circulating in communities serviced by these wastewater networks. Salivirus has been shown to have a worldwide distribution in Asia, Europe (20,21), USA (22), Brazil (13,23) and other African countries (10). The detection of SalV in nearly all the towns suggests that the virus is circulating in the community. Previous studies have found similar levels of the virus in wastewater (7,24,25). It would not be surprising if the worldwide distribution of SaIV could be associated with a significant portion of infections in children with diarrhea (13,26).

No	Sequence ID	Date	Collection	Site	Town	Province	Concentration	Accession No.
1	SalivirusLTP1/3168/Zambia	23-Sep-23	1	Lubuto WWTP	Ndola	Copperbelt	PEG	PP943388
2	SalivirusNEB1/3188/Zambia	23-Sep-23	1	Nkana East WWTP	Kitwe	Copperbelt	BMFS	PP943397
3	SalivirusNKB1/3186/Zambia	23-Sep-23	1	New Kanini WWTP	Ndola	Copperbelt	BMFS	PP943400
4	SalivirusCMB1/3196/Zambia	10-Oct-23	1	Chambishi SP	Chambishi	Copperbelt	BMFS	PP943394
5	SalivirusMDB2/3224/Zambia	10-Oct-23	2	Mindolo SP	Kitwe	Copperbelt	BMFS	PP943391
6	SalivirusNKB2/3226/Zambia	11-Oct-23	2	New Kanini WWTP	Kitwe	Copperbelt	BMFS	PP943401
7	SalivirusNKB2/3227/Zambia	11-Oct-23	2	New Kanini WWTP	Kitwe	Copperbelt	BMFS	PP943392
8	SalivirusMDP4/3256/Zambia	27-Oct-23	4	Mindolo SP	Kitwe	Copperbelt	PEG	PP943396
9	SalivirusNEB4/3260/Zambia	28-Oct-23	4	Nkana East WWTP	Kitwe	Copperbelt	BMFS	PP943398
10	SalivirusNKB4/3265/Zambia	28-Oct-23	4	New Kanini WWTP	Kitwe	Copperbelt	BMFS	PP943402
11	SalivirusLTP5/3279/Zambia	03-Nov-23	5	Lubuto WWTP	Kitwe	Copperbelt	PEG	PP943389
12	SalivirusNEB6/3288/Zambia	10-Nov-23	6	Nkana East WWTP	Kitwe	Copperbelt	BMFS	PP943399
13	SalivirusCHP5/3275/Zambia	17-Nov-23	5	Chipata Motel SP	Kitwe	Eastern	PEG	PP943393
14	SalivirusCHP6/3277/Zambia	24-Nov-23	6	Chipata Motel SP	Kitwe	Eastern	PEG	PP943387
15	SalivirusMDP8/3526/Zambia	26-Nov-23	8	Mindolo SP	Kitwe	Copperbelt	PEG	PP943390
16	SalivirusMDP10/3544/Zambia	07-Dec-23	10	Mindolo SP	Kitwe	Copperbelt	PEG	PP943395

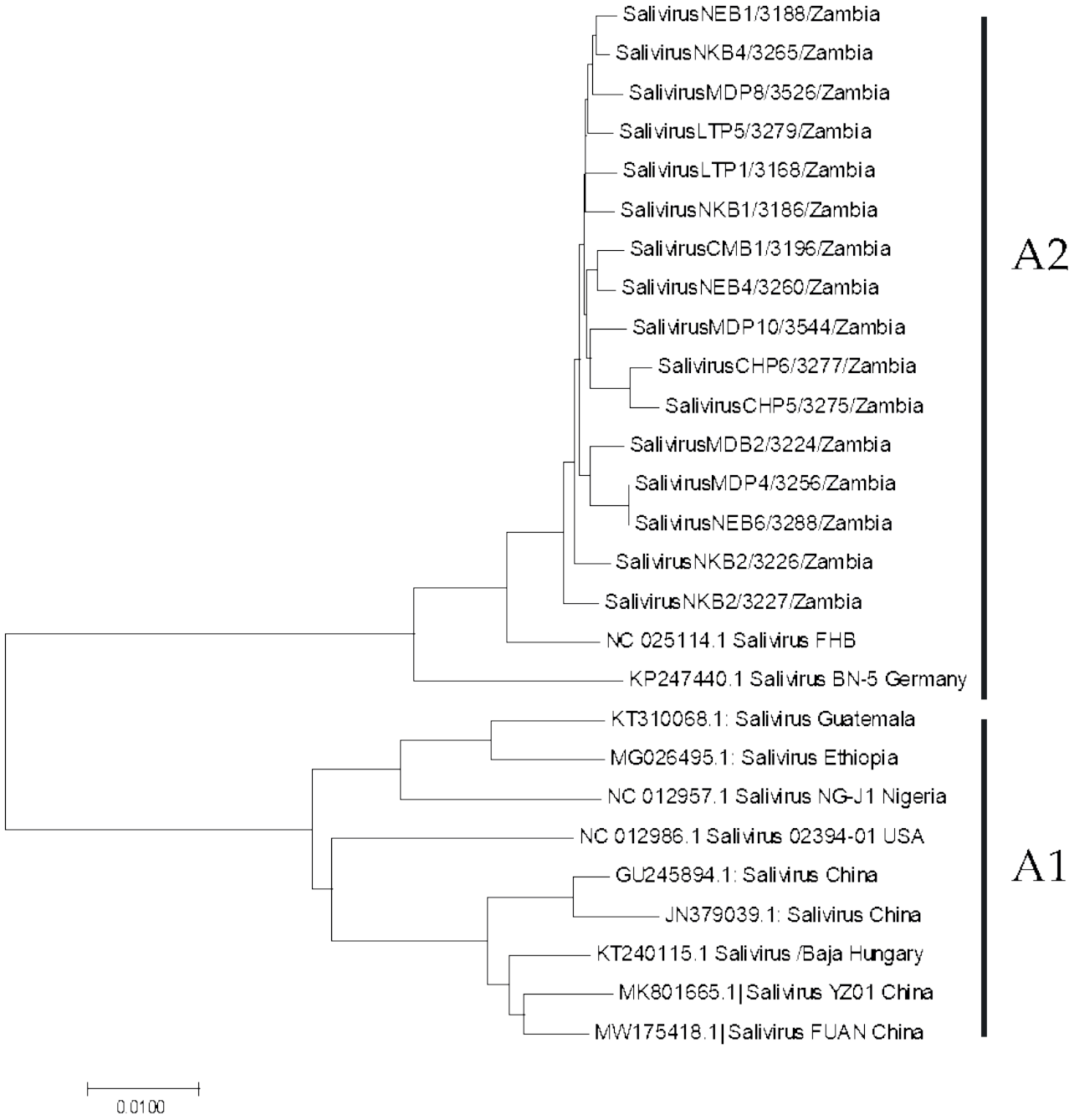

Figure 2: Phylogenetic analysis of nucleotide alignments based on the SalV full coding region (7073bp) detected in Copperbelt and Eastern province of Zambia inferred using the Neighbor-Joining method [1]. The Tree depicts the cluster of Zambia viruses among the A2 viruses. Some strains with less than the full coding regions were not included in the tree. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree.

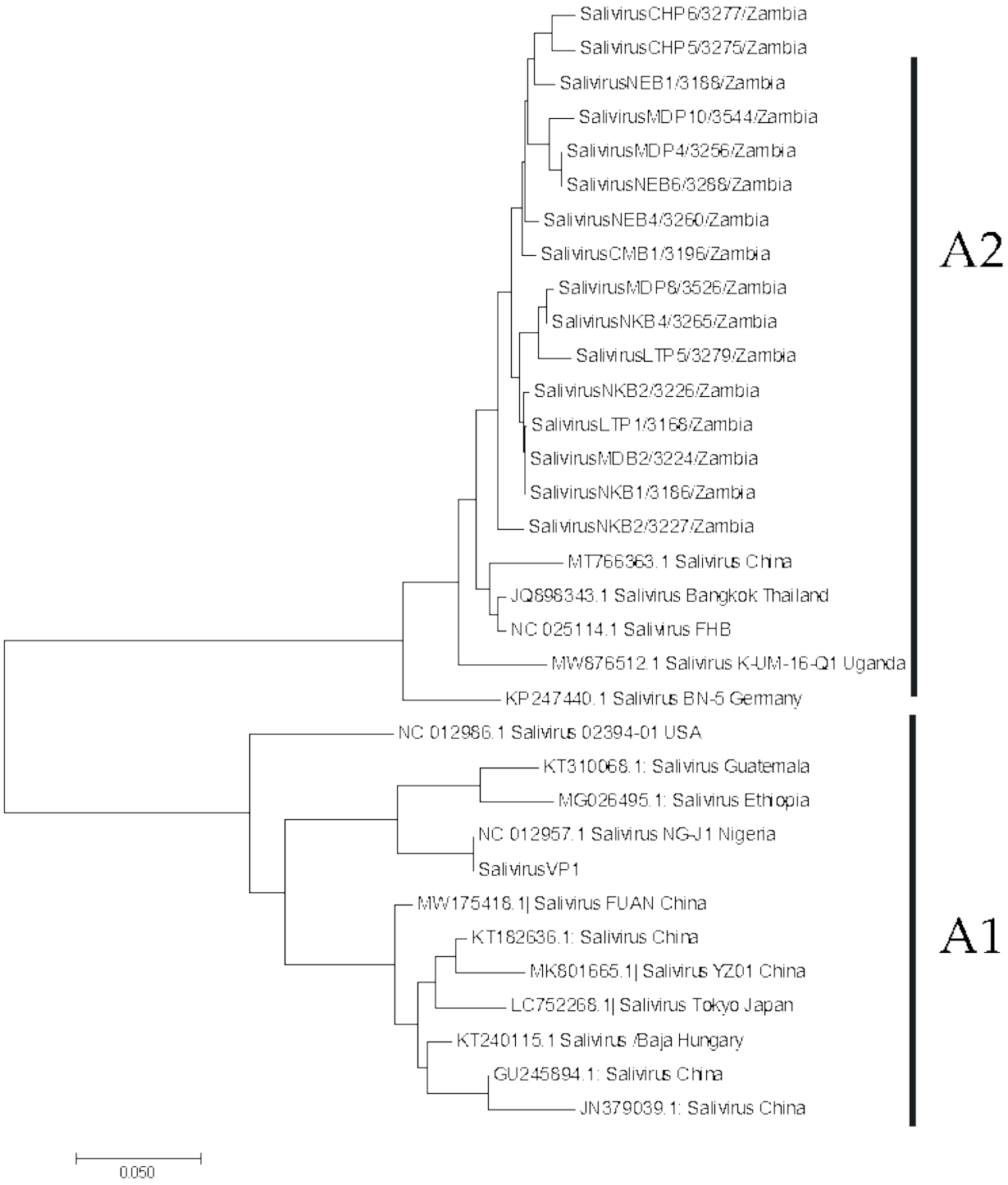

Figure 3: Phylogenetic analysis of nucleotide alignments based on the SalV VP1 region (828bp) detected in Copperbelt and Eastern province of Zambia inferred using the Neighbor-Joining method [1]. The Tree depicts the cluster of Zambia viruses among the A2 strain viruses region from Uganda, Europe and Asia.The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree.

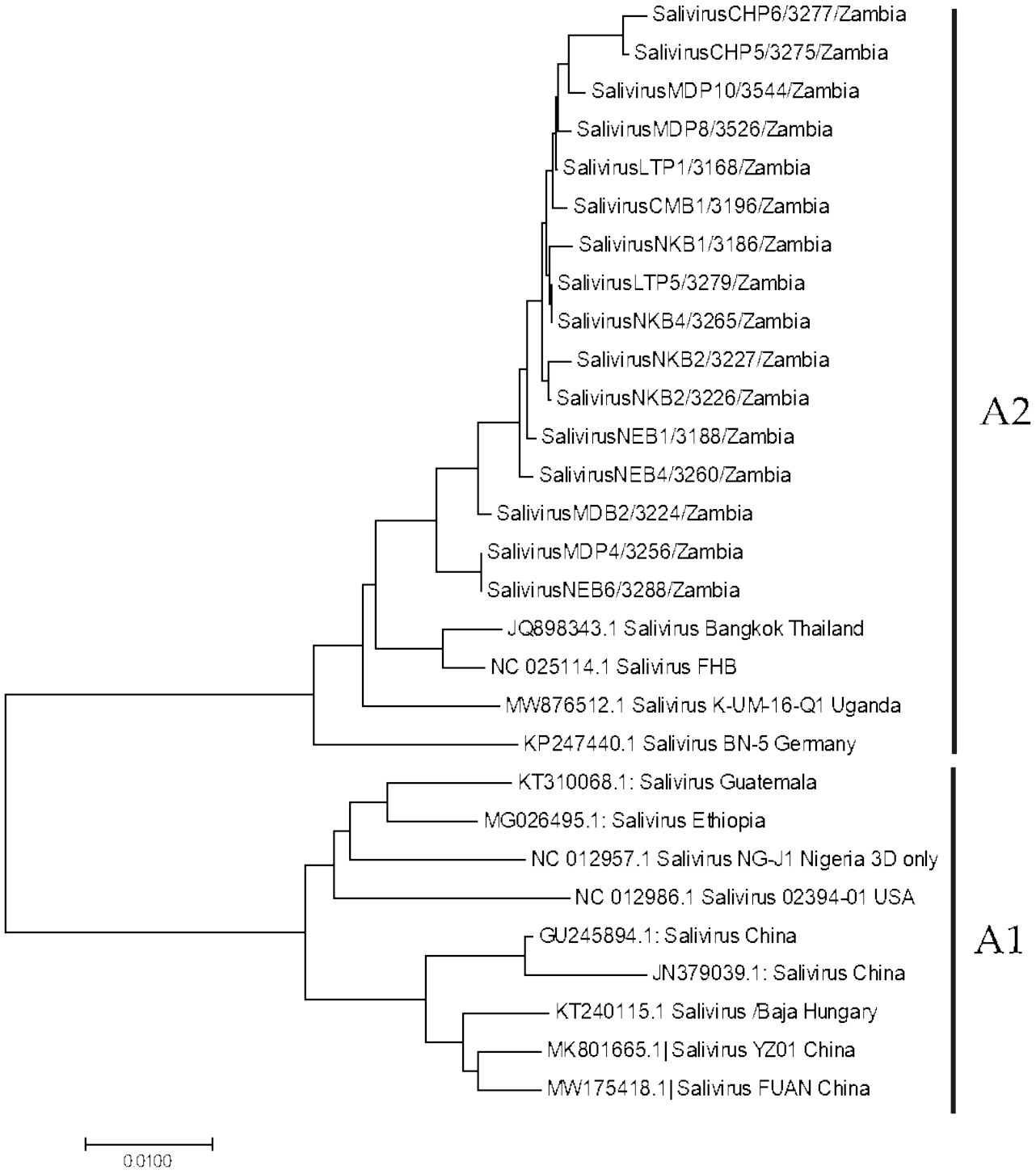

Figure 4: Phylogenetic analysis of nucleotide alignments based on the SalV 3D region (1416bp) detected in Copperbelt and Eastern province of Zambia inferred using the Neighbor-Joining method [1]. The Tree shows the cluster of Zambia viruses among the A2 strain viruses from Uganda, Europe and Asia. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree.

Previous reports of SalV from Africa (Tunisia) and other parts of the world identified genotype A1(10) . This study identified genotype A2 as the predominant genotype. Based on the entire coding region, the virus forms a distinct cluster within the genotype A2 group viruses. It remains to be established whether the presence of A2 signifies a higher risk of infection or disease in humans. So far there have been no reports comparing the difference in infectivity or pathogenicity of the genotypes A1 and A2. Therefore, the significance of SalV detected in cases of infections in the community requires further investigation.

There is sufficient evidence to support the importance of salivirus in human infections. Previous studies have demonstrated an association of SalV with other enteric viruses such as Norovirus and Rotavirus (27). In general, whether SalV aggravates diarrhea in affected individuals remains to be determined through investigation of the virus in cases of diarrhea. The abundance of the virus in wastewater suggests an intimate closeness of the virus with humans inhabiting the communities in the sewer shed. The virus is released through feces of infected individuals in the community resulting in the presence of the virus in wastewater.

Until now, the involvement of SaIV in these infections has not been determined. A handful of studies that have attempted to establish the role of SaIV in disease causation have been conducted (28,29). Our study, like many other previous reports have focused on the detection of SaIV in new areas where the virus has not been reported before and therefore little is known regarding the involvement of the virus in disease (10,30,31).

The study had limitations that included a short 10-week period of investigation. A longer period of study would provide more information regarding the seasonality of the virus in the environment (32). The prevalence of the virus in the communities serviced by these sewer watersheds remains to be established. The work is based on wastewater samples in absence of information regarding the presence or extent of the virus distribution in the population of interest. This can be achieved by investigating the presence of the virus in clinical specimens submitted for other diarrhea-related cases of diagnosis. For instance, a larger sample size comprising cases of diarrhea would help establish the true extent of the involvement of SalV.

However, the detection of SalV is a confirmation of its existence in the wastewater and therefore possible exposure to the population in the two provinces of Zambia. This finding highlights the importance of conducting further studies on SalV to better understand the molecular epidemiology, geographical distribution, immunity and etiological role in human enteric diseases and outbreaks with unknown etiology.

Conclusions

This is the first report of SalV genome detection in raw wastewater in Zambia. The data reveals widespread circulation of SalV in most of the sites on the Copperbelt and Eastern provinces. The presence of SaIV in wastewater strongly suggests the circulation of the virus in the community. It is possible that SalV plays an important role in the illness associated with diarrheal diseases in especially in children. Therefore, clinical and routine testing for SalV would reveal the extent and significance of SalV as a contributor to illnesses in the community.

Reference

1. Greninger AL, Runckel C, Chiu CY, Haggerty T, Parsonnet J, Ganem D, et al. The complete genome of klassevirus a novel picornavirus in pediatric stool. Virol J. 2009;6.

2. Aldabbagh S, Eckerle I, Müller A, Delwart EL, Eis-Hübinger AM. Salivirus type 1 and type 2 in patients with acute gastroenteritis,Germany. Journal of Clinical Virology.2015;72.

3. Reuter G, Pankovics P, Boros Á. Saliviruses-the first knowledge about a newly discovered human picornavirus. Vol. 27, Reviews in Medical Virology. 2017.

4. Mancini P, Bonanno Ferraro G, Suffredini E, Veneri C,Iaconelli M, Vicenza T, et al. Molecular Detection of Human Salivirus in Italy Through Monitoring of Urban Sewages. Food Environ Virol. 2020;12(1).

5. Daprà V, Galliano I, Montanari P, Zaniol E, Calvi C, Alliaudi C, et al. Bufavirus, Cosavirus, and Salivirus in Diarrheal Italian Infants. Inter virology. 2021;64(3).

6. Ng TFF, Magaña L, Montmayeur A, Lopez MR, Gregoricus N, Oberste MS, et al.Characterization of a salivirus (Picornaviridae) from a diarrheal child in Guatemala. Genome Announc. 2016;4(1).

7. Adineh M, Ghaderi M, Mousavi-Nasab SD.Occurrence of Salivirus in Sewage and River Water Samples in Karaj, Iran. Food Environ Virol. 2019;

8. Pei N, Zhang J, Ma J, Li L, Li M, Li J, et al.First report of human salivirus/klassevirus in respiratory specimens of a child with fatal adenovirus infection. Virus Genes.2016;52(5).

9. Bergallo M, Daprà V, Rassu M, Bonamin S, Cuccu R, Calvi C, et al. Prevalence and Clinical Profile of Human Salivirus in Children with Acute Gastroenteritis in Northern Italy, 2014-2015. Intervirology [Internet]. 2018 Aug 15 [cited 2024 Dec 3];61(1):49–52. Available from: https://dx.doi.org/10.1159/000490568

10. Ayouni S, Estienney M, Hammami S, Guediche MN, Pothier P, Aouni M, et al.Cosavirus, Salivirus and Bufavirus in diarrheal Tunisian infants. PLoS One. 2016;11(9).

11. Nielsen ACY, Gyhrs ML, Nielsen LP, Pedersen C, Böttiger B. Gastroenteritis and the novel picornaviruses aichi virus, cosavirus, saffold virus, and salivirus in young children. Journal of Clinical Virology. 2013;57(3).

12. Gao QY, Chen YX, Fang JY. 2019 Novel coronavirus infection and gastrointestinal tract. Vol. 21, Journal of Digestive Diseases. 2020.

13. Santos N, Mendes GS, Silva RC, Pena GA, Rojas M, Amorim AR, et al. Salivirus and aichivirus A infections in children with gastroenteritis in Brazil. Clinical Microbiology and Infection. 2015;21(8).

14. Yu JM, Ao YY, Liu N, Li LL, Duan ZJ. Salivirus in children and its association with childhood acute gastroenteritis: A paired case-control study. PLoS One. 2015;10(7).

15. Hamooya BM, Masenga SK, Halwiindi H. Predictors of diarrhea episodes and treatment-seeking behavior in under-five children: a longitudinal study from rural communities in Zambia. Pan Afr Med J[Internet]. 2020 May 1 [cited 2024 Nov 22];36:115. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7406458/

16.Shempela DM, Muleya W, Mudenda S, DakaV, Sikalima J, Kamayani M, et al.Wastewater Surveillance of SARS-CoV-2 in Zambia: An Early Warning Tool. Int J Mol Sci. 2024 Aug 1;25(16).

17. Mwenda JM, Ntoto KM, Abebe A, Enweronu-Laryea C, Amina I, Mchomvu J, et al. Burden and epidemiology of rotavirus diarrhea in selected african countries: Preliminary results from the african rotavirus surveillance network. Journal of Infectious Diseases. 2010;202(SUPPL. 1).

18. Howard LM, Mwape I, Siwingwa M, Simuyandi M, Guffey MB, Stringer JSA, et al. Norovirus infections in young children in lusaka province, zambia: Clinical characteristics and molecular epidemiology.BMC Infect Dis. 2017;17(1).

19. Chisenga CC, Bosomprah S, Makabilo Laban N, Mwila- Kazimbaya K, Mwaba J, Simuyandi M, et al. vAetiology of Diarrhoea in Children Under Five in Zambia Detected Using Luminex xTAG Gastrointestinal Pathogen Panel. Pediatric Infectious Diseases: Open Access.2018;03(02).

20. Yip CCY, Lo KL, Que TL, Lee RA, Chan KH, Yuen KY, et al. Epidemiology of human parechovirus, Aichi virus and salivirus in fecal samples from hospitalized children with gastroenteritis in Hong Kong. Virol J.2014;11(1).

21. Yu JM, Ao YY, Liu N, Li LL, Duan ZJ.Salivirus in children and its association with childhood acute gastroenteritis: A paired case-control study. PLoS One. 2015;10(7).

22. Kitajima M, Iker BC, Rachmadi AT, Haramoto E, Gerba CP. Quantification and Genetic Analysis of Salivirus/Klassevirus in Wastewater in Arizona, USA. Food Environ Virol. 2014;6(3).

23. Silva HD, Wosnjuk LAC, Santos SFO, Vilanova-Costa CAST, Pereira FC, Silveira-Lacerda EP, et al. Molecular detection of adenoviruses in lakes and rivers of Goiânia,Goiás, Brazil. Food Environ Virol. 2010;2(1).

24. Corpuz MVA, Buonerba A, Vigliotta G, ZarraT, Ballesteros F, Campiglia P, et al. Viruses in wastewater: occurrence, abundance and detection methods. Science of The Total Environment. 2020 Nov 25;745:140910.

25. Mancini P, Bonanno Ferraro G, Suffredini E, Veneri C, Iaconelli M, Vicenza T, et al. Molecular Detection of Human Salivirus in Italy Through Monitoring of Urban Sewages. Food Environ Virol [Internet]. 2020 Mar 1[cited 2024 Nov 22];12(1):68–74. Available from: https://link.springer.com/article/10.1007/s12560-019-09409-w

26. Itta KC, Patil T, Kalal S, Ghargi KV, Roy S.Salivirus in children with diarrhoea, western India. Vol. 52, International Journal of Infectious Diseases. 2016.

27. Bergallo M, Daprà V, Rassu M, Bonamin S, Cuccu R, Calvi C, et al. Prevalence and Clinical Profile of Human Salivirus in Children with Acute Gastroenteritis in Northern Italy, 2014-2015. Intervirology. 2018;61(1).

28. Lasure. N, Gopalkrishna. V. Clinico-epidemiology and genetic diversity of Salivirus in acute gastroenteritis cases from Pune, Western India: 2007–2011. Infection, Genetics and Evolution. 2016;44.

29. Yu JM, Ao YY, Liu N, Li LL, Duan ZJ. Salivirus in children and its association with childhood acute gastroenteritis: A paired case-control study. PLoS One. 2015;10(7).

30. Mejías-Molina C, Pico-Tomàs A, Martínez-Puchol S, Itarte M, Torrell H, Canela N, et al. Wastewater-based epidemiology applied at the building-level reveals distinct virome profiles based on the age of the contributing individuals. Hum Genomics. 2024;18(1).

31. Coutinho CRM, Cardoso JF, Siqueira JAM,Machado RS, Chagas Júnior WD das, Tavares FN, et al. Diversity of picornaviruses detected in diarrheal samples from children in Belém, Brazilian Amazon (1982-2019). J Med Virol. 2023;95(6).

32. Badru S, Khamrin P, Kumthip K, Yodmeeklin A, Surajinda S, Supadej K, et al. Molecular detection and genetic characterization of Salivirus in environmental water in Thailand.Infection, Genetics and Evolution. 2018;65.

33. Bochner AF, Makumbi I, Aderinola O, Abayneh A, Jetoh R, Yemanaberhan RL, et al.Implementation of the 7-1-7 target for detection, notification, and response to public health threats in five countries: a retrospective, observational study. Lancet Glob Health. 2023 Jun 1;11(6):e871-9.

34. Brown GW, Rhodes N, Tacheva B, Loewenson R, Shahid M, Poitier F. Challenges in international health financing and implications for the new pandemic fund.Global Health [Internet]. 2023 Dec 1 [cited 2025 May 10];19(1):97. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10696881/

35. Frieden TR, Lee CT, Bochner AF, Buissonnière M, McClelland A. 7-1-7: an organising principle, target, and accountability metric to make the world safer from pandemics. Vol. 398, The Lancet. Elsevier B.V.; 2021. p.638-40.

36. Mayigane LN, Vedrasco L, Chungong S. 7-1-7: the promise of tangible results through agility and accountability. Vol. 11, The Lancet Global Health. Elsevier Ltd; 2023. p. e805-6.

37. Frieden TR, Lee CT, Bochner AF, Buissonnière M, McClelland A. 7-1-7: an organising principle, target, and accountability metric to make the world safer from pandemics. Lancet [Internet]. 2021 Aug 14 [cited 2025 May 10];398(10300):638. Available from: https://pmc.ncbi.nlm.nih.gov/articlesPMC9636000/

38.Carter C, Anh NTL, Notter J. COVID-19disease: perspectives in low- and middle-in come countries. Clinics in Integrated Care[Internet]. 2020 Jul [cited 2025 May10];1:100005. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7261656/

39. Siedner MJ, Gostin LO, Cranmer HH,Kraemer JD.Strengthening the Detection of and Early Response to Public Health Emergencies: Lessons from the West African Ebola Epidemic. PLoS Med [Internet]. 2015 Mar 1 [cited 2025 May 10];12(3):e1001804. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4371887/

40. Weishaar H, Pozo-Martin F, Geurts B, Lopez de Abechuco E, Montt-Maray E, Cristea F, et al. Capacity-building during public health emergencies: perceived usefulness and cost savings of an online training on SARS-CoV-2 real-time polymerase chain reaction (qPCR) diagnostics in low- and middle-income settings during the COVID-19 pandemic. Front Public Health [Internet]. 2024 [cited 2025 May 10];12:1197729. Available from: https://pmc.ncbi.nlm.nih.gov/articlesPMC11192048/

41.Policy B on HS, Medicine I of, National Academies of Sciences E and M. StrengtheningOutbreak Management and Emergency Response Systems. Global Health Risk Frame work [Internet]. 2016 May 6 [cited 2025 May10]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK367950/

42. McGowan CR, Takahashi E, Romig L, Bertram K, Kadir A, Cummings R, et al.Community-based surveillance of infectious diseases: a systematic review of drivers of success. BMJ Glob Health [Internet]. 2022 Aug 19 [cited 2025 May 10];7(8):e009934. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9396156/

43. Alhassan JAK, Wills O. Public health surveillance through community health workers: a scoping review of evidence from

25 low-income and middle-income countries.BMJ Open [Internet]. 2024 Apr 5 [cited 2025 May 10];14(4):e079776. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11002386/

44. Keating P, Murray J, Schenkel K, Merson L, Seale A. Electronic data collection,management and analysis tools used for outbreak response in low- and middle-income countries: a systematic review and stakeholder survey. BMC Public Health [Internet]. 2021 Dec 1 [cited 2025 May 10];21(1):1741. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8464108/

45. Dash S, Parray AA, De Freitas L, Mithu MIH, Rahman MM, Ramasamy A, et al.Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. BMJ Glob Health [Internet]. 2021 Jan 29 [cited 2025 May 10];6(1):e004671. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7849320/

46. Biswas RK, Huq S, Afiaz A, Khan HTA. A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh. J Eval Clin Pract [Internet].2020 Dec 1 [cited 2025 May 10];26(6):1599. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7461018/

47. Yasobant S, Lekha KS, Thacker H, Solanki B, Bruchhausen W, Saxena D. Intersectoral collaboration and health system resilience during COVID-19: learnings from Ahmedabad, India. Health Policy Plan [Internet]. 2024 Nov 1 [cited 2025 May 10];39(2):i29–38. Available from: https://pubmed.ncbi.nlm.nih.gov/39552345/

RESEARCH ARTICLE

Strengthening Zambia's Response Using the 7-1-7 Framework: An evaluation of the management of national public health events in 2024.

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Cite this article: *Nonde, S., Sinyange, D., Mulenga, M., Kapapi, G., & Zulu, P. (2025). Strengthening Zambia's response using the 7-1-7 framework: An evaluation of the management of national public health events in 2024. Health Press, 09(1): 21- 29.*

Abstract

Timely detection, notification, and response are pivotal for controlling public-health emergencies. The 7-1-7 performance framework sets global benchmarks of ≤ 7 days for detection, ≤ 1 day for notification, and ≤ 7 days for response initiation. We evaluated Zambia's implementation of this framework in 2024. We retrospectively reviewed all nationally reported public-health events from 1 January to 31 December 2024. Timeliness for each 7-1-7 indicator was calculated, and bottlenecks were classified using the National Action Plan for Health Security bottleneck taxonomy. Ten public-health events met inclusion criteria. Eight events (80 %) achieved the detection target and nine (90 %) met the notification target, whereas only two (20 %) met the response initiation target. Bottlenecks were concentrated at the health-facility/community level (37 %), driven primarily by low clinical suspicion and limited familiarity with case definitions. Key system enablers included community-based surveillance, mobile notification technologies, and task-sharing strategies. Zambia has made substantial progress in detection and notification but faces persistent delays in initiating early response actions. Strengthening capacity at primary-health-care level, improving access to diagnostics, institutionalising digital notification platforms, establishing flexible financing mechanisms, and enhancing multisectoral collaboration are essential to meet all 7-1-7 targets.

Keyword: 7-1-7 framework, public health emergencies, health system strengthening

Introduction

Globally, the detection and response to infectious disease outbreaks remain a significant challenge, particularly in low- and middle-income countries (LMICs) (1). Outbreaks pose major threats due to their potential for rapid transmission, resulting in widespread illness and mortality, as well as economic and social disruptions at both national and global levels (2,3). The COVID-19 pandemic exposed global health system deficiencies in detecting, notifying and responding to these public health threats (1). Public health emergencies are complex events that demand coordinated capacities across various levels for timely detection and effective response. The rising frequency and scale of emerging infectious disease outbreaks in recent decades underscore the need for countries particularly LMICs to adopt structured frameworks to assess and strengthen health system performance in managing public health emergencies. Timeliness indicators provide a pragmatic means of assessing health system performance in managing public-health emergencies.

In 2021, the 7-1-7 framework was proposed as a set of global performance benchmarks to guide evaluation, advocacy, and prioritization of response improvements.(1,3,4). The framework defines three critical time-bound benchmarks: detection of a public health threat within seven days of emergence, notification of public health authorities within one day of detection, and initiation of early response actions within seven days of notification (5). It integrates timeliness metrics with real-event bottleneck analysis and applies a systems-based approach to evaluate national capacity and identify performance gaps for continuous improvement (4). Similar to the 95-95-95 targets for HIV, the 7-1-7 framework establishes a structure for accountability and facilitates communication, advocacy, and

prioritization of response improvements (1).

Zambia adopted 7-1-7 in 2023. This paper presents preliminary findings of an evaluation of Zambia's implementation of the 7-1-7 framework in 2024 to determine timeliness of public health event detection, notification and response initiation, as well as to identify bottlenecks and system enablers.

Methods

Study Design and Data Sources

We conducted a retrospective analysis of secondary data of events reported to the Zambia National Public Health Institute (ZNPHI) between 1 January and 31 December 2024. Events included were those classified as national public-health emergencies according to ZNPHI criteria. Each event was assessed against the 7-1-7 metrics. Detection time was defined as the interval between the index case or first epidemiologically linked case onset of symptoms and official case recognition. Notification time was measured from detection to reporting to the national authority. Response initiation was defined as commencement of interventions (e.g., case investigation, community engagement, vaccination campaigns) documented through action reports.

Bottlenecks and enablers identification and categorisation

Bottlenecks associated with delays and enablers were abstracted from the 7-1-7 consolidated spreadsheet and mapped according to the National Action Plan for Health Security (NAPHS) domains.

Analysis

Data was analysed in Excel. Descriptive statistics and bar-plots were produced. The overall 7-1-7 target achievement was assessed by calculating: (i) the number and proportion of events detected within seven days of emergence (First 7); (ii) the number and proportion of events notified within one day of detection (Next 1); and (iii) the number and proportion of events for which all seven early response components were completed within seven days of notification (Second 7). The proportion of events achieving full adherence to all 7-1-7 targets was also evaluated. Second, identified bottlenecks and enablers were summarized by metric and health system levels (community, facility, district, national).

Ethical Consideration

Ethical approval was obtained from the University of Zambia Biomedical Research Ethics Committee (REF. No. 6 610 202 5).

Results

Timeliness of detection, notification, and response

Ten public-health events were assessed (Table 3). Overall, 80 % (8/10) of events were detected within seven days and 90 % (9/10) were notified to the next administrative level within 24 h. In contrast, only 20 % (2/10) achieved early response initiation within seven days, meaning just two events met the complete 7-1-7 benchmark (Table 1).

Performance across the seven predefined early-response actions was heterogeneous (Table 2). While 70 % of events met targets for Actions 1, 2, 4, 5 and 6, and all applicable events met the target for Action 7, fewer than half (44 %) achieved the target for Action.

Bottleneck analysis

A total of 110 discrete bottlenecks were identified. Most (61 %, 67/110) impeded response initiation, whereas 35 % (38/110) affected detection and only 1 % (1/110) hindered notification (Table 4). As shown in Figure 1, bottlenecks were most common at the health-facility/community level (37 %), followed by district/provincial systems (31 %), national level processes (12 %), and issues spanning multiple levels (20 %).

The leading detection bottlenecks were low clinical suspicion among front-line health workers (34 %) and delayed care-seeking by patients (21 %). For response, the most frequent obstacles were lack of readily deployable response funds (16 %) and weak incident-management capacity (13 %). Other notable constraints included limited availability of diagnostics, delays in specimen transport, and shortages of personal protective equipment (Table 4).

Enablers Analysis

A total of 31 enablers supporting timely detection, notification, and response were identified. The majority facilitated response initiation (42%, 13/31), followed by detection (29%, 9/31), and notification (29%, 9/31) (Table 5). Enablers were mapped to six thematic categories: training and knowledge, surveillance systems, clinical vigilance, communication tools, multisectoral collaboration, and resource availability.

The leading enablers for detection were health work-

er training and knowledge of standard case definitions (44%) and functional surveillance systems such as routine IDSR reporting and event-based surveillance (33%).

Table 1 Overall Performance Against 7-1-7 Framework Targets

	Detection	Notification	Response	All Targets
# Met Target	8	9	2	2
% Met Target	80%	90%	20%	20%

Table 2 Performance on Early Response Actions

	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6	Action 7
# Met Target	7	7	4	7	7	7	4
# Events Applicable	10	10	9	10	10	10	4
% Met Target	70%	70%	44%	70%	70%	70%	100%

Table 3 7-1-7 Performance by Event

Event	District	Days to Detection	Days to Notification	Days to Early Response
Cholera	Kitwe	1	1	9
Suspected VHF	Chibombo	13	10	10
Suspected Mpox	Ikelenge	5	0	NA
Suspected Mpox	Kalumbila	1	0	26
Anthrax	Sinazongwe	0	0	99
Methanol Poisoning Outbreak	Pemba	2	0	NA
Methanol Poisoning Outbreak	Monze	1	0	NA
Methanol Poisoning Outbreak	Namwala	12	0	NA
Mpox	Chitambo	2	0	6
Cholera Outbreak	Nakonde	1	0	3

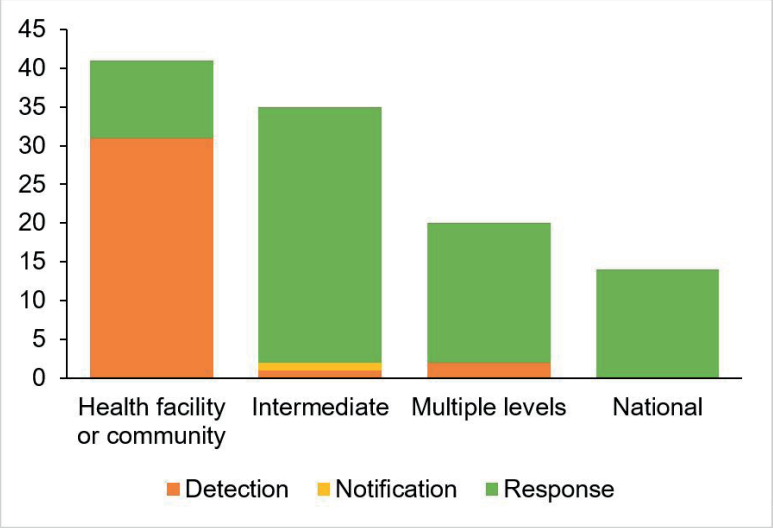

Figure 1 Distribution of bottlenecks by health system level and outbreak management function (detection, notification, and response)

Table 4 Bottlenecks to detection, notification, and response

Bottleneck Category (n = 110)	Detection (n = 38)	Notification (n = 1)	Response (n = 67)
Access issues (e.g. remote, fragile, conflict settings, climate conditions)	0	0	2 (3.0 %)
Delay in care-seeking by patient	8 (21.1 %)	0	6 (9.0 %)
Delayed specimen collection	0	0	3 (4.5 %)
Delayed specimen transportation	0	0	4 (6.0 %)
Failure to act on surveillance data	1 (2.6 %)	0	0
Failure to follow initial risk assessment or event verification procedures	0	0	1 (1.5 %)
Health professional with inadequate training in surveillance and response	5 (13.2 %)	0	5 (7.5 %)
Human resources gaps for public health	1 (2.6 %)	0	2 (3.0 %)
Inadequate coordination across public health units or agencies	0	0	2 (3.0 %)
Inadequate diagnostic commodities (lab reagents, RDTs, specimen collection kits)	0	0	2 (3.0 %)
Inadequate public financial assistance (e.g. treatments, to offset public health/social measure [PHSM] impacts)	0	0	4 (6.0 %)
Inadequate risk assessments, preparedness, or response plans	1 (2.6 %)	0	2 (3.0 %)
Laboratory reporting failure	0	0	1 (1.5 %)
Lack of available resources for response initiation or rapid resource mobilization	0	0	11 (16.4 %)
Lack of clinical surveillance focal point/capacity	1 (2.6 %)	0	0
Lack of coordination across public health units or agencies	0	0	1 (1.5 %)
Lack of diagnostic commodities (lab reagents, RDTs, specimen collection kits)	3 (7.9 %)	0	3 (4.5 %)
Lack of one health information sharing/collaboration	0	0	1 (1.5 %)
Lack of timely or complete surveillance data	1 (2.6 %)	1 (100 %)	0
Limited availability of countermeasures or personal protective equipment	1 (2.6 %)	0	4 (6.0 %)
Limited clinical case management capacity	2 (5.3 %)	0	2 (3.0 %)
Low awareness or clinical suspicion by health workers	13 (34.2 %)	0	0
Other	0	0	1 (1.5 %)
Risk communications or community engagement	1 (2.6 %)	0	1 (1.5 %)
Weak response coordination, including incident management and rapid response team capacity	0	0	9 (13.4 %)

Table 5 Enablers to detection, notification, and response

Enabler Category (n = 33)	Detection (n = 11)	Notification (n = 9)	Response (n = 13)
Training and knowledge in surveillance and case definitions	4 (36.4%)	1 (11.1%)	3 (23.1%)
Functional surveillance systems (routine, IDSR, EBS, FPPs)	3 (27.3%)	1 (11.1%)	1 (7.7%)
High index of suspicion by health workers	3 (27.3%)	0	0
Direct phone calls and personal communication tools	0	6 (66.7%)	0
Multisectoral collaboration and stakeholder support	1 (9.1%)	1 (11.1%)	5 (38.5%)
District-level preparedness and resource availability	0	0	5 (38.5%)

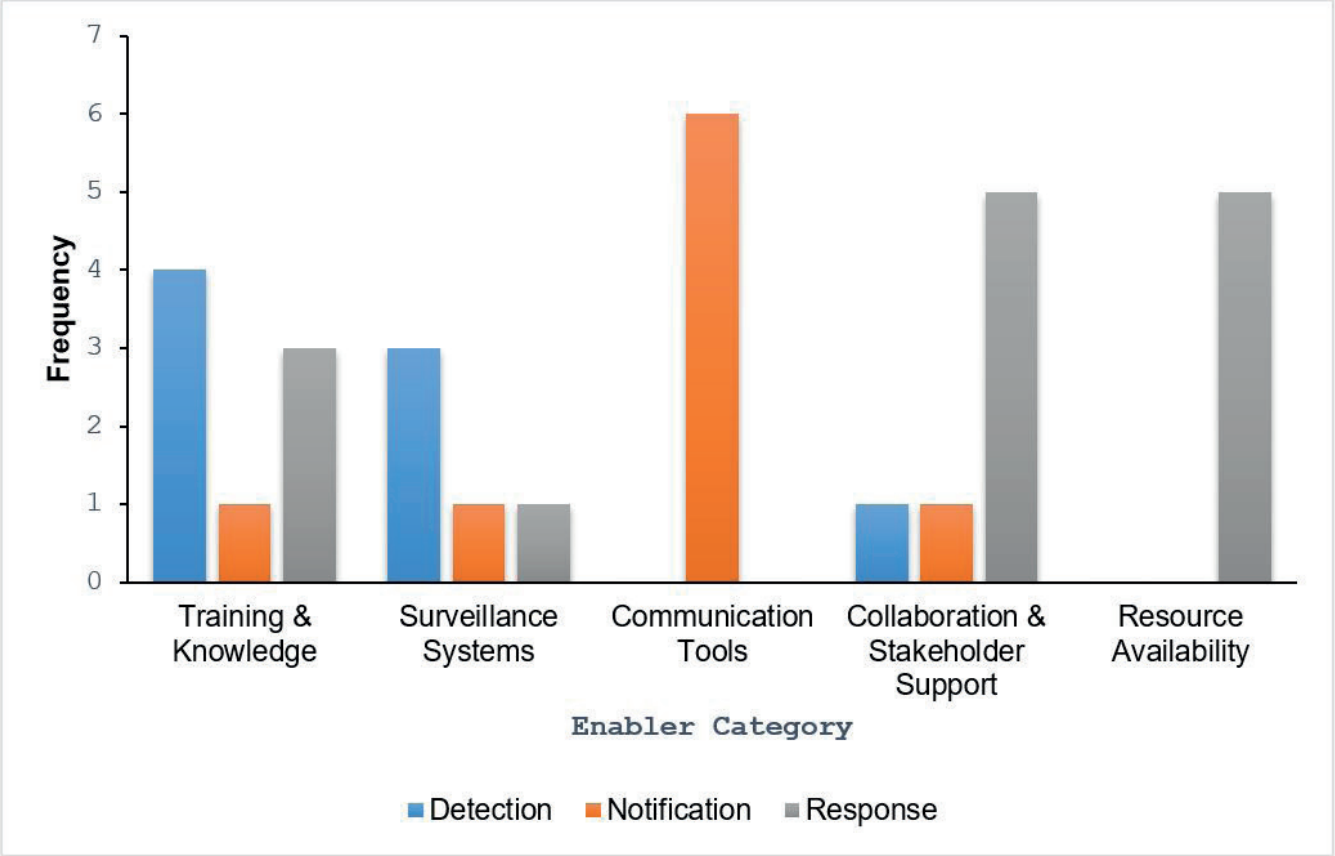

Figure 2 Enablers by Metric (Detection, Notification and Response).

High clinical suspicion by frontline providers also contributed to early case identification.

For notification, as shown in figure 2, the most cited enabler was communication tools such as the use of mobile phones and direct phone calls to relay alerts across facility, district, and national levels (67%). Enablers for response were largely structural and operational. The most common included multisectoral collaboration mechanisms (39%) and availability of resources at district level, such as GRZ funds and logistics support (39%), which facilitated timely deployment of response teams and countermeasures.

Discussion

This evaluation of Zambia's management of national public health events in 2024 assesses the country's performance in the detection, notification, and response to public health threats. During the review period, a total of 10 nationally significant public health events were recorded. Assessment against the 7-1-7 timelines indicate a strong performance in early detection

and timely notification, with 80% and 90% of events meeting the respective targets. Similar high detection and notification rates have been reported in other low- and middle-income countries (LMICs) implementing structured surveillance frameworks. For example, Frieden and others (2021) documented detection rates exceeding 75% across multiple African countries, indicating that systematic surveillance significantly enhances early disease identification.

However, only 20% of the public health events in Zambia met the early response initiation target, and consequently, only 20% achieved all three 7-1-7 benchmarks. This underscores significant challenges in promptly initiating response actions following detection and notification Comparable assessments have also found that achieving all three 7-1-7 targets remains a challenge for most LMICs. A retrospective study across five LMICs (Brazil, Ethiopia, Liberia, Nigeria, and Uganda) from 2018 to 2022 found that only 27% of 41 public health events met the complete 7-1-7 target (1), similar to Zambia's 20% achievement rate. While early detection and notification rates in the multi-country study were 54% and 71% respectively, the response initiation target was met in only 49% of events indicating that rapid response initiation is a common hurdle across LMICs (1).

The bottleneck analysis revealed that delays were concentrated at the health facility and community levels, which accounted for 37% of all identified bottlenecks. These bottlenecks predominantly affected detection and were primarily attributed to low clinical suspicion and limited familiarity with case definitions among frontline health workers. In contrast, bottlenecks at the intermediate and multiple levels were mainly related to response, while the national level recorded the fewest bottlenecks, all of which were also response-related.

These findings align with evidence from other low- and middle-income countries (LMICs), where limited preparedness at the primary health care (PHC) level often impedes effective outbreak control (6). Additionally, workforce shortages and constrained diagnostic capacity have been consistently reported as barriers to timely outbreak management in LMICs (7). Taken together, these findings highlight the need for increased and targeted investments at the health facility level where most events are initially detected to strengthen disease detection and response capacity (2).

Several enablers of improved response capacity were identified. These included community-based surveillance systems, mobile notification technologies, and task-sharing strategies, all of which contributed to more timely detection and response. Evidence from other studies supports these findings, highlighting that empowering community health workers (CHWs), strengthening digital reporting systems, fostering strong community engagement, adopting digital innovations, and enhancing multisectoral coordination are effective strategies for building resilient health system (8-11). Strategic investment in these areas could substantially enhance the timeliness and effectiveness of outbreak responses.

In light of these findings, future strategies to enhance outbreak response in Zambia should prioritize: (i) regular capacity-building initiatives at the primary health care (PHC) level to improve clinical suspicion and response readiness; (ii) improved access to diagnostic tools and essential medical supplies at PHC facilities; (iii) increased adoption of digital tools to strengthen surveillance, notification, and case management; and (iv) the expansion of task-sharing approaches to optimize the use of available human resource (6,8). Investments in community-based surveillance and mobile notification systems should be accelerated, complemented by efforts to strengthen risk communication and community engagement (RCCE) to build public trust and ensure active participation during outbreaks (12,13).

Moreover, establishing flexible funding mechanisms to support rapid resource mobilization during outbreaks will be critical to consistently achieving the 7-1-7 targets (14). In addition, fostering multisectoral collaboration among government agencies, non-governmental organizations, and communities will be essential to ensure timely and effective outbreak response (15).

This study has several limitations. First, the analysis relied on secondary data sources, which may be subject to reporting biases and inaccuracies. Second, the small number of events assessed (n=10) limits the generalizability of the findings, and results should be interpreted with caution. Future research should involve larger datasets and prospective study designs to generate more robust evidence and to validate these findings. Additionally, longitudinal studies could help track improvements in Zambia's outbreak response capabilities over time.

Conclusion

Zambia's implementation of the 7-1-7 framework in 2024 shows strong capacity for early detection and

prompt notification of public-health events; however, timely initiation of response actions particularly at the primary health care level remains a persistent challenge. Translating early detection into early response will require targeted investments that strengthen PHC readiness and streamline incident management. Additionally, strengthening the use of emergency funds by enacting a Statutory Instrument (SI) that formalizes rapid fund disbursement protocols, as well as prioritizing the use of local resources in times of financial instability or aid freeze to maintain essential outbreak response capabilities.

Community-based surveillance, mobile notification platforms, and task-sharing emerged as practical enablers and should be scaled to accelerate response timelines. Leveraging these strategies can help Zambia and other LMICs with similar constraints, consistently meet all 7-1-7 targets and enhance overall outbreak preparedness. Furthermore, leveraging global best practices and fostering partnerships will be essential to closing the gaps identified. This study reaffirms the 7-1-7 framework's utility for assessing system performance and exposing vulnerabilities.

References

1. Bochner AF, Makumbi I, Aderinola O, Abayneh A, Jetoh R, Yemanaberhan RL, et al.Implementation of the 7-1-7 target for detection, notification, and response to public health threats in five countries: a retrospective, observational study. Lancet Glob Health. 2023 Jun 1;11(6):e871-9.

2. Brown GW, Rhodes N, Tacheva B, Loewenson R, Shahid M, Poitier F. Challenges in international health financing and implications for the new pandemic fund. Global Health [Internet]. 2023 Dec 1 [cited 2025 May 10];19(1):97. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10696881/

3. Frieden TR, Lee CT, Bochner AF, Buissonnière M, McClelland A. 7-1-7: an organising principle, target, and accountability metric to make the world safer from pandemics. Vol. 398, The Lancet. Elsevier B.V.; 2021. p. 638-40.

4. Mayigane LN, Vedrasco L, Chungong S. 7-1-7: the promise of tangible results through agility and accountability. Vol. 11, The Lancet Global Health. Elsevier Ltd; 2023. p. e805–6.

5. Frieden TR, Lee CT, Bochner AF, Buissonnière M, McClelland A. 7-1-7: an organising principle, target, and accountability metric to make the world safer from pandemics. Lancet [Internet]. 2021 Aug 14 [cited 2025 May 10];398(10300):638. Available from: https://pmc.ncbi.nlm.nih.gov/articles PMC9636000/

6. Carter C, Anh NTL, Notter J. COVID-19 disease: perspectives in low- and middle-income countries. Clinics in Integrated Care[Internet]. 2020 Jul [cited 2025 May 10];1:100005. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7261656/

7. Siedner MJ, Gostin LO, Cranmer HH, Kraemer JD.Strengthening the Detection of and Early Response to Public Health Emergencies: Lessons from the West African Ebola Epidemic. PLoS Med [Internet]. 2015 Mar 1 [cited 2025 May 10];12(3):e1001804. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4371887/

8. Weishaar H, Pozo-Martin F, Geurts B, Lopez de Abechuco E, Montt-Maray E, Cristea F, et al. Capacity-building during public health emergencies: perceived usefulness and cost savings of an online training on SARS-CoV-2 real-time polymerase chain reaction (qPCR) diagnostics in low- and middle-income settings during the COVID-19 pandemic. Front Public Health [Internet]. 2024 [cited 2025May 10];12:1197729. Available from: https://pmc.ncbi.nlm.nih.gov/articlesPMC11192048/

9. Policy B on HS, Medicine I of, National Academies of Sciences E and M. Strengthening Outbreak Management and Emergency Response Systems. Global Health Risk Framework [Internet]. 2016 May 6 [cited 2025 May 10]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK367950/

10. McGowan CR, Takahashi E, Romig L, Bertram K, Kadir A, Cummings R, et al.Community-based surveillance of infectious diseases: a systematic review of drivers of success. BMJ Glob Health [Internet]. 2022 Aug 19 [cited 2025 May 10];7(8):e009934. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9396156/

11. Alhassan JAK, Wills O. Public health surveillance through community health workers: a scoping review of evidence from 25 low-income and middle-income countries. BMJ Open [Internet]. 2024 Apr 5 [cited 2025 May 10];14(4):e079776. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11002386/

12. Keating P, Murray J, Schenkel K, Merson L, Seale A. Electronic data collection, management and analysis tools used for outbreak response in low- and middle-income countries: a systematic review and stakeholder survey. BMC Public Health [Internet]. 2021 Dec 1 [cited 2025 May 10];21(1):1741. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8464108/

13. Dash S, Parray AA, De Freitas L, Mithu MIH, Rahman MM, Ramasamy A, et al. Combating the COVID-19 infodemic: a three-level approach for low and middle-income countries. BMJ Glob Health [Internet]. 2021 Jan 29 [cited 2025 May 10];6(1):e004671. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7849320/

14. Biswas RK, Huq S, Afiaz A, Khan HTA. A systematic assessment on COVID-19 preparedness and transition strategy in Bangladesh. J Eval Clin Pract [Internet]. 2020 Dec 1 [cited 2025 May 10];26(6):1599.Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC7461018/

15.Yasobant S, Lekha KS, Thacker H, Solanki B,Bruchhausen W, Saxena D. Intersectoral collaboration and health system resilience during COVID-19: learnings from Ahmedabad, India. Health Policy Plan [Internet]. 2024 Nov 1 [cited 2025 May 10];39(2):i29–38. Available from: https://pubmed.ncbi.nlm.nih.gov/39552345/

Mpox Case Investigation in Chitambo District, Zambia: Lessons from the First Reported Case in 2024

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Cite this article: *Ngulube, D., Mubemba, B., Tembo, E., Mutale, L., Mufwaya, S., Mwape, I., Shempela, D., Banda, D., & Sinyange, N. (2025). Mpox case investigation in Chitambo District, Zambia: Lessons from the first reported case in 2024. Health Press, 09(1): 30-41.*

Abstract

Mpox is a viral zoonotic disease with growing public health relevance in Africa. In October 2024, Zambia confirmed its first Mpox case in Chitambo District, involving a foreign truck driver with suspected cross-border and occupational exposure. Given Chitambo's strategic location along major transport routes, an investigation was conducted to assess potential community transmission and the district's outbreak preparedness.

A case report approach was used from October 14–19, 2024. Data were collected on the index case and 24 identified contacts using WHO and Zambia's IDSR protocols. Contact follow-up lasted 21 days. Genomic sequencing was performed to determine the virus strain, and a retrospective review of dermatological cases at two health facilities assessed undetected Mpox transmission. Timeliness of detection, notification, and response was evaluated using the 7-1-7 framework.

The index case, a 32-year-old male truck driver, exhibited rash symptoms consistent with Mpox. Among 24 contacts, 91.7% remained asymptomatic. Most contacts were young females (median age: 18.5 years). Genomic analysis confirmed Mpox Clade 1b. Dermatological case reviews found chickenpox and dermatitis as the most common diagnoses. The 7-1-7 evaluation showed case detection in 2 days, notification in 1 day, and full response within 6 days. However, challenges were noted in specimen handling (23.1% errors), delayed health-seeking behavior, and low risk perception.

While no community transmission was confirmed, this case highlights the role of mobile populations in Mpox spread. Strengthening surveillance, improving public awareness, and enhancing specimen handling and response capacity are critical for effective Mpox control in Zambia.

Keywords: Mpox, cross-border transmission, 7-1-7 framework,

Introduction

Mpox is a severe viral illness that affects humans, posing a risk of serious complications and even death (1). It is caused by the Mpox virus, belonging to the Orthopoxvirus family, which also includes the variola virus responsible for smallpox (2). The incubation period for mpox varies widely, with estimates ranging from 5 to 21 days. Recent studies have suggested a median incubation period of less than 10 days, with many cases presenting symptoms around 8 to 9 days post-exposure (3-5). In rare circumstances, the average incubation period can extend up to 21 days (5,6).

Historically, Mpox has been found in rural areas of Central and West Africa, especially near tropical rainforests were zoonotic transmission is suspected (7). The global epidemiological landscape has undergone a significant shift, with widespread outbreaks reported across over 94 countries, driven by international travel and human-to-human transmission (8). As of September 13, 2024, the Africa CDC reported 26,544 cases and 724 deaths across 15 African Union member states, with a 2.73% case fatality rate (9). The World Health Organization (WHO) initially declared Mpox a Public Health Emergency of International Concern (PHEIC) on July

23, 2022, in response to a surge in outbreaks (10,11). However, despite this initial declaration, the outbreak continued to escalate, prompting the Africa Centres for Disease Control and Prevention (Africa CDC) to declare Mpox a Public Health Emergency on August 13, 2024, followed by the WHO on August 14, 2024 (1,12). The declarations signaled a coordinated global response to address the growing crisis.

On the 9th of October 2024, Zambia reported its first confirmed Mpox case in Chitambo District, Central Province. The index case, a 32-year-old Tanzanian truck driver, developed symptoms after traveling through multiple transit hubs before reaching Chitambo district (Fig1). The detection of Mpox case in Zambia underscored the urgent need to investigate transmission dynamics and assess the risk of further spread. Given Chitambo District's role as a major transit hub, the index case also raised concerns about cross-border transmission and localized exposure. Further, limited epidemiological data on Mpox in Zambia necessitated a targeted investigation to understand disease patterns, strengthen surveillance, and improve outbreak preparedness (13). Thus, this investigation aimed to characterize the index case, assess secondary transmission risks, evaluate outbreak response effectiveness and provide recommendations for strengthening Mpox surveillance and control strategies. Understanding the public health response, diagnostic challenges, and risk factors associated with this case will inform future Mpox prevention efforts in similar high-mobility regions, ultimately contributing to more effective disease control measures.

Methods

Study Design

A case report study design was employed to investigate Zambia's first confirmed Mpox case in Chitambo District. The study followed standardized World Health Organization (WHO) Mpox case investigation protocols and Zambia's Integrated Disease Surveillance and Response (IDSR) framework, ensuring consistency in case detection, contact tracing, and outbreak response measures. A multidisciplinary approach was applied, incorporating epidemiological assessments, contact monitoring, laboratory diagnostics, and dermatological review of facility records to evaluate Mpox transmission risks.

Study Period and Setting

The investigation was conducted from 14-19th October 2024, in Chitambo District, Central Province, Zambia, located 470 km north-east of Lusaka and 357 km north-east of Kabwe along the Great North Road. The district spans 11,884.5 square kilometers, with a population of 113,465 residents.

Study Population

The study population consisted of the index Mpox case and identified contacts. Inclusion criteria covered individuals with a known direct or indirect exposure to the confirmed case within 21 days before symptom onset. Healthcare workers, household members, occupational colleagues, and social contacts were enlisted for monitoring. Individuals without any potential exposure or those outside the infectious period were excluded.

Data Collection

Data were systematically collected using WHO-approved Mpox case investigation forms, contact enlisting forms, and contact follow-up forms. Structured epidemiological interviews were conducted to assess clinical presentations, exposure history, and risk factors. Data were recorded digitally using Kobo Collect, enabling real-time data entry and streamlined management. Facility records were reviewed at Mukando Health Post (diagnosis site) and Katikulula Rural Health Facility (isolation site) to extract relevant clinical and epidemiological data on dermatological conditions. Collected data were exported to Microsoft Excel 2019 and analyzed in RStudio version 4.4.1. We presented descriptive statistics and charts and tables for our analysis.

Contact Tracing Approach and Assessment of Community Transmission

Contact tracing followed WHO guidelines, categorizing individuals based on primary (direct exposure) and secondary (indirect exposure) classifications. The confirmed case identified initial contacts, expanding the list. Traced individuals underwent 21-day symptom monitoring, assessed through house visits and telephone surveillance. Exposure pathways included skin-to-skin interaction, respiratory exposure, shared materials, and healthcare exposure with inadequate PPE were assessed alongside dermatological conditions using outpatient department registers at Mukando and Katikulula health facilities to identify potential undiagnosed Mpox infections.

7-1-7 Matrix Assessment

The investigation assessed outbreak response efficiency using the 7-1-7 framework, measuring the district's ability to detect cases within seven days, notify authorities within one day, and initiate response measures within seven days. Challenges and system constraints affecting Mpox detection, reporting, and response effectiveness were documented.

Laboratory Investigations

Specimen collection for diagnostic confirmation followed WHO laboratory protocols and included whole blood, lesion swabs, scabs, lesion fluid, and urine. Real-time polymerase chain reaction (PCR) testing was conducted using the FlexStar® Monkeypox Virus PCR Detection Kit (altona Diagnostics GmbH, Hamburg, Germany) on the QuantStudio™ 5 Real-Time PCR System (Applied Biosystems) at the Zambia National Public Health Institute (ZNPHI) laboratory. This assay allows for the qualitative detection of specific Mpox virus genes. Genomic sequencing was subsequently performed to identify the Mpox virus strain.

Results

Case Presentation

A 32-year-old male Tanzanian truck driver presented to Mukando Health Post on 4 October 2024 with a three-day history of an itchy body rash, joint pain, malaise, and sore throat. He had no known comorbidities and reported being HIV-negative. On presentation, the patient was clinically stable, a febrile (36.7°C), normotensive (145/87 mmHg), with a pulse rate of 97/min and no signs of respiratory distress. Initial examination revealed a papular rash predominantly affecting the face, trunk, upper limbs including the palms and lower limbs, sparing the soles; no genital or oral lesions were noted. Symptomatic treatment was initiated, including piriton (4 mg orally, twice daily for three days), penicillin V (500 mg, four times daily for five days), Brustan (400 mg, three times daily for three days), and benzyl benzoate lotion. At the two-week follow-up, cervical lymphadenopathy and lesion scabbing were observed, consistent with healing (Fig1). Laboratory screening was negative for syphilis (RPR) and for viral hepatitis B and C.

Timeline of Events

The index case entered Zambia on September 2, 2024, via Nakonde Border Post, transiting through Matumbo, Mkushi, Sabina, and Mokambo, where he arrived on September 6, 2024 (Fig 2).

During his stay in Mokambo, the patient reported contact with a female sex worker and interaction with another Tanzanian truck driver presenting with similar itchy skin lesions. The patient described face-to-face contact, skin contact through greetings, sharing beer from the same cup, and sharing cigarettes with the symptomatic truck driver. The fellow truck driver reportedly sought traditional medicine in the Democratic Republic of Congo (DRC) and recovered within 10 days.

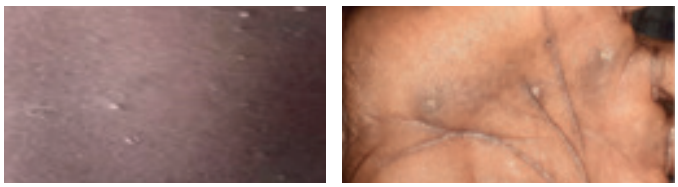

Figure 1: Different stages of Mpox lesions affecting parts of the body at two weeks follow up

Figure 2: Movements by date of the Mpox case, Chitambo, 2024

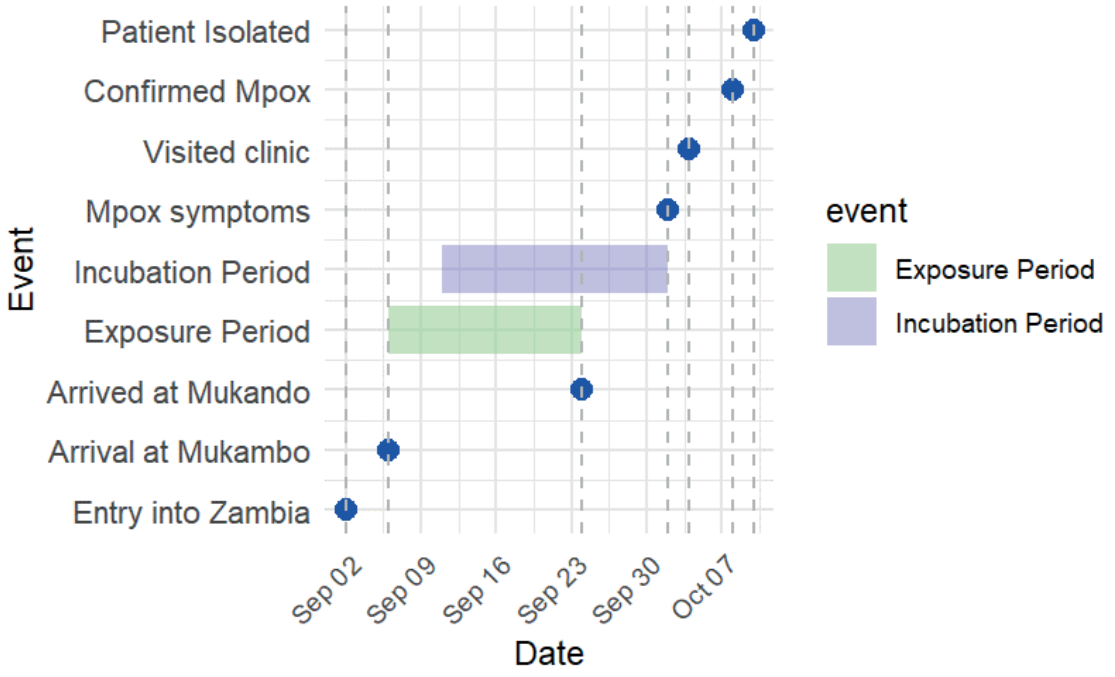

Figure 3: Timeline of the onset, diagnosis, and clinical outcomes of the mpox Case

Table 1 Detection of Mpox virus (MPXV) by real-time polymerase chain reaction (PCR), Chitambo district 2024

Case	Specimen collection date	Specimen type	Results
Patient 1	07/10/2024	Whole blood	**Positive**
	11/10/2024	Whole blood	Negative
		Dry swab of lesion	**Positive**
		Scab over lesion	**Positive**
		Fluid from lesion	Negative
	15/10/2024	Oral swab in VTM	Negative
		Whole blood	Negative
		Urine	Negative
		Dry swab over lesion	**Positive**
	19/10/2024	Skin scrapping	**Positive**
		Whole blood	Negative
		Urine	Negative
	25/10/2025	Scabs over lesions	Clade 1b

Table 2: Contacts descriptive information

Contact category		Number	Percentage (%)
Total contacts		24	-
Lost to follow-up		2	8.3
Monitored contacts		22	91.7
Monitored contacts breakdown:		N= (22)	-
Primary contacts		6	27.3
Secondary contacts		16	72.7
Gender	-	-	-
	Female	15	68.2
Median age		18.5	-
IQR		12-28	-

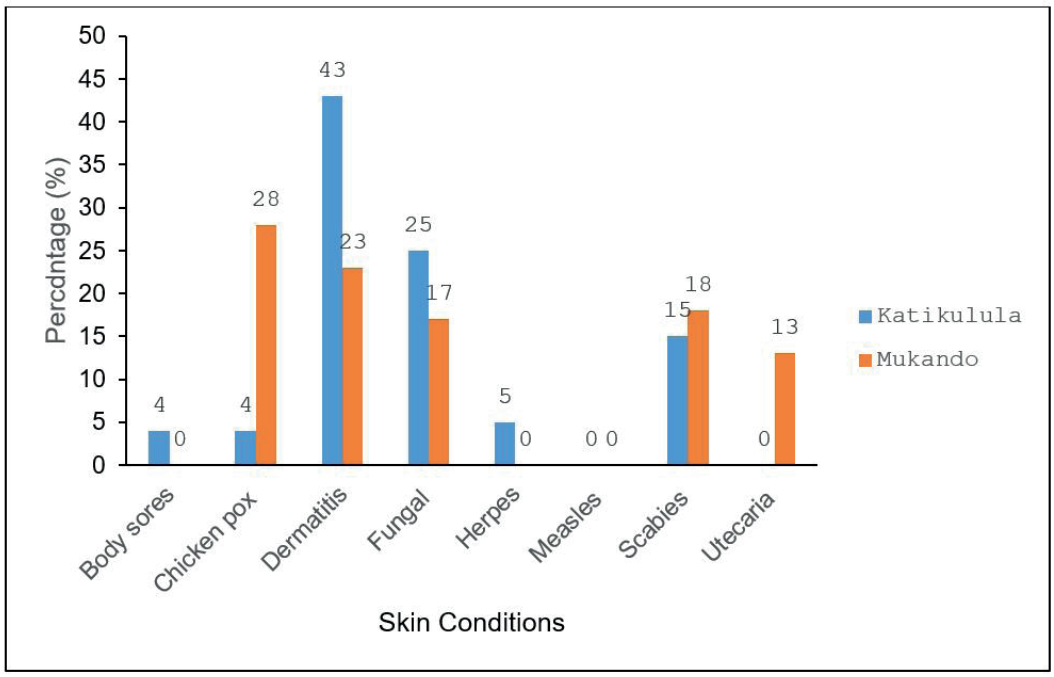

Figure 4: Analysis of Dermatological skin conditions at Katikulula and Mukando health post in Chitambo district, March to September 2024.

Table 3: Summary of 7-1-7 matrix assessment of Mpox outbreak, Chitambo 2024

Metric	Target timeline	Actual timeline	Status	Key bottlenecks	Key enablers
Outbreak detection	≤ 7 days	2 days	Achieved	Poor patient health seeking behavior	Effective surveillance: trained staff
Notification to authorities	≤ 1 day	1 day	Achieved	Nill	Efficient communication system
Response initiation	≤ 7 days	6 days	Achieved	Inadequate fuel, no IMS	Strong inter agency collaboration,

Laboratory Results

Diagnostic confirmation was conducted using PCR testing and genomic sequencing. Mpox virus was first detected in whole blood on October 7, 2024, with subsequent positive results in lesion swabs and scabs, while fluid samples tested negative, as summarized in Table 1. Genomic sequencing performed on October 25, 2024, confirmed the presence of the Clade 1b strain, which is associated with high transmissibility.

Contact Tracing and Assessment of Community Transmission

A total of 24 contacts were identified for monitoring and symptom surveillance; however, two contacts (8.3%) a female sex worker and a fellow truck driver were lost during follow-ups, leaving 22 contacts (91.7%) under full monitoring for the 21-days. Of these, six (27.3%) were classified as primary contacts, including one female sexual partner, three healthcare workers, and two close social associates, while the remaining 16 (72.7%) were secondary contacts identified through active case search. The demographic breakdown showed that 15 contacts (68.2%) were female, with a median age of 18.5 years (IQR: 12–28). None of the monitored contacts developed symptoms suggestive of Mpox during the follow-up period (Table 2).

A retrospective review of dermatological conditions recorded at Mukando and Katikulula health facilities between March and September 2024 revealed no cases aligned to Mpox but instead, revealed chickenpox as the most prevalent condition at Mukando (28%), while dermatitis was more common at Katikulula, accounting for 43% of the cases (Fig 4).

7-1-7 Matrix Assessment of Mpox Outbreak Response

The 7-1-7 framework was applied to assess outbreak detection, notification, and response efficiency (Table 3). The evaluation demonstrated that all response targets were met within the recommended timelines. Outbreak detection was achieved within 2 days, supported by trained personnel and active surveillance, although poor patient health-seeking behavior posed a challenge. Notification to public health authorities was completed within 1 day, facilitated by efficient communication systems. Response initiation occurred within 6 days, successfully meeting the 7-day target, despite challenges such as fuel shortages and the absence of an Incident Management System (IMS). Strong inter-agency collaboration played a critical role in resource mobilization, ensuring a timely outbreak response. Specifically, coordination among health authorities, local government, and partner organizations enabled resource mobilization, including emergency fuel supplies and deployment of personnel. Pre-existing partnerships and communication frameworks further streamlined decision-making, ensuring a timely response.

Discussion

We investigated Zambia's first confirmed Mpox case in Chitambo district, assessing the case characteristics, transmission dynamics and outbreak response efficiency. The index case, a Tanzanian truck driver, presented with characteristic Mpox symptoms and was confirmed to have Clade 1b through laboratory testing. Despite extensive contact tracing and retrospective facility record reviews, no secondary cases were identified, suggesting no evidence of local transmission among the people investigated. The outbreak response adhered to the 7-1-7 framework, indicating timely detection, notification, and intervention. These findings highlight the role of mobile populations in disease spread and underscore the need for strengthened surveillance and

diagnostic capacity.

The investigation found that the patient, during transit in Mokambo, reported contact with a symptomatic individual and a female sex worker. These exposures included face-to-face interaction, skin contact, sharing of items, and sexual contact all of which align with established Mpox transmission routes (14-16). While no secondary cases were identified, this is consistent with evidence that transmission risk depends on contact type and intensity, with intimate or prolonged contact posing higher risk (16). These findings highlight the importance of thorough exposure assessment during contact tracing, particularly among mobile populations.

Our findings confirm the presence of Mpox virus Clade 1b in Chitambo, Zambia. This clade has been associated with high transmissibility, particularly in African context (17–19). In Burundi, secondary attack rates of up to 14% have been reported among household and sexual contacts (18). However, the absence of secondary transmission in Zambia, despite involvement of Clade 1b, suggests the influence of specific contextual factors. This observation is consistent with a study indicating that Mpox transmission is highly dependent on the nature of exposure (18). For example, a study conducted in Bujumbura, Burundi, identified sexual contact and intra-household exposure as primary transmission routes, with no infections reported following casual or transit-related interactions paralleling the exposure scenario of our index case (18). In contrast, Clade 1b outbreaks in the Democratic Republic of Congo have demonstrated sustained transmission within familial caregiving and sexual networks (18). These findings underscore the role of exposure context in determining transmission outcomes, even with highly transmissible viral strains. Strengthening targeted surveillance and risk communication among mobile populations, such as truck drivers, is essential. Additionally, border health interventions and awareness campaigns focusing on high-risk exposures may aid in preventing future transmission.

In this investigation, we did not establish evidence of community transmission of Mpox. However, a review of health facility records during the period revealed that chickenpox and dermatitis were the most reported skin conditions. Both conditions can present with vesicular or pustular rashes that closely resemble early-stage Mpox, posing challenges for clinical differentiation (20-22). Similar diagnostic overlap has been reported in other settings, where Mpox cases were initially misclassified as varicella, particularly in the absence of laboratory confirmation (21,22) . While these findings do not indicate undetected community spread, they underscore the importance of strengthening syndromic surveillance systems for rash illnesses. Enhancing frontline clinician capacity to distinguish between Mpox and similar conditions, alongside expanded access to PCR testing for both Mpox and varicella viruses, could reduce misclassification and improve the sensitivity of outbreak detection efforts.

Response to the Mpox case in Chitambo met the 7-1-7 benchmark, with detection, notification, and response all occurring within recommended timeframes. Similar performance has been associated with improved outbreak control in other African countries. For instance, Nigeria and Kenya have reported that timely detection and response, supported by dedicated outbreak funds and rapid response teams, contributed to shorter outbreaks and limited transmission (23-25). However, maintaining such capacity will require investment in laboratory infrastructure, digital reporting systems, and workforce training (24).

This investigation faced several limitations. Incomplete contact tracing and reliance on self-reported information often conveyed through interpreters may have introduced recall and reporting biases. Logistical challenges, including fuel shortages and lack of pre-positioned response supplies, impeded timely field operations. Diagnostic variability across specimen types, suboptimal sample quality, and potential underreporting of skin conditions in outpatient records limited the accuracy of case ascertainment and retrospective exposure assessment. Additionally, the absence of phylogenetic analysis constrained the ability to infer regional transmission pathways. Future investigations should incorporate genomic sequencing and strengthen sample quality assurance to improve diagnostic yield and inform epidemiologic linkages.

Conclusion

This case underscores the importance of border surveillance, targeted health communication, and preparedness for infectious disease threats in transit corridors like Chitambo. Health systems in such areas need support in improving diagnostic capacity, managing high-risk mobile populations, and sustaining trained surveillance teams. Future responses would benefit from integrating Mpox into broader outbreak preparedness plans, strengthening border surveillance, and ensuring that rural facilities are equipped to recognize and respond to suspected cases promptly.

References

1. Bapolisi WA, Krasemann S, Wayengera M,Kirenga B, Bahizire E, Malembaka EB, et al.Mpox outbreak tecovirimat resistance, management approaches, and challenges in HIV-endemic regions. LancetInfect Dis. 2024;3099(24):1-2.

2. Satapathy P, Khatib MN, Gaidhane S, Zahiruddin QS, Alrasheed HA, Al-Subaie MF,et al. Multi-organ clinical manifestations of Mpox: an umbrella review of systematic reviews. BMC Infect Dis. 2024;24(1).

3. Miura F, van Ewijk CE, Backer JA, Xiridou M,Franz E, Op de Coul E, et al. Estimated incubation period for monkeypox cases confirmed in the Netherlands, May 2022.Euro Surveill Bull Eur sur les Mal Transm =Eur Commun Dis Bull. 2022 Jun;27(24).

4.McFarland SE, Marcus U, Hemmers L, MiuraF, Iñigo Martínez J, Martínez FM, et al. Estimated incubation period distributions of mpox using cases from two international European festivals and outbreaks in a club in Berlin, May to June 2022. Euro Surveill Bull Eur sur les Mal Transm = Eur Commun Dis Bull. 2023 Jul;28(27).

5. WHO. Multi-country outbreak of mpox.WHO Extern Situat Rep [Internet]. 2024;(28).Available from: https://www.who.int/publications/m/item/multi-country-outbreak-of-mpox--external-situation-report-28--19-september-2023

6. Massmed. Incubation Period, Symptoms and Contagiousness. 2024; Available from: https://www.massmed.org/Mpox/Incubation-Period,-Symptoms-and-Contagiousness/

7. Islam MM, Dutta P, Rashid R, Jaffery SS, Islam A, Farag E, et al. Pathogenicity and virulence of monkeypox at the human-animal-ecology interface. 2023 Dec;14(1):2186357.

8. Meo SA, Al-Khlaiwi T, Al Jassir FF, Meo AS.Impact of traveling on transmission trends of human monkeypox disease: worldwide data based observational analysis. Front Public Heal. 2023;11(June).

9. CDC A. Mpox Situation in Africa [Internet]. 2024. Available from: https://africacdc.org/download/outbreak-report-13-september-2024-mpox-situation-in-africa/

10. WHO. WHO Director-General declares the ongoing monkeypox outbreak a Public Health Emergency of International Concern [Internet]. 2022. Available from: https://www.who.int/europe/news/item/23-07-2022-who-director-general-declares-the-ongoing-monkeypox-outbreak-a-public health-event-of-international-concern

11. Parums D V. Editorial: Current Status of Non-Endemic Global Infections with the Monkeypox Virus. Vol. 28, Medical science monitor : international medical journal of experimental and clinical research. United States; 2022. p. e938203.

12. Rivers C, Watson C, Phelan AL. The Resurgence of Mpox in Africa. JAMA. 2024;332(13):1045–6.

13. ECDC. Risk assessment for the EU/EEA of the mpox epidemic caused by monkeypox virus clade I in affected African countries. 2024.

14. CDC. How Mpox Spreads | Mpox | CDC.2025.

15. Beeson A, Styczynski A, Hutson CL, Whitehill F, Angelo KM, Minhaj FS, et al. Mpox respiratory transmission: the state of the evidence. The Lancet Microbe. 2025 Apr 1;4(4):e277–83.

16. Kuehn R, Fox T, Guyatt G, Lutje V, Gould S.Infection prevention and control measures to reduce the transmission of mpox: A systematic review. PLOS Glob Public Heal. 2024 Jan 1;4(1):e0002731.

17. Srivastava S, Laxmi, Sharma K, Sridhar SB, Talath S, Shareef J, et al. Clade Ib: a new emerging threat in the Mpox outbreak. Front Pharmacol. 2024;15(December):1-16.

18. Otshudiema JO, Nkengurutse L, Kamwenubusa G, Diallo I, Sibomana A, Nsavyimana O, et al. Epidemiological Characteristics and Transmission Dynamics of Mpox in Bujumbura, Burundi: A Prospective Cohort Study. 2025;

19. Gueye AS. The surge of mpox in African countries. PAMJ 2025; 501. 2025 Mar 2;50(1).

20. WHO. Mpox. 2024.

21. Hughes CM, Liu L, Davidson WB, Radford KW, Wilkins K, Monroe B, et al. A Tale of Two Viruses: Coinfections of Monkeypox and Varicella Zoster Virus in the Democratic Republic of Congo. Am J Trop Med Hyg.2020 Feb 1;104(2):604.

22. Coppens J, Liesenborghs L, Vercauteren K, Esbroeck M Van, Van Dijck C. No Varicella Zoster Virus Infection among Mpox Cases in Antwerp, Belgium. Am J Trop Med Hyg. 2023;109(6):1282–3.

23. Bochner AF, Makumbi I, Aderinola O, Abayneh A, Jetoh R, Yemanaberhan RL, et al. Implementation of the 7-1-7 target for detection, notification, and response to public health threats in five countries: a retrospective, observational study. Lancet Glob Heal. 2023 Jun 1;11(6):e871–9.

24. Frieden TR, Lee CT, Bochner AF, Buissonnière M, McClelland A. 7-1-7: an organising principle, target, and accountability metric to make the world safer from pandemics. Lancet [Internet]. 2024 Aug 14 [cited 2025 May 13];398(10300):638–40. Available from: https://www.cdc.gov/global-health/impact/7-1-7-disease-detection.html

25. CDC. 7-1-7 Framework in Kenya | Global Health | CDC. 2024.

Case Report: Mpox related mortality in a 7 monthold infant in Zambia

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Cite this article: *Lilanda, Y., Simwaka, M., Malasa, M., Mwenya, F., Pepala, S., Pumulo, N., Sakala, J., Shempela, D., Banda, D., Mubemba, B., & Sinyange, N. (2025). Case report: Mpox-related mortality in a 7-month-old infant in Zambia. Health Press, 08(2): 42-51.*

Abstract

Mpox is a zoonotic disease caused by the orthopoxvirus genus, with increasing incidence among children in low- and middle-income countries. It is transmitted via human-to-human, animal-to-human, and vertical transmission pathways and is characterized by systemic symptoms and a distinctive rash. In March 2025, Zambia recorded its first Mpox-related mortality in a 7-month-old premature infant, prompting an investigation into contributing factors. A descriptive case study was conducted at Chipata First-Level Hospital in Lusaka Province to examine the diagnosis, treatment, and facility preparedness in managing this case.

The infant presented with respiratory distress and skin lesions two weeks after symptom onset. Initially misdiagnosed as chickenpox, she was later treated for pneumonia with suspected Mpox. Her condition worsened despite administration of antibiotics, oxygen therapy, and wound care. She was moved to an understaffed isolation ward, and no laboratory or radiological investigations were performed due to resource constraints. HIV status was assumed negative based on maternal history. The child deteriorated and died on the third day of admission.

This case highlights several healthcare system gaps in Mpox case management in Zambia. These include delayed health-seeking behavior, limited diagnostic capacity, staffing shortages, and weak surveillance and response systems. Risk factors such as prematurity and inadequate clinical suspicion may have further contributed to the fatal outcome. The findings underscore the urgent need for improved clinical awareness of Mpox, community engagement to encourage early care-seeking, enhanced diagnostic capacity, and better facility preparedness to manage future Mpox cases effectively and reduce mortality.

Key words: Mpox, Prematurity, Infant, Mortality

Introduction

Mpox (formerly known as Monkeypox) is a zoonotic disease that has been known to affect humans since the 1970s and has been observed to affect more children and adolescents in low and middle-income countries (1,2). It has a similar clinical presentation to smallpox, though Mpox presents with less severe disease. Clinical symptoms include; itchy and painful firm or rubbery lesions that are well circumscribed, and umbilicated in later stages usually affecting palms of hands and soles of feet but may affect various body parts at different times. Other features include fever, myalgia, chills and lymphadenopathy (3–5). The severity and the clinical features may vary depending on how the infection was acquired (3,4). Severity is also dependent on other factors. For example, very young age, poor nutrition status and being immunocompromised such as in HIV patients with high viral load and low CD4 count lead to severe disease outcomes (6–9). Incidence is higher in children and estimated to be as high as 18.1 / 100 000 among 5 - 9 year old (1,3,5). It affects more

males than females (1,2). A mortality rate of about 11% in unvaccinated individuals has been reported previously (2,8,10,11).

Mpox belongs to the family poxviridae and the genus orthopoxvirus, the same genus for smallpox. It is classified into 2 clades which are geographically structured. Clade I (formerly known as the Congo Basin or Central African clade) includes two subclades: Clade Ia and Clade Ib. Clade II (formerly known as the West African clade) includes two subclades: Clade IIa and Clade IIb. Clade I is associated with higher virulence and higher mortality compared to clade II (3,9,11–13).

The cases reported in Zambia so far are clade 1b (14). In the Central African Republic and the Democratic Republic of the Congo, clade I Mpox Virus (MPXV) has been reported. Similarly, Sudan has also recorded outbreaks linked primarily to clade I MPXV (15–17). Nigeria, however, has recorded an increase in cases of clade IIb (18). Aside from central African region, other regions including: North African region, European region, Region of the Americas, South-East Asia region, and Western Pacific region all show higher prevalence of clade II than clade I (16).

In terms of the transmission pathway, Mpox is "human-human and animal-human." The virus can initially infect humans through animal bites and scratches. Stool and flies have also been found to be possible vectors of transmission(19). Human to human transmission occurs through contact with bodily fluids, respiratory droplets or contact with exudates from the lesions or with contaminated surfaces (3,9,12,13). Mpox is also transmitted vertically from mother to unborn child and may also be transmitted through breastfeeding (5,20–23). When vertically transmitted from mother to unborn child, Mpox can lead to still births and miscarriages (20,24,25).

As of 31 March 2025, Zambia had recorded 36 confirmed cases of Mpox across 4 provinces (Central, Copperbelt, Lusaka and Western). Of these, there was an equal sex distribution and more than half (55%) were children. The country unfortunately recorded its first Mpox related mortality in a 7-month-old infant on the 13th March 2025 (14). Therefore, we investigated to understand the what may have contributed to the mortality. We looked at any delay in health seeking, diagnosis and management of the patient, patient follow ups and any risk factors that the patient had that may have contributed to the outcome.

Methods

Study design, setting and data collection

This was a descriptive study of a 7-month-old infant that was recorded as the first Mpox related death in Zambia. The investigation took place at Chipata First-Level Hospital, Mandevu constituency in Lusaka Province, Zambia. Data was gathered through in-person interviews with medical professionals involved in the management and treatment of the Mpox case, as well as a review of the deceased infant's medical records. In addition, an evaluation of the preparedness of healthcare facility to detect, manage and respond to Mpox cases was conducted.

Data Analysis

A detailed descriptive epidemiology of the case was conducted. The patients' demographics details, clinical features, treatment, and disease progression was analyzed and documented, including all relevant laboratory findings and assessment of the diagnosis timeline. To assess risk factors for Mpox mortality, we looked for any delays in seeking healthcare services and comorbid conditions. We assessed how patient was managed throughout the entire hospital stay and any gaps in healthcare delivery noted.

Ethical Considerations

Permission was sought from the Lusaka provincial health office and the senior medical superintendent for Chipata first-level hospital before beginning to look through the patient's medical records. To ensure privacy of the patient, the identities were not recorded. Permission was also sought to publish the information in a peer-reviewed journal.

Case Presentation

History

A 7-month-old female infant, born preterm at an unknown gestational age with a birth weight of 1.8 kg, presented at Chipata First-Level Hospital on March 13, 2025, with complaints of cough and respiratory difficulties for three days, skin lesions for seven days, a history of diarrhea before admission which had resolved and poor appetite but no vomiting or fever.

Prior to hospital admission, she had been seen at a local clinic for similar symptoms and received unknown medication, but her condition did not improve. She was still breastfeeding and had received all age-appropriate immunizations. Her HIV status was unknown, with reliance on maternal antenatal HIV results. She had no history of travel out of Lusaka and no known contact with an Mpox case. The mother was a housewife while the father was a businessman man who

sometimes traveled out of town.

Examination Findings

Upon initial examination at Chipata First-Level Hospital, the infant was in respiratory distress with a respiratory rate of 60 bpm, nasal flaring, and accessory muscle use, afebrile (36.3°C), with no pallor, jaundice, or cyanosis. Chest auscultation revealed bilateral basal fine crepitations. The skin had red fluid-filled lesions, some open with crusting around them. Cardiovascular examination showed normal heartrate with normal heart sounds. Examination of other systems was normal.

Initial diagnosis was dermatitis, later revised to bronchiolitis to rule out pneumonia with suspected chickenpox on same day. She was admitted for oxygen therapy, Amoxicillin and Paracetamol syrup.

Clinical Progression

Day 1: The child was admitted in a general pediatric ward for bronchiolitis to rule out pneumonia with chickenpox and given oxygen therapy, Amoxicillin and Paracetamol syrup. Investigations such as full blood count and chest x-ray were also ordered. Further nursing care included keeping the child warm and nasal suctioning as per required need.

Day 2: She became irritable and developed bleeding skin lesions. A diagnosis of pneumonia with suspected Mpox was made, prompting transfer to the isolation ward despite the ward having inadequate staffing. Treatment included Cefotaxime, calamine lotion, wound care, and continuation of oxygen therapy. Blood samples and swabs from the lesions were then collected and sent to the Zambia National Public Health Reference Laboratory (ZNPHRL) for Mpox polymerase chain reaction (PCR) testing and Next Generation sequencing (NGS).

Day 3: The patient remained in isolation, but at midnight, her mother noticed a change in her breathing. With no staff allocated to the isolation ward at that time, when the healthcare workers arrived, despite adequate resuscitation, the infant was unresponsive with dilated pupils and no cardiopulmonary activity. She was pronounced dead at 00:40 hours on March 15, 2025. Cause of death at that time was severe pneumonia in suspected Mpox patient.

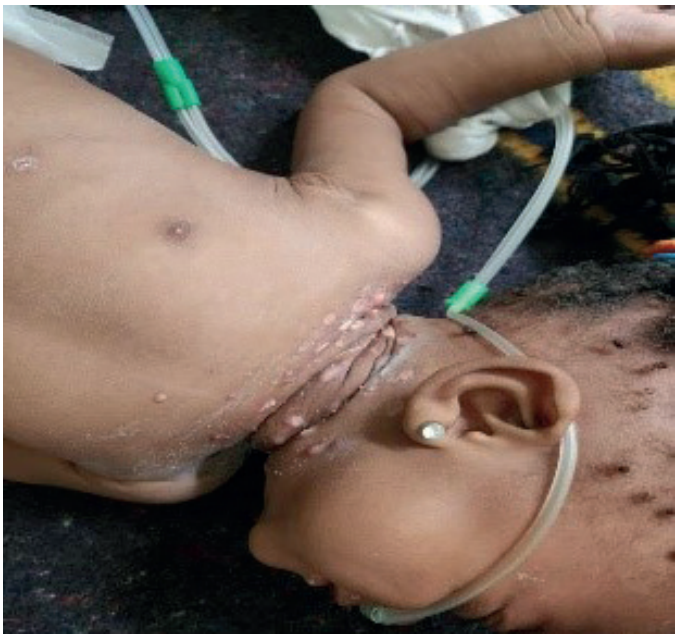

Figure 2: Some fluid filled lesions around the neck with some crusted

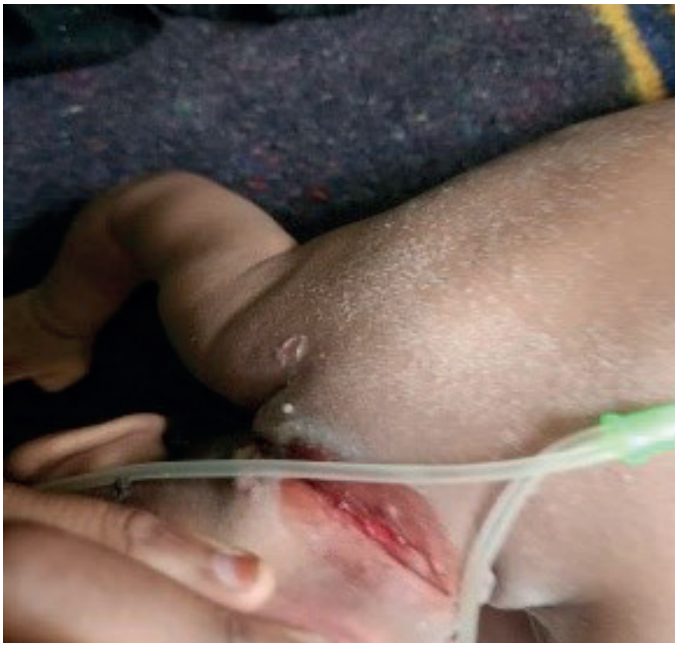

Figure 1: Bleeding skin lesion around the neck

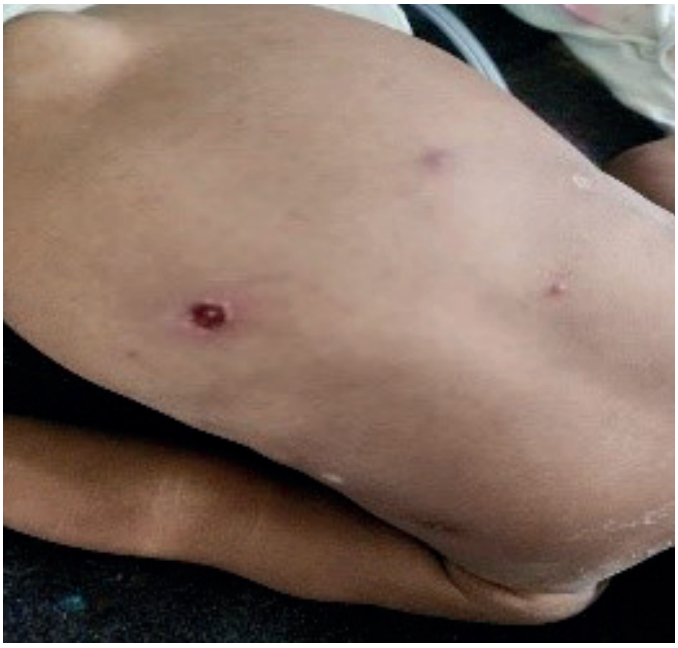

Figure 3: Crusted skin lesion on the abdomen

On the 17th of March, 2025 (2 days after patient's death), Chipata First-Level Hospital received the notification of a confirmed Mpox case result from ZNPHRL. The type of Mpox isolated was clade 1b. As a response to this notification, the next day, the sub-district rapid response team mobilized and visited the deceased's home for the purpose of notifying them on the results including contact tracing of close contacts. Health care workers that were in contact with the case were listed as contacts. A total of 7 contacts were enlisted, and followed up for a period of 21 days, and all contacts remained asymptomatic.

Discussion

This case report gives a detailed account of the first Mpox mortality recorded in Zambia involving a 7-month-old infant. It highlights the importance of seeking healthcare services early, critical need for increased community awareness, strengthened surveillance, increased index of mpox suspicion, early detection, and improved staffing of healthcare facilities in Zambia.

In agreement with our findings, previous studies have shown that children are at high risk for severe Mpox infection (3,16,26,27). The one-week delay in seeking medical attention may have contributed to the worsening of illness. Studies have shown that seeking early medical attention usually leads to better outcome in patients with Mpox (28,29). Therefore, risk communication and community sensitization needs to be intensified on early seeking of medical care to improve outcomes (30,31).

In terms of symptoms and diagnosis, the child presented with rash typical of Mpox. However, studies have shown that the lesions of chicken pox may be similar to those of Mpox (32,33). Therefore, there is need for high index of suspicion in any child that presents with chicken pox. The initial misdiagnosis of dermatitis at the referral hospital also suggests limitations in clinical awareness and low index of Mpox suspicion among some health care workers. High index of suspicion and proper management reduces Mpox mortality (9,28). More continuous medical education on Mpox symptoms, diagnosis and management especially in pediatric cases where presentation may be atypical needs to be conducted among health care workers (3,34,35).

There were inadequate investigations done on the child due to limited resources. Full blood count was ordered but not done due to lack of reagents. Another gap was lack of HIV testing and relying on maternal diagnosis. Studies have shown that patients with HIV and Mpox usually present with more severe symptoms and more complications (36–38). It therefore would have been necessary to know whether this child had HIV coinfection which may have contributed to poor prognosis. Emphasis should, therefore, be made to all health care workers to adhere to standard guidelines on Prevention of mother to child transmission(PMTCT) for three monthly HIV testing on breastfeeding mothers and their infants so as to reduce on mother to child HIV transmission (39).

The treatment of Mpox is supportive focusing on skin care and analgesia for pain relief (1,3,40). In some countries, Tecovirimat an antiviral is licensed for use in severe mpox cases in children, adolescents and adults (3,40). This patient presented with severe pneumonia and Mpox. Though rare, some studies have shown that in immune compromised, Mpox can present with complications including superimposed bacterial infection and pneumonia (28,40). Therefore, the treatment with the antibiotic may have been warranted.

Of significance is that the patient was born prematurely with a birth weight of 1.8kg. Premature infants have increased susceptibility to childhood infection due to inadequate immunity (41–43). A recent metanalyses from Congo DRC showed that weak immune system increased the risks of mortality from mpox (27). Prematurity in this child could have led to an increased susceptibility to severe Mpox infection and mortality despite having an adequate nutritional status (3).

Even though Chipata First Level Hospital had an isolation ward, it lacked enough staffing. Inadequate staff were allocated for the isolation ward, hence the ward lacked staffing during the night shift. Despite only having one patient, a well-staffed ward leads to proper patient care and reduces on mortality of patients as observed in other studies (44–46). Gaps in facility surveillance included; inadequate contact tracing and lack of detailed verbal autopsy, resulting in the failure to fully identify the source of the infection. The unwillingness from the child's family and the inadequate history given by the few family members who were interviewed may have contributed to the inadequate surveillance response activities. Contact tracing in Mpox is vital to prevent further disease spread (47,48).

Mpox infection in a 7-month-old with no history of travel or known contact with an Mpox case shows that there is ongoing transmission within the household or community (1,3). More community education on

Mpox needs to be done. Opportunities of community education include; child health clinics, radio programs, school assemblies, education in market places and media (27,30,31). Communities should be reassured on the lack of stigma as many of them may fail to seek healthcare in fear of being stigmatized (31,49).

While this case provides critical insights, the investigation faced limitations. A detailed verbal autopsy could not be conducted due to the family's mobility between residences, which also hindered effective contact tracing and family counselling.

Conclusion

This case report has highlighted some factors that may have contributed to Zambia's first Mpox-related death. Delays in seeking health care services and prematurity could have been the major contributing factors to the disease progression and eventual mortality. Educating communities about Mpox symptoms and preventive measures can reduce transmission risks. Strengthening Mpox surveillance and ensuring healthcare workers are equipped with better diagnostic guidelines will also improve early detection. Investing in training programs and ensuring sufficient medical supplies such as reagents for basic tests (e.g. full blood count), improving oxygen supplies in all health care facilities, and provision of adequate staff can enhance Mpox case management.

References

1. Sanchez Clemente N, Coles C, Paixao ES,Brickley EB, Whittaker E, Alfven T, et al. Paediatric, maternal, and congenital mpox: a systematic review and meta-analysis. Lancet Glob Heal [Internet]. 2024;12(4):e572–88. Available from: http://dx.doi.org/10.1016/S2214-109X(23)00607-1

2. Whitehouse ER, Bonwitt J, Hughes CM, Lushima RS, Likafi T, Nguete B, et al. Clinical and Epidemiological Findings from Enhanced Monkeypox Surveillance in Tshuapa Province, Democratic Republic of the Congo during 2011-2015. J Infect Dis. 2021;223(11):1870-8.

3. Beeson AM, Haston J, McCormick DW, Reynolds M, Chatham-Stephens K, McCollum AM, et al. Mpox in Children and Adolescents: Epidemiology, Clinical Features, Diagnosis, and Management. Pediatrics. 2023;151(2).

4. Reynolds MG, Yorita KL, Kuehnert MJ, Davidson WB, Huhn GD, Holman RC, et al. Clinical manifestations of human monkeypox influenced by route of infection. J Infect Dis. 2006;194(6):773–80.

5. Jezek Z, Gromyko AI, Szczeniowski M V. Human monkeypox. J Hyg Epidemiol Microbiol Immunol [Internet]. 1983;27(1):13-28. Available from: http://europepmc.org/abstract/MED/6304185

6. Sklenovská N, Van Ranst M. Emergence of Monkeypox as the Most Important Orthopoxvirus Infection in Humans. Front Public Heal. 2018;6(September):1–12.

7. Reynolds MG, McCollum AM, Nguete B, Lushima RS, Petersen BW. Improving the care and treatment of monkeypox patients in low-resource settings: Applying evidence from contemporary biomedical and smallpox biodefense research. Viruses. 2017;9(12).

8. Ježek Z, Szczeniowski M, Paluku KM, Mutombo M. Human Monkeypox: Clinical Features of 282 Patients. J Infect Dis. 1987;156(2):293–8.

9. World Health Organisation. Strategic_Framework_for_Enhancing_Prevention and control of mpox 2024 2027. 2024.

10. Wilson ME, Hughes JM, McCollum AM,Damon IK. Human monkeypox. Clin Infect Dis. 2014;58(2):260–7.

11. Meo MO, Meo MZ, Khan IM, Butt MA,Usmani AM, Meo SA. Rising epidemiological trends in prevalence and mortality of mpox: Global insights and analysis. Saudi Med J. 2024;45(12):1334–9.

12. Vakaniaki EH, Kacita C, Kinganda-Lusamaki E, O'Toole Á, Wawina-Bokalanga T, Mukadi-Bamuleka D, et al. Sustained human outbreak of a new MPXV clade I lineage in eastern Democratic Republic of the Congo. Nat Med. 2024;30(October).

13. Akingbola A, Adegbesan CA, Adewole O, Idahor C, Odukoya T, Nwaeze E, et al. Understanding the resurgence of mpox : key drivers and lessons from recent outbreaks in Africa. Trop Med Health [Internet]. 2025;1:1-12. Available from: https://doi.org/10.1186/s41182-024-00678-1

14. ZNPHI/MOH/WHO. ZAMBIA MPOX SITUATION REPORT 14. ZNPHI Sitrep week 14. 2025;(March):1–10.

15. Rimoin AW, Mulembakani PM, Johnston SC, Lloyd Smith JO, Kisalu NK, Kinkela TL, et al. Major increase in human monkeypox incidence 30 years after smallpox vaccination campaigns cease in the Democratic Republic of Congo. Proc Natl Acad Sci U S A. 2010;107(37):16262–7.

16. Laurenson-Schafer H, Sklenovská N, Hoxha A,Kerr SM, Ndumbi P, Fitzner J, et al. Description of the first global outbreak of mpox: an analysis of global surveillance data.Lancet Glob Heal. 2023;11(7):e1012–23.

17. Kalthan E, Tenguere J, Ndjapou SG, Koyazengbe TA, Mbomba J, Marada RM, et al. Investigation of an outbreak of monkeypox in an area occupied by armed groups, Central African Republic. Med Mal Infect [Internet]. 2018;48(4):263–8. Available from:https://doi.org/10.1016/j.med mal.2018.02.010

18. Awoyomi OJ, Njoga EO, Jaja IF, Oyeleye FA, Awoyomi PO, Ibrahim MA, et al. Mpox in Nigeria: Perceptions and knowledge of the disease among critical stakeholders-Global public health consequences. PLoS One [Internet]. 2023;18(3 March):1–22. Available from: http://dx.doi.org/10.1371/journal.pone.0283571

19. Patrono L V, Pléh K, Samuni L, Ulrich M, Röthemeier C, Sachse A, et al. Monkeypox virus emergence in wild chimpanzees reveals distinct clinical outcomes and viral diversity. Nat Microbiol [Internet]. 2020;5(7):955–65. Available from: https://doi.org/10.1038/s41564-020-0706-0

20. Mbala PK, Huggins JW, Riu-Rovira T, Ahuka SM, Mulembakani P, Rimoin AW, et al. Maternal and Fetal Outcomes among Pregnant Women with Human Monkeypox Infection in the Democratic Republic of Congo. J Infect Dis. 2017;216(7):824–8.

21. Schwartz DA, Ha S, Dashraath P, Baud D,Pittman PR, Waldorf KA. Mpox Virus in Pregnancy, the Placenta, and Newborn: An Emerging Poxvirus With Similarities to Smallpox and Other Orthopoxvirus Agents Causing Maternal and Fetal Disease. Arch Pathol Lab Med. 2023;147(7):746–57.

22. Oakley LP, Hufstetler K, O'Shea J, Sharpe JD, McArdle C, Neelam V, et al. Mpox Cases Among Cisgender Women and Pregnant Persons -United States, May 11–November 7, 2022. MMWR Morb Mortal Wkly Rep. 2023;72(1):9–14.

23. Nakoune E, Lampaert E, Ndjapou SG, Janssens C, Zuniga I, Van Herp M, et al. A Nosocomial Outbreak of Human Monkeypox in the Central African Republic. Open Forum Infect Dis. 2017;4(4):1–4.

24. Gostin LO, Jha AK, Finch A. The Mpox Global Health Emergency - A Time for Solidarity and Equity. N Engl J Med. 2024;1267–70.

25. Velázquez-Cervantes MA, Ulloa-Aguilar JM, León-Juárez M. Mpox and pregnancy: A neglected disease and its impact on perinatal health. Rev Clínica Española (English Ed. 2023;223(1):32–9.

26. Zimmermann P, Curtis N. Monkeypox-What Pediatricians Need to Know. Pediatr Infect Dis J [Internet]. 2022;41(12). Available from:https://journals.lww.com/pidj/fulltext/2022/12000/monkeypox_what_pediatricians_need_to_know.23.aspx

27. Zobel F, Cheuyem L, Zemsi A, Ndungo JH, Achangwa C, Takpando-le-grand DR, et al. Mpox severity and mortality in the most endemic focus in africa : a systematic review and meta-analysis (1970-2024). 2025;1–31.

28. Ugwu CLJ, Bragazzi NL, Wu J, Kong JD, Asgary A, Orbinski J, et al. Risk factors associated with human Mpox infection: A systematic review and meta-Analysis. BMJ Glob Heal. 2025;10(2):1–14.

29. Weissman JS, Stern R, Fielding SL, Epstein AM. Delayed Access to Health Care: Risk Factors, Reasons, and Consequences. Ann Intern Med [Internet]. 1991 Feb 15;114(4):325–31. Available from: https://doi.org/10.7326/0003-4819-114-4-325

30. Elechi KW, Soyemi T, Anuoluwa O, Clinton O, Adaobi OM, Godfrey OC, et al. Building Bridges : The Role of Effective Community Engagement Strategies for Mpox Prevention and Response. 2025;15(September).

31. Afzal M, Sah AK. Effectiveness of Public Health Campaigns on Mpox Awareness and Prevention in Rural India: A Narrative Review. Infect Dis Clin Pract [Internet]. 2025;33(3). Available from: https://journals.lww.com/infectdis/fulltext/2025/05000/effectiveness_of_public_health_campaigns_on_mpox.6.aspx

32. Rasizadeh R, Ali S, Parisa SA, and Bannazadeh Baghi H. Comparison of human monkeypox, chickenpox and smallpox: a comprehensive review of pathology and dermatological manifestations. Curr Med Res Opin [Internet]. 2023 May 4;39(5):751–60. Available from: https://doi.org/10.1080/03007995.2023.2200122

33. Goupeyou-youmsi J, Ajong BN, Minkandi CA, Adama M. Mpox clinical features and varicella-zoster virus coinfection in the Democratic Republic of Congo : a systematicreview and meta-analysis (1970 – 2024). 2025;0–3.

34. Sokunbi AE, Adeyemi O. Exploring atypical manifestations of Mpox: Anarrative review. Res J Heal Sci. 2024;12(1):71–81.

35. Sanchez Clemente N, Le Doare K, Mupere E, Nachega JB, Rulisa S, Titanji B. Hidden in plain sight: the threat of mpox to children and adolescents. Lancet Child Adolesc Heal [Internet]. 2024 Dec 1;8(12):849–51. Available from: https://doi.org/10.1016/S2352-4642(24)00298-0

36. Pesonel E, Laouénan C, Guiraud L, Bourner J, Hoffmann I, Molino D, et al. Clinical Characterization and Outcomes of Human Clade IIb Mpox Virus Disease : A European Multicenter Mpox Observational Cohort Study (MOSAIC). Clin Infect Dis [Internet]. 2025;1–14. Available from: https://doi.org/10.1093/cid/ciae657

37. Saldana CS, Kelley CF, Aldred BM, Cantos VD. Mpox and HIV: a Narrative Review. Curr HIV/AIDS Rep [Internet]. 2023;20(4):261–9. Available from: https://doi.org/10.1007/s11904-023-00661-1

38. Mitjà O, Alemany A, Marks M, Lezama MoraJI, Rodríguez-Aldama JC, Torres Silva MS, et al. Mpox in people with advanced HIV infection: a global case series. Lancet. 2023;401(10380):939–49.

39. Zambian Ministry of Health. for Treatment and Prevention of HIV Infection. 2022;(May).Available from: https://www.differenti atedservicedelivery.org/wp-content/uploads/August-2022-Zambia-Consolidated-Guide lines.pdf

40. Titanji BK, Hazra A, Zucker J. Mpox Clinical Presentation, Diagnostic Approaches, and Treatment Strategies: A Review. JAMA [Internet]. 2024 Nov 19;332(19):1652–62. Available from: https://doi.org/10.1001/jama.2024.21091

41. Strunk T, Andrew C, Peter R, Karen S, and Burgner D. Innate immunity in human newborn infants: prematurity means more thanimmaturity. J Matern Neonatal Med [Internet]. 2011 Jan 1;24(1):25–31. Available from: https://doi.org/10.3109/14767058.2010.482605

42. Idzikowski E, Connors TJ. Impact and Clinical Implications of Prematurity on Adaptive Immune Development. Curr Pediatr Rep [Internet]. 2020;8(4):194–201. Availablefrom: https://doi.org/10.1007/s40124-020-00234-5

43. Helmo FR, Eduardo Arthur Rodovalho A, Renata Alves de Andrade M, Viviane Oliveira S, Laura Penna R, Maria Luíza Gonçalves dosReis M, et al. Intrauterine infection, immune system and premature birth. J Matern Neonatal Med [Internet]. 2018 May 3;31(9):1227–33. Available from: https://doi.org/10.1080/14767058.2017.1311318

44. Needleman J, Shekelle PG. More ward nursing staff improves inpatient outcomes, but how much is enough? BMJ Qual Saf. 2019;28(8):603–5.

45. Whitman GR, Kim Y, Davidson LJ, Wolf GA,Wang SL. The Impact of Staffing on Patient Outcomes Across Specialty Units. JONA J Nurs Adm [Internet]. 2002;32(12). Available from: https://journals.lww.com/jonajournal/fulltext/2002/12000/the_impact_of_staffing_on_patient_outcomes_across.8.aspx

46. Griffiths P, Saville C, Ball JE, Chable R, Dimech A, Jones J, et al. The Safer Nursing Care Tool as a guide to nurse staffing requirements on hospital wards: observational and modelling study. Heal Serv Deliv Res. 2020;8(16):1–162.

47. Prins H, Coyer L, De Angelis S, Bluemel B, Cauchi D, Baka A. Evaluation of mpox contact tracing activities and data collection in EU/EEA countries during the 2022 multicountry outbreak in nonendemic countries. J Med Virol. 2024;96(1):1–9.

48. Chitwood MH, Kwon J, Savinkina A, Walker J, Bilinski A, Gonsalves G. Estimated Testing, Tracing, and Vaccination Targets for Containment of the US Mpox Outbreak. JAMA Netw Open. 2023;6(1):E2250984.

49. Derksen L, Muula A. Love in the Time of HIV : Theory and Evidence on Social Stigma and Health Seeking Behavior. 2014;

Q1 SUMMARY OF OUTBREAKS
1st January - 31st April 2025

MEASLES

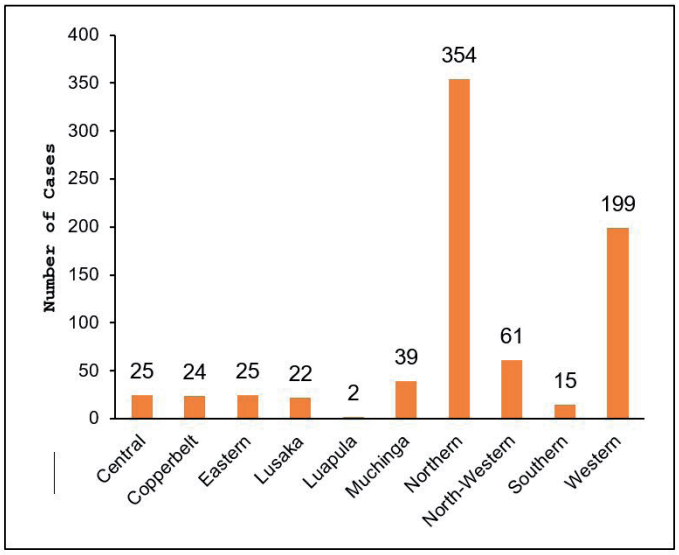

Figure 1 Quarter 1 Suspected Measles Cases by province (Source eIDSR, 2025)

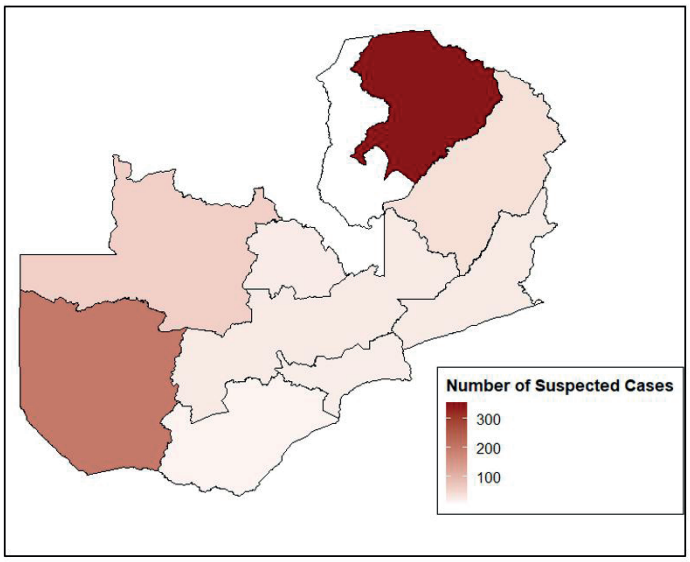

Figure 2 Map showing the distribution of suspected Measles cases

A total of 766 suspected measles cases were reported in Quarter 1, 2025, up from 652 in Q4, 2024, marking a reversal of the previous downward trend. Northern Province recorded the highest number of cases at 354, though this reflects a decline from 532 in Q4. Western Province followed with 199 cases, a sharp increase from zero. Muchinga Province reported 39 cases, continuing its downward trend from 67 in Q4 and 200 in Q3. Lusaka, Eastern, Copperbelt, and Central Provinces all saw increases from zero or low counts in Q4, reporting 22, 25, 24, and 25 cases respectively. North-Western and Southern Provinces reported 61 and 15 cases, while Luapula recorded 2.

While declines in Northern and Muchinga are encouraging, the resurgence in Western and other provinces highlights the need to strengthen immunization coverage and implement targeted vaccination campaigns.

ANTHRAX

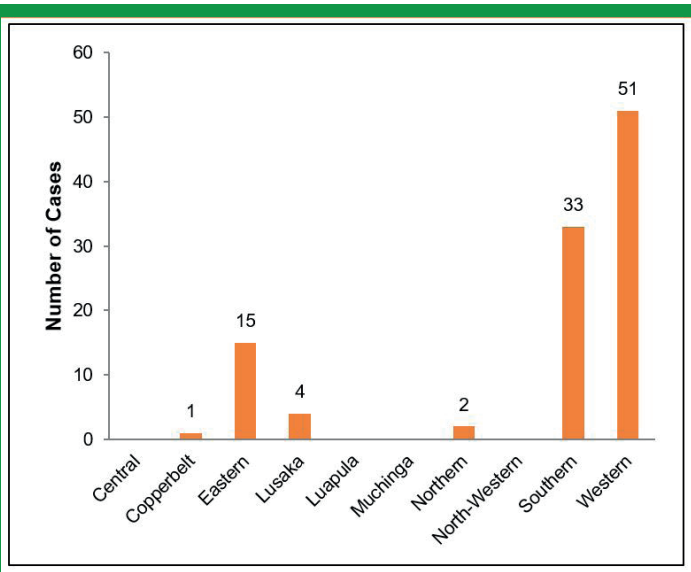

Figure 3 Quarter 1 Suspected Anthrax Cases by province (Source: eIDSR, 2025).

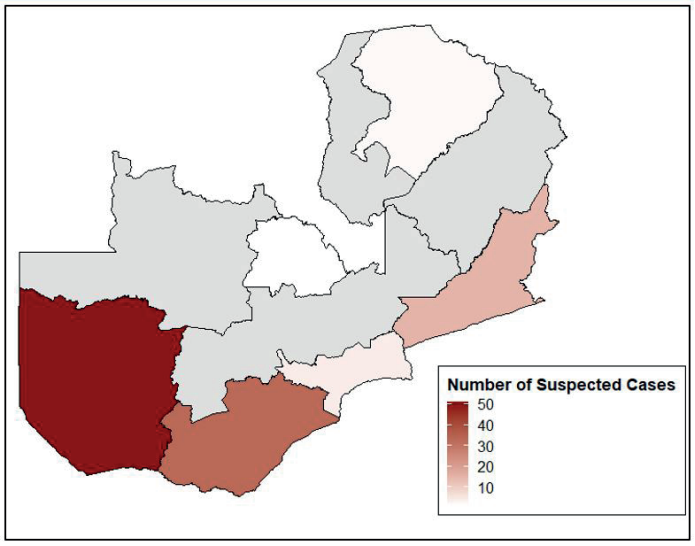

Figure 4 Map Showing the distribution of Suspected Anthrax Cases

In Quarter 1, 2025, 106 suspected anthrax cases were reported across eight provinces, marking a significant decline from 236 cases in Quarter 4, 2024. Western Province, where Anthrax is endemic remained the most affected with 51 cases, down from 126, while Southern Province reported 33 cases, a decrease from 92. Eastern Province recorded 15 cases, nearly doubling from 8. Despite the decline, public vigilance remains essential. The public is advised to maintain precautions, including sourcing meat from reputable vendors, thoroughly cooking meat, and promptly reporting suspected animal illnesses to health authorities.

BILHARZIA

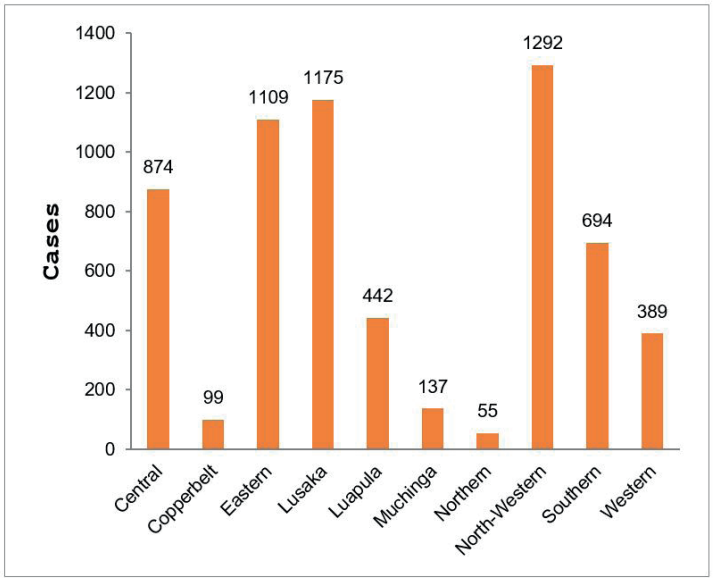

Figure 5 Quarter 1 suspected Bilharzia Cases by province (Source eIDSR, 2025)

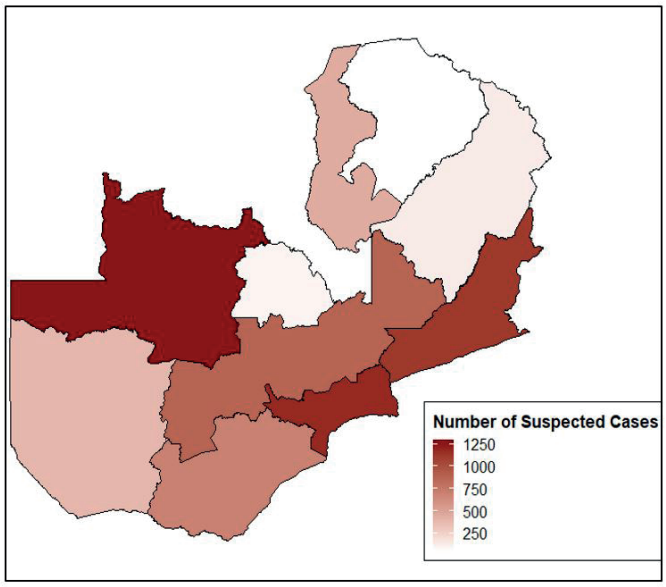

Figure 6 Map showing the distribution of suspected Bilharzia Cases

In Quarter 1, 2025, Zambia recorded 6,276 suspected Bilharzia cases across all ten provinces, reflecting a slight decrease from 6,839 cases in Quarter 4, 2024. North-Western Province remained the most affected with 1,292 cases, though slightly down from 1,377. Lusaka (1,175) and Eastern (1,109) also reported high numbers, both showing marginal declines. Central (874) and Southern (694) Provinces continued to report significant case counts, despite reductions from the previous quarter. Western (389), Muchinga (137), and Northern (55) also recorded decreases, while Luapula Province showed a modest increase to 442 cases from 415. Despite reductions in most provinces, the burden remains substantial, particularly in North-Western, Lusaka, and Eastern Provinces. There need to intensify WASH interventions, including the promotion of hygiene and sanitation practices, increased distribution of Information, Education and Communication (IEC) materials, and strengthened community engagement to reduce transmission.

TYPHOID FEVER

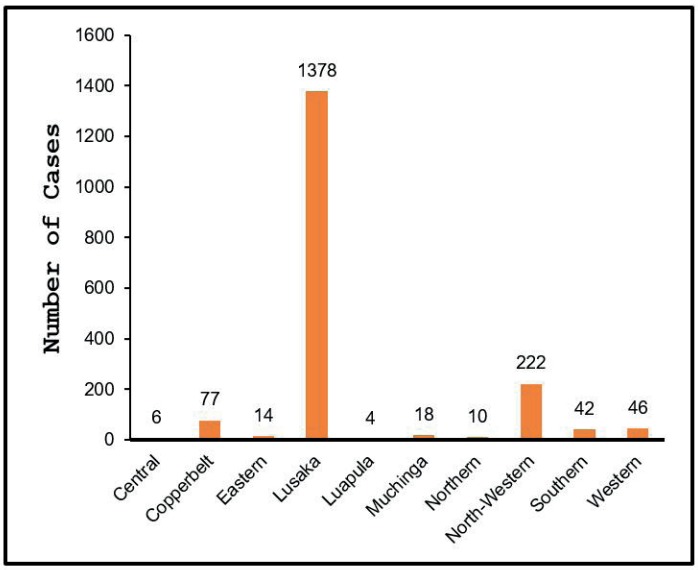

Figure 7 Quarter 1 reported suspected Typhoid Fever Cases by province (Source: eIDSR, 2025).

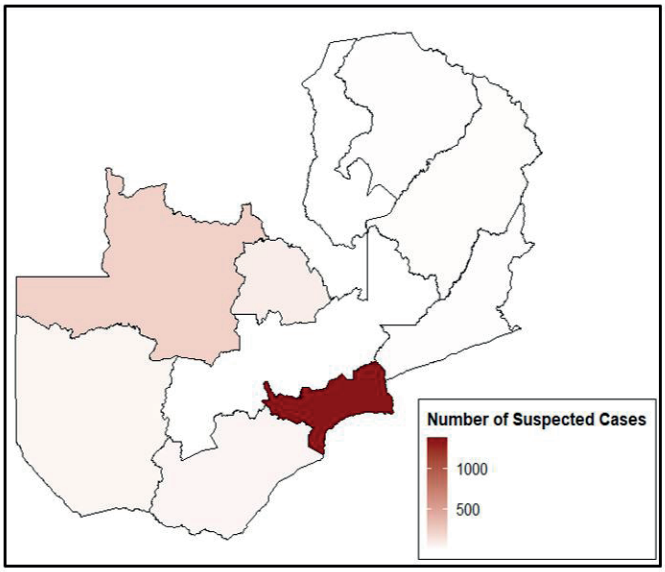

Figure 8 Map showing the distribution of suspected Typhoid Fever Cases

In Quarter 1, 2025, a total of 1,817 suspected Typhoid Fever cases were reported across Zambia's ten provinces, reflecting an increase from 1,286 cases in Quarter 4, 2024. Lusaka Province accounted for the majority (76%) of cases. This continues an upward trend, rising from 954 cases reported in quarter 4, 2024. North-Western Province followed with 222 cases, also rising from 145. Copperbelt (77), Western (46), and Southern (42) Provinces reported increased case numbers, with Southern showing a re-emergence after no reported cases in the previous quarter. Conversely, Eastern (14), Muchinga (18), Central (6), and Luapula (4) recorded declines. Northern Province saw a marginal increase from 8 to 10 cases. The rise in cases, particularly in Lusaka and North-Western, underscores the need for strengthened public health interventions, including improved sanitation, access to safe water, handwashing promotion, and food hygiene education to curb further transmission and protect at-risk populations.

ACUTE FLACCID PARALYSIS

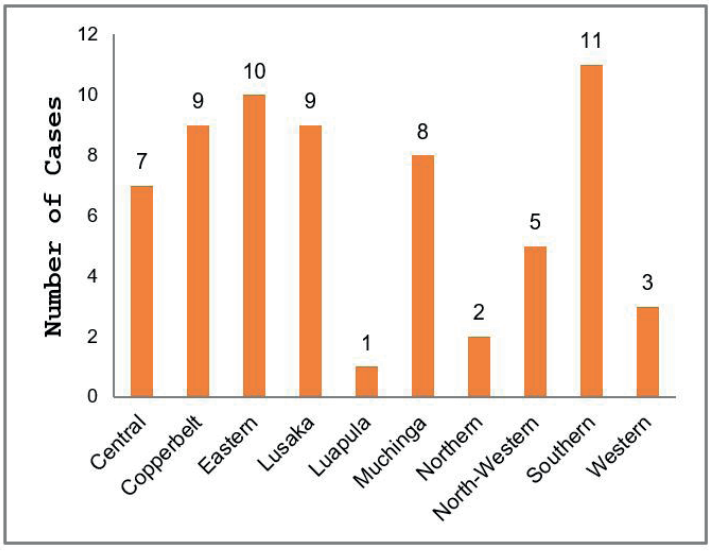

Figure 9 Quarter 1 reported suspected AFP per Province (Source: eIDSR, 2025).

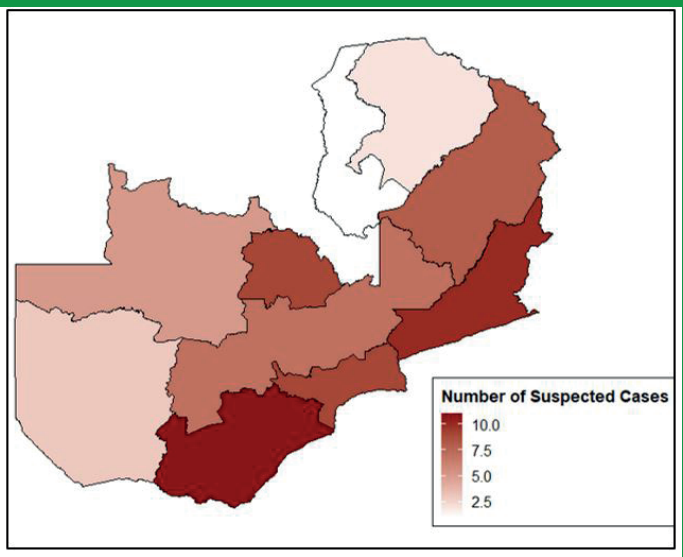

Figure 10 Map showing the distribution of AFP cases

In Quarter 1, 2025, a total of 65 suspected Acute Flaccid Paralysis (AFP) cases were reported across all ten provinces, down from 73 cases in Quarter 4, 2024. Southern Province recorded the highest number (11), followed by Eastern (10), and Copperbelt (9) and Lusaka (9). Northern (2) and Luapula (1) reported the fewest cases, while the most significant decrease was observed in Western Province (from 16 to 3). AFP is a key surveillance indicator for detecting poliovirus circulation, particularly in children under 15 years. The continued downward trend observed across three consecutive quarters underscores the importance of maintaining strong AFP surveillance, timely case investigation, and adequate laboratory support to sustain progress in poliovirus detection and response.

CHOLERA

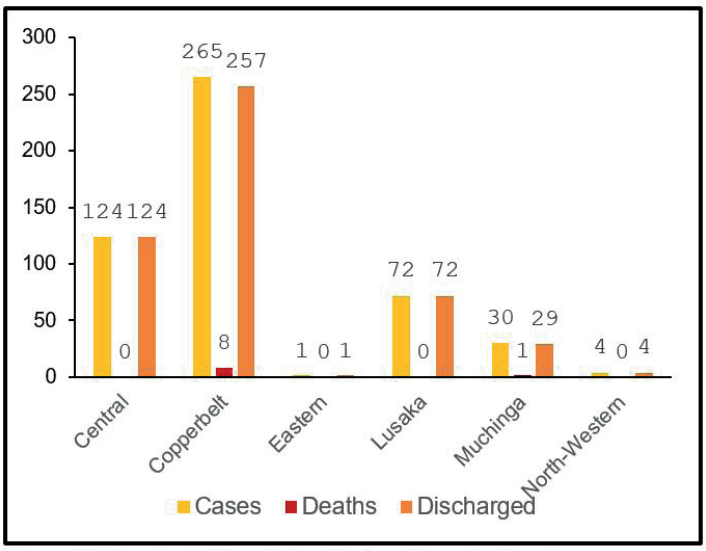

Figure 11 Quarter 1, Cumulative Cholera Cases by Province (Source Cholera situational report, 2025).

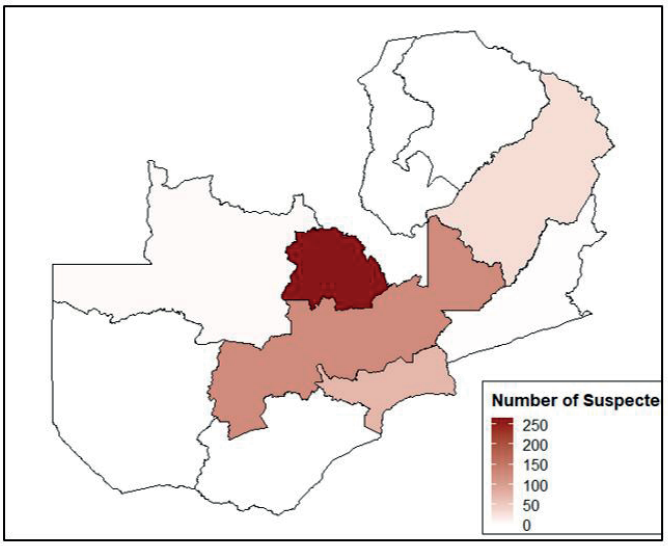

Figure 12 Map showing the distribution of suspected Bilharzia Cases

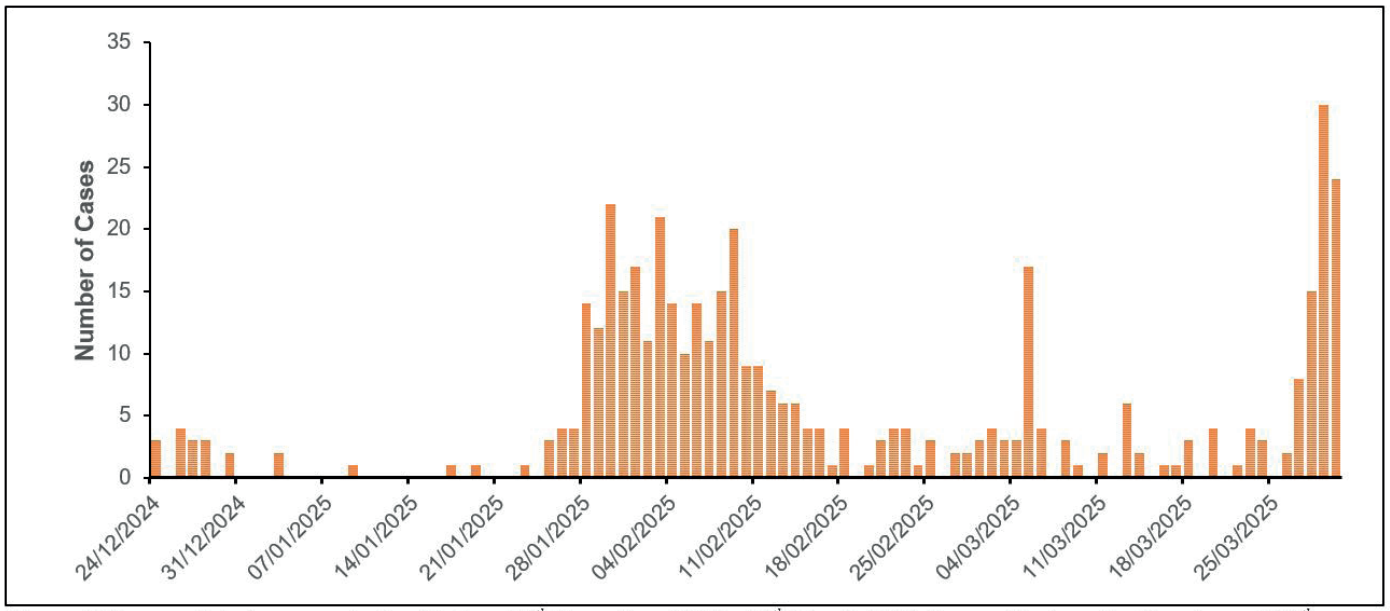

Figure 13 i curve of cholera cases in Zambia from 24th December, 2024 to 25th March, 2025 (Source Cholera situational report, 29th March, 2025).

By the end of Quarter 1, 2025, a cumulative total of 496 cholera cases had been reported across six provinces. The Copperbelt recorded the highest number of cases (265), followed by Central Province (124) and Lusaka Province (72). The lowest case counts were reported in Eastern (1 case) and North-Western (4 cases) Provinces. A total of 487 patients were discharged, and 9 deaths were recorded, resulting in a cumulative case fatality ratio (CFR) of 2%. The first cases of the current cholera outbreak were reported in Nakonde District in Muchinga Province in late December 2024. In January 2025, a case with no epidemiological link to the Muchinga outbreak was reported

at Kasumbalesa Market on the Copperbelt a major border market between Zambia and the Democratic Republic of Congo. Subsequently, additional cases were reported in other subdistricts of Copperbelt Province. As part of response, 1,428,424 people have been vaccinated in the affected districts.

Cholera is an acute diarrhoeal disease caused by ingestion of food or water contaminated with Vibrio cholerae, and it can be prevented through access to safe water, proper sanitation, good hygiene practices, and timely vaccination in high-risk areas. More information on the current cholera outbreak can found at https://w2.znphi.co.zm/resources/.

Summary Report Priority Diseases, Conditions and Events

Disease / Event	Week 1 - 13		
	Suspected	Tested	Confirmed
AFP	65	53	0
Anthrax	106	19	2
Cholera	726	583	430
COVID-19	3,499	2,769	137
Dog Bite	7,559	-	7,559
Dysentery	18,334	1,329	300
Schistosomiasis (Bilharzia)	6,266	2,539	555
Malaria	4,147,030	4,009,678	2,156,234
Measles	766	372	242
Meningitis (Neisseria)	187	127	2
MPox	178	148	35
Tuberculosis	120,292	109,596	5,192
Typhoid Fever	1,817	1,583	54

Data used was extracted from eIDSR on 16th May, 2025.

About eIDSR

The Electronic Integrated Disease Surveillance and Response System (eIDSR) is a disease surveillance system that is used to continuously and systematically collect, analyse, interpret, and visualize public health data. Data is collected at facility level and captured by district surveillance officers. The data reported in this bulletin was extracted from the system (except were indicated otherwise) on the aforementioned date.

For more information you can email *healthpress@znphi.co.zm*