Oxford Open Climate Change, 2025, **5(1)**, kgaf014
https://doi.org/10.1093/oxfclm/kgaf014
Advance Access Publication Date: 8 April 2025
Research Article

Health in a Changing Climate

Resilient health systems in action: How actor relationships and organizational adaptation shaped the health sector's response to the 2015–2018 Western Cape drought

Amanda V. Quintana[1,*], Susannah H. Mayhew[1], Sari Kovats[1], Lucy Gilson[1,2]

[1]Faculty of Public Health Policy, London School of Hygiene and Tropical Medicine, London WC1E 7HT, United Kingdom
[2]Division of Health Policy and Systems, School of Public Health, University of Cape Town, Cape Town 7925, South Africa

*Corresponding author. Faculty of Public Health Policy, London School of Hygiene and Tropical Medicine, Keppel St, London WC1E 7HT, UK.
E-mail: Amanda.Quintana@lshtm.ac.uk

Abstract

Climate change is making droughts more frequent and severe, creating serious challenges for health systems and vulnerable communities worldwide. From 2015 to 2018, the Western Cape Province, South Africa, faced an extreme drought that nearly led to "Day Zero"—a point when water supplies would run out. Despite this crisis, documentation of the drought overlooks the health sectors response. To understand how health decision-makers managed this drought, in-depth interviews with 31 people from the health sector and other related fields were conducted. Transcripts were anonymized, transcribed, and deductively and inductively coded. A thematic analysis grouped the findings into four large themes with sub-themes of enabling factors. The study revealed that the health sector played a vital role by ensuring hospitals and clinics had water, reducing water use in facilities, and working closely with other sectors to protect community health. Interestingly, the most critical factors in managing the crisis were not just physical resources like procuring water tanks or fixing pipes in hospitals but the "software" of the health system: strong relationships, good communication, and shared values among health workers and decision-makers. These elements, albeit complex, enabled quick and effective action during the drought, and remained responsive to population needs that allowed for an effective health system response. The findings provide important lessons for making health systems more resilient to future droughts and other climate-related challenges.

Keywords: Health Sector Response; Drought Response; Climate Change; Software; Health System; Coordination; Western Cape; South Africa

Background

Described as a slow onset silent killer, drought impacts on health are severe and can lead to public health disasters. Drought can impact known risks to health such as unsafe drinking water and poor sanitation, increased communicable disease transmission, disrupt health services, and hamper hand washing and other hygiene practices [1–4]. Increasing temperatures and decreasing precipitation caused by climate change are increasing the intensity and frequency of droughts around the world, where populations with high vulnerability suffer the most consequences. Studies highlight the importance of local drought and adaptation planning to manage impacts on human health and health systems [5, 6]. Without the appropriate responses and adaptations drought has implications for health systems and at-risk communities and is likely to contribute to existing challenges of limited water resources, population growth, poor water supply management, as well as public health challenges [7, 8].

South Africa is prone to climate-related hazards and is projected to experience significant increase in maximum and minimum annual temperatures, including higher frequency of droughts, especially in the Western Cape Province [9–12]. In the Western Cape, the potential impacts of climate change including heat stress, high precipitation, and drought have been shown to influence morbidity seen in hospital admissions and mortality [13].

The Western Cape Province is a drought affected province that experienced below average monthly rainfall from 2015 to 2017 [12, 14]. It led to a devastating and severe one in 400-year drought that severely affected the City of Cape Town water supply. At the drought's peak in 2017/2018, communities across the metropolitan City of Cape Town had water restrictions of 50 L of water per day to avoid what was known as "Day Zero", when the city would reach critically low water levels of 13.5% and water supplies would be turned off [15, 16]. It took a cross-government effort to respond to the drought and in late 2018 rains brought an end to the water crisis.

The governance challenges faced during the drought in Cape Town are well documented. They focus on water management and include delays in declaring the drought a disaster to poorly

Received: January 10, 2025. **Revised:** March 07, 2025. **Accepted:** April 02, 2025
© The Author(s) 2025. Published by Oxford University Press.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

managed water supplies and dam levels [16]. Several adaptation lessons from City of Cape Town reflected on the role of communication and data collection to strengthen urban water resilience [17]. Yet, Baudoin *et al.* found that despite the South Africa's previous experiences with drought across the country, the lessons are not captured, and the management response continues to focus on emergency relief rather than proactive and preventative policy [18]. Importantly, South African climate adaptation plans and policies that are for all sectors and for the health sector, at both the national and Western Cape level do not capture drought mitigating strategies or activities carried out by the health sector suggesting that the health sector was not a part of the response to a significant crisis [19].

Furthermore, despite the significant impact drought poses on health outcomes and systems, to date, there is little published evidence globally regarding subnational health actors' response to drought. A study by Lee *et al.* found a decrease in diarrheal disease incidence in Cape Town from 2010 to 2019, with no increase during the drought period. This suggests that sustained public health interventions were effective, particularly during the peak diarrheal season from November to May [20]. However, while the study highlights this health outcome, it does not assess the broader response of the health sector to the drought. The studies' interviews provided crucial context for the declining incidence, attributing it to key "hardware" components of the health system—such as vaccinations, a trained workforce, adequate service delivery, and sustained interventions. To gain a more comprehensive understanding, further research should examine "software" factors—intangible organizational and systemic capabilities that shape decision-making—and how their interaction with hardware elements influenced both disease trends and health sector responses during the drought [21]. Beyond this study, most research from Western Cape and other provinces of South Africa, looks at the impacts of drought on food security and livelihoods as well as adaptation actions of small-holder farmers [22, 23]. Finally, outside of South Africa, one distinctive paper in Ethiopia, looks at the impact of drought on community health systems, where community groups were found to play a key role in strengthening community health systems resilience during the 2015/16 Ethiopian drought [24].

Learning from the Western Cape provincial health sector's response to the drought can identify key response activities taken to mitigate drought and health risks and understand how health and wellbeing were supported. To investigate this further, health and non-health sector stakeholders at the Western Cape provincial, municipal, as well as national level were interviewed to understand how decision-makers managed drought risks, what health sector response activities took place, and how challenges and successes were managed.

Methods

Study site

The Western Cape Province sits on the southwest coast of South Africa and experienced three consecutive years of below average rainfall and intense drought. The province is comprised of five district municipalities and one metropolitan municipality, City of Cape Town. The responsibilities of health service provisions lie with the provinces and local authorities, where province is particularly responsible for the management and delivery of health services as well as coordinating policy development [25]. This study looks particularly at Western Cape provincial decision-makers who play a critical intermediary role between municipal and national level and provide guidance that should support coordinated action across the health system [26]. We sought to understand how South African adaptation and health stakeholders perceive and interact with climate risks, such as drought, and to identify the constraints and facilitators they experienced in relation to the 2017/18 Western Cape drought event.

Participant selection and data collection

Between February 2022 and June 2022, lead researcher AQ, with guidance from LG, conducted field work and a series of in-depth interviews in Cape Town, Western Cape province, South Africa. Participants selection criteria were as follows: South African decision-makers inside or outside the health sector working on climate adaptation who served in senior roles primarily at the Western Cape level, but also at the municipal and national levels, and who could have an influence on decision-making and policy implementation. Participants were selected based on whether they were current or past decision-makers at the time of data collection, rather than specifically on their engagement during the 2015–8 drought. A "snowball sampling technique" and authors identified in a document review from Quintana *et al.*, was used to identify interview participants [27]. Participants in sectors outside of health were identified as having authored climate adaptation or environment-related policy documents or were identified as key informants of climate and health and came from environment, disaster risk, climate, and development sectors.

As seen in Table 1 a total of 31 interviews were conducted, as data saturation was reached when no new insights or themes emerged, and participants represented all governance levels, with sufficient representation at the provincial level. Fifteen participants were from the health sector and 16 participants were from other sectors mentioned above. Most participants worked for Government and represented the provincial level.

Throughout this paper, the provincial health sector will be used to indicate health activities carried out by the Western Cape Province and local authorities. The Western Cape Department of Health and Wellness (WCDOHW) is the provincial health organization or government department where most health sector participants worked (see Government Department in Table 1). The health system is referred to as the broader system that includes the health sector as well as other sectors and stakeholders that influence health and wellbeing.

Participants invited to interview received a project information sheet and signed a consent form prior to the interview session that allowed recording, hand-written notes, and anonymized short quotes to be made. *Ethical approvals were received from the University of Cape Town (#756/2021) and London School of Hygiene and Tropical Medicine (#26533).*

Table 1. Characteristics of participants

Participant type	# of Participants ($n = 31$)	% of sample size
Health sector ($n = 15$)		48
National	3	10
Provincial	9	29
Municipal	3	10
Non-health sector ($n = 16$)		52
National	5	16
Provincial	7	23
Municipal	4	13
Stakeholder type	**# of Participants**	
Government Dept.	26	
Academia	3	
Civil Society/Other	2	

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

Interview sessions were 50–90 min in length and were guided by a piloted semi-structured interview guide that posed open-ended "why," and "how" questions such as "how do you manage drought risks." Participants were asked about their role and experience during the 2017/18 drought, to understand how decision makers manage climate risks. Challenges and enablers to working across sectors and governance levels on implementation of climate adaptations for health were also discussed.

Coding and analysis

Interviews were transcribed verbatim, including non-verbal sounds and expressions such as laughter, sighs, and filler words. Each transcript was transcribed twice, first using otter.ai and then lead researcher AQ completed a thorough transcription review. Each participant interview was assigned an ID number to anonymize personal and identifiable information. These Participant IDs are used to reference information gathered from interviews in the findings text. Transcripts were labeled and formatted using styles from McLellan *et al.* and uploaded to NVivo10 [28].

An inductive-deductive approach was taken to coding. First, guided by Charmaz, three transcripts were inductively free-coded using a line-by-line approach to capture implicit concerns as well as explicit statements [29]. Next, a code frame was developed with identified open codes, aligned with the interview guide and research questions. The code frame developed by AQ was reviewed by SM before applying to all interviews on NVivo.

During Round 1 coding on NVivo, additional concepts arose that added to the code frame. Such codes included "drought," "crisis to action" and other barrier and enabler codes. Round 1 codes were thematically grouped and reviewed with advisory team, SM and SK. Next, a second round of coding looked at all coded "drought" text and coded for response/action, policy/planning, health impact/inequity.

Finally, the Round 2 coded text was extracted for all 31 interviews into three spreadsheets organized by participant demographic data. Information on text themes, past/present responses to drought, policy, governance, and additional codes/information to cross-reference were assessed in the spreadsheets. Health system software factors that influenced the drought response were also identified.

Findings

Despite the absence of the Western Cape health sector drought response from wider policy documents and literature, the health sector was engaged in the drought response and navigated multiple challenges that surfaced. This section summarizes the health sector's response to the drought crisis in four key areas that arose from interview data, specifically: Management of Water Infrastructure and Maintenance; Assessment and Planning; Coordination of Response and Governance; and Behavior Change, and Communications. Across the four areas, several enabling factors emerged that are important for shaping decision-makers actions and responses within these areas.

Management of water infrastructure and maintenance

Ensuring health facilities had access to water was a provincial priority during the drought. The Western Cape Provincial Government played a lead role in supporting municipalities with water infrastructure and maintenance- related activities. In health facilities and hospitals such activities were led and carried out by the health sector.

> *"I think the critical thing was to protect our health facilities… that we had to do that and to make sure that they've got water, so a lot of generators too … and boreholes, catching rainwater, a purifying of water that actually was a tremendous effort to make sure water is available at clinics and hospitals. So a lot of effort went into that"* (Health Sector, Provincial, P015).

During the drought, a provincial government mandate was given to sink boreholes at all major hospitals, and this became a crucial part of the response alongside rainwater catchment, water purification methods, water pressure management and leak detection (P004, P012, P015).

Health Sector Participants discussed specific water infrastructure activities that took place in some hospitals. Table 2 captures examples of these activities as implemented in selected Western Cape (WC) hospitals. These were necessary to secure or maintain water supplies and reduce water consumption used in health service delivery practices such as for sterilization processes and hand washing.

Knowledge and information management

Participants discussed significant challenges with accessing previous information when carrying out water infrastructure activities during the drought. Respondents in and outside of the health sector described the inadequate recordkeeping and information management of hospital and facility infrastructure.

> *"They weren't updated… as plumbers came in, modernize the buildings, or changed where bathrooms work, etcetera, they just plugged into whichever connection it was… But we've seen lots of instances, especially around the drought, where there was infrastructure that had previously been invested in. So there were bore holes, for example, that had previously been drilled and equipped, where no one had touched it since the last drought. So, eight years ago, we did something and then we walked away from the hole. And now we're having to drill a new hole, or you have to actually do some sort of massive rehabilitation on the old structure"* (Non-Health Sector, Provincial, P018).

Due to improperly maintained infrastructure and poor information management of facility water infrastructure, the health sector's drought response was challenged (P010, P025, P018). Previous investment in drought mitigation activities, such as boreholes, were not accounted for due to poor record keeping. This was especially the case in Tertiary Hospital 2, where old piping and infrastructure were attended by different contractors over time so a comprehensive operations plan and map of the system was not known or maintained (P018, P016). Health sector respondents revealed that many facilities had previous boreholes that no longer functioned because they were forgotten or not maintained.

> *"And so that's one thing we did discover, actually. One or two of these hospitals had boreholes already, but they were defunct because they'd never been used. Well, they were sunk 15 years ago, or something. So yeah, I mean, it was really an emergency… but it was an in the moment response. I don't think they were doing it with the 15 years, 20 Years, 50 years in mind."* (Health Sector, Provincial, P019).

The poor maintenance of health facility water infrastructure may stem from inadequate information management during previous drought response activities, such as drilling boreholes, or even a reluctance to allocate the limited available resources toward maintenance efforts. Limited capacity and resources,

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

Table 2. Infrastructure activities in major WC hospitals identified by health sector participants

Hospital in Western Cape	Example health sector drought response activities
Tertiary Hospital 1 Teaching Hospital in Cape Town; Public funding	Up to nine boreholes sunk; recycling water in basin and toilets
Tertiary Hospital 2 Teaching Hospital in Cape Town; Public funding	Commissioning of a water osmosis treatment plant to treat water for human use (class 1) and drinking water that cost 120 million rand
District Hospital 1 located in Cape Town metro; Public funding	100 water tanks collecting rainwater that service smaller facilities like clinics and community health centers and an EMS facility
District Hospital 2 located in West Coast Region; Public funding	2 boreholes drawn

especially at municipal level health facilities often led municipalities to rely on emergency support during crisis like the drought, which as reflected by a non-health sector participant, creates *"a perverse incentive to not deal with your own infrastructure issues, if you can get other funds available to you in a crisis"* (Non-Health sector, Provincial, P018).

Involving senior leadership

When it came to the drought, respondents expressed the importance of good governance and involving leadership to support prioritization of water access, alternative strategies, and better water infrastructure maintenance (P001, P002, P006, P018).

> *"one thing that I've found to have been very effective is getting the buy in, especially like for the drought, we saw that the Premier was actually the champion the person championing it"* (Non-Health Sector, Provincial, P002).

This was especially true for the health sector which invested time in involving leadership. A health sector respondent noted that the provincial health department needed to place the drought as a priority among other competing priorities to ensure a place at the top of the health sector management agenda (P006). The management involved during the drought played a crucial role, as highlighted by a provincial health sector participant: *"when he speaks, people listen. So he's built the trust he's built the respect"* (Health Sector, Provincial, P008). Engaged leadership allowed for trust of the community and health workers to help access more resources, gain staff attention and increase capacity.

Finally, upon reflection of the institutional drought response by WC health leadership, institutional changes of drought risk mitigation activities were made. The WCDOHW underwent infrastructural changes during the drought and continued after the drought through an investment of a green building that included solar energy panels and water reuse infrastructure (P008). These organizational activities made the health department operations accountable to drought risk mitigation while also supporting sustainable and resilient health functions aligned with climate change planning.

Assessments and planning

The WC Provincial Disaster Management department identified "health" as the biggest provincial government risk during the drought, therefore health sector activities such as health facility needs assessments and planning were prioritized. Government stakeholders began anticipating what might happen, especially if water ran out completely, and how to respond by developing policies looking at alternative water supplies and anticipating related infectious disease risks (P027, P010, P010).

Interview respondents shared that the provincial health department carried out needs assessments for hospitals and health facilities (P004, P006, P008, P010). Facilities were assessed to learn what water intensive activities were occurring in them (P008) and where water supplies could be delivered based on positioning of a hospital (P004). Before drilling boreholes at any of the hospitals or facilities, geological surveys, a systematic investigation of surface and subsurface conditions, were conducted to ensure there was a possibility to drill successfully as well as where to place Reverse Osmosis facilities (P004 and P008). The health sector led on service delivery continuity planning, such as water substitution in theatres, and engaged in plans to support communities through the drought by identifying where community water collection points and standpipes could be placed across the City of Cape Town to receive quality assured water from a potable supply (P006 and P011).

Day Zero Plans, synonymous to contingency plans, were in place in case there were critically low water levels and water supplies would need to be turned off. Although there were several drought specific and related policies and plans in the Western Cape, none were publicly available for the health sector. Instead, provincial health sector participants revealed there was an internal Day Zero Contingency Plan that was not externally shared to avoid causing fear among the community (P006, P008, P015).

> *"It is a preparedness plan. This is an action plan. If this doesn't get done, the way it's written in this document, your facility and your patients are going to suffer… there is one for drought, it's basically putting responsibilities to people's names, contact the person, this is the person you do, etcetera. It's an action. If this happens, this is what we want you to do"* (Health Sector, Provincial, P008).

Although it did not get to this point, the development of sector-specific contingency plans was an important part of the drought response.

Strategic and long-term planning

Despite assessments and geological requirements, quick actions led to planning oversights. An example of this comes from a large investment to draw boreholes and connect them to the water supply in District Hospital 2.

> *"At [District Hospital 2] we drilled two and spent a lot of money you know, connecting them to the to the hospital's water supply. And then we discovered that what was the issue there were the magnesium content was too high. And so we couldn't use it in our operating theatres because it's precipitated onto the glassware. So there'd been a couple of ups and downs"* (Health Sector, Provincial, P026).

Such a costly investment might have been avoided with more thorough planning, better integration of cross-sector knowledge, and effective information management of infrastructure, as

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

previously discussed, before initiating water access activities. In addition, during the drought crisis, there was limited room for needed innovation and strategic planning. A municipal health sector participant reflected on the lack of strategic long-term thinking during the drought.

> *"But the way that drought infiltrated policy was quite interesting, in the sense that any planning, or proposals that you had to do had to include a drought mitigation or adaptation plan to the drought and to water use in general… And the kind of bigger picture thinking from a departmental level wasn't necessarily there. There wasn't thought of how my work impacts climate in general, in the long term is really short-term thinking"* (Health Sector, Municipal, P023).

The absence of thinking of the long-term in previous droughts resulted in a lack of learning that impacted the 2017/18 drought response, as a respondent described:

> *"So, we in fact, um had to manage a drought long before 2017, which never made it on the radar… There were five municipalities in one district within one district. And we did some amazing things. And those learnings, unfortunately, were not carried through to 2017"* (Non-Health Sector, Provincial, P030)

When it came to long term planning, a respondent discussed that during the drought the focus was dealing with the immediate threat and that long-term planning was put off and the responsibility of specific sectors (P012). However during the drought crisis the WCDOHW considered future impacts by addressing growing health disparities in informal areas and townships. At the drought's peak, the health sector was particularly concerned about the heightened risk of communicable diseases in vulnerable communities due to poor water quality and limited access to running water and sanitation in households and surrounding facilities that were exacerbated by already problematic stagnant sewage systems predating the drought (P015, P019, P023, P027).

> *"At the time of the initial drought starting, there was a lot of talk from the public around informal settlements and water … the fact that informal settlements are really unmetered… , people aren't billed or anything for water. And that, I think, was obviously very misfocused. … So, the strategy there was actually really to make sure people still had enough water and there was no requirement or ask for people in informal areas to use less water. So, I think from the health perspective, that was also very clear to everybody in the city government that that was not the problem. The problem there was making sure people had enough water"* (Non-Health Sector, Municipal, P012).

Respondents in and outside of the health sector expressed that the provincial health department advocated for at risk communities and health risk mitigation strategies during the drought (P012, P003, P009). The health sector did this by collaborating with government counterparts to oppose water restrictions and advocate for water access points in informal areas, emphasizing the heightened health risks these communities face. This health-led, intergovernmental initiative promoted equity-focused planning and became a cornerstone of the sector's drought response. By ensuring at-risk communities had sufficient water, future potential health crises were avoided.

Early-prioritization

Before declared a disaster by national government, drought activities were prioritized on senior leaders' agendas among other issues that was critical to swift action. A provincial health respondent described the efforts made within the health department to prioritize drought response activities.

> *"What we did was, first of all, we had to escalate this as a priority. Okay, so it was on the top management agenda, right, as a very important issue. That, you know, that sounds easier. But remember, it comes in a context of many competing priorities, right. So just surfacing the issue and escalating it as a priority is an important thing in itself"* (Health Sector, Provincial, Participant 006).

Compounding events such as electrical power supply issues, made the prioritization of the drought even more important. One participant shared that the health department's plans to sink boreholes at all 32 district hospitals in the province, many of which are situated in rural areas, were sidelined by other competing issues (P019). For example, in the Central Karoo district existing water infrastructure issues (corrosion, burst pipes, leakages) and limited health workforce capacity were exacerbated by the drought (P025). These challenges in rural Central Karoo were further magnified by local government instability and a lack of funding (P018, P025). In the instance of Central Karoo, the involvement of cross-sector support such as from Department of Education and Department of Social Development, allowed for investments in additional water storage containers, such as JOJO tanks, to address existing issues with the water supply and extreme heat (P025).

Finally, several respondents discussed that previously prioritized activities were hindered and not institutionalized due to the end of the drought. This abrupt shift in focus and priorities undermined earlier investments and efforts in drought risk mitigation.

> *"There was a lot of good investment happening during the drought, it would have been better, in some ways for the drought to be one more year longer just to embed that, because we got most of the way in our programs, and certainly for the health facilities… So ideally, our emphasis and our budget focus should not have moved off water for at least two or three more years, because there was still work to be done."* (Non-Health Sector, Provincial, P018).

Coordination of response and governance

As the drought worsened, the WC Disaster Management coordinated sectors to act. The health sector collaborated with other sectors to assess which facilities could utilize ground water reserves (P006) and manage compounding risks outside of facilities, such as heat risks to communities (P015). Health sector participants across national, provincial and municipal acknowledged that there was little to no engagement or response from the national level, especially from the national health department, during the WC drought (P007, P016, P028). Instead, there was significant cross-sectoral provincial support of municipal level response activities, especially for municipalities outside of Metropolitan City of Cape Town.

> *"So, when we were in the midst of the drought, we did a lot of work with respect to awareness raising and providing technical assistance to municipalities that needed, by support engineers, helping them to think through things and so forth and so on."* (Non-Health Sector, Provincial, P030).

Institutional mechanisms

The interview data showed that the WC Provincial drought response worked across sectors and governance levels to resolve challenges of funding and capacity, especially when working with

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

municipalities and the City of Cape Town. This coordination was aided by meeting mechanisms. The health sector participated in and led various coordination approaches during the drought, such as health clusters, that allowed emergency medical services within the WCDOHW to take a functional decision-making approach, to continuously communicate and appropriately respond to the water crisis (P006, P008, P10).

This health cluster approach taken from disaster management, included being clear about who makes decisions at what levels and allowed the health sector to connect regularly with relevant stakeholders to discuss the drought response in detail (P008).

> *"I think what we've done with this are forums that meet on a regular basis, is kind of realize that you can unpack everything. Education cannot say, well, it's not going to impact me. Right, education will go and interrogate How could this potentially impact me?"* (Health Sector, Provincial, P008).

Regular gatherings allowed for strong health sector coordination with disaster management, environment, water, and other key sectors that improved the understanding of health impacts and facilitated consistent communication.

Such cross-sectoral gatherings also aided cross-governance challenges during the drought, particularly at municipal level. Before the water crisis, there were existing challenges due in large part to capacity constraints and a lack of empowerment at municipal levels to act.

> *"I think some of the some of the department's understanding their role, and also that they need to delegate the role and give authority to people at a lower level within their department so that we could resolve matters at a much more local level that does not have to come up to provincial level, for example"* (Health Sector, Provincial, P015).

Local authorities also often faced constrained budgets and capacity challenges in delivering basic services (P013). Therefore, the provincial government provided additional support to district and local municipalities during the drought. Coordination between provincial disaster management, the provincial health department, and municipalities resolved issues related to water and infrastructure needs and resulted in active participation in clusters (P010). Notably, a provincial health sector participant highlighted effective collaboration between the environment department, the health department, and municipalities on water sanitation, despite ongoing challenges with local governance and leadership.

> *"I think our Department of Environmental Affairs were actually very good. And they work very closely with municipalities in terms of their role of water and sanitation. And obviously, there's a separate department for local government, which strengthens the governance of municipalities. So, you can have the most wonderful strategy, but if you don't get leadership and governance at the local level it's not gonna help. So, I think, from various angles, and with the limited resources, financial and human, and with all the politics at local level, I think we did generally not too bad" (*Health Sector, Provincial, P015).

Interpersonal relationships

Critical to good coordination across sectors was existing positive relationships within and across sectors. Health sector respondents described challenges working across sectors where previously fragile inter-personal relationships were tainted due to a perceived lack of urgency to take action that compromised health sector drought response activities. Health sector participants expressed that despite the crisis setting, other sectors seemed to delay carrying out their part in health sector drought response activities.

> *"So, for example, with the drought, there was a clear identification of the need for certain infrastructure work to be done. But we are not allowed to do infrastructure work, that is a Department of Public Works. And that partnership very often became quite problematic, because we've got the urgency and they have to deliver and they don't necessarily have the urgency"* (Health Sector, Provincial, P015).

Another example was raised by a participant's account of regulatory process challenges between the WDOHW and the City of Cape Town in the commissioning of a water osmosis plant in Tertiary Hospital 2. It was described that the provincial health department ran into municipal water use license approval issues for the facility from the City of Cape Town (P004). Interpersonal challenges, that included power dynamics between the provincial and municipal level actors potentially contributed to the process delays (P005, P018).

Relationships between government peers became critical to action. A health sector participant described that the WCDOHW also needed to persuade other departments, such as the Department of Treasury, to release financing for health sector drought response activities (P008). Alongside persuasion tactics, political buy-in and trust was seen as necessary to alleviate financing and coordination barriers for all sectors and to get other sectors to respond in an appropriate timeframe.

> *"People say, what is one of the nicest tools that you use for disaster medicine, it's my telephone. And because it consists of people I trust and will know will come to the party"* (Health Sector, Provincial, P008).

Additionally, what appeared to circumvent relationship challenges across sectors and governance levels and supported the follow through of drought response activities was identifying a "champion" or point person.

> *"I think there has been a couple of like, really good, you know, visionary people, I think, in the province that have that have got the experience that have been involved … and I think there's been there is really some real, you know, quality work done around those people that have understood it, and, and also that have been, you know, very passionate about it. And they've lobbied quite well,"* (Non-Health Sector, Provincial, P010).

Behavior change and communication

Across all interviews, the Cape Town and broader Western Cape communities were recognized as integral to the drought response. Community participation in reducing water consumption prompted significant shifts in individual and household behaviors. These changes included altering water usage for activities such as flushing, bathing, recreation, and handwashing, as well as addressing household leakages and seeking alternative potable water sources. (P020, P002, P008, P012, P005).

In working with communities, the province and municipal governments coordinated on messaging to motivate the public to spare water, modify hand washing to sanitizing, and safely use grey water to avoid sickness (P015 and P012). Communities and households helped manage the water crisis and such behaviors were sustained even after the drought was over (P008 and P006).

Health sector communications to health facilities and hospitals were also pivotal in the drought response. The health sector enforced water-saving activities, emphasized accountability amongst the health workforce, and issued behavior change

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

communications to health workers and doctors. The provincial health department released internal policy documents with strategies for health workers and doctors to save water in operating theatres (P008) and hosted communication campaigns in hospitals and health facilities to modify handwashing behaviors (P015 and P008).

Communication practices

Participants noted that, in addition to water restrictions and community accountability measures to reduce household water usage, trusted information and unified messaging played a key role in fostering positive changes in community behaviors during the response (P008, P012). This crucial shift in communication style from provincial government departments proved effective for community compliance and behavior change

> *"The messaging at some point shifted, then became very much more focused on [the] kind of messaging of we can get through this together sort of message. Previously had been quite focused on a message of compliance of like you mustn't waste water and don't be selfish kind of messaging and actually didn't respond quite well to. So, once it shifted to a more, I think, open message of this is an unprecedented climate change event. We can get through this, and we'll be okay, then I think people were … there seemed to be a general shift in behavior change."* (Non-Health Sector, Provincial, P01).

In addition to water use monitoring established in hospitals to hold the health workforce accountable (P015) the use of trusted and transparent information facilitated behavioral changes and enhanced compliance.

> *"They responded to daily or weekly announcements that was trusted information. This is the dam levels. Don't do this, do this. Don't do that. And likewise, we wanted to get people to start realizing with indexes, that it becomes a trusted source of information. And if we can respond to it, so [can] people."* (Health Sector, Provincial, P008).

A municipal health sector participant expressed concerns about the health sector's communications to communities, noting that promoting of a change in handwashing behaviors could conflict with previous messages encouraging handwashing to prevent disease spread and other health issues (P020). While behavior change messaging was not always effective or complied with, these concerns highlight that public health promotion and prevention practices were top of mind for health professionals at provincial and municipal levels, even amidst a crisis.

"Doing things differently"

Several respondents discussed challenges with adaptation during the water crisis, particularly with "doing things differently." These ranged from a reluctance of stakeholders to follow directives from senior officials (P006), limited organizational agility due to pre-established plans and budgets (P010), to high costs that deter innovation and change (P012).

> *"I think the people who are nervous about doing things differently, are concerned about the costs, if you get it wrong, like there's no second chance to do it properly, because you've spent your money already. And yeah, so it creates risk."* (Non-Health Sector, Municipal, P012).

Challenges with adapting were also present within health facilities and hospitals where there was a reluctance with compliance and changing behaviors despite requirements to limit excess water use.

> *"We come up with a circular or policy document that talks about doing things different in theater to save water. Now the most impossible people to get to change their mind are surgeons"* (Health Sector, Provincial, P008).

To overcome this challenge, the provincial health sector conducted research projects to generate and validate evidence of the benefits of changing hand hygiene practices amongst doctors and surgeons (P008). **Box 1** highlights how the provincial health sector took action to instill a change in behavior amongst surgeons and doctors during the drought.

Discussion

To date, there are few papers on how the health sector responds to drought and, despite literature on the Western Cape's drought experience, there is little documentation capturing the health sector's role in the response. This paper aims to address this gap by capturing first-hand insights from South African decision-makers who experienced the 2017/18 water crisis, contributing uniquely to the Western Cape drought literature and enriching the broader empirical research. The evidence illustrates enabling

Box 1. Doing Things differently behavior change in surgeons during drought.

During the drought, doctors and surgeons were unaware of their water usage and showed resistance to changing handwashing behaviors, as they were taught to scrub to prevent infections. To respond to this resistance, the WCDOHW conducted research to generate evidence that dispelled doctor and surgeons' concerns. The evidence showed that limiting water use for handwashing and replacing with alcohol to sanitize hands did not compromise hand hygiene before a procedure. The project also identified the amount of water used in operating theatres which used 60 liters per scrub (P015, P008)

"So then we did a research project, and we looked at one orthopedic theater. They use 60 l per scrub, they do 220 cases, we did the maths and we're basically saying that [they're] using 157,000 liters per year. So just by doing things differently, by not using so much water but using alcohol, we brought it back to make a difference. If you get to the surgeon, and he is washing his hands for five minutes it makes no difference. Yeah, but you've shown them the case studies and the research, then suddenly, you know, people just buy into it." (Health Sector, Provincial, P008).

"In our theatres, we ultimately promoted for doctors not to scrub so vigorously before theatre procedures because the evidence was if they do proper sanitizing, it is as good as a water scrub before a procedure. We looked at a lot of research and [saw] what's possible, how could we, how can we get by with the least water to use" (Health Sector, Provincial, P015).

The research evidence prompted a change in hand washing behaviors for doctors and surgeons, which became helpful for the subsequent COVID pandemic, and ultimately reduced water use in facilities, especially during operations.

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

factors and captures critical lessons for strengthening health systems to future droughts and climate-related risks.

The drought was one of several topics covered during participant interviews, which may have resulted in limited detail on response activities. However, since information about the drought emerged organically from the interviews, the risk of confirmation bias was minimized. Recall bias may have affected participants' ability to accurately recall details of the drought, which occurred years before the interviews and after COVID-19. However, responses were cross-checked across diverse interviewees, balancing direct involvement, institutional memory, and lived experience, while open-ended questions helped improve recall accuracy. To gain a more comprehensive understanding of the health sector's drought response, additional interviews with health facility managers could have provided valuable insights into specific health facility and hospital activities. Finally, as interviewees were recounting past actions and experiences related to the drought, there is a possibility of recall bias.

As evidenced by the preceding analysis, the Western Cape health sector played a significant role in the 2017/18 drought response. The health sector worked in health facilities and hospitals to manage water infrastructure, support assessments and planning, and reduce water consumption among health workers and staff. It also worked with other sectors to support the health and well-being of communities by prioritizing health risks in planning and meetings and supporting public messaging to modify water use behaviors.

The research evidence shows how existing health systems infrastructure and emergency response mechanisms, along with the recognition amongst decision makers that the drought constituted a crisis, was essential to the response. Yet, the true enabler of health sector action was what health systems analysts call health system "software," encompassing the people, relationships, values, and processes that facilitated effective decision-making and collaboration [30]. System "software" can be divided into tangible features (organizational processes, skills, knowledge) and the intangible (power, values, relationships, and communications) where intangible software features in particular shape behaviors and organizational capabilities essential to navigate changes [30–33]. Health system literature discusses the important interactions between software and "hardware" features, such as infrastructure and institutional mechanisms highlighted in the analysis, where software elements play a significant role [31, 34–38]. This is supported by findings from Kagwanja *et al.* where in response to various system shocks and stressors, health organizational capacities relied on software elements such as values and communications to adapt and transform, strengthening everyday resilience [39]. In the case of the Western Cape drought, identified software factors and how they interacted with hardware factors elaborate how the health sector drought response occurred the way it did and point to critical elements that should be sustained to support health systems strengthening.

Firstly, the findings reveal how people (software)—whether it was senior leadership or other key personnel—facilitated a successful drought response. Engaging senior leadership and management allowed for the prioritization of repairs and maintenance of health facility infrastructure (hardware). At the time of the drought, the WCDOHW had recognized the importance of robust health systems leadership and management, which could have better prepared senior leaders within the Department. Notably, a 2016 health leadership development strategy highlighted critical leadership competencies for managers across the health system [40]. In addition to engaged leadership, respondents identified the role of individual "champions" (software), who represented a cause or department and collaborate across government, as critical to action during the drought. Healthcare management scholarship emphasizes the essential role of such actors in driving change and promoting innovations within organizational and local context, though their influence tends to diminish during later stages of implementation as new circumstances arise [41–44]. Champions are often well connected and display characteristics of trust and motivation to alleviate health system barriers and encourage uptake of evidence-based health care interventions [43, 45]. In the case of the drought, champions emerged as actors who facilitated action, specifically of hardware-related activities within hospitals and health care facilities such as drawing boreholes, connecting water supplies to health infrastructure and accessing needed resources.

Second, as the analysis demonstrates, coordination across governance levels and sectors during times of crisis still relies heavily on software—particularly personal relationships—for action to take place. Documented in literature from the Western Cape drought, institutional relations, along with technical skills, were critical for mutual accountability and clarity in roles across sectors [17]. Although disaster coordination structures like health clusters (hardware), supported coordination among cross sector actors during the drought, strong pre-established relationships allowed for rapid formation of task teams and trusted partnerships that addressed cross-cutting issues such as the equitable availability of water supplies to communities and healthcare facilities. Engelbrecht and Gilson support this finding when highlighting how governance and leadership that emphasizes constructive relationships between key health service delivery actors in South Africa "create collaborative cultures of reflection, problem-solving and action" [26]. During times of crisis, like the COVID pandemic, relationships between subnational and local actors were strengthened that enabled local responsiveness. Vallabhjee and colleagues argue this was due to stewardship and distributed leadership, sharing decision-making authority across an organization, that allowed the Western Cape government to work closely with local stakeholders to deal with day-to-day activities [46]. Processes should also allow for flexible forms of accountability at the local level, while maintaining enough role clarity. In the South African health system, dominant vertical accountability processes were found to limit the improvement of quality-of-care strategies and undermine needed innovation and agency to implement policy changes [47–49]. In these instances, having flexible institutional mechanisms or parastatal committees that allow for rapid decision-making across sectors, especially at provincial and local level, even outside of a disaster and that coordinates all actors around mutually agreed priorities, can support sustained action [46, 50].

Finally, features of communication practices and values—particularly "doing things differently" and the sharing of trusted information—enabled action within the health workforce and across communities. As captured in organizational psychology and health management scholarship, crises that are uncertain in nature can be catalysts for creativity and innovation beyond the individual level [51–53]. In the example of the research study conducted to inform doctors and surgeons of their excess water use, the WCDOHW chose to address the needs and concerns of health workers to generate evidence and ultimately change water use behaviors in hospitals. In the long term, the agile nature in which a solution was found would not only facilitate long-term behavior changes that indeed became helpful during the

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

ensuing COVID crisis, but it also builds trust and facilitates innovation, allowing for easier problem-solving of complex problems in the future. Furthermore, the research study during the drought demonstrates what Beghetto discusses as "creative action" that requires "the willingness to think and act in new and different ways in an effort to navigate uncertainty and potential threats during times of crisis" [53]. In addition to adopting new approaches, the dissemination of trusted information were critical to action. Literature from the drought highlighted that public data on dam levels and unified messaging not only guided organizational and community responses and individual actions but cultivated collective accountability [54]. The findings underscore how people can use their own initiative and organizational processes (software) to navigate uncertainty and overcome hardware challenges (like inadequate water infrastructure, lack in financing, etc.) through strategic connections and adapting communications and approaches.

Implication of findings

Indeed, as demonstrated in this paper, complex emergencies like the drought have cross-sectoral impacts that, coupled with organizational interdependencies, challenge coordination and learning efforts [55].

The emergency risk management and public policy literature emphasizes that during crises, cross-sector and cross-organizational working can be more efficient due to prioritization of the crisis and decision-makers working toward the same shared objective, which the experiences of participants of this research supports [56–59]. Yet after a crisis period, collaborative learnings and long-term planning, if they occur at all, often happen independently instead of across sectors or organizations [60]. Scholarship on collaborative governance emphasize working and planning across institutional structures that can also manage a diverse set of actors to actively work together, especially on ongoing, complex issues, such as a drought or climate-related risks [58, 59]. In fact, Emerson and Anh 2022 suggest that interpersonal and behavioral dynamics among actors, and the functional dynamics of building capacity for collaborative action, which is made up of processes, institutional arrangements, leadership, knowledge, and resources, are at the heart of collaborative governance [59]. These dynamics are examples of software, which as this analysis shows, were critical components for driving health sector action during the Western Cape drought and are paramount to strengthen health systems against future droughts and climate-related risks. To move beyond situational crises to long-term coordination and practice, approaches that align cross-organizational expectations and actions and consider factors that enable the willingness and ability of stakeholders and decision makers (software) are needed [57, 61].

Conclusion

Although enabling factors like people, relationships, and values are difficult to bring into policy and strategy documents, the health system can institutionalize adaptive processes and learnings that center "people." This study indicates that these processes were supported by strong inter-sectoral and cross-sectoral relationships during times of crisis to ensure that the health system remains functional under a range of future stressors, from water scarcity to pandemics. Given the complexity behind climate-related challenges, iterative learning and cross-sectoral engagements are essential. This is especially important among multi-sector stakeholders at local levels, who will need to be agile and willing to work differently from pre-determined forms of engagement. Future research should investigate health sector responses to other climate-related shocks and stressors to identify specific actions that were sustained and what factors supported health system action.

Acknowledgements

We would like to express our gratitude to the study participants who shared their time and insights to this research. A special thank you to the health systems research 2024 global conference attendees who provided constructive feedback to the presentation of this study's findings.

Author contributions

Amanda V. Quintana (Conceptualization [lead], Data curation [lead], Formal analysis [lead], Investigation [lead], Methodology [lead], Project administration [lead], Writing—original draft [lead], Writing—review & editing [lead]) Susannah Mayhew (Conceptualization [supporting], Methodology [supporting], Supervision [lead], Validation [lead], Writing—review & editing [supporting]) Sari Kovats (Conceptualization [supporting], Supervision [supporting], Writing—review & editing [supporting]) Lucy Gilson (Data curation [supporting], Supervision [supporting], Validation [supporting], Writing—review & editing [supporting])

Conflict of interest: None declared.

Funding

This research study did not receive research funding. A travel grant was offered in 2022 by LSHTM to support partial field work costs in South Africa.

Data availability

The data underlying this article are available in the article and in its online supplementary material. Further data cannot be shared publicly for the privacy and anonymity of individuals that participated in the study.

References

1. Stanke C, Kerac M, Prudhomme C *et al.* Health effects of drought: a systematic review of the evidence. *PLoS Curr* 2013;**5**:1. https://doi.org/10.1371/currents.dis.7a2cee9e980f91ad7697b570bcc4b004
2. Salvador C, Nieto R, Vicente-Serrano SM *et al.* Public health implications of drought in a climate change context: a critical review. *Annu Rev Public Health* 2023;**44**:213–32.
3. Smith LT, Aragão LEOC, Sabel CE *et al.* Drought impacts on children's respiratory health in the Brazilian Amazon. *Sci Rep* 2014;**4**:3726. https://doi.org/10.1038/srep03726
4. Mosley LM. Drought impacts on the water quality of freshwater systems; review and integration. *Earth Sci Rev* 2015; **140**:203–14.
5. Mani ZA, Khorram-Manesh A, Goniewicz K. Global health emergencies of extreme drought events: historical impacts and future preparedness. *Atmosphere (Basel)* 2024;**15**:1137. https://doi.org/10.3390/atmos15091137
6. Sena A, Barcellos C, Freitas C *et al.* Managing the health impacts of drought in Brazil. *Int J Environ Res Public Health* 2014; **11**:10737–51.

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

7. Midgley GF, Chapman RA, Mukheibir P *et al.* Impacts, Vulnerability and Adaptation in Key South African Sectors: An Input into the Long Term Mitigation Scenarios Process, LTMS Input Report 5. Cape Town, 2007.
8. Ebi KL, Bowen K. Extreme events as sources of health vulnerability: drought as an example. *Weather Clim Extrem* 2016; **11**:95–102.
9. Orimoloye IR, Belle JA, Orimoloye YM *et al.* Drought: a common environmental disaster. *Atmosphere (Basel)* 2022;**13**:111. https://doi.org/10.3390/atmos13010111
10. Orimoloye IR, Ololade OO, Mazinyo SP *et al.* Spatial assessment of drought severity in Cape Town area, South Africa. *Heliyon* 2019;**5**:e02148. https://doi.org/10.1016/j.heliyon.2019.e02148
11. MacKellar N, New M, Jack C. Observed and modelled trends in rainfall and temperature for South Africa: 1960-2010. *S Afr J Sci* 2014;**110**:13. https://doi.org/10.1590/sajs.2014/20130353
12. Odoulami RC, Wolski P, New M. Attributing the driving mechanisms of the 2015–2017 drought in the Western Cape (South Africa) using self-organising maps. *Environ Res Lett* 2023;**18**: 074043. https://doi.org/10.1088/1748-9326/ace26f
13. Ziervogel G, New M, Archer Van Garderen E *et al.* Climate change impacts and adaptation in South Africa. *WIREs Clim Change* 2014;**5**:605–20.
14. Otto FE, Wolski P, Lehner F *et al.* Anthropogenic influence on the drivers of the western cape drought 2015–2017. *Environ Res Lett* 2018;**13**;124010. https://doi.org/10.1088/1748-9326/aae9f9
15. Western Cape Government Department of Local Government. *Compilation of the 15-Year Western Cape Integrated Drought and Water Response Plan*. Western Cape, South Africa: Western Cape Government Department of Local Government, 2022.
16. Ziervogel G, Franklin B, Thorson J. Unpacking the cape town drought: lessons learned, Report for cities support programme undertaken by African Centre for Cities, National Treasury, South Africa, 2019, 1–26.
17. Ziervogel G. What Cape Towns drought can teach other cities about climate adaptation. *The Water Wheel*, May/June Issue, 2019.
18. Baudoin MA, Vogel C, Nortje K *et al.* Living with drought in South Africa: lessons learnt from the recent El Niño drought period. *Int J Dis Risk Reduct* 2017;**23**:128–37.
19. Quintana AV, Mayhew SH, Kovats S *et al.* A story of (in)coherence: climate adaptation for health in South African policies. *Health Policy Plan* 2024;**39**:1–12.
20. Lee TT, Dalvie MA, Röösli M *et al.* Understanding diarrhoeal diseases in response to climate variability and drought in Cape Town, South Africa: a mixed methods approach. *Infect Dis Poverty* 2023;**12**:76. https://doi.org/10.1186/s40249-023-01127-7
21. Burger N, Gilson L. How has the concept of health system software been used in health policy and systems research? A scoping review. *Health Policy Plan* 2025;**40**:391–408.
22. Fanadzo M, Ncube B, French A *et al.* Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Phys Chem Earth* 2021;**124**:102986. https://doi.org/10.1016/j.pce.2021.102986
23. Shikwambana S, Malaza N, Ncube B. Enhancing the resilience and adaptive capacity of smallholder farmers to drought in the Limpopo Province, South Africa. *Conservation* 2022;**2**:435–49.
24. Rawat A, Karlstrom J, Ameha A *et al.* The contribution of community health systems to resilience: case study of the response to the drought in Ethiopia. *J Glob Health* 2022; **12**:14001.
25. Gilson L, Brady L, Naledi T et al. Development of the health system in the Western Cape: experiences since 1994. SAHR 20th Year Anniversary Edition. 2017;**6**:59–69.
26. Engelbrecht E, Gilson L, Governance, Leadership and Management. In: Makubalo L, Chikte U, Pillay Y *et al.* (eds) *The South Africa Health Reforms: 2015—2020. The Road Ahead*. Johannesburg, South Africa: Wits Health Consortium, 2022.
27. Reed MS, Graves A, Dandy N *et al.* Who's in and why? A typology of stakeholder analysis methods for natural resource management. *J Environ Manage* 2009;**90**:1933–49.
28. McLellan E, MaCqueen KM, Neidig JL. Beyond the qualitative interview: data preparation and transcription. *Field Methods* 2003; **15**:63–84.
29. Charmaz K. *Constructing grounded theory: a practical guide through qualitative analysis*. London: Sage Publications, 2006.
30. Sheikh K, Gilson L, Agyepong IA *et al.* Building the field of health policy and systems research: framing the questions. *PLoS Med* 2011;**8**:e1001073.
31. Aragón AO. A case for surfacing theories of change for purposeful organisational capacity development. *IDS Bull* 2010;**41**:36–46.
32. Elloker S, Olckers P, Gilson L. *et al.* Crises, routines and innovations the complexities and possibilities of sub-district management. *South Africa Health Review (SAHR)*. 2012.
33. Balabanova D, Mills A, Conteh L *et al.* Good health at low cost 25 years on: Lessons for the future of health systems strengthening. *Lancet* 2013;**381**:2118–33.
34. Mayhew SH, Warren CE, Ndwiga C *et al.* Health systems software factors and their effect on the integration of sexual and reproductive health and HIV services. *Lancet HIV* 2020;**7**: e711–e720. https://doi.org/10.1016/S2352-3018(20)30201-0
35. Sheikh K, George A, Gilson L. People-centred science: Strengthening the practice of health policy and systems research. *Health Res Policy Syst* 2014;**12**:19. https://doi.org/10.1186/1478-4505-12-19
36. Gilson L, Lehmann U, Schneider H. Practicing governance towards equity in health systems: LMIC perspectives and experience. *Int J Equity Health* 2017;**16**:171. https://doi.org/10.1186/s12939-017-0665-0
37. Mayhew SH, Sweeney S, Warren CE *et al.* Numbers, systems, people: how interactions influence integration. Insights from case studies of HIV and reproductive health services delivery in Kenya. *Population Council* 2017;**32**:67–81.
38. Gilson L, Vallabhjee K, Naledi T *et al.* Examining sustained subnational health system development: experience from the Western Cape Province, South Africa, 1994-2016. *Health Policy Plan* 2024;**39**:1087–98.
39. Kagwanja N, Waithaka D, Nzinga J *et al.* Shocks, stress and everyday health system resilience: experiences from the Kenyan coast. *Health Policy Plan* 2020;**35**:522–35.
40. Western Cape Government: Health. *Leadership Competency Framework*. Cape Town, South Africa: Western Cape Department of Health, 2016.
41. Hendy J, Barlow J. The role of the organizational champion in achieving health system change. *Soc Sci Med* 2012;**74**:348–55.
42. Santos WJ, Graham ID, Lalonde M *et al.* The effectiveness of champions in implementing innovations in health care: a systematic review. *Implement Sci Commun* 2022;**3**:80. https://doi.org/10.1186/s43058-022-00315-0
43. George ER, Sabin LL, Elliott PA *et al.* Examining health care champions: a mixed-methods study exploring self and peer perspectives of champions. *Implement Res Pract* 2022; **3**: 26334895221077880.
44. Miech EJ, Rattray NA, Flanagan ME *et al.* Inside help: an integrative review of champions in healthcare-related implementation. *SAGE Open Med* 2018;**6**:2050312118773261. https://doi.org/10.1177/2050312118773261

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

45. Lofters A, Prakash V, Devotta K *et al.* The potential benefits of "community champions" in the healthcare system. *Healthc Manage Forum* 2023;**36**:382–7.
46. Vallabhjee K, Gilson L, Davies MA *et al.* Reflections on the health system response to COVID-19 in the Western Cape Province. *S Afr Health Rev* 2021;**16**:173–87.
47. Scott V, Gilson L. Exploring how different modes of governance act across health system levels to influence primary healthcare facility managers' use of information in decision-making: Experience from Cape Town, South Africa Lucy Gilson. *Int J Equity Health* 2017;**16**:159. https://doi.org/10.1186/s12939-017-0660-5
48. Nxumalo N, Gilson L, Goudge J *et al.* Accountability mechanisms and the value of relationships: experiences of frontline managers at subnational level in Kenya and South Africa. *BMJ Glob Health* 2018;**3**:e000842.
49. Mukinda FK, Van Belle S, George A *et al.* The crowded space of local accountability for maternal, newborn and child health: a case study of the South African health system. *Health Policy Plan* 2020;**35**:279–90.
50. Orievulu KS, Iwuji CC. Institutional responses to drought in a high HIV prevalence setting in rural South Africa. *Int J Environ Res Public Health* 2021;**19**:434.
51. Cohen AK, Cromwell JR. How to respond to the COVID-19 pandemic with more creativity and innovation. *Popul Health Manag* 2021;**24**:153–5.
52. Solnit R. *A Paradise Built in Hell: The Extraordinary Communities That Arise in Disaster*. Penguin, 2010.
53. Beghetto RA. How times of crisis serve as a catalyst for creative action: an agentic perspective. *Front Psychol* 2020;**11**:600685. https://doi.org/10.3389/fpsyg.2020.600685
54. Ziervogel G, Morgan G. The adaptive governance capacities of the city of Cape Town built in response to extreme events. *J of Extr Even* 2022;**9**. https://doi.org/10.1142/s2345737622500051
55. Boin A. The new world of crises and crisis management: implications for policymaking and research. *Review of Policy Research* 2009;**26**:367–77.
56. Bynander F, Nohrstedt D. *Collaborative Crisis Management Inter-Organizational Approaches to Extreme Events*. 1st edn. Abingdon, UK: Routledge., 2020.
57. Nohrstedt D, Bynander F, Parker C *et al.* Managing crises collaboratively: prospects and problems—a systematic literature review. *Perspect Public Manag Gov* 2018;**1**:257–71.
58. Emerson K, Nabatchi T. *Collaborative Governance Regimes*. Washington, DC: Georgetown University Press, 2015.
59. Emerson K, Ahn M. *Collaborative Governance Regimes Informing Practice through Research*. Washington, DC: Brookings Institution Press, 2022.
60. Steen-Tveit K, Munkvold BE, Rustenberg K. Enhancing cross-organizational collaboration in crisis management: Outcomes from a full-scale regional exercise in Norway. *Contingencies Crisis Mgmt* 2024;**32**:1–14. https://doi.org/10.1111/1468-5973.70000
61. Drabek TL, McEntire DA. Emergent phenomena and multiorganizational coordination in disasters: lessons from the research literature. *Int J Mass Emerg Disasters* 2002;**20**:197–224.

Downloaded from https://academic.oup.com/oocc/article/5/1/kgaf014/8108829 by guest on 20 August 2025

© The Author(s) 2025. Published by Oxford University Press.
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.
Oxford Open Climate Change, 2025, 5, 1–11
https://doi.org/10.1093/oxfclm/kgaf014
Research Article