CALLANGES OF PRIMARY HEALTH CARE IN SUDAN AND THE ROLE OF THE HEALTH SYSTEM BUILDING BLOCKS AS CONTRIBUTING FACTORS

Rethinking Primary Health Care in Sudan's Journey to Universal Health Coverage

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CHALLENGES OF PRIMARY HEALTH CARE IN SUDAN AND THE ROLE OF THE HEALTH SYSTEM BUILDING BLOCKS AS CONTRIBUTING FACTORS
Rethinking Primary Health Care in Sudan's Journey to Universal Health Coverage: A literature review

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Science in Public Health

By

Abdalazim Mirghani Ali Mohamed

Declaration:

Where other people's work has been used (from either a printed or virtual source or any other source), this has been carefully acknowledged and referenced in accordance with academic requirements.
The thesis ***Challenges of Primary Health Care in Sudan and the Role of the Health System Building Blocks as Contributing Factors*** is my own work.

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Abstract:

Introduction: Sudan is a low-income country, with overall poor health indicators. Policymakers have prioritized primary health care to achieve Universal Health Coverage (UHC) in Sudan, but there remains inadequate access to quality primary care services. This study aims to analyze the challenges of primary health care and to provide recommendations for its improvement to achieve UHC.

Methodology: This study is a literature review using the conceptual framework for transforming health systems towards Sustainable Development Goal 3 to analyze the challenges of primary health care and the role of health system building blocks as contributing factors in the context of Sudan, with lessons drawn from other low-to-middle-income-countries with similar context to Sudan.

Results: The study has found significant challenges with primary health care in Sudan. Primary care service delivery is challenged by inadequate provision of the essential care package. Multi-sectoral policies and social determinants of health are under-addressed, affecting health outcomes and equity. Empowering communities remains limited with no institutional framework for their engagement. Health system building blocks significantly affect primary healthcare in Sudan. Human Resources for Health, infrastructure, and health financing were found to be the most critical factors affecting access and quality of primary care services.

Conclusion: Addressing the identified challenges and enhancing primary care service delivery are crucial steps toward achieving UHC and improving the regional and urban-rural disparities in access to primary care. Policymakers must strengthen the health system building blocks and engage communities to improve health outcomes and equity in the country.

Keywords: Primary Health Care, Primary Care, Health System, Building Blocks, Sudan

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Abbreviations

AHC	**Academy of Health Sciences**
ANC	**Antenatal Care**
BCG	**Bacillus Calmette Guerin**
BOD	**Burden of Disease**
CBI	**Community-Based Initiative**
CFR	**Case Fatality Rate**
CHE	**Current Health Expenditure**
CHSS	**Community Health System Strengthening**
CHW	**Community Health Worker**
COVID-19	**Corona Virus Disease**
DTP	**Diphteria, Tetanus, and Pertusis**
DTP/HEPB/HiB	**Pentavalent Vaccine**
EPI	**Extended Program on Immunization**
FGM	**Female Genital Mutilation**
FHC	**Family Health Center**
FHU	**Family Health Unit**
FMOH	**Federal Ministry of Health**
GAVI	**Global Alliance for Vaccines and Immunization**
GDP	**Gross Domestic Product**
HAQ	**Healthcare Access and Quality**
Hep B3	**Hepatitis B vaccine**
HEW	**Health Extension Worker**
HiAPs	**Health in All Policies**
HIS	**Health Information System**
HRH	**Human Resources for Health**
IMCI	**Integrated Management of Childhood Illness**
LGA	**Local Government Act**
LLIN	**Long-Lasting Insecticidal Net**
LMIC	**Low-to-Middle-Income Country**
MCH	**Mother and Child Health**
MCV	**Measles Vaccine**
MICS	**Multiple Indicator Cluster Survey**
NCDs	**Non-Communicable Diseases**
NHCC	**National Health Coordination Council**
NHIF	**National Health Insurance Fund**
NMPB	**National Medicines and Poisons Board**
NMSF	**National Medical Supplies Fund**
OOPE	**Out of Pocket Expenditure**
OPV	**Oral Polio Vaccine**
PCV	**Pneumococcal Vaccine**
PHC	**Primary Health Care**
PPMs	**Provider Payment Mechanisms**
SBB	**Sugar-Sweetened Beverages**
SCI	**Service Coverage Index**

SDG	**Sustainable Development Goal**
SDOH	**Social Determinants of Health**
SMOH	**State Ministry of Health**
SNHP	**Sudan's National Health Policy**
UHC	**Universal Health Coverage**
UNICEF	**United Nations Children's Fund**
VAT	**Value Added Tax**
WHO	**World Health Organization**

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Chapter 1: Background

Country Sudan

Sudan is a country with a land area of 1.8 million square kilometers and it is bordered by seven countries: South Sudan, the Central African Republic, Chad, Libya, Egypt, Eritrea, and Ethiopia. The Nile River runs through Sudan, with an 853-kilometer-long coastline offering access to the red sea (Annex 1 shows the map of Sudan) (1).

Sudan has experienced conflicts since its independence. There are still remnant conflicts in the Darfur region, South Kordofan, and Blue Nile State as post-peace agreement residues. The country's social service organizations, especially the health sector, were impacted as a result, either directly or indirectly. That is, while some regions experienced conflict, others suffered because of the implications of housing the displaced populations or due to the misuse of resources intended for development. In April 2023 a new fight erupted between rival forces and as of then has resulted in humanitarian crises (2,3). Sudan has been impacted frequently by natural disasters such as heavy rain, floods, and droughts (4).

Sudan's total population is 42.8 million, with 70% living in rural areas and 8% are pastoralists. There are 2.2 million internally displaced people and refugees from neighboring countries, along with a growing transformation toward urbanization. Women in Sudan constitute half of the population, with those in reproductive age accounting for 25% of the population. The total fertility rate in the country is 4.5 with a population growth rate of 2.4%. While the crude birth rate and crude death rate are 34, and 7 per 1000 respectively. Sudan has a young population, as evidenced by the 18.4 years median age of the population (1,2,5–10). Figures 1.1 and 1.2 show the population pyramid in Sudan, in 2023 and 2050.

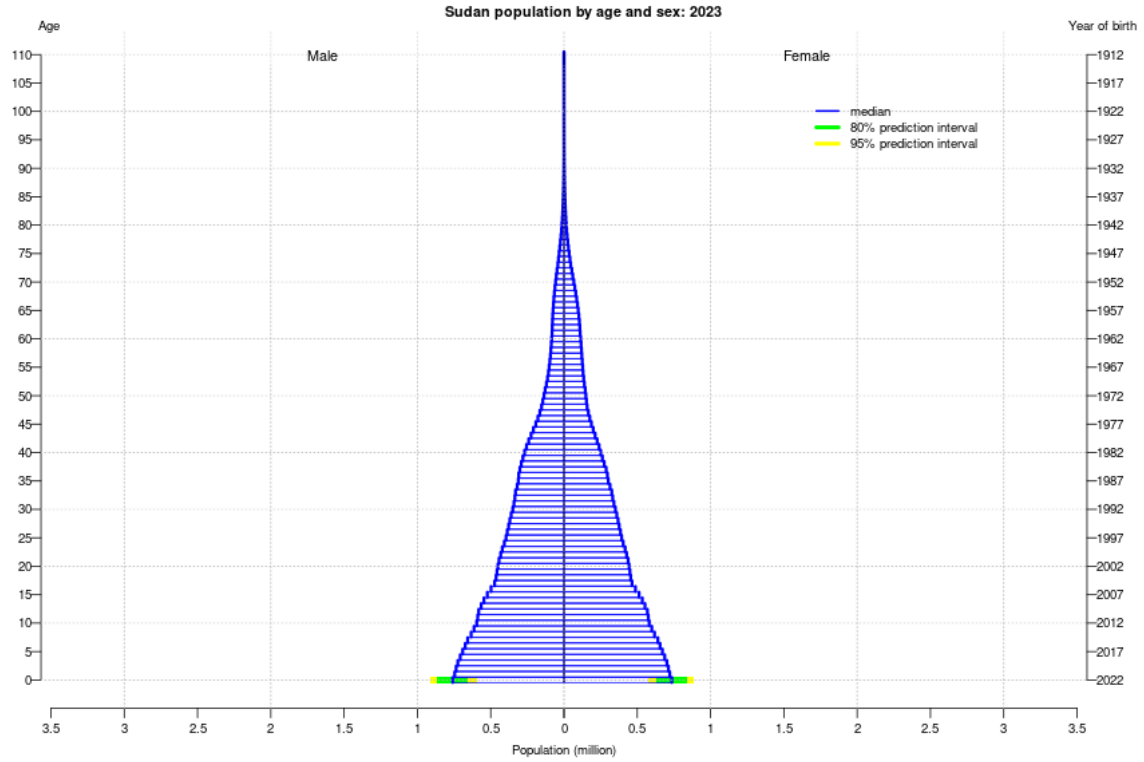


Figure 1. 1: Sudan's population pyramid in 2023.

Source: World Population Prospects, United Nations (11).

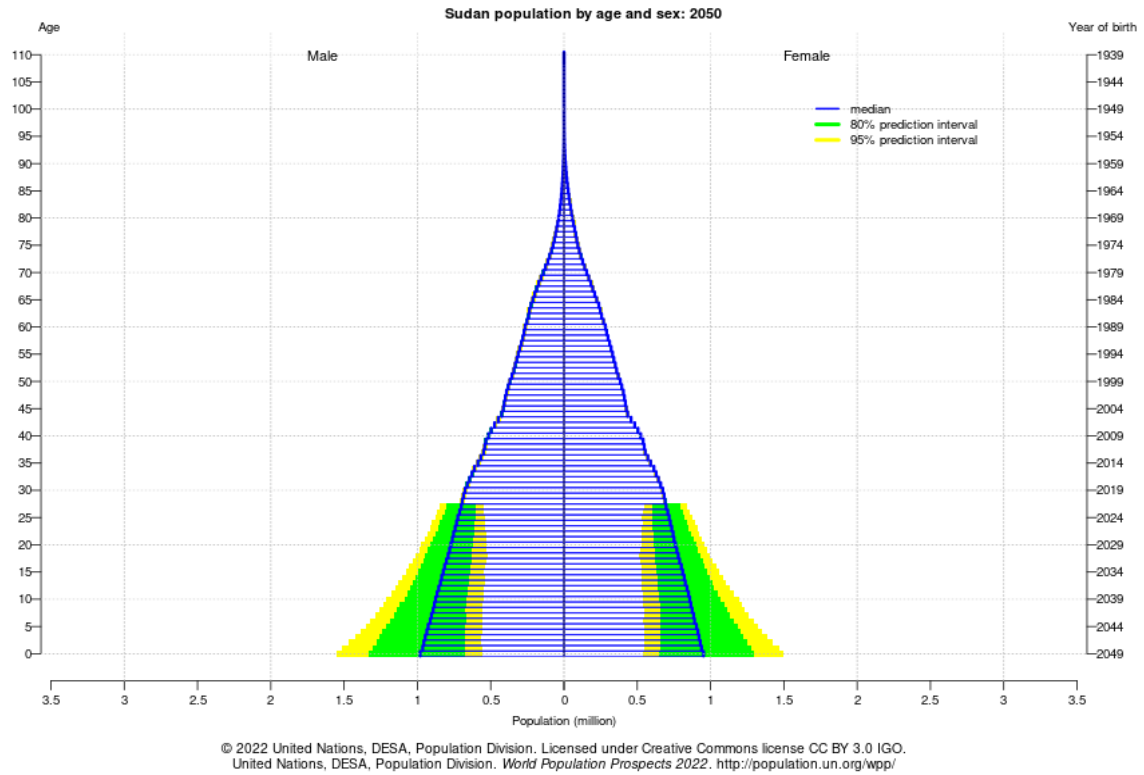


Figure 1. 2: Sudan's population pyramid projection in 2050.

Source: World Population Prospects, United Nations (11).

Sudan's economy experienced a severe financial crisis in 2018, and the Gross Domestic Product (GDP) per capita declined to 977 US$, classifying Sudan as a low-income country. In 2021 the GDP per capita further declined to 749.7 US$. Sudan's government debt in 2020 was at 183% of the GDP making it a heavily indebted poor country. The unemployment rate is high in the country. In 2021, 19% of the labor force was unemployed, especially women and young people who had a 32% and 40% unemployment rate respectively (2,12–15). According to the Local Government Act (LGA) of 2003, also known as the Decentralization Act, Sudan is a federated republic with a multiparty system, but organizational and legislative setups differ from state to state. It is comprised of 18 states with a total of 184 localities. In 2018 Sudan had mass demonstrations that ousted the rule of the previous regime, followed by a transition for 2 years, which was interrupted by a military coup in October 2021 (2,15). Sudan is culturally and ethnically diverse with hundreds of tribes and languages. The main language is the Arabic language, and the majority of the population is Muslim. Sudan ranked low on the human development index with a value of 0.508, and the adult literacy rate of people aged 15 and above was 61%, while the gross primary and secondary school enrolment was 79% and 46% respectively (2,16,17).

The percentage of Sudanese people living in poverty rose from 34% in 2009 to 38% in 2014, and it may have reached 54% in 2021. 8% of the population lives in extreme poverty, with 46.5% of people earning less than 1 US$ per day below the poverty line. The rural population is the worst affected, especially women and internally displaced persons, and according to the Sudan Multiple Indicator Cluster Survey (MICS) 81% of the population had access to clean water, and 27% had improved sanitation (6,18,19).

The Burden of Disease (BOD) in DALYs per 100.000 population has decreased over the past 20 years in Sudan, particularly communicable diseases' burden, which has declined significantly, with a smaller decline of Non-Communicable Diseases (NCDs) (see Figures 1.3 and 1.4). However, the Sudanese health system is considered fragile and suffers from poor investments in its strengthening, and consequently, the health indicators of the country are frequently poor. For instance, the under-five mortality in Sudan is 55 deaths per 1,000 live births, which is one of the highest in the region especially when compared to countries with similar contexts and neighboring countries like Kenya, Uganda, Ghana, and Egypt. The United Nations Children's Fund (UNICEF) estimates that 78,000 children under five die yearly in Sudan due to preventable diseases, while the percentage of children under five with diarrhea and had an oral rehydration solution treatment was 20%. In addition, the Sudan household survey, in 2010, reported that 26.8% of children between the age of 5 to 59 months had diarrhea, while 18.7% of the same age group were suspected to have pneumonia two weeks before the survey (2,17,20–23).

Maternal mortality is also high in the country. It is estimated at 270 per 100,000 live births in 2020, and it is mainly related to insufficient Antenatal Care (ANC) and the lack of skilled birth attendants. Iodine, iron, and vitamin A deficits are the most prominent micronutrient deficiencies which continue to be a serious issue for children under five. Severe stunting prevalence was 15.1% and 2.2 million children need treatment for moderate acute malnutrition(2,17,20–23). Table 1.1 shows the main health indicators in Sudan, in 2021.

Table 1. 1: The main health indicators for Sudan in the year 2021.

Indicator	Value
Crude Birth Rate (per 1,000 population)	34
Crude Death Rate (per 1,000 population)	7
Total Fertility Rate (births per woman)	4.5
Life Expectancy at Birth (years)	65
Infant Mortality Rate (per 1,000 live births)	39
Under 5 Mortality Rate (per 1,000 live births)	55
Maternal Mortality Ratio (modelled estimate, per 100,000 live births)	270
Maternal Mortality Ratio (national estimate, per 100,000 live births) (2010)	237
Source: World Bank Open Data. Sudan (17)	

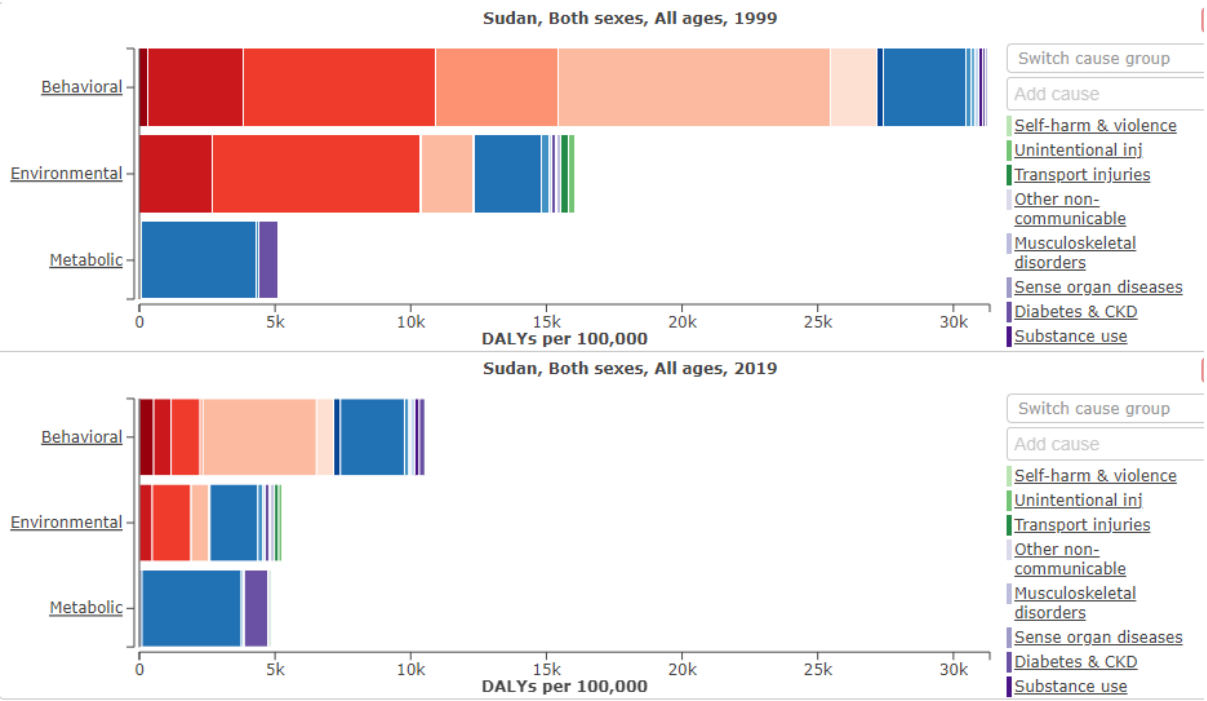


Figure 1. 3: Burden of Disease in Sudan expressed in DALYs per 100,000, Comparison between years 1999 and 2019.

Source: Institute of Health Metrics and Evaluation (IHME) (23).

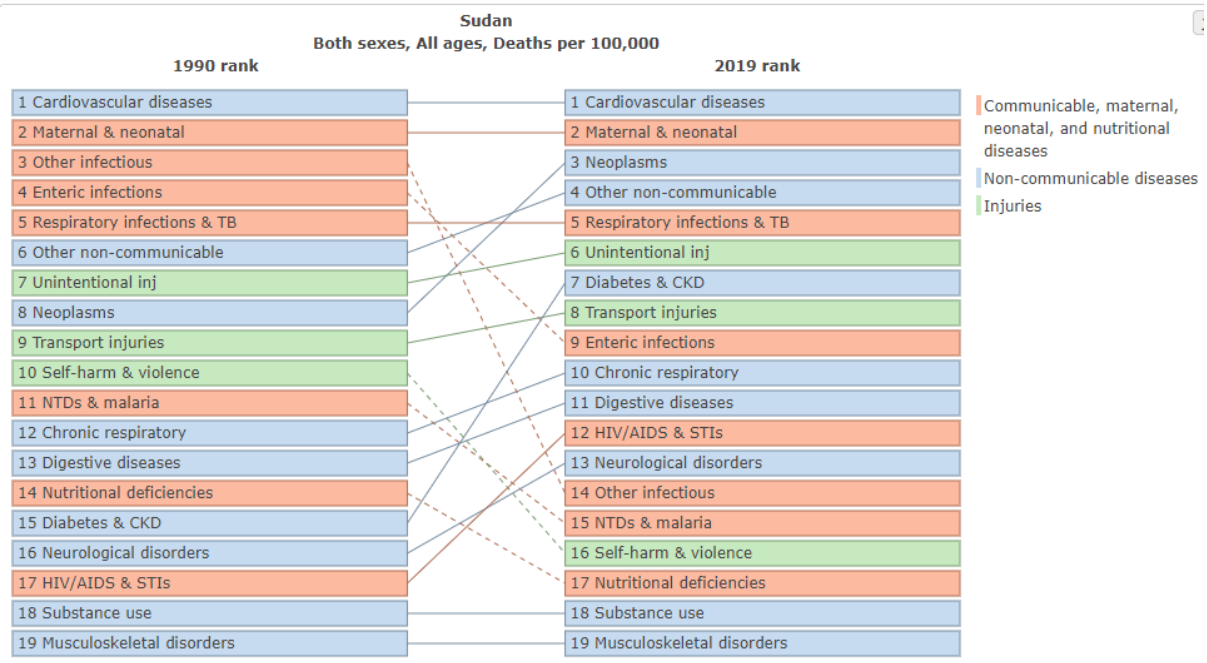


Figure 1. 4: Top 19 causes of death across all ages in Sudan between 1990 and 2019.

Source: Institute of Health Metrics and Evaluation (IHME) (23).

Sudan has a federal system of governance composed of three levels according to the LGA of 2003: federal, state, and local levels. The health system service delivery is organized into the three basic arrangements, primary, secondary, and tertiary. Secondary and tertiary care is

provided collaboratively by the public and private sectors; however, the private sector is mostly active in urban areas. Screening, diagnostic, and therapeutic services are provided as secondary care in both health centers and hospitals, where major surgical and specialized tertiary care is primarily provided at larger public and private hospitals. These hospitals and centers accept patients without being referred by primary facilities, indicating an inefficient referral system (24).

Primary health care and Universal Health Coverage

Primary Health Care (PHC) as described in the Alma-Ata declaration is a whole government and a whole of society approach that combines three key components multisectoral policies and action, empowered people and communities, and primary care and essential public health as the core of integrated health services. It is a vision towards Universal Health Coverage (UHC) and Sustainable Development Goals (SDGs) (25).

As a large portion of the population worldwide still lacks access to health facilities for basic services, PHC must be expanded at the community and household levels to be effective. A robust PHC system is necessary for UHC as it has principles of universal coverage and equitable access with an emphasis on disease prevention and health promotion represents a cornerstone for UHC (26–28).

Most countries direct most of their health spending on secondary and tertiary care with significant amounts spent on expensive medicines and equipment frequently generating slight improvements in health outcomes, while up to 90% of essential services can be provided through PHC, and by expenditure, and investing in PHC global life expectancy may increase by 5-6 years. On the other hand, the vision of PHC is to shift perspectives on health from professionals, hospitals, and diseases towards understanding that social, economic, and environmental factors also impact people's health and well-being (29).

Evidence shows that health systems based around PHC produce better health outcomes at lower costs, service coverage, improving equity, financial protection, and positive effects towards the direction of UHC. Hence, Achieving UHC requires a renewed emphasis on high-quality primary care that puts people at the center (30–32).

Chapter 2: Problem statement, justification, and research objectives

Problem statement

Sudan has committed to moving in the direction of UHC. One of the principles and policy directions was prioritizing PHC as a fundamental prerequisite to facilitate moving towards UHC, but there remain significant and numerous challenges to reaching the commitment (33–36).

According to the world bank, the UHC service coverage index[1] (SCI) for Sudan is 44, lower than countries with similar income such as Kenya and Uganda, and lower than its neighboring country Egypt, which had a UHC service coverage index of 53, 49, and 70 respectively (37).

The UHC effective coverage index is 52, which is similar to Kenya's, while the health care access and quality (HAQ) index is 46, higher in comparison to Uganda's HAQ index of 31.

Catastrophic health expenditures affect 18% of the urban and rural population to spend more than 10% of their income on health in comparison to the global average of 11.7% and push 5% under the poverty line (33) (38–41).

Primary care in Sudan is provided through community services, Family Health Units (FHUs) that serve populations of 5000-1000, Family Health Centers (FHCs) that serve up to 20.000, and local-level rural hospitals which serve populations of 100.000-250.000. FHCs account for about 41% of the total health visits, with a variation in the utilization of FHUs and dispensaries which ranges from (1-18%) between rural and urban areas of the total health visits (42,43).

One of the major challenges facing Sudan's health system is adequate access to high-quality primary care services. The problem is related to many interdependent factors; firstly, Sudan has entered an epidemiological and demographic transition. Unhealthy lifestyles and behavioral changes are now evident to contribute to the problem. Although overall BOD has decreased, especially due to the decrease in communicable diseases, and even NCDs, they still constitute a challenge for the health system in Sudan including primary care services, with an increased demand from a more conscient population. In addition, the primary care minimum package expansion falls short of the required level and is not available to the majority of the most in need. And the governance, financing, and delivery models employed by the health system do not promote the best possible access to primary care services (15,23,42,44–47).

[1] UHC SCI, which is officially reported in the SDGs as an indicator for UHC coverage, has several shortcomings: not covering a broad range of services, not covering quality of care, and not covering more specialized hospital service coverage. Other indicators are being piloted in LMICs that aim to address these shortcomings, like the UHC effective coverage index, and the HAQ index. A disadvantage of these indicators, however, is that they require more robust information systems, and by default of such improved information systems, they depend often on modeling.

Secondly, the Sudanese healthcare system is skewed towards hospital care and prioritizes hospital and urban centrism. This manifests itself in the fact that about 33% of the population has no access to primary health facilities within five kilometers. The service delivery is fragmented between multiple providers and of limited coverage for example only 22% of the population had coverage for the Integrated Management of Childhood Illnesses services (IMCI), and only 42% of the population had access to critical Mother and Child Health (MCH) services Additionally, urban-rural disparities exist in the provision of packages. About 52% of the urban centers provide the minimum package in comparison to only 3.8% of the rural centers, and 21% of the FHUs. Access to basic health services is constrained, particularly in rural areas, where most of the Sudanese population lives, and this emphasizes the importance of PHC in advancing the country's health. Overall, 71%of the population lives within 5 km of the nearest PHC facility, but this varies from state to state with North Kordufan having the least access between states; only 53% lives within 5 km of the nearest health facility, and ranges from 88% in urban to 61% in rural areas, which is illustrated by a 25% more utilization of the outpatient services by urban residents than rural dwellers, however, utilization could also be influenced by socio-cultural factors, and the different perceptions of disease between urban and rural populations (42,48–53).

Thirdly, primary care facilities suffer from conflict in various parts of the country making provision of services especially more limited in conflict areas. Both of these factors have resulted in the non-functionality of a vast number of PHC facilities because of human resources shortages and physical infrastructure problems, and might have contributed to higher healthcare costs, and placed an additional burden on the poorest quintiles in both urban and rural areas, while the availability of primary care greatly reduces the impact of income inequalities on health outcome (32,48,54–56)

According to the national characterization of health facilities, the FHUs and local hospitals in urban areas provided primary care services with medical physicians on staff, while paramedics served as the only healthcare providers in rural areas, and according to the Federal Ministry of Health (FMOH), health map, Sudan has 2078 PHC centers and 380 rural hospitals. Essential medicines are accessible only through 43% of these health facilities. The primary care services utilization on average is 0,543 visits per person per year, ranging from 0,482 for urban, where the use of private services is nearly double the rural locations and 0,582 for rural residents. The richer households utilize outpatient services more than poorer households, and the rate of utilization grows as the household's per capita income rises (48,49,57).

Fourthly, in terms of effective coverage, according to the 2015, Khartoum state health insurance report, the service coverage of public FHCs was 67% all over Khartoum state (57,58).

PHC facilities ought to be the initial point of contact under the Sudan referral system, but over 80% of patients in Khartoum state for example seek secondary-level care directly as soon as they feel ill. A study in 2017, on bypassing PHC facilities for common childhood illnesses in Khartoum state found that the most cited reasons by interviewees for approaching hospitals directly were that hospitals are nearer than PHC facilities, the higher quality of services provided at hospitals, and the availability of doctors at the secondary level. The lack

of health insurance services was the second most frequent reason for bypassing PHC facilities (56,57).
Within the main characteristics of PHC, policies such as pro-poor, universal coverage, and minimum co-payment are of great importance. The role and engagement of the community remain lacking inside the domains of health policy and healthcare services. And eventually, the poor health system outcomes in Sudan can be explained by the low score of its primary care system (42,54).

Justification

Sudan has committed to shifting away from a hospital-centric delivery system to improve PHC coverage, particularly for the poor. Despite the Adoption of PHC as a strategic priority high on the FMOH agendas, in the country's health finance policy 2016, and the National Health Sector Strategic plan within the context of decentralization of the local health system to reach UHC, it is still not delivering on the promises; there is insufficient investment made in primary care with a referral process that is usually ineffective. It experiences shortages in human resources, and most importantly in finance. The efficiency of the system is affected by the fragmentation of service delivery between numerous providers including the National Health Insurance Fund (NHIF)[2], Non-Governmental Organizations, the military, the police, and the private sector (34–36).
The implementation of Sudan's health sector reforms to improve health sector governance and achievement of UHC will be accomplished through increasing the population's access to high-quality primary care services in terms of affordability, comprehensiveness, trust, and perceived quality of these services. As well as providing financial protection (1,42,53).
Direct provision of clinical and public health services has always been the core focus of PHC. But to deliver these services, health systems also need to perform enabling functions like resource generation, stewardship, and financing. PHC and the supporting and enabling structures are crucial for achieving and enhancing UHC and bringing together a resilient and prepared health system. Thus, to analyze the service delivery at the primary care level, the underlying determinants in terms of the different building blocks of the health system would also need to be analyzed (59,60).
In most, if not all, settings, the PHC approach serves as the programmatic vehicle for UHC. It is multisectoral, including connections to education, nutrition, and water and sanitation. It emphasizes community engagement and social accountability. It provides a platform for integrating services for communicable diseases with these for women's and child's health and NCDs and continues to be the most cost-effective way to address comprehensive health needs close to people's homes and communities (61).
Effective people-centered primary care as the core of integrated services with community trust can be the cornerstone of a health system that is responsive to the population's needs. With only 8 years left to fulfill the SDGs, ongoing setbacks in ensuring equitable access to and affordable health care may make achieving UHC not possible by 2030 (62).

[2] The NHIF also acts as a provider of services in Sudan through its own facilities.

Little attention has been given to PHC as a whole society and government approach in Sudan, and literature analyzing primary care service delivery with the health systems' building blocks as contributing factors is limited. And hence, this study aims to look at the challenges faced by the PHC in Sudan, and how it is affected by other supportive health system functions, on the way to achieving UHC in Sudan.

Research Objectives

General Objective

To analyze the challenges faced by primary health care in Sudan, and to provide policy recommendations for policymakers in Sudan for the improvement of primary health care to achieve UHC and the SDG targets.

Specific objectives

1. To analyze the challenges faced by primary health care in Sudan.
2. To understand how the delivery of primary care services in Sudan is affected by the building blocks of the health system.
3. To provide and deduct evidence-based policy options from different Low-to-Middle-Income Countries (LMICs) with a similar context to Sudan for enhancing and transforming PHC to reach UHC.
4. To provide recommendations for policymakers in Sudan for the improvement of PHC and to achieve Sudan's commitment to reach UHC through prioritizing PHC.

Chapter 3: Methodology and Analytical Framework

This study employed a literature review method to analyze the challenges of PHC and the role of health system building blocks as contributing factors. Primarily to primary care services, and to some extent the other two components: multi-sectoral action and community empowerment. The study area is in the PHC system and primary care service delivery in the context of Sudan as the main study setting, and where possible and relevant in other LMICs with a similar context to Sudan.

Search strategy

The databases searched included: PubMed, ScienceDirect, MEDLINE, and google scholar databases, in addition to Vrije Universiteit online library. The search for literature in Google Scholar was discontinued after 5 pages of continued irrelevant articles. Google search engine was used to search for websites of the World Health Organization (WHO), UNICEF, and the World Bank.

The search included scientific peer-reviewed articles, grey literature, WHO reports, UNICEF reports, World Bank reports, and FMOH of Sudan reports and policy documents, both published and unpublished. The unpublished resources were received from officials in the health sector in Sudan. The snowballing technique was used by following the references listed in the collected articles.

Annex 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 “primary health care” “primary care” and” health system building blocks” and terms relating to the study contexts such as ”Sudan” “Africa” and “LMICs” using Boolean operators “AND” and “OR”.

Inclusion and exclusion criteria

The review included both English and Arabic language literature deemed to be relevant. The range of the search in terms of year of publication was back up to 2010 due to the scarcity of recent data on the study area, but only if they reflected the current situation of the health system or the PHC in Sudan. It included literature from geographical locations of similar context to Sudan.

Limitations of the study design

The selection of the relevant documents for the literature review might be influenced by my judgment and personal opinion, and the study relies on existing data, reports, and policy documents that may have been outdated, or there may have been limited access to certain sources which could affect the comprehensiveness of the study by the availability or quality of such documents. Some resources might lack robust methodologies and might lead to potential inaccuracies in the results; hence, peer-reviewed articles were prioritized, and the quality of sources was carefully assessed. Another limitation is that despite the study including both literature in the English and Arabic language, there might still be relevant literature in other languages not considered.

Analytical framework

This study will adopt the "Conceptual framework for transforming health systems towards SDG 3 target" by Stenberg K et al. (see Figure 3.1) in the lancet commission on financing transformative health systems towards the achievement of the Health SDG, published in July 2017 (63).

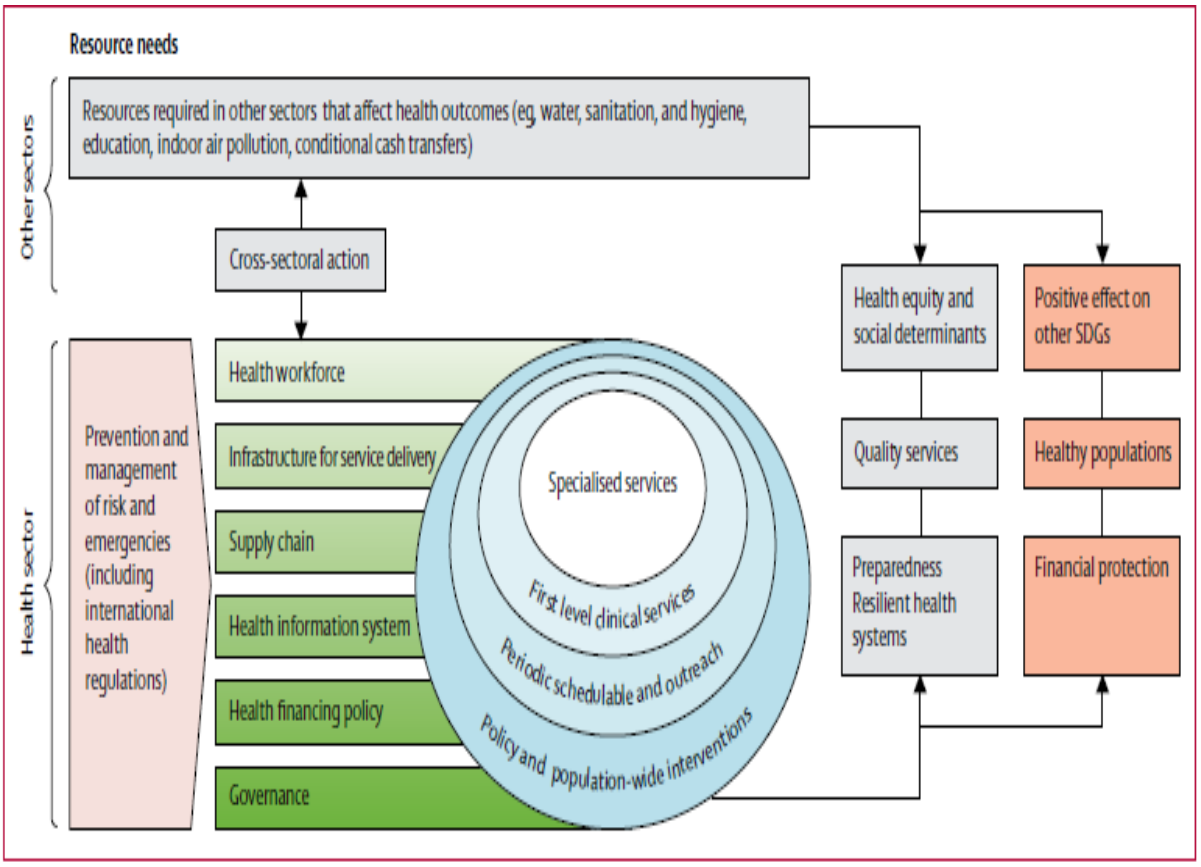


Figure 3. 1: Conceptual framework for transforming health systems towards SDG 3 targets.

Source: Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries (63).

The framework will be used because it establishes a clear causal chain to address the research questions logically. More clearly it provides a systematic way for literature search, and it guides to help analyze, structure, and organize the results of the study. The following Table 3.1 shows the themes and sub-themes extracted from the analytical framework of the study.

Table 3. 1: The main themes and sub-themes derived from the analytical framework of the study.

Research Objectives	Themes	Sub-themes
To analyze the challenges faced by primary health care in Sudan.	- Primary care and essential public health functions as the core of integrated services. - Multi-sectoral policies and actions. - Empowered people and communities.	- First-level clinical services. - Periodic schedulable and outreach. - Policy and population-wide interventions. - Cross-sectoral action - Empowered people and communities (adapted).
To understand how the delivery of primary care services in Sudan is affected by the building blocks of the health system.	- Health system building blocks.	- Health workforce. - Infrastructure for service delivery. - Supply chain. - Health information system - Health financing policy - Governance.

To provide and deduct evidence-based policy options from different LMICs with a similar context to Sudan for enhancing and transforming PHC to reach UHC.	- Primary care and essential public health functions as the core of integrated services. - Multi-sectoral policies and actions. - Empowered people and communities. - Health system building blocks.	- First-level clinical services. - Periodic schedulable and outreach. - Policy and population-wide interventions. - Cross-sectoral action - Empowered people and communities (adapted). - Health workforce. - Infrastructure for service delivery. - Supply chain. - Health information system - Health financing policy - Governance.
To provide recommendations for policymakers in Sudan for the improvement of PHC and to achieve Sudan's commitment to reach UHC through prioritizing PHC.		

The framework places health systems with a service delivery centered around people at the center and identifies the health system building blocks namely human resources, infrastructure, supply chain, governance, health financing, and health information systems as closely interlinked and contributing to service delivery and population-wide as well as cross-sectoral interventions. It examines how a people-centered service delivery along with coordinated cross-sectoral action can be used to push national health systems to deliver equitable, comprehensive, and integrated high-quality services that are receptive to the needs of the populations they serve and completely in line with the goals of UHC. Additionally, it considers contextual factors which could act as constraints towards improving PHC systems such as security, and conflicts, and this is why this framework was selected by the study. However, the framework does not include empowered people and communities as an element, but due to its importance, and as an essential component of PHC it will be

conceptualized as a component of governance, and the institutional setup of community and people's role and representation in governance.
Other frameworks such as Hanson K et al "framework for people-centered financing of PHC" were considered but excluded because they focus solely on financing (64).

Scope of the study:

Defining PHC:

PHC has been operationalized in different ways in different contexts, this study will define the PHC as: "a coordination mechanism which links primary care, community care, wider public health interventions, and long-term care services, and as a service delivery platform, together with the human and other resources needed for it to function effectively." (64)
Thereby, based on this definition, and with the guide of the 3 proposed measures for PHC investment needs by the lancet "Guideposts for investment in PHC" and the essential packages of the "Disease Control Priorities vol. 9" (see Annex 3) (65,66), the study will focus on the essential components of PHC including cross-sectional policies and action and social determinants, empowered people and communities, primary care and essential public health functions as the core of integrated services. However, according to the definition of the study, and despite them being included inside PHC in Sudan, the study will not discuss the specialized services and the rural hospitals.
Afterward, the contributing factors to primary care service delivery in terms of health system building blocks will be discussed, along with a reflection on conflicts while discussing health system resilience and preparedness. Because the framework is extensive, and they are not part of the study scope the interlinkages with SDGs and international health regulations will not be studied. But given the fact the study discusses service delivery, it will reflect on health equity and quality services, however, not as a main focus of the analysis.

Chapter 4: Results

This chapter will be organized based on the objectives and the analytical framework of the study. The first part of the chapter will describe and analyze the challenges of PHC in Sudan, with a focus on primary care service delivery, which will be organized into first-level clinical services, outreach, and population-wide interventions based on the framework. Additionally, it will reflect on multi-sectoral policies and actions, and empowered people and communities as essential components of PHC. The next part will analyze the role of the health system building blocks as contributing factors while providing evidence-based policy options and interventions from LMICs where applicable and relevant for Sudan under each section.

Part 1: Primary health care challenges

Primary care and essential public health functions as the core of integrated health services:

First-level clinical services

In this section, an overview of the challenges of service delivery of the primary care basic package will be provided, afterwards it will provide a more detailed exploration of immunization services as one example of the essential primary care package in Sudan.
The basic package of care in Sudan includes maternal and reproductive health services, nutrition services, immunization, infectious diseases, and free medicines. The country lacks health facilities that provide a comprehensive and complete care package. Only 24% of primary care facilities offer a full basic package of care, and only 5% offer a comprehensive care package. The availability of these packages is variable with regional disparities, as low in some states as 10% in North Kordufan, 12% in Gezira state, and 15% in Gedarif and Sennar states. Consequently, the proportion of women who had at least four antenatal visits during their most recent pregnancy was 51% in the whole of Sudan, with the lowest number of visits reported in West Kordufan (41%), Gedarif (37%), and an average of 40% across all Darfur's five states. Women in the reproductive age group are in need of reproductive and sexual health services. According to the MICS 2014, the contraceptive prevalence rate in Sudan is 12%, and the unmet need for contraceptives is almost 30%, which puts Sudan among the lowest in the African region (42,67–69).
Children under the age of five are particularly exposed to compounded threats of malnutrition and vaccine-preventable and infectious diseases. Malnutrition is one of the leading causes of death of children under five, however, the percentage of PHC facilities providing IMCI services according to a health facility census done by the PHC Directorate General in 10 out of 18 states, in 2020, was as low as 16% in North Kordufan state and 29% in Red Sea state, with the rest of the states ranged between 40% and 50%. While the average availability of nutrition services in the surveyed states was 42%, with Northern states being the lowest (18%) (51,67).
The services provided at the primary care level lack comprehensiveness, for instance, in Sudan there is a significant burden of disease due to NCDs, but the essential benefits package

does not include services for these diseases. And this package remains unintegrated between different providers. The referral system and gatekeeping are ineffective which limits the role of primary care as the first point of contact, which in turn affects the main characteristics of effective primary care including as well: person-centeredness, coordination, and continuity. The quality of services at primary care public facilities is a key challenge; clinical protocols, guidelines, quality standards, and indicators do not exist and there is no effective quality assurance system. These results match what Balla et al. reported in a study, in 2016, on patient satisfaction with services at the primary level in Khartoum state, concluding with low patient satisfaction concerning access, continuity, person-centeredness, health education, and comprehensiveness (42,49,53,70–72).

Community-based services are provided by Community Health Workers (CHWs):

They cover a population living in the area of 5 km with a population of less than 5000. They provide a service package that includes family, mother, and child health, disease prevention, and health promotion (refer to Annex 4). Recently 13,000 community midwives have been trained as part of the PHC expansion project driven by the PHC expansion policy. The PHC expansion project started in 2017 and is still operating. It aims to expand the primary care services concerning infrastructure of facilities, training, and capacity building of human resources, ensure the provision of essential drugs, and improve referral services capacities. One of the major initiatives that had some successes was the one midwife per village initiative, with the deployment of 1000 state-paid midwives in Kassala state, and the 100% service availability of Blue Nile state by midwives (49,73,74).

Evidence suggests that the community services package and training of CHWs is not uniform and fragmented, and there exist many parallel approaches. The development of a comprehensive community health package and the training of a single CHW for a specific number of households may be necessary to lessen this fragmentation. However, the literature was limited about community-based services in Sudan in terms of their performance, quality, and reach (74).

The Expanded Program on Immunization (EPI) in Sudan, which is considered one of the most successful immunization programs in Africa, is nearly completely reliant on foreign aid from international partners like Global Alliance for Vaccines and Immunization (GAVI), UNICEF, and the WHO, while the government only contributes a small portion of the operating costs of the program (75–80).

Seven routine vaccines are offered by the program: Bacillus Calmette Guerin vaccine (BCG), oral polio vaccine (OPV), pentavalent vaccine (DTP/HepB/HiB), rotavirus vaccine, pneumococcal vaccine (PCV), measles vaccine (MCV) and meningococcal vaccine. These vaccines are delivered through thousands of fixed and outreach sites, and hundreds of mobile teams, and the services are provided for free to the Sudanese population as well as to refugees (75,77,78).

Sudan’s routine immunization coverage varies with different vaccines. Measles vaccination rates significantly increased in 2017, with MCV1 reaching 90% for the first time and MCV2 reaching 72% at the national level. But in 2021 the MCV1 coverage dropped to 80%. Other vaccines have achieved the intended coverage of more than 90% since 2008 (BCG, Penta 3, and polio3), before dropping in coverage in 2021, with a dropout rate between the first and third doses of more than 5%. The percentage of districts with pentavalent third dose coverage

equal to or more than 80%, was almost 80% in 2021, which is less than the target for GAVI's indicator for equity in geographical distribution (89%) (78,80–83). Table 4.1 shows a comparison of some routine vaccination coverage rates in Sudan between the years 2017, 2020, and the year 2021.

Table 4. 1: Comparison of certain routine immunization coverage in the years 2017, 2020, and 2021.

Year	Coverage by antigen in percentage		
	MCV1	DPT	HebB3
2017	90	95	95
2020	86	90	90
2021	81	84	84

Sources: WHO and UNICEF estimates of immunization coverage: 2021 revision (from reports submitted by Member States regarding national immunization coverage and from survey reports) (81).

World Bank Data: Immunization (% children ages 12-23 months) (82).

Note: given the current security situation, these figures may even be lower. It is likely that these figures have dropped considerably and may not give an accurate picture of the recent situation.

The program's service delivery faced many operational challenges, particularly in maintaining outreach and mobile site strategies, mainly due to a lack of training and transportation, insufficient financing and resources, and high staff turnover. This could constitute a big problem for rural areas coverage, as more than 70% of immunization coverage in these areas was achieved by mobile and outreach strategies Regarding the fixed sites, and according to the latest PHC facilities survey, in 2021, only 54% of the PHC facilities in Sudan provide immunization services which is considered one of the essential PHC services in Sudan (51,75,79,84).

Other challenges appear in urban-rural disparities, for instance, a study in Nyala locality, in South Darfur state, in 2014, showed that children from urban areas were more likely to complete their vaccination dosages than children from rural areas. The weak health service in such remote locations could be the reason (75,79).

Insecurities, conflicts, and natural disasters like floods also add to the challenges of vaccines service delivery, for example, 'Jebel Marra' in the Darfur region, a conflict-affected region in Sudan, has not been accessible to health services including EPI for a long period. A state such as South Darfur has failed in recent years to reach its immunization coverage target (79).

Other studies in Khartoum and River Nile states have reported that the children of educated mothers had more likelihood of being vaccinated correctly than children of uneducated mothers. This fact also shows the importance of tackling the social determinant of health as an essential component of PHC (85,86).

Periodic schedulable and outreach

This section will focus on periodic schedulable and outreach services through the example of bed nets as part of vector control in Sudan.

In Sudan, malaria remains one of the main causes of death. The whole Sudanese population is at risk of malaria, especially children under 5, pregnant women, and marginalized communities. In 2021, the incidence of malaria per 1000 population at risk was 72.8 with 30% of the cases among children under five. Malaria mortality has increased from 1.8 in 2016 to 7.5 deaths per 100,000 population in 2018. The mortality rates continue to rise, and according to the Global Fund, the ongoing trends may mean Sudan will not be able to decrease malaria morbidity and mortality by 30% by 2025 (87–90).

Recently, Sudan has expanded outreach services by distributing long-lasting insecticidal treated bed nets (LLINs) to 12 malaria-risk states. The nationwide mass distribution campaigns are carried out now every three years instead of annually. In policy, every pregnant woman should get free LLINs through ANC and infants through the EPI. However, The proportion of pregnant women who received LLINs is 55.6%, and the proportion of the other high-risk group (children under 5) receiving these bed nets is only 44% (87,91).

These campaigns are faced with many challenges, for instance, there is a poor utilization of the LLNIs: a study in 2021, on the impact of malaria control interventions on malaria infection, in areas with irrigated schemes like “Gezira” and “Sennar” states, showed a low utilization of LLINs as low as 18.6%. This poor utilization was due to poor communication and community engagement activities. Evidence from a nutrition project in Burkina Faso, Ghana, Senegal, and Togo, established a network of community volunteers and community health committees to reach and facilitate the distribution of LLINs to pregnant women through community-based health promotion and care, and the result was an increased proportion of pregnant women and children under 5 sleeping under LLINs bed nets. The difference between these projects and outreach in Sudan was the use of interactive approaches at the community level facilitated by their FMOH (87,91–93).

Policy and population-wide interventions

This section will analyze regulatory and legislative interventions such as tobacco tax and taxes on Sugar-Sweetened Beverages (SBB) that aim at behavioral adjustment and as preventive interventions (65).

Sudan levies Value Added Tax (VAT) of 17% on retail prices exclusive of VAT and an ad valorem tax of 230% on cigarettes produced locally. Cigarettes that are imported are subject to a 17% VAT, a 40% extra tax, and an import charge of 40% of the producer price value (94).

A particular excise duty of 75 Sudanese pounds is imposed on the importation of raw tobacco used by domestic cigarette manufacturers. This tax revenue will be used to fund state, health, and educational programs. The excise tax share on price of the cigarettes is 60% which is below the recommended 70% (94).

According to the WHO, Sudan does not employ taxes on SSB, however, in 2021, Sudan has committed to the International Monetary Fund (IMF) to remove VAT exemption of SSB, and to increase VAT rates on tobacco as part of the Structural Adjustment Program and as a corrective health tax. The evidence available on SSBs taxes should be sufficient for policymakers, as the increase in the price of SBBs is associated with a decrease in their consumption and an increase in consumption of healthier alternatives. Moreover, a high price of SBBs could result in a modest reduction in population weight (95–97).

Female Genital Mutilation (FGM) is highly prevalent in Sudan, with almost 70% of Sudanese females having undergone FGM. To combat this high prevalence the FMOH has started a multi-sectoral strategy that was crowned by the criminalization of FGM in 2020. However, FGM remains deeply rooted in cultural practices, and most of the circumcision is performed by midwives. The FMOH, in partnership with WHO and the Ministry of Education, has developed educational content on FGM to be taught at schools since 70% of young females in Sudan attend primary schools (98–100).

Cross-sectional policies and action and social determinants

The Alma-Ata and Astana declarations have emphasized that the role of PHC extends beyond only clinical service delivery, and as the main vehicle to reach UHC, PHC encompasses public goods, such as clean water and sanitation, healthy nutrition policies, FGM and gender equality, food security, non-discrimination across ethnic groups, that tackle Social Determinants of Health (SDOH), which are determined by policies that usually lie outside the health sector. Hence, it emphasizes the importance as well of multisectoral policies and action (101,102).

In Sudan, these policies and actions are crucial due to its frequent outbreaks of diseases like cholera, malaria, and measles, as well as the vicious cycle between poverty and diseases and their sequelae such as malnutrition, and indoor air pollution. Addressing socioeconomic class, gender, race, and their intersections are one of the main policy objectives of Sudan's National Health Policy (SNHP) 2017-2030. Additionally, a developing country like Sudan faces climate change effects, for instance, the floods of 2020 affected 900,000 people, and were the worst in decades, and the country is vulnerable to droughts and food insecurities. Finally, the security situation and conflicts have always constituted an overwhelming problem. All these threats disproportionately affect vulnerable and disadvantaged populations, aggravating the already existing inequalities (54,103–107).

Recently, Sudan has taken several steps toward the adoption and implementation of the Health in All Policies (HiAP) approach. With the mandate to promote health and health equity for all Sudanese citizens, and to ensure that other sectors' policies are supportive and favorable to health. Recognizing the importance of SDOH and that health is a multifaceted concept requiring the engagement of various sectors was the main impetus for the adoption of the HiAP approach, because previously multi-sectoral action lacked a clear implementation

strategy. A National Health Coordination Council (NHCC) which is chaired by the president of the country was created to supervise the process along with the national parliament. FMOH is responsible for direct monitoring and preparing reports that are delivered to the NHCC. (54,108). Figure 4.1 below shows the governance structure for the HiAP approach.

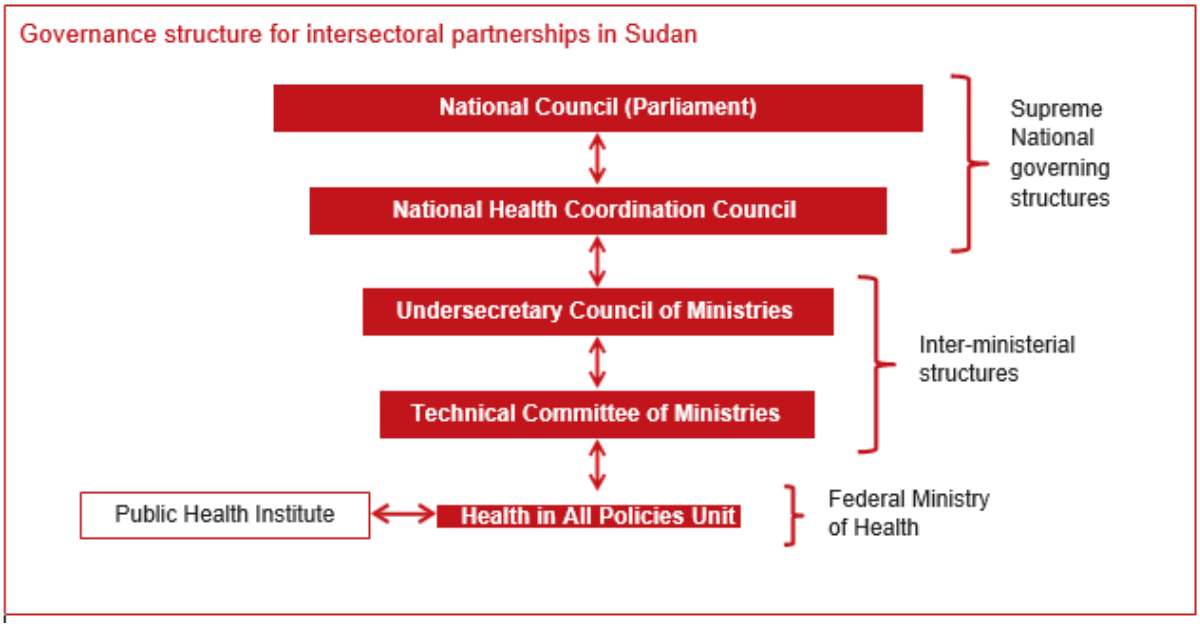


Figure 4. 1: Governance structure for inter-sectoral partnerships in Sudan

Source: Sudan's Health in All Policies Experience (108).

Using the HiAP approach, 27 priority health challenges were identified based on their prevalence (see Table 4.2). An assessment done by the Public Health Institute, in Sudan, found that there were numerous steering committees and task forces initiated, but they were not efficient in handling priority issues, and sometimes lacked a strategic perspective. This could be ascribed to the fact that the supreme governing bodies were not informed systematically about the core activities each sector undertake, there was an absence of horizontal mechanisms that enable each sector to know about policies and legislation of other sectors promptly, there were gaps in communication, coordination, data quality and monitoring for better policy planning. For example, for malaria and vector control, there was poor commitment of agricultural schemes to the recommended vector control intervention in terms of infrastructure, with a lack of human and financial resources to implement inter and intra-sectional collaborations, which are not legally binding essentially (87,108).

Table 4. 2: Priority health challenges identified by the HiAP approach.

Source: Sudan HiAP experience, case studies from around the world (108).

Priority Health Conditions

Malaria	**Tuberculosis**	**Tobacco and drug abuse**
Measles	**Diabetes**	**Human Immunodeficiency Virus (HIV)**
Waterborne diseases	**Hypertension**	**Irrational use of medicines**
Malnutrition and micronutrient deficiencies	**Heart disease**	**Road traffic accidents**
Typhoid fever	**Arthritis**	**Cancer**
Renal diseases	**Thyroid diseases**	**Epilepsy**
Respiratory diseases (asthma, pneumonia, tonsillitis)	**Epilepsy**	**Schistosomiasis**
Maternal hemorrhage	**Guinea Worm or Dracunculiasis**	**Bilharziasis**
Maternal sepsis	**Maternal hypertension**	**Onchocerciasis (river blindness; guinea worm or dracunculiasis)**

Multi-sectoral action is very context-dependent and remains challenging for almost all LMICs, and many High-Income Countries. Investments in financing, human resources, and accountability structures are necessary to support it. However, bringing together policymakers from different sectors to share their experience have not been supported sufficiently, a lot can be learned from multisectoral collaboration that does not involve the health sector. Additionally, the involvement of non-state stakeholders such as the private sector and civil society is as well crucial to establish a partnership approach to accomplish the agreed system level and PHC goals (109,110).

Empowered people and communities

The Astana vision document highlights this component and the essential role communities play in their health and well-being through three expressions of empowerment: People and communities as advocates contributing to the planning and implementation of policies,

people and communities as co-developer participating in the organization, and delivery of health services, and people and communities as self-carers and caregivers actively engaging in the co-creation of their health. As communities have a more broad perspective on health and well-being, actively engaging communities in the different elements and design of PHC can result in improved community health (71,111).

An example of community empowerment in Sudan is the basic needs development program in 'Dar Mali', River Nile state, which is part of the Community-Based Initiatives (CBI) of the WHO Eastern Mediterranean Region (EMRO). An important component of the basic needs development program is the enabling of women, and enhancing women's contribution to their health and the health of their families. Measures designed to improve health and well-being are also included through improving health services, nutrition, access to clean water, and improved sanitation (112,113).

The program in Dar Mali has been started in 1998 for a community of over 2000 population, and two components of community empowerment can be extracted: First, as co-developers of health and social services, the community developed a garbage disposal system using local tools and resources; they built a community-based health information system that collects and analyzes data to facilitate the planning and administration of health and development programs; and they built a safe drinking water system that serves the entire village. Second, as self-carers and caregivers they took part in malaria prevention initiatives through the distribution of treated bed nets. Promotion of health and educational activities took place by female clusters after receiving training in maternal and childcare (112,114).

The above-mentioned accomplishments reflected the importance of gender and ethnic diversity representation and the involvement of lower socio-economic classes. All these factors not only contribute to the short-term success of community involvement in PHC regarding issues of equity of access to PHC services, particularly for marginalized populations but also to the long-term sustainability of such initiatives (111,113,115,116).

CBI in Sudan lacked the expression of people as advocates for policies and is not widely operationalized. Sustainability and integrating them into national levels are challenges for community engagement in PHC. Overall, there remains a lack of integration and active involvement of communities and stakeholders in the setting, planning, and delivery of PHC national health policies and services, also in maintaining oversight and social accountability. The exact role and models of community participation in PHC remain vaguely defined (112,114,117).

In Ethiopia, Health Extension Workers (HEWs) program provides a positive example of community participation. It was introduced to bolster linkages between communities and the health system and improve the capacity of community groups to take ownership of health programs. Using The Community Health System Strengthening (CHSS) model to improve ANC visits, HIV testing among pregnant women, and sanitation. The CHSS model increased pregnancy identification and women receiving their first ANC visit, increased the proportion of proper latrine use, and the proportion of pregnant women referred by an HEW and tested for HIV (111,118).

Part 2: Contributing Factors: The health system building blocks and health system resilience

Human Resources for Health (HRH):

The FMOH's Directorate General of Human Resources Development is the main governing body of the HRH in Sudan. The lack of resources at lower levels has limited the capacity of human resources at the PHC level. Governance of HRH remains inadequate mainly due to a lack of sufficient data on HRH to guide these processes and there is a lack of coordination between different stakeholders. Although the management and administration of HRH are completely decentralized to the states and localities, the localities have limited autonomy, and there is generally poor management of HRH at the PHC level, where some localities do not have a locality management team (15,54,74,103,119).

The great majority of HRH work in the public sector, while 9% work exclusively in the private sector, but the dual practice is extremely common, which has contributed to health workers' absenteeism at PHC facilities and resulted in less availability of care at public sector and increased patients Out-of-Pocket Expenditure (OOPE) because they have to pay at the private sector (15,54,120).

Pre-service training and health worker production are the responsibilities of the Ministry of Higher Education. The FMOH also created the Academy of Health Sciences (AHS) to produce allied health professionals to balance the inadequate skill mix of health professionals, with women comprising 72% of these allied health professionals (15,24,103,121,122).

The size of the health workforce is inadequate, and there are high levels of vacancies. A 25% vacancy rate was reported by 6 Sudanese states in 2011, and vacancies at PHC were much higher than in hospitals, and were 69% and 29%, respectively (15,123).

In 2021, Sudan had 0.2 physicians per 1000 population lower than average 1.3 in LMICs, and only 0.3 nurses for every 1000 of the population which is also lower when compared to LMICs average of 2.6 nurses per 1000 population (see Figures 4.2 and 4.3). In 2019, Sudan had 1 skilled health worker per 1000 population, lower than the recommended 4.5 per 1000 population. The nurse-to-physician ratio is 1.5 compared to South Africa's 6. There are also significant geographical variations, for example, the Northern state had 0.89 nurses per 1000 population, while South Darfur had zero despite being populated with 4 million people. 70% of the health professionals work in urban areas (serving only 30% of the population), with 38% of them working in Khartoum. Only 30% of the workforce work at the PHC level. This skewed distribution which reflects development distortions and urban-rural disparities clearly shows the intention of HRH to leave for curative care, higher levels, and cities where remunerations and opportunities for dual practice are higher, and thus maintains the structure of low-skilled HRH at PHC and peripheries (15,24,56,103).

Women make up half of the workforce, and 62% of the nurses are females. This has an important significance on HRH when gender and societal norms are considered. Additionally, they face legal restrictions, such as not working during the night hours, and challenges in practicing that could make them drop out, which could affect the size, distribution, and equity of the health workforce (15,124).

Migration and brain drain constitute a great challenge for the HRH in Sudan, with over 30% of medical graduates migrating yearly. Also, recently, nurses, midwives, and public health specialists have also been migrating outside and inside the country, and over half of the family physicians who have been trained under the family approach policy have migrated to work abroad. The main reasons behind migration are unemployment, low pay, poor working environment, lack of infrastructure and basic equipment at facilities, and security concerns (54,70,103,125–127).

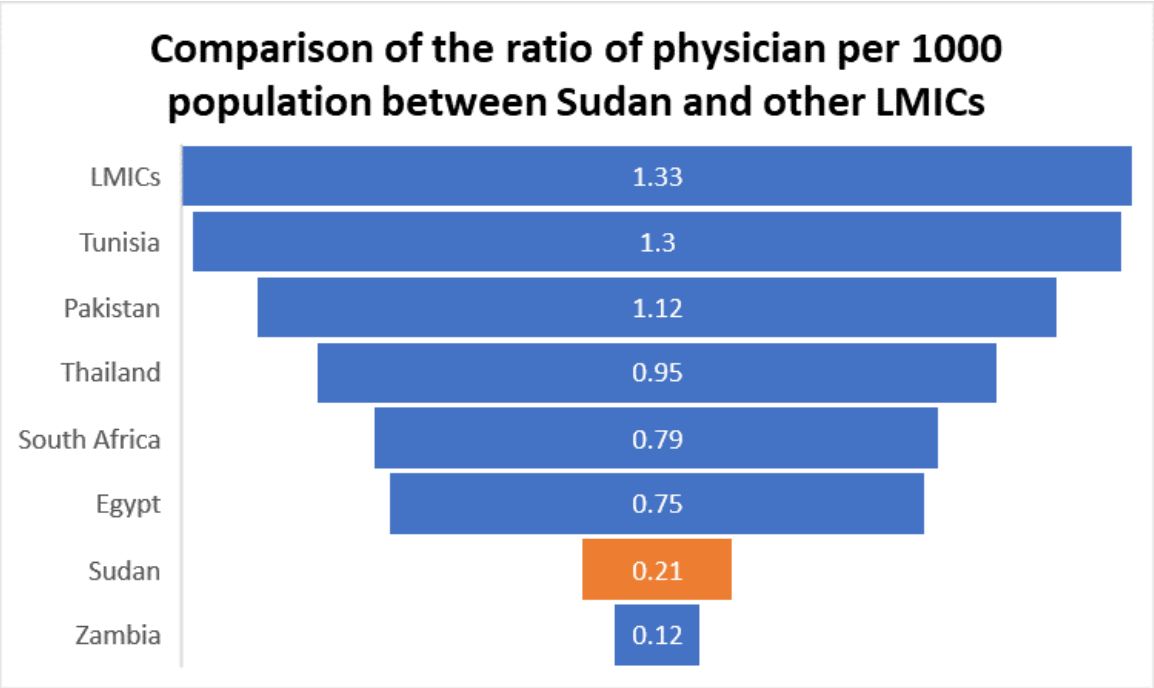


Figure 4. 2: Comparison of the ratio of physicians per 1000 population between Sudan and some LMICs with LMICs average

Source: Sudan's health workforce matters report (15).

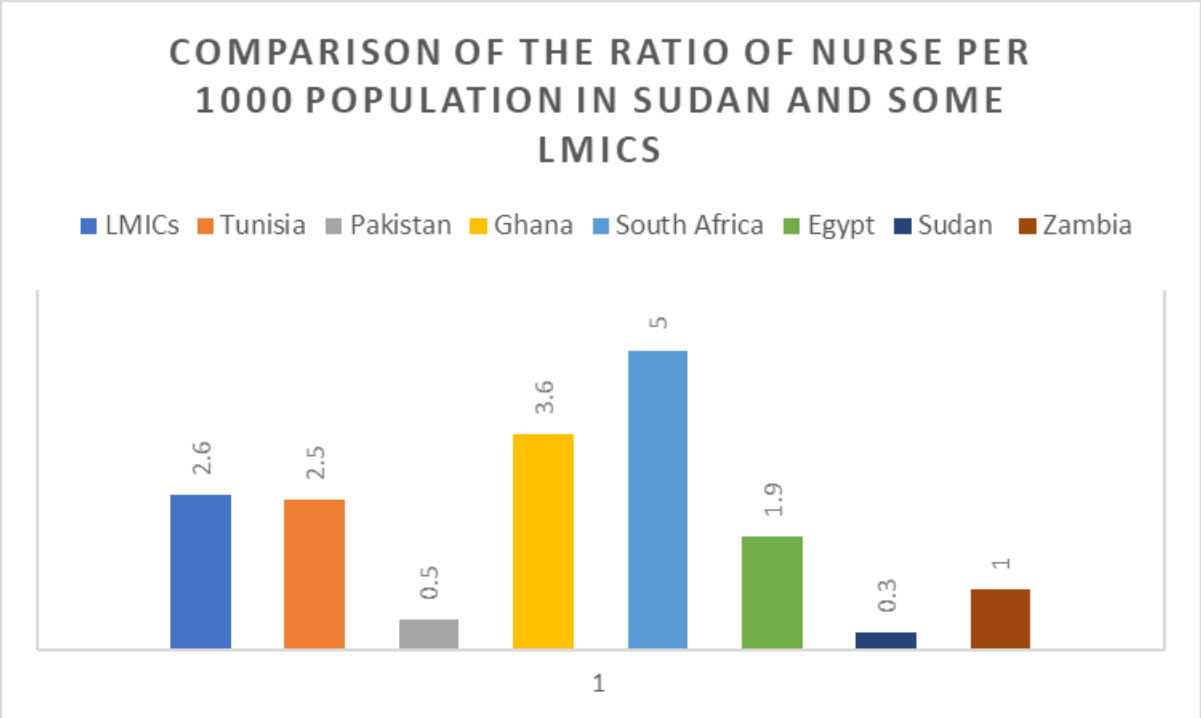


Figure 4. 3: Comparison of the ratio of nurses per 1000 population between Sudan and some LMICs with LMICs average.

Source: Sudan's health workforce matters report (15).

All the above-mentioned factors have affected HRH availability and performance at the PHC level, and in turn, had a negative impact on the population's access to care. The PHC facility census in 2020, showed that almost one-fifth of the surveyed facilities were not functioning because they either lacked HRH or were maldistributed. The absence of a medical cadre was one of the reasons patients decide to bypass PHC and self-refer to secondary care, as reported by Ahmed ME et al. (51,57,106).

Sudan has prioritized targeting a more equitable geographical distribution of health personnel. However, they focused only on financial incentives, and it is difficult to keep HRH in remote areas, for many reasons including poor living and working conditions, and safety concerns, especially at conflict-affected regions. South Africa and Thailand have been adopting a mandatory community rural service, with strict penalties in case of non-adherence, leading to better rural PHC staff retention. Sudan could try introducing such measures in the future in safe remote areas (15,55,74,128–130).

Infrastructure for service delivery

Sudan's health system has been affected by economic crises, inherent structural problems, and conflicts in some areas. This disruption of infrastructure in turn has affected healthcare service delivery either directly, or indirectly by having an impact on health system functions, and other sectors that lie outside the health sector but have consequences on health (4,24,44,55,131–133).

According to the WHO, in 2020, Sudan's PHC facilities to population ratio was 1.5 per 10,000 population, which is below the required level. The ratio of facilities providing primary

care services should be one to every 5000 of the population based on the FMOH 5 years strategy for PHC (4,134).
The health facility census in 2020, showed that 53% of the surveyed facilities had a water supply, and 51% had an electricity supply (see Figures 4.4 and 4.5). While the availability of functional and usable latrines at PHC facilities was highest in Khartoum state at 81%, and lowest in North Kordufan state at 47% (51).

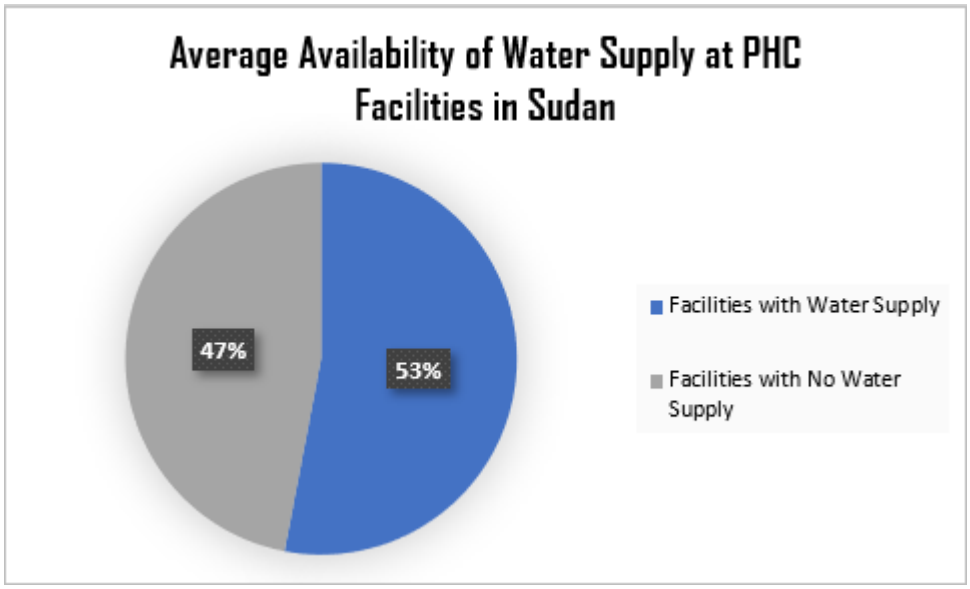


Figure 4. 4: The average availability of water supply at PHC facilities in 10 surveyed states in Sudan, in 2021.

Source: Health facility census, Health map data survey 2021 (51).

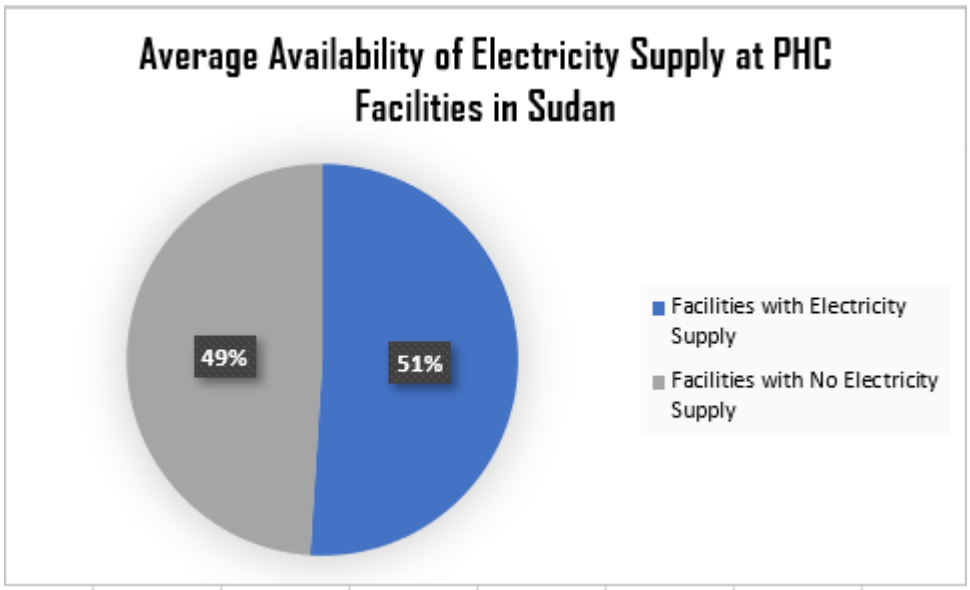


Figure 4. 5: The average availability of electricity supply at PHC facilities in Sudan, in 2021.

Source: Health facility census, Health map data survey 2021 (51).

In Gedarif state which has a total of 406 PHC facilities, 8% were not functioning, and 61% of the non-functioning facilities were due to either building or equipment problems. While

Gezira state had 24% non-functioning facilities, and more than half were due to infrastructural problems. South Darfur state had 104 non-functioning PHC facilities out of 417, and 75% of their non-functionality was attributable to equipment unavailability and issues of infrastructure. In North Kordufan, only 39% of the PHC facilities had a scale available for monitoring children's weight (51,74,135). Figure 4.6 provides the detailed proportions of functioning and non-functioning PHC facilities in Sudan, in 2021.

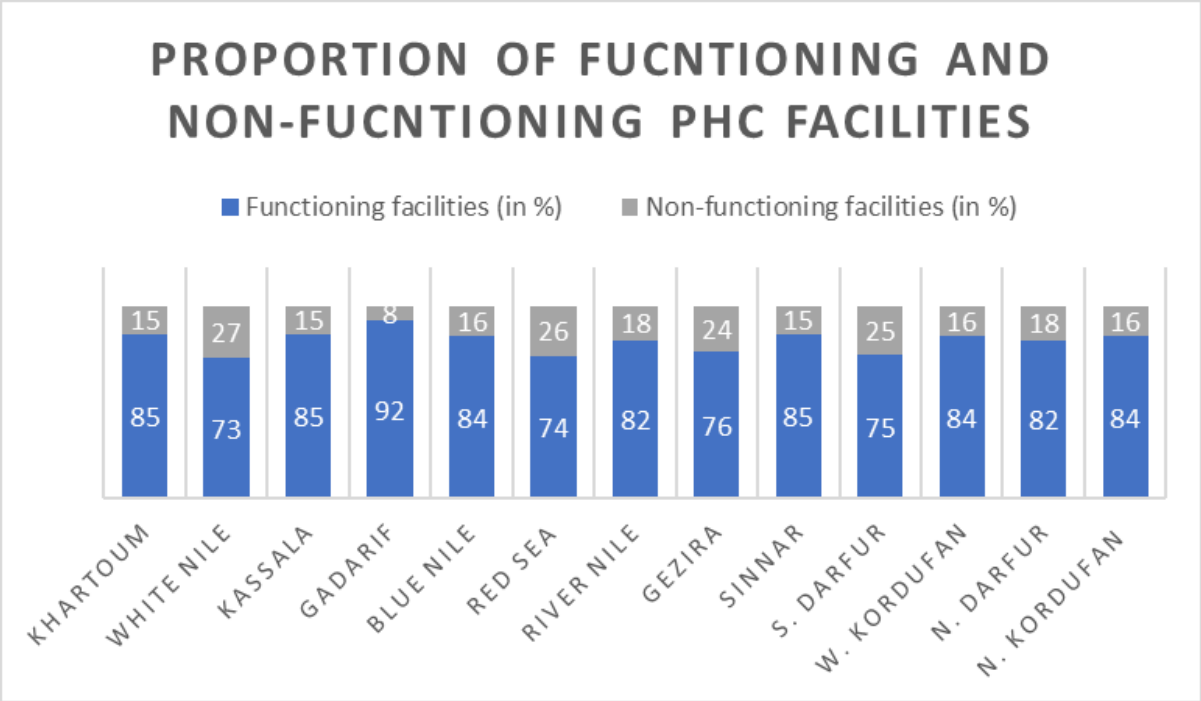


Figure 4. 6: Proportions of functioning and non-functioning facilities in 13 states in Sudan in 2021 (The criteria for non-functionality were based on three elements: infrastructure, equipment, and HRH).

Source: Health facility census, Health map data survey 2021 (51).

The FMOH has given PHC infrastructure an increased amount of attention lately. As part of the PHC expansion project. The project targeted the construction of 763 FHUs and 355 FHCs, as well as their supply with the necessary equipment and medicine (70). Table 4.3 shows the PHC expansion project achievements (at infrastructure) until 2017.

Table 4. 3: Infrastructure targets and achievements of the PHC expansion project until 2017

Activity	Target	Achievement
Build Family Health Units	763	441

Build Family Health Centers	355	174

Source: Family Practice in the Eastern Mediterranean Region: Universal Health Coverage and Quality Primary Care (70).

Supply chain

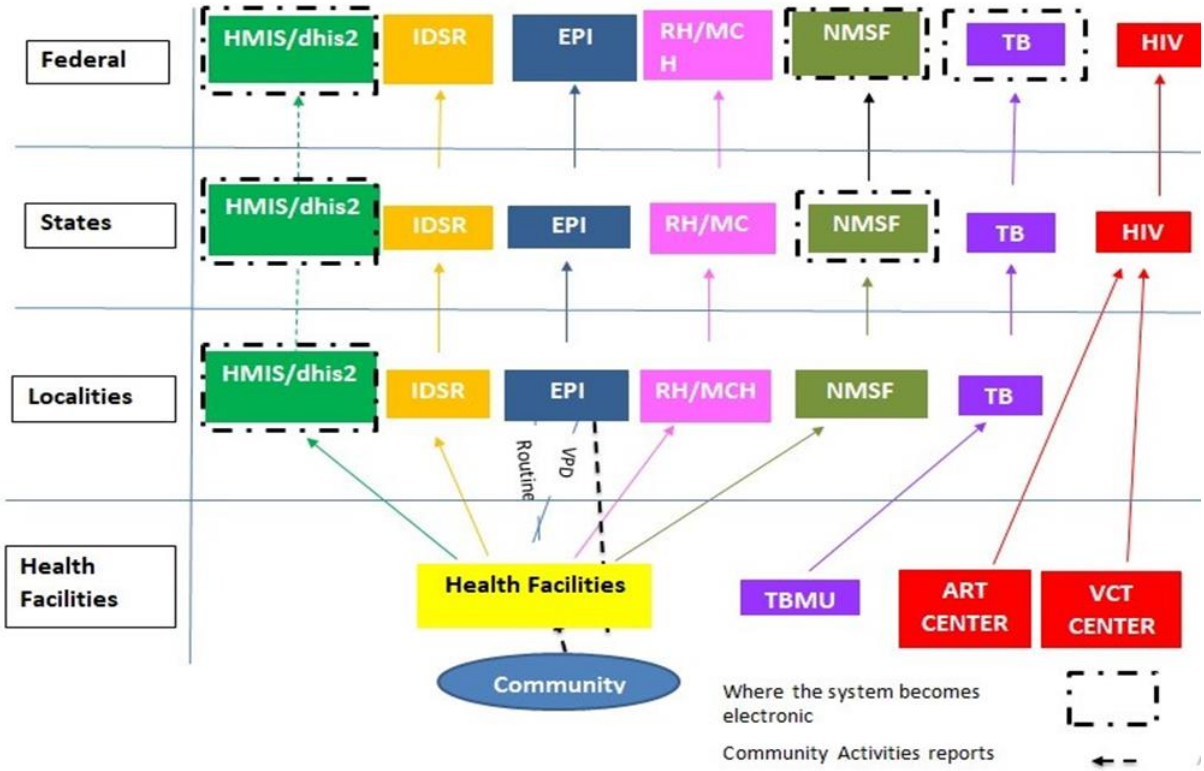
The pharmaceutical sector and supply of medical products and health technologies are governed at both federal and state levels. First, through the pharmacy general directorate at the FMOH and the National Drug Policy 2014. Second, the National Medicines and Poisons Board (NMPB), is charged with registering pharmaceuticals in the country, overseeing their quality, and taking corrective measures. Third, the actual procurement and supply management in the public sector is done through a unified supply system which is the National Medical Supply Fund (NMSF), which procures, stores, and distributes the above-mentioned items regulated by the NMPB. (54,87,132,136–138).

The NMSF has suffered from economic crises, international sanctions imposed on Sudan, and financial delays in government support for free health programs. In 2021, 37% of PHC facilities did not provide the free treatment package for under five children, with only 8% of the PHC facilities in North Kordufan state providing the package. Only 69% of MCH essential drugs were supplied to the PHC facilities. Also, stockouts of essential medicines were frequent in PHC facilities due to poor forecasting and inadequate supply chain management (51,54,70,87,139,140).

Digital systems have been used to mitigate supply chain issues in many LMICs such as India, Nigeria, and Mozambique. For instance, in South Africa developed a mobile application that enables health facilities in PHC to track and record stock levels daily. A cloud-based data management system stores the data, and it can send notifications when the stock becomes low. This intervention could be applicable in the Sudanese context to solve the poor stock monitoring at health facilities (141,142).

Health information system

The Health Information System (HIS) of Sudan uses a bottom-up approach where data gathered from facilities is assembled at the locality level, then this is submitted to the State Ministry of Health (SMOH) and further combined and delivered to the FMOH, where all completed forms from all states are brought together annually to produce an annual statistical report (See Figure 4.7). The process is usually entirely paper-based and manual (24,70,143).



ART: Antiretroviral Treatment; IDSR: Integrated Disease Surveillance and Response, RH/MCH: Reproductive Health/Mother and Child Health; TBMU: Tuberculosis Management Unit; VCT: Voluntary Counselling and Testing.

Figure 4. 7: The bottom-up approach and the data flow of the HIS in Sudan.

Source: Assessment of Sudan's HIS 2020 (7).

The HIS in Sudan is fragmented with numerous institutions apart from the FMOH including the military, the police, the NHIF, and the private sector participating in health service delivery and collecting health-related information, which are rarely captured and reported. It is reported that there exist around 13 parallel information systems fragmenting the broad HIS (7,54,56,74,144).

The HIS has a low budget and an inadequate human resources distribution between states, only 1% of the SMOHs budget is allocated to their HIS compared to the globally advocated allocation of 5%. One of the main challenges is the low reporting rates, particularly at PHC, The PHC facilities had only an 18% reporting rate to higher levels in terms of completeness. Staffing needs for HIS are usually not accounted for in human resource calculation, particularly at the locality level. (7,51,54,56,145).

Sudan's population-based survey, surveillance, and routine facility report and surveys are not linked together and are conducted in program/disease-specific areas without a broader HIS view. There are several vertical programs such as MCH still not in use in the District Health Information System, and it suffers from infrastructure issues such as internet and electricity availability, and the assurance of data quality in terms of completeness, and in-time reporting (7,54,56,74,143).

Community-based HIS was piloted in 2014 in 2 states of Sudan, they mainly registered vital statistics of births and deaths, but it has not been scaled up since then. It was linked with the

community-integrated case management through CHWs, but the issue was that the CHW's information generated was linked with the health facilities, and the problems of reporting and completeness of data in health facilities would mirror the CHW's reporting (7).
In terms of the feedback loop of the HIS, there is a lack of familiarity with data analysis, limited capacity for data dissemination, and the data produced are rarely used to support decision-making at both facility and national levels (7,24).
Sahay et al. argue that the system must be designed to be inherently hybrid to provide both offline and online data entry with the ability to sync both forms in areas where HIS for PHC is constrained by infrastructure inadequacy as in Sudan and most of the LMICs. Also, interventions for improving HIS at the district level in Sub-Saharan Africa that were found effective focused, not only on the technical aspect but on addressing the overall data quality and information sharing culture too, which is one of the challenges of the Sudanese HIS (7,146,147).

Health financing:

Sudan has a limited fiscal capacity and limited revenues generated from public sources, which limit funding the health system in a way that offers financial protection; instead, the health system finance is, to a big extent, reliant on OOPE (Table 4.4 shows the main health financing indicators in Sudan from 2017-2020). Another key concern is the political instability which affects and could be potentially limiting to priority setting for public spending on health (24,34,40).
Sudan implements a mixed system of public health finance, through the NHIF and general revenues. The health financing system is fragmented across the three functions. Furthermore, the Provider Payment Mechanisms (PPMs) are not related to their performance, and there are no clear criteria for service pricing (34,40,56,148).

Table 4. 4: The main health financing indicator of the health financing system in Sudan in the years 2017, 2018, 2019, and 2020.

Source: Global Health Expenditure Database, WHO (149).

NHA Indicator	Value in millions current US$			
	In 2017	In 2018	In 2019	In 2020
The Current Health Expenditure as a % of GDP	6	4	5	3
The Current Health Expenditure (CHE) per capita in US$	71	36	36	23
Domestic General Government Health Expenditure (GGHE-D) as % of Current Health Expenditure (CHE)	17	23	22	34

Domestic Private Health Expenditure (PVT-D) as % of Current Health Expenditure (CHE)	77	70	70	59
Out of Pocket (OOPS) as % of Current Health Expenditure (CHE)	72	67	67	53
Domestic General Government Health Expenditure (GGHE-D) as % of GDP	1	1	1	1
Domestic General Government Health Expenditure (GGHE-D) as % of General Government Expenditure (GGE)	8	6	5	10
Note: Although OOPE as a share of Current Health Expenditure (CHE) has declined between 2017 and 2020, it was accompanied by a decline in the total CHE, which might indicate that people are spending less on health!				

At the PHC level, in Sudan, people spent over 36% of the total OOPE, mainly on user fees and medicines costs, despite the constitution stating that PHC and emergency care should be provided free of charge. This finding is compatible with the lancet commission on essential medicines for UHC, which reported that 62% of pharmaceutical expenditures in LMICs were privately financed and most likely from OOPE mainly due to the poor prepayment pooling of resources (2,4,149,150).

A comparison of different countries from different income levels showed that households are prone to OOPE and catastrophic health expenditure for primary care services more than other non-primary care services. This fact can also be seen in Sudan in terms that while the FMOH and the NHIF policies adopt a broad-based pyramid prioritizing PHC, in reality, the NHIF mainly invests in secondary and tertiary care. A study by Ahmed et al. stated that 63% of the PHC facilities in the country are not covered by the NHIF, and only a negligible 0.01% of the NHIF resources go to PHC (36,51,57,64).

PHC can reduce the financial burden for households by reducing over-treatment. For instance, it was found that families' OOPE was lower when using IMCI facilities than when using non-IMCI facilities, mostly because of more sensible drug use. That is because when PHC is provided by an unorganized private sector depending on OOPE, each provider may attempt over-servicing (64,151–154).

The LGA 2003 assigned localities to take responsibility for PHC components while not ensuring that there were enough resources for this level of the health system. For instance, the share of PHC of public financing is only 6% according to Hassanain et al. which conflicts with the WHO estimation in Table 4.5 below which shows the main PHC expenditure indicators in Sudan, in 2020 (4,42,103).

Table 4. 5: The main PHC expenditure indicators in Sudan in 2020.

Indicator	Value (in million current US$)
Primary Health Care (PHC) Expenditure per Capita in US$	13
Primary Health Care (PHC) Expenditure as % of Current Health Expenditure (CHE)	57
Domestic General Government Expenditure on PHC per capita in US$	4
Domestic General Government Expenditure on PHC as % of GGHE-D	47
Domestic General Government Expenditure on PHC as % of PHC	28
External Expenditure on PHC as % of PHC	5
Domestic Private Expenditure on PHC as % of PHC	67
Source: Global Health Expenditure Database (149).	

PPMs are another method for ensuring resources are used efficiently and reach frontline providers. It also has a role in addressing OOPE by ensuring that providers do not require informal fees nor do patients get sent to pharmacies for purchasing medicines because providers are poorly resourced. In Sudan, the NHIF uses fee-for-service as a PPM, while the MOH distributes funds to their health facilities in a global budget mechanism with little or no autonomy (56,64,155,156).

The lancet commission on the financing of PHC proposed a blended payment mechanism based on capitation but it would be context-dependent. A crucial component for primary care, which is the continuity of care is embedded into the capitation mechanism, and providers should have some extent of managerial autonomy. This matches a pilot of PPMs to solve problems related to access and utilization for under-five healthcare services, which was implemented in North Kordufan, Sudan. The project used mainly capitation as the main PPM for PHC, with a combination of global budget and fee for service for secondary care, and the result was an increase of coverage of primary care services up to 95% and improved utilization of health services in all localities of the state. The capitation method, however, also has some drawbacks such as under-provision incentives, and unnecessary referrals. This

is why broader strategic purchasing of the finance system is important such as gatekeeping and strong referral system, contracting out of providers, which was found to create competition between different providers and improve the quality of services in some LMICs, as well as setting clear boundaries between primary, secondary and tertiary care (64,155,157,158).

Governance

Based on the LGA, the federal level provides financial and technical support to the states, develops strategic plans and policies, and oversees SMOHs' performance. SMOHs are tasked with planning for health and addressing specific health needs at the state level. Additionally, SMOHs are mandated with the establishment of PHC facilities, implementation of national health policies, and monitoring local governments' performance. PHC services delivery is the responsibility of the locality government, but in practice, there is minimal involvement from localities (54,56,87,159,160). Figure 4.8 below shows the relation between the different levels of governance of the health system in Sudan and the position of PHC in the structure.

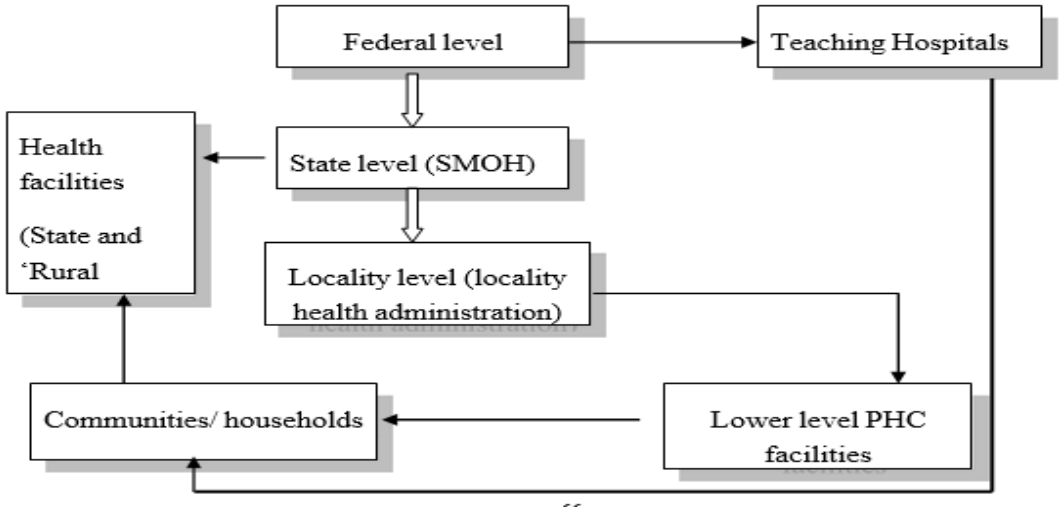


Figure 4. 8: The relationship between the different levels of governance of the health system and the position of PHC in Sudan.

Source: Sudan health system financing review report (56).

The local level, which is responsible for implementing essential health and health control activities that have a direct impact on community health, is challenged with a lack of resources and poor planning and monitoring capacities hindering the implementation of their responsibilities, and in turn, affecting the PHC service delivery (7,45,54,56,87,161).
In the area of health policy, several policies have been developed to reform the health system, not to mention PHC expansion policy, MCH policies, and family health policy, however, the implementation of these policies is constrained by the unclear processes of implementation outlined in the policy documents, and the weak implementation capacities at the health system's 'lower' levels (24,87,161).
Community health governance, which is missing in Sudan with respect to both PHC governance and community empowerment, has been a crucial policy tool for decentralizing

PHC through the participation of local community leaders, politicians, and civil society representatives in enhancing PHC. And it was translated into village committees formed by health ministries in several LMICs with positive outcomes on improving the PHC and its governance (162–165).

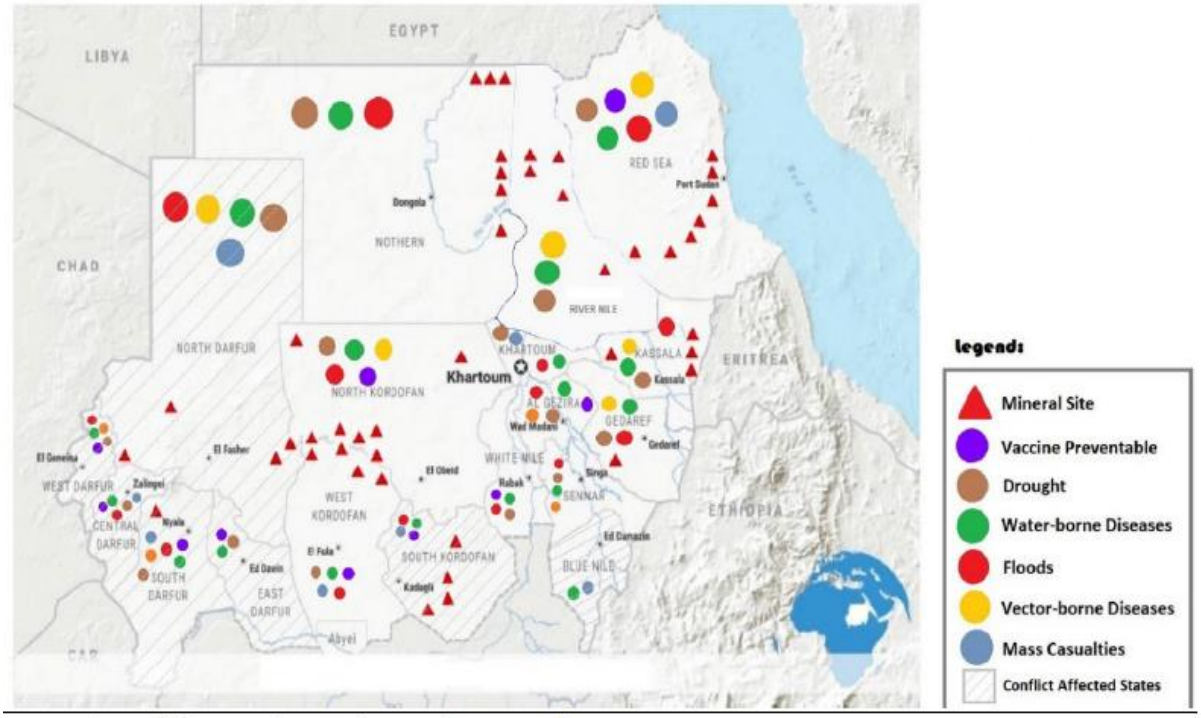
Strong managerial capacity is crucial for effective PHC, especially at lower levels. Limited evidence exists on good management in LMICs and how to build managerial capacities to strengthen PHC. A study in Ghana found better management performance associated with better service quality and drug availability and concluded with the scarce evidence on strategies for better management of PHC in LMICs. In Ethiopia, a multifaceted approach through on-site training, mentorship, and a hospital administration master resulted in improving performance standards in 86 hospitals from 27% to 51%. But additional efforts are needed to know whether such interventions would also be effective at the PHC level (157,166,167).

Preparedness and resilient health system

Sudan has faced, and continues to face, a variety of health emergencies brought about by natural hazards, armed conflicts, and epidemics, that have had a significant impact on people, health services, and infrastructure throughout most parts of the country. (See Map 4.1) (50,106,168–170).

During the Covid pandemic, Sudan struggled to cope with the outbreak, surrounded by an environment of civil unrest, and the military coup in 2021. Sudan's Case Fatality Rate (CFR) was 7.7, which is much higher than the reported 2.3 CFR. The surveillance was weak with poor risk communication, particularly to rural communities, with a lack of clear protocols to guide the assessment of the continuity of essential health services. According to an assessment conducted in Khartoum state in 104 PHC facilities, there was a disruption of essential medicines supply and a reduction in utilization of ANC services. Growth monitoring and micronutrient interventions were also disrupted. This shows that the most impact of discontinuity of care falls on the hard-to-reach population, women, and children (168,169,171,172).

In Darfur, the conflicts have multiplied the need for health services, but at the same time, it decreased the number of health facilities. From 2002 until 2010 the number of PHC’s FHCs dropped from 86 to 61, and the FHUs decreased by 64%. With the effects the conflict had on infrastructure, it was challenging to distribute, store and deliver COVID-19 vaccines in the region, while the current conflict which erupted in April 2023 has had devastating effects and left thousands of people without care, and the health system in Sudan nearly collapsed (55,173,174).



Map 4. 1: Distribution of multi-hazard in Sudan 2020

Source: Sudan Multi-Hazard and Preparedness Plan 2020 (104).

Chapter 5: Discussion

Challenges of primary health care in Sudan:

Primary care and essential public health functions:

Concerning primary care service delivery, this study has identified that the basic package of primary care is provided by 24% of PHC facilities, with the presence of regional disparities. Only half of the women had at least 4 ANC visits during their last pregnancies. The average availability of nutrition services at PHC facilities was 42%, and the average availability of IMCI services ranged between 40-50% in most of Sudan's states. This under-provision of the essential care package is one of the main challenges given that these packages include nutrition, maternal and reproductive health, and vaccination services. While malnutrition remains one of the leading causes of death for under-five children, and the high maternal mortality in Sudan. The routine immunization coverage indicators have dropped between 2017 and 2021 due to institutional and operational challenges, in addition to conflicts and the COVID-19 pandemic. The program could not meet the targets of routine immunization, particularly in the hard-to-reach areas, and this has contributed to the resurgence of diseases like measles in recent years. Given the most recent situation in Sudan, currently, all these indicators might be worse than from a few years ago.

Primary care lacks comprehensiveness and is not based on person-centeredness, and the weak referral system and gatekeeping affect its coordination across the whole continuum of care. The quality of the services remains a challenge with no quality assurance guidelines or protocols. The community-based services, despite some successes achieved with pilot projects, the evidence found suggests it is still requiring more efforts to lessen the parallel approaches and fragmentation in the training of CHWs and more efforts to increase its reach.

Multi-sectoral policies and action and SDOH:

Health is influenced by structural and intermediate social determinants that lie outside the health sector. Sudan has a high level of poverty, malnutrition, and a considerable portion of the population does not have access to clean water and sanitation. The country has made progress with designing a road map for the HiAP approach to facilitate multi-sectoral action, but coordination mechanisms, poor oversight, and planning have hindered efforts to tackle the main health priorities identified by the approach. Although the local level is an ideal level for PHC to take all the living conditions of people into account and address SDOH, not all SDOH can be tackled at the local level. Many intersectoral actions and activities of the HiAP approach are also in the domain of national health, and others even in the global domain.

Empowered people and communities:

The people and community empowerment as a component of a whole society PHC approach in Sudan is still not widely operationalized except for some isolated initiatives. Communities are not included as an important stakeholders in the planning, and policymaking nor as co-developers of health and social services. Engaging communities in the development of services can increase cultural sensitivity and patient satisfaction, hence increasing service uptake, particularly for disadvantaged populations. Examples from other LMICs identified by

the study, emphasize how the use of interactive approaches and linking communities have had a positive effect on the utilization of LLINs and consequently on the protection of pregnant women and children. One example is the HEWs program in Ethiopia, which is designed to improve community ownership of health, and their link with the health system, and had positive outcomes, increasing women's ANC visits and sanitation. The latest SNHP have stressed the need for community engagement, but models for community participation and policies to define and ensure their role in planning and oversight of health activities need to be strengthened, particularly for women and vulnerable population.

Health system building blocks as contributing factors to primary care service delivery:

In consideration of the health system building blocks, it was found that HRH, infrastructure, and health financing were the most important contributing factors to service delivery in terms of its availability, access, and quality of care. The HRH, for instance, faces challenges across all domains of the labor market framework. There exists poor governance of HRH, a lack of sufficient data on HRH, and they are paid poor salaries, especially at the PHC level. These issues have led to dual practice resulting in health workers' absenteeism at PHC facilities, and less availability of care at PHC facilities. Furthermore, the regional and urban-rural variations in the distribution of HRH, as well as disparities between different levels of care with PHC and rural areas having a lower distribution of HRH have led to inequalities in access to primary care between urban and rural areas. Additionally, there is an inadequate skill mix of the Sudanese HRH, but efforts have been made by the FMOH to balance this inadequacy by establishing the AHS. Gender disparity is another important issue, as women constitute almost half of the workforce, but they face legal restrictions and societal challenges to practicing. Learning from the successful experiences of some LMICs in introducing a mandatory rural year may improve retention in safe remote areas, along with other complementary strategies to financial incentives.

The study has found that a considerable proportion of PHC facilities in Sudan are not functioning either due to infrastructure, insufficient HRH, or equipment. Service provision at primary care has been affected by the lack of water and electricity supply at some facilities. These infrastructure problems, mainly lack of internet and electricity supply have in turn affected the HIS. The health financing in Sudan, being mindful of its fragmentation, the constitution provides that primary care should be provided free of cost, but people have to undergo a substantial OOPE. Additionally, despite PHC being prioritized in the latest health financing policy, it remains underfunded according to the available evidence. The main PHC expenditure indicators of Sudan, in 2020, could indicate low spending on PHC from domestic public sources. While increasing expenditure on PHC services, particularly from domestic public sources is advocated by many policymakers as PHC can play a crucial role in reducing households' expenditure on health. However, there is no global consensus on benchmarks for what is an appropriate level of funding for PHC, and for a full picture more information is needed on how PHC expenditure is financed, and additional information to know if these PHC services are of good quality. Besides, sometimes the classification of costs may be

ambiguous, as in the example of district hospitals, which can be taken as part of PHC depending on a country's definition of PHC.
These building blocks are not isolated, but interconnected, for example, governance is important for HRH distribution, and retention, and could play a role in their migration. All of these would also depend on an effective HIS to facilitate decision-making and identify areas of HRH shortages. Also, in the evidence found from LMICs community engagement and governance for PHC intersect and could strengthen each other reciprocally. Inadequate infrastructure can impact the availability and quality of primary care, leading to increased OOPE as people seek care from alternative providers. The supply chain is also affected by adequate infrastructure, and the presence of quality data to foresee stockouts. The interplay of these factors requires a comprehensive approach to address the challenges of PHC in Sudan.
Natural and man-made disasters have disrupted the health system in Sudan, and the provision of primary care services in Sudan in many areas. Overall, all these building blocks have been affected by enormous economic and financial crises, international sanctions, and security problems. Armed conflicts have displaced millions internally and outside the country, left people with no shelter, nor access to water and sanitation, and exacerbated food insecurities. It disrupted supply chains, restricted access to primary care services, and had an enormous effect on Sudan's health outcomes both directly and indirectly. The currently ongoing conflict in Sudan has likely compounded these consequences, albeit the extent to which cannot be determined currently.
Globally, one of the main challenges of PHC is that it has been operationalized in many ways, and there exists no consensus on what is and what is not PHC. This nonclarity about what constitutes PHC has led to challenges with measuring and monitoring expenditure on PHC. Eventually, a uniform definition will be needed to enable a better cross-country comparison and PHC spending monitoring.

Strengths and Limitations of the Study

The framework the study employed was useful to look into the challenges of primary care service delivery, which was the main focus of the study, and in terms of how the different health system building blocks influence this service delivery. It also included multi-sectoral policies and actions, which are components of PHC and relevant to the objectives of the study, however, it did not include the component of empowered people and communities, and this could be one of the limitations of this framework when studying PHC. The framework was meant for a broader health system analysis. Taking it for the study of PHC may have missed a proper emphasis on the characteristics (comprehensiveness, integration of care, first contact care, continuity of care, and person-centeredness) and components of the PHC approach: personal service delivery and public health actions; community empowerment and engagement; and third the SDOH component, related to the intersectoral nature of health.
One of the properties of the framework is that it included health system resilience as an element and conflicts and climate change as contextual factors which are important in the context of Sudan. One of the challenges while using the framework was how broad is it, and many elements of the framework were not covered either based on its relevance or the focus of the study.

The study could have been strengthened by triangulation of data by using key informant interviews. The study intended to conduct key informants' interviews, but the situation in Sudan precluded it. Another limitation is the limited literature found published about Sudan, particularly in the recent period of 5 years, due to COVID, conflicts, and continued political disputes. Hardly any reliable data were available beyond the health sector review from 2016-2017, apart from some humanitarian assessments. Health situation and service delivery have likely considerably deteriorated over the past years. Hence, the search strategy and inclusion criteria have been eventually changed to include literature that date back to 2010. Also, the study definition of PHC did not include rural hospitals, while they are included as part of the PHC in Sudan, hence, data and literature from Sudan might have affected the robustness of the results of the study. The same could be said for comparisons with other LMICs because of the non-existence of a consistent definition of PHC globally, as mentioned previously. The strength of the study lies in the reinvigorated attention and the greater emphasis given to PHC both globally and in Sudan, with the concurrence that PHC is to be prioritized for achieving UHC in Sudan.

Chapter 6: Conclusion and Recommendations

This study aimed at analyzing the challenges faced by PHC in Sudan, and to provide evidence-based policy recommendations to improve PHC, as policymakers in the country have identified PHC as an urgent priority on the way to achieving UHC and the SDGs. Through an analysis of the challenges affecting primary care service delivery (and to a minor extent the other two components of PHC) and their interplay with the health system building blocks, the study highlights key areas for improvement.

In the current political and security situation in Sudan, it is hardly possible to make any sensible conclusion or recommendation before considering the dominant influence of the security and political challenges. Almost everything else turns either insignificant or itself influenced by these political and security challenges.

The research findings point out several significant challenges concerning PHC in Sudan. One important issue is the inadequate provision of the basic package of primary care in many PHC facilities, leading to regional disparities in access to essential services which relate to the poor main health indicators in Sudan such as maternal mortality and child mortality. Additionally, primary care and essential public health functions lack the main characteristics for effective primary care. These characteristics are in an ideal situation when they are strengthened with a strong gate-keeping process and by incentives to use primary care services such as no OOPE. But the study identified that people in Sudan undergo a considerable OOPE with a weak gatekeeping system.

Community-based services and community empowerment could be one of the main strategies by which PHC reaches or dialogues with the disadvantaged population. But in Sudan they did not have a clear strategy and institutional framework, preventing communities from actively participating in their health and well-being, along with limited literature that analyzes this level of service inside the Sudanese primary care. Similarly, addressing structural and SDOH is crucial for achieving better health outcomes in Sudan. The Sudanese health authorities have attempted to address these determinants at the national level through the HiAP approach, but many barriers such as the lack of a horizontal mechanism for coordination, the gaps in communication, and the supreme governing bodies not being informed of each sector activities precluded its successful implementation. Additionally, many determinants were not addressed in the HiAP such as gender, ethnicity (which plays a dominant role in many conflicts in Sudan), and disability. However, it must be realized that part of this, for example, the local living environment, depends on the institutional setting in which people can actively be involved in shaping their environment. Eventually, these findings of PHC challenges in Sudan will not facilitate achieving the desired UHC goal.

The study found that health system building blocks such as the skewed distribution of HRH, their poor pay at the PHC level, the inadequate infrastructure, and the poor PHC financing play vital roles in determining the availability, accessibility, and quality of primary care services. These factors influence each other mutually and in turn, influence the whole continuum of primary care. Policymakers and stakeholders need to consider these interlinkages while designing and implementing interventions. Additionally, tailored strategies might be required for different regions and population groups to ensure equitable access to quality healthcare services. An important contextual factor that affects PHC

approaches in Sudan is the long history of ongoing conflicts. They represent an overwhelming problem not only to primary care, but to the whole health system, and any strategies would need to consider this factor.

Recommendations:

The government of Sudan, FMOH, and policymakers are recommended to:

In the short term:

1- **Fostering long peace and reconciliation between the warring factions in Sudan.** This serves as the most urgent priority, and without it, the rest of the recommendations will likely be not applicable.
2- **Strengthen the basic package of primary care.** Ensure that all PHC facilities provide the full package of primary care services and address regional disparities to improve access and equity in service delivery. As well as the inclusion of family planning, and NCDs in the basic package as they contribute significantly to the burden of disease.
3- **Improve human resources for health training, distribution, and retention.** Addressing the shortages and vacancies at the PHC level by addressing the pay differences between higher levels of care and PHC level, between urban and rural areas, and enhancing the capacity of CHWs in remote areas. Addressing the imbalance in the skill mix by improving states' recruitment of the AHS. Retention and distribution can be improved by prioritizing students from rural areas, investing in better wages for health workers, and investing in their housing in safe remote areas.
4- **Enhance infrastructure** by improving water and electricity supply, and scaling up the efforts of the PHC expansion project to build facilities that are closer to people's everyday environment.

In the medium term

5- **Enhance community engagement and empowerment.** Develop governance and accountability mechanisms to include communities as stakeholders in health planning and in co-organizing their health services, fostering their active participation in the decision-making process in a meaningful way. This can be done by providing improved health information and education, with special attention given to vulnerable populations and the role of CHW as an intermediary.

In the long term:

6- **The current system of financing through general revenues can be maintained and increased** to guarantee a minimum level, in terms of HRH, availability of essential drugs, and quality of care. With efforts to realign external funding from international partners that fund disease-specific programs. Although it would be challenging, the Sudanese government might demand that these funds are also directed to PHC strengthening, as these program's goals can be achieved through a strong PHC system.

For future research:

- As this research focused on the challenges of PHC, more focused research can be done with a focus on the best practices and mechanisms to enhance the connection and interface between primary care and PHC that could apply to Sudan. Also, research with a focus on the outcomes of primary care service delivery in terms of quality, efficiency, and equity.
- Thorough research that studies PHC financing and the political economy that lies behind the process of funding PHC.

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Annexes:

Annex (1): The map of the Republic of Sudan, shows the 18 states of Sudan and its bordering countries.

Source: Ontheworldmap.com, https://ontheworldmap.com/sudan/

Annex (2): The detailed specific key terms used in the search strategy for each specific objective.

Objective	Database/ Search Engines	Keywords		Keywords		
1. To analyze the challenges faced by primary health care in Sudan.	PubMed VU Library Google Google Scholar	Community involvement OR Community engagement OR Community care OR Local health committee OR health committees OR Periodic outreach OR periodic schedulable services OR LLNIs OR immunization OR vaccines OR vaccination OR routine immunization OR Cross-sectional action OR cross-sectional policy OR multi-sectoral policy OR multi-sectoral action OR Health in All Policies OR Policy wide interventions OR Population-wide interventions OR Behavioural change	AND	Primary Health Care OR Locality OR Equity OR health outcomes OR Gender OR Maternal care OR child health OR LLNIs OR Bed nets OR vector control OR malaria control OR Pregnant women OR children under 5 OR EPI OR coverage OR measles OR GAVI OR UNICEF OR WHO OR World Bank OR BCG OR DPT OR pentavalent OR Water OR Sanitation OR Vector control OR Environmental Health OR Social determinants OR Obesity OR diabetes OR Tobacco tax OR Sugar-Sweetened Beverage tax OR FGM Primary Health Care	AND	Sudan OR LICs OR LMICs OR Sub-Saharan Africa OR Africa

2. To understand how the delivery of primary care services in Sudan is affected by the building blocks of the health system.		Health finance OR financing OR Health finance system/ OR Governance OR Stewardship OR Policy making OR Policy process OR Decentralizatio n OR Management OR Drug Shortage OR Medical Supplies OR supply chain OR medicine OR equipment OR health technology OR NMSF OR NMPB OR medicine availability OR medicine affordability OR Essential medicine OR Health Information System OR Human Resources for Health OR HRH OR HRH education OR OR Health workforce OR Health Professionals OR community health worker OR Infrastructure OR Functioning		OR Universal Health Coverage OR Resource generation OR resource mobilization OR Pooling OR fund pooling OR pooled funds OR resource allocation OR strategic purchasing OR Provider Payment Mechanisms/ OR Locality OR local governments OR stock-out OR DHIS2 OR HRH policies OR HRH training OR HRH governance OR HRH information system OR Water OR Electricity OR Conflicts OR Hazards OR Climate Change OR Floods OR COVID-19 OR Epidemics OR Cholera OR Measles OR Polio OR Continuity of care OR Essential services		

		facilities OR Health System Resilience OR Preparedness OR				
3. To provide and deduct evidence-based policy options from different LMICs with similar context to Sudan for enhancing and transforming the PHC to reach UHC		Same specific key terms above				LICs OR LMICs OR Sub-Saharan Africa OR Africa
4. To provide recommendations for policymakers in Sudan for the improvement of the PHC and to achieve Sudan's commitment to reach UHC through the expansion of high-quality PHC.						

Annex (3): The three proposed measures by the Lancet guideposts for investment in primary health care.

Source: Guideposts for investment in primary health care and projected resource needs in 67 low-income and middle-income countries: a modelling study (65).

	Measure 1: focus on preventive and outpatient care as the basis for PHC	Measure 2: expanded measure considering general inpatient care and supportive health systems	Measure 3: broader PHC measure including cross-sectoral investment
Description	This measure centres on preventive and outpatient care. Preventive interventions incorporate public health interventions such as behaviour change, policy, and tax interventions when aimed at adjusting behaviour. Outpatient care is limited to non-specialist outpatient care services, using definitions commonly applied within a health accounts framework. This measure also includes a share of the required resources for information systems, good governance and financing.	This measure adds general inpatient care, orthopaedic devices, and prosthetics; full health sector cost for strengthening information systems, good governance, and financing; and the cost of health emergency preparedness (and compliance with the International Health Regulations).	This measure captures broader cross-sectoral investments important for advancing PHC, including investments in water, sanitation, and hygiene; indoor air pollution; and food safety. This measure also considers essential information-gathering functions, done only in part by the health sector, such as censuses and civil registry systems.
Rationale	This measure is aligned with a common understanding that PHC primarily reflects first contact at lower (close-to-patient) levels of the health system and should focus on preventive care and general outpatient care; it thereby centres on the essential components of PHC in promoting preventive and close-to-client services	This measure captures a broader interpretation of the Alma-Ata declaration and considers skilled care at birth, which otherwise would not be covered under PHC; the boundaries for this measure remain limited to the health sector	This measure responds to the broad SDG agenda and the need to consider cross-sectoral investments as PHC is advanced in the 21st century; the boundaries are expanded beyond the health sector to include key cross-sectoral interventions
Consistency with expenditure monitoring	The measure is consistent with the health-care based approaches put forward by Van de Maele and colleagues[3] for monitoring PHC expenditure	This measure goes beyond current proposed approaches for monitoring expenditure on PHC, which do not include inpatient care when delivered in hospitals	This measure goes beyond current proposed approaches for monitoring expenditure on PHC using health accounts, which by necessity are limited to the health sector only
Health intervention components	Population-based interventions; generalised outpatient care; medicines, diagnostic tests, and supplies; programme support costs	Population-based interventions; generalised outpatient care; generalised inpatient care; medicines, diagnostic tests, and supplies; orthopaedic devices and prosthetics; programme support costs	Population-based interventions; generalised outpatient care; generalised inpatient care; medicines, diagnostic tests, and supplies; orthopaedic devices and prosthetics; programme support costs; conditional cash transfers for demand generation; cross-sectoral interventions (eg, water, sanitation, and hygiene; road safety; violence reduction; pollution control; and food safety)
Functional service delivery systems components	Health workforce salaries and in-service training; health facility infrastructure construction, refurbishing, and maintenance; medical equipment purchase and maintenance; logistics and supply chain	Health workforce salaries and in-service training; health facility infrastructure construction, refurbishing, and maintenance; medical equipment purchase and maintenance; logistics and supply chain	Health workforce salaries and in-service training; health facility infrastructure construction, refurbishing, and maintenance; medical equipment purchase and maintenance; logistics and supply chain
Governance, financing, and monitoring components	Governance (share 80%); financing (share 80%); health information systems (some components); and laboratory capacity	Governance (full 100%); financing (full 100%); health information systems; health emergency preparedness; emergency response	Governance (full 100%); financing (full 100%); health information systems in the health sector and beyond; health emergency preparedness; emergency response

PHC=primary health care. SDG=Sustainable Development Goal.

	Measure 1	Measure 2	Measure 3
Health interventions			
Number of health interventions considered as PHC (out of 188 interventions in original SDG model)	143	152	160
Examples of interventions included under each PHC measure, by platform			
Policy and population-wide interventions	Legislative and regulatory interventions such as taxes on alcohol and tobacco, marketing restrictions, and bans; population-level behaviour change communication campaigns—eg, breastfeeding for infants and safe sex to reduce HIV transmission	Same as M1	Same as M1, plus water, sanitation, and hygiene interventions
Periodic outreach and schedulable services	Vaccination programmes; family planning; nutrition counselling and micronutrient supplementation	Same as M1	Same as M1
First-level clinical services	Disease-specific pharmaceutical treatment through outpatient care (eg, oral antibiotics for pneumonia, first-line tuberculosis treatment, standard glycaemic control treatment for diabetes); counselling and support for behaviour change (eg, smoking cessation)	Same as M1, plus normal delivery and basic neonate resuscitation	Same as M2
Care provided at first level and above	Mammography to detect breast cancer; treatment of asthma and chronic obstructive pulmonary disease	Same as M1, plus basic emergency obstetric care	Same as M2

Health system strengthening			
Health workforce	Health workforce estimates are calculated for three categories: medical doctors, nurses or midwifes, and other. We use a bottom-up approach to estimate the full-time equivalent workers required to provide the defined package of PHC interventions, by country and by year. Bottom-up estimates were also calculated for the full SDG set of interventions and a relative share was subsequently estimated for PHC. The relative share was applied to the total number of health workers estimated to be required for the WHO SDG price tag, which was based on target population-density ratios. Using this approach, the estimated health worker cost for PHC is a proportion of the population-density-based cost as estimated in the SDG price tag.	Similar to M1, we calculate the share of health workers' time spent delivering PHC interventions within the context of the overall SDG price tag; under M2, the share is greater, because it includes more interventions than M1. In order to account for generalised inpatient care, we include an additional share of health worker time.	Same as M2
Infrastructure and equipment	The model includes costs for health centres, district hospitals, and provincial hospitals. The full costs of building, refurbishing, and maintaining health centres is attributed to PHC. For district hospitals and provincial hospitals, we include a percentage share of the cost required to construct, refurbish, and equip. The share is derived from national health accounts expenditure data on non-specialised outpatient care in low-income and middle-income countries (33% for district hospitals and 3% for provincial hospitals).	Similar to M1, we include the full cost of health centres. We increase the share of costs allocated to PHC from district hospitals to 81% to account for general (non-specialised) inpatient care, and similarly increase the share to 27% for provincial hospitals. Again, the shares are based on data from national health accounts.	Same as M2
Health information system	Costs for strengthening the health-facility-based system	Costs include components related to strengthening the health-facility-based system, administrative information systems, public health institutes, and administration of surveys	Same as M2, plus the full cost for a census and civil registry system (includes costs beyond the health sector)
Medicines, diagnostics, and supplies	Costs are directly estimated based on medicines, diagnostics, and supplies required for each intervention, multiplied by the numbers reached by country and year	Same as M1, plus a greater cost because more interventions are included	Same as M2, plus considering a greater number of interventions
Supply chain	The cost of supply chain was estimated by taking a share of the supply chain cost from the 2017 WHO SDG price tag; the share is based on the relative total cost of commodities provided under each PHC package, compared with the total cost of commodities estimated in the SDG price tag; costs for cold chain are estimated separately and included fully	Same as M1, plus considering the specific commodity costs for M2; cold chain is separate and included fully	Same as M2, plus considering the specific commodity costs for M3; cold chain is separate and included fully
Health financing	80% of health-financing-related costs are included	The full health-financing costs are included	Same as M2
Governance	80% of governance-related costs are included	The full governance costs are included	Same as M2
Emergency risk management or International Health Regulations	A share of laboratory costs at the district and provincial hospital level; the share applied is the same as for the infrastructure component	Same as M1, plus all costs for preparedness except poison control centres and national laboratories	Same as M2
Emergency relief (health worker hazard pay for working in distressed settings)	Included in their entirety	Included in their entirety	Included in their entirety
Facility reconstruction in post-conflict settings	Included in their entirety	Included in their entirety	Included in their entirety

(Table 2 continues on next page)

Annex (4): Summary of the main roles of different levels of primary health care in Sudan. Source: Sudan Health Sector Joint Annual Review (JAR) 2016-2017 (74).

Level of health care	Catchment population	Main services provided	Minimum staff requirements	Minimum lab services need to be available	Minimum X-ray services that needs to be available	Types of emergency services
Community Based Services	<5000	Community services package which include family, mother and child health, disease control and health promotion	Community health worker and midwife Village midwife	None	None	First aid and referral of cases
Family Health Unit (FHU)	5000-10,000	Provide preventive, basic curative common diseases. These services include maternal and child health, treatment of diseases like malaria, TB, STI and health promotion	Medical assistant Nurse Village midwife	RDT for malaria	None	First aid and referral of cases
Family Health Centre (FHC)	10,000-20,000	▪ Provide preventive, curative and promotive services. These services include maternal and child health, prevention of diseases and health promotion ▪ Provide services related to advance technologies such as laboratories and other diagnostic services ▪ Hub for PHC and referral to the next level	A team with a minimum of 12 staff headed by family physician or general practitioner	RDT for Malaria, general routine tests, blood grouping and cross matching,	None	First aid and referral of cases, Basic Emergency Obstetric and Neonatal Care (EMONC)
Rural Hospital	100, 000 to 250,000 population, according to population density	▪ Provide emergency services, Outpatient clinic, Laboratory, X-ray, Pharmacy, Blood bank, Nutrition, Dentistry, Operating theatre, physiotherapy. ▪ Second referral level within the PHC and the link between the PHC and secondary level of health cares ▪ Hub for PHC and referral to the next level	Family medicine specialist, general practitioners, technologists, technicians (lab, X ray, pharmacy), medical assistants, nurses and administrative staff	RDT for Malaria, general routine tests, blood grouping and cross matching, screening for hepatitis, syphilis and HIV,	Plain X ray, Ultrasound	Basic and Comprehensive Emergency Obstetric and Neonatal Care (EMONC), Surgical and accidental emergencies, admission, referral of cases to the secondary level