Review Article

Climate-related disruptions to health facility services in South Sudan: Evidence, vulnerabilities, and integrated resilience

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ABSTRACT

Climate change is impacting health services via flooding, extreme heat, drought, disease outbreaks, and other hazards. The most profound impact of climate change is seen on health facilities (HFs) in fragile and conflict-affected regions, which already face challenges due to poor infrastructure, insecurity, and resource scarcity. This narrative review highlights the impact of climate-induced hazards on HFs' service delivery, using South Sudan as a country example, and explains the importance of linking preparedness to the sustainability of the healthcare system. The review was conducted in accordance with the Scale for the Assessment of Narrative Review Articles (SANRA), and evidence was analysed using the WHO Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities as an analytical framework. In 2024, flooding had affected up to 58 HFs in five counties, with almost 90 being inaccessible. In 2025, at least 121 HFs were affected, and it was later reported that 144 HFs were damaged. These climate-related effects occur within a broader context of underdeveloped infrastructure, where about 70% of the population had no access to basic healthcare services, 7% had access to electricity, 41% to potable water, and 10% to improved sanitation. HF-specific evidence reveals problems with infection prevention and control, lack of coordination, guidelines, vector control, staff management, training, waste segregation, incineration, and disposal sites for medical waste. The combination of flooding, cholera outbreaks, and insecurity in Jonglei, Unity, and Upper Nile States illustrates the hazards HFs face.

Keywords: flooding, health facility resilience, fragile health systems, disaster preparedness, South Sudan

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Introduction

The negative impact of climate change on the functioning of health facilities (HFs) continues to increase due to heatwaves, flooding, drought, and disease outbreaks, particularly in vulnerable and crisis settings that have been neglected in climate and health studies.[1–3] HFs play an important role as key referral and emergency treatment facilities. Failure to function well in such situations affects access to emergency surgery, obstetric and in-patient care, and diagnostic tests.[4]

South Sudan, independent since 2011, illustrates this well, having faced conflicts, political turbulence, and a fragile health sector, alongside high vulnerability to floods, global warming, and disease outbreaks.[5] Although HFs in sub-Saharan Africa have faced flooding and other environmental hazards, little is known about how these hazards affect their ability to function effectively.[6]

Method

This review was conducted and appraised using the Scale for the Assessment of Narrative Review Articles (SANRA), a validated quality appraisal tool covering justification of importance, objectives, literature search, referencing, level of evidence, and data presentation.[7] The literature used was obtained through a search in PubMed and Google Scholar databases, as well as grey literature in World Health Organisation (WHO), OCHA, Inter-governmental Authority on Development (IGAD), and Médecins Sans Frontières (MSF) databases. The search terms employed included: health facility resilience, climate change and health care systems, fragile countries and health, flooding and health facilities, health system of South Sudan, and disaster preparedness. Table 1 summarises the inclusion and exclusion criteria applied during source selection.

The evidence was synthesized using a theme-based approach and evaluated in light of WHO Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities framework.[8]

How climate hazards hamper health facility (HF) services

There is much more to how climate hazards impact HFs than physical destruction of facilities.[1,6] Flooding can affect infrastructure, contaminate water, disrupt electricity systems and supply chains, limit movement of healthcare workers and ambulance access, and cause HF admissions associated with displacement, injuries, and waterborne disease outbreaks.[6] In addition, it could interrupt fuel supplies for generators, hampering theatres, oxygen concentrators, vaccine cold rooms, sterilisation, and communication processes in referrals.[6]

Climate hazards also harm HF service delivery by increasing risks to children, the elderly, and febrile patients; reducing the potency of drugs and vaccines; increasing staff fatigue; and hampering ward ventilation.[1] Climate-change-related disease outbreaks increase patient numbers, strain infection prevention systems, and exacerbate cholera, water, sanitation, and hygiene (WASH), and nutrition challenges. Floods increase the risk of cholera and other waterborne diseases, heat fosters vector-borne diseases like malaria, and agricultural disruption leads to admissions due to malnutrition.[1] In a fragile setting, climate hazards coexist with insecurity and difficult access roads, making single-hazard preparedness ineffective.

Case study: South Sudan

In 2024, according to the World Health Organisation Regional Office for Africa, there were 58 health facilities in five counties that were submerged, and 90 health facilities were cut off from access after the closure of 15 key roads leading to Juba, which includes tertiary-level health care facilities.[9] In 2025, floods continued to disrupt health-service delivery with at least 121 health facilities being affected, and increasing cases of malaria, respiratory infections, and diarrhoea reported in the flood-affected areas.[10] The 2026 Humanitarian Needs and Response Plan reported damage to 144 HFs during flooding.[11] This

Table 1. Inclusion and exclusion criteria for source selection

Criterion	Inclusion	Exclusion
Language	English	Non-English
Publication type	Peer-reviewed articles, grey literature, policy documents	Opinion pieces without evidence base
Topic	Health facility resilience, climate hazards, fragile health systems, disaster preparedness	Studies unrelated to health systems or climate
Setting	Fragile, conflict-affected, or low-resource settings; South Sudan	High-income country settings only
Date	2016 to present	Pre-2016

climate hazard affects not only inpatient, emergency, and maternal health services but also outpatient consultations, especially when no other HFs are available.[4,6]

National-level lack of infrastructure adds to vulnerabilities during flooding, insecurity, and outbreaks. According to the World Bank (2024), about 70% of South Sudanese lack basic health-care services, with only 7% having access to electricity, 41% to potable water, and 10% to improved sanitation.[12] At the HF level, poor readiness to deal with infection prevention and control (IPC) and WASH has been identified. A cross-sectional analysis of 151 health facilities in six high-risk states (Jonglei, Unity, Upper Nile, Northern Bahr el Ghazal, Central Equatoria, and Western Equatoria) revealed significant deficiencies with regard to IPC/WASH coordination, IPC/WASH guidelines and standard operating procedures (SOPs), vector control, human resource management, and training. Other gaps included the lack of waste segregation protocols, high-temperature incinerators, and proper storage facilities for waste materials.[13]

The presence of both floods and cholera cases in Jonglei, Unity, and Upper Nile states highlights the multi-hazard that HFs in South Sudan face, where healthcare workers have to deal with an increase in the number of cholera cases, which require huge amounts of clean water, along with effective infection control and waste management practices, just when there are floods that interrupt these facilities.[5,10] Conflict adds to this problem, as illustrated by the 2025 bombing of the Médecins Sans Frontières-supported hospital in Old Fangak, while insecurity limits staff movements, delivery of medical supplies, and patients' access to the hospital.[5,14]

South Sudan used flood response plans, oral cholera vaccination campaigns, rapid response teams, and IGAD regional cooperation to deal with these disasters.[5] These solutions are rather short-term and externally funded. As soon as priorities are changed and funding decreases, preparedness is compromised, thus highlighting the need to transition from emergency activation to building HF resilience.[3,4,15]

Towards integrated health facility resilience

Findings from South Sudan and existing literature show that HF resilience in fragile settings requires more than emergency plans. It demands investment in the functional systems that make those plans effective: energy systems, water supply, waste management, and resilient infrastructure.[6,15] These systems are not auxiliary but critical to routine and emergency functions.

Health Facility resilience in the face of climate shocks is only possible if such systems are effective; otherwise, even moderate floods and heatwaves can interrupt HF operations.[2] Sustainability and preparedness need to be addressed as complementary issues, rather than separate issues that donor agencies and different departments tackle. Solar energy, water supply, waste management facilities, and climate-resilient infrastructure should be considered components of HF preparedness.[8]

The knowledge and policy gap persists, with information at HFs on service delivery during climate shocks and the link between sustainability practices and preparedness in fragile-state HFs needing further study.[3] Financial resources dedicated to climate finance to support health system resilience are still inadequate, and donor investments are not always harmonised with national plans and initiatives.[2] Addressing this gap calls for research, policy reform, and finance that build institutions, not only respond to disasters.[4]

Conclusion

HFs in South Sudan must cope with vulnerability to climate shocks, weak infrastructure, and interruptions caused by conflict. In addition to damaging physical structures, climate shocks disrupt HFs' energy, water, waste management, and other infrastructure systems which are important for HF safety. The resilience of HFs requires integrating sustainability practices into preparedness planning, evidence generation, and aligning donor investments. Communities without alternatives in health care have no option but to rely on these HFs during climate shocks.

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