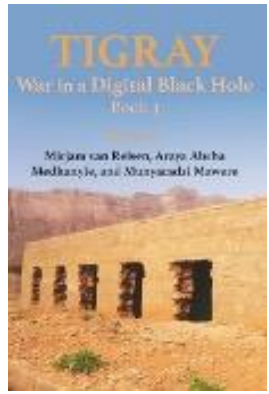
A Reinforcement Feedback Loop: Medical Care Services in Ayder Hospital during War

Simret Niguse, Hale Teka Tseghay & Mirjam Van Reisen

Chapter in:
Tigray. War in a Digital Black Hole. Book 3.



Cite as: Niguse, S., Tseghay, H. T. & Van Reisen, M. (2024). A Reinforcement Feedback Loop: Medical Care Services in Ayder Hospital during War. In: Van Reisen, M. & Mawere, M. (eds.) *Tigray. War in a Digital Black Hole*, Volume 1. Langaa, Bamenda. Pp. 337-366. Chapter URL: https://www.researchgate.net/publication/385552648_A_Reinforcement_Feedback_Loop_Medical_Care_Services_in_Ayder_Hospital_during_War
Book URL:
https://www.researchgate.net/publication/385402687_Tigray_War_in_a_Digital_Black_Hole_Book_3

The Note on Content and Editorial Decisions can be found here:
https://raee.eu/wp-content/uploads/2024/11/Note-on-Content-and-Editorial-Decisions_Van-Reisen-Medhanyie-Mawere_Tigray_Hysteresis-of-War_Book-3_2024.pdf
The list of figures in colour can be found here:
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A Reinforcement Feedback Loop: Medical Care Services in Ayder Hospital during War

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Don't be regretful for what was in the past,
don't be oblivious to what is to come.

Abstract

The war in Tigray severely damaged healthcare services, worsened by a 22-month siege, which caused extreme difficulties due to shortages and military interference. Tertiary medical at Ayder Comprehensive Specialized Hospital narrowly avoided collapse just before the Pretoria Cessation of Hostilities Agreement. The conflict resulted in significant human and infrastructure losses, resource depletion, and restricted patient access, leading to numerous preventable deaths and hampering rebuilding efforts. Despite these challenges, healthcare providers showed remarkable resilience. War and siege create a reinforcement feedback loop that triggers a tipping point, making recovery difficult and requiring higher conditions for restoration. Despite these challenges, healthcare providers showed remarkable resilience and dedication, continuing to offer care under dire conditions. Their commitment underscored the importance of support systems to maintain healthcare provision. The experience highlighted the critical role of health workers in adapting to and overcoming challenges. To build resilience, Ayder Hospital should focus on retaining health workers and integrating coping strategies learned during the crisis.

Keywords: Tigray war, healthcare, tertiary care, health resilience, hysteresis, feedback loop, health workers, Ethiopia

Introduction

Before the outbreak of the conflict, Tigray's healthcare system was recognised for its extensive primary healthcare initiatives led by health extension workers (Kloos, 1998) and was considered a model for the nation's healthcare efforts. Moreover, metrics such as institutional delivery, antenatal care, postnatal care, and neonatal mortality were all heading in the right direction towards meeting national and global targets (EPHI & ICF, 2019).

The Tigray region has a population of 6 million people. Ayder Comprehensive Specialized Hospital is the largest hospital in the region, based in Mekelle, the capital of Tigray. It is, or was, the second-largest hospital in Ethiopia before the war. Ayder Hospital is one of only a few referral hospitals across the whole of Ethiopia, a country with a population of over 100 million people. Ayder Hospital serves as the primary referral and specialised medical centre for a catchment population of 8 million people, including those from Tigray, Afar, and the south-eastern part of Amhara region state. Founded in 2008, the hospital provides a wide range of medical services to patients of all ages, both in and out-patients. Ayder Hospital is a teaching hospital and implements over 70 teaching programmes.

The hospital has 624 in-patient beds across its four major departments and other specialties. with over 100 specialists in various areas of medical specialisation and an adequate number of other health professionals, Ayder Hospital was able to offer quality care to patients in need. Notably, the hospital's major specialties include paediatrics and child health, as well as gynaecology and obstetrics, both with over 50 specialists and adequate staff members. Due to the influx of displaced people and new visitors from neighbouring Eritrea, the hospital was serving a much larger population than the 6 million people of Tigray – at least this was the situation before the outbreak of the war in November 2020.

During the war, Ayder Hospital remained one of the few active hospitals and continued to provide care to a significant number of patients. This research investigates how the siege was a critical factor

that affected the functioning of Ayder Hospital. This study seeks to provide a comprehensive understanding of medical care provision at the hospital during the siege. It focuses on the challenges faced by Ayder Hospital in providing and sustaining tertiary medical care services during the Tigray conflict. The research questions addressed is: *What were the challenges in providing tertiary medical care services in Ayder Hospital during the Tigray war and siege and how did the hospital adapt during the period from November 2020 through November 2022?*

Methodology

This is a qualitative deductive grounded theory case study. The data was collected from May 2022 to February 2023 in the Ayder Hospital. The methodology included in-depth interviews (IDI) and focus group discussions (FGD) with healthcare providers from the paediatrics and child health, as well as obstetrics and gynaecology departments at Ayder Hospital. In total 41 persons participated in the study.

Eligible participants were healthcare providers working in the maternal and child health departments at Ayder Hospital during the data collection period, categorised as senior practitioners, residents, nurses, or midwives. Concerning the sample size and sampling procedures the following criteria were used. Participants were purposively selected based on:

- Professional type
- Sex
- Department of work
- Work experience at Ayder Hospital
- Position within their service unit

An expert's discussion was conducted to identify relevant criteria for selection, resulting in a total sample size of 41 healthcare providers. To ensure professional diversity, participants were selected from:

- Nursing staff
- Medical trainees
- Senior practitioners

The administrative structure of Ayder Hospital was used to prepare a list of eligible potential participants who could provide rich

information on their experiences during the siege. Saturation of information was achieved at the 15th to 17th interviews. Table 9.1 provides a detailed breakdown of sample size determination for each criterion and Table 9.2 shows the description of FGDs and IDIs.

Table 9.1. Distribution of participants (n=41)

Participant groups (n=41)	Sex		Marital status		Experience in Ayder Hospital		Position in service unit	
	Male	*Female*	*Married*	*Single*	*<5 years*	*5 years & above*	*Yes*	*No*
Seniors	6	0	4	2	1	5	3	3
Residents	11	7	7	11	7	11	0	18
Nurses	3	6	6	3	2	7	2	7
Midwives	6	2	6	2	1	7	1	7
Total	**26**	**15**	**23**	**18**	**11**	**30**	**6**	**35**

Table 9.2 sets out the breakdown of participants in the study based on their sex, marital status, years of experience in the hospital, and position in the service unit. The total number of participants in each category is also provided, giving an overview of the composition of the study participants. Table 9.2 shows that a total of 4 FGDs and 13 IDIs were conducted.

Each FGD consisted of 7 participants from paediatric residents, obstetrics and gynaecology residents, paediatric nurses, and midwives while the IDIs involved key informant interviews with each

departments' heads, each departments' head nurses, and the hospital chief clinical director. Additional IDIs conducted with residents of each department who didn't participate on the FGDs.

Table 9.2. FGD description of participants (n=28)

FGDs (#=4, n=28)	Participants	Number	Age (minimum-maximum)	Experience in Ayder Hospital (years) (minimum-maximum)
FGD 1	PCH residents	7	27–34	2–7
FGD 2	PCH nurses	7	28–39	2–12
FGD 3	OBGYN residents	7	28–34	2–6
FGD 4	Midwives	7	26–38	2–10

Note: PCH=paediatrics and child health, OBGYN=obstetrics and gynaecology

Four focus group discussions were held, each consisting of seven members, with groups of nurses, midwives, and residents from both departments, followed by in-depth interviews with thirteen participants.

Table 9.3. IDI description of participants (n=13)

IDIs	Participants	Gender	Age	Experience in Ayder Hospital (years)
IDI 1	PCH head nurse 1	Male	35	8
IDI 2	PCH head nurse 2	Female	33	7
IDI 3	Midwives' vice head	Male	33	8
IDI 4	PCH department head	Male	38	12
IDI 5	OBGYN department head	Male	33	8
IDI 6	Chief clinical director	Male	37	10
IDI 7	OBGYN senior	Male	32	7
IDI 8	PCH senior	Male	30	3

IDIs	Participants	Gender	Age	Experience in Ayder Hospital (years)
IDI 9	OBGYN senior	Male	35	6
IDI 10	PCH resident	Female	28	4
IDI 11	OBGYN resident	Male	29	2
IDI 12	PCH resident	Male	28	3
IDI 13	OBGYN resident	Male	28	2

Note: PCH=paediatrics and child health, OBGYN=obstetrics and gynaecology

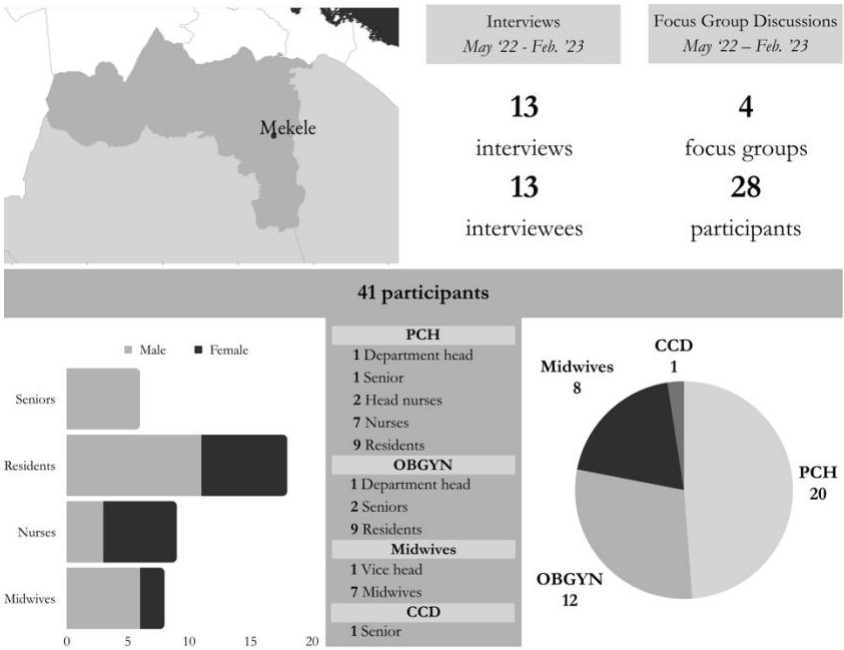

Figure 9.1. Data used and collected in the study

Data collection procedure

The investigator developed a semi-structured interview guide with open-ended questions for IDIs and FGDs. The interview guide was subject to modification to incorporate conditions, mentioned by participants, that were relevant for further investigation. The data were collected by four investigators, who were trained to conduct the interviews, and who transcribed each interview word-for-word and performed the coding of the interviews.

Data analysis

A coding-labelling analysis was carried out on the data. The data were imported into Atlas.ti qualitative data analysis software Version 9 for coding and analysis. Two investigators independently coded all the transcripts inductively, checked for the reliability of their codes, and resolved any coding differences with a third investigator. Field notes and investigator's memos were linked to respective files in the software for analysis. The investigators presented the list of developed codes for peer debriefing sessions with all investigators for labelling of codes in the data. The investigators refined the code labelling together, systematically grouped similar codes into categories, and grouped similar categories into themes.

Findings

The results are presented in four parts: background, challenges in providing health services, coping mechanisms, and the negative loop that emerged due to the spiralling effect of challenges.

Background and context

This case study showed that health workers showed remarkable dedication. This corroborates with findings that health workers adapt to changing circumstances by developing new skills and finding innovative ways to deliver healthcare (Witter *et al.*, 2017). Health workers can develop resilience to cope with the challenges of delivering healthcare during war. This can involve developing coping strategies to manage stress and trauma (Elnakib *et al.*, 2021). These

adaptations can surprisingly improve care, even under the most challenging situations.

During the war, an attack was launched on the health facilities in Tigray and many health facilities were destroyed and looted. When Eritrean troops invaded Mekelle, the Ayder Hospital was attacked to loot it. The following was reported on 5 December 2020, during a comprehensive communication blockade of the region:

> *Attempts by federal troops and Eritrean troops to loot the Ayder hospital, the main referral hospital in Mekelle, 80% of patients are wounded by the bombardment of the city. Two civilians were killed and four injured as they resisted.* (EEPA, 2020, SR 17)

It was reported that the community living around the Ayder Hospital defended the hospital to prevent it from being taken over by Eritrean troops. Two days later it is reported that:

> *Tigray doctor states in a text message that they are working with a severe lack of basic equipment, including lack of light, fuel, food, gloves, and antibiotics. Their ambulance was taken by soldiers.* (EEPA, 2020, SR 19*)*

On 17 January 2021, it was reported that "20,000 health workers and other government civil servants are not receiving their salary for over two months with some exceptions" (EEPA, 2020, SR 58) On 19 February 2021, it was communicated that:

> *A letter is posted at Ayder Referral Hospital in Mekelle stating that patients who were beneficiaries of community-based health insurance, free, and other scheme users are no longer considered for health services if they are not able to pay.* (EEPA, 2020, SR 88)

The communication states that:

> *Previously patients who were unable to pay were able to get health services for free when they provided a support letter from their respective administration. At this critical time, free health services are stopped for people who are not able to pay.* (EEPA, 2020, SR 88)

The consequences of the siege were increasingly noticeable. On the 25 May 2021, it was reported that Ayder Hospital was using expired medication and that its medication supplies had run out:

> *The Guardian is reporting that Ayder Referral Hospital in Tigray is using expired medication and paracetamol to treat terminally ill cancer patients. According to one doctor, the hospital only has 16% of the medication it needs. In a letter, doctors said cancer care was "almost non-existent.* (EEPA, 2021, SR 211)

The consequences of the siege on transport were also reported:

> *And on the 2nd of June 2022 the chief clinical director, Dr Kibrom Gebreselassie was reported as stating that the Ayder Comprehensive Specialized Hospital had reached a stage where it "could not provide services to patients, after 19 months of conflict.* (EEPA, 2022, SR 215)

A few days later the chief clinical director Dr Kibrom Gebreselassie, said "that 32 people have died in just 12 days due to lack of oxygen, antibiotics, fuel and anaesthesia drugs" and "eleven of them were neonates" (EEPA, 2022, SR 220). Dr Amanuel from Ayder Hospital was reported as saying that "lack of fuel, medicines and supplies have made the situation unworkable for the hospital" (EEPA, 2022, SR 225). Specific reports were made of the hospital running out of insulin and patients arriving from far trying to find medication, are told these are not available (EEPA, 2022, SR 275). It was reported on 4 October 2022 by the BBC that hospital staff has not been paid for 17 months (EEPA, 2022, SR 282).

Imminent collapse

On 31 October 2022, Dr Kibrom Gebreselassie warned that Ayder Hospital will collapse soon "if left without support – with only 9% of medical facilities operational according to the World Health Organisation" (EEPA, 2022, SR 301). A few days later the Cessation of Hostilities Agreement was signed in Pretoria and the collapse was averted. However, the continued lack of supplies continued to trouble the hospital, and Dr Kibrom Gebreselassie reported in February 2023 that he is concerned that many health workers are leaving (EEPA, 2021, SR 337).

Challenges to service provision

The following themes were identified:

- Restrictions faced by healthcare professionals

- Challenges faced by the civilian population seeking assistance
- Lack of hospital supplies
- Lack of public facilities
- Military obstacles
- Curfew restrictions
- The inadequate response from humanitarian agencies

These challenges are discussed in more detail below.

Severe restrictions faced by healthcare professionals

A range of challenges came up in the interviews, restricting the availability of health workers involved in the health service delivery for patient care.

The healthcare professionals faced severe security concerns and healthcare staff members relocated for safety purposes, while others left to look for food or employment elsewhere:

> *I live 10 kilometres away from my workplace [Ayder Hospital]. There is no transport service provided by the hospital, nor can I afford public transport fee. So, I arrive at work one to two hours late on foot; then I start my duty without a proper handover from the previous team. Later, I leave work earlier than I should because it takes me 2 hours to reach home.* (Interviewee 1007, a focus group interview by Teka, face-to-face, June 2022)

Unfortunately, some staff's whereabouts remain unknown, while others have been confirmed dead. The departments had to be run on significantly reduced teams:

> *In the department of gynaecology and obstetrics; 2 specialists, 22 specialty trainees and some midwives have left their work. One of our midwives was killed by soldiers while he was looking for a safer place to live with his family in the villages.* (Interviewee 1001, interview by Teka, face-to-face, June 2022)

Hunger among health professionals was prevalent. Due to the war, the healthcare professionals were not paid their salary and they could not access their savings because of the banking services interruption. Most resident physicians claimed that eating three times a day was unthinkable and twice a luxury.

Who thought that I could be worried about what to eat? (Interviewee 1002, interview by Niguse, face-to-face, June 2022)

The lack of food would affect the ability of the health workers to provide services:

Once, while I was operating a mother in the OR [operating room], my assistant doctor collapsed to the ground. I had to continue my surgery alone telling the assistant midwife to take care of him. When we realised it was due to hypoglycaemia, he was provided with glucose and later we found out that he had not eaten his dinner because he couldn't afford. (Interviewee 1003, focus group interview by Teka, face-to-face, June 2022)

Health professionals also suffered from mental problems. Most participants stated that they found that the health professional was double burdened. Firstly, they lacked necessities for personal living and family support, as they did not receive salaries and could not look after their own families:

As a paediatrics specialty trainee, it has been a moral question for me to advise parents on how to feed their kids properly when I can't provide my baby with the things. It is such a haunting experience. (Interviewee 1002, interview by Niguse, face-to-face, June 2022)

Despite these challenges doctors and health workers continued to deliver services:

Once, I remember my colleague's gynaecology resident had to clean the operating room (OR), wash the OR drapes with a bare hand, and risk doing a caesarean section with bloody OR cloths all on his own because there were no cleaners and electric power to sterilize the OR drapes. (Interviewee 1003, a focus group interview by Teka, face-to-face, June 2022)

Health workers felt the burden of having to respond to the suffering from the trauma they developed as the result of the failure to be able to take care of their patients:

At some moment of the time around December 2021, when I couldn't provide my clients with the basic drugs they needed, I was in a dilemma about whether to withdraw myself from clinical practice or not. It is morally effective. (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

The helplessness with access only to limited resources while facing overwhelming needs led to despair and moral injury. This included having to deal with the triggers of the military operations causing trauma to the health workers:

> *There have been frustrations since the onset of war specially when there is air strikes and heavy artillery shelling. Even the sound of a moving oxygen cylinder and stretcher in the hospital freaks me out because it resembles the sound of a fighting aircraft.* (Interviewee 1008, a focus group interview by Niguse, face-to-face, June 2022).

Health professionals also had feelings of helplessness and frustration from observing their patients dying from preventable causes, and situations which were also dangerous for the health workers who had to deliver services without the ability to protect themselves against infection from the patients:

> *We have been engaged barehanded with labouring mothers whose Hepatitis and HIV status is unknown without wearing any gloves since it was not available in the hospital.* (Interviewee 1007, a focus group interview by Teka, face-to-face, June 2022)

Moreover, the constant threat of violence and danger and lack of safety, added another third layer of stress, making it difficult to find moments of relief or peace.

Challenges faced by the civilian population seeking healthcare

The communications blackout, interruption of banking services, military curfews, and aerial and drone bombardments during the active war period brought serious impediments to patient care. Patient flows decreased, and those who came to the hospitals seeking care usually presented late in the course of their disease:

> *A 4-year-old had a severe headache. His parents understood the seriousness of his condition. However, they could not bring him for fear of being targeted as they transported him to our hospital. As time went by, the child's condition deteriorated and he finally lost consciousness. Then the family had to take a risk to come to our hospital. After he received medical support at our hospital he survived. However, in my professional opinion, the baby will live with permanent disabilities.* (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

Many clients (patients) with known illnesses who had follow-up in the hospital were lost from follow up.

> *I used to see a minimum of 20 cardiac patients per day on follow-up before the current situation. But now, I see four to five cardiac patients only. I am not sure what could have happened to the majority of our patients.* (Interviewee 1005, interview by Niguse, face-to-face, July 2022)

Similarly, there were incidents of patients fleeing from the hospital whenever there was an airstrike and shelling around the hospital or the city.

Lack of hospital supply

Most participants reported that lack of hospital supply had been a major challenge. Lack of basic laboratory services due to interruption of supply of reagents, a malfunctioning CT scan and MRI machines facing maintenance issues, and the lack of spares impacted diagnostic services. The absence of basic childhood vaccines deeply concerned childcare providers. Shortage of consumables like detergents, basic medications like antibiotics and Intravenous (IV) fluids, oxygen supply, medical gloves, and gauze in the hospital had negatively affected service provision:

> *We don't have any budget to buy drugs, the stores of our providers in the region are empty, and humanitarian agencies bring a negligible amount in type and quantity. It is difficult to sustain service in this manner.* (Interviewee 1006, interview by Niguse, face-to-face, July 2022)

Lack of basic supplies contributed directly to avoidable deaths:

> *There is frequent interruption of basic lifesaving services during the siege. In six six-month period, lack of oxygen has directly contributed to the death of 40 paediatrics patients.* (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

The other major challenge was a total lack of fuel to run backup generators during power outages.

Lack of public facilities

Bank, electric, communication, and transportation blackouts in the siege that was imposed during the war, caused great problems to the provision of services in Ayder Hospital. The siege in the region

resulted in the complete closure of the government and privately owned banks which led to difficulty accessing savings for transportation and medical services. Salaries of civil servants were not paid from June 2021 onwards to the time the interviews were conducted, and health workers were not able to access their savings.

Frequent and prolonged electricity interruptions caused severe hypothermia leading to the deaths of new-borns, closure of operation theatres, and interruptions of most services, incidents that were reported by almost all participants.

The other main public facility challenge was communication blackout. Labouring mothers and critically sick children were not able to call for ambulances. First-line medical trainees and physicians had difficulties reaching their consultants for medical advice and decisions and situations ended up in extreme levels of health risks. Examples given included an open patient's abdomen brought to a consultant's home for further engagement. Another doctor recalled:

> *I live within the compound of the hospital. Previously, I used to hear a minimum of 5 ambulance alarms per day but now it has been more than 6 months since I heard the alarm of an ambulance. Emergency patients and labouring mothers are not able to call for the service.* (Interviewee 1001, interview by Teka, face-to-face, June 2022)

Challenges with public transport were significant from the start of the war in November 2020 until the time of the research. Initially, the sudden interruption of public transport services at the onset of the war due to curfews significantly reduced the patient flow from different zones of the region to the Ayder Hospital.

Impact of military

After the war broke out on 3 November 2020, heavy artillery shelling around the hospital broke out. Doctors who lived within the compound of the hospital found that they had no choice other than to flee from the hospital after two strikes hit within 50 meters radius of where they lived in November 2020:

> *I live around the hospital. On 28 November 2020, while I was returning home from work, two heavy artilleries hit within a 50-meter radius of my home. I and my friends*

ran away to a far place immediately and returned home after a week. (Interviewee 1005, interview by Niguse, July 2022)

The presence of the Ethiopian National Defence Force (ENDF) military within the hospital compound in the first period of the war, influenced the care provision in Ayder Hospital.

One problem was the threats to health workers forced to treat the soldiers with health problems. Testimony of such a situation is as following:

There was one female ENDF who came with profuse bleeding from the genital area; we found out it was a spontaneous abortion. Her husband, military personnel himself, brought her a soft drink and she vomited it right away. Then he started to threaten us that he would kill us if anything bad happened to her. We were so scared of losing her. She was also accompanied by 6 more troops who had their guns in the procedure room. She survived the procedure, though it was so a scary moment. (Interviewee 1003, a focus group interview by Teka, face-to-face, June 2022)

The presence of the ENDF troops was also a deterrent for patients to come to the hospital, especially for victims of sexual violence perpetrated by the ENDF military:

Because ENDF has used the hospital as a camp, many health professionals preferred to stay at home. Many victims of gender-based violence who came to get service were obliged to back off from the hospital since the offenders' team was at the gate of the hospital. Moreover, medical students were raped by ENDF troops who resided within the hospital. The perpetrators were identified and taken by police. We have a recorded document if needed. (Interviewee 1006, interview by Niguse, face-to-face, July 2022)

Misbehaviour and shooting led to incidents that further compounded to health concerns:

The ENDF who camped within the hospital compound used to fire guns just into the air in times of celebration. For example, in January 2021, they continuously fired for more than an hour following the capture of some higher officials. During the celebration, we and our patients were frustrated and there were incidents of child bullet injury from nearby houses, and the window of the PCH ward was also broken

with a running bullet. (Interviewee 1009, a focus group interview by Niguse, face-to-face, June 2022)

The perceived disrespect of the ENDF military vis à vis the people of Tigray further added to fear for both health workers and patients to come to the Ayder Hospital:

The troops in the hospital used to tell us that the ENDF came to safeguard the people of Tigray, but what they were doing is opposite to what they say. It was suffocating, cruel, and horrible. (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

A lack of sense of safety associated with military issues were abundant negatively affecting both the health workers and the patients.

Curfew restriction

Soon after the federal government took over Mekelle city in November 2020, curfew restrictions were set by the interim government of Tigray. The curfew restrictions included prohibited movements from 6 PM to 6 AM, which also applied to ambulance movements in the first two months of the interim government.

Labor and delivery unit care providers were extremely anxious about the curfew set by the command post considering the emergency nature of most of their duties. These providers claimed that they lost possibly salvageable cases as the mothers had to stay at home due to the curfew restrictions, resulting in avoidable complications causing maternal death secondary to bleeding. In response to this, pregnant mothers whose estimated date of delivery approached, used to come to the hospital early, preferring to stay in groups on the grounds within the hospital compound, before the onset of labour because they were afraid of labour starting overnight when there was a curfew restriction.

People who were injured during the night had to wait until the next morning to arrive at the hospital. Some physicians reported that they were forced to stay in the hospital overnight once it got late while working; while others said that they had to leave the hospital if curfew time approached, even if they had not completed their duties and had

not made a proper handover. It was not without danger for health workers if they were caught outside during the curfew:

> *Most of the consultant physicians live in a compound next to the hospital which is five minutes' walk. Once upon a time, my colleague Obstetrician decided to help technically after he received a call from other staff in the hospital and went out at 9:30 PM. He was caught by the ENDF troops in the hospital and was told to bow down on his knees and he was threatened. So, we had difficulty assisting our colleagues in time of need.* (Interviewee 1001, interview by Teka, face-to-face, June 2022)

Patients who needed urgent management beyond the capacity of on-duty care providers that necessitated more senior consultation did not receive the care they needed.

The response from humanitarian agencies

Most health workers were disappointed by the delayed and inadequate response of national and international humanitarian agencies. The fact that the Paediatric wards were filled with malnourished children was a clear indicator of the hunger in the community, participants stated. Empty hospital pharmacy stores showed the lack of medicine, and health workers expressed disappointment in the humanitarian agencies to assist. Some participants said that they had another perception of United Nations (UN) agencies and non-governmental organisations (NGOs) before the war and that they were disillusioned:

> *Patients come across many kilometres when they hear about a new drug supply arrival by humanitarian agencies on the media. They assume as if many drug items have arrived, but in actuality this was not the case. And as a consequence, at times arguments emerged between patients and care providers.* (Interviewee 1006, interview by Niguse, face-to-face, July 2022)

Disillusionment was also recorded, especially regarding what was interpreted as a political intention of the international community not to support the Tigray region with humanitarian aid when it needed it most:

> *I thought the world was civilised enough to differentiate between humanity and politics. Now am learning that foreign interferences are solely benefit-focused not*

humanity-focused. I have lost hope in the so-called multilateral organisations. (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

The interviews showed that most care providers believed that thousands of lives could have been saved if humanitarian aid had supported the hospital services.

Coping mechanisms

This section identifies the conditions that mitigated the collapse of the Ayder Hospital.

Emergency preparedness

The emergency preparedness level of the hospital was not good at the onset of the war in November 2020. Soon after the war started, the hospital ran out of emergency drug supplies including gloves and basic antibiotics. Following the federal forces taking over the Tigray region, and the resumption of public facilities like transportation, the hospital had a relatively better drug stock for the first 8 months of the war. The situation changed in June 2021 after Tigray forces took over Mekelle city and a total siege was imposed in the region. Since the hospital store had full stock, emergency preparedness was better concerning supplies in the first few months of the siege until it reached a critical point in January 2022.

Building partnerships emerges as a crucial coping mechanism in addressing challenges in health service delivery within war-affected areas. Networking between hospitals becomes imperative, facilitating the sharing of resources, knowledge, and expertise. Collaborative efforts foster resilience, allowing healthcare providers to pool their limited resources, coordinate services, and mitigate the impact of conflict.

Changing treatment protocol

Physicians reported that changing treatment protocol to use second or third-line drugs to align with the available ones was a routine occurrence. Participants from the maternal health side also testified to using a single-use operation set for multiple deliveries since sterilized materials were scarce especially when the electric power was

gone. Treating severe infections with oral antibiotics while intravenous antibiotics were needed, doing surgeries without a drape or operation room close, skipping medication doses, recycling disposable gloves, and using expired drugs to treat patients including cancer patients, were some of the solutions in the hospital. As sterile gauze was lacking for emergency surgeries, wound care, and delivery room care; initiatives were started by the hospital staff to collect cultural clothes from the society, which were cut and processed for use instead of gauze. Participants enjoyed the inventiveness of circumventing the challenges imposed on them and their ability to fulfil their medical duty in some way regardless of the challenges.

Inventive coping mechanisms and creativity

Coping mechanisms that were identified by the interviewees included:

- Use of expired drugs
- Recycling disposable gloves
- Employing local innovations
- Use of traditional medicine
- Focus on lifesaving measures only
- Non-standard practices

Table 9.4 below offers examples of citations related to each of these coping mechanisms.

Table 9.4. Coping mechanisms

Coping mechanisms	Elaborative quotes
Use of expired drugs	*I think it is worth trying to use expired drugs rather than seeing our patients gone for granted. We shall use the available outdated drugs until they are finished once we obtain informed consent from our patients. What choice do we have?* (Interviewee 1002, interview by Niguse, face-to-face, June 2022)

Coping mechanisms	Elaborative quotes
Recycling disposable gloves	*Starting in January 2022 and 5 subsequent months, we had no gloves at all. The direction given by the hospital administration was to wash and recycle the gloves. After recycling them, they become so sticky inside and we had to struggle to wear them back. At times, I prefer to give care with bare hands.* (Interviewee 1008, a focus group interview by Niguse, face-to-face, June 2022)
Local innovations	*Normal saline was prepared solely from tap water and salt for use in wound care.* (Interviewee 1005, interview by Niguse, face-to-face, July 2022)
Traditional medicine	*A practice that has never existed in the history of the medical world…. Since things are getting better and worse, we have started to read books written a century ago as to take a pearl of wisdom from traditional practice as all we have is our hands only. We are pulled back to that era.* (Interviewee 1006, interview by Niguse, face-to-face, July 2022)
Focus on lifesaving	*I had many labouring mothers on whom surgery was indicated for a ruptured uterus to give birth via caesarean section. The standard is to salvage the baby, the uterus, and the mother. Currently, the practice focuses on saving the life of the mother only as there is no room for the 'fantasy' of saving the uterus and the baby.* (Interviewee 1012, interview by Teka, face-to-face, June 2022)
Non-standard practices	*As lifesaving intravenous fluids are not available in the hospital, we try to treat the paediatric patients with other substandard and locally prepared fluids via nasogastric tube and at worst*

Coping mechanisms	Elaborative quotes
	situations, we have treated dehydrated children with carbonated commercial soft drinks. (Interviewee 1004, interview by Niguse, face-to-face, June 2022)

While the hospital reached a critical phase concerning supply, the presence of private pharmacies that were providing essential drugs, even if at extremely expensive cost, helped the hospital to continue giving service. Key informants stated that the redistribution of distributed medical supplies in the region also helped to balance the equity and maximized the use of available resources. The coping mechanisms were proudly seen as a form of resilience by most participants.

Personal dedication, courage, and pride

Health professionals in the hospital were not paid any salary during the war. The salaries fall under the Ministry of Health of the Ethiopian government and during the siege, the salaries were stopped. Despite this very difficult situation, the health workers dared to continue providing services. They had to do this under very difficult circumstances and few items available in the hospital.

The participants said that they believed that it would be part of the Tigray people's struggle to serve the people without any payment:

> *I know that I am losing many salvageable patients and it hurts to experience that. Still, if I can help one mother why would I stay at home? I should come and help to save that life.* (Interviewee 1003, a focus group interview by Teka, face-to-face, June 2022)

Contributing to the society: "I come here to support my society psychologically"

The dedication of the Ayder Hospital staff was a critical factor to tip the balance to continued professional services being provided by the hospital during the war and the siege. The courageous resilience of

health professionals was a major factor in sustaining service provision expressed in different ways.

> *Even if we have nothing to provide to our clients, we have to be available in the hospital for those who come believing in us. At least we can support them psychologically.* (Interviewee 1009, focus group interview by Niguse, face-to-face, June 2022)

The inventiveness, the pride and the sense of achievement, that against all odds, the services were continued, can be seen as a critical factor of resilience, and delaying the tipping point towards the termination of tertiary health services in the region.

Reinforcement feedback loop due to spiralling challenges

As per a report released in November 2021, only 30% of the region's 47 hospitals, 17% of the 233 health centres, 11.5% of the 269 ambulances, and none of the 712 health posts were operational six months into the war (Gesesew *et al.*, 2021).

The trends in patient flows changed over time. In the first 8 months of the war, paediatric wards were filled with children who were victims of direct war related injuries like bullets, explosives, heavy artillery, air strikes, and drone injuries.

> *I work in the above-five paediatric wards. In the first eight months of war, half of the paediatric ward was occupied with direct war related injuries of children mostly due to shelling and explosive injuries. We had an average of 40 such paediatrics patients at a time.* (Interviewee 1010, interview by Niguse, face-to-face, June 2022)

Later, during the siege, cases of malnutrition significantly increased and the focus of the services were towards emergency cases of malnutrition:

> *I work in the under-five paediatric wards. The degree of malnutrition increased by three-fold. For instance, immediately before the war, we had a maximum of twelve malnutrition cases per month in the ward, but now we have 42 malnutrition cases per month.* (Interviewee 1011, interview by Niguse, face-to-face, June 2022)

Participants from the obstetrics and gynaecology side observed a higher rate of victims of sexual violence and rape which in turn increased the number of sexually transmitted diseases and the need for induced abortion. On the other hand, complications of neglected labour such as cephalopelvic disproportion (CPD), obstructed labour, intrauterine foetal death (IUFD), and fistula started to reappear in a higher number.

Food provision to patients was interrupted as the hospital food stock ran out of food supply. Treatment of chronic diseases became unaffordable by the hospital in terms of supply.

The challenges aggravated by other challenges can be considered a positive forward loop which precipitates a loop towards a tipping point, in which the situation transforms into a new entirely different situation governed by other conditions.

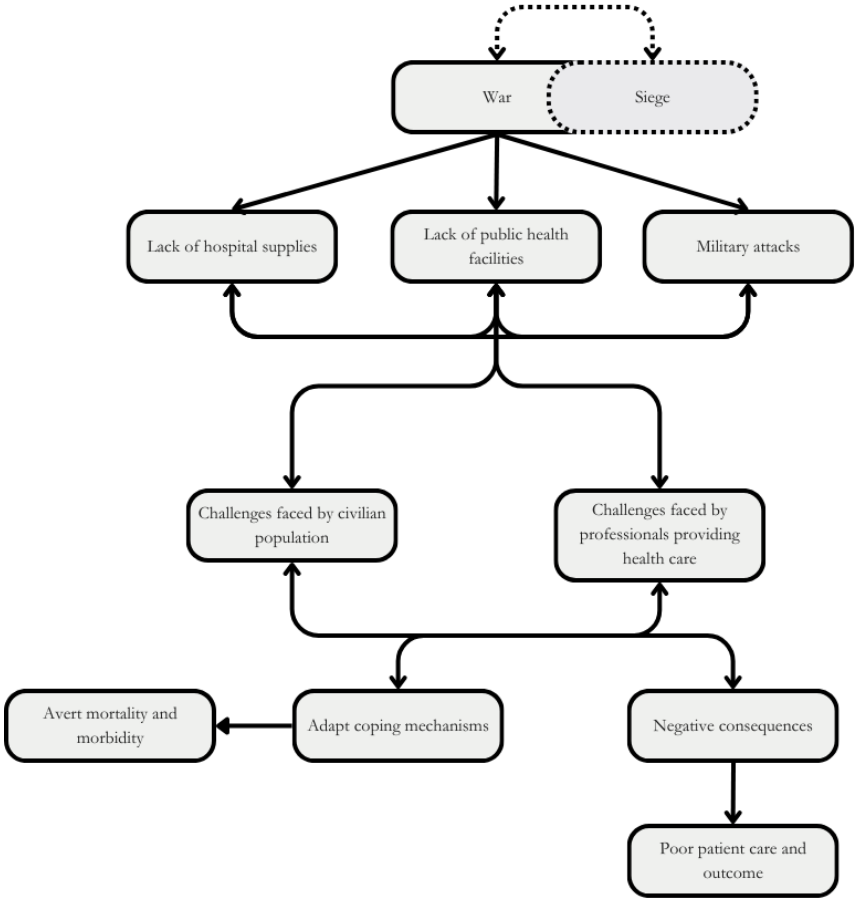

Figure 9.2. Framework showing the multidimensional effects of war and siege causing a reinforcement feedback loop on healthcare services

A reinforcement feedback loops caused by the multidimensional effects of war and siege triggers a tipping point transforming the situation in an alternative new situation. The concept of hysteresis hypothesises that critical factors contribute to the tipping point in which a situation transforms into a new one. To return to the original state, the critical conditions need to be restored to a higher level.

The model of Stocker (2024) predicts that a return to the previous situation is difficult. The concept of hysteresis explains that the conditions leading to the tipping point crashing the hospital into a new situation need to be met to a much further level than the level at

the tipping point, for the situation to return to the original one. The emphasis is on studying the conditions leading to the tipping point, in the specific situation of war and a long-lasting siege instilled during this war, and the conditions that prevent it from reaching the tipping point. This should increase the knowledge of resilience in healthcare provision during war and siege.

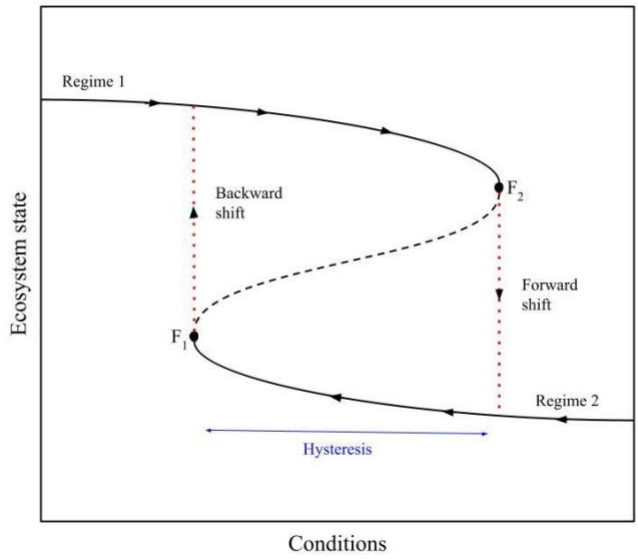

Figure 9.3. Critical transitions of a reinforcement feedback loop
Source: Stocker (2024) adapted from Scheffer *et al.* (2012)

Conclusion

The full-scale war in Ethiopia's Tigray region from November 2020 to November 2022 (ICHREE, 2023) caused significant damage to the provision of healthcare services. One of the major challenges facing healthcare provision was the siege, which lasted for 22 months. The participants reported extreme difficulties in all aspects of health service delivery due to issues with the availability of healthcare professionals, restrictions on the civilian population seeking treatment, lack of supplies, and military interference. Ayder Hospital struggled to provide and sustain tertiary medical care services during the conflict and siege, leading to numerous preventable deaths. The

situation worsened when the hospital lost access to resources such as savings, electricity, communication, and transport, as was the case in Tigray. The war and subsequent blockade have had a direct and indirect impact on health workers, staff, patients (including children), and overall service delivery.

Ayder Hospital only just managed to avert a total collapse. It was facing a complete failure, reported on 31 October 2022, just days before the Pretoria Cessation of Hostilities Agreement was signed. During the war and siege, the challenges faced by Ayder Hospital were numerous and profound. The unimaginable toll on human lives and infrastructure severely disrupted services at the Hospital, as well as in the entire healthcare system in Tigray, leaving communities vulnerable and in need of urgent medical assistance. Amid the chaos, healthcare providers found themselves wrestling with enormous obstacles, from limited resources and damaged facilities to security risks and population displacement. However, even amid such adversity, remarkable coping mechanisms emerged, as communities and healthcare professionals strived to ensure the provision of essential healthcare services at Ayder Hospital.

Moreover, the extreme shortage of circulating cash exacerbated the challenges, as individuals struggled to afford healthcare services and providers were unable to access necessary funds for the operation of their facilities. These economic and social disruptions amplified the impact of the war and siege on health service delivery, emphasising the need for comprehensive support and resources to mitigate these obstacles.

The study shows that reinforcement feedback caused by war and siege can trigger a tipping point, transforming situations irreversibly. The concept of hysteresis suggests that restoring conditions to a higher level than the tipping point is necessary for recovery. Stocker's (2024) model indicates that returning to the previous state is challenging, emphasising the need to understand conditions that lead to the tipping point, as well as the factors that prevent it being reached, to enhance healthcare resilience during conflicts.

One observation from this study is that despite these challenges, healthcare providers in Ayder Hospital showed remarkable resilience

and dedication, continuing to offer care under dire conditions. Their commitment underscored the importance of support systems to maintain healthcare provision. The experience highlighted the critical role of health workers in adapting to and overcoming challenges. To build resilience, Ayder Hospital should focus on retaining its health workers and integrating coping strategies learnt during the crisis in its system of service delivery.

Acknowledgements

The authors would like to thank the frontline care providers and health advocators for their unreserved and continuous effort to save thousands of lives in a dire situation. We appreciate the commitment of our interviewees and focus group discussion participants who provided valuable input relevant for the study. We also like to thank the MARCH (Maternal Adolescent Reproductive and Child Health) research centre in Mekelle University for coordinating the team for this research. We thank the editorial team for their prompt support and guidance in the process from research formulation to the final copyediting steps. We thank the double-blind peer reviewers for their valuable comments and suggestions.

Authors' contributions

The first author designed the research, established the research framework, and implemented the study. The second author reviewed earlier versions, and conducted the interviews. Both authors collected the data, organised the coding and labelling, analysed the data and reviewed all the article versions. The third author carried out the coding-labelling of the entries of the EEPA Situation Report. The third author reviewed and edited all the article versions in detail and provided suggestions on the conceptual framework.

Ethical considerations

This research was carried out under ethical clearance obtained from Mekelle University, reference number MU-IRB 1976/2022.

This chapter should be read in conjunction with the 'Note on Content and Editorial Decisions'.

Disclosure statement

No potential conflict of interest was reported by the authors.

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