TUBERCULOSIS DIAGNOSIS AND TREATMENT IN CHAD:

EXPLORING THE UTILISATION OF THE NATIONAL

TUBERCULOSIS PROGAMME SERVICES.

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In co-operation with:
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To all who died from TB because they didn’t know about it …

TUBERCULOSIS DIAGNOSIS AND TREATMENT IN CHAD: EXPLORING THE UTILISATION OF THE NATIONAL TUBERCULOSIS PROGAMME SERVICES.

A thesis submitted in partial fulfillment of the requirement for the degree of
Master of International Health

by

Mariam Abdelkerim
Chad

Declaration:
Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.
The thesis **Tuberculosis diagnosis and treatment in Chad: exploring the utilisation of the national tuberculosis programme services** is my own work.

Signature: 

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Acronyms

AFB:	Acid Fast Bacillus
ART:	Anti Retroviral Therapy
CHW:	Community Health Workers
CNR:	Case Notification Rate
COOPI:	Italian Cooperation Foundation
DHS:	Demographic Health Survey
DOT:	Directly Observed Treatment
DOTS:	Directly Observed Treatment Strategy
DSR:	Regional Health Delegation
GDP:	Gross Domestic Product
GFATM:	Global Fund to fight Aids, TB and Malaria
GIS:	Geographical Information System
HAL Inserm:	French National Open Repository
HIV:	Human Immunodeficiency Virus
IMC:	International Medical Corps
INSEED:	National Bureau of Statistics
IOM:	International Organization for Migration
IUATLD:	International Union Against TB and Lung Diseases
KNCV:	Tuberculosis Foundation to Eliminate TB
LMIC's:	Low and Middle Income Countries
MDR-TB:	Multi-Drugs Resistant - TB
MOH:	Ministry Of Health
MSF:	Doctors Without Borders
MTB/RIF:	Mycobacterium Tuberculosis/Rifampicin
NTP:	National Tuberculosis Programme
TB:	Tuberculosis
UNOCHA:	United Nations Office for the Coordination Humanitarian Affairs
WHO:	The World Health Organization
ZR:	Responsibility Area (Health post)

Glossary

Access: Access to health care is driven by the availability of the health care, accessibility (geographically), its affordability (cost) and acceptability (cultural).

Bacteriologically confirmed TB case: refers to positive by smear microscopy, culture or by WHO - approved rapid diagnostics - such as Xpert Mycobacterium Tuberculosis/Rifampicin (MTB/RIF). At the time of this study the Xpert MTB/RIF was available at the central Laboratory in N'Djamena, in Moundou and Am-Timan hospitals.

Lost to follow-up: is a non-judgemental wording for "defaulter" which refers to a patient who was diagnosed but did not to start his/her treatment or who discontinued his/her treatment for 2 consecutive months or more.

Maps: Three maps were produced using Geographic Information System (GIS) software and disaggregated data of 2015 cohort obtained from the National Tuberculosis Program (NTP). The administrative shape file was downloaded from the United Nations Office of the Coordination of Humanitarian Affaires (UNOCHA) website. Twenty-Two Regional Health Delegations (DSRs), instead of 23 are reflected as per the NTP report. This resulted by merging the borders between Borkou and Tibesti. In the absence of the Global Positioning System (GPS) coordinates, the TB treatment units were digitised using Google maps. A technique learned from the course on "mapping health inequalities using GIS.

Presumptive TB: means patient with suggestive signs of TB; the friendly way of saying "TB suspect"

Tuberculosis: Tuberculosis (TB) will be referring to all forms of human TB caused by mycobacterium tuberculosis.

Utilisation: Utilisation of NTP services will refer to access, diagnosis, treatment (including ART for TB/HIV co-infection), follow-up and treatment outcomes.

Abstract

Background: Tuberculosis (TB) is a public health concern in Chad. In 2015, the notification rate was 46% lower than the World Health Organization (WHO) estimation of 152/100,000. This study aims at understanding factors that may underlie the TB service utilisation in Chad in order to formulate recommendation(s) for the National TB Program (NTP).

Methods: The study included a literature review of factors that may hinder or enable TB patients to utilize NTP services and a spatial analysis of the 2015 NTP TB cohort. The Andersen Model was adapted to structure the search, data analysis and interpretation of results of the literature review.

Findings: TB was more reported in the south, it was higher among adults aged 25-34 years, found in 2 males for every female, while 22% of this cohort suffered from TB and HIV co-infection and 17% were lost to follow-up. The smear positive rate amongst tested was high (16-31%) in the south.

Literature review revealed that where the services where available, the degree of knowledge about the disease was found to predominantly determine its use. Other factors associated to the services utilization were the rural/urban disparity, age, sex, income level, service providers' availability and knowledge, distance, beliefs and illness level.

Conclusion and recommendation: Overall underutilisation of services and non-adherence to treatment was found. Apart from male's burden that requires to be addressed, the decentralization of TB services to the peripheral level, the community involvement and a patient centred approach would result in a higher notification particularly in the north.

Key words: Tuberculosis, utilisation, barriers, enablers and Chad

Word count: 11,008

INTRODUCTION

Tuberculosis (TB) remains one of the leading health problems in developing countries. The World Health Organization (WHO) reports that 49 million deaths were averted globally by TB treatment between 2000 and 2015. Yet, the disease claims 5,000 lives each day globally. When diagnosed timely and treated adequately, it is expected that 99% of patients get cured (1). Pulmonary TB is prevalent among the socio-economic disadvantaged groups (2,3). This burden largely impacts the Low and Middle Income Countries (LMIC's), where 95% of deaths from the disease occur (4).

In 2015, the WHO estimated that in Chad, 5,700 people died from the disease. These are amongst the 740,000 who died of TB in the Sub-Saharan African region. The incidence rate in Chad that year was lower when compared with the average in Sub-Saharan Africa (see Table 1). Approximately 21,000 (14,000 – 30,000) individuals were estimated to have developed the disease in Chad according to the WHO 2015 report (4). For the same Period, the National Tuberculosis Programme (NTP) reported 12,026 (all types of TB) inclusive of 11,471 New and relapse TB. The treatment coverage was 54% (5). Recently, the WHO has added Chad to the list of countries for 2016-2020 with a high burden of TB and Human Immunodeficiency Virus (HIV) co-infection (4). This addition was based on the threshold of greater or equal to 1,000 estimated incident TB/HIV cases per year. In 2015, TB/HIV co-infection in Chad was notified amongst 1,752 (22% of tested) individuals. Sixty seven per cent (67%) were on anti-retroviral therapy (ART) as 43 on Cotrimoxazole (5).

Locations / Indicators	World	Sub-Saharan Africa	Chad
Incidence including HIV positive	142 (119–166)	275 (239–314)	152 (98–217)
Mortality	24 (22–27)	75(63–88)	40 (30–52

Table 1. Comparison of TB Incidence and Mortality Estimated Rates in year 2015 (4)

Chad has an NTP since 1990. The program is mainly supported by international funding and technical assistance; including personnel and diagnostic equipment. It is stipulated in the NTP's strategy 2014-2018, that it aims at collaborating with other health sectors and the communities, to fight the TB epidemic.

The main objective of the NTP is to reduce the mortality and morbidity due to the disease, through promotion of TB prevention, active TB cases detection and treatment (6). This objective is in line with the "END TB" strategy of the WHO (7). Since year 2007, TB diagnosis and treatment have been added to the list of free of charge care within government facilities (8).

In their analysis, on the constraints to scale up health related interventions in Chad, Wyss et al. states the unequal distribution of health structures and health force; this analysis also revealed the low utilisation of preventive and curative services pertaining to both demand and supply side issues (9).

This study aims to explore the variables that may enhance or hinder the utilisation of TB services in Chad. The outcome will be shared with the NTP along with recommendations.

Before enrolling into the master programme at the Royal Tropical Institute, the author has worked since 2000 with the Migration Health Division of the International Organization for Migration (IOM). Its resettlement programme pays detailed attention to TB diagnosis and ensures TB treatment among refugees. TB detection and control, remains an important public health concern to countries that are sending and receiving refugees. She was involved in TB diagnosis and treatment of stakeholders within urban, refugee camps, post-earthquake and political instability.

Though the author did not work in Chad, her country of origin, the fragile health care system and its inability to sustain the major health programmes have always been a concern. The author desires to return to Chad and contribute with colleagues on the ground. She intends to use the acquired knowledge from this master programmes and practice it in prevention of communicable and non-communicable diseases.

1 BACKGROUND

1.1 Geography

Chad is a landlocked country in the middle of the African continent. Its 1,284,000-km^2 surface makes it the 5th largest country of the continent. From the north and clockwise Libya, Sudan, Central African Republic, Cameroon, Nigeria and Niger share their borders with Chad.

1.2 Transport and Mobility

Because of the country's size and its basic road infrastructure, it is not easy to travel within the country. In remote areas where, facilities are not within reachable distance, access to health services is difficult (6). The weak road infrastructure has an impact on access to and utilisation of health services (see maps).

1.3 Population

Chad has a diversified but relatively small population (see Figure 1[1]). In the last demographic health survey, the sampled population revealed the existence of 12 linguistic groups and 216 dialects. French and Arabic are the official languages. This linguistic diversity can be expected to be a challenge in communication between patients and non-native health care providers. Chad is home to 52.1% Muslim, 43.0% Christian and 4.9% who practice other forms of faith or none (10).

In a survey, conducted by the National Bureau of Statistics (INSEED) in the capital N'Djamena in 2010, the population density was 1,870/km^2. Five years later, it had reached 2,356/km^2, which is equal of a 26% increase (10). The northern regions have less than 1/km^2 whereas the central part counts between 5 individuals to less than 30/km^2. The southern part excluding N'Djamena shows a range of regional population densities that varied from 41 to 96/ km^2.

Population* : 14,037,042
Life expectancy at birth*: 53 years
GDP*: 10.889 Billion (USD)
Adult literacy rate*: 40.01%
56% of the population = Access to clean water**
9,935 individuals / Health centre**
148,558 individuals / Hospital**

Figure 1. General Indicators for Chad 2015 (11,64).

[1] *Data pulled from *World Bank, **Demographic Health Survey*

[2] *The regimen is 2(RHEZ)/4(RH)*

1.4 Education

The literacy rate in Chad is one of the lowest in the world. The last census revealed that 62.4% of the sampled population did not receive any form of schooling (11).

1.5 Socio-Economic Situation

It is estimated that 80% of the population is living below the poverty line. Moreover, social tension, uneven distribution of the low health force and their lack of motivation in terms of remunerations, slow down the implementation of public health programmes (12).

1.6 Health System

The health system in Chad is pyramidal with 3 levels of responsibility and activities (see figure 2).

The central level includes the Ministry of Health (MOH), all national programmes, institutions, senior and technical departments. The 4 national referral hospitals also fall under this central level. This is the conception and policy level.

The intermediate and strategic level is composed of the 23 DSRs. These DSR's are planned in line with the country's 23 administrative regions. The intermediate and strategic level of the health system lies within the responsibility of the 23 medical officers in charge of a DSR each.

The peripheral level known as the implementation level is composed of Responsibility Areas (ZR). These ZR are designed along the administrative departments. One hundred and seven (107) out of 138 district hospitals and 1,334 out of 1,652 health centres (80.75%) are functioning (10).

1.6.1 Health Workforce and Challenges

The small health workforce - 1 doctor/28,466 population, 1 Nurse/12,903 population and 1 midwife/9,596 women within reproductive age - unevenly distributed over the country's territory, weakens health services utilisation in Chad. At the time of this study the MOH reported 3 pulmonologists for the country; all are working in the main cities (12).

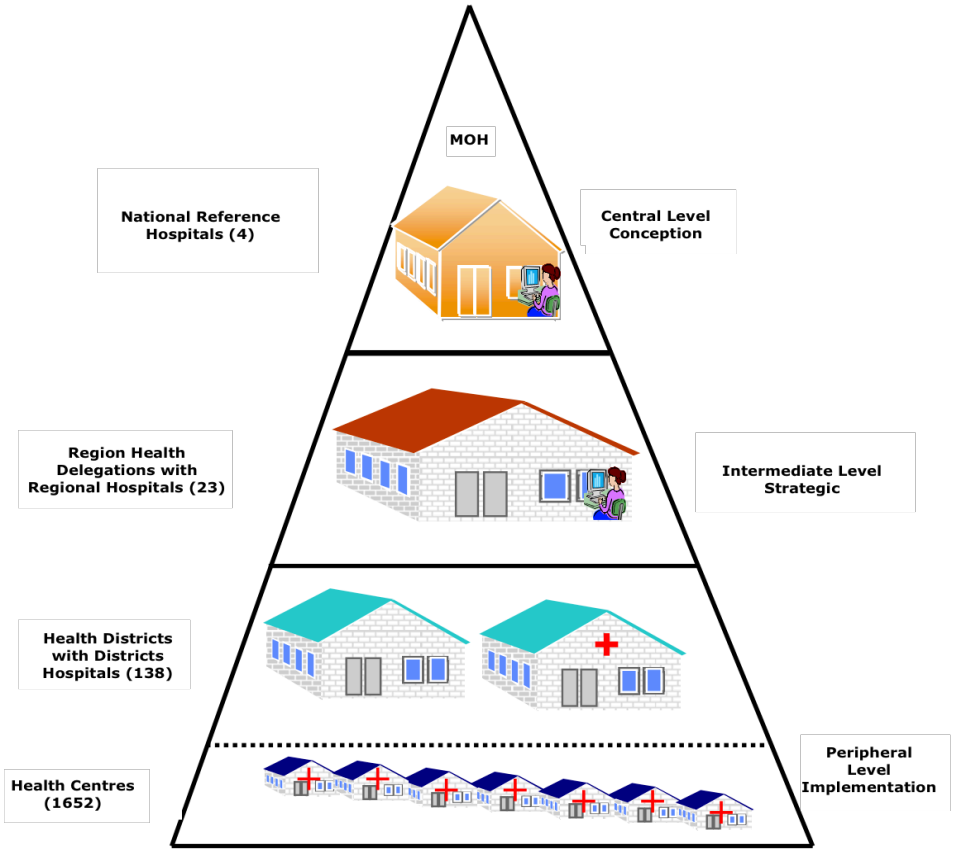


Figure 2. Chad's Health System (8,10)

1.6.2 Health Financing Mechanisms

The fight against TB is among the national priorities. However funding is lacking. The budget allocated to the health system represented 5.52% of the nationals' in 2015, far less than the 15% of Abuja declaration (13). The NTP 2016 budget equals US$ 1.7 million (14). This is received from international partners mostly (85%). The NTP coordinates with its international partners such as Doctors Without Borders (MSF-Holland), Italian Cooperation Foundation (COOPI) and International Medical Corps (IMC) for technical assistance. The Global Fund to fight against AIDS, TB and Malaria (GFATM) is one of the main donors to the NTP.

1.6.3 Health Status and Trends

In 2015, upper and lower respiratory tract infections, ranked second and third among major complaints. Any cough lasting for longer than 2 weeks is suggested to be referred for sputum smear test for TB, regardless of the patient's age (10). As seen in table 2, the MOH's 2015 statistics published that 15,470 individuals reporting 2 weeks lasting cough were subjected to TB diagnosis using sputum microscopic test. On the other hand the NTP notified 88/100,000 in 2015 while the WHO estimate for the same year was 152/100,000. The NTP diagnosis data also shows that 14,547 people with cough of which 22.1% (2,978) were found to have positive sputum smear. This means that there is an important under reporting of tests performed. It is likely that the lab report is incomplete. Yet these numbers may give an indication of the positivity rate amongst tested people.

Age group	Population	New cases	Detection rate (per 100,000 population)
0-11 months	505,793	898	178
1-4 years	2,255,564	1,570	70
5-14 years	4,148,870	2,342	56
15 years and older	6,759,857	10,660	158
Total	13,670,084	15,470	113

Table 2. Age Disaggregated Patients Reporting 2 Weeks Long Cough in 2015, Chad (10)

1.6.4 TB Services

The NTP sex disaggregated report of case notification shows a ratio of 2 male for 1 female. Such observation were also seen in studies done in Sub-Sahara Africa as well as in the WHO estimations (5,14–16). Nevertheless this may not reflect the true distribution of the burden between male and female. In 2015, the active age group of 15 to 44 year represented 61.9% of the TB notified cases (5)

Shortly after the WHO recommendation in 1993, the NTP adopted the Directly Observed Therapy Strategy (DOTS). This strategy, as described by Dr. K. Styblo in 1979 and adapted in the Toman's TB guidelines (1), revolves around 5 key principles:

a) Political commitment;
b) Case detection through quality assured microscopic diagnosis;
c) Standardised and supervised short course chemotherapy;
d) Regular and uninterrupted supply;
e) Evaluation and supervision.

The NTP aims at reducing the TB burden by 25% by the year 2025. Its specific objectives, as mentioned in the "Strategic Plan 2014 – 2018" (15), are to:

- Increase the notification of new TB cases to 85/100,000 population by 2018
- Increase the treatment success rate to 85% by 2018 (from 69% in 2013)
- Increase the HIV testing rate for new TB cases to 90% by 2018 (from 43% in 2013)
- Ensure 100% care for Multi-Drugs Resistant (MDR-TB) cases notified yearly.

The NTP improvements in reaching its targets are commendable though they fall short.

a) The new cases of pulmonary TB, with smear positive, was 39.9%, compared to 25% in 2013 and 2014 (5,17).
b) The treatment success rate (74%) was below the NTP objective of 85%; however this is a major improvement from the 22% in 2008 (5)

The rather slow progress, in reaching the NTP objectives, could be linked to the weakness of the health system. The health system is hampered by a wide range of issues; for instance the lack of human resources: medical and non medical, as well as insufficient funds is repeated in national reports (10,12).

2 PROBLEM STATEMENT AND JUSTIFICATION, OBJECTIVES, AND METHODOLOGY

2.1 Problem Statement and Justification

Generally, studies on health utilisation focus on its determinants, which goes beyond quantifying the use of health services (18–20). According to Andersen's Health Behaviour Model, these determinants are characterized by patients' predisposing and enabling factors as well as its illness needs to access primary health care (21). Similarly, health utilisation in LMIC's is influenced by determinants such as the socio-economic status, age, sex, education, environment (including believes and stigma) as well as the health services availability, accessibility and affordability (21–23).

2.1.1 General Health Services

Low utilisation of preventive and curative services contributes to poor health indicators (9). Some of these health indicators translate into the following:

- 1 child out of 10 dies before the age of 5,
- 4 out of 10 children suffer from severe malnutrition,
- life expectancy at birth is 53 years,
- 1 women out of 1,000 dies while pregnant, during or after delivery
- the success rate for TB treatment (all types) is lower than the set target of 85% (4).

Access to health facilities remains a critical problem in Chad, namely in areas with a low population density which is 2/3 of the territory.
It is also reported that around 18% of health facilities structurally exist, but are not functioning because of the lack of personnel and or equipment (12).

2.1.2 TB Services

The NTP is created in 1990. It falls under the MOH and its services are provided within the existing public health scheme.
Most people with presumptive TB would seek care at the primary level of the health system. From these health centres they are referred to the NTP services located in district hospital(s) within the patients vicinity, for diagnosis and

eventual treatment. Some people with presumptive TB may access the NTP services directly. Severely sick, as well as relapse and retreatment cases, are admitted for the intensive phase of their treatment. They ought to continue the continuation phase, as ambulatory patient either within the same district hospital, or the health facility within their vicinity. Figure 3 shows a summary of patient's flow as described by the NTP.

Diagnosis is mainly done bacteriological: microscopy using the Ziehl-Neelsen method on 3 specimens. Samples are collected consecutively 1 on the spot, 1 the following morning and a second spot when delivering the morning sample. Mycobacterium Tuberculosis (MTB) culture is not available; the central laboratory is negotiating with its partner in Cameroon for future collaboration (5). Radiology diagnosis is performed where available.

The year 2010 marked the last update of the national TB treatment technical guidelines (17). Justifying the 6 months Directly Observed Therapy (DOT) for all new cases as per the WHO recommendation for using rifampicin throughout. A combination of 4 drugs (RHEZ)[2] is prescribed during the intensive phase of 2 months duration and 2 drugs (RH) for the 4 months of the continuation phase. Retreatment, relapse and lost to follow-up with sputum smear positive TB cases, will extend this phase by 1 extra month, and the continuation phase by 2 months. The guidelines strictly recommend DOT at the providing health care facility for all regimens. However, for patients living far away from the facility, supervision arrangement could be made with the community's agent or leader.

The WHO recommends running TB and HIV services jointly. This coordination of activities will for instance optimise early TB detection amongst HIV positive cases as well as latent TB treatment. In Chad, both programmes are merging efforts, yet the Isoniazid preventive therapy is not among the NTP activities (15). However 65.9% of the 2015 cohort benefitted from the HIV diagnostic test; which resulted into 22% TB/HIV co-infection amongst the tested patients (24).

[2] *The regimen is 2(RHEZ)/4(RH)*
R = Rifampicin; H = Isoniazid; E = Ethambutol; Z = Pyrazinamide

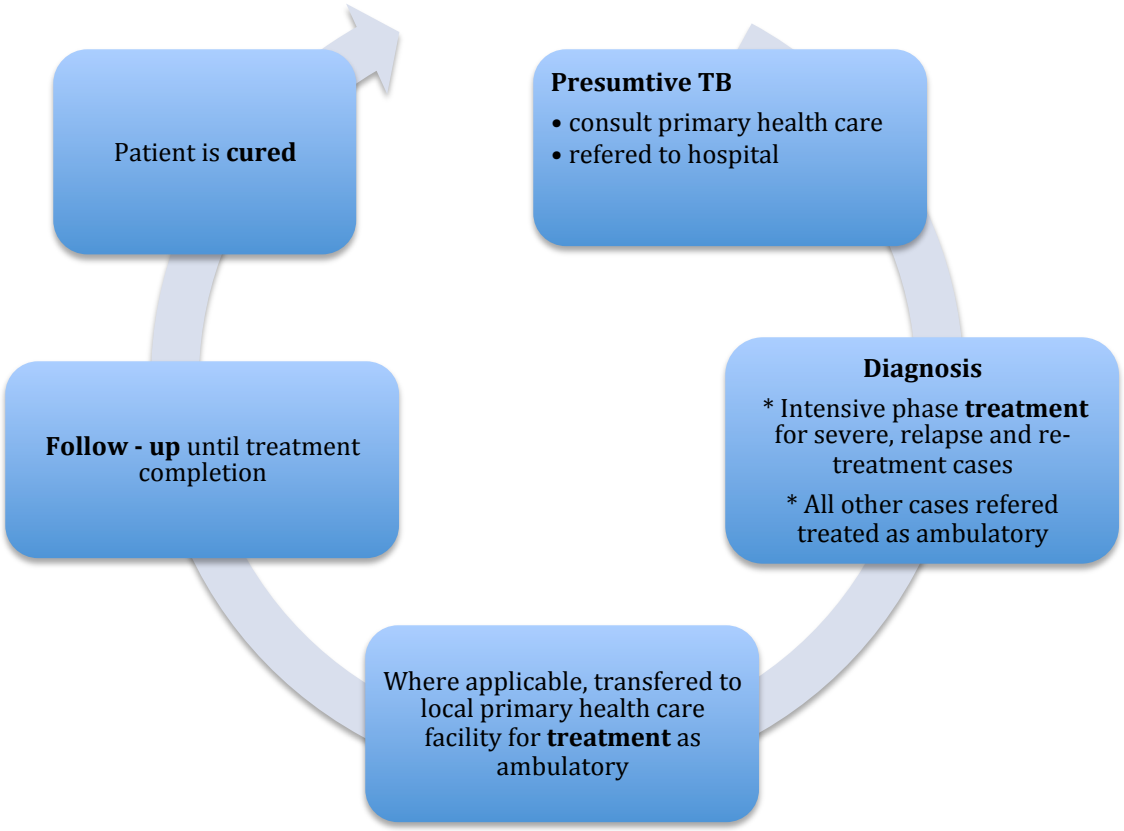


Figure 3. Patients' Path when Utilising TB Services

In this study, the author will explore the health system with a focus on TB services utilisation through the NTP. This study will identify positive and negative factors that affect the TB services utilisation, potential gaps, as well as best practices. An optimal utilisation of the NTP services would result into a higher TB detection, an enhanced treatment success and a reduction of new infectious cases.
Based on findings, specific recommendations will be shared with the NTP and partners for optimising TB care in Chad.

2.2 Objectives

Main Objective
To understand factors that may underlie the TB services utilisation in Chad in order to formulate recommendation(s) to the NTP.

Specific Objectives

1. Explore the utilisation of TB services using disaggregated data by comparing notifications against the WHO estimated burden, as well as the regional differences in treatment coverage.
2. Explore the factors that may hinder or enable patients with presumptive TB to utilize NTP services in Chad. Examples from Sub-Sahara African countries towards efficient TB services utilisation for diagnosis and treatment will be included.
3. Formulate recommendations based on the identified findings and share them with the NTP to improve utilisation of NTP services, thus improving TB services in Chad.

2.3 Methodology

This study is a desk based descriptive literature review. It has two components

a) Review of existing academic literature
b) Quantitative and spatial analysis. Data extraction and analysis from NTP 2015 cohort diagnostic and treatment spreadsheets.

By conducting this literature review and the 2015 cohort data analysis, the author aims at providing an overview of the current TB services and factors influencing utilisation in Chad. This approach will reveal what is already known and not known, as well as gaps and inconsistencies revolving around the phenomenon.

2.3.1 Quantitative and Spatial Analysis

The burden of TB in Chad is illustrated using the 2015 cohort diagnostic and treatment outcome indicators. At the time of this study, the said data was courteously shared by the NTP, upon request from the author, with up to date information on the NTP services utilisation.

Indicators such as the Case Notification Rate (CNR) as well as the positivity and the treatment success rates were calculated, using the standard formulas (25,26). The CNR, being the number of new and relapse TB cases notified in a given year, per 100,000 population. The treatment success rate, meaning the number of cases reported as cured and as having completed their treatment divided by the total number that that started treatment in a given period.

Rifampicin resistant and multidrug resistant notification is excluded from this calculation. As for the positivity rate, it is the percentage of the patients whose sputum tested positive among the total people with presumptive TB tested.
The level of TB services utilisation using these performance indicators in the 22 DSRs was shown using GIS software. 3 Maps were used for the spatial illustration of the regional sputum positivity, amongst people with presumptive TB tested for Acid-Fast Bacilli (AFB), the treatment success rates for the 2015 cohort, as well as regional disaggregation of the notification rates. These variables will be used to analyse the services utilisation in terms of detection and treatment outcome. The findings will be included in chapter 3. The TB diagnostic and treatment centres layer has been added to each map to show the services distribution through the country.

2.3.2 Conceptual Framework

The Andersen Model of Health Services Utilisation (27) has been adapted in figure 4 to structure our search, data analysis and interpretation of results. The data obtained from this literature review has been categorized and analysed through the components of the model. These components are social determinants, health service system, individual determinants and health service utilisation.
The Andersen Model was initially published in 1968, 1973, reviewed in 1995 and 2005 (21,27,28). Other studies investigating health services utilisation, health systems and health conditions (21,23,29,30) have also used Andersen's Model. Its four components, as shown in figure 4 comprise factors that enable or hinder the health care utilisation among individuals. The factors are also emphasized in the individual determinants, which are predisposing, enabling and illness level.
In this study predisposing will refer to demographic and social factors. For instance: health literacy and beliefs. Enabling will pertain to factors that ease the use of the TB services by the patients with presumptive TB. For example: availability, accessibility and free of charge services. Perceived and evaluated symptoms are associated with illness level that motivates individuals to use the TB services.
The author echoes Andersen's' emphasis about his Model showing that health service utilisation is intertwined with the services availability, access to these services and the associated cost (27). Patients, who live within the proximity of the hospital, will more likely utilize the TB services. They may however fail to cover cost associated with their treatment follow-up tests (31). Despite the free

TB diagnosis and treatment, indirect expenses due to TB faced by TB-affected families can be overwhelming and could affect adherence to treatment.
TB does not fear borders and therefore, moves along with infected people. In 2015 Chad hosted the 10th largest refugee population: 369,500 refugees crossed the border from Sudan and the Central African Republic (32). TB among refugees is not the aim of this thesis. Since human beings often socialize, it is nevertheless worth adding migration, under the predisposing factors of the individual determinants in the Andersen model (see figure 4).

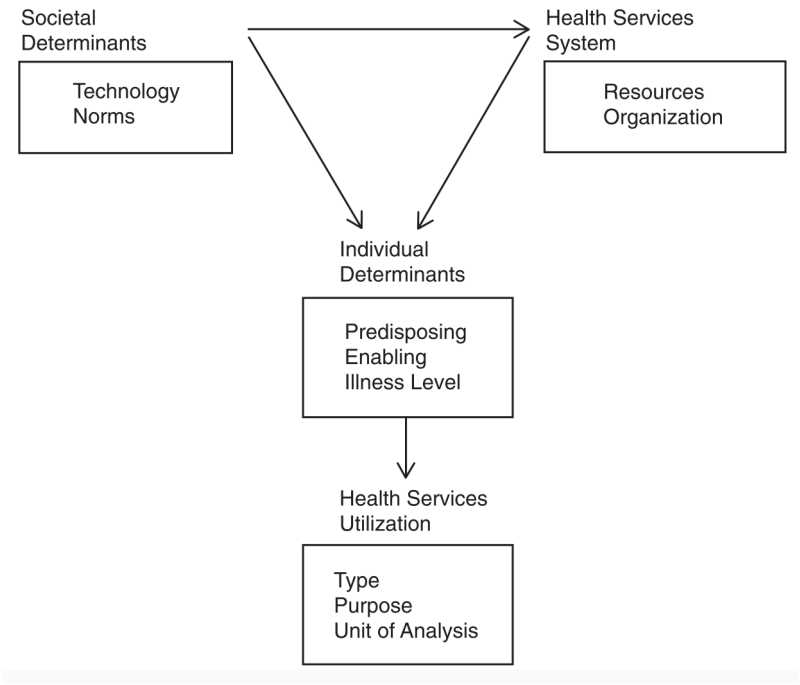


Figure 4. Andersen's Behavioural Framework for Health Services Utilization (27)

2.3.3 Search Strategy and Table

Using the keywords in table 3, PubMed, PLOS ONE, and Cochrane were searched to extract literature published between the year 2000 and 2017 in French and English.
Websites of the WHO, the International Union Against Tuberculosis and Lung Disease (IUATLD), the Tuberculosis Foundation to Eliminate TB (KNCV) were accessed for technical literature on TB management. National reports were extracted from the INSEED's website. In the absence of an electronic platform,

the NTP reports and its technical documents were obtained via electronic mailing correspondences.
Snowballing from the references of articles yielded extra articles on the topic.

TUBERCULOSIS OR TB	AND	SERVICE UTILIZATION / UTILISATION OR ACCESS OR HEALTH SEEKING BEHAVIOUR OR PATHWAY	AND	BARRIERS OR ENABLER OR ENABLING OR AVAILABILITY OR DISTANCE OR GEOGRAPHICAL BARRIERS OR BEHAVIOUR OR BELIEFS OR GENDER OR AGE OR SOCIO-ECONOMIC OR STIGMA	AND	CHAD OR TCHAD OR SUB-SAHARAN AFRICA OR SUB-SAHARA AFRICA

Table 3. Keywords used for Literature Search

2.3.4 Selection Criteria of Articles and Studies

Articles were screened by title and abstract. Only academic papers were gathered. Mostly in English but a good number were in French, published between 2000 and May 2017. No formal quality assessment of the literature was done. However relevance for TB services utilisation in Chad and Sub-Sahara Africa remained essential.

2.3.5 Limitations of the Literature Review

There is a general paucity of research, thus little is published from and on Chad. Data from peer-reviewed studies on TB services utilisation conducted in Sub-Sahara African countries has been selected and analysed. A justification is provided whenever such data is being used to support the Chadian findings. This

may affect the accuracy of the conclusion and consequently the recommendations.

2.3.6 Ethical Considerations

This research project involves literature review, as well as secondary data analysis of aggregated notification and treatment outcome obtained from the NTP. Thus an ethical clearance was not required. The thesis will be stored in the Royal Tropical Institute repository.

3 FINDINGS

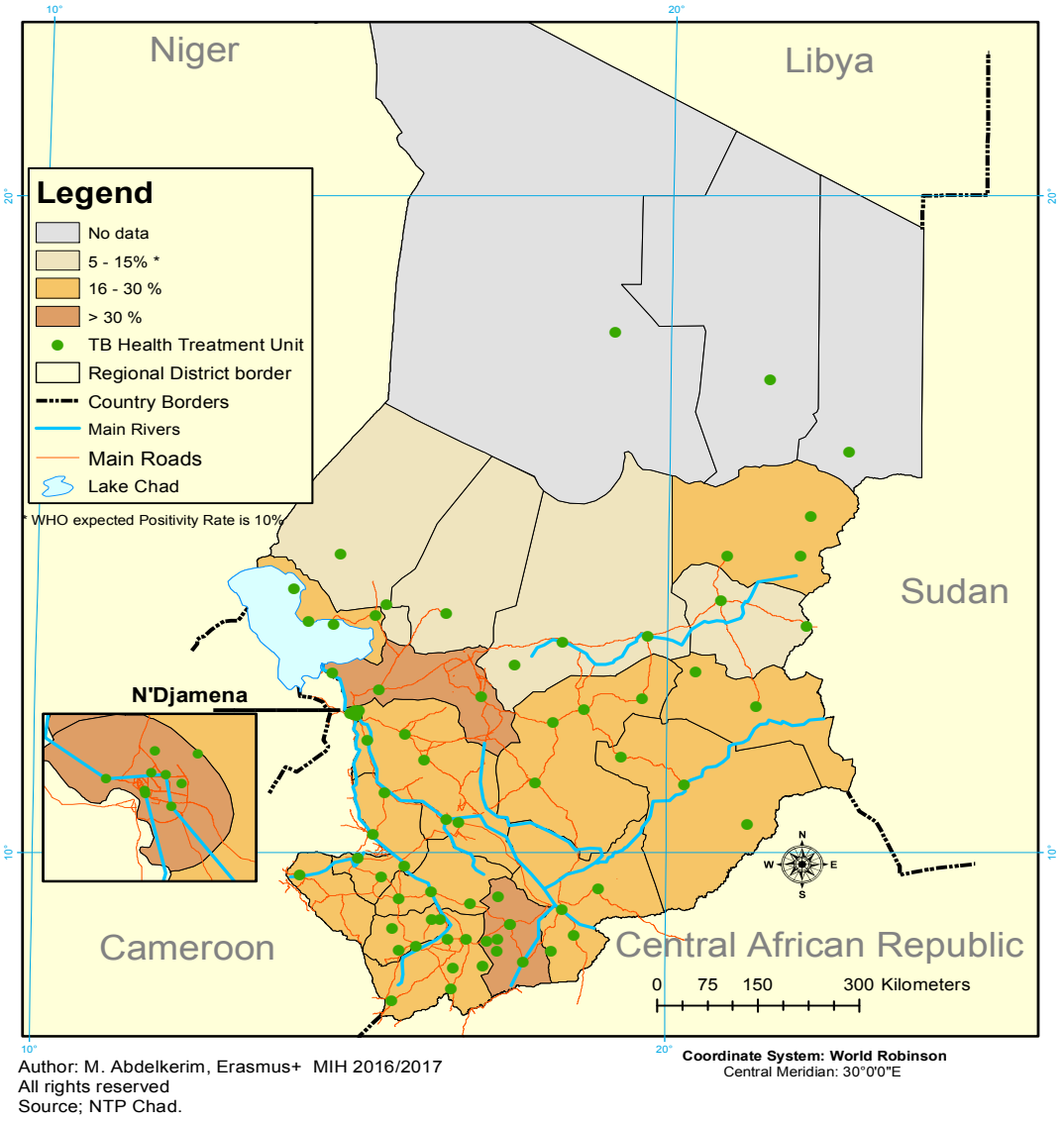
3.1 Spatial Distribution of Indicators

Spatial illustration of the regional smear positivity, amongst people with presumptive TB tested for AFB as well as the treatment success rates for the 2015 cohort are shown in map 1 and 2 respectively. Map 3 shows a regional disaggregation of the CNR. All maps have been embedded with the regional TB services distribution.
The performance indicators laid on map 1, 2 and 3 were used to described TB service utilisation in this sub-chapter. These are mainly the CNR, positivity and treatment success rates, as well as the regional age and sex disaggregation for the 2015 cohort. Where necessary, illustrations were made with Sub-Sahara African countries with same or better performance.

One of the facts mentioned in the NTP's appeal to the GFATM round 8 funding, is the inequitable distribution of the TB incidence over the country (6). When comparing the 2015 cohorts' CNR (88/100,000 population) with the WHO estimated (152/100,000), there seems to be an underutilisation of the TB services (1,5). TB services in 2015 were used by 54% of the estimated TB cases.

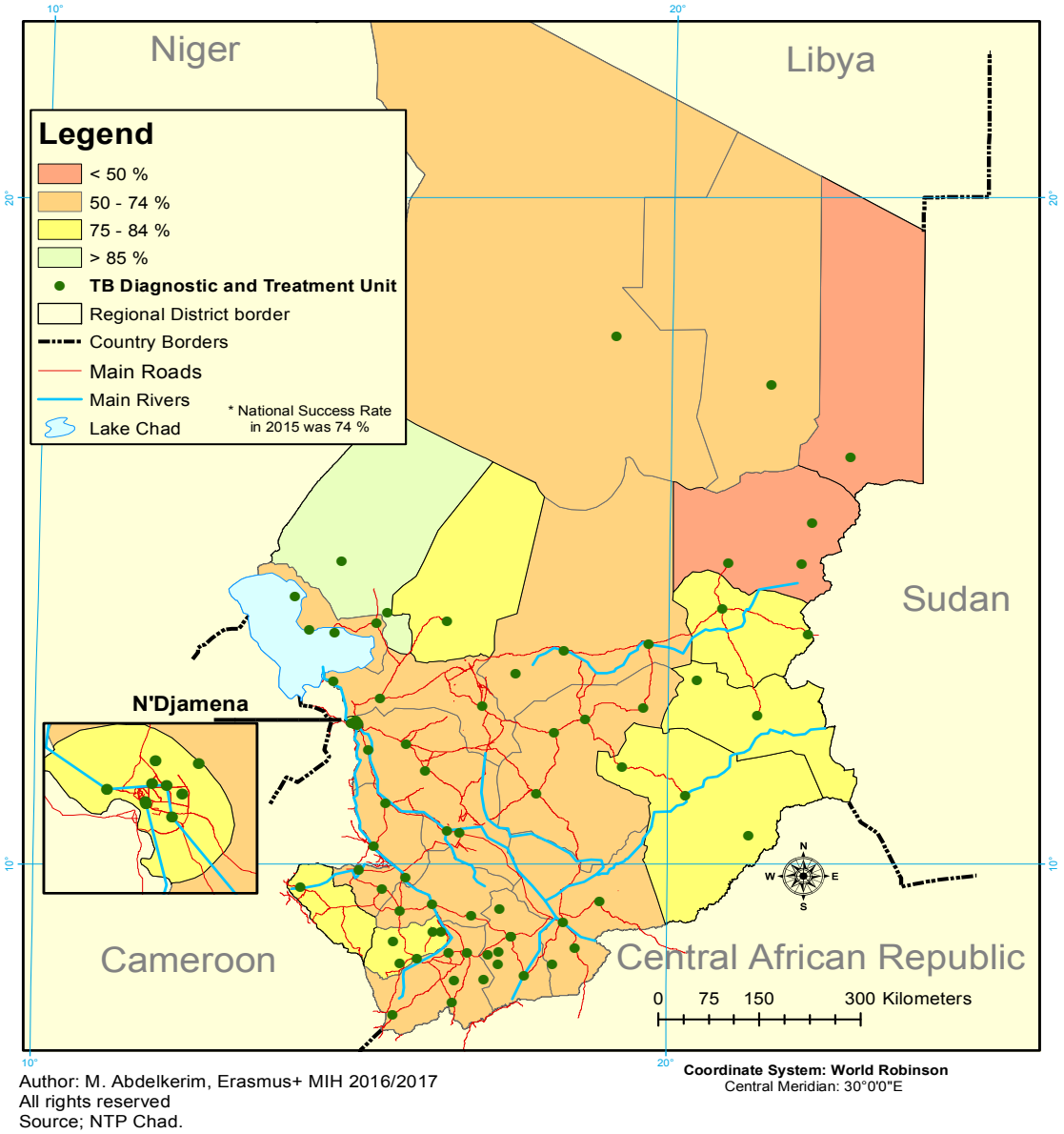
The notification in the northern part of the country is lower than in the southern part and it is highest in some of the most southern districts. Close to two third of the country, from the north to the center, has reported less than 20 cases per 100,000. These are the low notifications bordered DSRs. In 2003 Wyss et al. mentioned the scarcity of health facilities in the northern desert zone (9), which is one of the factors that could explain the low TB notification. But even here in some areas it is lower than the national estimates and therefore likely to be under-diagnosed. Chari Baguirmi (9.7/100,000) region is sharing its borders with N'Djamena (high) and Moyen Chari (high). The later are respectively reported the highest cases: 383.9/100,000 and 185.2/100,000 respectively. Keeping in mind that people from Chari Baguirmi for instance will choose to use facilities within their proximity, thus registered in Ndjamena or Moyen Chari.

Map 1. Regional TB Positivity rates Chad 2015



Map 1. Regional Distribution of 2015 Sputum Positivity Rates amongst all AFB Tested (6,25,26,33–36)

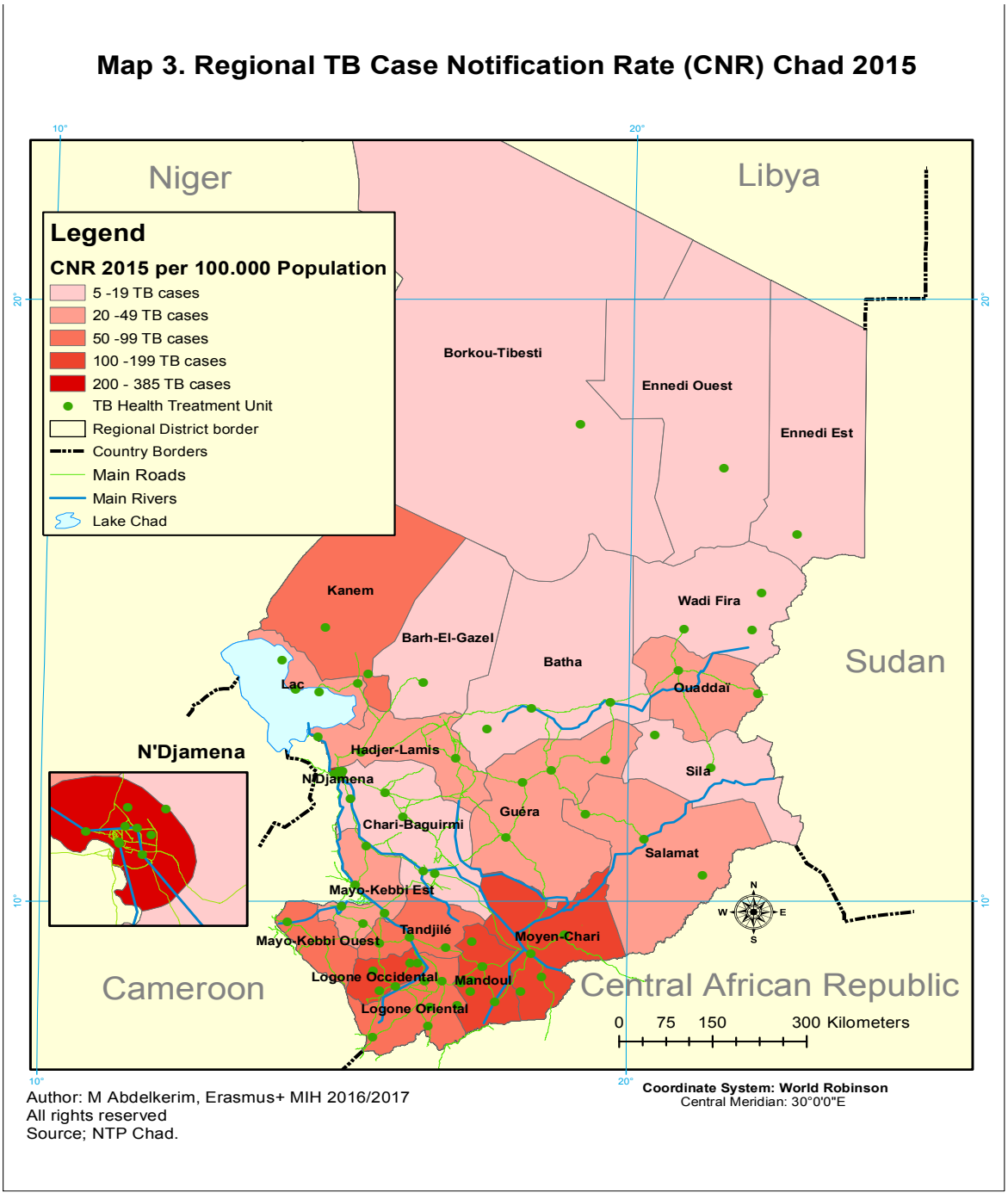
Map 2. Regional TB Treatment Success rates Chad 2015



Author: M. Abdelkerim, Erasmus+ MIH 2016/2017

Source; NTP Chad.

Map 2. Regional Distribution of 2015 TB Treatment Success Rates in Chad (6,25,26,33–36)



Map 3. Regional Distribution of 2015 TB CNR per 100,000 population in Chad (6,25,26,33–36)

The 2015 cohort data reveals that 1/6 (4,524) of the N'Djamena registered cases had TB/HIV co-infection. The HIV prevalence could be one of the explanations for the high TB notification in N'Djamena. It further underlines the likely under diagnosis in Borkou-Tibesti that also has a high HIV prevalence but one of the lowest TB notification rates. The positivity rate on map 1 was 21% country wise. The 2015 new and relapse TB cases age and sex disaggregated diagnosis data showed that the majority of new TB cases is within the age group of 25 and 34 years old. Which is similar to previous years cohorts (15,37,38). Children below the age of 15 represented 7.72%. As shown in figure 5 and annex II, the male:female ratio of 2 to 1 also remained the same. Which implies that the burden of the disease is higher among men. Consecutively men could be using TB services than female.

Notifications from Borkou-Tibesti, Ennedi Est and Ennedi Ouest were not only low but seem incomplete. The data for these districts showed respectively 3 males, 0 and 0 diagnosed versus 12, 6 and 4 in the treatment outcome summary. The treatment outcome is disaggregated in types of TB. Some cases among the 24 treated where classified as new TB with negative smear. This shows a gap in health information management notably since district level data is generally recorded manually.

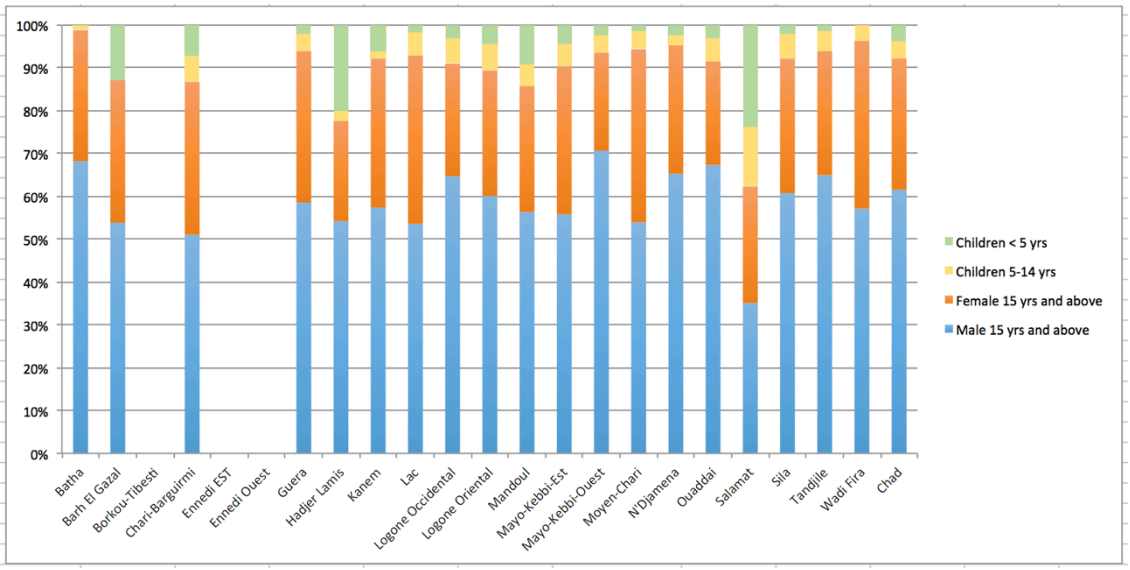


Figure 5. Age and Sex Disaggregation for 2015 New and Relapse TB in Chad

3.2 Literature Review

3.2.1 Characteristics of Included Studies

The search yielded 383 articles. Attempts in other search engines (PLOS ONE and Cochrane) were less productive and sometimes nil for articles on the subject in Chad. The French National Open Repository (HAL INSERM) revealed articles that were already acquired in the initial search. No response was obtained from one Chadian researcher contacted by email. After a primary screen, through title and abstract and after removal of duplicates, 64 articles met the selection criteria. However only 9 articles were specific to Chad and these were included. As shown in figure 6, a further review and addition led to 100, out of which 63 which were finally used.

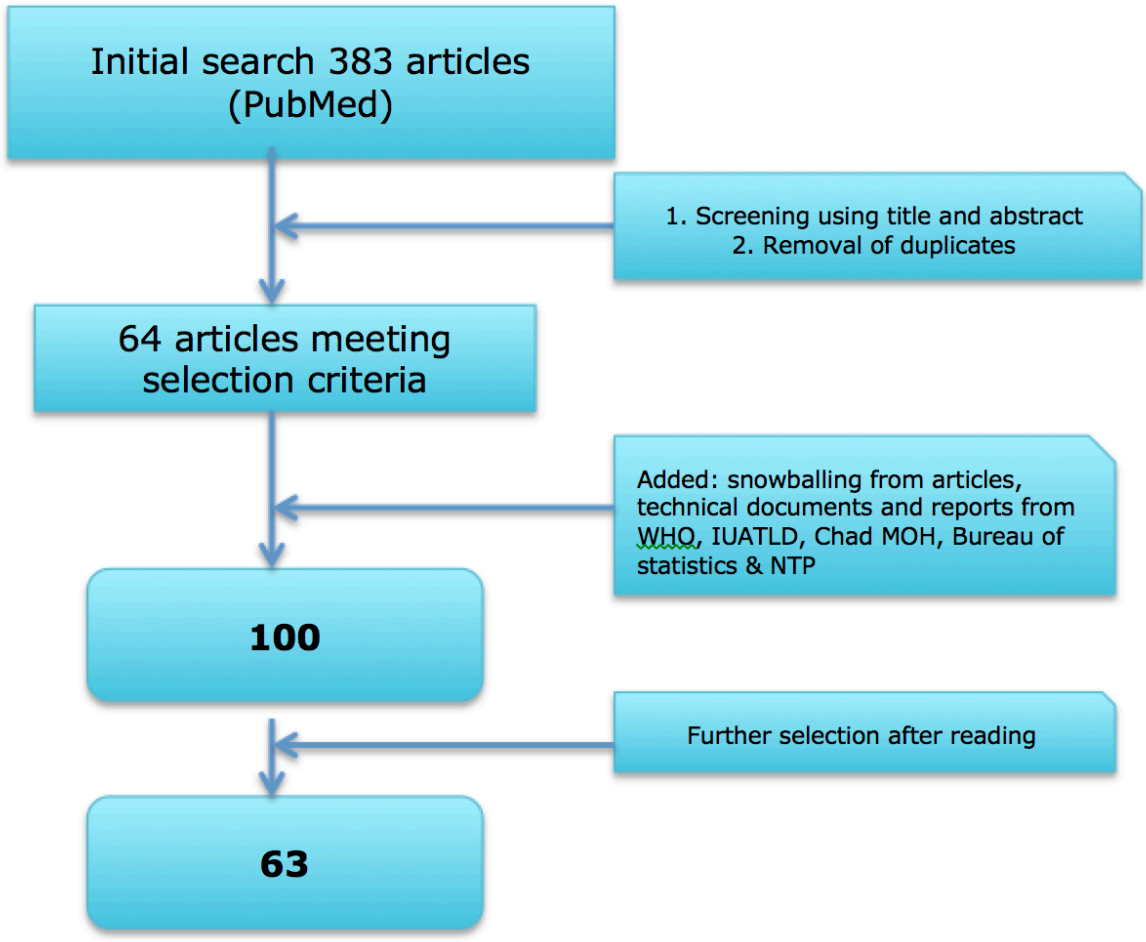


Figure 6. Literature Search and Selection

3.2.2 Societal Determinants

Societal technology and norms that influence TB services utilisation will be narrated in this sub-chapter.

As stated by Ngangro et al. few Chadians benefit from health insurance coverage (39). The social security system is at its early stage of development and covers only certain professional categories (private and para-public sectors). Most households use out of pocket money to cover their health expenses. The social customs are as such that family members and friends contribute to cover for the first occurrence of medical expenses. The stigma and the lack of knowledge about the TB leave people with choices as such as self-medication, home-based care or traditional healing. The use of health care services is most common when the patient's condition worsens (10).

3.2.3 Health Services System

Resources and organisation of the health system should ideally shape the delivery of care to the communities (27). As mentioned earlier, the national priorities for public health include the fight against TB. However, the financial commitment as reported by the NTP remains insufficient (5) therefore the dependence on foreign aid.

The NTP is attached to the division of transmissible and non-transmissible diseases within the department of diseases prevention, environment and fight against diseases. This department is connected to the General Management of Health Activities (DGAS), which falls under the supervision of the secretary general of the MOH (15).
A national coordinator, assisted by an international technical expert and 16 staff members, operates the central office of the NTP (see annex II).

The services provided within the NTP are currently included in the minimum activities package of the health centres. While at the district hospitals' level it is added to the complementary activities package (12). In 2015, the delivered TB services were reported by 74 diagnostic and treatment facilities across the 22 DSRs of the country (see map 2).

TB services are centralized within the public health system: the main health provider. The private sector of health services is not yet fully developed. Private clinics and nursing centres are slowly operating but mainly in the capital city of N'Djamena. Since almost no coordination is seen with the MOH, it is difficult to find data on the activities undertaken in such practices (10). This report further

stated that TB services are not provided in the private sector. However it does not mention about the referral of patients with presumptive TB by private practitioners to the NTP.

Early detection and adequate treatment of TB cases are the NTP priority (17); this active case finding is to avoid further spreading of the bacteria within communities but also to treat infectious sources. In order to perform adequately and to improve the epidemiology of TB, the NTP is working towards:

1. **Coverage** of the programme in urban and rural,
2. **Continuity** of the preventive and curative services in all facilities,
3. **Accommodation** by adapting its services to the reality within the communities
4. **Integration** of the NTP services in the existing health system structures. Services are inclusive of people with presumptive TB identification, detection and treatment (15)

Efforts but mostly resources are required to organise these four conditions; shaping the TB services as such may result in increasing its use by communities (27).

The NTP reported that the primary health care providers at peripheral/dispensary level are not involved in the management of TB. Which led the programme to lean more on centralized care at health centres and hospitals level (6). However the understaffed hospitals are overloaded with other activities so that access to TB care is limited. The national referral hospital of N'Djamena does not have a specific referral system between the health centres and the pulmonology ward. This makes follow–up, after discharge, cumbersome to patients and health providers. It is important to note that infection control within the hospital is also reported to be lacking. For instance the use of a surgical mask, and the lack of aeration in the treatment rooms does not protect health workers (15).

According to Ngangro et al. the health system contributed to a 2.4 times delay (36 [19–65] days) to diagnose and initiate treatment. Whereas is the same study, patient delayed by 15 [7-30] days to consult the NTP services from the onset cough (16). A gender specific barrier was also found in this intervention. Female patient delay was shorter than male. Nevertheless once they have accessed the initial care they seemed to encounter gender associated barriers that hindered their progression. The variable of the health system delaying female's TB services use, includes lack of respect from health care providers, financial independence, lower social status and family responsibilities (40).

In order to prevent losing patients, undergoing TB treatment, psychosocial activities were reported to have been coordinated in 4 hospitals in N'Djamena. This is to provide health education as well as to ensure adherence to treatment (5). However, there was no information on the effectiveness of this intervention. According to the NTP, 700 Community Health Workers (CHW) have been trained to assist with adherence to treatment and patients tracking (6). A gap in the patient referral to peripheral care during the continuation phase could be part of the lack of adherence to treatment.

As mentioned in section III.1 distance is one of the barriers to TB service utilisation nationwide. The floods during rainy season in the central and southern region further hinder access to health facilities. This may call for the health system to emphasize on mobile clinics as seen by the assistance provided by international health aid workers. The rainfalls not only alleviate people from the heat waves of the dry season and are ideal for farming, however it is also during the rainy season that malaria, upper and lower respiratory tract infections among other infections are predominant. Given the lack of communities involvement in DOT, one would wonder how affected are the TB services in such areas.

Access to and utilisation of primary health services in Chad is further hindered by its weak health structure, including and not limited to the lack of personnel and equipment (41). Increase of health structures, diagnosis services and refresher training of workforce in performance as well as regional districts management could enhance the use of TB services. In Salamat, Lac, Kanem, Hadjer Lamis the outreach through outpatient mobile clinics as well as CHW may have resulted in an increased awareness among patients and their respective communities on the disease. The NTP ought to look further at these regions and replicate the same in the rest of the country. Keeping in mind that international aid may not be sustainable.

Apart from the central laboratory refurbishment the NTP also secured from its French partner (ESTHER) and MSF-Holland diagnostic equipment. Am-Timan and Moundou hospitals located respectively in Salamat and Logone Occidental have been equipped with Xpert MTB/RIF and their laboratory personnel were trained on how to use this technology (5,15). This led to the identification of 33 multidrug resistant cases that have been initiated on second line TB treatment in N'Djamena (31 cases) and (2 cases) in Logone Occidental regions (5).

With the round 8 GFATM, all 22 DSRs have been equipped with fluorescent microscopes. Consequent training of 72 laboratory technicians on quality diagnosis and reporting took place. In year 2015, 22 laboratories (31%) out of

the 72 laboratories participated in the quality control. This is a rather low participation, but it showed 99% accuracy on positive and negative slides control reading.

Through the same funds the capacity building trainings for the NTP personnel (nurse, doctors) were conducted (6). The supervision of the TB focal points at DRS level is performed regularly through an established information management system. Feedback on quarterly and annual national reports is shared from each DSR to encourage better performance (5,15,37,42,38).

According to the NTP Strategic Plan (15) the TB treatment provision and supply management is still lacking. The national drugs management, where the TB drugs management falls under, is not satisfactory. For instance, the focal point in some health centres lack the supply order forms which leads to interruption of treatment (15).

It is important that the NTP has included an expansion of its services as well as involving the communities in the fight against TB. Apart from the performance indicator elucidated so far, no other evidence about these interventions were found.

3.2.4 Individual Determinants

Individuals are dependent on (1) predisposing factors, (2) their ability and (3) their illness level to use health services where and when available (21). These are factors of the individual determinants, which will be elaborated in the context of the NTP services utilisation by people with presumptive TB.

3.2.4.1 Predisposing Factors

Demographic (age, sex, marital status), social (education, occupation, family size, mobility) and beliefs are factors that influence individuals to seek for health care (21).
In 2003 Wyss et al. revealed that female, low education levels, as well as socio cultural factors prevent the utilisation of health care in rural Chad (9). These are found relevant in terms of TB services utilisation (10,16,31). The male:female ratio was shown in the NTP report, in studies conducted by Ngnangro et al. as well as in WHO estimations (5,31,37,38,43); Female with presumptive TB symptoms often endures socio-cultural barriers that affect their health seeking behaviour (16). As mentioned in the 2015 cohort analysis (see III.1) men, could

be among the very sick people who were tested, as they delay longer than female to seek care.

Living conditions, low or lack of income, transport and food cost and mostly low literacy about health, is found to be associated with health seeking behaviour (44). In the rural areas, despite the large land, an entire family would live in a hut made of dried grass branches and keep their cattle in the compound. In the suburbs of the main cities where the poorest would reside, aluminium steel roof are used to cover a room or two - depending on the size of the family – made of mud and grass bricks. In both settings water and sanitation are not adequate. Most farmers and cattle owners' live in the rural area, work with their nuclear family members and the income is manage by the head of the family. Often children don't or would only attend school until they are able to assist their parents. In the main cities, the situation is different because of the economic growth and infrastructures. In a multicentre study, half of the patients had no job; hence no revenue and 58% were counting on family support. Only 27% claimed to be financially self-sufficient (39).

Stigma around TB as well as HIV is reported by the NTP with no further details (15); An urban study revealed that 12% of respondents associate TB to non microbial cause such as inheritance from family, dust, witchcraft, stress, alcoholism, cold, smoking cigarettes (39). As for HIV, it is looked at as a result of promiscuous sexual behaviour. In both circumstances and except from close family members, people would outcast such patients, a common example is prevent from marrying any family member of the TB patient.

The harsh climate and bad harvests lead to insufficient food among farmers in the central part of country where severe malnutrition occurs every year. But certain cultural believes were found to unintentionally cause more harm than good (45). For instance: traditional potions made of cow milk fat mixed with honey are supposed to heal productive cough. Visiting the "marabout" known as a religious leader, who would recite healing verses over a bowl of water is still a common practice. This water is considered holy and can cure diseases. Often, traditional healers would cut using razor blades on the belly and hands of sick people. Such practices would not heal TB; nonetheless some could result in lethal poisoning and infections. What if these healers were infectious? Or how many times have they been in close contact with infectious TB patients? MSF reported providing on the job training to health personnel, community health workers to offer health education for mothers on hygiene, nutrition and prevention of infectious diseases. People with presumptive TB seeking care at the next-door traditional healer prior to the TB services, was found to be

common and not only in Chad (40). In the year 2000, Malawi had more or less a similar TB burden as Chad in the current stage. Salaniponi et al. explored the health seeking behaviour of sputum smear positive patients (46) from 5 districts (compared to 3 in Chad). The respondents' size was larger (1,099) and was comprised of rural and urban settings of Malawi. The cohort in Chad was 3.8 times less than in Malawi: 286 patients who were all registered in 3 urban hospitals. 41% in Chad versus 30% from the Malawi study consulted non-formal practices including traditional healers. However the median total delay between the onset of cough and diagnosis were similar: 57.5 days and 56 days respectively (46,47). The total delay is the accrual of both patient and health system delay.

In their hospital based surveys conducted by Ngangro et al. the median age was 32 years. Of these respondents 32% did not adhere to treatment and hence where lost to follow-up (39). This study further confirmed that a low education level and ignorance about TB, its mode of transmission and treatment were strongly associated with non-adherence to treatment. Age, from 55 years and above showed no statistical difference in terms of adherence to treatment with an odd ratio of 1.13 95% CI [0.37-3.47] (6); When added distance (16) and low education level (15,39,40,46) this resulted into barriers to TB services utilisation, thus these variables contributed further to delayed access and use of TB services.

Neither the NTP nor other studies reported TB cases special groups such as nomads, army and penal institutions.

3.2.4.2 Enabling Factors

In his 2015 publication, Andersen explained that utilisation is dependent on individuals' ability to secure care (27). Family and community also have their role to play in the health seeking behaviour.

The prevalent poverty in rural Chad is one of the main barriers to health care utilisation (9). Ngangro et al. found in a hospital-based survey from two major cities that half of the studied population is unemployed, thus had no income (47). Informal practices (self medication, use of counterfeit medications sold by ambulant dealers or groceries shops, religious and traditional healers) are often within patients with presumptive TB residential vicinity are also affordable (16,31,47). Burkina Faso is a landlocked country with limited and health inequities similar to Chads'. A study using focus group discussions followed by selective individual interviews in three districts tackled access and adherence to

TB treatment (48); Use of TB services in all 3 districts was rated as the last option. The study further showed that despite the free of charge TB diagnosis and treatment, females with lack or limited financial income, reported being restricted from accessing TB services.

As mentioned in the background chapter, people with presumptive TB will have to cover long distance to reach health facilities (10). Most of them will have to consult a local primary health centre then, referred to district hospital or to the TB services if symptoms are obviously suggestive of TB. The national estimated demographic load per health centre is 9,935 inhabitants and 148,588 per hospital. In highly populated areas, presumptive TB symptoms patients may have to face long waiting hours, which may result in spreading the bacteria while coughing and or spitting near other patients.

The free of charge TB diagnosis and treatment does not seem to encourage the TB services use (15,11,44). Ngangro et al. established that factors like low TB services coverage, expenditures and use of a traditional healer or a non-skilled professional contributes to a delay in diagnosis and start of treatment (31). In this study, 63% of the studied population would have not been able to use the services, if the family members had not covered for the associated costs. One fourth (1/4) would have contaminated at least 5 to 10 close contacts, for having started treatment only 95 days post initial symptoms.

The communities involvement in TB prevention, and treatment adherence was mentioned to be lacking, in the Chadian based studies (16,31,39).

3.2.4.3 Illness Level

In the Chadian society, health care is associated with sickness. Unless a person is bed ridden or severely injured, formal health care is not routinely used. The health seeking behaviour is intertwined with the low health literacy of communities in Chad (9). People with presumptive TB's lack of knowledge about the disease, was reported to be predominantly associated with a delay in diagnosis, and adherence to treatment (39,47). The national smear positivity rate represented in 2013, 1/4 and 1/5 in 2015 of the diagnosed cases (5,37,38). Patients with presumptive TB facing barriers elucidated in the individual determinants (see section 3.2.4.1 and 3.2.4.2) and often are very sick when utilising the TB services.

According to the NTP guidelines, severely sick, relapse and difficult cases, are hospitalized during the intensive phase of the treatment to ensure treatment

adherence. More than 80% of two hospital-based surveys were found to have sputum smear positive TB (47). Yet another study conducted in 3 hospitals showed that 32% of cases defaulted between the end of the intensive phase and the beginning of the continuation phase (39). Noting that this is the period when patients feel better and if they fail to finish the treatment because of not understanding its importance, they could develop drug(s) resistance. In 2015, the NTP treatment outcome report shows that 17% of the cohort was lost to follow-up. The latter suggests looking into the quality of care in terms of information provided to patients about the disease and its treatment. Though contact evaluation is mentioned in the TB management guide, there is no evidence that this is being done throughout the country. Contact evaluation could increase the detection rate by diagnosing cases in the early stage of the disease (49). Through contact evaluation details, patients could be tracked when they don't report to the DOT. Since distance is shown to be a major barrier to TB service utilisation, supplementing feeding in the DOT could be introduced as a part of patient focused approach to enhance adherence to treatment.

3.2.5 Health Services Utilisation

The characteristics of health services utilisation include the type, purpose and unit of analysis. The WHO estimates for TB attributed death rate (excluding HIV positive) per 100,000 population in Chad has dropped from 27 [16 – 41] in 2000 to 23 [13 – 35] in 2015. The estimated incidence rates on the contrary, remained within the range of 151 to 152 per 100,000 population, for the same period, except for 2014 when a slight peak to 159/100,000 was seen (14). On the other hand, performance indicators as the notification and treatment success rates started to improve in 2003. The notification rate had reached its highest - 89/100,000 population - in the year 2008 from 64/100,000. The treatment success rate remarkably reached 74% in 2015 from 22% in 2008 (5,15,24,37). A calculation of the NTP coverage, using the national notifications divided by the WHO estimated number of new TB cases in 2013, 2014 and 2015 resulted in 59%, 60% and 57% respectively.

Despite the lack of functionality of the established national technical working group on the collaboration of TB and HIV activities, HIV and TB focal points on the ground are showing some improvement through their activities. HIV testing among TB cases has reached 65.9% in 2015 from 40.3% in 2013 (5,37). This shows an improvement, from previous years, which could result from the health staff offering HIV test. A certain level of stigma alleviation consequent to a better understanding of TB/HIV co-infection among health providers and patients could

also be considered. Anti-retroviral treatment is also progressively provided to patients with TB/HIV co-infection. In 2014, 67% of the TB/HIV co-infected patients were provided with both TB and anti retroviral treatment (5). Diagnosis and treatment for HIV and TB are among the free of charge care provided by the government when using the public health services. Such approach is known to increase the use of TB services (27).

Another study revealed the difficulties in accessing health facilities and the quality of the TB services are associated with treatment adherence namely in urban settings. For instance 27% of the hospitalized TB cases in N'Djamena, were lost to follow-up between the end of the intensive phase or once discharge from the hospital for the continuation phase (39).

Andersen argues that once people have used health services, there's a tendency that they will return when similar symptoms recur (28). This is because they know how the system works. The 2015 cohort showed that 5.7% were among cases that are being re-treated either because of relapse or treatment failure or earlier interruption.

4 DISCUSSION

Tuberculosis remains a concern in Chad. This study looked at the TB services utilisation through performance indicators in comparison to the WHO estimations. The spatial analysis, using 2015 cohort data from the NTP, revealed an overall CNR (88/100,000 population) that was lower when compared to the WHO estimate (152/100,000). The coverage rate (54%) could explain either an under detection of cases, or it could be that only sick people consult and are therefore diagnosed.
HIV prevalence rate, from the 2014 national survey, was reported to be the highest in the Borkou-Tibesti (5.3%) and in N'Djamena (4.0%) regions (10). One should note that the northern region, despite its low population density, is known for its chronic militia and cross border activities to Libya and Sudan. The lowest rate of 0.1% was recorded in Logone Oriental. The ratio urban:rural is 4.3% and 0.6% respectively. HIV is found among 5.8% women and 2.9% men, however there seems to be no difference among men and women in rural areas (10). Tosi et al. cited by Ngangro et al. study on TB/HIV co-infection showed that 33% among TB patients, treated in the national referral hospital of N'Djamena, were HIV positive (31).In addition to HIV/AIDS, diabetes, alcohol misuse, indoor air pollution and under-nutrition was reported in the WHO 2016 report to be amongst the predisposing social risk factors of TB in endemic countries (4).

As shown on the map the unequal geographic distribution of TB services seem to be aligning the notification. Nevertheless, one should note that TB burden; population density and health service distribution would influence the expected notification. For instance, if the burden is high, a low health services density could result in low notification. The regional notification varied from being low in the north to high in the south. This seems to be in line with the population density. When looking at the district levels, Ennedi East reported 4 new cases per 100,000 compared to 384 in N'Djamena. Whilst Ennedi East low populated (0,98/km^2), N'Djamena is highly (2,356/km^2) populated (10). However regions with high rates in the south also surrounded others that have reported low rates. Such low rates among high burden imply an under-notification of TB cases. The southern region would show a high rate if early TB detection and contact evaluation was practiced. Given the fact that there is also a much lower density of health facilities in these rural areas, it is likely that there is also under diagnosis in the rural areas due to accessibility issues. This seems to be the case

for the northwestern region where the HIV prevalence is high and therefore the burden likely to be higher there.

There is unequal distribution of TB services. The alarming situation remains the north with 3 TB services centres for the third of the country. Access to health services in the central part of the country was not any better: 50 km to a health centre and 100 km to a hospital on average. The high sputum positivity rate also points in the direction of problems in accessing diagnostic services with people only being tested when they are very sick. The diagnosis and treatment outcome data from the northern part seemed incomplete, thus not analysed. However that area requires further interventions to improve the health system, provision of care and its use.
A spatial depiction of the percentage of cases showing positive smears among total tested was done (see map 2). This was to explore the quality of diagnosis and testing of people with presumptive TB. Four (4) DSRs out of 22 showed a positivity rate within the norm of 5 to 15% (1). This means that all the symptomatic people are being tested. It is important to note that in all the other districts only people with severe symptoms seem to be tested and therefore many presumptive TB patients being missed.

These 4 regions were within the central band of the country, but also had in common: harsh climate, low education, low health structure and chronic malnutrition. The latter was one of the reasons clarifying the presence of international health workers (50,45). The increased services and its outreach through the CHW and mobile clinics have definitely enhanced the TB services utilisation in this part of the country. In fact 2 out of the 4 DSRs: Kanem and Ouaddai have shown respectively a treatment success rate of 92 and 83%. They have surpassed the NTP target (85%) and the national treatment success rate (74%) for 2015 cohort.

Five (5) additional regions showed a relatively high notification and are performing well, despite their treatment success being under 85%. These regions also benefited from the international health organizations. Among these is the city of N'Djamena, which notified the highest and treated at a slightly higher rate than the nationals'. Although the high positivity rate of the sputum tests indicates that even here there is likely under-diagnosis and cases being missed. Nonetheless in this location, 87% of the TB/HIV patients used the services by ingesting the anti-TB and ART (5,24). This shows that these particular patients who have used the health system for pre-existing condition were better informed about the organization of care and about TB disease.

Despite its relatively good treatment outcome, the very high positivity rate of 31% is suggestive of under-diagnosing TB in N'Djamena. The reason for that may then be more related to people accessing the services or an overload of the services and therefore an insufficient number of people with suspected TB being offered a test. HIV prevalence being the highest (4%) and its atypical TB symptoms is one of the reasons that only the sick people are being tested. Hadjar Lamis and Mandoul have respectively reported a positivity rate of 34% and have malnutrition among children in common. Their population density is higher (25 and 47/km^2) which reveals the health services shortage and an under-detection of cases.

The north and central regions seemed to have notified way less TB cases than estimated. Such regions would benefit from active cases detection. Kenya's last TB prevalence survey revealed that cases were missed even if they've consulted. Because they didn't report the usual symptoms such as long lasting cough, weight lost. Yet their chest x-ray showed pattern of active TB. One of the recommendation was to expand the symptoms to include cough of any duration, fatigue, fever, and shortness of breath (51). Using this example and enhancing community-based awareness to seek care early when such symptoms occur could be justified and used in Chad.

Other studies in urban settings in Chad and Burkina Faso (16,52), found that the overload of services as a common variable, results in referring limited number of people with presumptive TB for testing. Most of these are very sick people with obvious symptoms (35). To contain and prevent further contagion within communities, TB services in urban settings seem to lean towards hospital care for the intensive phase. Yet 1 out of 4 in the case of N'Djamena was lost to follow-up in 2015. A qualitative research in Burkina Faso revealed 3 barriers to adherence to treatment: difficulty to access the designated DOT centres, a high number of follow-up visits and the quality of the interaction with health providers when utilizing TB services (48).

Though the climate layer was not added to this map, it remains the reason for the higher population density in the central and Southern part of the country. The rough desert living conditions have not eased the development of infrastructure, including shelter, education, transport; just to name few of the determinants of health (53).

The latest Demographic Health Survey (DHS) highlighted the recurrence of severe malnutrition among children under 5 years old. The 2015 prevalence for acute and chronic malnutrition was 11.7% [10.9 – 12.5] and 29.0% [27.6 –

30.4] respectively. (10,11). Most central and southern regions are affected. This is shown in the age and sex disaggregated tabulation in annex 2. When looking at the percentage of TB for this age group (3.8%) reported in 2015, there could be TB under-reporting in Kanem, Barh El Gazel, Lac, Hadjer Lamis, Ouaddai, Sila, Salamat, Moyen Chari, Mandoul, Mayo-Kebbi Est and Chari Baguirmi. MSF and IMC have been supporting the MOH by providing mostly primary health care in these areas. Ouaddai, Salamat and Lac had radiology services support, while Ouaddai also benefitted from surgical care, namely for victims of road traffic accidents, occurring on the first asphalted road infrastructures. The Lac, eastern and southern areas have been hosting conflict-affected populations from Nigeria, Cameron, Niger, Central African Republic and Sudan (45,50).

At the time of this study, Chad has not yet conducted the WHO recommended national TB prevalence survey. Some countries with a high burden, that have done so, found a difference from the WHO estimation. Kenya, for instance has conducted its second national TB survey since 1958. The country wideness and population cultural variety can be assimilated in to the Chadian context. Its NTP has proven a good performance in TB control (19) namely with TB prevention among people living with HIV. Yet, the 2015-2016 survey showed that the WHO estimated (233/100,000) was way less than the (558/100,000) surveyed (54,55). Zambia's public health concerns for TB can be related to the Chadian current context. These similarities can be found within the HIV pandemic as well as the high level of poverty that could inflate the TB infection. Upon selection by the WHO, the first national TB prevalence survey among 15 years and above was conducted between 2014 and 2015. The survey showed a higher TB prevalence (455/100,000) when compared with (388/100,000) WHO 's estimation (56).

Chad would benefit from a national survey that is important in the management of TB in such a wide country. It will provide a comprehensive understanding of the burden, but also a good grip of the regional differences and how to tackle them. Because of the trainings associated, the work force could perceive and understand the need to record and use the findings to evaluate their work.

4.1 Individual Factors

The most affected **Age** category in Chad is similar to the Sub-Sahara African region (4). **Female** happen to have less delays in accessing and utilizing care yet, male seem to carry the burden of the disease. Females, at times, could accrue some delay because of the acceptability of the services.

Despite improvements made by the NTP, the notification of TB cases are still low because of the limited services, geographical access, but also the limited **knowledge about the disease** (39,40) in rural as well as urban settings. **Stigma** was found to affect individuals with presumptive TB health seeking behaviour. It could further be one of the barriers from the health provider's side that result into not offering TB diagnosis and further HIV test to all TB patients.

A common finding in the literature is the association of **social beliefs** and low or no education that led to using formal health services (inclusive of TB care) as the last choice (16,20,31,57). Stigma from health providers was mentioned by respondents in a qualitative intervention in rural and urban Burkina Faso as one of the barriers to adherence to DOT (48). In Chad, people with presumptive TB and HIV may seek care with a delay or outside their community of origin because of stigma.

Studies on **cost** of burden showed that other associated expenses pertaining to transport, follow-up (radiology and laboratory) contribute to the catastrophic spending of the TB patient, family and friends (58–61). This makes it very difficult for the poorest, whose education level does not enable them to use the formal services at least in the early stages of the disease. Eliminating follow-up cost and decentralisation of the services could improve the TB services utilisation in urban and rural settings. In Kenya, efforts were made by the NTP headquarters to ensure that TB was a prioritised at local level and local coordinators were involved in districts level planning (19). By year 2006, TB diagnostic using sputum smear and treatment was made possible in more than 700 facilities: making TB services available at peripheral level, thus increasing the TB notification.

One interesting find related to the **residential factors** and enhanced services utilisation is the region of Kanem, where the TB treatment outcome was 92%. This shows how increased services, outreach by involving **communities** and mobile clinics, but also addressing the underlying factors (malnutrition, auto immune diseases) and adding radiology for diagnosis, when required, can show success in the fight against TB.

4.2 Health System

According to the NTP reports, the numbers of TB cases notified, have doubled between 2007 and 2015 (6,10). This shows that there's an **improvement of the diagnosis and treatment**. Nevertheless, the unequal distribution of health

structures and personnel, leaves the northern communities almost excluded. The MOH has not been successful in the assignment of health workers in rural areas. There's a need to scale up, not only the facilities but also secure personnel in the NTP. The current **population and facility ratio** is way under the WHO standards. This makes **distance to reach health services** a major barrier to TB services utilisation.

The high sputum positivity rate amongst tested suggests that health providers refer cases of which they are convinced to have the disease.

The **male:female ratio** could imply that males have a higher disease burden. The WHO reports that recent national prevalence survey in Africa and Asia have shown higher detection and reporting gaps in male than female (14) Factors underlying this gender inequality could be looked upon. Tackling this burden is crucial for TB prevention and care (62).

The centralized TB services hampered the involvement of peripheral health care providers. Namely when these **health providers were not familiar with the technical guidance** in terms of symptoms, referral, treatment, follow-up and data compilation. This means that cases may have consulted at an early stage of the disease but missed. The treatment protocol in use was found strict when it comes to the DOT administration (39,48). Health providers could flex the attendance timing for patients as such that they could comfortably use the services at their convenience. South Africa ranks third in the world in terms of TB burden after India and China. An analysis of the determinants of adherence to DOT revealed that daily visits caused considerable burden on the health system in addition to patients and their families. Suggestion was made to opt for a patient-focused approach (4,63). For example patient could choose his or her own time within proposed working hours and respect it. Furthermore, supplementary feeding in the form of high energetic bar and milk as well as transport vouchers could be offered on daily basis and throughout the length of the TB treatment. In line with the high personnel constraints, the Chadian TB treatment guidelines allows designated community members to supervise treatment with patients consent (17).
The communities' involvement was limited to the world TB day. In order to increase the use of the available services it is necessary to disseminate information about the disease in the health centres but also by reaching out to the community. Patients could also advocate in the fight against TB.

An integrated approach to handle TB/HIV co-infection in the other regions, following the example of N'Djamena, would be a good start to the fusion of these two services and should not be handled separately.

4.3 Study Limitation

Research on TB is lacking in Chad. The NTP work force is engaged in its daily workload and has hardly any time left to evaluate its own work. The little research, national and technical literature gave a certain degree of insight in the TB services utilisation. Andersen's model was useful to capture and categorize findings from the literature. At times, factors associated with TB services utilisation, were intertwined among the predisposing, enabling and illness level. However in line with the aim of this literature review, factors that enable or prevent the TB services utilisation have been depicted using its four blocks.

Data from the northern regions was not used in the spatial analysis and resulted in a biased interpretation that may not represent the whole country.

Some of the findings where compared with other African studies which could result into another bias, as it may not be representative of the context.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

TB services use in Chad is still at a concerning level. The NTP's performance is remarkable yet indicators have fallen shorter than targeted. Exception is made for the notification rate of 85/100,000 reached in 2015. The current coverage level of the TB treatment services is low 54% and the infection seems to be high in the southern regions. Given high positivity rates among individuals tested, the extremely low notification in the north may not representative of the burden. Factors determining the low utilisation of the NTP services were found on both the user and provider sides.

The scarcity and unequal distribution of TB services make it difficult for people with presumptive TB to access and use it. However people with presumptive TB living within the vicinity of the services may have utilized the NTP directly.

Free of charge diagnosis and treatment is not yet enabling the use of services, since the initial consultation fee at the primary health care is for most of people with presumptive TB a barrier. The fact that individuals with symptoms of presumptive TB are using the TB services as a last choice explains why many cases are still missed, thus the low notification.

The loss of 20% of the cohort to follow-up could be attributed to lack of a patient centred approach. This includes rigid DOT, lack of supplementary food and transport assistance, lack of understanding of the treatment duration to name few. Involving communities for instance could have eased the tracking of lost patients. These lost patients would not only continue to infect others within their communities but contribute to the emerging MDR-TB. The rigidity of the DOT is a variable that does not empower patients: especially among very poor and patients whose knowledge about the disease is limited.

The other individual's characteristics such as very young or elderly age, sex (male), low education level, social beliefs and the level of illness were found to contribute to delay in utilizing the services.

5.2 Recommendations

Since the current strategic framework ends in 2018, the following recommendations could be opportune. They have been listed by order of priority and feasibility. Apart from the national prevalence survey, the rest could be performed promptly but are essentially subjective human resources followed by cost and time.

- Adherence to treatment requires a particular attention therefore should be given the outmost priority. This should be in the whole country except in Kanem where the treatment success rate is 92%. Lessons could be learned from Kanem and adapted to fit the rest of the country. Noting that communities will use services that are fitted to their environment. Particularly in the south inclusive of N'Djamena. With targeted interventions, the NTP through its service providers would aim to avoid further dissemination of the infection but also to control the emerging resistance to 1st line treatment.
- DSR's TB focal points could encourage community involvement within their regions in the disease prevention by liaising with successfully treated community's members who could advocate. Additionally stakeholder's analysis should be conducted to include traditional healers, religious guides, teachers, youth, retail drugs sellers and community health workers. The list could be expanded as needed. Behavioural change takes time and should include the Ministry of Education for inclusion of TB awareness in their recreational yet educational activities in primary and secondary level.
- Upon completion of planned training in the current strategic framework, the NTP headquarters to facilitate the gradual decentralisation of the diagnostic and treatment by each DSR's focal point(s) to the peripheral level. While treatment can relatively easily be decentralized, the decentralisation of diagnosis may be a bit more difficult in low-density areas. Here sputum transport systems or mobile outreach for diagnosis may be a solution. An emphasis on accurate data recording and reporting ought to be made. This will mean an increase in the managerial portfolio of the TB focal point in every DSR. Involving the community in DOT could also be introduced at this stage.

- In parallel of all these recommendations the NTP should strengthen its workforce quantitatively and qualitatively. This increase is needed at the peripheral level thus ensuring active detection.
- The NTP central level to materialize the planned patient centred approach, consider incorporating health providers' kindliness to flex the DOT timing. Thus avoiding the long waiting time but also avoid mixing with other patients. Facilitation of transport vouchers, food supplements using national and international social actors using the example of Kenya.
- Early case detection should be part of the routine at every health centre and hospital. NTP could coordinate with MOH for a refresher training of health work force. Once cases are registered in the system, efforts to ensure completion of treatment should be strengthened through community awareness and involvement. This should also include contact evaluation and latent TB treatment for special groups such as people living with HIV, undernourished and poor people for instance.
- A national prevalence survey would be advantageous and highly recommended. Though it will require an extensive training of personnel in conducting this survey and upcoming interventions. The training will also serve as a refresher on TB management. International technical assistance will be required. Such survey remains essential in the fight against TB. The results of the survey will lean towards policy and technical guidance adaptation for best interventions. This recommendation falls under the NTPs' coordination at the central level and the MOH.
- The variety of finding from the regional depiction using GIS mapping were informative. While some regions have a very low case detection, which may be mostly caused by lack of geographical access to services: long distance to nearest diagnostic facility; there are other regions that still seem to have an under-diagnosis (high positivity rate of tests done). Nevertheless where it may not be the geographical access but where other issues may play a role: financial barriers in access, or low quality of health staff who do not recognize the symptoms, or the laboratory staff may be overworked and refuse to test sputum unless someone presents with clear and severe symptoms. Consequently DSRs would be encouraged to further analyse the specific problems in their own region and try to address these.

The author believes that this research provides readers with an overview of the available information on TB services utilisation in Chad. It could be helpful to the NTP's intention to undertake research in the near future.

To increase its services utilisation the NTP should consider to: 1. Make its free care accessible to all 2. Tailor its services such that they are known and acceptable by the communities 3. Ensure that the total financial implication on the patient side is not a burden.

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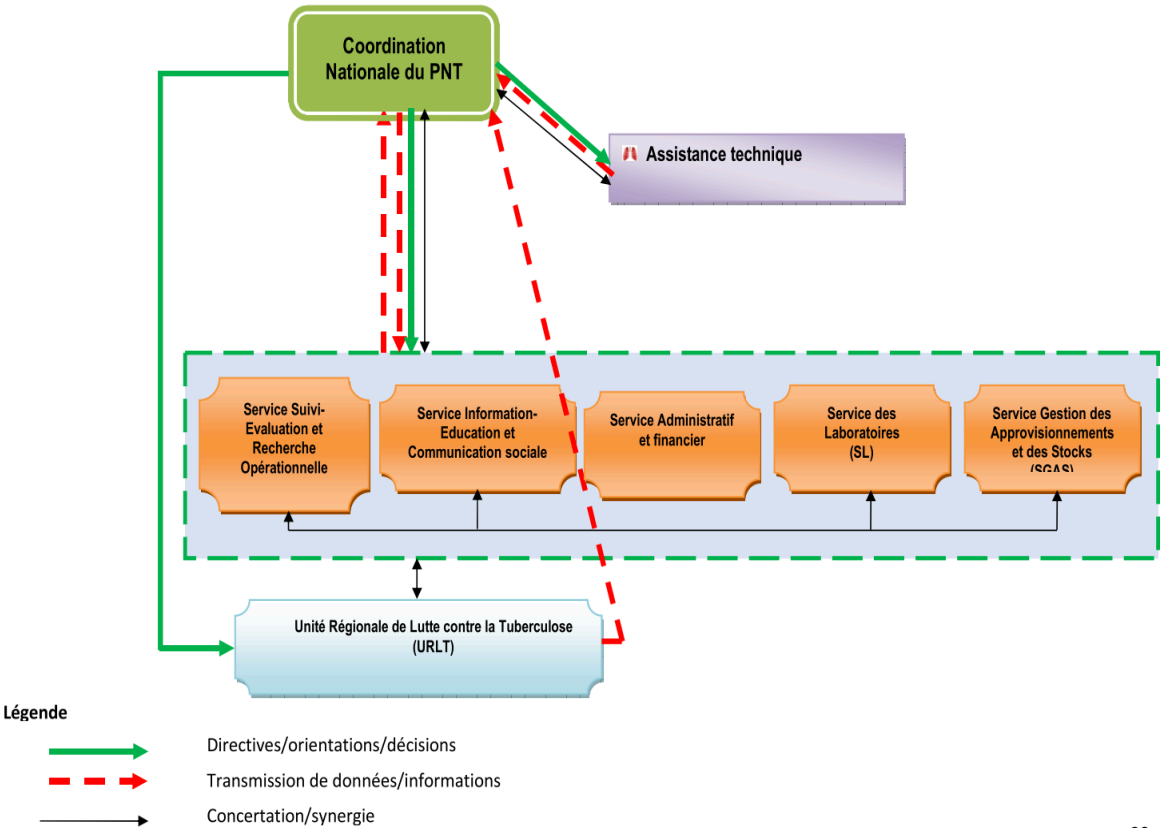
ANNEXES

Annex I

Functional structure of the NTP (15)



Annex II

Regional distribution new and relapse TB cases by Age and Sex

DSR	New and Relapse Pulmonary TB case using 2015 cohort diagnosis age and sex disaggregated data												
	0-4 yrs		5-14 yrs		>15 yrs		TOTAL			>15 yrs		<15 yrs	
	04 M	04 F	514 M	514 F	15 M	15F	TOT M	TOT F	TOT	Male 15 yrs and above	Female 15 yrs and above	Children 0 - 4 yrs	Children 5-14 yrs
Batha	0	0	1	0	58	26	59	26	85	68%	31%	0%	1%
Barh El Gazal	3	2	0	0	21	13	24	15	39	54%	33%	13%	0%
Borkou-Tibesti	0	0	0	0	0	0	0	0	0	0%	0%	0%	0%
Chari-Barguirmi	3	4	3	3	50	35	56	42	98	51%	36%	7%	6%
Ennedi EST	0	0	1	0	1	0	2	0	0	0%	0%	0%	0%
Ennedi Ouest	0	0	0	0	1	0	1	0	0	0%	0%	0%	0%
Guera	2	2	6	2	116	70	124	74	198	59%	35%	2%	4%
Hadjer Lamis	29	11	4	1	109	47	142	59	201	54%	23%	20%	2%
Kanem	4	3	2	0	66	40	72	43	115	57%	35%	6%	2%
Lac	3	2	6	10	158	116	167	128	295	54%	39%	2%	5%
Logone Occidental	14	12	28	26	577	235	619	273	892	65%	26%	3%	6%
Logone Oriental	20	12	27	16	425	207	472	235	707	60%	29%	5%	6%
Mandoul	45	37	20	26	510	267	575	330	905	56%	30%	9%	5%
Mayo-Kebbi-Est	15	13	19	15	362	224	396	252	648	56%	35%	4%	5%
Mayo-Kebbi-Ouest	5	4	9	6	265	86	279	96	375	71%	23%	2%	4%
Moyen-Chari	11	3	23	15	501	376	535	394	929	54%	40%	2%	4%
N'Djamena	50	55	48	38	2,709	1,250	2,807	1,343	4150	65%	30%	3%	2%
Ouaddai	2	8	9	10	233	84	244	102	346	67%	24%	3%	5%
Salamat	11	16	11	5	40	31	62	52	114	35%	27%	24%	14%
Sila	0	1	2	1	31	16	33	18	51	61%	31%	2%	6%
Tandjile	4	3	17	5	317	142	338	150	488	65%	29%	1%	5%
Wadi Fira	0	0	1	1	32	22	33	23	56	57%	39%	0%	4%
Chad	221	188	237	180	6,582	3,287	7,040	3,655	10,695	61.54%	30.73%	3.82%	3.90%