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Patterns of HIV Care and Livelihood Experiences among People Living with HIV following Flood Events in Rural KwaZulu-Natal, South Africa

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Abstract

Background

KwaZulu-Natal (KZN) has experienced recurrent floods, with the April 2022 floods regarded as among the most devastating in South Africa's recorded history. We examined how flood-related extreme weather events shaped healthcare utilisation, HIV treatment continuity and livelihood experiences among people living with HIV (PLHIV) in rural KwaZulu-Natal.

Methods

We conducted an exploratory qualitative descriptive study in Hlabisa, uMkhanyakude District, KwaZulu-Natal. We conducted individual in-depth interviews with 26 PLHIV and four key informants. Six of the interviewed PLHIV also took part in a focus group discussion, and eight community health workers took part in a second focus group discussion. We analysed the data thematically using NVivo 15.

Results

Participants described how flooding disrupted healthcare access, livelihoods and well-being. Damaged roads, flooded rivers, and transport disruptions hindered access to HIV services, while livelihood losses contributed to food insecurity and emotional distress. Adaptive HIV service strategies, such as multi-month antiretroviral therapy dispensing and community-based delivery, provided some protection against prolonged treatment interruption, although their effectiveness depended on accessible routes, functioning facilities and available outreach capacity.

Conclusions

Our findings suggest that maintaining HIV services alone may not address the wider consequences of flooding. Climate-resilient HIV programming, including flexible treatment delivery, should be embedded within multisectoral measures that support livelihoods, equitable disaster assistance and community recovery for everyone in flood-affected areas.

1. Background

Climate change is a major and growing threat to population health because it increases exposure to extreme weather and compounds existing social and health-system vulnerabilities [1]. Health systems in low- and middle-income countries may be particularly affected where recurrent climatic shocks intersect with resource constraints and dependence on continuous care [2, 3]. Sub-Saharan Africa (SSA) remains the global epicentre of the HIV epidemic, with more than 60% of all people living with HIV (PLHIV) [4]. South Africa contributes substantially to this regional burden and currently carries the largest HIV

epidemic globally, with an estimated 8.15 million PLHIV. There are approximately 1.98 million PLHIV in KwaZulu-Natal (KZN) Province, where HIV prevalence is 16.0% [4–6]. In this context, Extreme Weather Events (EWEs) not only pose a general health risk but also threaten to undermine treatment continuity, erode livelihoods and amplify existing socio-economic inequalities.

Prior research has established important links between climate-related EWEs, HIV care disruptions, and livelihood vulnerability in Southern Africa, with evidence showing how floods and droughts interrupt healthcare access, reduce treatment continuity, and intensify socio-economic precarity among PLHIV [7–11]. A recent study from Zimbabwe reported this convergence of climate shocks, livelihoods and HIV/TB care, with most affected participants reporting disruptions to HIV services. Food insecurity, water shortages, crop failure, livestock losses, declining income and increased transport costs were identified as key barriers to treatment adherence and healthcare access [12]. Similarly, Logie et al. [13] found that repeated exposure to EWEs among adolescent girls and young women in Kenya was associated with food, water and sanitation insecurity. In turn, this resource insecurity was linked to greater HIV vulnerability, including a greater likelihood of transactional sex, intimate partner violence, increased sexual and reproductive health stigma and less decision-making power within intimate relationships. These findings identify broader structural pathways through which climate-related resource insecurity may intensify HIV vulnerability beyond disruptions to healthcare access alone. Nevertheless, limited research has examined how healthcare disruption, livelihood insecurity and institutional responses interact during household and service-system recovery following floods, particularly among adults receiving HIV treatment in rural South African settings.

EWEs, particularly floods, storms and drought, have become an increasingly important concern in South Africa and have attracted growing scholarly and policy attention [3, 7]. Consistent with global trends, a growing body of evidence suggests that these events are occurring with greater frequency and intensity across the country [14]. Historical records document more than 210 significant flood events between 1900 and 2022 and suggest that flood occurrence in KZN has likely doubled over the last century [14]. Also, since 1950, the frequency of extreme multi-day rainfall events has increased [14], contributing to substantial social, economic and infrastructural impacts [14]. This changing context has expanded the scope of inquiry beyond the immediate impacts of disasters to consider how recurrent environmental shocks affect vulnerability, resilience and recovery among different population groups. For example, Amusan et al. [15] examined how flooding in rural KZN disproportionately affected women through its impacts on subsistence agriculture, food security and access to resources, demonstrating that vulnerability is shaped not only by exposure to a hazard but also by underlying social and economic inequalities.

Similarly, using a systems approach, Orievulu et al. [8] explored the effects of drought on HIV treatment adherence in rural South Africa and found that drought indirectly affects adherence by intensifying pre-existing socioeconomic vulnerabilities and creating competing demands between healthcare needs and livelihood survival. The limited evidence to date points to a growing need for more integrated understanding of how EWEs shape both healthcare and livelihood trajectories among vulnerable

populations, particularly in settings characterised by high HIV prevalence, poverty and recurrent climate-related shocks. In this paper, we examine how flood-related EWEs shaped healthcare utilisation, treatment continuity, and everyday livelihood experiences among PLHIV in rural KZN. Specifically, we explored how flooding affected access to HIV care and treatment continuity, how it affected household livelihoods, food security and wellbeing, and how formal assistance and informal support shaped recovery.

2. Methods

2.1 Study Design

This paper draws on the qualitative component of a broader mixed-methods project examining the health, social and economic impacts of flood-related EWEs among PLHIV in KwaZulu-Natal, South Africa [3]. We adopted an exploratory qualitative descriptive design to obtain a detailed, experience-based account of how participants experienced flooding and its consequences, without seeking to generate or test theory[16]. Semi-structured in-depth interviews (IDIs) with PLHIV generated detailed individual accounts of flood exposure, HIV care and livelihood disruption. Focus group discussions (FGDs) enabled collective reflection among PLHIV and among community health workers (CHWs). Key informant interviews (KIIs) captured institutional perspectives on disaster management, environmental governance and HIV service delivery.

2.2 Study Setting

We conducted the study in the Africa Health Research Institute (AHRI) Health and Demographic Surveillance System (HDSS) area in Hlabisa subdistrict, uMkhanyakude District Municipality, KwaZulu-Natal. The HDSS routinely collects household demographic, health and migration data. The area is predominantly rural, with dispersed settlements under traditional leadership and high levels of poverty and unemployment. Livelihoods include government grants, informal economic activities, small-scale agriculture and tourism-related work [3, 17–19].The Hlabisa landscape is relatively flat, crossed by rivers and streams and interspersed with wetlands. Some settlements lie on floodplains; sandy soils frequently render roads impassable in the rainy season [20]. These contemporary socioeconomic conditions are closely linked to the area's historical development pattern and spatial planning. As part of the former KwaZulu homeland under apartheid, the region experienced prolonged underinvestment in economic infrastructure and public services. Fragmented settlement, infrastructure backlogs and limited piped-water access compound these risks. The municipal Integrated Development Plan [20] identifies heavy rainfall, flooding and poor road infrastructure as high-priority hazards, with the potential to isolate communities and disrupt healthcare access. UMkhanyakude is among KwaZulu-Natal's highest HIV-prevalence districts [3]. HIV treatment in the subdistrict is delivered mainly through a network of primary healthcare clinics, so access to care depends on the same roads and river crossings that flooding disrupts [3, 20]. These intersecting conditions of high HIV prevalence, livelihood insecurity and documented climate sensitivity made this area a particularly appropriate setting for this study.

2.3 Sampling and Participant Recruitment

We used criterion-based sampling, a form of purposive sampling in which participants are selected because they meet predefined criteria relevant to the research question [21]. Potentially eligible PLHIV were identified from an AHRI HDSS-derived sampling frame. Eligibility criteria were being aged ≥ 18 years; having been diagnosed with HIV and initiated antiretroviral therapy before the April 2022 KwaZulu-Natal floods; residing in Hlabisa during the flooding period; and being able to provide informed consent. From this frame, we randomly selected individuals for telephone screening to minimise discretionary selection by field researchers. We defined two exposure groups at the design stage. Direct exposure referred to participants whose households or immediate neighbourhoods were inundated or sustained flood-related structural damage. Less direct exposure referred to participants living in neighbourhoods that were not flooded but were affected by wider disruption to roads, transport, electricity, markets and health services. This distinction was retained for description. During recruitment, it became evident that most eligible individuals had experienced some form of flood-related disruption, including those living outside flooded neighbourhoods.

Trained AHRI social science research assistants (SSRAs) (SN, NdM, YM, NgM, SNx, NN, BM), fluent in isiZulu and experienced in community-based interviewing in the HDSS area, contacted eligible individuals by telephone. Callers identified themselves as AHRI research staff, confirmed eligibility, explained the study's purpose, the voluntary nature of participation, and the right to refuse or withdraw without affecting HIV care, and invited participation only after this explanation. Participants scheduled interviews at a time and place they chose. Recruitment continued alongside interviewing and regular team review of transcripts until successive interviews added little new information to the information gathered on healthcare access, treatment continuity, livelihoods, and assistance and recovery.

The final sample comprised 26 PLHIV (19 directly and seven less directly exposed) who took part in IDIs. We also invited six PLHIV to take part in a separate FGD that explored shared and divergent experiences in greater depth. Participation in the group was voluntary, separately consented and not a condition of the interview. We purposively selected CHWs (n = 8) for a second focus-group discussion because of their involvement in community-based HIV support and home visits during and after flooding. We purposively selected key informants (n = 4) for individual interviews based on their formal responsibilities: municipal planning and disaster management (n = 2), environmental management in the Department of Forestry, Fisheries and the Environment (n = 1), and HIV service delivery in the Department of Health HAST unit (n = 1). The key-informant sample was intended to provide institutional perspective, not to represent all stakeholder groups in the district.

2.4 Data Collection

We developed separate semi-structured topic guides for PLHIV, CHWs and key informants, based on the study aims and the S3E protocol [3]. The guides were developed specifically for this study; English versions are provided in Supplementary File 1.The guides covered flood exposure and household damage, mobility and clinic access, collection of antiretroviral therapy (ART) and treatment continuity,

livelihoods and food, emotional wellbeing, and disaster assistance and recovery. Although the study was framed around the April 2022 floods, the guides also asked about later episodes of heavy rainfall and storms that participants judged relevant to their care and livelihoods. Experienced SSRAs conducted the PLHIV IDIs and both FGDs in isiZulu. The PLHIV IDIs and FGD took place between April 2025 and March 2026, and the CHW FGD and KIIs between April and August 2026. NMZ and SN conducted the KIIs in English or isiZulu, according to participants' preference. Individual interviews lasted 45–60 minutes in private settings chosen by participants; FGDs lasted approximately 90 minutes at AHRI. KIIs lasted 45–60 minutes and took place in participants' offices or online via Microsoft Teams. With consent, all sessions were audio-recorded, transcribed verbatim and, where conducted in isiZulu, translated into English. Translations were quality-checked, and interviewers wrote field notes recording contextual observations and reflections to inform analysis.

2.5 Data Analysis

We analysed the data using a hybrid thematic approach that followed Braun and Clarke's six-phase process of familiarisation, code generation, searching for themes, reviewing themes, defining and naming themes, and writing the report [22]. Analysis combined a deductive structure organised around the research questions and topic guides with inductive coding that allowed new concepts to emerge from the transcripts. An initial codebook was developed by NMZ from the study objectives, research questions and interview guides and reviewed by SN and SB. Codes were reviewed, refined and grouped into themes and subthemes linked to the study aims which were discussed with the team. Coding was undertaken in NVivo 15. After completing the initial analysis, the first author (NMZ) shared the emerging themes with the co-authors (NdM, SB, SN, KSO, CI) for independent review and critical reflection to strengthen the credibility and trustworthiness of the findings.

2.6 Reflexivity, Positionality, and Trustworthiness

The research team comprised trained social science researchers familiar with qualitative health research and the local context. The interviewers had no prior personal or clinical relationships with participants, although their affiliation with AHRI and familiarity with the study setting may have influenced how participants understood and responded to them. To support reflexivity, interviewers wrote field notes after each interview, recording their observations and reflecting on how their role and presence may have influenced participants' responses. These reflections were discussed in regular team debriefing sessions. During analysis, the first author (NMZ) kept analytic memos to record coding decisions and to question her own assumptions about the data. Emerging interpretations were discussed within the research team (NMZ, NdM, SN, NgM, KSO, SNx, NN, BM), which reviewed supporting extracts, questioned assumptions and identified inconsistencies [23].

We strengthened credibility by triangulating accounts from PLHIV, community health workers and key informants, and by comparing the experiences of directly and less directly exposed participants[24]. We collected data and conducted preliminary analysis iteratively, allowing us to examine emerging patterns in subsequent interviews. We audio-recorded interviews, transcribed them verbatim and translated them

into English, with transcripts undergoing quality checks[25]. We supported dependability and confirmability through a shared coding framework, systematic documentation of coding and analytic decisions in NVivo, and collective review of developing themes. Illustrative quotations are presented to demonstrate the relationship between participants' accounts and our interpretations, while detailed descriptions of the study setting and participants support assessment of the findings' transferability.

2.7 Ethical Considerations

We obtained ethical approval from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal (BREC/00006821/2024) and the Brighton and Sussex Medical School Research Governance and Ethics Committee (ERA/BSMS9P2V/2/6). All participants provided written informed consent. They were informed of the study purpose, the voluntary nature of participation, their right to withdraw at any stage without consequence, and the measures taken to protect confidentiality. We obtained consent for audio recording. Pseudonyms and unique identifiers were used in transcription, analysis and reporting. We stored audio files, transcripts and related materials on password-protected systems accessible only to authorised members of the research team.

3. Results

3.1 Sociodemographic characteristics of PLHIV

Of the 26 PLHIV, most were female (65.4%, n = 17) and middle-aged (57.7%, n = 15). Eleven (42.3%) were unemployed, eight (30.8%) relied on informal livelihood activities, 14 (53.8%) had not completed secondary education, and 18 (69.2%) lived in extended-family households. Table 1 presents the sociodemographic profile, disaggregated by flood-exposure status. Nineteen participants were classified as directly exposed (household inundation or flood-related structural damage) and seven as less directly exposed (disruptions to transport, infrastructure or services without household flooding).

Table 1
Sociodemographic characteristics of participants living with HIV (n = 26)

Demographic Dimension / Variable	Exposed (n = 19)	Less directly exposed(n = 7)	Total (N = 26)
Gender			
Female	12 (63.2%)	5 (71.4%)	17 (65.4%)
Male	7 (36.8%)	2 (28.6%)	9 (34.6%)
Age Group			
Youth (< 35 years)	2 (10.5%)	2 (28.6%)	4 (15.4%)
Middle-aged adults (35–59 years)	11 (57.9%)	4 (57.1%)	15 (57.7%)
Elderly (60 + years)	5 (26.3%)	1 (14.3%)	6 (23.1%)
Not stated	1 (5.3%)	0 (0.0%)	1 (3.8%)
Employment & Livelihood Status			
Unemployed	9 (47.4%)	2 (28.6%)	11 (42.3%)
Self-employed / Informal work	5 (26.3%)	3 (42.9%)	8 (30.8%)
Temporary / Informal employment	2 (10.5%)	1 (14.3%)	3 (11.5%)
Formally employed	2 (10.5%)	1 (14.3%)	3 (11.5%)
Not stated	1 (5.3%)	0 (0.0%)	1 (3.8%)
Educational Attainment			
No formal education	4 (21.1%)	0 (0.0%)	4 (15.4%)
Primary education	2 (10.5%)	0 (0.0%)	2 (7.7%)
Secondary incomplete	8 (42.1%)	6 (85.7%)	14 (53.8%)
Secondary completed (Grade 12)	2 (10.5%)	1 (14.3%)	3 (11.5%)
Not stated	3 (15.8%)	0 (0.0%)	3 (11.5%)
Household Structure			
Extended	15 (78.9%)	3 (42.9%)	18 (69.2%)
Nuclear	2 (10.5%)	3 (42.9%)	5 (19.2%)
Living alone	1 (5.3%)	0 (0.0%)	1 (3.8%)
Not disclosed	1 (5.3%)	1 (14.3%)	2 (7.7%)

Our analysis of the PLHIV interviews, CHW and PLHIV focus-group discussions and KIIs generated five interconnected themes, as shown in Fig. 1. Theme 1, Flood exposure and disruptions, frames flooding as the contextual shock that cuts across homes, mobility, clinics and daily life. Themes 2–4 describe lived experience: accessing and maintaining HIV care during flooding (Theme 2), livelihood losses and household insecurity (Theme 3), and emotional distress and psychosocial support needs (Theme 4). Theme 5 addresses the wider response: access to disaster assistance and recovery support.

3.2 Flood Exposure and Disruptions

Participants recalled the April 2022 floods alongside subsequent episodes of heavy rainfall and storms that damaged homes, possessions and community infrastructure. Some perceived later events as more severe. Although experiences varied by location and exposure, disruptions extended beyond the immediate period of heavy rainfall and affected households that had sustained little or no physical damage.

Within exposed households, floodwaters damaged food, furniture, clothing and educational materials. One participant recalled that *"water filled the house, food and school things were damaged"* (Female, 24 years, directly exposed, IDI). Strong winds accompanying heavy rainfall also damaged housing structures, as another explained: *"The roofing sheets were blown away, you would see the house shaking and see that the roofing sheets want to come off"* (Male, 60 years, directly exposed, IDI). Participants additionally reported damage to schools, churches, roads and businesses, alongside injuries and deaths. Recounting losses in surrounding communities, one participant stated: *"People died because houses were blown away and people were hit, and a house collapsed in Machibini, where a child died and in Mapheleni*" (Female, 59 years, directly exposed, IDI).

Less exposed participants, those whose homes were neither flooded nor structurally damaged, nevertheless experienced disruptions to shared infrastructure. One explained: *"Neighbours were the most affected. Fortunately, nothing happened at my home, but in the community, there were issues like electricity going off because of poles, the road, things like that*" (Female, 43 years, less directly exposed, IDI). Road damage constrained both pedestrian movement and transport availability: *"It was hard to walk here, it was unwalkable, the road was bad…We do not have transport if the road is damaged"* (Female, 43 years, less directly exposed, IDI). These accounts indicate that household damage alone did not capture the extent of disruption, as dependence on shared infrastructure exposed otherwise undamaged households to wider community impacts.

3.3 Accessing and maintaining HIV care during flooding

Continuity of HIV care during flooding depended on a passable route, a functioning facility, usable household medication and a service able to absorb delayed demand. When several conditions failed simultaneously, participants delayed collection, relied on informal alternatives or, in a small number of accounts, ceased further collection attempts.

3.3.1 Getting to the clinic

The first constraint was mobility. For PLHIV, this combined physical isolation with the expense of travel: *"It really affected me especially getting to the clinic for collecting my pills. The road was impassable because of the flooding ravine. I didn't even have taxi money to get to the clinic"* (Female, 65 years, directly exposed, IDI). CHWs described the same barrier from the provider side. Flooded rivers prevented workers from reaching their posts and residents from reaching facilities: *"We were unable to cross the rivers ourselves, so we could not get to work… they could not even get to the clinic. We were unable to help in any way"* (CHW FGD, P8). Injured people called CHWs for help that could not be delivered because *"there was no way to cross the river to take them to the clinic or hospital"* (CHW FGD, P6). Institutional actors recognised the problem. The municipal informant noted that *"sometimes some areas were not accessible. So, thinking of someone who needed to go to the clinic during that time was very difficult"* (KII 01). These routes were least usable for people with already limited mobility. One participant with chronic knee problems found the journey to collect ART particularly difficult in heavy rain (PLHIV FGD, P3). CHWs described mountainous settlements and a single small bridge that stopped all movement whenever the river rose (CHW FGD, P8). For these participants, multi-month dispensing and collection by a relative only helped if someone else could walk the route.

3.3.2 Failure at the facility

Access also failed at the clinic itself, in ways that affected everyone using the facility, not only PLHIV. One participant recalled arriving at the clinic and being unable to collect her ART because the facility had flooded (Female, 24 years, directly exposed, IDI). A CHW independently described staff unable to issue stock: "The staff were unable to take out medication and give it to the people who were there at that time because the water had already entered and filled parts of the clinic. In the end, people had to turn back and could not receive their medication". Reopening did not restore access to previous levels (CHW FGD, P4). People whose appointment dates had passed, including PLHIV due to collect ART, arrived together with those attending on schedule. The resulting overcrowding discouraged some people from persisting: "This created another challenge; once the situation passed and the clinic reopened, it became overcrowded… Some people became discouraged and stopped trying to collect their medication because of what had happened" (CHW FGD, P4). The interruption was therefore not only a single missed visit. It disrupted the appointment system itself, with downstream effects that led to loss of patient data as one participant recalled that some facilities "needed to be closed" after being flooded, resulting in "a lot of data that was lost" and an increase in clients who missed appointments and were subsequently recorded as lost to follow-up (KII 03).

3.3.3 Treatment continuity and adaptive service delivery

Adaptive responses operated across household, community and institutional levels. Multi-month dispensing and early medication collection provided some participants with sufficient ART to withstand short-term interruptions in clinic access. However, these protective stocks were not entirely secure, rain entering through damaged roofs wet and ruined tablets. Replacement required a referral and an outreach

vehicle whose arrival depended on water levels and road conditions (CHW FGD, P3). Where formal services were inaccessible, participants relied on informal and sometimes precarious coping strategies. These included asking family members to collect medication when the rain was heavy and, as one FGD participant described, borrowing tablets from a peer on the same regimen and replacing them after the next clinic visit (PLHIV FGD, P2). Others suggested medication pick-up points closer to home for periods of continuous rain, pointing to an unmet need rather than an existing practice (PLHIV FGD).

Formal service adaptations were more coordinated. Clinic staff printed appointment lists, traced clients who had missed scheduled visits and, with NGO support, arranged community delivery of treatment (KII 03). CHWs complemented these measures by using alternative routes to reach accessible households, conducting basic health assessments, providing first aid while patients awaited formal care, and delivering guidance on water purification and oral rehydration solution preparation amid disrupted water supplies (CHW FGD, P3). These activities extended well beyond routine HIV support, positioning CHWs as de facto first responders while also increasing their workload and responsibility during the floods.

3.4 Livelihood losses, food insecurity and financial strain

Participants described floods and severe weather events as having profound consequences for household livelihoods and economic security. The impacts extended beyond the immediate destruction caused by floodwaters and storms, affecting food production, income generation, household expenditure and longer-term recovery efforts. For many participants, these events disrupted the livelihood activities on which households depended for food and income, while simultaneously creating new financial demands associated with repairing damaged homes, replacing lost assets and meeting basic household needs.

3.4.1 Food Insecurity and the Loss of Livelihood Assets

Participants linked flood impacts to the destruction of household food production systems. Home gardens, crops, fruit trees and livestock were damaged or destroyed, undermining important food sources and reducing household self-sufficiency. One participant vividly described the scale of losses experienced: *“Everything was flooded… the maize, eh, even the house collapsed, many things happened, and the cattle died, the goats as well, and the chickens.” (Female, 52, directly exposed, IDI)*

Participants also described the longer-term implications of these losses, noting that the destruction of gardens increased dependence on purchased food and reduced household resilience. As one participant explained:

“My garden here, I had planted maize throughout this garden. There was nothing left; it was completely destroyed; it was all flattened... I mean even spinach until now; we can’t get spinach anymore. We now have to buy it, whereas we used to eat it here from the garden.” (Male, 72, directly exposed, IDI)

Importantly, some participants had not replanted, which extended the effects of flooding beyond the immediate event. One participant who lost crops and chickens explained, “I did not plant again because I

became discouraged" (Female, 52, directly exposed, IDI), while another said he no longer had the strength to re-fence a garden that livestock now entered (Male, 72, directly exposed, IDI). Household gardens supported food availability and reduced reliance on purchased food; their destruction therefore contributed to longer-term food insecurity and financial strain.

3.4.2 Income loss, financial strain and recovery

Flooding also interrupted income generation by restricting mobility, preventing work attendance and damaging productive resources. These effects were particularly immediate for informal workers whose income depended on daily activity and access to locally sourced materials. One participant described how flooding interrupted a small-scale livelihood activity on which the household depended:

"The income I used to make stopped coming in. As I said, I used to sell grass mats, but everything just stopped. The place where we collect materials to make the mats was flooded. We couldn't get anything until the water subsided. Only the pension money helped us during that time." (Female, 65, directly exposed, IDI)

The same event did not leave every household in the same position. Capacity to absorb asset loss and finance repairs tracked socioeconomic position. Unemployed participants and those living on grants had little or no savings: *"As someone who is unemployed, you don't have savings at all or if you do, they are very limited. You don't even know what you'll have to put together to survive. So, you are affected in that way too."* (Male, age not stated, directly exposed, IDI). This pattern is consistent with Table 1. Nearly half of exposed participants were unemployed (47.4%), and most of the remainder depended on informal or self-employment that flooding itself interrupted. An environmental officer described the same gradient and said the worst-affected households were "those people who were already vulnerable… unemployed or maybe their infrastructure that they already had was poor" (KII 04).

3.5 Emotional distress and psychosocial support needs

Participants generally situated emotional distress within accumulated losses rather than attributing it solely to HIV-care disruption. Fear about treatment interruption intersected with damaged homes, lost work, disrupted routines and uncertainty about assistance. One person living with HIV recalled: *"During that time, it was scary. Everything was up and down. It was scary, you would worry that maybe the clinic would get damaged and we wouldn't be able to get our pills properly"* (Female, 19 years, directly exposed, IDI). Another described collapse after simultaneous loss of home, work and routine: *"As someone who is sick, I broke down completely, you know… They said maybe I was just stressed, thinking it was because I lost everything I had. Even at work, I wasn't working anymore, I was just someone sitting at home. That situation really hit me hard"* (Male, 58 years, directly exposed, IDI). It was evident from the findings that emotional distress was closely tied to broader experiences of loss, uncertainty, and socioeconomic disruption, with concerns regarding healthcare access and treatment continuity representing one dimension of a wider set of recovery challenges faced by participants.

One key informant reported that social workers from the Department of Social Development could provide counselling but described initial disaster assessments as focusing primarily on shelter, food and clothing. Counselling was generally initiated only when psychological distress became visible or was reported by traditional leaders or ward councillors. As the informant explained, *"they check whether they have shelter, whether they have food [and] whether they have things to wear… psychosocial [support] becomes a matter of whether counselling is needed"* (KII 03).

CHWs described pre-existing concerns about HIV disclosure and stigma that could constrain the use of visible support groups during emergencies. One CHW observed, *"They do not want to be known as part of the support group since it is easy for them to be stigmatised… The problem now is how they get that support; they cannot get it because they are not known"* (CHW FGD, P2). CHWs also encountered individuals who continued to conceal their treatment from household members and expressed a persistent sense of being *"different from others"* (CHW FGD, P1). These findings suggest that psychosocial support following floods cannot rely exclusively on visibly HIV-specific structures. Support mechanisms must safeguard confidentiality, minimise the risk of involuntary disclosure and address the continuing stigma that prevents affected individuals from accessing both emotional and practical assistance.

3.6 Access to Assistance and Recovery Support

Key informants described how formal relief was meant to work. After a flood, the municipal disaster management unit assessed damaged households, compiled a beneficiary list and referred households to other departments: the Department of Human Settlements for temporary residential units and, later, permanent housing; the Department of Social Development and the South African Social Security Agency for food parcels or disaster relief vouchers of about R2,000-R3,000; and the Department of Home Affairs for replacement identity documents. Households evacuated to community halls received meals for three days, water from district tanks and items such as foam mattresses, blankets and plastic sheeting (KII 02). Access to most relief therefore depended on being assessed and referred, a process in which ward councillors and local task teams were involved (KII 02).

However, participants commonly perceived formal post-disaster assistance as slow, incomplete or unevenly allocated. Some interpreted the selection process as politically mediated or corrupt. One participant explained:

"It was the councillors; I don't know what the process was. Because we all registered, but when feedback came, it went to those they had already chosen." (Female, 49, directly exposed, IDI)

Similarly, another participant reflected:

"You can register fifteen affected people, but perhaps only one or two end up receiving assistance while the rest get nothing. We suspect corruption. Sometimes they bring temporary structures, small park homes, but even those are not suitable. For example, a single park home may be expected to accommodate a family of

six, including boys and girls. Everyone is expected to stay together in that one structure while being told to keep waiting" (PLHIV FGD, P5)

Institutional accounts help explain why this pattern persisted. One municipal informant said government "was not as proactive" (KII 01). There was no ring-fenced budget for rapid recovery, no GIS with which to identify high-risk settlements, and no implementation plan to turn warnings into operations (KII 01). The same informant reported that households affected in 2022 had, in some cases, only recently received temporary housing and were still waiting for permanent structures (KII 01). Municipal food support was time-limited and budget-bound; the same official acknowledged that households "most likely" still lacked food after the programme stopped (KII 01). A disaster-management informant reported political pressure to prioritise certain communities, unresolved housing cases, and residents who later refused assessment because earlier visits had produced no help (KII 02).

Where formal assistance was delayed or insufficient, participants described relying on family members, neighbours and personal resources to recover from losses. Community support emerged as an important mechanism through which households repaired damaged homes, secured food and accommodated affected relatives. One participant explained:

"If you're my relative and your house collapses and you're unemployed, I must step in, right? So that you don't sleep outside. I must offer that support so that the children can eat and even buy roofing sheets, so people have a place to sleep." (Male, 49, directly exposed, IDI)

Others reported repairing homes through collective community efforts or drawing on pensions, savings and borrowed money to replace damaged assets and restore basic living conditions. These accounts suggest that recovery was often driven by household and community coping mechanisms when institutional support was insufficient.

4. Discussion

The aim of this study was to examine how flood-related EWEs shaped healthcare utilisation, treatment continuity and livelihood experiences among PLHIV in rural KwaZulu-Natal. The findings suggest that these domains were linked and not parallel. This is consistent with a growing literature that treats extreme weather as a threat to HIV care acting through social and economic pathways, not only through damaged infrastructure and facilities [7–13]. It is also consistent with evidence that flooding can simultaneously affect livelihoods, healthcare access, housing and community safety [26], and with qualitative work from rural South Africa showing that drought undermined adherence by intensifying poverty and creating competing demands between clinic attendance and household survival [8]. This study adds evidence from a specific setting. In a district with a mature antiretroviral programme, CHWs and established adaptive dispensing practices, prolonged treatment interruption was not described as the dominant outcome. Household recovery, food security and access to official assistance were.

That pattern both supports and qualifies current reviews of extreme weather and HIV. Systematic reviews have documented service disruption, delayed collection and reduced continuity as recurrent consequences of floods and related events [7, 10, 27]. Those consequences were present in this study; impassable routes, temporary clinic closure and damaged household medication were all reported. Although disruptions to HIV care were reported, participants generally described these as temporary, with prolonged treatment interruption not emerging as a prominent feature of their accounts. One possible explanation is that established ART-delivery mechanisms, including multi-month dispensing, early medication collection, community-based support, patient tracing and outreach delivery, buffered some disruptions. However, this interpretation should remain cautious because the study did not measure adherence, determine the duration of treatment interruptions or assess programme effectiveness before and after the floods. The findings therefore do not suggest that flood-related disruption to HIV services is unimportant. Rather, participants' accounts indicate that, in this setting, existing treatment-delivery mechanisms offered some capacity for adaptation, whereas livelihood recovery and relief systems appeared to have fewer readily deployable safeguards.

The livelihood observations acquire HIV-specific significance when read against evidence on nutrition and adherence. Destruction of gardens and livestock increased dependence on purchased food while reducing income. Food insecurity has been associated with poorer antiretroviral adherence and with difficulty managing treatment-related side effects [28, 29]. Related work has linked flood-related agricultural loss among women in rural KwaZulu-Natal to food insecurity [15], and has associated extreme weather with food, water and sanitation insecurity and subsequent HIV-related vulnerability in Kenya [13].

Accounts of post-disaster assistance speak to a second body of work on recovery and social vulnerability in South Africa. Participants' and CHWs' descriptions of opaque selection, perceived political influence, and temporary measures that did not become durable solutions are consistent with research showing that access to recovery resources may be shaped by local power and social connection [30, 31]. They are also consistent with assessments of disaster preparedness after the 2022 KwaZulu-Natal floods, which identified weaknesses in planning, communication, infrastructure and intersectoral coordination [1]. Key informants in this study did not contradict that assessment. They described limited proactivity, constrained budgets, incomplete follow-up and weak coordination across departments. Of particular relevance to HIV programming, key informants gave differing accounts of whether PLHIV were considered in flood planning. While one reported that people on chronic medication, including PLHIV, received assistance, none described a specific mechanism for identifying or prioritising them, and others acknowledged that PLHIV were not currently considered. This suggests that PLHIV were not systematically treated as a priority group in flood planning, despite the district's high HIV prevalence.

The position of CHWs connects the HIV-service literature with scholarship on frontline disaster labour. Community-based support is frequently cited as a mechanism for maintaining chronic care during crises [7]. In this study that mechanism was evident. It was also costly for the workers concerned, who lived in

the same settlements, sustained household losses and absorbed requests for assistance they could not fulfil. Mental health needs associated with asset loss and uncertainty were widely described and weakly institutionalised, which accords with broader concerns that psychosocial support is poorly integrated into disaster response [32]. Strategies that rely on CHWs during extreme weather need to account for their own exposure. Treating them only as a delivery channel underestimates both their contribution and the risk that unmet community expectations will undermine their role.

Variation in impact and recovery should be interpreted in the light of intersectional approaches to climate vulnerability, which caution against treating risk as a fixed attribute of a single group [33, 34]. The findings do not support a uniform category of “vulnerable people living with HIV.” They suggest that treatment dependence interacted with unemployment, grant reliance, extended-household caregiving, older age and geographic isolation conditions already documented in municipal descriptions of Hlabisa [17]. This is a reason that a single adaptive measure will be uneven in its effect.

5. Limitations

Several limitations should be considered when interpreting these findings. First, the study was conducted within a single, predominantly rural HDSS setting; therefore, the findings may be less transferable to urban areas or other health-system contexts. Although the 26 interviews generated detailed accounts of flood-related disruption, HIV care and livelihood recovery, the qualitative design was not intended to support statistical comparisons across demographic or exposure groups. Such comparisons are captured in a separate objective of the broader S3E project and will be reported separately [3]. Second, the initial sampling plan was to recruit 15 flood-exposed and 15 unexposed people living with HIV. As recruitment and interviewing proceeded, it became clear that most eligible individuals had experienced some form of direct or indirect flood-related disruption. The exposed/unexposed contrast was therefore blurred. Indirect exposure through roads, clinics, markets and electricity was itself an important finding, but it reduces the value of the binary as an analytic strategy. Third, interviews were conducted retrospectively and may have been affected by incomplete or selective recall. Interviews conducted in isiZulu were also translated into English, creating the possibility that some meanings or culturally specific expressions were not fully retained, despite transcription and translation quality checks. Finally, the small number of key informants limited the breadth of institutional perspectives and should not be interpreted as representing their organisations' official positions.

6. Conclusion and Recommendations

This study highlights the interconnected effects of flood-related EWEs on HIV care, livelihoods, food security and psychosocial well-being among PLHIV in rural KwaZulu-Natal. Adaptive HIV service-delivery strategies, including multi-month dispensing, early medication collection and community-based support, buffered some acute interruptions and helped maintain treatment continuity where routes, facilities and outreach remained usable. Livelihood recovery was slower and more uncertain, with participants continuing to experience food insecurity, financial strain and uneven access to disaster relief.

Safeguarding the gains of HIV programmes in a changing climate therefore requires more than continuity of clinical supply; it also requires strengthening the social, economic and infrastructural systems that enable people to reach, sustain and benefit from that care. Four implications follow. First, disaster relief needs transparent beneficiary-selection criteria, timely communication on application status, independent monitoring and accessible grievance mechanisms, in line with the Disaster Management Act and National Disaster Management Framework [35, 36]. Second, recovery programmes should restore livelihoods by supporting food production, replacing productive assets and protecting informal work. Third, psychosocial support should be a routine part of disaster response, delivered in ways that protect confidentiality for PLHIV. Fourth, adaptive HIV service delivery, including multi-month dispensing, early collection and community-based support, should be maintained and extended to communities that floods isolate.

Abbreviations

AHRI
Africa Health Research Institute
ART
Antiretroviral Therapy
BREC
Biomedical Research Ethics Committee
BSMS
Brighton and Sussex Medical School
CHW
community health worker
EWE
Extreme Weather Event
FGD
Focus Group Discussion
GIS
Geographic Information System
HAST
HIV and AIDS, STI and TB
HDSS
Health and Demographic Surveillance System
HIV
Human Immunodeficiency Virus
IDI
In-Depth Interview
IDP
Integrated Development Plan

KII
Key Informant Interview
KZN
KwaZulu-Natal
NGO
Non-Governmental Organisation
PLHIV
People Living With HIV
S3E
Social and Economic Impact of Extreme Weather Events
SSA
Sub-Saharan Africa
STI
Sexually Transmitted Infection
TB
Tuberculosis

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal, South Africa (BREC/00006821/2024), and the Brighton and Sussex Medical School Research Governance and Ethics Committee, United Kingdom (ERA/BSMS9P2V/2/6). The study was conducted in accordance with the Declaration of Helsinki and applicable national and institutional ethical guidelines. All participants provided written informed consent prior to participation.

Consent for publication

Not applicable. The manuscript does not contain individual persons' identifiable data, images or videos.

Competing interests

The authors declare that they have no competing interests.

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purpose of open access, the author has applied a CC BY public copyright licence to any Author Accepted Manuscript version arising from this submission. The funders did not play any role in the design of the study; the collection, analysis, and interpretation of data; or the writing of this manuscript.

Author Contribution

SB, KSO and CI conceptualised the study. KSO, MS, NdM and YM developed the initial methodology. NMZ, SN, NdM, YM, NgM, MS, SNx, NN and BM contributed to the investigation and data collection. NMZ led the formal analysis and interpretation of the findings and drafted the manuscript. SB, KSO, JS, DK and CI provided supervision and critical intellectual input. All authors reviewed, revised and approved the final manuscript.

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Data Availability

The qualitative data generated and analysed during this study are not publicly available because they contain sensitive information relating to HIV status and personal experiences, and public release could compromise participant privacy. De-identified data may be available from the corresponding author on reasonable request, subject to approval under the relevant ethics and Africa Health Research Institute data-access procedures.

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Figures

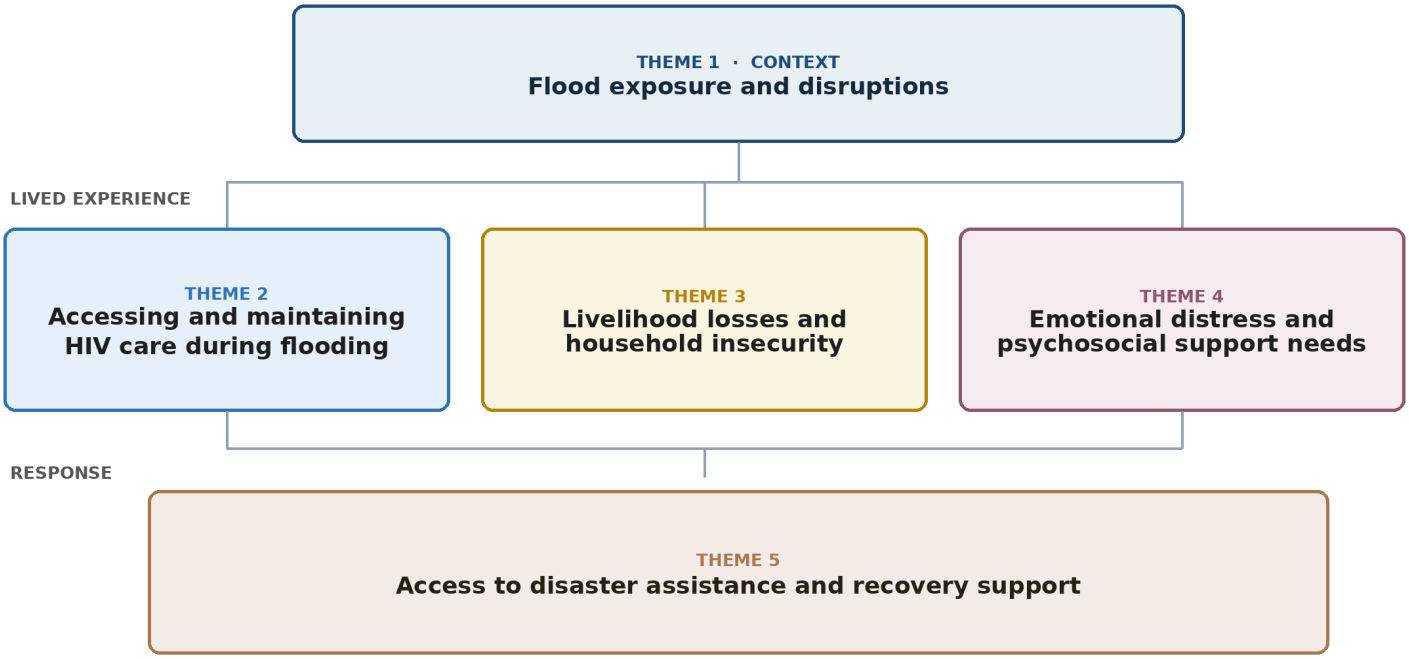


Figure 1

Thematic structure of the findings.

Supplementary Files

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- SupplementaryData.docx