Health system factors influencing Maternal health service provision in conflict-affected settings in Khartoum, Sudan

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in Public Health and Health Equity

by

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Master of Science in Public Health and Health Equity

09 September 2024 – 29 August 2025

KIT Institute/Vrije Universiteit Amsterdam

Amsterdam, The Netherlands

August 2025

Organised by:

KIT Institute

Amsterdam, The Netherlands

In cooperation with:

Vrije Universiteit Amsterdam (VU)

Amsterdam, The Netherlands

Abstract

Introduction

Sudan has long faced high maternal mortality, compounded by fragile health systems and political instability. The outbreak of armed conflict in April 2023 severely disrupted maternal health services in Khartoum State, causing the collapse of critical infrastructure, mass displacement, and restricted access to healthcare. Understanding how conflict affects maternal health service delivery is essential for shaping responsive health systems in fragile contexts.

Objective

To explore health system factors influencing the provision of maternal health services in conflict-affected settings in Khartoum State, Sudan, focusing on governance, service delivery, and human resources for health.

Methodology

This mixed-methods study was guided by the WHO Health System Framework (2007). It combined a comprehensive literature review with key informant interviews involving professionals from government, UN agencies, and INGOs.

Results

Maternal health services in Khartoum were critically disrupted by the conflict. Governance became fragmented, and decision-making was decentralised and inconsistent. Service delivery collapsed due to insecurity, destruction of infrastructure, looting of supplies, and referral system breakdowns. Human resource shortages were exacerbated by displacement, poor working conditions, and insecurity. Despite these challenges, community midwives played a vital role in sustaining maternal healthcare.

Conclusion

Conflict has magnified existing health system weaknesses. Fragmented governance, workforce shortage, and disrupted service delivery severely affected service provision and quality of care. Investing in decentralised governance, midwifery training, workforce retention, and context-adaptive solutions is essential for rebuilding resilient maternal health services in Sudan and similar fragile contexts.

Keywords: Maternal Health, Conflict-Affected Settings, Service Delivery, Governance, Human Resources for Health

Word count: 1172

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Abbreviations

Abbreviation	Full Term
ANC	Antenatal Care
BEmONC	Basic Emergency Obstetric and Newborn Care
CEmONC	Comprehensive Emergency Obstetric and Newborn Care
COVID	Coronavirus Disease
DHIS	District Health Information System
EmONC	Emergency Obstetric and Newborn Care
FHC	Family Health Centre
FHU	Family Health Unit
FMOH	Federal Ministry of Health
GDP	Gross Domestic Product
HAC	Humanitarian Aid Commission
HIC	High-Income Countries
HRH	Human Resources for Health
IDP	Internally Displaced Person
INGO	International Non-Governmental Organisation
IRC	International Rescue Committee
KI	Key Informant
KII	Key Informant Interview
KIT	Royal Tropical Institute
LMIC	Low- and Middle-Income Countries
MICS	Multiple Indicator Cluster Survey
MOH	Ministry of Health
MSF	Médecins Sans Frontières (Doctors Without Borders)
NGO	Non-Governmental Organization
PHC	Primary Health Care
PNC	Postnatal Care
PPP	Public-Private Partnership
REC	Research Ethics Committee
RMNCAH	Reproductive, Maternal, Newborn, Child and Adolescent Health
RSF	Rapid Support Forces
SAF	Sudanese Armed Forces
SAPA	Sudanese American Physicians Association
SBA	Skilled Birth Attendant
SDG	Sustainable Development Goal
SGH	State General Hospital
SMOH	State Ministry of Health
SRH	Sexual and Reproductive Health

UHC	**Universal Health Coverage**
UN	**United Nations**
UNFPA	**United Nations Population Fund**
UNICEF	**United Nations Children's Fund**
WHO	**World Health Organization**

Acknowledgment

In the name of Allah, the Most Gracious, the Most Merciful. I extend my deepest gratitude to Allah for granting me the strength, patience, and perseverance to complete this academic journey.

I am sincerely thankful to my family for their unwavering support, love, and encouragement throughout this process. Their belief in my potential, even during the most difficult times, has been a constant source of strength.

To my friends in Sudan, the Netherlands, and beyond—thank you for your continued support, encouragement, and companionship. Your presence has been invaluable, and I am truly grateful for the role each of you has played in this journey.

I would also like to express my appreciation to my academic and thesis supervisors for their dedicated guidance, insightful feedback, and continuous encouragement, which have been critical to the development and completion of this thesis.

Finally, I am profoundly grateful to the KIT team, the academic facilitators, and the KIT Fund Scholarship for providing me with the opportunity, resources, and support necessary to pursue this programme. Their contribution has been instrumental in making this achievement possible.

Dedication

“In a time of deceit, telling the truth is a revolutionary act.”

— George Orwell

To the mothers who laboured in the shadows of war, whose courage outlasted the sound of gunfire—and to the children born not into peace, but into the quiet defiance of survival.

To the missing, whose names remain unspoken in official ledgers but are carved deeply into the hearts of the living.

To the victims of sexual violence, whose pain was often met with silence, yet whose endurance is an act of resistance, and whose dignity can never be erased.

To all victims of Sudan’s conflict—this work is a small light held up against the darkness you have known.

To my beloved family, whose love carried me through uncertainty, and to my friends, who stood beside me when I faltered.

This thesis is yours as much as mine.

May it speak softly but firmly for those too often unheard.

Introduction

My name is **Amal Hassan Abdullah Hassan**, a medical doctor and Community Medicine resident from Sudan. I have always been passionate about health equity, particularly in ensuring access to essential health services for vulnerable populations. Following the outbreak of armed conflict in Sudan in April 2023, I served at the Ministry of Health within the Primary Healthcare General Directorate as a Coordination and Partnership Officer. In this role, I was responsible for coordinating the efforts of humanitarian actors to support the overburdened and fragmented health system, particularly in responding to the needs of internally displaced persons (IDPs). This role offered me a front-row view into the operational challenges and systemic barriers faced by the maternal health sector amidst crisis and conflict.

This thesis, titled *"Health System Factors Influencing Maternal Health Service Provision in Conflict-Affected Settings in Khartoum, Sudan"*, stems directly from my experience during this period. It explores how conflict affects key components of the health system—governance, service delivery, and human resources—and how these disruptions shape the delivery of maternal healthcare in Khartoum, the epicentre of the 2023 conflict.

I chose this subject not only because of my professional involvement but also due to the urgent need to document and understand how systemic weaknesses, compounded by war, impact the health and survival of women and mothers. With maternal mortality rates already among the highest in the world, the war in Sudan has made access to quality maternal healthcare even more precarious.

The general objective of this thesis is to explore the health system factors that influence maternal health service provision in conflict-affected settings in Khartoum. Through this research, I hope to contribute evidence that can inform more resilient, coordinated, and context-adaptive responses to maternal health in fragile settings. I also hope it will amplify the voices of healthcare workers and institutions operating in the most difficult circumstances and ultimately help shape policy and humanitarian strategies that better serve Sudanese women and their families

Chapter 1: Background

1.1 Conflict-affected settings and fragile states

Fragility: "Fragility is defined as a systemic condition or situation characterized by an extremely low level of institutional and governance capacity, which significantly impedes the state's ability to function effectively, maintain peace, and foster economic and social development." (1)

Conflict: "Conflict is defined as a situation of acute insecurity driven by the use of deadly force by a group—including state forces, organized non-state groups, or other irregular entities—with a political purpose or motivation. Such force can be two-sided—involving engagement between multiple organized, armed sides, at times resulting in collateral civilian harm—or one-sided, in which a group specifically targets civilians." (1)

1.2 Context of Sudan

1.2.1 Geography and Demography

Sudan, located at the nexus of the Middle East and Sub-Saharan Africa (2) It is the third-largest country on the African continent and has an estimated population of 50 million people spread across 18 states (3,4) (see Figure 1.1). It borders Egypt to the north, while its eastern frontier meets the Red Sea, Eritrea, and Ethiopia. To the south lies South Sudan, and its western limits adjoin the Central African Republic and Chad (2). Owing to its geographic location, Sudan serves both as a host and a transit point for refugees and asylum seekers. It ranks among the top ten countries globally in hosting refugees, according to the latest tracking from December 2021–January 2022. Sudan, accommodating approximately 926,000 individuals, the majority of whom originate from South Sudan (5). Urbanisation remains limited; almost two-thirds of the population lives in rural areas (3). Sudan also has a youthful demographic, with a median age of 18.4 years and a life expectancy of 66 years (6,7). The gender ratio is nearly equal (8). According to the 2024 demographic report, the annual population growth rate stands at 0.8% (9), and the total fertility rate has declined to 4.3 births per woman compared to seven in 1973 (10).

Sudan is a highly diverse country, home to over 597 tribes that collectively speak more than 400 languages and dialects (11). While Arabic is the primary spoken language, both Arabic and English are officially recognised under constitutional law (12) The country also hosts 71 living indigenous languages, reflecting its rich linguistic heritage (13). In terms of religion, Islam is the dominant faith, practised by approximately 91% of the population (14).

Figure 1.1: Map of the Republic of Sudan

Source: https://www.worldatlas.com/maps/sudanv

1.2.2 Political landscape

Sudan has experienced significant political upheaval since the 2018 uprising that led to the removal of President Omar al-Bashir in April 2019. A transitional government was formed, initiating reforms and signing the Juba Peace Agreement in 2020 with major armed groups. However, a military coup in October 2021 disrupted the transition, leading to political instability. Despite efforts to restore civilian rule through the 2022 Political Framework Agreement, deep divisions persisted. These tensions culminated in April 2023 in violent conflict between the

Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF), derailing the political process and plunging the country into renewed crisis (2).

1.2.3 Economy

Sudan is classified by the World Bank as a low-income country and is also listed among the 49 least developed countries (15). Following the secession of South Sudan, Sudan lost around 75% of its oil production and nearly half of its national revenue, a loss from which it has yet to recover. This economic downturn is evident in the sharp decline of its GDP, which fell from $2,034.5 to $816.5 by 2018, just before the revolution (16).

Following the 2018 revolution that ended Omar al-Bashir's 30-year rule, Sudan experienced a brief period of fragile economic recovery, which was first disrupted by COVID-19 and later halted by a military coup in 2021 (17). The outbreak of armed conflict in April 2023 further worsened the country's economic and humanitarian conditions. Due to ongoing instability, up-to-date inflation figures and reliable poverty data are unavailable. However, estimates based on GDP per capita suggest that the share of the population living on less than $2.15 per day has risen sharply—from 15.3% in 2014 to 56.7% in 2024. Extreme poverty is projected to remain high amid continued conflict and economic uncertainty (17).

1.2.4 2023 conflict

Since April 15, 2023, Sudan has been engulfed in a nationwide conflict between the Rapid Support Forces (RSF) and the Sudanese Armed Forces (SAF), which began in the capital, Khartoum, and quickly spread to other states, triggering one of the world's most severe displacement crises (18,19). As of mid-2025, over 12 million people have been displaced by the conflict. Additionally, more than 25 million people, over half of Sudan's population, are in urgent need of humanitarian assistance, including food, shelter, healthcare, and protection services (20).

1.2.5 Khartoum

Khartoum, Sudan's capital, consists of three interconnected cities: Khartoum, Khartoum North (Bahri), and Omdurman, which together form a unified metropolitan area located at the confluence of the Blue and White Nile rivers (see figure 1.2). This urban cluster, often referred to as the "tripartite metropolis," is home to nearly 19% of Sudan's total population. Khartoum hosts the governmental authorities, including both federal and state Ministries of Health, as well as the headquarters of various international organisations (21).

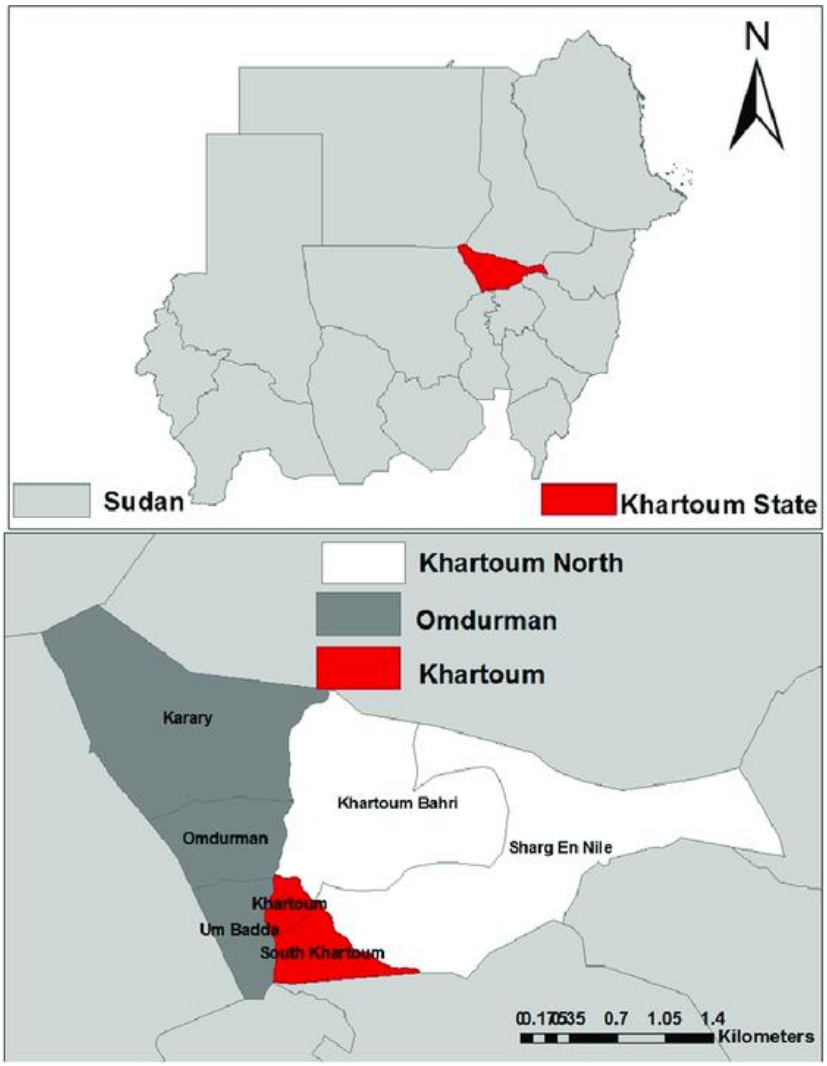

Figure 1.2 shows the map of Khartoum State.
Source: https://www.researchgate.net/figure/Map-of-Khartoum-State-showing-locations-where-samples-were-collected_fig1_315089604

1.2.6 Health System Organization

Sudan's healthcare system operates through a three-tier structure. At the national level, the Federal Ministry of Health (FMOH) is tasked with setting national health policies, plans, and strategies. Below it, the State Ministries of Health (SMOH) across the 18 states play a significant role in planning and implementing these strategies at the state level. The third level is composed of localities, which are responsible for the delivery of health services. These roles are outlined in Figure 1.3 (22).

The health system is decentralised, with services structured across primary, secondary, and tertiary levels of care. Emphasis is placed on Primary Health Care (PHC) as a foundational pathway to achieving Universal Health Coverage (UHC). The PHC includes Family Health Units (FHUs), Family Health Centres (FHCs), and local hospitals, while State General Hospitals (SGHs) function as referral centres at the state level (22).

Along with FMOH and SMOH, the military medical services, police, universities, and the private sector offer health services in Sudan. Meanwhile, FMOH also partners with nonprofit organisations and NGOs to support service delivery, especially for internally displaced persons (IDPs) and refugee populations, ensuring coordinated efforts through the PHC system (22).

Federal	Policy, planning, legislation, coordination, external relations, capacity building, tertiary referral centres
States	Operational planning, human resources for health, capacity building, secondary and rural hospitals
Localities	Primary health care services, midwifery and maternal and child health, environmental health, vector control,human resources for health

Figure 1.3: Roles and Responsibilities of different tiers within the health system

Source: https://apps.who.int/iris/handle/10665/351258

1.2.7 Maternal Healthcare Service Overview in Sudan:

Maternal health refers to the “health of women during pregnancy, childbirth, and the postnatal period.” It’s a fundamental human right and an important pillar of public health (23). Maternal health services within the public sector in Sudan are provided through all levels of the health system—primary, secondary, and tertiary—and are integrated into the primary health care package. Primary health care is provided through health facilities (Family Health Centres and Family Health Units) and by Community Health Workers (CHWs) and Village Midwives. Sudan's maternal health services depend heavily on village midwives, as more than 70% of deliveries take place at home (22).

Chapter 2: Problem Statement, Justification and Objectives

2.1 Problem statement

Sudan's maternal mortality ratio is among the highest in the world, with a ratio of 265 per 100,000 live births, according to the recent UN Interagency Group report 2025 (24), which is far from the sustainable developmental goal SDG target for 2030 of 70 per 100,000 live births (25).

Furthermore, the lifetime risk of maternal death remains alarmingly high, with one in every 90 women at risk of dying from pregnancy-related causes (24). The risk of maternal death during pregnancy is greatest around labour, birth, and the immediate postpartum period, given the potential for complications, and the most common causes of maternal deaths in Sudan are bleeding, pregnancy-induced hypertension, infections, anaemia and septicaemia (22). Almost 70% of those maternal deaths are attributed to limited access to life-saving services and gaps in referral services (26).

Sudan implemented several key strategies to reduce maternal mortality. These include the Reproductive Health Strategy (2012–2016) and the "Ten in Five" Reproductive, Maternal, Newborn, Child, and Adolescent Health RMNCAH Strategy (2016–2020), which aimed to expand access to quality family planning, ensure skilled care during pregnancy and childbirth, and provide functional emergency obstetric and neonatal services (27). The Ministry of Health responded by increasing the training and deployment of community midwives and offering continuous professional development. A costed roadmap for maternal and child mortality reduction was also developed under the National Health Policy (2017–2030), which prioritises improved healthcare access for vulnerable populations and guarantees free maternal services, including prenatal, delivery, and postnatal care, as part of Sudan's essential health service package (22). Furthermore, the most recent Sexual and Reproductive Health (SRH) Policy (2022–2030) introduced several policies under the theme of safe motherhood, including the provision of the "continuum of care" model; ensuring accessible and appropriate antenatal, natal, and postnatal care for all pregnant and lactating women; and the design and implementation of a comprehensive emergency obstetric care program (26).

Despite these efforts, the proportion of ANC coverage, which means coverage by 4 visits, is 51.2%, which is low, and the proportion of women receiving ANC at least once during their pregnancy is 74% (28). According to the WHO Global Health Observatory, the proportion of births attended by skilled health personnel is 78% (28). Only 13.4% of women across the country gave birth in health facilities in 2021, while 40% of at-home deliveries were not attended by a skilled birth attendant (26).

However, these indicators have worsened due to the severe armed conflict that erupted in April 2023 in the capital, Khartoum, leading to the largest displacement crisis (19), with over 12 million

Internally Displaced People (IDPs) and over 2.5 million women and girls of reproductive age displaced, and more than 250,000 pregnant women are in need of childbirth services, and 84,000 are expected to give birth in the next 90 days (29). Moreover, malnutrition among pregnant and breastfeeding women has reached critical levels, with 1.2 million cases of acute malnutrition reported as of March 2024 (30). Coupled with the profound mental health toll caused by ongoing insecurity, this has contributed to a rise in preterm births, placing additional pressure on already overstretched health care services, particularly in the absence of adequate neonatal critical care (30).

2.2 Justification

Globally, about 830 women die from pregnancy- or childbirth-related complications every day. Almost all maternal deaths occur in low- and middle-income countries (LMIC), and more than half of maternal deaths occur in fragile and humanitarian settings (23,31). Currently, countries with a UN Humanitarian Appeal account for 58% of global maternal deaths, 38% of newborn deaths, and 36% of stillbirths (32). The literature revealed that women of reproductive age living in conflict settings face a mortality rate three times higher than those in stable regions due to the lack of essential maternal health services such as skilled birth attendants, emergency obstetric care, and contraceptive services (33,34). In LMICs, women have a higher average number of pregnancies, and their risk of dying from pregnancy-related complications is greater. The likelihood that a woman will die from a maternal cause is 1 in 180 in LMICs, compared to 1 in 4,900 in high-income countries (HICs). Moreover, in fragile states, where health systems often collapse, this risk increases significantly to 1 in 54, highlighting the impact of inadequate healthcare (33).

Maternal health services in conflict-affected areas are hindered by insecurity, staff shortages, high staff turnover, shortages of medical supplies and equipment, and destruction of infrastructure, compounded by limited funding and competing priorities, coordination challenges, bureaucratic impediments, remote locations, and connectivity and communication challenges limiting the effectiveness of aid efforts (33).

Additionally, there is a significant research gap, as there are no qualitative studies specifically exploring the health system factors affecting maternal health services provision in conflict-affected zones in Sudan (35). This pressing need for research is further amplified by the urgent challenges posed by the ongoing conflict to improve maternal health interventions in such dynamic settings.

2.3 General objective

Exploring health systems factors influencing maternal health service provision in conflict-affected settings in Khartoum state, Sudan

2.4 Specific Objectives

1. To explore health system governance, service delivery, and human resources for maternal healthcare services provision in conflict-affected settings in Khartoum, Sudan.
2. To investigate the role of non-governmental actors in the service provision of maternal healthcare during the 2023 war outbreak in Khartoum, Sudan.
3. To give recommendations to policymakers and actors who work in maternal health service provision in conflict-affected settings.

Chapter 3: Methodology

3.1 Study design

This study employed a **mixed-methods design**, combining a review of **existing literature** with **key informant interviews (KIIs)** to explore the health system factors influencing the implementation of maternal health services in conflict-affected settings, with a focus on Khartoum State, Sudan. The mixed-methods approach was selected to enable triangulation of data from multiple sources, thereby enhancing the depth and validity of the findings. KIIs were used to validate and enrich the findings from the literature review, ensuring that the evidence reflects current realities and expert perspectives in the field.

The WHO Health System Framework 2007 informed the search strategy, development of research tools as a topic guide, data analysis from documents and literature, data analysis of interviews, and presentation of findings in this study (35).

Study area: Khartoum state was chosen as it is the capital city of Sudan; it is the political, economic, and administrative heart of the country and possesses the largest concentration of health facilities and workforce in Sudan, including 26% of the country's hospital beds and 70% of emergency room beds, and it accounts for half of all Caesarean sections performed nationally (36). It was the epicentre of the ongoing 2023 conflict, where the initial and most severe clashes began, with areas divided between the Sudanese Army Forces (SAF) and the Rapid Support Forces (RSF) control, posing unique and varied challenges for maternal health service provision.

3.2 Sampling

Key Informants: The respondents were chosen using a purposive sampling and snowballing technique based on their role as policymakers or administrators, who were professionals involved in maternal health service delivery in Khartoum State during the ongoing 2023 conflict.

Search strategy for the literature review: The databases searched included PubMed, Scopus, and Google Scholar, as well as the Vrije Universiteit online library. Google search engine was used to search for websites of the UNFPA, WHO, UNICEF, MSF, Sudanese American Physician Association (SAPA), International Rescue Committee (IRC), WHO Health cluster and Relief Web.

The search included scientific peer-reviewed articles, grey literature that included UNFPA reports, WHO reports, UNICEF reports, MSF reports, SAPA reports, Health cluster reports and SRH subsector reports and FMOH of Sudan reports and policy documents, both published and unpublished. The unpublished resources were received from officials in the Federal and State Ministry of Health in Sudan. The snowballing technique was used by following the references listed in the collected articles.

Annexe 1 (Table 2) shows the detailed specific key terms used to search for literature for each specific objective. But the general search terms used a combination of terms such as "maternal

health”, “health system”, and” conflict” and terms relating to the study contexts such as” Sudan” and “Horn of Africa” using Boolean operators “AND” and “OR”.

The review included peer-reviewed articles and grey literature from Sudan and countries with similar socio-demographic characteristics, such as South Sudan, Somalia, Ethiopia, and Yemen. The focus was on literature published from 2011 onward, as 2011 marked the secession of South Sudan from Sudan, ensuring that all selected articles were relevant to the Sudanese context. Only Arabic and English literature were included.

3.3 Data collection

Literature review: A total of 108 documents were initially identified through the search. Titles and abstracts were screened for relevance, and duplicates were removed. Following the screening process, 90 documents were selected for full-text review. Final inclusion was based on relevance to the study objectives, quality of evidence, and focus on maternal health services in conflict or fragile settings. In total, 60 documents were included in the final analysis.

KIIs: A total of five KIIs were conducted in June and July 2025 with professionals involved in maternal health service delivery in Khartoum State during the ongoing 2023 conflict. Key informants were contacted via email and WhatsApp. Due to the critical situation in Sudan at the time of the study, interviews were conducted remotely using Microsoft Teams or Google Meet. Each interview lasted between one hour and one and a half hours and was guided by a topic guide based on the WHO Health System Framework (2007). Interviews were conducted in either Arabic or English, depending on the interviewee’s preference, and were recorded after obtaining verbal and written informed consent. Arabic interviews were translated into English, and all interviews were fully transcribed.

3.4 Data Analysis

Literature review: Each document was carefully reviewed to identify relevant content, and specific codes were assigned to segments of text that corresponded to key topics such as health workforce shortages, infrastructure, and decision making. These codes were then organised under broader themes aligned with the WHO Health System Framework (2007), which served as the guiding structure for thematic analysis. To maintain consistency and transparency, the same coding process was applied across all documents. The analysis was conducted manually using tools such as Microsoft Word and Excel, with techniques including highlighting and thematic categorisation.

KII: The data were analysed manually on MS Excel using a thematic analysis approach. The WHO Health System Framework (2007) served as the foundation for deductive coding. As the analysis progressed, additional themes emerged and were incorporated inductively; these new themes were subsequently categorised under the relevant health system components. After coding, the data were summarised to identify the key findings of the study.

3.5 limitations

Literature review: By not including pre-2011 literature, the review may have excluded sources that are still relevant to understanding Sudan's health system challenges, many of which have existed long before the 2023 conflict.

KIIs: Although interviews were conducted in Arabic and English, translation can lead to loss of nuance, especially for technical terms or emotional expressions.

3.6 Ethical consideration

For the literature review, all sources were accurately cited, and care was taken to include balanced, representative, and credible evidence. For Key informant interviews, a waiver was obtained from the Research Ethics Committee (REC) at KIT Royal Tropical Institute (see Annexe 2). Informed consent was obtained from each participant (see Annexe 3), and their confidentiality was maintained. Data collected from participants was stored securely in a file accessible only to the researcher and will be destroyed upon study completion. All identifying information was anonymised to protect participant privacy.

3.7 Conceptual Framework

The study was guided by the WHO Health System Framework (Figure 1.4). It was chosen due to its comprehensiveness, global recognition, and adaptability to different health system contexts, including those affected by crisis. Notably, it was adopted by the Sudan Federal Ministry of Health to inform the National Health Policy (2017–2020), and the national sexual and reproductive health policy (2022–2030). The framework organises the health system into six interrelated components: service delivery, health workforce, information, medical products and technologies, financing, and leadership/governance.

The study focused on three key components: governance, service delivery, and human resources for health, which are deeply interlinked and are most relevant at the service provision level in conflict-affected settings, directly impacting frontline maternal healthcare.

Governance was prioritized due to its central role in coordinating health sector responses, allocating resources, adapting policies, determining accountability mechanisms and facilitating coordination between humanitarian actors, which directly influence both service delivery and HRH management.

Human resources for health were included because the health workforce is often directly and severely impacted during armed conflict, which compromises the continuity of maternal health services. Investigating HRH also provides insights into the adaptive and innovative strategies employed to maintain service provision during crises.

Service delivery was selected as it represents the operational interface between the health system and the population. Disruptions at this level have immediate and visible consequences for

maternal and newborn health outcomes. focusing on service delivery enables the exploration of barriers and innovative responses to maintain maternal health services provision during conflict

The **finance** component was excluded due to the reallocation of national budgets toward defence during conflict, and the near-total reliance of the health sector on humanitarian aid (5), which limits the ability to assess financial governance. The **health information system** was also excluded, as the DHIS has collapsed, rendering data collection and routine reporting non-functional in the current context (37). Similarly, **medical products, vaccines, and technology** supply-related issues were included under the service delivery block, without delving into their details, which would require a separate, focused investigation.

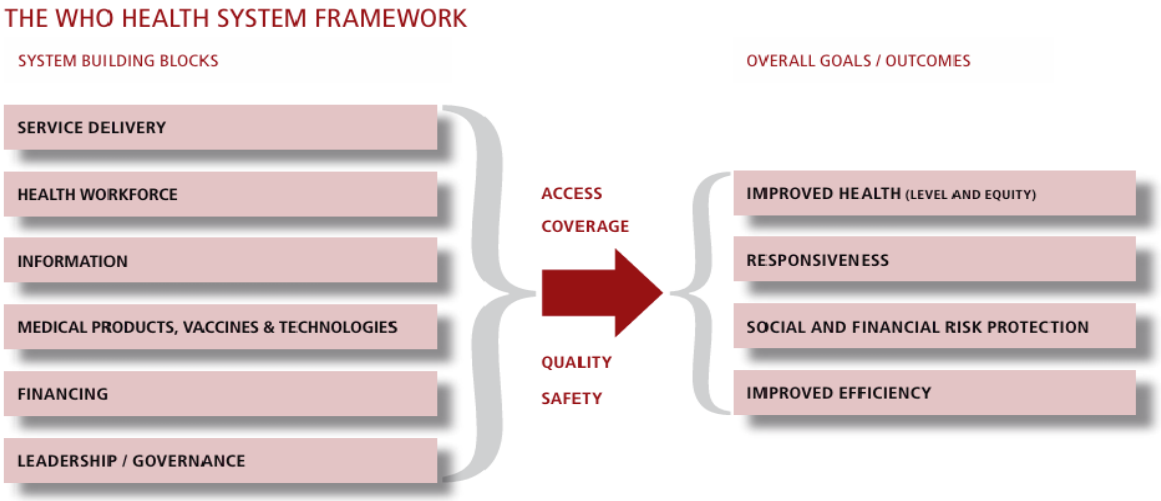

Figure 1.4: The WHO health system building blocks framework 2007.

Source: https://iris.who.int/handle/10665/43918

Chapter 4: Results

This chapter presents findings based on three WHO health system building blocks: governance, service delivery and human resources for health. findings were drawn from 60 peer-reviewed and grey literature articles and five key informant interviews. Interview participants included policymakers and health administrators directly engaged in maternal health service provision in conflict-affected Khartoum during the 2023 crisis. Results are organised thematically according to the selected building blocks.

A list of participants is provided in Table 1.

Table 1: List of participating entities

Institution	Number of interviews	Code
UN Agencies	1	UN Agency representative
International Organisation	3	INGO representative
Government	1	FMOH, SMOH representative

4.1 Governance

According to the literature, after the eruption of the 2023 war in Khartoum State, and in response to the escalating conflict and insecurity, both the Federal Ministry of Health (FMOH) and the Khartoum State Ministry of Health (SMOH) relocated their operations to safer regions (38). After a short period, the Khartoum SMOH resumed its operations in Omdurman, leveraging its status as a SAF-controlled area (39).

The health system experienced a severe shock in the aftermath of the 2023 conflict, with nearly two-thirds of health facilities becoming non-functional (37). The looting and destruction of the National Public Health Laboratory, the Central Blood Bank, and the warehouses of the National Medical Supply Fund further crippled service delivery. The Ministry of Health operated with only 10% of its pre-war staff, reflecting a major loss of institutional capacity. It received no funding during the first three months of the war and was able to support only 10% of health facilities across the country. Additionally, the national health insurance scheme was paralysed by the conflict and the economic crisis, forcing most hospitals to rely on out-of-pocket payments from patients (40,41).

Humanitarian response coordination

The humanitarian response in Sudan is coordinated through the UN cluster approach, which was established in Sudan in 2009 as the primary mechanism to coordinate the activities of humanitarian partners in the country (42,43). It comprises approximately 24 national NGOs, 23 INGOs, 8 United Nations agencies, 5 donors, and the government, represented by the relevant departments of the Ministry of Health (44). Following the 2023 armed conflict, the cluster expanded its areas of operation, adding Khartoum (42). The national health cluster, led by the

WHO, includes several technical working groups or subsectors, such as the SRH working group, which is led by UNFPA. Under the national SRH subsector, there are three subnational SRH subsectors: the Central Zone, the Eastern Zone, and the Western Zone. Each of these subnational subsectors is overseen. Khartoum State falls under the Eastern Zone subnational health cluster (45).

SRH Working Group/Subsector in Sudan was established in August 2024 under the Health Cluster, with its inaugural meeting held on August 27. The group includes over 30 organisations, UN agencies, international and national NGOs, and representatives from the State and Federal Ministries of Health (46,47).

governance fragmentation

At the onset of the conflict, there was no clear, nationally driven policy direction. The health system functioned in an uncoordinated, autopilot manner, with decision-making largely occurring at the state level (48), pushing the weakly decentralised health system into a state of forced and fragmented decentralisation (49).

Furthermore, the coordination of maternal healthcare service responses is hindered by several challenges, including the lack of clearly defined roles and responsibilities across different levels of governance, as highlighted by several key informants. This has led to confusion and conflict among the FMOH, SMOH, HAC (Humanitarian Aid Commission) and other partners, ultimately weakening governance and undermining accountability, a problem that already existed before the conflict (49,50).

interviews highlighted challenges in coordinating health responses, particularly within the Health Cluster, describing the system as carrying a 'heavy load' due to difficulties in aligning goals and strategies, and inconsistent information sharing that hindered effective collaboration.

Based on the interviews, a major barrier to effective coordination is the limited commitment from cluster partners. Although many of them provide maternal health services as part of the primary healthcare package, their engagement in the SRH sub-sector remains weak, reflected in low attendance at meetings and poor reporting. This lack of participation hinders effective planning and decision-making and reveals partner accountability gaps. One key informant explained that many partners are unaware of the importance of reporting for coordination and resource mobilisation, often prioritising donor reporting over sector-wide collaboration. The KI stated:

"I think most partners don't realise the importance of reporting. We rely on this data for decision-making, resource mobilisation, and understanding the needs of beneficiaries in targeted areas. However, many prefer to report to their donors, assuming it's more important since donors provide the funding. This issue isn't limited to the SRH working group; it affects coordination across the entire health cluster." [UN Agency representative]

Data sharing and transparency

Another key barrier raised during the interviews was the issue of weak reporting. Participants emphasised longstanding challenges with data availability and quality in Sudan. Even prior to the outbreak of the war, reliable data were limited. For example, the last Multiple Indicator Cluster Survey (MICS) was conducted in 2014, rendering it outdated and inadequate for planning purposes. Routine data collection through reproductive health programs and the District Health Information System (DHIS) was consistently weak, with poor data quality and low levels of reporting completeness (51).

The literature review found that the situation worsened with the onset of the conflict, particularly during its early stages, when much of the data from the preceding two years was lost. Fortunately, some of this information was later recovered (49). However, according to interviews, the DHIS was no longer functioning in conflict-affected areas such as Khartoum. As a result, the cluster now relies heavily on data provided by humanitarian actors supporting public health facilities and delivering maternal health services in these regions. Despite this, reporting rates remain low and are further compounded by issues related to data accuracy (43,49) .

Decision making

According to interviews, the decision-making process regarding where to intervene and which services to provide is influenced by several key factors, including security conditions, accessibility, patterns of internally displaced people (IDP) movement within the state, and population density. The participants believe that humanitarian actors rely on guidance from the Humanitarian Response Plan. According to a key informant, organisations operating in conflict-affected areas play a vital role by providing critical information, such as supply gaps, reported cases, and service coverage. In some instances, unofficial data sources are also used to inform decisions, especially when formal reporting is unavailable.

It was also highlighted during interviews that the process of decision-making, while it is a multi-factorial process, is also influenced by politics and social media. A key informant mentioned:

“In Sudan, we have 12,000 renal dialysis cases. These 12,000 cases, in terms of investment, energy, and supply, require a huge effort. And it's highly politicised. People have always focused on that group of patients and talked about dialysis, but they are not talking about how many pregnant women have lost their lives. Although if we take, I’m sure, just 5% of what we spend on dialysis, we could save more than 50,000 mothers and children. That is the opportunity cost of politics.’’ [INGO representative]

Bureaucracy and aid militarisation:

The bureaucracy, administrative process and security permits were mentioned by many key informants as a factor that slows the health interventions. Travel permits are required for every movement, and obtaining visas for international staff is a lengthy process, an issue that existed even before the war. Additionally, securing permits for medical supplies is difficult, access to

certain areas remains restricted, and multiple security checkpoints further delay operations. One key informant mentioned:

"*We had a case where we had supplies arriving. We literally had to go plead to get them. It was extremely difficult; they stopped us, took our phones and passports, all for a security check. It was very hard to get the supplies, even though it was a small amount of supplies and didn't take us long to collect."* [INGO representative]

Conversely, another key informant pointed out that this administrative process is due to security concerns and security authorities operate based on protocols they consider appropriate for the context, and this is often misunderstood by humanitarian actors, who perceive it as a barrier to access and consider it a weaponisation of the humanitarian interventions. A key informant mentioned:

"From day zero, since we started our operation, with some challenges, following certain procedures and protocols that are applied by the security authorities' requirements, we were able to have national staff, international staff, money, supplies, materials, and our operation did not stop for a moment … There is access to humanitarian actors in all areas in Sudan, with no limitations, with some exceptions. Of course, this is not a generalisation. These exceptions are granting travel permits from the authorities due to security concerns, as they have always explained to us." [INGO representative]

Public Private Partnership

Several interviewees highlighted the role of public–private not-for-profit partnerships as important facilitators of the humanitarian health response. By operating within public health facilities. In contrast the private for-profit health sector involvement in the humanitarian response has remained limited. A sector that had long been under-regulated and inadequately engaged, even before the outbreak of the conflict (49,50) Key informants expressed concern that, although the private sector continued to operate, its primary motivation appeared to be financial rather than humanitarian.

"Unfortunately, the private sector has always been present, and it's been demanding money. Although it's good to have something for money better than having nothing, the humanitarian spirit within humanitarian care providers, particularly in the private sector, was challenging. The integrity of medical ethics was being challenged and tested during wartime, and I can tell you, unfortunately, it hasn't been a really good outcome." [INGO representative]

4.2 Service Delivery

Nature of conflict

Literature revealed that the intensity and nature of the conflict, whether it's active, protracted, or cyclical, affect the service delivery in terms of what service is delivered, how and where. It affects the availability of the service over time and by geographical location (52). In Khartoum, given the extreme insecurity and active shooting, almost two-thirds of the tertiary hospitals were out of service, health care providers are unable to reach health care facilities, are themselves displaced, or have been attacked (18).

Security

Interviews indicated that maternal healthcare service provision in Khartoum State faced a critical breakdown due to the conflict, and security was a key barrier hindering service provision in the state. According to key informants within the first two months of the war in Khartoum, the healthcare system was nearly paralysed, with widespread facility closures and major disruptions to service provision. Literature revealed that due to the conflict, thirteen hospitals were bombed, and 19 others were ordered to evacuate (53,54), some of which were forcibly militarised and converted into barracks by the RSF (37). An estimated 61% of health facilities were shut down, and only 16% remained fully operational, though even among these, many experienced intermittent service disruptions, with some temporarily closing and later reopening depending on the security situation (18).

Numerous maternity clinics ceased functioning, including Omdurman Maternity Hospital, the largest referral centre for maternal healthcare in Sudan, highlighting the brutality of the conflict and the scale of the collapse in essential maternal health services (18). According to key informants, the security situation and attacks on health facilities hindered many maternity hospitals from providing services, causing them to cease functioning.

One of the KI mentioned:

"Healthcare has been almost completely abolished in Khartoum State, especially in the first two months of the war. These were the most critical periods. After that, for example, in Khartoum, we had only the Saudi Hospital that remained running and operational. But soon after that, there was a bit of an incident in and around the hospital. The hospital ceased to be able to provide healthcare because of safety concerns." [INGO representative]

Geographical location

According to interviews, the delivery of health services varied significantly across different areas of Khartoum state, largely due to fluctuating security conditions. Khartoum and Bahri were reported to be more severely affected compared to Omdurman, with health providers and patients facing major challenges in moving between these areas. Key informants noted that those areas controlled by the RSF were largely inaccessible similarly, the literature indicated that the

Ministry of Health classified them as unreachable for medical monitoring and surveillance. According to the UNFPA annual 2024 report, for a time, there was only one hospital in Khartoum city, which was under RSF control, that was providing maternity services (46), and the number of health facilities was changing according to the security conditions. A key informant mentioned:

"In Bahri and Khartoum, most of the health facilities remain at the same number, declining or shifting with some security challenges. Whereas in Omdurman, the number of facilities has been increasingly expanding." [INGO representative]

Capacity of the health system before the war

According to the literature and the key informants, the capacity of the health system before the conflict was a major determinant (52). Sudan's health system was already overstretched and burdened before the outbreak of the 2023 war, having been affected by years of conflict and economic crisis, human resources shortage and fragmented funding. Before the war, the ANC coverage in Sudan was 51.2%, and the EmONC services coverage was limited to around 46% (29). Although Khartoum hosts the largest concentration of health facilities and workforce in the country, including 26% of Sudan's hospital beds and 70% of emergency room beds(36) , its health system capacity was considered insufficient even before the war, and the ongoing conflict has further exacerbated these existing weaknesses (46,55).

Infrastructure

Both interviews and literature consistently highlight inadequate infrastructure as a major barrier to maternal health service delivery. This challenge has been documented in comparable conflict-affected settings, including South Sudan, Somalia, Ethiopia, and Yemen (56–58). the damage caused by the conflict to the hospitals in Khartoum state, which resulted in many hospitals closing, was cited as a barrier by many responders.

In Somila, the provision of hospital-based services was not possible until the reconstruction of the existing facilities (56). This poor infrastructure of maternity wards, delivery rooms and newborn intensive care units hinders the provision of the services (58).

Health facilities in Khartoum State have been severely affected by frequent blackouts and water shortages. These disruptions have significantly compromised life-saving interventions, particularly emergency obstetric and neonatal care (EmONC) and blood transfusion services (59). Moreover, power outages have impacted the storage of essential maternal health supplies, such as oxytocin, which is critical during childbirth and for the effective delivery of EmONC services, leading to their spoilage (18,29,46) .

In other countries like South Sudan and Yemen, the frequent disruptions in electricity and water supply, coupled with limited access to crucial resources such as generators, fuel, and stable communication networks, severely hinder the capacity of health systems to deliver essential services, particularly during obstetric emergencies (57,58). In the absence of reliable power, surgical procedures such as C-sections cannot proceed, sterilisation processes are compromised,

and critical obstetric life-saving interventions become unfeasible. In South Sudan, widespread power outages led to the complete loss of blood supplies stored in blood banks, while the absence of consistent electricity has emerged as a major factor contributing to mortality among preterm infants (58). Similarly, in Yemen, prolonged and repeated electricity disruptions have severely compromised the proper storage of vaccines and essential medicines, further undermining healthcare delivery (57).

Human resources for health

A critical barrier to effective service delivery, frequently cited in both interviews and existing literature, was the shortage and limited availability of the health workforce, including medical doctors, nurses, midwives, and biomedical engineers.

Medical supplies and equipment

Shortages of medicines, medical supplies, and essential equipment, including laboratory testing tools and reagents, ultrasound machines, gloves, examination couches, and operation tables, have been widely reported by Key informants (5,60). The lack of medical equipment for assessing pregnant women attending antenatal care clinics has posed a significant challenge for midwives in South Sudan. Even basic items and small medical materials are lacking, forcing healthcare providers to resort to makeshift solutions, such as using cloth as gauze and ordinary blades instead of surgical blades, as reported in Ethiopia. These pervasive deficiencies have significantly compromised the standards and quality of maternal healthcare (58,61,62) .

The ongoing conflict in Sudan has significantly disrupted the national supply chain system, critically impacting the service delivery of maternal healthcare (46). All 26 of the country's pharmaceutical factories that were located in Khartoum state were looted or destroyed (40,41).

Medicines were being stolen, warehouses were being looted, and supplies were not reaching areas affected by active fighting (63). A key informant reported that their warehouses in Khartoum were looted and that supplies were sent in convoys to Khartoum city, which was under RSF control; however, they do not know where those supplies ended up or whether they reached their intended destination. Moreover, literature revealed that lifesaving surgical supplies that contain supplies which are used for Obstetric emergencies and C-sections are sometimes blocked by authorities from reaching health facilities in areas of Khartoum that are under RSF control (64). This militarisation and forcible redirection of humanitarian aid have caused critical shortages of medical supplies and equipment (53).

The shortage and irregularity of supplies, along with frequent and prolonged stockouts of essential medicines, were repeatedly cited by interviewees as barriers to service delivery. In South Sudan, a mismatch between the supply of medicines and the demand for services persists, exacerbated by a pharmaceutical supply system based on a push model that is unresponsive to actual needs (63).

Referral system

According to interviews, in Khartoum state, the formal referral system was disrupted; the conflict resulted in the loss of numerous ambulances, leaving ambulance services largely unavailable (65). Similar challenges have also been reported in Ethiopia and Yemen (57,62). According to the UNFPA, community-based referrals by midwives and using tuk-tuks as a means for transporting cases were used in Khartoum (66).

Interviews also revealed that sometimes people had to rely on donkeys for transportation to health facilities and pay high prices for travel, both within the city and when attempting to reach the nearest safe state, the River Nile State, for medical emergencies. And key informants emphasised the severe challenges pregnant women faced in accessing health facilities due to security concerns. Crossing frontlines often resulted in being stopped, turned back, or delayed, which could completely obstruct referrals or force them to take long, costly detours. Even in areas considered relatively safe, accessing referral services remained difficult because of complex and layered security obstacles (67,68). Key informants noted that such delays frequently hinder timely arrival at health facilities and access to appropriate care. As a result, conditions like obstructed labour were often diagnosed too late, leading to poor outcomes, including fetal loss and increased risk to the mother's life, thereby contributing to elevated maternal mortality rates

While ambulance services were eventually made available by health authorities and supported by international non-governmental organisations (INGOs) to facilitate the transfer of medical emergencies outside the state, key informants noted that these efforts were inadequate. The referral process was hindered by lengthy and demanding administrative procedures, including the need to secure fuel and provide incentives for drivers and accompanying health personnel.

A KI mentioned:

"Regarding the referral system, the emergency department tried to activate it early. But still, it wasn't functioning as effectively as needed. Sometimes the procedures were a bit inefficient, lengthy processes, with many requirements, and there was immense pressure on the referral system itself. That's why it didn't work as effectively as needed. We even had discussions, as a team, with the SMoH about how we could possibly involve military aviation in this effort. But of course, there were safety and security issues. So, it ambulance services were available and functioning to some extent, but not to the desired level." [INGO representative]

Population movement

Interviews indicated that the ongoing population displacement driven by active conflict significantly restricts both the provision of and access to maternal health services in Khartoum, which was also noted in systematic reviews. This movement places immense strain on healthcare systems in relatively safer areas, where the influx of displaced individuals, alongside growing needs within host communities, leads to surging demand. In Yemen, this dynamic has resulted in more people seeking care in public facilities and those supported by international NGOs, as these services remain free of charge, in contrast to the private sector, whose costs become untenable (57,61).

Natural disaster

According to key informants, natural disasters such as heavy rains further hindered maternal health service delivery in Khartoum. Literature revealed that natural disasters intensify existing disparities and contribute to frequent shortages of medical supplies and obstruct both community midwives from reaching patients and health providers from accessing hospitals (68). Additionally, such events can trigger new waves of displacement, adding further complexity to an already strained health system (62,63).

Adaptive solutions to sustain service delivery

Despite the numerous barriers to service delivery, several adaptive strategies were implemented to sustain maternal healthcare services within Khartoum state, according to interviews. One such intervention was the use of mobile clinics, which provided antenatal care (ANC), postnatal care (PNC), and nutritional services. These clinics helped reach displaced and underserved populations; however, their effectiveness was constrained by security concerns, especially in areas experiencing active conflict or considered unsafe (67,69–71).

Another key strategy was the involvement of community midwives, who played a critical role in maintaining service continuity. According to interviews, their phone numbers were widely circulated among healthcare workers, patients, and local residents, enabling them to act as accessible and trusted providers within their communities. Literature highlighted that their presence ensured a level of continuity in maternal care, particularly when formal health services were inaccessible (18,30,67,72).

Another innovative response that was reported by key informants was the volunteer-based initiative involving obstetricians, who provided remote consultation services to midwives and medical doctors working in hospitals. This initiative helped strengthen clinical decision-making and ensured that frontline providers had access to expert guidance despite the disrupted health system (49,67,73).

Based on interviews, partnerships with national non-governmental organisations (NGOs) were a good approach to sustaining maternal health services. These collaborations included financial support to cover operational costs of their clinics, provision of medical supplies, and contributions to capacity-building efforts such as staff training and ongoing supervision.

4.3 Human Resources for Health

Shortage of HRH

Armed conflicts often worsen the existing fragilities within national health systems and contribute to the accelerated displacement of healthcare personnel. Interviews revealed that a critical shortage of human resources for health (HRH) was a major barrier to the delivery of maternal health services in Khartoum during the conflict.

Before the war, Sudan faced a widespread shortage of healthcare providers, with most of the country's human resources for health concentrated in Khartoum. However, due to the conflict, many healthcare workers were displaced within the country or fled abroad, worsening the shortage (49). This issue had been a longstanding challenge for Sudan's health system, even prior to the outbreak of the 2023 conflict. In 2019, Sudan had only about 0.2 physicians per 1,000 people, which is significantly below the WHO recommended threshold of 4.5 health workers per 1,000 people needed to provide essential health services. This figure includes all medical doctors, not just specialists such as gynaecologists and obstetricians (74). According to interviews, the shortage of staff was a major barrier to service delivery, as it significantly increased the workload on existing personnel. One KI described the situation:

"Availability was a problem. The number of staff was not sufficient. There was a very, very high workload, and sometimes the shift felt like a nightmare. No matter how we tried to divide the work, it was still extremely difficult. So, we needed more staff." [INGO representative]

A key informant noted that most qualified healthcare professionals had left the state, and those who remained were either employed by international NGOs or working as community midwives. The shortage of HRH was not unique to Sudan but was also reported in neighbouring countries with similar contexts, such as South Sudan and Somalia. A particular concern has been the scarcity of specialists, such as gynaecologists and obstetricians, whose absence has been consistently highlighted in the literature as a major impediment to effective service delivery (52,56,58,63,75).

According to interviews, the shortage of obstetricians in Khartoum was especially severe during the conflict. This gap significantly hindered the provision of emergency obstetric and newborn care (EmONC). A KI mentioned:

"We were lacking the specific specialities we needed. For example, we needed a gynaecologist in the hospital, and we didn't have one. We had no OB-GYN specialist who could perform surgeries related to that speciality." [INGO representative]

The situation in Sudan was compounded by the destruction of tertiary hospitals, which left many maternity hospitals offering emergency obstetric and newborn care (EmONC) services non-functional (76). Similarly, in Somalia, humanitarian organisations were unable to provide CEmONC services for almost five months during the conflict, as they struggled to find obstetricians to meet the demand for care (56).

While the scarcity of midwives is generally a major issue in conflict-affected settings (77), the situation in Khartoum presented a contrast. According to interviews, community midwives played a central role in sustaining maternal healthcare delivery during the conflict, and this was also evident in the literature (18,30). However, these efforts were hindered by several shortfalls, as most community midwives were not adequately skilled, lacked necessary supervision, and lost their midwifery equipment during the war (47), and the training they received did not meet international standards for skilled birth attendants (78). These challenges were further exacerbated by the difficulty of accessing patients during an active shooting. According to the

literature, midwives also had to navigate high-risk transportation, unsafe accommodations, and the threat of sexual harassment. They were often reluctant to attend births at night, even in their own communities, due to fears of attacks by smugglers (58,75,77).

Furthermore, they were unable to manage all cases, particularly complicated ones that required the involvement of an obstetrician in case management. According to key informants, a volunteer-led initiative was launched by obstetricians to support midwives remotely through phone consultations in Khartoum, and it was successful, as one KI mentioned:

"The initiative by obstetricians to support midwives remotely was a success and supported many midwives during delivery. I remember one story in particular; my friend's sister was about to give birth while they were living in an area of active gunfire in Khartoum. Because of the security situation, the midwives couldn't reach her. They ended up reaching out to a neighbour, who happened to be a veterinarian. With remote guidance and supervision from an obstetrician, she was able to assist with the delivery, and thankfully, the baby was born safely. It's a story that shows how crucial that kind of support was during the conflict". [UN Agency representative]

The shortage of human resources extended beyond healthcare providers to include managerial staff (63).As both the FMOH and the State Ministry of Health MOH faced staff deficits, further undermining their overall capacity to coordinate, implement, and effectively monitor health programs (40,41).

High turnover

One of the key challenges facing Sudan's healthcare system before the outbreak of the war was the high turnover rate among the health workforce, particularly at the senior level. A significant number of Sudanese health professionals left the country in search of better opportunities, driven by factors such as brain drain, economic instability, and the appeal of improved working conditions. The war further exacerbates the situation as the majority of the health workforce was displaced, whether internally as IDPs or externally as refugees (49).

Economic factors

Economic factors were frequently cited in interviews as a key reason for the high turnover of health workers. Many sought better-paying opportunities abroad, chose to work in the private sector over the public sector, or pursued higher-salaried positions with humanitarian agencies. A KI mentioned:

"People left for another country looking for better opportunities for themselves, for their families as well. So, running for life, looking for income, looking for a better life for themselves and their families, for their kids and their education and for a more socially stable life, this is what they want" [INGO representative]

This was also seen in Yemen. Moreover, the role of international organisations in offering financial incentives sparked further concern in Yemen as it encouraged health workers to prioritise

financial gain, shifting between roles based on the size of the stipend rather than professional commitment, which further contributed to the high staff turnover. Additionally, health workers on short-term contracts often left for roles offering higher or more consistent incentive payments (57).

Economic factors also contributed to staff demotivation, poor performance, and a shortage. According to interviews in Khartoum, health providers went without government salaries for nearly a year and a half, causing staff shortages and turnover (47).In a similar context, like South Sudan, the lack of incentives contributed to demotivating community health workers (CHWs) and had a negative impact on strategies for the deployment of community midwives (63).

In Yemen, inconsistencies in incentive structures among humanitarian organisations were found to create tensions among health workers and volunteers. Tensions were also reported between permanent staff and those hired on short-term contracts, negatively affecting motivation and teamwork. While disparities in salary scales between international NGOs were noted as a common issue in Yemen, leading to recruitment challenges and inter-organisational friction (57), this was not observed in Khartoum, where incentive rates were standardised and regulated by the Ministry of Health according to interviews.

Another key factor contributing to staff turnover is the nature and intensity of the conflict itself. Research indicates that prolonged conflicts significantly drive high turnover rates. In South Sudan, the protracted nature of the conflict has played a major role in the continued high turnover of staff, further exacerbating the shortage of midwives and negatively affecting their availability in these regions (61,75).

Training

In addition to workforce shortages and high turnover, limited training opportunities and inadequate clinical competencies among existing health workers have been identified as major barriers to the effective delivery of maternal health services in conflict-affected settings (61). According to interviews, no training in maternal health was provided to healthcare personnel during the conflict in Khartoum. According to a study assessing the perceived preparedness, knowledge, and skills of Sudanese healthcare professionals in disaster management during the ongoing 2023-armed conflict found that participants rated themselves as moderately prepared, knowledgeable, and skilled in disaster management (79).

In other countries like Yemen, even when staff are present, they often lack the competencies needed to effectively provide the services they are responsible for. A systematic review pointed out that the limited training of health workers, particularly in obstetric and newborn care, was a major barrier to delivering quality care in conflict-affected settings (57,61).

Midwifery training in Sudan is inadequate, as community midwives do not meet the international standards required for Skilled Birth Attendants (78). Even though Sudan's maternal health services rely heavily on midwives. Over 70% of deliveries occur at home, underscoring the essential role

midwives play (22). The training in nursing and midwifery in Sudan faces significant challenges, including shortages in both faculty and clinical placements (74). In November 2022, just a few months before the outbreak of the war, the Ministry of Higher Education in Sudan upgraded the Academy of Health Sciences, which is the body responsible for the training of nurses, midwives, and other allied health professionals in Sudan, to a university. This step marked a significant advancement in midwifery education (80). However, due to the war, the Academy of Health Sciences had to suspend the training of nurses, midwives, and other allied health professionals in Khartoum. Training activities continued at its branches in safer states (40,41).

According to key informants, the war not only disrupted the training of midwives but also significantly impacted the professional development of medical doctors, particularly in obstetrics and gynaecology, as well as the internship program for newly graduated medical doctors. Medical training was suspended for a period in Khartoum, prompting many doctors to relocate to other hospitals in search of opportunities to continue their training. A KI mentioned:

"The war disrupted Sudan's medical training system, halting the career progression of medical doctors, whether specialists, residents, or interns. As a result, many were working in an unofficial or informal capacity." [INGO representative]

Insecurity

Insecurity has been widely recognised as a significant barrier to the provision of health services in conflict-affected areas, primarily due to the heightened risk of targeted violence, threats, and abductions involving healthcare workers (52). Numerous incidents of killing, attacks, kidnappings, and intimidation have been reported by key informants and documented by entities such as the Ministry of Health, international NGOs, and UN agencies. Since the onset of fighting in April 2023 until December 2024, there have been 542 documented attacks on Sudan's healthcare system. Tragically, at least 122 healthcare workers have lost their lives, while 90 others have been detained (81). In Omdurman, Al-Nao Hospital was struck by shellfire on multiple occasions, leading to the deaths of two healthcare providers and significant disruptions to medical services. Similarly, at Al-Saudi Maternity Hospital, a health worker was fatally shot inside the maternity ward, prompting the temporary closure of the facility. In Khartoum city, Médecins Sans Frontières (MSF) staff working at Al-Turkish Hospital were physically assaulted by members of the RSF while transporting medical supplies. Health workers were frequently stopped at checkpoints, where they were subjected to threats, intimidation, and physical assault. Caregivers within the hospital were also beaten on several occasions, and armed forces reportedly arrested volunteers working in hospitals under accusations of supporting opposing armed groups (82).

In other conflict-affected settings, such as Yemen, health facilities have similarly been targeted by armed individuals who entered hospitals to intimidate medical personnel, extort protection fees, demand free medications, or insist on preferential treatment for their relatives (57).

Interview findings revealed that the insecurity severely restricted health providers' ability to reach hospitals and attend to pregnant women in need of delivery care. This environment of constant

risk was a major factor contributing to high staff turnover and health workforce shortages. Furthermore, it had a detrimental impact on staff morale and job satisfaction issues that were also highlighted in the literature (77). KIs mentioned:

"Some areas were unstable, and doctors were working in places where the RSF could launch an attack at any moment. I remember one time I couldn't make it to the hospital because there was heavy crossfire around us." [INGO representative]

"There were many health professionals from various categories who were available and genuinely willing to help, but they lacked the means and did not feel safe or secure." [INGO representative]

Similarly, in South Sudan, safety concerns frequently compelled health workers to avoid remaining overnight at health facilities. Additionally, staff often declined to accompany patients in ambulances during nighttime hours, citing heightened security risks (58,75). In Yemen, hospital managers reported that the absence of security personnel forced them to assume responsibility for monitoring facility entry and ensuring patient safety (57).

Mental health toll

Another challenge highlighted by key informants was the psychological impact of the conflict on health workers. The ongoing insecurity and exposure to violence have taken a significant mental toll, affecting both their professional performance and personal well-being (83). As a result, many health workers have experienced symptoms of mental health disorders, including stress, anxiety, and burnout

Working environment and living conditions

The work environment and living conditions were mentioned several times in the interview as a barrier for health providers, hindering them from providing maternal health services. The power outage, water cuts, and no network for communication affected the consultation and coordination of maternal health services at the hospital level, and the shortage of supplies and equipment, like ultrasound.

"Working environment is really a big challenge, healthcare providers are part of the population. So, what affects the population affects them. If there is not enough food, not enough money, no water, no power, they are also affected. Yet people are expecting them to be able to deliver. And that's a big challenge." [INGO professional]

Chapter 5: Discussion, Conclusion and Recommendations

This study explored the health system factors influencing maternal health service provision in conflict-affected settings in Khartoum, Sudan, using the WHO Health System Framework. The discussion synthesises findings across three key building blocks: governance, service delivery, and human resources for health.

5.1 Discussion

This study explored the health system factors influencing maternal health service provision in conflict-affected settings in Khartoum, Sudan, using the WHO Health System Framework. The discussion synthesises findings across three key building blocks: governance, service delivery, and human resources for health.

Governance

One of the key findings that affected maternal healthcare provision in Khartoum after the conflict was fragmented governance. This fragmentation occurred as a result of the conflict, which caused chaos and led both the federal and state Ministries of Health to relocate to other, safer states, functioning with only about 10% of their original staff. The conflict disrupted institutional presence and coordination between different levels of the health system. This fragmentation resulted in reactive decision-making and weakened mechanisms of accountability between the Ministry of Health and its partners.

However, this fragmentation was not solely caused by the war; health governance was already weak before the conflict began (50). This weakness was reported in a few studies examining the implementation of health system decentralisation in Khartoum State, with some describing it as a failure (84,85). Many factors may have contributed to weak governance, such as poor coordination and intersectoral collaboration between different ministries and levels of government, the lack of an operational health sector strategic development framework, and poorly defined roles and responsibilities of major actors (50).

Moreover, the political instability the country experienced in the years leading up to the conflict resulted in a leadership vacuum, particularly due to the frequent turnover of leadership positions at both federal and state levels(48,86). These changes were often influenced by political factors rather than technical considerations, weakening governance and negatively affecting policy direction, development and implementation.

In a similar context, such as Yemen, following the escalation of conflict, the health system became fragmented, and health system governance shifted toward de facto decentralization. This shift

significantly weakened governance due to the absence of a unified policy and planning framework (87). In contrast, Sudan had already adopted a de jure decentralisation framework prior to the conflict, providing a legal and institutional foundation. The war intensified decentralisation in practice, shifting decision-making authority from the national to the state level. If managed effectively, this shift could offer an opportunity to strengthen local resilience and adaptability within the health system.

Service delivery

One of the key findings affecting maternal health service delivery in Khartoum after the conflict was the widespread insecurity that led to the extreme disruption of services. Health facilities were attacked, infrastructure was damaged, the referral system was largely non-functional, and the flow of medical supplies and humanitarian aid was interrupted. These security conditions severely affected the continuity and quality of maternal health services.

This massive destruction of infrastructure was due to the intensity of the conflict, as almost two-thirds of hospitals were not functioning, and some were militarised. The situation was especially critical in Khartoum, where the intensity of the conflict was exceptionally high due to the city's status as the capital. Both parties to the conflict targeted key infrastructure and strategic locations in an effort to control the city, resulting in widespread damage (88). While such attacks on health facilities and obstruction of medical care violate international humanitarian law under the Geneva Conventions, violations and attacks on health facilities and healthcare professionals continued (89).

A major contributing factor to the collapse in service delivery was the interruption of medical supply chains. This was not only due to the extreme security situation, bureaucratic restrictions, and militarisation of aid that limited the movement of supplies, but also the centralised nature of Sudan's health supply chain system prior to the conflict. Central warehouses of the National Medical Supply Fund and all 26 pharmaceutical factories for the whole country were in Khartoum, and most were looted, affecting not only Khartoum but the entire country (40). This reflects a weakness in the decentralised governance system that existed even before the war.

The health system's capacity before the war was also a factor that contributed to the challenges in service delivery during the conflict. The system was already burdened and overstretched, and the war further exacerbated these weaknesses. As a result of this collapse, maternal health services shifted toward community-based care as an adaptive solution. Service provision became almost entirely dependent on community midwives, who became the frontline providers. Mobile clinics were also utilised; however, their effectiveness was hindered by the prevailing security conditions.

Similar patterns have been observed in other conflict-affected settings. In South Sudan and Somalia, the conflict led to the breakdown of formal health systems and increased reliance on

community health workers and traditional birth attendants (90). Beyond their core role in maternal health, midwives in some humanitarian settings provided important services such as family planning in Palestine, sexual and reproductive health care for adolescents in Burundi and Uganda, and support for the prevention of mother-to-child transmission of HIV and emergency care in Northern Uganda (90). These contributions show that midwives played a vital role in broader reproductive health and community support during crises, not just in delivering babies (90).

Human Resources for Health

One of the key barriers to maternal healthcare service delivery in Khartoum during the conflict was the shortage and high turnover of healthcare professionals, particularly among skilled and specialised cadres. This workforce crisis severely disrupted the availability and quality of maternal services, as many facilities were left understaffed, and EmONC services were severely affected due to the shortage of obstetricians. The shortage not only limited access to skilled birth attendance and emergency obstetric care but also overburdened the remaining staff, further weakening the overall health system response.

This finding reflects the broader fragility of Sudan's health system in times of crisis. While the ongoing conflict introduced a new and acute layer of insecurity, many of the drivers of workforce attrition, such as poor working conditions, economic instability, weak human resource management and insufficient training, have long existed (74).

Multiple interrelated factors contributed to this situation. First, extreme insecurity during the conflict, including targeted attacks on health workers and facilities, led many staff to flee to protect themselves and their families. Over 120 health professional lost their lives, and many others were subjected to threats, abductions, or violence (68,81). Second, economic hardship, a problem both before and during the war, played a central role. Even prior to the conflict, health workers faced low and irregular salaries, caused by insufficient government health spending and inadequate HRH policy, including poor planning and ineffective management of the health workforce (74). The war further compounded these issues: many staff went over a year without pay, driving many to seek opportunities in the private sector, INGOs, or abroad. These dynamics highlight the broader governance weakness and fragmentation within Sudan's health sector.

In response to the crisis, some training programmes resumed, demonstrating a degree of system resilience. However, the conflict environment posed serious challenges to the quality and comprehensiveness of training, with limited regulation and oversight. Investment in training is critical, but without strong quality assurance frameworks, the long-term effectiveness of such efforts remains uncertain.

As the health system collapsed, community midwives became the primary providers of maternal care in Khartoum. Despite this vital role, their training was often insufficient to meet international

standards. Although midwifery has received investment in Sudan, especially given that over 70% of births take place at home, the crisis exposed significant gaps in their preparedness and supervision(47). One of the key challenges was the lack of direct supervision, even though efforts such as the volunteer obstetrician initiative provided some guidance. In the absence of consistent oversight, midwives showed notable resilience by organising themselves within their communities and continuing to provide care under extremely difficult circumstances (47). Stronger, sustained investment in midwifery training and support, aligned with global standards, is essential to strengthen the maternal healthcare system.

Similar experiences have been observed in other conflict-affected settings. In Syria, over a decade of civil war has severely depleted the health workforce through targeted attacks, forced displacement, and emigration of skilled professionals. Health facilities were routinely bombed, and physicians and nurses faced kidnapping, torture, or death, leading many to flee (91). As a result, underserved communities increasingly relied on midwives and community health volunteers, often operating with minimal training or supervision (92). These frontline workers played a critical role in sustaining maternal and basic health services, despite lacking formal support structures. Sudan's war highlights how conflict exposes the fragility of health workforce systems and underscores the urgency of building resilient, well-governed HRH policies before crises emerge.

5.1.1 Implications of the study

The findings of this study can inform post-conflict national health, reproductive health, and human resources for health (HRH) policies in Sudan. They also offer valuable guidance for improving the coordination, planning, and strategic design of maternal healthcare within humanitarian responses not only in Khartoum but across other conflict-affected areas in the country. Lastly, this research contributes to the limited evidence base on maternal health in active conflict settings in Sudan and underscores the importance of ongoing research, documentation, analysis, and learning in such fragile contexts

5.1.2 Strengths and limitations

A key strength of this study is its use of a mixed-methods design, which allowed for the triangulation of data and strengthened the validity of findings. By incorporating perspectives from key informant interviews, the study captures grounded, context-specific insights that reflect the real-life challenges faced within the country's health system during the conflict.

This study primarily focuses on selected health system components, namely governance, service delivery, and human resources, and does not examine other components such as financing, medical products and technologies, or health information systems. As a result, the findings may not capture the full spectrum of barriers affecting the provision of maternal health services in conflict-affected settings.

Another limitation of this study is the scarcity of peer-reviewed research from Sudan. This is largely due to the ongoing conflict and the significant challenges associated with conducting and publishing research in such a context. Consequently, much of the literature used to inform the Sudan-specific context was drawn from commentaries and grey literature rather than from rigorously reviewed academic sources.

Furthermore, the small sample size due to the crisis in Sudan, which made it difficult to reach many potential respondents, as they were either unavailable or preoccupied with emergency responsibilities. In addition, because the conflict began in 2023, there is a potential risk of recall bias, which may affect the accuracy of participants' responses.

5.2 Conclusion

This study examined the health system factors influencing maternal health service provision in conflict-affected settings in Khartoum, Sudan, using the WHO Health System Framework. Through a focused analysis of governance, service delivery, and human resources for health, the study found that the ongoing conflict severely disrupted maternal healthcare, not only by damaging infrastructure and displacing institutions, but also by deepening long-standing system weaknesses.

Weak governance, which existed before the conflict, became more pronounced as ministries relocated, coordination broke down, and accountability mechanisms weakened. Service delivery collapsed under the weight of insecurity, targeted attacks, and the looting of centralized supply chains, leaving large parts of the health system inoperable. Meanwhile, the health workforce already overstretched by insecurity, economic hardship, working conditions leading to high turnover and shortage of skilled providers. Amid this breakdown, community midwives emerged as frontline responders, yet they were often undertrained and unsupported, despite their central role in sustaining maternal care.

These findings highlight the urgent need to rebuild Sudan's maternal health system not only through governance reform that strengthens decentralization, and long-term workforce support. The study also provides useful guidance for humanitarian actors, showing how emergency responses should be aligned with broader health system needs, especially in places where maternal health is already at risk.

there is severe need for investment in a national midwifery strengthening programme that combines improved training and supervision particularly in conflict-affected and underserved areas. Such investment would not only enhance quality of care during crises but also contribute to long-term system resilience.

Finally, this study raises important questions for future research: How can decentralized health governance be structured to respond effectively in times of conflict? What models of community-based care can ensure quality and continuity when formal systems collapse? Addressing these gaps will be essential for building a more equitable, responsive, and crisis-resilient maternal health system in Sudan and other fragile contexts.

5.3 Recommendations

FMOH, SMoH and policymakers are recommended to:

Governances

1. **Strengthen decentralisation**
   Developing operational guidelines that clearly define the roles, mandates, and responsibilities of FMOH, SMoH, Health directorates and departments, and humanitarian actors.

Service delivery

2. **Establish Community-Linked Maternity Waiting Homes**
   Collaborate with communities, INGOs, and NGOs to build and manage maternity waiting homes near health facilities in secure conflict-affected settings and link them with community midwives.
3. **Strengthen Context-Adaptive Referral Systems**
   Support the development of low-cost, locally adapted referral systems using community-managed transport (e.g., tuk-tuks, carts, or boats).

Human resources for health

4. **Develop Midwifery Education and Accreditation Systems**
   Establish an accreditation system for midwifery education in collaboration with institutional partners such as UNFPA to ensure standardised, high-quality training that meets international standards for SBA.

5. **Rotate and Retain Skilled Staff**
   Implement a rotation policy that deploys senior and specialist health professionals to serve temporarily in secure, conflict-affected settings. And prioritise the recruitment and retention of local healthcare professionals from within the affected communities.

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Appendices

Annexe 1: Keywords used in search strategy

Table 2: Keywords used for search strategy

OR		OR		OR
Health system		Conflict		Sudan
Health System Building Blocks		War		South Sudan
Maternal Health		Fragile state		Somalia
ANC	AND	Crisis	AND	Ethiopia
PNC		Humanitarian		Eritrea
Childbirth				Chad
EmONC				Yemen
Governance				East Africa
Leadership				
Service delivery				Horn of Africa
Human Resources for Health				
Health workforce				

Annexe 2: Letter waiver request for primary data collection

From: Amal Hassan Abdullah Hassan *Amsterdam,5th June 2025*

To: KIT Research Ethics Committee

Dear Lisanne Gerstel and Fernando Maldonado,

This letter is to request a waiver of ethical clearance for a study on **Health system factors influencing Maternal health service provision in conflict-affected settings**. The study takes place in *Sudan*.

The study is implemented by *Amal Hassan Abdullah Hassan* in the context of *KIT thesis research*. The purpose of the study is to explore the health system factors that influence the provision of maternal health services in conflict-affected settings. The study focuses on understanding how governance, service delivery, and human resources affect maternal health service provision during times of conflict. The study results will be used to provide recommendations to the stakeholders involved in providing maternal health services and policymakers in Sudan.

The methodology of the study consists of a *Literature review and key informant interviews*. The number of respondents is seven. Respondents will be selected purposefully in the capacity of their profession. The research team consists of one person.

I would like to kindly request the Research Ethical Committee for a waiver of ethical clearance for this study for the following reasons:

1. As mentioned above, the questions will solely concern the knowledge, insights and experiences based on the professional roles of the respondents. The data collection tool is developed for experts in the field of public health, to share their experience and opinion on the research topic. The data collection tool does not include any personal questions and participants are free to skip questions if they consider them to be irrelevant.

2. The participants will be asked for informed consent before the data collection, to make sure voluntary and informed participation is taking place. The participant is requested to participate and can decide to decline or withdraw participation at any moment during the process without any effect on reputation, or other consequences like *loss of employment or discrimination*.

3. Participating in this study does not bear any physical, psychological and/or socio-economical risk or discomfort. *the study does not require any personal or sensitive information*

4. The data collection tool was developed by *Amal Hassan Abdullah Hassan* based on *consultation of thesis advisor*.

5. All information will be derived, processed, stored and published anonymously*. names and any identifying details will be removed from the data before analysis. Unique codes will be assigned to each participant to ensure anonymity. The data will be securely stored on encrypted devices, accessible only to the researcher, and will be destroyed 6 months after the thesis is published.*

6. Furthermore, the research is scientifically sound and justified, described in a clear detailed protocol, and conducted in accordance with the basic ethical principles of the Declaration of Helsinki.

The data collection tool guide can be found in Annex 1 to this letter and the informed consent form can be found in Annex 2.

I hope to have informed you sufficiently on the objective and content of this study to make a decision on our request.

Yours sincerely,

Amal Hassan

Annexe 3: Informed consent form

Introduction

I am AMAL HASSAN ABDULLAH HASSAN, an MSc student in public health at the KIT Institute. I am currently conducting a study focused on Maternal health services' provision during conflict. The objective of this research is to explore health systems factors influencing maternal health service provision in conflict-affected settings and provide recommendations to policymakers to improve maternal health services provision during crisis and address existing gaps in the literature. Given your involvement in Maternal health services provision in Khartoum state in Sudan during the 2023 conflict, I would like to invite you to participate in this study.

Informed consent form

Hello, my name is AMAL HASSAN ABDULLAH HASSAN, and I am a researcher from the KIT Institute. I am conducting a study titled: "Health System Factors Influencing Maternal Health Service Provision in Conflict-Affected Settings in Khartoum, Sudan." The aim of this study is to explore the health system factors that influence the provision of maternal health services in conflict-affected areas. The study will help provide recommendations to policymakers and stakeholders to improve service delivery in such challenging settings. The study will take place from March to August 2025.

Procedures including confidentiality

The interview will be conducted in a private setting to ensure confidentiality and will last approximately one hour. With your consent, I will record the interview to ensure accuracy. All recorded information will be kept completely confidential. Your name will not be recorded or documented. Notes will be securely stored and only accessible to the research team. The recorded files will be deleted six months after the study's completion.

In any publications, the findings will focus on the general Maternal health services provision rather than on your specific responses.

Risk, discomforts and right to withdraw

Even after agreeing to participate in the interview, you are free to decline to answer any questions that make you uncomfortable, with no impact on your reputation or any other aspect of your life. You also have the right to withdraw from the study at any time. If any questions cause discomfort, you can choose to stop the interview or refuse to respond to those questions.

Benefits

While this study may not provide direct benefits to you, the results will contribute valuable insights that can help improve maternal health services in conflict-affected settings in Sudan.

Sharing the results

Once the study is completed, I will share the results with you and key stakeholders involved in maternal health services' provision, including the Federal Ministry of Health, State Ministry of Health, UN Agencies, INGOs, NGOs, and other relevant actors. Additionally, the results will be published in a written report through the KIT Institute. If you would like to receive a copy of the report, please inform us, and we will ensure you receive one..

Consent and contact

Do you have any questions that you would like to ask?

Are there any things you would like me to explain again or say more about?

Do you agree to participate in the interview?

DECLARATION: TO BE SIGNED BY THE RESPONDENT

Agreement respondent

The purpose of the interview was explained to me, and I agree to be interviewed ……. (name of person).

_____

Signed Date

If you have any questions or want to file a complaint about the research, you may contact:

Contact information organisation	Contact for Ethics Committee
Amal Hassan a.hassan@student.kit.nl amalhassan1910@hotmail.com	researchethics@kit.nl

Annexe 4: Declaration for Use of Generative AI (GenAI)

KIT Institute (Masters or Short course) Participants

Declaration for Use of Generative AI (GenAI)

Please complete and submit this form as an annex on the last page of your assignment file; and not as a separate document.

Check the box that applies to your completion of this assignment:

☐ I confirm that I have not used any generative AI tools to complete this assignment.

☒ I confirm that I have used generative AI tool(s) in accordance with the *"Guidelines for the use of Generative AI for KIT Institute Master's and Short course participants".* Below, I have listed the GenAI tools used and for what specific purpose:

Generative AI tool used	Purpose of use
1. perprexlisity	brainstorming
2.	
…	