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Walden University

College of Health Sciences and Public Policy

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Esland Shilongo

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Walden University
2022

Abstract

Treatment Outcomes and Associated Factors in TB/HIV-Coinfected Patients in Namibia

by

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

Epidemiolgy

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April 2022

Abstract

HIV and TB have merged into a deadly coepidemic in Namibia. Currently, though, TB and HIV data at the national, regional, and district level might be underreported and insufficient to understand the full burden and outcome rates of TB and HIV. Targeting the TB outcomes rate among TB/HIV-coinfected individuals is an effective strategy for decreasing future TB burden and furthering the gains in the control of both diseases. The objective of this study was: to assess the outcomes of patients registered for anti-TB treatment in //Karas Region which has the largests burden of TB in Namibia. A 5-year retrospective cohort study was used to evaluate successful (cured, treatment completed) and unsuccessful (death, treatment failure, default, and loss to follow-up) TB treatment outcomes. The epidemiological disease triangle framework served as the theoretical foundation. Health facility records were reviewed for 200 TB/HIV-coinfected patients for the period 2016-2020 in the Keetmanshoop Health District of the //Karas Region.The data were analyzed using chi-square and multivariate logistic regression with 95% confidence interval. At 79.5%, treatment success in the Keetmanshoop Health District was below the >90% recommended target set by the World Health Organization. Conclusion, treatment success outcomes were still below the target set by the WHO (>90%). Geographical location, distance to the health facility, unemployment, and adverse TB medication interaction were associated factors to unsuccessful TB outcome. The study promotes social change by providing actionable management strategies and policies to strengthen the control of TB/HIV programs for the prioritization of TB/HIV- coinfected patients at increased risk of experiencing unsuccessful treatment outcome in the Keetmanshoop District.

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Chapter 1: Introduction to the Study

Although it is the fourth, least densely populated country in the world, Namibia has been classified among the four countries with the highest rates of TB and HIV/AIDS infections in the world (World Health Organization [WHO], 2018). The country's estimated population was 2,633,918 million people in 2022 (Worldometers, 2020). Yet, at 446 cases per 100,000 persons, Namibia had the fifth highest TB case notification rate (CNR) in the world in 2020 (Kibuule et al., 2020). Similarly, Namibia had the second highest prevalence rate of HIV 17.2% in 2018 and co-infection among TB cases in Namibia was 66.9% in 2018 and the CNR was estimated to be three times higher than the national estimate in 2018 (i.e. over 1 000 cases per 100, 000 population) (Kibuule et al., 2019).

Namibia TB death rate was at level of 59 cases per 100,000 people in 2020, up from 57 cases per 100,000 people previous year, this is a change of 3.51 % (Knoema, 2020). Namibia has a generalized HIV epidemic, with 8.3% of the general population living with HIV (2020 Spectrum Model). HIV/AIDS was responsible for an estimated 3,052 deaths in 2020 in Namibia. (U.S. Presidency Emergency Plan for AIDS Relief [PepFar], 2020). This indicates that there is a high burden from each disease and a considerable co-infection rate. Indicating that the continued upward trajectory of TB rates makes it urgent to mount sustained efforts in the form of assessing the TB treatment outcome rate among TB/HIV coinfected patients to continue the fight against the disease.

Namibia is also included among the countries with very high rates of TB/HIV co-infection, with an HIV prevalence of 38% among TB patients in 2016 (Ministry of Health and Social Services [MoHSS], 2016b). Namibia also remains one of the country with the 2 highest HIV prevalence rate in the world, according to the Surveillance Report of the 2016 National HIV Sentinel Survey (MoHSS, 2016c) the prevalence rate was at 17.2% in 2020 (Jonas et

al.,2020). To put this in perspective it means that Namibia as country on average, about 4 out of every 10 patients with TB are also HIV-positive (MoHSS, 2016a). The rate of TB patients with known HIV status is 99% with 97% ART initiation among those who tested positive (PepFar, 2020).

Compounding these issues, HIV/AIDS and TB have merged into a deadly co-epidemic in Namibia. In absolute numbers, the country has the highest number of people living with HIV and TB (WHO, 2020). Government figures show an HIV prevalence of 38% among TB patients in 2016 (MoHSS, 2017b). With skilled health professional density: 31.5 per 10000 populations in 2007 (WHO, 2021). Yet, in Namibia one out of every 25 cases of TB is "lost/miss to follow-up" (L/MTFU). This has negatively affected national efforts to end the disease by 2035 (Kibuule et al., 2020). This scenario indicates that there is a high burden from each disease and a considerable co-infection rate with a calamitous TB outcome rate among the populace (Tanue et al., 2019).

Therefore, the continued upward trajectory and poor TB outcomes cases of TB cases makes it urgent to assess TB treatment outcomes among TB/HIV- coinfected patients in the Keetmanshoop District of the //Karas Region (Ejeta et al., 2018). Namibia stands at 561 TB incidence per 100 000 populations (WHO, 2016). There were 700 deaths in the country from TB-related infections in 2015 (MoHSS, 2015). Pulmonary tuberculosis (PTB) is an airborne infectious disease of the lower respiratory tract caused by *Mycobacterium tuberculosis (Mtb).* Treatment outcomes are important indicators of successful TB control policy.

Despite efforts to implement effective treatment for over five decades, it has been estimated that one-third of the global population has contracted TB, Glaziou et al. (2018) and 5–10% developed disease progression during their lifetime (WHO, 2018). Worldwide, TB causes an estimated 1.8 million case fatalities yearly, with approximately 80% of these deaths coming from 22 high-burden countries one of which is Namibia (Noppert et al., 2015). TB is

one of the top 10 causes of death and the leading cause from a single preventable infectious agent above HIV/AIDS (WHO, 2020). In 2019, an estimated 10 million people fell ill with TB worldwide (5.6 million men, 3.2 million women and 1.2 million children), the disease is present in all countries and age groups (WHO, 2020), but is curable and preventable (WHO, 2020). The increasing relationship between TB and HIV observed over the past 2 decades complicates TB control, among TB/HIV co-infected patients, especially in low income settings such as Keetmanshoop, Namibia (Letang et al., 2020).

The number of coinfections continues to distress the survival, health, and well-being of an enormous number of people (Azeez et al., 2018). Despite the noticeable wide spread antiretroviral scale up and contemporary diagnostic tools, models and treatment, HIV-associated TB continues to increase (WHO, 2020). Both structural and vertical risk factors, such as type of housing, overcrowding, and homelessness, and individual risk factors such as smoking, age, HIV/TB coinfection, and multidrug resistance have influenced this trajectory (Singh et al., 2020). Upstream economic forces and macro-level factors are also contributing factors (Adu, 2019; Stubs et al., 2019).

Despite a 2% decline in incidence rates annually in recent years (WHO, 2018a), global health leaders have attempted to definitively address the enduring global scourge of TB. The WHO launched the the End TB Strategy in 2014, with the goal of reducing global TB incidence by 90%, reducing mortality by 95%, and eliminating catastrophic treatment costs by 2035 (WHO, 2015). The importance of this global initiative was further underscored in 2015 by the high-profile incorporation of accelerated health targets into the United Nations Sustainable Development Goals, which aim to achieve an 80% reduction in global TB incidence and a 90% reduction in deaths by the year 2030 (United Nations [UN], 2015). Notwithstanding the groundswell of international support for achieving these health targets, global TB prevention and control efforts are now being threatened by myriad challenges. These include significant

gaps in funding; lack of access to diagnostic and treatment services in many resource-limited settings; and the emergence and transmission of multidrug-resistant TB (MDR-TB) strains across sub-Saharan Africa, Asia, and Eastern Europe (WHO, 2018a., 2018b).

Poor treatment outcome rates, treatment failure, and unsuccessful disease control program, coupled with continued transmission, have resulted in the emergence and spread of MDR-TB, (i.e., TB resistant to rifampicin and isoniazid drugs (Dheda et al., 2010). MDR-TB continues to present a global challenge to TB control efforts. Cure rates for MDR-TB are very low globally, ranging from 40% to 70% compared to the corresponding cure rates for drug susceptible TB that range from 75% to 95% in well-run TB control programs (Anderson et al., 2013). MDR-TB cure rates are lowest in Africa (mean 48%), particularly sub-Saharan Africa where HIV prevalence is also highest (Musa et al., 2017).

TB occurs in every part of the world. In 2019, the largest number of new TB cases occurred in the WHO South-East Asian region, with 44% of new cases, followed by the WHO African region, with 25% of new cases and the WHO Western Pacific with 18%. In 2019, 87% of new TB cases occurred in the 30 high TB burden countries including Namibia. Eight countries accounted for two thirds of the new TB cases: India, Indonesia, China, Philippines, Pakistan, Nigeria, Bangladesh and South Africa (WHO, 2020). TB is an old disease and studies of human skeletons show that it has affected humans for thousands of years (Hershkovitz et al., 2015), despite its 100 percent curableness (Nahid et al., 2016; Shah& Reed, 2014; WHO, 2015).

TB can occur among both people living with HIV and those without HIV, threatening treatment outcomes including survival rates. However, little is known about the association of successful TB treatment outcomes and HIV status in Namibia. Unsuccessful treatment of TB may lead to more adverse forms of drug resistant TB that are more difficult and expensive to treat and manage. Treatment for MDR-TB and XDR-TB was shown to often pose serious and

adverse side effects that in some circumstances may lead to non-adherence to treatment, which further makes the drug resistant forms of TB more difficult to treat (Htun et al., 2018), and hinders the outcomes poor. Untreated TB accelerates the development of HIV infection to AIDS (Ogyiri et al., 2019). This is due to the HIV epidemic that has greatly transformed the epidemiological sequence of TB, TB transforms the normal history (Carlucci et al., 2017; Rocha et al., 2003; Schutz et al., 2010).

On the other hand, HIV infection predisposes to the development of active TB, and the course of HIV-related immunodeficiency is worsened by active TB infection (Amare et al., 2015; Asebe et al., 2013; Tessema, 2009; Shastri et al., 2013). HIV fuels the TB epidemic, and increasing the likelihood of death (Babatunde et al., 2016; Gebremariam et al, 2016). TB-HIV co-infected people are experiencing high risk of mortality and rapid disease progression (Tola et al., 2019). It is a known fact that, treatment of co-infected patients can be complex because of overlapping drug toxicities and interactions (Ejeta et al., 2014; Shaweno &Worku, 2012).

Furthermore, HIV-positive TB patients are a challenge to TB services, as they are more likely to have diagnostic delays (Asebe et al., 2015; Shaweno &Worku, 2012; Nglazi et al., 2015; Clérigo et al., 2018), duration of treatment, frequency of drug administration, pill burden, and complications of therapy are some of the challenges associated with the coinfection (Ejeta et al., 2014; Sinshaw et al., 2017).

Also patients who are co-infected with HIV encounter different problems in the management of their disease like high loss to follow up rates, non-adherence and relapse rate (Babatunde et al., 2016; Ahmed et al., 2018; Saini et al., 2018).Co-infection adversely affects socio-economic development and challenges successful treatment outcome (Madan et al., 2018; Gebremariam et al., 2016), among TB/HIV co-infected patients.This is indicative that district notification, regional notification and national notification, including vital assessment of TB treatment outcomes rates, and registration systems need to be strengthened towards the

goal of direct measurement of TB incidence and mortality in Keetmanshoop District and Namibia in general. This further put forward the notion that there is a necessity for robust assessment of TB treatment outcomes among TB/HIV coinfected patients, because the understanding of these forces by both policy makers and healthcare givers will slow down the trajectory, and will result in higher outcome rate.

Active, transmissible TB disease develops in 2% to 10% of persons infected with *Mtb* who fail to receive and complete preventive treatment, while others remain latently infected or naturally clear the infection (Campbell, Chen et al., 2015; Cardona, 2010; Houben & Dodd, 2016; Kahwati et al.,2016; Lewinsohn et al., 2016; Raviglione & Sulis, 2016; Subedi et al., 2015; WHO, 2016a). One (1) in four deaths among people living with HIV can be attributed to TB, and many of these deaths occur in resource-limited settings especially in sub-Saharan Africa, this include Namibia, which accounts for approximately 40% of deaths in this population (Gupta et al., 2015). PLHIV have an increased risk of TB due to depletion of TB-specific T-helper cells increasing their risk (5–10% per year) of progressing from TB infection to TB disease (WHO, 2020).

PLHIV are more likely to advance from TB infection to TB disease as well as have accelerated disease progression, and both factors can contribute to outbreaks of TB in TB/HIV coinfected people. HIV also can increase the risk of recurrent TB disease in individuals with a history of prior TB (WHO, 2020). Approximately one-third of all deaths among PLHIV are attributable to TB, with over 95% of TB mortality occurring in low- and middle- income countries (WHO, 2017), including Namibia. TB preventative therapy (TPT) reduces the progression from infection to TB disease in PLHIV by up to 62% and reduces mortality by up to 39%, both being independent of ART status (Abossie, 2017; Badje, 2017). An estimated 30 % of HIV infected persons have dual infection with TB (WHO, 2018). Although infection with *Mtb* exists on a spectrum of non-infectious latency to active disease. It is estimated that nearly

one quarter to one third of the global population is asymptomatically infected with *Mtb* with an additional 1% newly infected each year (Campbell, Chen et al., 2015; Cardona, 2010; Houben & Dodd, 2016; Hartman-Adams et al., 2014; Moghaddam, Moghadam, Khademi, Bahreini, & Saeidi, 2016; Subedi et al., 2015; WHO, 2016a).

The WHO defines TB treatment success as documented cure or completion of anti-TB therapy (ATT); unsuccessful TB treatment outcomes include death, treatment failure, default from care/loss to follow-up (LTFU), or unknown outcome (WHO, 2018). Treatment success is when a patient is cured or completed treatment. Treatment outcome monitoring Kedebe (2020), serves as a tool to assess the TB treatment quality provided by the health care system. A more comprehensive understanding of the epidemiology of TB treatment outcomes for adults co-infected with TB/HIV as well as the factors associated with treatment outcome may assist TB control programs to more appropriately deploy resources to improve treatment completion rates and subsequently improve population health. Funding for the provision of TB prevention, diagnostic and treatment services has more than doubled since 2006 but continues to fall short of what is needed (WHO,2019).

Compared to HIV-negative individuals, studies have shown that HIV/TB co-infected individuals are less likely to have successful TB treatment outcomes.

The menace of progressing from latent to active TB has been estimated to be about 20 times greater in PLWHA than among those without HIV infection with a higher risk of transmitting the infection to others (Luetkemeyer, 2018). Indicating that without treatment it is projected that on average 1 in 10 people with latent TB infection will get sick with TB disease in the future (CDC, 2018). Treatment and TB treatment outcomes is essential to controlling TB since it substantially reduces the risk that latent TB infection will progress to TB disease (CDC, 2018). Moreover, the risk remains significantly higher even after immune reconstitution with antiretroviral therapy thus, signifying that there is a need for a collaborative approach,

monitoring of TB treatment outcomes rates to identify and better manage TB in this population to achieve succefull TB treatment outcomes among TB/HIV co-infected patients. Globally, it has been found that TB incidence is decreasing at about 2% per year.

This needs to accelerate to a 4–5% annual decline to reach the 2020 milestones of the End TB Strategy (WHO, 2018). If the decline in frequency carry on at this rate of 2%, this indicates that it will not be conceivable to reach the 80% reduction in TB incidence that is necessary for meeting the End TB Strategy target and the Sustainable Development Goal of Ending the TB epidemic by 2030 (WHO,2015). In 2018, an estimated 10 million incident TB cases and 1.5 million TB deaths occurred reductions of 2% and 5%, respectively, from 2017. The rationale is that; successful TB treatment outcomes has a positive significant effect on the overall control of TB among HIV co-infected patients.

Therefore, completing prescribed medication in active cases is of prime importance to TB control programmes (WHO, 2020). This support the estimates that diagnosis and successful treatment of people with TB prevents millions of deaths each year (an estimated 54 million over the period 2000–2017), however, there are still large and persistent gaps in assessing succefull TB outcomes rate, detection, treatment, monitoring and documenting successful TB treatment outcomes among TB/HIV coinfected patients (WHO, 2018), to reach the required targets.

A dynamic interaction exists between TB and HIV infection. TB accelerates the progression of disease in PLHIV, and PLHIV have increased susceptibility to TB infection. TB is a major cause of mortality among PLHIV, while HIV has been found to be responsible for failure of TB-control programs in achieving targets and rates set out by WHO, particularly in high-burden countries. The joint effect of HIV and TB pestilences has confronted the feeble systems of healthcare in resource-limited countries (Azeez, Ndege, & Mutambayi, 2018; Carlucci et al., 2017). In these resource-poor settings, limited data exist both on treatment

outcomes and ways to carry out interventions. As a result, assessing the treatment outcomes of TB and identifying its associated factors is an integral part of the intervention that will significally contributes to the successful and higher TB treatment outcomes among TB patient with HIV. WHO (2018), also recommends that TB treatment completion outcomes be monitored, as monitoring is a vital part of the surveillance needed to successfully eliminate TB.

However, in Namibia there is a paucity of data on treatment outcomes among TB/HIV coinfected patients who had successful TB treatment outcome, is not well known or ascertained. Hence, it is imperative to identify the factors associated with poor treatment rate of TB and HIV to assess whether HIV status and use of anti-retroviral treatment in HIV co-infected TB patients have significant effect on the treatment outcomes of TB, in order to make appropriate recommendations.The success or otherwise of the implementation of the TB/HIV control strategies will determine whether the second objective of the STOP TB strategy (Protect vulnerable populations from TB, TB/HIV and multidrug-resistant TB) as well as Goal-3 of the Sustainable Development Goal (SDG) which emphasized healthy lives and well-being for all; could be achieved (Tola et al., 2019).

Therefore, this study sought to determine the success treatment rate outcomes of TB patients coinfected with HIV and associated factors in Keetmanshoop Health District of the //Karas Region. Also to assess the outcomes of patients registered for anti TB treatment, and to identify factors associated with treatment outcomes of tuberculosis. An understanding of such relationship will contribute to policy makers and healthcare providers to develop strategies to target such groups and improve on treatment outcomes rate in Keetmanshoop District. Assessing TB treatment outcomes and contributing factors through a continued research can assist policy makers and healthcare providers in planning interventions to overcome the barriers and improve patient treatment response and outcomes. Moreover, it can also serve as an indicator for the quality of TB treatment provided. This study focuses on all

these contributing factors of succesfull and unsuccessful treatment outcome for a better risk assessment and stratification of TB patients and identify effective surveillance and management strategies to strengthen the control programs of TB/HIV coinfected people in Keetmanshoop District.

This will be done through sustained strengthening and expansion of the regional and national TB/HIV programmes policies for successful treatment outcomes. This study investigated these issues using secondary data collected from the Health Information System (HIS) data base in the Keetmanshoop State hospital, //Karas Region.

Background

WHO's (2019), public health approach has played a pivotal role in the management of TB (and HIV and AIDS) in low-and middle-income countries. This approach stresses standardized and simplified treatment protocols, decentralized service delivery to reach large numbers of people primarily through the public sector, and engagement with lower- level healthcare workers to deliver care. In some programs, it involves the provision of free healthcare services to the public. The historical and more recent declines in TB burden have largely happened alongside improvements in socioeconomic indicators (Trauer et al., 2019).

Although Namibia is among the countries that are worst affected by TB, significant improvements have been made in the country in terms of TB diagnosis, treatment, and care (MoHSS, 2019). However, regional trends have continued to show variations in case notification, and some regions have had better treatment outcomes than others (MoHSS, 2019). This occurrence can be partially attributed to the vastness of the country and differences in terms of resource availability and distribution.

Namibia remains one of the countries with the greatest burden of TB and HIV (MoHSS, 2016). Assessing successful TB treatment outcomes is one TB control measure. Furthermore,

adherence to TB therapy is an important factor in treatment outcomes, which is a critical indicator for evaluating TB treatment programs (Sariem et al., 2020).

In the in the current study, I assessed TB treatment outcomes and associated factors in Keetmanshoop District of the //Karas Region in Namibia. The increasing bidirectional synergetic relationship between TB and HIV observed over the past two decades poses unparalleled health challenges to TB control, among TB/HIV- co-infected patients in Namibia especially in the Keetmanshoop District (Letang et al., 2020). This is especially so in low-income settings such as Keetmanshoop District, Namibia. Millions of people continue to fall sick with TB each year (WHO, 2019). A total of 1.4 million people died from TB in 2019 (including 208 000 people with HIV) (WHO, 2020).

Worldwide, Namibia was ranked seventh among 20 high TB burden countries based on an absolute number of incident cases in 2018 (WHO, 2019). It was one of 10 high TB burden countries in 2018 based on the severity of disease burden incidence per capita (WHO, 2019). Successful treatment outcomes of TB vary from country to country, nonetheless, several studies have reported age, biological sex, comorbidity, underlying health conditions, pre-treatment weight, and financial status or family support as factors that influence treatment outcomes of TB in sub-Saharan Africa (Abebe et al., 2019; Peltzer & Low, 2014). Researchers have found comorbidity with HIV to be strongly associated with TB treatment outcomes (Tola et al., 2019; Abebe, 2019; Peltzer & Louw, 2014).

Moreover, most studies report that being male, being an older adult, and having a large family size are associated with unsuccessful treatment outcomes in sub-Saharan Africa (Peltzer & Louw, 2014; Aliyu et al., 2018). According to WHO (2019), about 6 million adult men globally contracted TB and around 840,000 died from it in 2017. Roughly 3.2 million women contracted, and nearly half a million adult women fell ill and died from, TB in 2017 (WHO, 2019). However, the factors influencing treatment outcome may vary from one setting or region

to another. For instance, other researchers reported successful treatment outcome rate of 82.5% in the Volta region, 90.2% in the Central region, and 90.7% in the Greater Accra region of Ghana (Ohene et al., 2019; Tetteh et al., 2018).

Assessing TB treatment outcomes and understanding the specific reasons for poor treatment outcomes is important for stakeholders working to improve the management of TB/HIV co-infected patients (Ahmed et al., 2018; Beyene et al., 2016; Sileshi et al., 2013; 2016; Sileshi et al., 2013; Sinshaw et al., 2017). The WHO (2020) noted that a good performing tuberculosis program should achieve at least a 90% treatment success rate and 85% cure rate. These targets contribute to the effective reduction of tuberculosis transmission at household and community levels, and in reducing tuberculosis related complications and mortality (British HIV Association [BHIVA], 2019).

Nonetheless, TB control programs all over the world have challenges in meeting the recommended treatment success target rates particularly for persons with new bacteriologically confirmed pulmonary tuberculosis (BC-PTB) diagnosis, diagnosed with coinfections of TB/HIV. According to current data, global treatment success rate for persons with new BC-PTB diagnosis improved from 82% in 2016 (STOP TB PARTNERSHIP, 2017), to 85% in 2017 (WHO, 2019), although recommendable, it is still lower than the desired target of at least 90%. Sub Saharan Africa including Namibia has the highest burden of TB and the slowest decline in the number of TB incident cases (WHO, 2018), and suboptimal TB treatment success rate (Izudi et al., 2019).

Recent systematic review and meta-analysis show a treatment success rate of 76.2% among persons with BC-PTB in sub-Saharan Africa over the past 10 years Izudi et al. (2019), far below the global treatment success rate of 85% (WHO, 2019) and the WHO recommended rate of at least 90% (WHO,2018).This meta-analysis also shows that sub-Saharan Africa, including Namibia may be experiencing a gradual but steady decline in successful TB treatment

outcome rate (Izudi et al.,2019).There is therefore a need to conduct research that can inform interventions to improve treatment success rate particularly in Keetmanshoop District where the burden of TB and HIV are both very high.

In 2018, 7 million new TB cases were notified to national authorities and reported to WHO (WHO, 2019). This reflects a significant gap of 3 million between incident and notified cases. Ten countries accounted for about 80% of the gap, with India, Nigeria, Indonesia and the Philippines accounting for more than half of the total (WHO, 2019).Therefore, the rationale is reducing the risk of reactivation by treating and monitoring the successful outcomes of TB treatment not only in TB/HIV coinfected patient but TB in general, this can prevent masses of deaths and morbidity, saves the health care system and public resources, and ensures those infected suffer minimal to no lifelong consequences from disease, but enjoy good quality of life and good health prognosis. The quick recognition of signs and symptoms consistent with TB disease and initiate TB treatment minimizes transmission and leads to more rapid cure of the individual via treatment (Nahid et al., 2016).

The combination of rifampin (RIF), isoniazid (INH), pyrazinamide, and ethambutol, collectively referred to as RIPE, are recommended for administration in one of four different regimens and over two distinct phases for at least 6 months in persons with active TB (CDC, 2013b; Nahid et al., 2016). For patients with newly diagnosed pulmonary tuberculosis, the preferred regimen consists of daily RIPE for a duration of 8 weeks or 56 doses (intensive phase) followed by RIF and INH for an additional 18 weeks or 126 doses (continuation phase) (Nahid et al., 2016). In most parts of the world, including Keetmanshoop Health District, this regimen is delivered under directly observed therapy-short course (DOTS), which manage TB disease. The DOTS strategy is the most cost-effective public health approach to fight TB. Given under the supervision of the health care provider to improve compliance and ensure no adverse events take place. Under most circumstances, treatment of active TB spans 6 months; however,

complicated disease or drug resistance can extend the treatment time drastically (Nahid et al., 2016).

Whilst, treatment for TB and HIV (and Co-morbidities) the preferred 1st line ART regimen for TB-HIV patients: TDF + FTC (or 3TC) + EFV (at 600mg once daily) – Inclusion of Dolutegravir-based regimen as alternate 1st line TDF + FTC (or 3TC) + DTG (at 50mg twice daily) – For patients on PI-based regimens: Option 1: Substitute rifampicin in the TB treatment with rifabutin Option 2: If Rifabutin is unavailable or contraindicated, maintain rifampicin in TB treatment and use PI based regimen super boosted with ritonavir (TDF or AZT + 3TC with LPV/r 400mg+ritonavir 400 mg BD) – If PI, DTG or EFV-based regimens cannot be used in patients on rifampicin, consider Triple nucleoside regimen temporarily (MoHSS,2019).

TB and HIV (2) TB Preventive Therapy – Recommended to use TPT as a general term rather than IPT – TPT regimens 9H - 9 months of isoniazid alone – Current recommended regimen for PLHIV in Namibia. The following are acceptable alternatives when adequately justified & with consultation – 36H – Isoniazid alone for at least 36 months – 3HP – Isoniazid (weekly) and rifapentine (weekly) for 3 months – 6H – Isoniazid alone for 6 months (MoHSS, 2019). TB presentation in PLHIV TB is common in people living with HIV. The diagnosis of TB in the HIV-infected patient can be challenging (MoHSS, 2019).

The HIV-infected TB patient whose immune system is relatively intact may present in the same manner as TB in HIV-negative patient, with typical symptoms such as cavitary or upper lobe pulmonary disease, positive sputum smear microscopy, etc. However, the HIV-infected TB patient with advanced immunodeficiency is more likely to present with sputum-smear negative pulmonary disease and disseminated TB (blood borne, extra-pulmonary), making a firm diagnosis (with positive sputum smear or culture) more difficult (MoHSS,2019). TB preventative therapy (TPT) reduces the progression from infection to TB disease in PLHIV

by up to 62% and reduces mortality by up to 39%, both being independent of ART status (Abossie & Yohannes, 2017; Badje et al., 2017; Whalen et al., 1997).

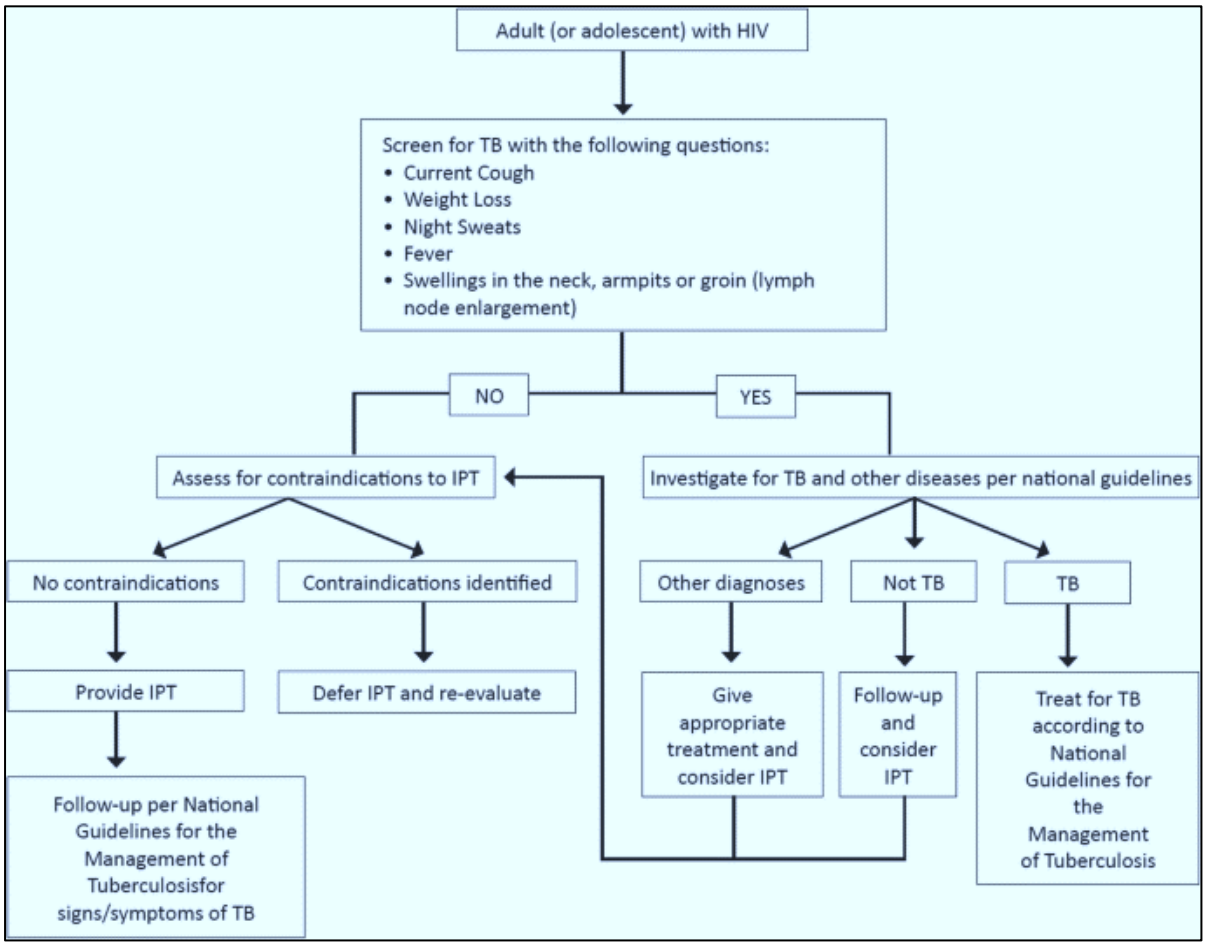
Responding to these challenges, Namibia has been working towards implementing WHO recommendations for prevention of tuberculosis in PLHIV, including scaling up of TPT, treatment of TB disease, and early antiretroviral therapy (ART) initiation (WHO, 2011). TPT was introduced in Namibia as a nation-wide program in 2006/07 (MoHSS, 2018). In 2014–15, this project was initiated to quantitatively and qualitatively evaluate TPT services in Namibia.

Globally, a variety of challenges have been described with respect to the implementation of TPT in resource-limited settings Surie et al. (2019), including supply problems; Teklay et al. (2017), medication side effects Maharaj et al.(2017), substandard monitoring and evaluation activities Getahun et al. (2010), inadequate health care infrastructure; Cowan et al. (2013), poor TB screening practices; Charles et al. (2016), limited understanding of TPT by prescribers Lester et al. (2010), and patients Gust et al. 2016; Mindachew et al. (2016), limited access to health care (Jacobson et al., 2016); HIV stigma (Ayele et al., 2016) and socio-economic issues that undermine household security (Codecasa et al., 2013; Makanjuola et al., 2014).

In Namibia, though all PLHV > 5 years old are eligible, it was not clear to what extent PLHIV were screened for TB or, when eligible, how many initiated and completed TPT. Also, challenges associated with implementation of TPT remained ill-defined, though step-wise instruction on TB symptom screening and treatment is included in the National ART and TB Treatment Guidelines (MoHSS, 2014).

Figure 1

Algorithm for Screening and Isoniazid Preventive Therapy Among Adults and Adolescents With HIV



The global magnitude of TB underreporting was 40% in 2017, and the three attributable factors were under-diagnosis, underreporting, and challenges with TB estimates (Chin & Hanson, 2017; WHO, 2018a). TB reporting is part of the WHO standards of TB care (WHO standard 27) (WHO, 2018c) which states that "all health care providers must report both new and retreatment TB cases and their treatment outcomes to national public health authorities conform applicable legal requirements and policies."

TB reporting is a process of reporting diagnosed TB cases from all care providers to relevant health authorities which in turn report to WHO (Uplekar et al., 2016) and this process involves people, people with the right qualifications, processes, and tools with clear roles and responsibilities; standard definitions, standard reporting tools, and, guidelines (Ali et al., 2018;

WHO, 2014). Therefore, TB underreporting covers TB cases diagnosed, detected in health care facilities records but not present in the TB registers of the corresponding public health department (Morales-García et al., 2015).

In Namibia there are inherent problems with this, TPT is underreported in Namibia due to incomplete data collection for PLHIV in whom TB has been excluded or is suspected because data, from symptom screening to treatment, is captured piecemeal across two electronic and three paper data registries (Roscoe et al., 2020). These registries include: the electronic patient management system (ePMS) (captures HIV and TPT data, but not active TB data) and the electronic TB register (ETR) (captures active TB data); as well as the paper patient HIV care booklet, TB register, and TPT register (formally IPT register) (Roscoe et al., 2020). Both electronic and paper databases are susceptible to incomplete data entry, and ePMS and ETR are prone to transcription errors when entering data located in paper registers. As well, data concurrence across registers can be inconsistent, and implementation of TPT in Namibia at the facility level is also thought to be highly variable (Roscoe et al., 2020).

It is worth mentioning that, it is increasingly well-established that upstream economic forces reduce fiscal space for national governments to invest in health and social programs, thereby limiting the recruitment and retention of adequate numbers of well-trained medical and nursing personnel needed to address the various challenges in health systems. Such policies also limit investing in social protection in general (Stubbs et al., 2017).

Direct measurement of TB underreporting or under-diagnosis is challenging especially in TB high endemic countries such as Namibia where presumptive TB cases can access care either in the private, public or other non-NTP facilities without effective referrals or linkages (WHO, 2012). Another challenge to direct TB measurement in High TB Burden Countries (HBC) is the fact that individuals have no unique identification number or there is a lack of a comprehensive database for TB patients (WHO, 2012). Inventory studies are widely used to

assess the magnitude of TB underreporting by comparing the number of TB cases meeting the standard definitions recorded at health care facilities (public or private) with the TB cases notified to the local and national authorities] (Sismanidis et al., n.d.; WHO, 2012). These comparisons between facility data and local or national databases require 'record linkages' which can be done by deterministically (using unique identification number) or probabilistically using a combination of patient characteristics (for example, age, sex, phone number) (Sismanidis et al., n.d.; WHO, 2012).

The following are important facilitating factors for conducting quality inventory studies: availability of case-based data at all reporting levels and not only aggregated data, use of standard definitions by all health care providers, adequate staffing, involvement of care providers outside the NTP network, and existence of at least three fairly independent data sources (Sismanidis et al., n.d.; WHO, 2012). TB underreporting is a symptom of a broader public health surveillance problem and functionality of the general health system. The magnitude of TB underreporting varies between nations and within the same country (Uplekar et al., 2016).

Sismanidis et al. (n.d.) stated that: TB underreporting found was context-dependent ranging around 15% in European countries, 20% in Africa, 30% in the Eastern Mediterranean region, and 50% in countries in Asia with a large private sector. Studies in different countries found different results, for example, Mlotshwa et al. (2017) reported a magnitude of 34% underreporting of smear-positive TB cases between facility paper-based records and the NTP records in Kenya. Similar findings were published by Bassili et al. (2010), Furtado da Luz & Braga (2018), Morales-García et al. (2015), and Fatima (2015) with underreporting of 29% in Yemen, 40% in Cape Verde, and 14.4% (0 to 45.2%) in Spain and 27% in Pakistan, respectively. The TB inventory study in Lagos reported an estimated TB underreporting of 42% (Mitchell et al., 2018). Non-Adherence to disease reporting and notification is not only

related to TB but to most notifiable diseases (Aniwada & Obionu, 2016; Iwu et al., 2016; Phalkey et al., 2015). The common challenges with surveillance systems by health care workers include low awareness of their roles, ignorance on the reporting guidelines, reporting tools, processes, and the list of the notifiable diseases. Further considerations are cumbersomeness of the TB reporting tools, workload, and inadequate capacity to complete the TB reporting tools, and weak coordination and communication between the different levels of reporting (Iwu et al., 2016; Abubakar et al., 2013; Ledikwe et al., 2014).

In China over a quarter of TB cases recorded in the internal hospital records were not entered into the national TB reporting systems, leading to an under representation of national TB cases. Factors associated with underreporting included unqualified and overworked health personnel, poor supervision and accountability at local and national levels, and a complicated incohesive health information management system (Zhou et al., 2019).

Similarly, there is also evidence that India, Namibia, and Thailand all suffer from a lack of national data standardization and accessibility Zhou et al., (2019), and might not accurately report the number of confirmed TB cases. It is also reasonable to assume that many other low- and middle-income countries without high functioning health information management systems could face similar problems. The underreporting of TB impacts the capacity to accurately evaluate the epidemiology of the disease. Therefore, a reliable TB surveillance and reporting system is essential for accurately mapping the disease and developing appropriate strategies to meet the WHO End TB Strategy.

It is widely agreed notion that TB rates mirror the economic and socio-cultural conditions within a country, as well as other macro-level or structural determinants of health (Adu et al., 2019). As a disease of poverty, TB in Namiba is driven by structural and upstream forces and is disproportionally affecting the economically disadvantaged and marginalized in society, with highly uneven distribution globally (Adu et al., 2019). With respect to TB itself,

a recent modelling analysis of the 22 high-burden TB countries in which Namibia is included, added to the evidence that macro-level factors have a significant impact on TB incidence (Adu et al., 2019).

This added further proof to previous predictive modelling that demonstrated that global TB incidence would be reduced by 84·3% if poverty were eliminated; and implementation of social protection measures alone would reduce tuberculosis incidence by 76.1% (Carter et al., 2018). Numerous studies have indeed shown that incentives such cash transfers to patients with TB might improve treatment outcomes (Boccia, 2016; Klein, 2019; Oliosi, 2019; Ukwaya, 2019), including food parcels, however any incentive or motivation should be given at the health centres with strict controls or through biometrics techniques. This support further evidence to previous predictive modelling that demonstrated that global TB incidence would be reduced by 84.3% if poverty were eliminated; and implementation of social protection measures alone would reduce TB incidence by 76.1% (Carter, et al. (2018), as mentioned early.

Additional, worth revealing in this this paper, I use the terms "upstream", "systemic" or "macro-level" factors, this refer to processes that modify or affect traditional proximate risk factors of TB disease (Adu et al.,2019). Notwithstanding the debates and nuances each of these terms hold, I used this these terms interchangeably throughout this writing. Proximate factors are those circumstances related to direct exposure to infectious droplets (including what are sometimes referred to as "meso-level" factors such as hospital infection control measures) and/or individual level factors ("micro-level") that impair the host's defense against TB (such as [HI]V, malnutrition, tobacco smoke, alcohol, silicosis, diabetes and others).

TB's systemic foundations in Namibia, was created as a result of the Apartheid system and Karim et al. (2009), stated that, the social, economic and environmental conditions that were created in Namibia as a result of the dragonian Apartheid system have favoured the growth and transmission of TB (Karim et al., 2009). Subsequently, Weyer et al. (2009),

identified the bequest of neglect of the disease, to poor management and the fragmented health services as the main drivers of the TB epidemic in Namibia. Namibia inherited a fragmented health care system based on racial line from the Apartheid South African regime. Echoieng the same sentiments Adu et al. (2021), stated that other barriers to effective TB control have been identified as the HIV epidemic, poor socioeconomic conditions and the shortage of human resources for health. Notwithstanding these recent studies, evidence base regarding government policy responses to known local socioeconomic factors are hindering the successful TB treatment outcomes.

Separately , it is worthwhile to mention that albeit the extensive general discussion of the effects of upstream forces on health which also affects the succefull TB treatment outcomes among TB/HIV co-infected patient in Namibia , there has been limited empirical studies, let alone systematic evidence from a quantitative angle documenting policy responses to such pathways in the area of successful TB treatment outcomes and its associated factors among TB/HIV Co-infected patients in Keetmanshoop District Namibia ,thus the gap still remains.

The rationale is treatment success is an indicator of the performance of national tuberculosis control programme, and that discordance between perceived succefull TB treatment outcomes and its associated factors may point out gaps and suggest the need for further policy considerations and studies. Furthermore, the percentage of patients treated successfully is a key indicator for monitoring and evaluating the effectiveness of the TB DOT program (Kedebe, 2017).

In addition to the obvious benefit to individual patients, successful treatment outcomes of infectious cases of TB is essential to prevent the spread of the infection. However, it is founded that there is lack of evidence on the individual patient TB treatment outcomes of TB patients co-infected with TB/HIV. It is also relevant to understand the differential patient

completion outcome rate of HIV co-infected TB patients and to identify and assess the risk factors that are associated with these.

Furthermore, there are no readily available data describing successful TB treatment outcomes among adult co-infected with TB/HIV in the Keetmanshoop District of the //Karas Region Namibia. Albeit, routine monitoring and surveillance of the extent of the TB treatment outcome and its associated factors is important, very few if no studies were conducted in the Keetmanshoop District of the //Karas Region, Namibia. Therefore, the urgency to investigate the assessment of successful TB outcomes and its associated treatment factors among TB/HIV co-infected patients in the Keetmanshoop District of the //Karas Region, Namibia to ascertain how these perceived successful outcomes of TB are being addressed and to reduce the TB disease burden and increase favourable outcomes among TB/HIV coinfected patients.

Factors That Influence the Utilization of Health Care Services

General factors that are associated with or contribute to the use or neglect of health care services by patients in all areas of medical services are discussed in this study. I felt that it was necessary to provide a more detailed analysis that better defines these factors and barriers starting with overview of barriers to medication adherence. The following are five barriers that may hinder or prevent consistent adherence to medication for people living with HIV and TB and are like those which also hinder or prevent steady adherence to antiretroviral therapy for the treatment of HIV.

Access to Healthcare

Perhaps one of the greatest barriers is situated within the context of the disparities known to characterize healthcare. Health inequalities throughout the course of life frequently begin at early ages. When precarious circumstances expose young people to acute events and chronic stressors while simultaneously providing fewer resources with which to control and regulate these negative influences on one's overall health (Horwitz, 2005). Despite advances

in healthcare, difficulty in accessing healthcare persists for people with limited resources (Burbank, 2006; Emlet, 2004).

Personal Belief Systems

Adherence is moderated by factors that are culturally sensitive and/or multi-level in scope (Jin et al., 2008; Nicca et al., 2007). Included here are personal belief systems, as these hold the potential to influence adherence to medication, particularly for people living with HIV and TB. Does an individual believe that medication will be effective in treating TB or HIV? Is another means of treatment preferred? When levels of adherence are sub-therapeutic, consideration should be given to individual beliefs about medications (Jin et al., 2008; Kalichman et al., 2006; Reynolds et al., 2004) and the feasibility of complying with these medication (Fletcher et al., 2005; Kalia et al., 2006; Reynolds et al., 2004), as individuals may doubt their abilities to adhere to medication regularly (Jin et al., 2008; Johnson et al., 2006; Kalia et al., 2006).

Lack of Trust within the Patient-Physician Relationship

Missing from the barriers to adherence is trust. Patient trust is difficult to define, even within a single discipline (Hall et al., 2002). The ability to trust may be directed at individuals, society, and/or the systems that constitute society (e.g. the healthcare system). Varying amounts of trust may be present. For instance, patients may trust their own physicians that they started the treatment with or health care worker and yet distrust the rotation of healthcare workers or government healthcare facilities Whetten et al. (2006) or the healthcare system in general (Armstrong et al., 2006; Corbie-Smith & Ford, 2006).

Research suggests that individuals living with HIV/TB and who trust their healthcare providers follow through with out-patient visits on a more frequent basis, make fewer visits to the emergency department, and adhere to medication regimens while demonstrating improved mental and physical health as compared to individuals living with HIV and who distrust their

healthcare providers and the healthcare system (Johnson et al., 2012; Whetten et al., 2006).Thus, higher levels of trust in one's physician or health care worker may facilitate adherence to medication (Fiscella et al., 2004; Haskard et al., 2009; Johnson et al., 2012), such as medication for people living with HIV and TB.

Study Setting

In order to have a clear understanding of the problem, it is important to have some background information of the area in which the study will be conducted. Grove, Gray, and Burns (2015), describe the research setting as the site or location used to conduct a study (p. 276). The study setting will be natural because, the researcher will not manipulate or change the environment for the study (Grove et al., 2015, p. 277). Geographically, Namibia is located in South-West Africa and has a land surface area of 824,295 km2 making it Africa's fifth largest country.

Based on Woldometer (2020) elaboration of the UN's data of of 2020, the countries population was estimated at 2, 622,436 million people in 2020, with just over half of the population (51.1%) living in rural areas and 48.9% in urban areas (NSA, 2015). Namibia has an ethnically and culturally diverse population with eleven different language groups. Namibia is divided into 14 administrative regions that are further subdivided into 35 health districts (MoHSS, 2016).

The //Karas Region is the southern most and least densely populated of the 14 regions of Namibia; its capital is Keetmanshoop. The name assigned to the region reflects the prominence of the //Karas mountain range in its southern part. According to Knoema (2020), the population of Keetmanshoop is at around 20,977 and the population of //Karas Region is at around 77,421, density 0.48/km2 (1.2/sq. mi) and covers an area of 161,514 km² (62,361 sq mi) (Knoema, 2020). The District has 8 public health care facilities (5 primary health care clinics, 2 primary health care centres, one (01) district hospital which serves as regional

hospital, two health centres and four PHC and a number of outreach points. TB patients are served at the health facilities and at the TB DOT point (a container at the location in Keetmanshoop peri-urban) (MoHSS, 2016). The PHC clinics include A, B, C and D clinic, while the health centres are A and B.

Patients diagnosed with tuberculosis usually come to designated health facility to collect their tuberculosis medicines either on a daily basis, or after every two weeks or monthly to refill their medicines, while those hospitalized drink their medications under nurses' supervision in the ward. The clinics and health centres are involved in providing minor treatments and follow up care to the communities. There is also a military sick bay, but this is responsible for military personnel only. TB patients, who are soldiers (military), are registered in the district TB register at the TB clinic of the MoHSS, but they attend their own DOT services at the military sickbay in the army base in Keetmanshoop.

//Karas Region was selected because of its high TB CNR of over 996 cases per /1000 per 100,000 population) estimated to be three times higher than the national estimate, thus making //Karas Region a hotspots and interest of study (Kibuule et al.,2019). Because of high prevalence of HIV co-infection among TB cases at 66.9% (Kibuule et al., 2019). Because of its high MDR TB and high defaulter rate of 6%, TB failure rate of 8%, defaulter rate of 6% and fatality rate of 7% for treatment outcome of new smear positive TB cases, in 2011, death rate was 14%, failure rate 9% (MoHSS, 2016). Furthermore, the Districts health facilities are sparsely located and outreach services are far and in-between and most of the times not available. There are still practices of relief duty at remote clinics on a regular basis, because of shortage of permanent health care workers at remote health facilities.

Problem Statement

Much is known about the transmission, etiology, epidemiology, risk factors, signs and symptoms, and prevention methods of TB and HIV. Researchers have also learned how TB

and HIV progress in stages and infects individuals as a single disease or in combination, and what the unique health and social challenges posed by coinfection are (WHO, 2018). Alas, much is unknown about TB outcomes in HIV co-infected individuals. Specifically, there is a lack of knowledge of this double infection challenges the TB treatment outcome, and causes morbidity and mortality among TB and HIV-coinfected adult individuals (Tanue et al., 2019). TB and HIV co-infection challenges treatment and worsens the TB treatment outcome (Tanue et al., 2019). Globally, TB incidence is falling at about 2% per year and between 2015 and 2019 the cumulative reduction was 9% WHO (2020), and in most regions it is not fast enough to reach the first (2020) milestones of End TB Strategy (WHO,2020). This was less than half the way to the End TB Strategy milestone of 20% reduction between 2015 and 2020 (WHO, 2020).

Ending the TB epidemic by 2030 is among the health targets of the United Nations Sustainable Development Goals (SDGs) (WHO, 2020). A total of 1.4 million people died from TB in 2019 (including 208 000 people with HIV). In 2019, an estimated 10 million people fell ill TB worldwide (WHO, 2020). In 2019, the 30 high TB burden countries accounted for 87% of new TB cases (WHO, 2020). Eight countries account for two thirds of the total, with India leading the count, followed by Indonesia, China, the Philippines, Pakistan, Nigeria, Bangladesh and South Africa (WHO,2020). It is estimated that 44% of people living with HIV and TB are unaware of their coinfection and are therefore not receiving care (UNAIDS, 2020).

Complicating this issue is that at the national regionaland district level, TB and HIV data might be underreported, and not sufficient to understand, and plan the full burden and outcomes rates of TB and HIV. Because TPT is underreported in Namibia due to incomplete data collection for PLHIV in whom TB has been excluded or is suspected because data, from symptom screening to treatment, is captured piecemeal across two electronic and three paper data registries (Roscoe et al., 2020). Hence, the current national-, regional-, and district- level

data on the outcomes rates among TB and HIV- coinfected might not be the true reflection of the situation in the Keetmanshoop District of the //Karas Region, Namibia (Roscoe et al., 2020).

Therefore, this study is important because it includes data measures on successful TB treatment outcomes and associated factors in TB/HIV- co-infected patients in the area. In Keetmanshoop District, screening, enrolling and initiating for TB and HIV and data capturing are done by community councillors with little or no education in statistics and/or data capturing. Hence, questioning the true scale and reflection of the public health problem in the Keetmanshoop District. HIV and TB form a lethal combination, each speeding the other's progress. In 2019, about 208 000 people died of HIV-associated TB. The percentage of notified TB patients who had a documented HIV test result in 2019 was 69%, up from 64% in 2018. In the WHO African Region, where the burden of HIV-associated TB is highest, 86% of TB patients had a documented HIV test result. Overall in 2019, 88% of TB patients known to be living with HIV were on ART (WHO, 2020).

Co-infection with HIV is associated with significantly increased likelihood of mortality from TB disease, and HIV co-infected TB patients have significantly lower cure rates and lower treatment success rates compared to non-HIV infected TB patients (Ali et al., 2016). HIV patients with active TB disease have a probability of dying of 15–20 % at 1 year while those without active TB disease have 7–8 % probability of dying at 1 year (Ali et al., 2016). Furthermore, reports also indicate that people living with HIV are 20 to 21times more likely to develop active TB than those HIV negative people (Luetkemeyer, 2018). In general, TB affects about one-third of the 36.7 million people living with HIV worldwide (Kebede, 2017).

Even though, the implementation of DOTS increases treatment success and decrease transmission of resistant TB, TB kills over 4000 people, every day (WHO, 2020), Global TB incidence is still growing at 1% a year due to the rapid increase in Africa, including Namibia

and especially affects the most vulnerable such as the poorest, unemployed and the malnourished. It is not clear which factors are major contributors to poor outcome of TB patients in the Keetmanshoop Health District //Karas Region. Therefore, this study will assist in forecasting TB treatment outcome and identifying factors that can help to forecast poor treatment outcome which will help to identify those patients that are at a higher risk of poor treatment outcome while being treated with anti-TB medication. In, Namibia for TB control, public health officials currently emphasizes control contact tracing for immediate household contacts and, to a certain extent, self-reporting (MoHSS, 2019). This scenario has the potential to miss other forms of TB transmissions and to contribute to unsuccessful TB outcomes among dual infected patient (MoHSS, 2020).

Complicating this issue is that, at the national, regional, and district level, TB and HIV data might be under reported, and not insufficient to understand the full burden and outcome rates of TB and HIV, due to incomplete data collection for PLHIV in whom TB has been excluded or is suspected because data, from symptom screening to treatment, is captured piecemeal across two electronic and three paper data registries (Roscoe et al., 2020). Hence, the current national-, regional, and district level data on the outcomes rates among TB and HIV coinfected might not be the true reflection of the situation in the Keetmanshoop District of the //Karas Region, Namibia. Therefore, this study is important because it includes data on successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in the area Keetmanshoop District of the //Karas Region, Namibia.

Despite the availability of effective drugs for treating both HIV/AIDS and TB, the co-management of TB and AIDS has proved very difficult largely because of non-adherence due to high pill burden, drug-drug interaction, and distance to health centres, unemployment, geographical location (residence) and side effects which results in poor tb treatment outcomes. There is also a worrisome convergence of multi-drug resistant or extensively drug-resistant

tuberculosis in the setting of HIV infection causing a high mortality rate (WHO, 2020). To overcome this problem, the WHO recommends that Highly Active Anti-retroviral therapy (HAART) should be given as early as possible within eight weeks of TB treatment initiation regardless of CD4 count (WHO, 2020). There is also evidence that early initiation of ART in people living with HIV significantly improves survival of co-infected patients and reduces excess risk for opportunistic disease or death, besides having a significant role in TB prevention.

High rates of successful TB treatment outcomes have the potential to reduce overall health care costs associated with TB control, improve immediate and future individual health outcomes and prognosis, and reduce the potential spiralling of future spread of drug-resistant strains of *Mtb* (Hirsch-Moverman et al., 2008). There must be strong policy efforts to understand the epidemiology of TB treatment outcomes and its associated factors among TB/HIV coinfected patient and treatment outcomes tendencies in high-risk people as these individuals act as a future reservoir for transmissible disease and contribute to the slowing of progress toward TB eradication and successful outcomes (Salinas et al., 2016).

The undescribed TB treatment completion rates in Keetmanshoop Health District may point out, that there is a large pool of persons at risk of experiencing reactivated TB who could potentially spread TB disease to others and require costly health care interventions to address future advanced disease. It is unknown what factors may contribute to rates of successful TB treatment outcomes in this cohort of people in Keetmanshoop District of the //Karas Region.

However, some published literature from the international, high-incidence TB settings inconsistently indicate a variety of host, environmental, and agent factors influence the successful TB treatment completion outcomes rates for persons with TB/HIV (Campbell, Chen et al., 2015; Hirsch-Moverman et al., 2008; Johnson et al., 2016; Parsyan et al.,2007; Sandgren et al., 2016). TB-HIV co-infected people are facing multifaceted problems like high LTFU

rates, poor treatment adherence, high TB recurrence rate, and high mortality risk. If undetected and untreated, persons with TB are at risk of developing active TB disease (Pareek et al., 2016). The progression from latency to active TB has the potential to cause individual death, requires a substantial amount of health care and a scramble for inadequate and sporadically allocated public-sector resources to prevent transmission and ensure disease is cured, and if untreated this can also cause long term lung tissue damage or other more austere consequences and dire prognosis. However, what remains to be studied are the factors involved in successful treatment outcomes among TB/HIV coinfected patients in Keetmanshoop Health District of the //Karas Region.

Also what potential factors of LTFU, interactive host, agent, environmental factors and (i.e. patient demographics, socioeconomic status, may be associated with successful treatment outcomes or poor outcomes. In the absence of the above, TB has the potential to threaten the gains made therefore, assessing successful TB treatment outcomes among TB/HIV coinfected patients, the actual treatment of TB is the most cost-effective control strategy for high-incidence countries for averting future TB disease with some studies indicating and estimating that nearly 40% of cases of active TB are preventable (Blount et al., 2016; Campbell et al.,2014; CDC, 2013; Varkey et al.,2007), signifying that prevention is always better and cheaper than cure.

These rigid research findings highlighted the importance that geographical setting may have on TB treatment outcomes rates, but the limited settings in which the epidemiology of TB treatment outcome rates has been studied do not ensure generalization. In Keetmanshoop, where geography (sparsely populated area), poverty, unemployment, alcohol, and distance can pose a significant barrier to accessing the limited TB resources, TB control program metrics aim for a successful TB treatment outcome rate at or above the national 2020 target of 85% for persons initiating TB therapy (CDC, 2015b; CDC, 2016b). High rates of completion of

preventive therapy have the potential to reduce overall health care costs associated with TB control, improve immediate and future individual health outcomes, and dampen the potential future spread of drug-resistant strains of *Mtb* (Hirsch-Moverman et al., 2008). Understanding successful TB treatment outcomes rates in Keetmanshoop Health District may also assist with identifying when patient is at greatest risk for not completing therapy (Vozoris & Batt, 2016). This gap in knowledge without current empirical data potentially has the ability to prevent reductions to future TB/HIV-related morbidity and mortality among this cohort of people in Keetmanshoop, //Karas Region.

Studies are, therefore needed in this setting to allow TB control programs serving high-risk populations, including TB/HIV coinfected patients to identify the factors associated with successful treatment completion or noncompletion outcomes. Findings from such studies may promote more appropriate use of tailor made interventions, considering the limited resources available.

Namibia gained its independence in 1990, and inherited the legacy of structurally unequal health care system created by the apartheid regime of South Africa which was occupying the territory of Namibia. Post-independence Namibia's healthcare delivery system reflected a traditional medical model, focused mainly on hospital-based and curative services (MoHSS, 2016). A health system that was based on racial grounds. Hence, gaps in access to health care exist till today not only between rural and urban dwellers but also between rich and poor, and these reflected presence or absence of White populations.

Which continues to exist in Namibia through "socioeconomic issues like poverty, unemployment, overcrowding, and poor housing are the traditional structural drivers which have been there and still exist because of Apartheid in Namibia – and which have now been perpetuated in the post-Apartheid settings. In a nutshell "you have traditional structural inequalities that have been engineered because of the previous Apartheid regime which has

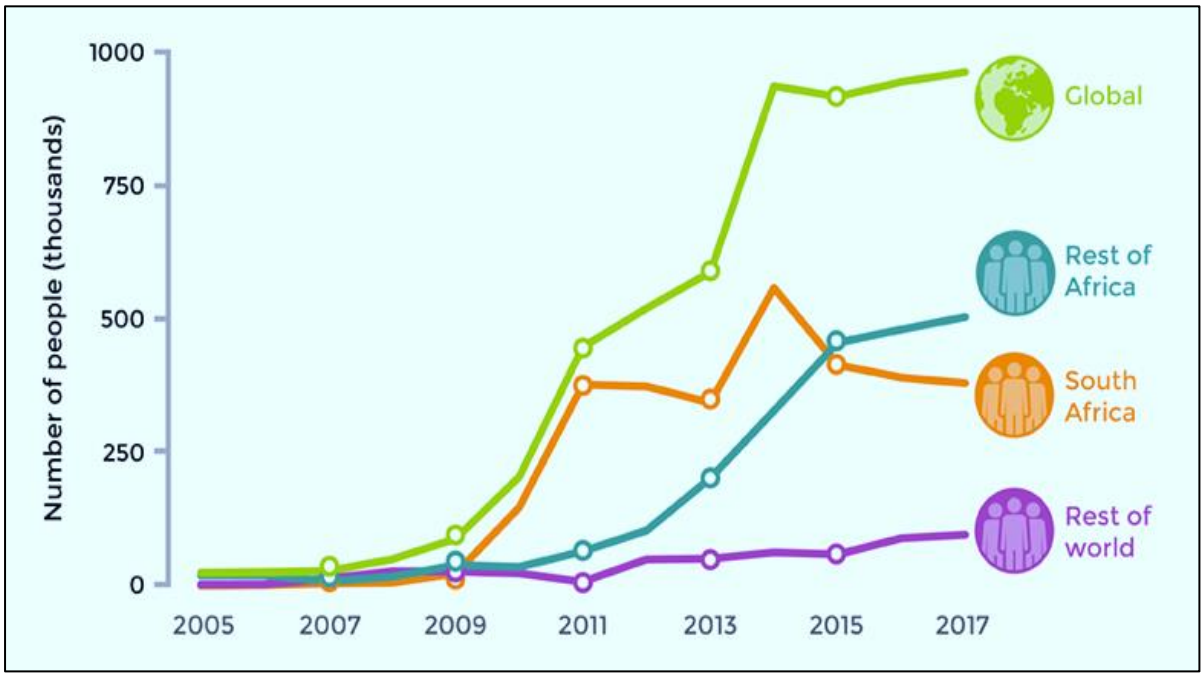
been perpetuated in the new dawn of democracy in Namibia." TB is driven by poverty, drawing attention to the fact that TB is often referred to as a disease of the poor (Adu & Spiegel, 2021).

There is de-prioritization particularly of public health services divided along racial lines and the haves and don't haves. Poverty leads to poor nutrition, which reduces the immune response to infections including TB. "People in poverty [acquire TB] in the sense that they would not have the right nutrition status that would prevent them from getting diseases or the immune system they require, or they would find themselves in [an] environment that do not protect them from respiratory conditions (Adu & Spiegel,2021).

"The social justice aspect of TB plays a big role and this needs to be observed and addressed urgently". Reaching the milestones for reductions in TB cases and deaths set for 2020 and 2025 requires the annual decline in the global TB incidence rate to accelerate from 1.5% per year in 2015 to 4–5% per year by 2020, and then to 10% per year by 2025. Second, the global proportion of people with TB who die from the disease (the case fatality ratio, or CFR) needs to be reduced to 10% by 2020 and then to 6.5% by 2025, but is only possible if all those with TB disease can access high-quality treatment (WHO, 2017) and the outcomes rates are quantified.

Figure 2

Global Provision of TB-Preventative Treatment to People Who Were Newly Enrolled in HIV Care, 2005-2017



Source: WHO Data 2018

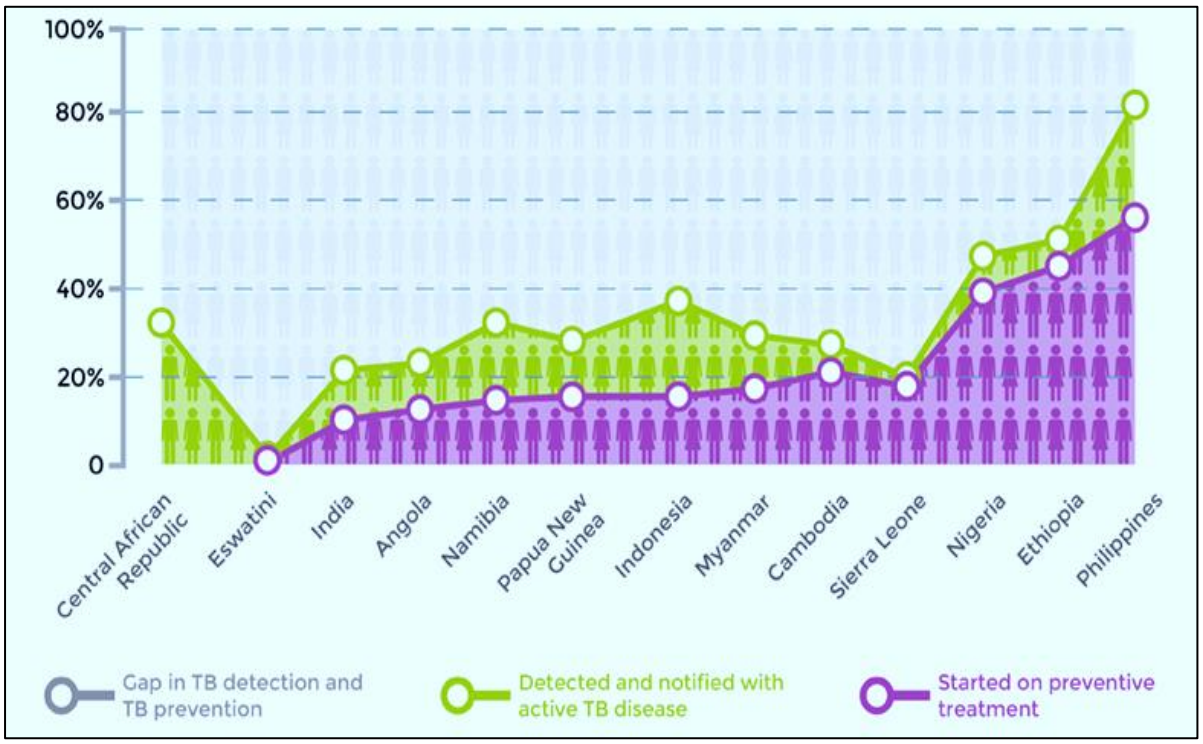
The 2016 United Nations Political Declaration on Ending AIDS includes a goal to reduce TB-related deaths among people living with HIV by 75% by 2020. In addition, all countries belonging to WHO and the United Nations have committed to ending TB as a public health problem by 2030. To reach this goal, TB deaths must reduce by 90% and incidence of active TB by 80% from 2015 levels.

However, progress towards ending TB is slow, and persistent gaps in preventing, diagnosing and treating TB remain (WHO, 2018). This indicates that if progress continues to stall, in the next 20 years, almost one billion people will become newly infected with TB, and 35 million people will die of the disease (UNAIDS,2018). Along with WHO, UNAIDS has called for urgent action on this issue, advising countries to integrate HIV and TB services by ensuring HIV prevention and treatment programmes include regular TB screening, preventive

therapy and early treatment. There are significant gaps in the detection and provision of TB preventive treatment to people living with HIV for selected high TB burden countries and high TB/HIV burden countries. In 2018, there were 477 000 reported cases of TB among people living with HIV, of whom 86% were on antiretroviral therapy (WHO, 2019). Most of the gaps in detection and treatment were in the WHO African Region, where the burden of HIV-associated TB is highest (WHO, 2019).

Figure 3

Gaps in TB Detection and TB Prevention for People Who Were Newly Enrolled in HIV Care in 2017 (Selected Countries)



Source: WHO Data 2018

TB treatment saved 58 (53—64) million lives globally between 2000 and 2018. In 2018, 7 million new TB cases were notified to national authorities and reported to WHO. This reflects a gap of 3 million between incident and notified cases. Ten countries accounted for about 80% of the gap, with India, Nigeria, Indonesia and the Philippines accounting for more

than half of the total. The global treatment success rate for people newly diagnosed with TB was 85% in 2017(WHO, 2019).

Namibia's health services are twofold: private (serving 18% of the population with medical aid) and public (serving the remaining 82%). This, in part, is due to the country's high income inequality. Access to healthcare is comparably good with 76% of the population living within a 10km radius of a healthcare facility (MoHSS, 2019). Given the underpinnings and challenges Namibian healthcare system suffers from many systemic challenges which cause TB to thrive. Understaffing in health facilities, mismanagement, lack of funds, noncompliance with basic infection control and poor TB surveillance were some of the health system challenges (MoHSS, 2019). There is no permanently appointed person looking after infection control in some of the institutions. Resource allocation as a health system factor that impacts the healthcare system's ability to combat TB.

Similarly, Kibuule et al. (2019), also reported on the problem saying that the burden of TB/HIV continues to increase with an estimated, prevalence of HIV co-infection among TB cases at 66.9%. In Namibia transmitted infection is responsible for more than half of MDR-TB cases; however, evidence demonstrates that transmission is not always from TB patients on effective treatment but rather also from unsuspected cases (MoHSS, 2019). TB infection control (TB-IC) in healthcare facilities focuses primarily on patients with known and suspected TB. This scenario indicates that active case finding is often lacking and neglected in Namibia (MoHSS, 2019).

The existence of stigma continues to heighten TB and HIV in Namibia. The impact of stigma on TB-related care is the difficulty in measuring this construct accurately to know the extent to which stigma on TB-related care is a barrier. However, there is a profound stigma associated with TB because of its association with poverty and with HIV, itself highly

stigmatized in the community and work places. One of those reasons is there is still a stigma. No one wants to be diagnosed of TB. If you are employed, you don't know how that might affect your employment and you don't want to be unemployed." This stigma prevents self-disclosure and care-seeking behaviour (Wouters et al., 2017). Despite a seemingly strong structural approach, the National strategic plan (NSP) projected cost estimates do not reflect this commitment. Of the eight goals, goal number four which specifically addresses the structural drivers has a significantly lower budget compared to goal number two, which contains the most curative elements.

The epidemiology of TB is a key element to understanding the complexity of this global health burden. WHO reports that TB is a leading killer of HIV patients, with one in every three deaths among HIV patients was due to TB (WHO, 2018b). In some settings, up to 50% of patients with both TB disease and HIV infection die during TB treatment with most deaths occurring within 2 months of being diagnosed with TB (WHO, 2018b). Life expectancy at birth in Namibia has in the recent years declined to about 62 years mainly because of the impact of the HIV and AIDS pandemic, the major causes of mortality and morbidity, some of the notable causes of death in Namibia are mostly, lower respiratory infections, followed by ischemic heart disease and TB on its own ranked fourth (CDC, 2017).

One key goal of the WHO's End TB strategy is a zero catastrophic cost for patients and families affected by TB (WHO, 2015). This shows that the socioeconomic needs of those patients and their families need to be appropriately addressed in order to reduce the high rates of infections. One of the socio-economic barriers is access and affordability of transportation to get to the facilities; some patients report late at health facilities because they do not have the money for transportation (MoHSS, 2017b). Although some facilities provide transportation

for patients, this is still a major barrier for accessing TB care for many and better understanding is needed of the barriers that patients face.

Even though a comprehensive view of all the barriers that prevent access to TB treatment is lacking, it is well-known that socioeconomic deprivation, poor housing, overcrowding, malnutrition and distance continue to drive the epidemic in Namibia especially in Keetmanshoop. Hence, a strategic plan to tackle TB and HIV needs and to allocate funding directly to these factors (WHO, 2016). With standard treatment, TB is curable in over 95% of cases, even in PLHIV, provided there is no drug resistance. Untreated TB is often fatal, especially in PLHIV. Mtb HIV co-infections pose particular diagnostic and therapeutic challenges and exert immense pressure on health care systems in African countries including Namibia which is having a large populations of co-infected individuals (NIH, 2020).

Patients with latent infection are the largest reservoir for potential transmission. Although most patients with latent infection will not die of TB, the greatest danger is in reactivation (active TB after remote infection) cases and the subsequent silent spread to close contacts. In contrast, recent infection accounts for the majority of active TB cases in highly endemic areas (WHO, 2018b). The risk of reactivation TB is estimated as 10% per lifetime. Impaired immunity, as in the case of HIV infection, increases the risk to 10% per year (WHO, 2018b).

For every year that a single person with active TB is untreated, he or she will infect an average of 10–15 people (WHO, 2018b). HIV-negative people are estimated to be sputum smear positive (i.e., with acid fast bacilli observed in sputum) 1–3 y prior to diagnosis in resource-poor settings (WHO, 2018b). By these estimates, a single person with active TB could infect as many as 45 other individuals. It is no surprise that this disease remains a global health threat for which the incidence has not been reduced despite tremendous efforts. Furthermore, miss doses and non-adherence to TB treatment threatens the successful TB treatment outcome,

increases the risk of TB spread, and leads to the development of drug resistance (MoHSS, 2019). FAST (Find cases Actively, Separate safely and Treat effectively) is a novel, refocused administrative approach to decrease the spread of TB in healthcare facilities (Barrera et al., 2015). The goal of FAST is to reduce nosocomial transmission through the early detection of infectious TB cases and prompt initiation of effective treatment, however shortages of health care workers, ancillary and laboratory staff are challenges noted for the effective implementation of FAST in the Namibian public health care system (Barrera et al., 2015).

Although, Namibia is estimated to be at 95-95-92 as defined by the UNAIDS 95-95-95 treatment cascade; one of the first high-burden countries to approach epidemic control (PEPFAR, 2020). In 2018, the country notified 8,108 TB cases (61% male and 39% female), translating to a CNR of 336/100,000. The majority of the cases were aged 25-34 years (MoHSS, 2019). The high case load is attributed mainly to the HIV epidemic as reflected by an HIV prevalence of 17.2% among antenatal clinic attendees in 2016 and an HIV prevalence rate of 35% among TB patients in 2018. The rate of TB patients with known HIV status is 99% with 97% ART initiation among those who tested positive. Similarly, the recently completed TB Disease Prevalence Survey (DPS) confirmed Namibia's position among the top high TB burden countries reporting the rate of bacteriologically confirmed TB as 465/100,000 (95% CI: 340-590) (MoHSS, 2019).

TB among males was significantly higher (60%) than females. HIV-positive rate was 13.5% among participants who knew their HIV status at the end of the survey (83.5%). HIV positivity rate among DR-TB patients was 42% and ART was initiated among 89% of these (MoHSS, 2019). TB and HIV treatment was provided free of charge in Namibia. However, there are other related costs such as transportation costs, limited access to treatment. Consequently, the efforts of the government to respond to the increased burden of TB were mitigated by the aforementioned challenge. However, the focus of the problem is in the

Keetmanshoop Health District, //Karas Region where there is reported TB failure rate of 8%, defaulter rate of 6% and fatality rate of 7% for treatment outcome of new smear positive TB cases, while treatment outcome for new smear positive patients co-infected with TB/HIV in Keetmanshoop Health District the reported death rate was 14%, failure rate 9% and defaulter rate of 2% (MoHSS, 2019).

Furthermore, according to the National Tuberculosis and Leprosy Control Programme (NTLCP) (2020), //Karas, Hardap and Erongo regions are the regions with the highest TB burden in the country. Keetmanshoop District of the //Karas Region is one of the areas most threatened by TB, Keetmanshoop District of the //Karas Region reported 757 cases of all forms of TB and CNR of 996/100 000, the highest in the country (MoHSS, 2019).

Treatment success rate for re-treatment cases nationally for Namibia was reported as 73%; //Karas Region 78%, Hardap 77% and Erongo 86% for the 2011 cohort; overall, the treatment success rate both nationally and for these high TB burden regions was below the 90% target (MoHSS, 2016a). Similarly, although from different studies, (Kibuule at al., 2019), reported on the same problem stating that the burden of TB/HIV continues to increase with an estimated, prevalence of HIV co-infection among TB cases at 66.9% and in some geopolitical regions of Namibia, such as Erongo, Hardap, //Karas and Oshikoto, and the CNR is estimated to be three times higher than the national estimate (i.e. over 1 000 cases per 100, 000 population), thus making this regions including Keetmanshoop District of the //Karas Region hotspots and interest of study.

Additionally, Kibuule et al. (2019), stated that Namibia, has the fifth highest TB case CNR, i.e. the number of new TB cases notified in a country per 100 000 population) globally. Kibuule et al. (2019), also indicated that, in 2017, a total of 700 TB associated deaths were registered in Namibia, a middle-income country in Southern Africa with a population of 2.5 million people (Kibuule et al., 2019). The high TB CNR in Namibia has been linked to the HIV

epidemic (with a prevalence estimated between, 14% - 17%), resulting in a resurgence of TB (Kibuule et al., 2019). Consequently, Luetkemeyer (2018), indicated that the risk of progressing from latent to active TB is estimated to be about 20 times greater in PLWHA than among those without HIV infection with a higher risk of transmitting the infection to others. WHO (2018), argue that TB and HIV-co-infection are associated with significantly increased likelihood of mortality with HIV co-infected TB patients having significantly lower cure rates and lower treatment success rates compared to non-HIV infected TB patients.

It has been observed that patients diagnosed with TB in Keetmanshoop District are missing their DOTS several times. Including absconding from hospital, some are smoking and they present themselves at health facilities under the influence of alcohol as observed by Keetmanshoop nurses at TB ward clinics and Centre for disease control (CDC) centres (MoHSS, 2019). Furthermore, Kibuule et al. (2020), pointed out that in Namibia, one out of every 25 cases of TB is LTFU. This has impacted negatively on national efforts to end the disease by 2035.

Correspondingly, WHO (2017), brings into focus that the gap between notified cases reported by the National Tuberculosis Program (NTLP) and the incidence estimated by WHO, suggested that Namibia was missing approximately 30% of TB cases. The National Planning Commission (2018), argued that the missed TB cases are generally responsible for the growing spread of TB and the high number of TB cases places a burden on health and social services infrastructure. Additionally, patients who fail to return for follow- up TB treatment are more likely to develop drug-resistant tuberculosis (DR-TB).

Moreover, the missed TB cases are generally responsible for the growing spread of TB, consequently, the high number of TB cases places a burden on health and social services infrastructure (NPC, 2018). The implication of such statistics is that some contributing factors are probably being overlooked in the management of patients and that of TB/HIV. WHO

(2016), also reported on the problem that the gradual rise in incidence of drug-resistant TB (DR-TB) and poor treatment outcomes such as LTFU (i.e. an interruption of TB treatment for at least two consecutive months) and death are major barriers to ending TB in Namibia. Furthermore, WHO (2016), argued that LTFU is an important risk factor for re-emergence of TB strains resistant to first-line anti-TB drugs. Nonetheless, Meressa et al. (2015), also argued that one of the key barriers to successful treatment globally, has been high rates of patients who were lost to follow-up and at the same time.

On the other hand, The Joint United Nations Programme on HIV/AIDS [UNAIDS] estimates that by 2020, the total resources needed for HIV/AIDS responses in LMIC's will be a sum of US$ 26.2 billion, which is US$ 4.9 billion higher than the investment in 2017 (US$21.3 billion) (Snapshot - HIV investment,2019). Filling this financial resource gap in these countries, including Namibia, becomes a significant challenge as they are shifting to self-sustain financing of TB and HIV/AIDS programs due to a rapid decrease of foreign aid (Snapshot - HIV investment, 2019; Olakunde & Ndukwe, 2015). Besides, World Bank (2019), explain that in Namibia, TB and HIV are funded primary by external global partners namely the Global Fund to fight AIDS, TB and Malaria (GFATM), the United States Agency for International Development (USAID), and the President's Emergency Plan For AIDS Relief (PEPFAR). On the domestic front, spending on TB remains low at 3% of total health expenditure (THE), with persistent funding gaps especially from National level to lower government levels (World Bank, 2019).

Correspondingly, World Bank (2019) also explain that Namibia's HIV/AIDS response is mainly financed by donors, in 2017 donors dedicated about 80% of their health spending to the HIV/AIDS response and the Namibian government spent, about 13% of total health expenditure (THE). This scenario will have the potential to "stall" the progress to successful TB treatment outcome among TB/HIV co-infected patient in the Keetmanshoop District.

Moreover, threaten and destabilize the gains in the control of both diseases. There is also a major Global Fund initiative underway to combat TB in this sector and considerable other efforts, however attention to associated implications for broader community spread and disease control has been limited.

While the efforts are welcomed and underway, they are certainly laudable, the fact that none of these are explicitly addressed in the Strategic Plan to combat this disease is problematic, and as such failure to do so contributes to continued neglect of needed focus on underlying drivers.Given, the TB treatment success rate in Namibia which was estimated at 83% in 2015 lower than the WHO target of 90%, it is safe to assume that the main reason for this success rate is due to the reduction in funding the country has received from international donors such as the Global Fund and PEPFAR (Menges, 2018).

It could be argued that the budgetary allocation specified was low, as structural issues related to social determinants of health are covered in strategic plans in other departments or related to other issues. Nonetheless, I argue that strategic plans to combat TB in high burden settings need to directly consider such drivers to prompt the necessary changes and reduce the burden of this and other such diseases. Therefore, with limited available resources, selecting optimal allocation strategies is vital to achieving the highest benefits with the lowest costs.

Greenberg et al. (2015), argued there is still a significant number of TB and people living with HIV and AIDS (PLWHA) who cannot access adequate HIV care due to lack of funds, long distances from service providers, lack of nutritional food and access to quality health care facilities. Similarly, CDC (2016b), also reported on the problem stating that that a total of 34% of PLWHA cannot access HIV care and thus remain viremic with an increased risk of infecting other people with the disease. Equally, Taghizade et al. (2016), stated that each year over one (1) million deaths from TB occur and about 3.6 million people with TB are still

missed by the health systems annually and therefore fail to receive appropriate care. Gomes et al. (2016), also reported on the problem by arguing that the importance of identifying sub-groups with a high risk of TB and its consequences has been emphasised. NIH (2019), found that people with latent TB infection have a 5 to 15% lifetime risk of developing active TB disease and this risk increases for people with compromised immune systems, such as those living with HIV, people receiving immunosuppressive therapy (such as individuals being treated for cancer), as well as diabetics, smokers and the malnourished.

Furthermore, WHO (2018), stated that sub-Saharan Africa bears the brunt of the dual epidemic, accounting for approximately 84% of all deaths from HIV-associated TB in 2018 (WHO, 2018). Unfortunately, Meressa et al. (2015), reported on the same problem by saying that of the 34 of 107 countries that have not achieved the WHO target for treatment success of ≥75% are in Africa including Namibia. MoHSS (2019), quantified that at present TB cases in Namibia are primarily detected through passive surveillance with infrequent active surveillance among selected groups.

While the number of people diagnosed and reported through the country's surveillance system for TB is well documented, however the number of people with active TB at any given time is unknown.There is limited or no data on the following group's patients with TB treated outside the public health sector, patients with symptoms compatible with TB at any given time, including the proportion who are being appropriately investigated, and patients with TB but who have not accessed the available health services.

These has the potential to derail the treatment completion and its associated factors among TB/HIV co-infected patients in //Karas Region and Namibia in general (MoHSS, 2019). The World Bank (2020), indicated that although Namibia is ranked in the upper middle income (UMI) category by the UN, however many Namibians continue to experience poverty and

social deprivation. The World Bank (2020), found that the proportion of the population living below the national poverty datum line was estimated to stand at 17.4% in 2015/16. A total of 28.7% of the population is considered poor while 15% is considered abysmally poor (World Bank, 2020). Poverty is high in rural (37%) as compared to urban areas (15%), and the unemployment rate is estimated at 29.9%, with a poverty incidence rate estimated at 50.1% (World Bank, 2020). As a social disease, TB is highly sensitive to structural violence.

With Namibia's overall state of economic development, the country should not be burdened by TB and HIV coinfection at this rate. However, due to its massive income and health-related inequalities, the disease continues to persist (NPC, 2018). Income inequality has worsened over the years with Namibia's Gini coefficient index (a measure of inequality) increasing at 57.2 in 2015 (World Bank, 2020). While Palma Ratio was at 5.8 both among the highest in the world further suggesting significant inequalities in wealth distribution in the Namibia (NPC, 2018). About half of the population (53.8%) lives below the national poverty line (World Bank, 2019).

According to the World Bank (2020), there are approximately 1,222 doctors,784 doctors work in the public sector and 438 work in the the private sector in 2018. Half of the physicians work in the Khomas the region containing Namibia's capital. In 2018 there were approximately 0.4182 physicians (per 1,000 people) (World Bank, 2020). Similarly, the chronically underfunded public sector which serves about 84% of the population, is staffed by only 30% of doctors in the country (World Bank, 2019). Hence the World Bank (2019), found that the Ohangwena region reports the lowest bed density compared to its population and in contrast, the Ohangwena region has a relatively high number of primary care outpatient facilities. A total of about 21% of Namibians live more than 10km away from a health provider and some people travel long distances to access health services (World Bank, 2019).

Also, the World Bank (2019), argued that in Namibia, TB services are disproportionately distributed in favour of urban areas, potentially leaving a larger proportion of people from rural areas with poor access to TB care. Geographic barriers related to rural living influence access to TB care and clinical outcomes. Additionally, World Bank (2019), bring into focus that individual risk factors of rural residents such as low educational attainment and income can influence care-seeking behaviours, resulting in treatment delays, poor treatment adherence and miserable outcomes with regards to TB treatment.

Studies suggest that poor access to health care could also lead patients to seek less credible alternative health care. Although urban residence is a recognised risk factor for TB, especially in rapidly urbanising communities due to poor living conditions, World Bank (2019), argue that the gap in TB services coverage especially specialist services such as diagnosis of extra-pulmonary and smear-negative TB (which are largely urban-based), between the regions in the country, as well as between the rural and urban areas.

This scenario may have worsened inequalities to treatment access which affects the successful treatment outcome. This imbalance may also further worsen rural-urban inequalities in TB/HIV health care and long distance to health facility is a big challenge in management and control of tuberculosis, which will ultimately translate to poor TB treatment outcomes.

Although, The World Bank (2019), found that Namibia has adequate health infrastructure, in 2018, the public health sector comprised overall 373 health facilities with a total of 7,551 beds in the sector, this results in a population-to-bed ratio of 3.2 beds per 1000 population in the public sector, which is comparable to higher-income countries including New Zealand, Norway, Portugal, and Turkey. However, the country faces regional challenges in sparsely populated areas which affect access to these health facilities. The World Bank (2019), reported on the problem saying that there are significant regional inequalities in Namibia, most health facilities are in a few towns in the northern and central regions of the country.

Bruchfeld et al. (2015), argue that these challenges are made worse by clinical problems related to the duration of treatment, the frequency of drug administration, pill burden, management of drug interactions, and complications of therapy such as drug toxicity and immune reconstitution inflammatory syndrome (IRIS). Since such patients are being treated for two infectious diseases, the goals of treatment for both must be balanced through therapy integration, use of concurrent Antiretroviral Therapy (ART), prevention of HIV-related co-morbidities, controlling drug toxicity, and monitoring of IRIS (Bruchfeld et al., 2015). This would bring optimal outcomes and completion in terms of treatment response and prevention of drug resistance.

Similarly, Bruchfeld et al. (2015), also upheld the notion that the dual treatment with HIV and TB medication which predisposes patients to serious adverse drug reaction such as (IRIS), hepatotoxicity and drug interactions, and clinical problems about the duration of treatment, frequency of drug administration, hepatotoxicity among patients on co-treatment with the first-line ART and anti – TB medication, and the interaction between rifampicin which lowers the plasma levels, antiretroviral drugs such as efavirens (pill burden), and complications of therapy like drug toxicity and IRIS is another challenge. This has the potential to cause a serious concern as it can lead to unsuccesful treatment outcomes.

Naghavi et al. (2019), also argue that the most crucial factor is non-adherence or non-compliance to the treatment regimen, which contributes to multi-drug resistance in Namibia. Non-compliance with prescribed treatment is a compelling cause of preventable mortality. Kasper et al. (2015), pointed out that the growing number of drug resistant tuberculosis (DR-TB) cases notified across countries is another major global public health concern which also includes Namibia. PEPFAR (2019), reported on the problem saying that over 500,000 cases of multi-drug resistant TB (i.e. the MDR, TB resistance to two first line anti-tuberculosis drugs, which is rifampicin and isoniazid) annually. Sinai (2018), found that , that the patient flow and

service organization, in theory, has five different models for integrating HIV and TB services that can be distinguished: (1) entry via TB service, with referral for HIV testing and care; (2) entry via TB service, on-site HIV testing, and referral for HIV care; (3) entry via HIV service with referral for TB screening and treatment; (4) entry via HIV service, on-site TB screening, and referral for TB diagnosis and treatment; and (5) TB and HIV services provided at a single facility by a single team.

Dissimilarly, Sinai et al. (2018), argued that in most public health facilities in South Africa including Namibia, HIV and TB services are provided according to models 2 or 3. For an HIV patient, this means that she or he must queue for HIV services mostly this centres are at secluded places. At the beginning of the HIV visit, the provider asks the HIV patient about some TB symptoms. If symptomatic, i.e. if the patient responds with a "yes" to one or more of the questions about TB symptoms, the patient is referred to TB services for testing, often in the same facility.

The patient then must queue for the TB service, where she or he gets a sputum bottle and is instructed to go outside to collect sputum and return to the TB services centre. If the patient is diagnosed with TB, a TB treatment is usually provided and monitored by the TB provider (Sinai et al., 2018). Thus, Sinai et al. (2018), also found that TB patient first must queue for TB services. During the initial or first visit, she or he is asked about his/her HIV status. If she or he has never been tested, or the last negative test is older than 12 months, the patient is tested for HIV.

This can be initiated by the TB provider but is often done by HIV community counsellors and testing providers at the same facility. If the patient is found to be HIV positive, she or he may be initiated on ART by the TB service provider or alternatively by the HIV provider at the same facility normally the CDC clinic, however, monitoring ART is done by HIV providers only mostly nurses. It is observed that there are several problems intrinsic in

this drill. First, patients who are screened for TB symptoms and found to be symptomatic are inconvenienced by the need to wait for the TB treatment services, having already waited in a queue to see the HIV provider when they arrived at the facility (Sinai, et al., 2018).

Naidoo et al. (2017), recounted on the same problem arguing that some patients lose their tolerance and leave the facility before they see the TB provider to obtain their sputum test. If these patients have TB, it is a lost opportunity for early diagnosis and treatment. By the time they return to the facility they may already be extremely sick and may have spread the infection to others unknowingly. This analogously also applies to TB patients who are found to be HIV positive (Naidoo et al., 2017).

Furthermore, in Namibia there is a program called "Ideal Clinic" an initiative to integrate HIV/TB, but this initiative remains vague. This is because this program strives for an 'integration of clinical service management' (ICSM) which means that chronic conditions (among them HIV and TB) are supposed to be managed by one team under one roof like a "stop and shop", where all the services are available under one roof. However, this is not the case (Hunter et al., 2017; National Department of Health, Republic of South Africa, 2017).

Sinai et al. (2018), argued that because of the vertical structure of services in the MohSS, TB providers do not, or only poorly, communicate test results of TB, or TB-treatment details, with HIV providers who treat the same patient for HIV. TB providers can and do test their patients for HIV, and if positive initiate treatment. However, HIV treatment providers suspecting TB, are usually not allowed to test for TB. They need to refer the patient to the TB clinic or service. If the patient should be treated for both HIV and TB, the two providers treat and follow-up on the two diseases separately. Patient records are also kept separately (Sinai, et al., 2018). Such vertical organization of services can result in reduced TB case findings and poor or delayed linkage to care, as well as low rates of ART therapy ART-initiation. This hampers the successful TB treatment outcomes among TB/HIV patients. Better integration of

TB and HIV services, so that they are offered through a coordinated approach, can address these shortcomings and result in more efficient and cost-effective services, which will contribute to successful completion outcomes with regards to TB (Sinai, et al., 2018).

Equally, MoHSS (2017), testified on the problem saying that, non-adherence is assumed to be most common among the Namibian communities, because of the difficulty experienced in accessing health services, as the area is sparsely populated, lack of transport for tracing patients who have missed their treatment, distance to the health care facilities for follow-up ,and not having money to pay for transport to the health care facility for follow-up, an lack of supervision by health workers and/or a lack of understanding by patients. As a consequence, Naghavi et al. (2019), argued that from the perspective of healthcare providers, non-compliance with therapy is an important clinical issue due to two factors: first, it has a significant impact on clinical and therapeutic outcomes and leads to disease progression, increased visits to outpatient clinics, re-admission, and hospitalization.

When patients do not follow the therapeutic plan, the effects of the plan are not realized, which may lead to treatment failure and life-threatening reactions. This non-adherence or compliance is also worsened by the fact that many nurses cannot communicate with most TB patients as they do not speak the local vernacular or dialect. This leads to poor understanding, and poor communication, which has potentially detrimental effects on health education and possibly treatment adherence and treatment success outcomes rates, including the rotation of health care workers, which could also be contributory factors (Naghavi et al., 2017). The Patriot (2018), contended that not having adequate health care workers amid growing patient numbers, and poor leadership is to blame for the current “muddle” prevailing in the ministry of health, including a lack of equipment and medical provisions, maladministration and a heavy workload. Moreover, MoHSS (2019), has also identified the high turnover of nurses at TB and ART clinics, as well as the poor quality care given to TB

patients, as two of the factors that make it difficult to achieve the national and international outcome targets.

Similarly, the MoHSS (2017), reasoned that by far the greatest constraint on reaching the target for case detection and cure is the lack of trained and qualified human resources in Namibia. The human resources that facilitate the implementation of DOT might lack an understanding of the concept of DOTS and they would seem not to have a positive attitude to TB patients. Health care workers (HCW) in Namibia have been criticised for their negative attitude towards TB patients and the poor-quality care they provide for these patients.

It might be that these negative and prejudicial attitudes have resulted from limited knowledge, lack of information, stress and being over worked (MoHSS, 2017). In this setting, the literature on the magnitude of this problem is still scarce in Keetmanshoop District especially in the southern part Keetmanshoop Namibia. There is no readily available data describing successful TB treatment outcomes and its associated factors among TB/HIV co-infected patients in the Keetmanshoop Health District in the //Karas Southern Region of Namibia or in Namibia in general. An understanding of TB treatment outcomes completion and its associated factors may help to improve the management of TB infections in Keetmanshoop Health District.

Therefore, this study sought to assess TB treatment outcomes and its associated factors among TB-HIV-coinfected adults in the Keetmanshoop Health District of the //Karas Region, Namibia. Furthermore, this study will fill the existing gap on the understanding and development of policies, interventions and guidelines that will focus specifically on TB/HIV co-infected patients which may provide evidence for evaluating the performance of the TB control program in the country and direct future efforts contributing to positive social change at the individual and community level. Also, this quantitative retrospective study will provide the platform for affected persons and communities, civil society organizations, health-care

providers, policy makers, development partners and others to advocate, discuss and plan further collaboration to fulfil the promise of reaching all people with quality TB prevention and care services, as well as enabling TB prevention through multisectoral development efforts thereby contributing to positive social change. The objective was to assess the outcomes of TB treatment and associated factors among TB-HIV co-infected patients in Keetmanshoop town, Southern part of Namibia. This study assessed TB treatment outcomes using a five-year record from 2016-2020 of TB patients who received treatment in Keetmanshoop District.

However, further research is warranted either with the same study design or with different factors or any other study design or method to examine the possible patient factors associated with TB treatment outcomes in TB/HIV- coinfected adults to address the high incidence of the mortality rate and missed cases of TB, in Namibia despite decades of DOTS implementation.

Purpose of the Study

The main purpose of this retrospective quantitative study was to assess in depth the outcome of TB treatment and its associated factors among TB/HIV-coinfected adult patients in the Keetmanshoop District of the //Karas Region of Namibia. These patients' attended Keetmanshoop State TB Clinic and CDC Health center in the Keetmanshoop Health District. Keetmanshoop District was chosen due to its high prevalence of HIV co-infection among TB cases in Namibia, currently estimated at 66.9% (Kibuule et al., 2018). Additionally, also due to its high CNR estimated to be three times higher than the national estimate (i.e. over 1,000 cases per 100,000 population) (Kibuule et al., 2018). I used retrospective longitudinal quantitative method. Event base retrospective analysis was essential in determining (a) the outcomes of TB among HIV coinfected patients how many months' patients, (b) how many months' patients diagnosed with TB remained on therapy, completed therapy, or were lost to LTFU, and (c) the probability that TB/HIV coinfected patients experienced the event (e.g.,

treatment outcomes). Use of this design was also helpful in determining which covariates were potentially associated with the outcome of interest. This analysis was particularly useful for identifying those potential covariates and associated risk factors that may be host-, environment-, or agent-specific.

Published research findings from the high incidence TB setting inconsistently indicate that host factors such as age, gender, unemployment, education, income, smoking, alcohol, distance, employment, and pill burden influence treatment completion rates for persons with diagnose with TB/HIV (WHO, 2020). The main contribution of this study was knowledge of successful treatment outcomes. TB treatment outcome is affected by a multitude of factors, such as the age of the patient, gender, drug adverse reaction, socioeconomic status, distance and geographic location.

Furthermore, this research was essential for assessing whether these covariates and factors consistently influence successful treatment outcomes in this cohort, which to my knowledge, has not been explored in the Keetmanshoop Health District in Namibia. I designed the study's research questions (RQ's) and hypotheses to asses the successful TB treatment and its associated factors among TB/HIV- coinfectedion adult patients enrolled at the Keetmanshoop State health facilities, namely the TB clinic and CDC HAART ARV clinic.

Successful TB treatment outcome rates have the potential to reduce future disease burden among TB/HIV-coinfected adult patients and improve health and excellent prognosis and good quality of life. Current research involving this high-incidence cohort might inform the development of programs and interventions to improve outcome rates among TB/HIV-coinfected patients in the Keetmanshoop Health District. In this quantitative study, the relationship between the age of the patients, TB category, and treatment completion was investigated. Also the extent to which HIV status and gender predict the likelihood of TB treatment outcome was assessed. The main outcome of interest in this study was treatment

outcome. The dependent variable was binary, with a simple "YES" for treatment completed and "NO" for treatment not completed.

The independent variables that were tested for treatment completion were participant's age, gender, adverse TB treatment reaction, geographic location (residence), distance to the clinic and TB category. Participants' education, marital status, and geographic location were the controlled covariates that was adjusted for in this study. In this study successful TB outcomes of participants was known as and was classified as having completed their treatment if their record showed that they had completed their treatment for greater than or equal to 180 days (six months) and 24 months for MDR-TB (TB Alliance, 2020).

Identifying and describing these factors associated with treatment outcomes and associated factors in TB/HIV-coinfected patients in Namibia, which are likely to differ by types and levels of health care, will enhance targeted public health responses and approaches to improve the underreporting of TB. The study will determine TB assessment issues in the context of the Nambian health care setting. The outcome of this study will be used to improve TB case reporting and notification in Nambia by understanding the magnitude of TB success and unsuccessful TB outcome rates among TB and HIV coinfected patients.

As a consequence, this study is unique in the sense that it will address an under researched area with limited information regarding successful TB and HIV co-infection treatment outcomes and its associated factors in the Keetmanshoop District. The findings may guide the development of appropriate and targeted public health interventions to strengthen TB reporting in the Keetmanshoop District of the //Karas Region, Namibia. Be as it may, the main purpose of this study was aimed at assessing successful tuberculosis (TB) treatment outcomes and its associated factors among TB/HIV Co-infected patients in the //Karas Region Keetmanshoop, Namibia.

Research Question(s) and Hypotheses

I addressed the following RQs and hypotheses in this quantitative study

RQ 1: Is there an association among successful TB treatment outcomes and associate treatment factors when adjusting for, treatment outcomes and adverse TB drug reaction?

$H_0$1: There are no statistically significant differences in association among successful TB outcomes and associated treatment factors when adjusting for adverse TB drug interaction.

$H_1$1: There are statistically significant differences in successful TB treatment outcomes and when adjusting for TB drug interaction.

RQ2: Does gender predict the likelihood of treatment completion among TB patients in Namibia when adjusting for marital status?

$H_0$2: There is no difference in the odds of TB treatment completion between men and women among TB patients in Namibia when adjusting, marital status.

$H_1$1: The odds of treatment outcomes are different for men and women among TB patients in Namibia when adjusting marital status.

RQ3: Is there an association among TB-case category and TB treatment outcomes among TB patients in Namibia when adjusting for geographic location and distance?

$H_0$3: There is no association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting geographic location and distance.

$H_1$3: There is an association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting for education, marital status, and geographic location.

Theoretical Background

The theoretical framework for this study was Andersen's (1968, 1995) behavioral model of health service utilization. Several researchers have used this model to explore factors that affect health service use, including different health care systems as well with different chronic diseases such as TB /HIV and cardiovascular diseases (Wendimagegn &Bezuidenhout,

2019). The model demonstrates how a variety of factors influence health service utilization. The model predicts that health service usage is determined by predisposing factors, enabling factors, and the need for health service utilization (Li et al., 2015). Predisposing factors include demographic factors such as age, gender, and race; social factors such as education, occupation, poverty, unemployment and social relationships (family status); and mental factors or health beliefs such as attitude, values, and knowledge about health and health services (Li et al., 2015).

Enabling factors are conditions that enable service utilization (Li et al., 2015). They may include access to insurance, family and community support, and organizational and logistical factors such as means of transportation, travel time, and waiting time for services (Anderson, 1995). Babitsch et al. (2012), reported on the problem saying that the need for health service usage can be described as perceived need (an individual's perception of their health), and actual need as objectively assessed by a medical care professional.

The predisposing factors involve people's socio-cultural characteristics, which exist before an illness occurs (Andersen, 1995). The socio-cultural characteristics include race/ethnicity, culture, occupation, social networks and interactions, and education. Health beliefs are also categorized under socio-cultural factors and include attitudes, social values, and existing knowledge regarding the health care system (Andersen, 1995).

Finally, need factors represent the most common reasons for use in health care services and involve health issues that necessitate the use of health services. Grounded on Andersen's model, this model postulates that health behaviours need to be identified before the enactment of health behavior models. According to Andersen (1995), effective behavioural change can come about only when a specific set of health behaviours are targeted. The targeted change that was measured in this study was the assessment of successful TB treatment outcome and its associated factors among TB/HIV co-infected adult patients. Therefore, Andersen's model offers guidance on the characteristics that dictates medical care usage. This conceptual

framework was the basis for understanding, designing, analysing, and assessing ways to assess successful TB treatment outcomes and its associated factors among TB/HIV co-infected adult patients.

Rationale for Choosing Andersen's Model

Rationale for choosing Anderson Model was because of its robustness and flexibility in the usage of health care utilization, and in the assessment of successful tuberculosis treatment outcome and its associated factors among TB/HIV co-infected patients. It will also allow me to select dependent variables that are related to specific hypotheses of my studies, in particular with regards to the usage in the broader context of people living with HIV and TB, and the life course with co-infection (Anderson, 1995). The added rationale for choosing this model, is based on the fact that this model is relevant to the consideration of trust in relation to medication and/or treatment adherence.

Because recent repetitions of this theoretical framework help to examine psychological and psychosocial factors as they describe attitudes towards healthcare providers as well as beliefs about the healthcare system (Andersen & Newman, 2005; Bradley et al., 2002). As a result, an entirely new perspective is created. Furthermore, the rationale for choosing the Andersen–Newman Behavioural Model of Health Service Use (Andersen, 1995; Andersen & Newman, 1973; Bradley et al., 2002), is appropriate as a conceptual basis for understanding human behavior, specifically which of the patient within the patient–physician relationship co-infected with TB/HIV.

Whereas this conceptual model may appear at first as primarily representative of sociological constructs (e.g. systems, the family), the original model (Andersen, 1968) evolved throughout the years to include concepts and constructs that are representative of psychology (e.g. behaviours of the individual, feedback loops) as well as public health and healthcare (e.g. resources) (Andersen & Newman, 2005). Furthermore, the model lends itself to the study of

the influence of physician trust on adherence to statins in people living with HIV and TB, the model includes predisposing factors such as demographic variables (e.g. age, education, occupation) as well as personal attitudes and sets of beliefs about health services and/or knowledge about diseases (Andersen & Newman, 2005; Bradley et al., 2002).

The notion of "trust" and the presence of trust in one's physician are related to predisposing factors surrounding one's attitudes and beliefs about healthcare services and the physicians or healthcare workers who provide these services. The purpose of the model was to demonstrate how a variety of factors influences health service utilization. The dyadic context of chronic health conditions, scope and significance of aging, with HIV, factors that influence the utilization of health care services, barriers to medication adherence, access to healthcare, alcohol use and/or abuse, personal belief systems, lack of trust within the patient–physician relationship, these concepts are outlined below. These helped me in the assessment of successful TB treatment outcome and its associated factors among TB/HIV co-infected patients.

The Dyadic Context of Chronic Health Conditions

Individual lives are dynamic and change with the aging process. The same may be said of the health of individuals as they age and view health with increasing importance over the course of life with chronic diseases such as TB and HIV. Aging and health occur within the context of human relationships, specifically within the dyadic relationships attributed to couples, family members, and friends. This relationship allows for the ability of each member of the dyad to confront and overcome challenges associated with the temporal process of living with and managing chronic health conditions such as TB and HIV (Berg & Upchurch, 2007; Leventhal et al. 2003; Sebern & Woda, 2012; Sebern & Whitlatch, 2007; Whitlatch et al., 2006). The ideas of dyadic coping and the sharing of stressors between two individuals within a relationship (Berg & Upchurch, 2007) speak to the notion that the burden of chronic health

conditions may be shared, even between patient, family, healthcare workers and the community at large (Halbesleben & Rathert, 2008). However, everyone within the dyadic relationship responds differently to the stressors that characterize chronic illness such as TB and HIV as individual chronic disease or as co-infection.

Whereas the dyadic relationship within the context of chronic healthcare conditions has yet to be tested more thoroughly, research suggests that trust is central to the success of dyadic relationships (Lewicki, 2006). This is particularly the case because the dyadic relationship provides for the "power of the situation", in which both individuals within the dyadic relationship share the desire to understand how behaviours (e.g. adherence to medications and /or treatment) are influenced not only by properties of each individual (e.g. as patient or physician or healthcare worker) but also by the elements of the situation (e.g. whether trust, food, is/not present and shared). The dyadic relationship shared between patient and physician is no exception. This is a case in point when it comes to TB and HIV, because of the stigma associated with these diseases.

Scope and Significance of Aging, with HIV

Aging with HIV amidst an array of other medically complex health conditions such as TB and comorbidities such as diabetes, hypertension is not uncommon in modern society. Particularly because people diagnosed with HIV are living longer and productive life now (Fultz et al., 2006; Johnson et al., 2012; Stewart & Weinberg, 2010) with the presence of co-morbidities such as diabetes, cardio vascular diseases, age should be considered when discussing HIV, including culture and respect (Justice et al., 2006; Justice et al., 2006). Likewise, statistically significant associations exist between antiretroviral therapy and TB including CVD (Crane et al., 2006; Johnson et al., 2012; Palacios & Santos, 2007); therefore, just as failure to adhere to antiretroviral therapy is detrimental to older people or people living

with HIV, failure to adhere to treatment of TB or HIV may prove harmful to this same group of people (Kamin & Grinspoon, 2005; Sudano et al., 2006).

Arguably, when the dyadic relationship shared between the patient and physician is characterized by trust, adherence to medication may occur to a greater extent even though medication non-adherence is considered multi-factorial (Bosworth, 2010; Jin et al., 2008). Likewise, because of a trusting patient–physician relationship, fewer barriers to healthcare services may manifest themselves (as strongly) during a patient's lifetime.

Therefore, Andersen's model offered me guidance on the characteristics that dictates medical care usage such barriers to medication, adherence and non-adherence to medication especially chronic medication such as ART medication and medication that is taken over a long period of time like TB medication, access to healthcare, alcohol use and/or abuse, mental health issues, personal belief systems. Including successful tuberculosis treatment outcome such cured, completed treatment", "defaulted/interrupted", "failed", "died", and "not evaluated" including its associated factors among TB/HIV co-infected patients.

Nature of the Study

This was a retrospective epidemiological quantitative longitudinal study of successful TB treatment outcomes rates and associated factors. I used secondary data to explore what factors influenced the likelihood of fail treatment, poor treatment, default, missed doses, and death. Such a design is consistent with research grounded by Koch's (1882) germ theory of disease and (Gordon's (1953) epidemiologic model TB has been well documented as a disease of social context that is influenced by host, environment, and agent-related factors (Hirsch-Moverman et al.,2010; Raviglione & Sulis, 2016; Venkatraman et al.,2013). In a retrospective study, the outcome of interest is already known. I conducted a trace back using the database with the specific intention of exploring the relationship between the successful TB treatment outcome and associated factors, including possible risk factors, among TB/HIV co-infected

patients and associated factors, including possible risk factors among TB/HIV co-infected patients (Ranganathan & Aggarwal, 2018). This type of study was particularly useful for evaluating the relationship between risk factors and the development of disease, and the completion of treatments over different lengths of time. Similarly, because data were already collected for given individuals within a predefined group, appropriate statistical testing was employed to analyze change over time for the group as a whole, or for particular individuals (Caruana et al., 2015).

This afforded me the ability to identify and relate events to exposures, and to further define these exposures with regards to presence, timing and chronicity (Caruana, et al., 2015). I used secondary data from the HIS data base of patients who had previously been diagnosed and had completed TB treatment outcome and were HIV positive, and registered in TB facilities administering the DOTS program in Keetmanshoop District. I randomly selected data from //Karas Keetmanshoop Health District centers namely, Keetmanshoop urban TB/HIV center, Tses rural Health District Health centre, Berseba rural health district, health centre and Koes rural in the //Karas Region of Namibia.

After extracting the secondary data from HIS database, subsequently I also review the same data of the patients from their follow-up treatment records and hospital registers to avoid duplication. I used retrospective design base on Caruana et al. (2015) observation that a retrospective design it is cost effective and time saving and does not expose subjects to harm due to intervention effects. Additionally, it is suitable for the analysis of multiple outcomes.

Definitions

I define the following terms to clarify their usage throughout this document. The definitions might be differenct than general usage.

Operational Definitions

Cured: A pulmonary TB patient with bacteriologically confirmed TB at the beginning of treatment who was smear-or culture-negative in the last month of treatment and on at least one previous occasion.

Defaulter: patient who had been on treatment for at least 4 weeks and whose treatment was interrupted for 8 or more consecutive weeks.

Died: A TB patient who dies for any reason before starting or during treatment.

Miss/loss to follow-up: A TB patient who has been on treatment for at least 4 weeks and whose treatment was interrupted for 8 or more consecutive weeks.

Marital status: For this study, in a relationship at the time of diagnosis. The variable was dichotomized into married, not married, divorced, and others.

New case: A patient who had never had treatment for TB or who had been on anti-TB treatment for fewer than 4 weeks.

New patients: Patients who have never have been treated for TB or who have taken anti-TB drugs for less than 1 month.

Not evaluated: A TB patient for whom no treatment outcome is assigned. This includes cases "transferred out" to another treatment unit as well as cases for whom the treatment outcome is unknown to the reporting unit (WHO, 2015).

Successful TB treatment outcome: if the TB patients were cured (negative smear microscopy at the end of the treatment and on at least one previous follow-up test) or completed treatment with resolution of symptoms.

Unsuccessful outcome: if the treatment resulted in treatment failure (remaining smear positive after 5 months of treatment), patients defaulted (patients who interrupted their treatment for two consecutive months or more after registration), or patients died.

Treatment Failure: Treatment failure: a patient who, while on treatment, remained smeary positive or became again smear positive at the end of the five months or later, after

commencing treatment or a patient who was PTB-negative at the beginning and turned out smear positive at the end of the intensive phase.

Poor Outcome: Treatment of TB patients that resulted in treatment failure (i.e., remaining smear-positive after 5 months of treatment), LTFU (i.e., patients who interrupted their treatment for 2 or more consecutive months or more after registration), or death (WHO, 2015).

Dependent Variable

Treatment completion: For the purpose of this study treatment completion refers, to patients who have completed at least 168 doses of their medication (6 months' treatment) and their initial positive sputum converted to negative sputum at the end of the treatment. It will also include those who do not meet this conversion criterion, but neither can they be described as having failed treatment. They will include patients with sputum-positive and sputum-negative pulmonary TB as well as those with EPTB disease that has been described as free of the active TB disease after treatment.

Independent Variables

Age: for the purpose of this study age refers to as the time between the day a person was born and time, they were diagnosed with TB expressed in years. In this study, the measurement of age was a categorical variable.

Gender: This is a nominal variable that is defined as the being of male or female (WHO, 2015).

Covariates

Geographic location: In this study geographic location was known and define as //Karas region one of the 14 regions of the country (Southern Namibia, health districts namely Keetmanshoop urban, Tses rural, Berseba rural) from where patient data will be collected and

where patients are assumed to reside during the course of treatment. The variable will be measured at the nominal level of measurement.

Assumptions

The assumptions at the conclusion of this study was based on the fact that the following assumptions hold true. It was assumed that the hospital registers and patient visit records from the two chosen state health centres had obtained the relevant data that was representative of all TB and HIV cases in the //Karas Health District within the specified period of time. The assumption is that all cases monitored by the centres was followed to the end and that the end points (deaths), LTFU, completed, not completed, cured, not cured, were correctly recorded.

It was assuming that the premise on which these assumption holds, may be difficult to ascertain since most deaths are likely not to be reported, and there were incomplete records making it difficult for the researcher to ascertain endpoint or conclude loss-to follow-up. This study involved the assessment of successful TB treatment completion and its associated factors among TB/HIV co-infected patients using *chi*-square. Furthermore, this study similarly abided by the following statistical assumptions, the statistical assumptions relating to chi-square tests and cross-tabulations was satisfied and or observed before the statistical analysis by the researcher.

The assumption that requires all groups to be independent was observed and an *ANCOVA* test was conducted where any two groups are related. Given, that the assumption for *chi*-square testing the variables being compared should be nominal or ordinal in nature. Transformation was of the ratio variables was conducted into nominal or ordinal variables and was used in chi-square tests. The *p* value that was used to determine whether a predictor variable was statistically significant at a threshold of $p < .05$ (Singhal & Rana, 2015). Finally, the TB case reporting practices in 2014 are still relevant in 2022.

Scope and Delimitations

This quantitative longitudinal retrospective cohort study aimed to assess what the successful TB treatment among coinfected TB/HIV adult patient completion rate was in adults diagnosed with TB in Keetmanshoop Health District, as well as what variables may have been predictive of poor outcomes in this population. Weekly, monthly and annually and consistently statistics, of adult patients account for a majority of the state's confirmed TB cases and thus, the successful outcomes of TB therapy may be critical to decreasing future rates of TB disease in the health district and improving community health by preventing the risk of future transmission.

The choice of not assessing multiple Health Districts and centres in the //Karas Region, even though such a comparison may have yielded a better picture, was to allow for better understanding of the health districts chosen. It would have been cumbersome to collect information from all the Health Districts in //Karas Region due to distance, time limit and or economic reasons. Present research on this phenomenon has focused only on adult patient's data diagnosed with TB and coinfected with TB/HIV under the government DOTS program and HIV in the //Karas Region of the Keetmanshoop District between the years 2016 to 2020.

Hence, the findings of this study should not be generalised to other Health Districts, regions or the private health sector in Namibia, so generalize findings to situations that may not be relatable. This research and the subsequent focus on adult patients may help ensure TB control program interventions aimed at improving TB treatment successful outcomes rates are developed from conducting research in the appropriate setting but may also provide insight into the urban versus rural dichotomy of TB control. The sample included in this study was limited to adult patients from 18-65 years identified as having diagnosed and on or was on TB treatment and HIV, entered in the HIS system. The HIS system is the most vigorous and reliable source

for both HIV and TB medical screening information for MoHSS in the country. All patients' submitted data are entered into HIS.

Limitations

The major limitation of this study was the use of existing data which was aggregated. The limitations of the study are related to the inherent limitation of a retrospective study design and use of secondary data, which includes challenges with data quality and the likely misalignment between the secondary dataset and current research questions.Two unique limitations for an inventory study in a situation like Namibia include the lack of unique identification numbers which makes it difficult to match patients between different levels of registration, and secondly, patient movement and self-referral make it equally challenging to match patients.

As a result, important covariates like participant age which was aggregated on wide intervals did not give sufficient meaning to explain the observed findings, like effect of age on mortality due to TB. As a result, no conclusive associations could be made on age as an important explanatory variable of mortality in this study.

Fewer variables existing in the national TB surveillance system resulted in some factors important to the study not being included in the analysis as anticipated, thus resulting in the study missing out on important associations. Another, limitation was that only secondary data from the HIS data base system, hospital registers and patient records, in the Keetmanshoop District were analysed. Therefore, this study was limited to only those TB patients registered in those DOTS centres who receive TB. Hence it cannot be generalized to other districts or regions. Furthermore, this study may be limited by inconsistencies in the general medical practices with regards to TB and more specifically if it involves HIV, although Namibian health care workers should be abiding by the same National TB guideline on treatment and CDC Technical Instructions (Dara et al., 2013; Lee et al., 2013). Also, the medical evaluation

provider interpretation of diagnostic results may contribute to misclassification bias. These differences in practice may produce varying rates of data completeness and outcomes which may also influence the overall successful rate in TB treatment rates among TB/HIV coinfected adult patients.

Because sites were purposively sampled, the findings may not comprise a completely representative sample generalizable to all HIV and TB care and treatment services in Namibia. Data abstractors working on the quantitative data may not have been completely blinded to the hypothesis, which may have introduced reviewer bias. Quantitative data was obtained using secondary availability sampling, which could have made the findings vulnerable to selection bias and sampling error.

The study was based on the paper-based TB reporting system, even though the program commenced phased implementation of electronic TB reporting. At the time of the study, the data capture and storage system at the clinics was still manual and recorded on hard paper copies instead of electronically. An additional concern of this research involves the potential to underestimate the true rates of succefull TB treatment outcomes due to patients being LTFU but also due to the interval in which medication adherence and completion is measured in Keetmanshoop Health District.

TB/HIV coinfected Patient on TB treatment may move out of Health District and complete therapy in the new Health District or Region or, since many are sent home with an entire month's or two months' worth of medication, may actually finish all required doses but not present back to the specific health centre or clinic or TB clinic which are managing their care resulting in records indicating LTFU or noncompletion when TB therapy may have actually been completed. Furthermore, government personnel responsible for dispensing TB treatment medications may only know if a patient does not complete treatment if they do not show up for monthly clinic visits or fill monthly prescriptions, limiting the level of data analysis

that can be performed and the conclusions that can be drawn related to the number of days from initiation to failure and miss doses when they are on DOTS.

DOTS, observe a more accurate and detailed log of actual date's medication is observed being ingested is perfect, however would be logistically taxing in Keetmanshoop Health District. Lastly, it is possible that some patients seek care in the private sector and thus, could be excluded in this research if the provider does not submit follow-up TB data to the state. Furthermore, both electronic and paper databases are susceptible to incomplete data entry, and HIS are prone to transcription errors when entering data located in paper registers.

As well, data concurrence across registers can be inconsistent, and implementation at the facility level is also thought to be highly variable. It is also possible that patient information may have been lost during storage, especially in situations where patients have more than one patient card. In addition, there was no way to match patient information from previous encounters, as is easily done with electronic data recording and storage. These limitations may have led to loss of vital information and may threaten the validity of the outcome, depending on the magnitude of the loss.

There was also a potential threat to both internal and external validity with respect to the secondary data on study participants that are collected and stored. One of the major threats to validity in this study was the selection of the regional clinics in question, as well as the selection of samples within the study period in each of these hospitals. Some patients may also be turned off by the personnel in the treatment center. Changes in such personnel who act as an agent of instrumentation in outcome measurement may have affected changes in the outcome as well. The data analyzed included TB cases reported in 2015, while the data were analysed in 2021, therefore, there was the possibility that the health care workers who reported and /or captured the TB cases in 2015 were not the same as the health care workers in 2021. The study was only conducted in Keetmanshoop which is not representative of Namibia (the

peculiarities of Keetmanshoop include population density, a low proportion of private health care facilities, low socioeconomic and educational status of people and the health care worker/population ratio).

Another limitation of this study was related to the use of retrospective secondary data, which cannot be assessed for various factors identified by different studies as assumed to have an impact on treatment outcome of TB/HIV co-infected patients (Caruana et al., 2015). Limitation of retrospective studies, is the use of secondary data, which increases the likelihood of bias in the findings. Another limitation in the use of secondary data was, when applying secondary data analysis to data collected by someone else, you relinquish control over many important aspects of a study, and including the specific research questions that can be answered (Weston et al., 2019).

Furthermore, Caruana et al. (2015), also argued that limitation of retrospective studies is the vulnerability to recall and misclassification bias, which can affect the reliability and validity of findings. This study was only involving patients in public health clinics in the Keetmanshoop TB clinic and HAART clinic. Hence this results cannot be applicable to the patients in a private health care facilities and other public health care services offering the same treatment.

Significance

This was a unique study considering the sequence of TB and HIV outcomes among TB patients in the Keetmanshoop District. Quantifying the successful outcomes rate and understanding the associated risk factors for poor treatment outcomes in the, Keetmanshoop Health District, Namibia will help bring about the significance and prominence of the outcome rate problem to the attention of MoHSS officials and the population in this setting. Additionally, this research may produce positive social change by providing a foundation for the deployment of more tailored and appropriate public health interventions, including funding,

recruiting more qualified health care workers, and building more facilities for this cohort of people in the Keetmanshoop Health District.

Timely interventions may improve TB treatment outcomes rates in Keetmanshoop and lessen the future burden of TB disease in the region thus improving the community's overall health and reducing the strain on already limited TB and HIV resources in the Keetmanshoop Health District. These potential improvements in health may also be long term since the risk of re-exposure to *Mtb* in the low-incidence setting is small. The results of this study may provide the MoHSS TB Control Program and the health care community with greater insight into treatment outcomes, noncompletion rates as well as into which cohort or segment of the population have the greatest risk for not completing therapy.

Therefore, the findings of this study will have a significant effect on the following levels: patient, community, and health system. The timeliness, accuracy, and completeness of TB cases will provide information on the quality of care at the patient level by providing information on the type of diagnostic method used and treatment regimens provided, level of adherence and the treatment outcome. At the community level, it will give a better understanding of the burden of TB and HIV and its distribution for better planning and community engagement. In addition, at the public health level, it will enable understanding of the burden of TB and HIV to facilitate prioritization, planning, and appropriate resource allocation (WHO, 2020).

The sequence of the TB reporting approach will give a better understanding of the current situation by a different type of health care facility, including associated factors and will help to develop targeted approaches towards strengthening TB reporting practices. The findings will be presented in existing TB platforms in Namibia; annual TB review meetings (a yearly event for all stakeholders within TB program technical and funding agents), and the partners' forum meeting, which is a quarterly activity organized by the national TB program.

The findings could assist the TB program and different TB stakeholders including non-governmental organizations (NGO) with input for reinforcing TB reporting in the Keetmanshoop District and the larger Region. The resulting understanding and improvements of such a relationship in TB reporting would help for policy makers and health professionals involved in the program in understanding the precise disease burden and its distribution, thus allowing effective planning and focusing on targeted resource allocation to where it is most needed.

TB reporting (including mandatory TB notification) is emphasized as an fundamental part of the regulatory framework for implementing the WHO End TB Strategy for ending the TB epidemic by 2030 (Uplekar et al., 2016). Therefore, the outcome of this study will create positive social change by improving the DOTS program's efficacy and TB outcomes rate. At the same time, the study findings may identify the characteristics of those cohort of patient population who are at high risk of defaulting on their treatment, thereby providing information that can lead to improved national surveillance. Increased monitoring of such groups and providing special attention to them, may improve compliance, adherence and, reduce the TB burden in the population. The significance of this study provided much-needed insights by providing readily up-to-date available empirical data on TB/HIV adults patients in Keetmanshoop District.

Acumen of adequate readily available data with regard to TB/HIV/AIDS co-infection will assists and improve the service rendered to patients by health care workers and influence their use of treatment facilities, decreasing the defaulter rate, thereby increasing TB treatment completion and outcome rate among TB/HIV co-infected patients, thereby contributing to positive social change.The study will not only contribute to a body of knowledge, but the study results if implemented will be useful to influence and inform policymakers and programme managers in matters that might improve overall management of TB and HIV in health facilities

in Namibia. Hence, the significance of this study is that its results will make a significant contribution towards closing the gap in knowledge with regards to TB/HIV co-infection.

This will be achieved by providing the much-needed insights into the process by strengthening collaborative TB/HIV management activities and providing a realistic approach to service provision and delivery. This study created a lens through which the Namibian health care curriculum specialists and MoHSS policymakers may mold appropriate TB/HIV curricula and policies for all healthcare workers for the ssuccessful TB treatment outcome and its associated factors among TB/HIV co-infected Patients.

This study also provided the current status of TB and HIV mortality rates in the region which is in-line with making a contribution to the overall vision and mission of the National Health Policy Framework 2010- 2020, the fifth National Development Plan (NDP5), Vision 2030 and the Harambee Prosperity Plan 2016/17 - 2019/20. Including the Third Medium Term Strategic Plan for Tuberculosis and Leprosy 2017/18 – 2021/22 which is meant to increase treatment success rate for the drug-susceptible from 83% (2015 cohort) to 90%, and for the drug-resistant from 60% (2014 cohort) to 77%, by 2021.

Inter-alia increase coverage of HIV testing among TB patients to 100%, coverage of ART among TB/ HIV patients to 100% (Republic of Namibia 5th National Development Plan (NDP5), (2017). Thereby contributing to positive social change and development, by understanding the impact of the TB on HIV coinfected patients will lead to attaining the global treatment success rates (TSR) of 90% and the WHO's target for detecting new TB infection of 70% cure, and detect 85% of those cohorts (Tola et al., 2019). Including achieving high TB treatment outcome rates among TB/HIV co-infected patients in the Keetmanshoop District.

Summary

This chapter contained an overview of the study and the research problem, namely TB/HIV co-infection as a public health problem in Namibia as well as globally. I provided background information about the successful TB treatment outcome and its associated factors among TB/HIV co-infected patientsin the district and region and about the related influence of TB treatments and adherence. The problem statement, purpose of the objective, and the RQs and hypotheses followed. After discussing the theoretical foundation and nature of the study, I defined and considered the assumptions, scope, and delimitations, limitation, and significance of the study. In Chapter 2, I will review literature that is relevant to the topic under review.

Chapter 2: Literature Review

Introduction

In the high-incidence TB setting of Keetmanshoop District in Namibia, the large pool of TB and HIV patients and unsuccessful TB outcomes are the most immediate obstacles for achieving a succesful TB treatment outcome rate among HIV coinfected patients.To prevent future transmission if reactivation occurs, persons with TB and HIV may benefit from the 60% to 90% efficacy of eradicating *Mtb* by completing preventive treatment (Dobler & Marks, 2012; Getahun et al., 2015; Menzies et al., 2011).However, there is little published research about the epidemiology of TB treatment outcomes among adult patients coinfected residing in the Keetmanshoop Health District, which has limited resources and a high prevalence of both TB and HIV (Kibuule et al., 2020). In studying this topic, I sought to address this gap in the literature.

The findings from this study may help public health workers to potentially reduce disease burden by identifying interventions that improve TB treatment and prevent future transmission. Predicting the risk of TB treatment outcomes can be a successful approach to improving poor completion rates in high-risk populations. Predicting the risk of TB treatment outcomes can be a successful approach to improving poor completion rates in high-risk populations (Shieh et al., 2006).

Several studies has also highlighted this phenomenon in various urban, and high-incidence TB settings ,that there are inconsistencies in identifying the variables associated with preventive treatment completion and unsuccessful TB treatment outcomes (Hirsch-Moverman et al., 2008; Johnson et al., 2016; Lin & Melendez-Torres, 2016).This gap highlights the potential role that geography and TB resource availability may play in ensuring high completion rates (Hirsch-Moverman et al., 2008; Johnson et al., 2016; Lin & Melendez-Torres, 2016). Researchers has determined that host, agent, structural and environmental

factors associated with treatment completion may interact and influence treatment outcomes, making these factors appropriate targets for study (Coly & Morisky, 2004; Hirsch-Moverman, et al., 2008; Malangu & Yamutamba, 2016; Parsyan et al., 2007). The future threat of TB will remain constant challenge unless treatment outcomes rates can be better achieved.

Identifying potential host, agent, and environmental predictors of failure for this cohort in Keetmanshoop District may also assist with intervention development aiming to improve outcome rates. The sporadic TB resources, limited availability of those with clinical expertise, and the vast geography of //Karas Region in Keetmanshoop can pose significant barriers to high treatment completion/outcome rates (MoHSS, 2019). Therefore, early identification of outcomes and poor outcomes predisposing factors may help public health workers to better target interventions, and improve outcome rates and community health, which may have a positive social impact on the Keetmanshoop populace.

In Chapter 1, I discussed the background and rationale of this study. In this chapter I will review relevant literature from various books, peer reviewed scholarly articles, and government websites to provide more insight into the research problem was thoroughly studied. Certain aspects of TB/HIV co-infection and DOT are discussed as they pertain to this study as well as studies conducted by various researchers concerning to the research. In this literature review, I identify some key issues that need to be addressed to achieve the required treatment success rate.

Furthermore, this chapter functions as a review of literature regarding the known history of TB and HIV, screening practices in Namibia for TB and HIV co-infected adult patients, the known epidemiology of TB and HIV in //Karas Region, Keetmanshoop Health District, Namibia. The impact of and risk factors associated with having TB and HIV, and the documented predictors of TB treatment outcome in certain populations are also addressed. The literature search and review focused on publications related to TB and HIV care and treatment

outcomes and the specific associations between participants and outcomes rates in the Namibian context and international settings.

Literature Search Strategy

For this research, I identified relevant literature review by querying electronic databases using Boolean searches including the phrases *co-infection, TB/HIV, TB treatment, successful and unsuccesful TB treatment outcome rates, and completion predictors*. Alternative searches were conducted, using electronic databases, using TB or latent tuberculosis infection and treatment adherence or predictors of adherence. I used Google Scholar to gain more familiarity with the terminology of similar research.

MEDLINE, CINAHL, ProQuest Nursing and Allied Health Source, ProQuest Health and Medical Collection, PubMed, Science Direct, and EBSCO electronic databases were used to identify peer-reviewed studies. I also used Walden's Thoreau Multi-Database Search tool to ensure that any previously unsearched databases were identified.

Initial broad searches were critical not only to the process of better defining future search terminology and strategies, but also in identifying authors and publications likely influential to TB and HIV treatment outcomes research. The long-standing history of TB research indicated some prioritization of published works was necessary for this literature review. I frequently referenced seminal publications on the history of *Mtb* as a disease throughout this research.

However, I emphasized finding more recent works. Most peer-reviewed works critical to forming an understanding of TB/HIV co-infection outcomes for both HIV and TB, treatment outcomes, and risk factor or predictors of successful outcomes were limited to publication within the most recent 4 years (2016-2020). Précises and critiques of the identified, applicable, peer-reviewed literature are found throughout this chapter. Additionally, references cited in the reviewed literature waswere also essential to identifying more potentially related publications.

I incoproated findings and reviews from the Database of Promoting Health Effectiveness Reviews (DoPHER), health systems evidence, and national guidelines was employed. In addition, recent literature from the PROSPERO systematic reviews register, and the International Journal TB and HIV and Lung Disease were perused. I also reviewed reliable websites. The literary search strategy included peer-reviewed studies that had a defined sampling procedure and that were published in English.

Theoretical Foundation

The research work was based on the theoretical complexity theory in healthcare, which is concerned with functionality and changes within a given healthcare system in limited resource setting with both high TB and HIV coinfection burden in the Keetmanshoop District health care system. Beginning from the assumption that the field of healthcare delivery has become increasingly complex as presented in the early sections and through out of this quantitative retrospective research dissertation, this establish the grounds for this study.

Complexity theory in healthcare is concerned with functionality and changes within a given healthcare system, beginning from the assumption that the field of healthcare delivery has become increasingly complex (Kannampallil et al., 2011; Kernick, 2004). Complexity has been applied across various disciplines with each discipline offering a unique understanding of the term. Manson (2001), divided complexity theory into three; algorithmic complexity, deterministic complexity, and aggregate complexity.

In this paper, I subscribed to “aggregate complexity” which concerns the relationships between individual components in a complex adaptive system (in this case, integrated TB-HIV care operating within a wider health care system), in a resource limited setting with high burden of TB and HIV and poor socioeconomic status. Aggregate complexity is generally regarded as the qualitative component of the complexity theory (Kernick, 2004). Complexity theory views healthcare facilities organized around specific chronic disease management such as TB

including its outcome and HIV in “complex adaptive systems”. This complex adaptive system is a group of individual agents, specialized health workers in the field of TB and HIV management, whose actions are interrelated Hanson and Ford (2001), and the interactions among the specialized units are more critical than the discrete actions of individual components (Weberg,2012). According to Mason (2001), understanding aggregate complexity will require an exploration of key sets of interrelated concepts that define a complex system.

These key concepts include: relationships between entities; internal structures and the surrounding environment; learning and emergent behaviour, and the various ways by which a complex system can transform and improve the management and final outcomes of a chronic disease (Kannampallil et al., 2011). A keystone of aggregate complexity is the relationships that exist among the various components. Here, the concern is about the interactions among the various components of the system; TB and HIV service providers, the TB/chest unit, HIV/counselling unit, laboratory, X-ray unit, pharmacy/dispensary, and other units/wards with a direct or indirect relationship with TB and HIV management and the clients or patients. With regards to the internal structure, it is assumed that the components of a system and their relationships are not different.

Consequently, the actions of the related units are or should aim at ensuring a better outcome for health service users/clients, especially the most vulnerable in the society. Thus, in the various models of care; separate, linkage, specific referals, collaboration, social support, these should have fully integrated systems, each unit and their staff have to follow the laid down treatment protocols.

A key element in the existence of a complex system is the environment. Here, the environment is the broader political, social, and organizational context the physical infrastructure (units) for the management of TB and HIV in the health facility. To a large extent, the environment determines the level of interactions that will take place between the

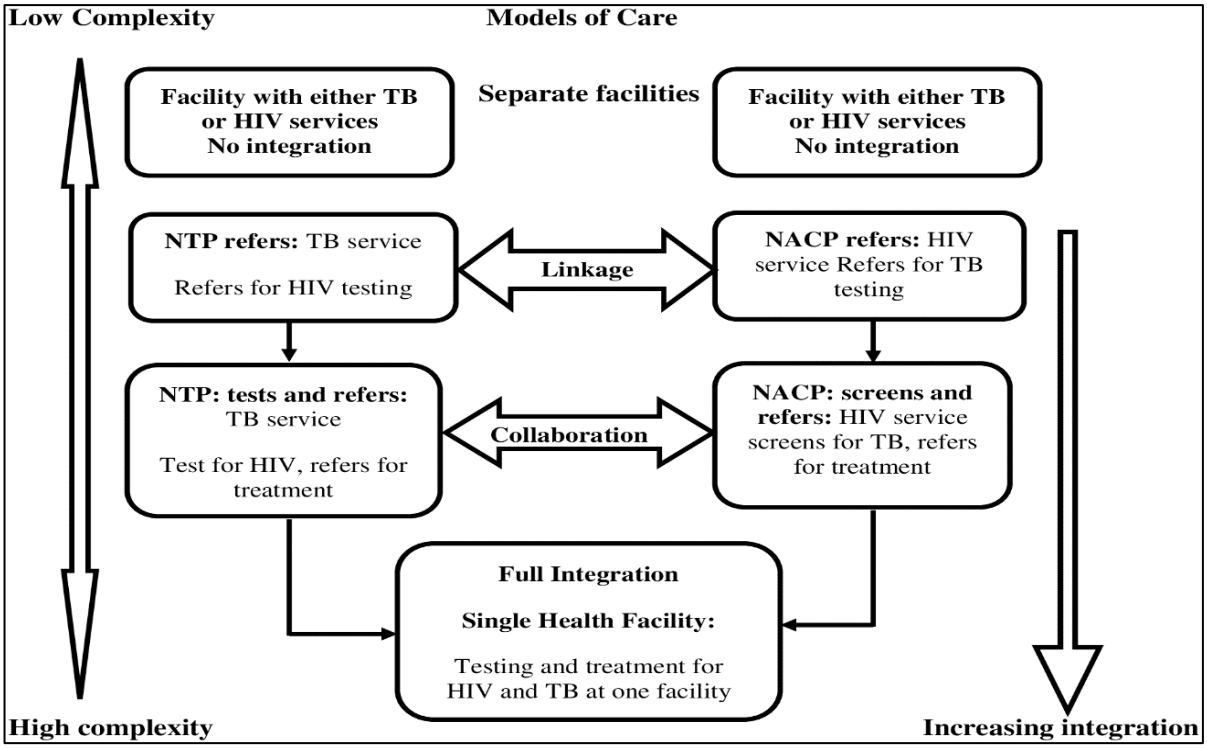
components of a complex system. However, a complex system like healthcare is not entirely dependent on the environment, but actively shapes and reacts to changes over time because of the range of suitable internal mechanism (Belrhiti et al., 2018; Plsek & Greenhalgh, 2001). In rare cases where the components lack the ability to respond to new interactions with the environment, there is a potential for appalling results or outcomes. In a public healthcare system where unpredictability is high, there is a need for changes to be made over time. A critical characteristic of a complex system is self-organization, which allows for changes to the internal structure to better interact with the environment.

Unlike many organizational theories that assume stability, a major strength of aggregate complexity lies with its position that systems such as healthcare are constantly changing their internal structure and external environment. The complexity theory offered us an opportunity to understand how a complex system like integrated coinfection of TB-HIV care operates, challenges to scaling-up integration, including management and the need for individual units to interact in order to produce the desired result and outcomes. TB and HIV reporting is an expected behavior (standard of TB care) and a requirement by law, therefore, the constructs of algorithmic complexity, deterministic complexity, aggregate complexity, and environment, are the broader political, social, organizational context, including the physical infrastructure (units) for the management of TB and HIV in the health facility and the entire TB and HIV process.

This constructs form essential determinants of health and behavior through attitude, accessibility of quality care and the influence of variables like knowledge, experience, employment or socio-economic status, age, gender, distance to the health centre, adverse TB medication interaction, the salience of the behavior, habit or maintenance, and engagement in the entire complex health system process. **Figure 4** below provides a summary of the interaction between the multiple variables in complexity theory in healthcare.

Figure 4

Models of Care and Levels of Complexity



Source: https://doi.org/10.1371/journal.pone.0235843.g001

Literature Review Related to Key Variables and/or Concepts

In this section, I provide an overview of the literature that is relevant to the field of study and by doing so, used relevant available research evidence to make denotation of the study and analyse research data effectively.TB and HIV burden, TB outcomes, in Keetmanshoop District of the //Karas Region, Worldwide, Namibia , SADC region, was explored with a particular focus on TB outcome rates, including the theoretical foundation of models of care and levels of complexity that guide this study. McCombes (2020), defined a literature review as a survey of scholarly sources on a specific topic.

The literature review provided the researcher with an overview of current knowledge, allowing to identify relevant theories, methods, and gaps in the existing research, which involves finding, reading, understanding and forming conclusions about the published research and theory on the research topic and assessment of successful TB treatment completion and

its associated factors among TB/HIV co-infected patients in //Karas Region Keetmanshoop, Namibia. Therefore, a literature review assisted me to address research questions with a power that no single study has (Snyder, 2019).

The Activities of the National TB Control Programme in Namibia

In order for readers to better appreciate and to have a clearer view of the problem in question, I will endeavoured to explain firstly the health care system in which patients with TB are managed and treated. The National Tuberculosis Control Programme (NTCP) was started in 1991 after a MoHSS and a WHO review revealed that TB was a serious public health problem in Namibia and that the control activities at the time were inadequate and did not meet the required standard.

The aim of the NTCP was to cure the individual person's disease, restore their capacity for their activities of daily living quickly and restore them to their position in the family and community to which they belong. For the community, NTCP was intended to decrease the spread of TB infection and force the disappearance of the disease from society (MoHSS, 2016). In Namibia, TB programme activities are fully integrated at the service level: nurses and doctors undertake the activities for diagnosis and treatment and TB care services are available free of charge in the public sector.

The NTCP's activities are implemented through a decentralised system at national, regional, district and community levels. At national level, the NTCP as part of Directorate of Special Programmes is responsible for the overall coordination, implementation, monitoring and evaluation of TB control (MoHSS, 2016). NTCP staffs at national level comprise a chief medical officer, a chief programme administrator and two senior health programme administrators. The national referral unit, which is situated at Katutura state hospital in Windhoek, Capital city, provides specialised TB care (MoHSS, 2016). Patients are admitted to this unit from throughout the entire country if case management becomes too complicated to

be managed at regional level (MoHSS, 2016). The unit is also responsible for the orientation and in-service training of medical doctors and nurses in the clinical management of TB (MoHSS, 2016). At regional level, Namibia is divided into 14 political regions. Each region has a chief health programme administrator and a senior health programme administrator who fall under the Directorate of Special Diseases Programme for HIV/AIDS, TB and Malaria. These people form part of the Regional Management Team (RMT) and are responsible for coordinating and supporting TB control activities in the region.

The regional referral hospital admits and manages patients with complications resulting from TB, drug resistant TB and TB/HIV co-infection. Because of the danger of MDR and the emergence of a more dangerous form of resistance, XDR, the NTCP is establishing treatment centres for the management of MDR at some regional hospitals. The aim is to ensure maximum isolation of these patients until smear conversion. Ideally, medical doctors and nurses who have received special training in the management of drug resistant TB should care for these patients (MoHSS, 2016).

At the District level, the District Coordinating Committee (DCC) is responsible for overall health planning, coordination, management and implementation of TB care and control activities. The coordination and implementation of TB control activities are the responsibility of the principal medical officer (PMO), the primary health care supervisor and two registered nurses for special programmes responsible for HIV/AIDS, malaria and TB.

Medical doctors and nurses at district hospitals diagnose, treat and admit TB patients where necessary. These officers must have undergone training in the management of TB cases, including TB/HIV (MoHSS, 2016). All peripheral health units (health centres, clinics and mobile services) are involved in TB control and care. Health workers working at this level have received training in TB management and are expected to identify most TB suspects seeking care. They should be able to provide initial and follow-up care, treatment and proper

supervision; where possible they screen patients for HIV and provide counselling. They also have a major role to play in defaulter tracing and in educating patients and the community at large. Other stakeholders, such as TB activists in both the public and the private sectors, non-governmental organisations (NGOs) and community-based organisations (CBOs) are partners in TB control (MoHSS, 2016). At the community level, community health workers are actively involved in TB prevention and control.

They assist the health services in providing health education and creating awareness among community members. They help as DOT supporters and assist in tracing patients who have interrupted their treatment. Health workers play a leading role in ensuring that all stakeholders and the community are given proper information. This is possible only if health workers are also well trained and motivated and have the required knowledge and a positive attitude (MoHSS, 2016).

Promotion of Adherence to TB Treatment

TB makes a major contribution to the disease burden of developing countries, and Namibia is no exception, where it is exacerbated by HIV epidemic. The implementation of DOTS in Namibia since 1996 has improved the availability of anti-TB medicine, bacteriological diagnosis, political commitment and programme monitoring and reporting. TB medicines are taken for a minimum of six months (and 8 months for re-treatment) and are taken under the direct observation of another person, such as a health care provider or a lay volunteer.

Treatment for TB in the public sector is available even in the remotest areas and is provided free of charge. Yet, the cure rate in Namibia remains at 75%, far below the WHO target of 85% (MoHSS, 2016). DOTS has been proven to be effective in diverse parts of the world because it was developed from the collective best practices, clinical trials and programmatic operations of TB control over decades (MoHSS ,2016). In 1996, the Namibian

government also adopted the DOTS strategies with the aim of detecting 70% of new infectious TB cases and treating and successfully curing 85% of detected cases by 2005.

One of the elements of the DOTS strategy is standardised short-course chemotherapy for all cases of TB under proper case management conditions, including directly observed treatment (DOT). DOT is reported to be the most effective and reliable measure for TB treatment because patients take and swallow the anti-TB medicine in the presence of an observer (MoHSS, 2016). This makes it most likely that the patient will be cured and is the most likely intervention that prevents the transmission of the bacillus. If DOT is strengthened, and all smear-positive TB patients have taken their full courses of treatment, the possibility of further infection, defaulter cases, and drug resistance will be reduced and will therefore increase the cure rate (MoHSS, 2016).

Similarly, WHO (2015), confirm that curing smear-positive patients is currently the best available means of preventing tuberculosis. If applied perfectly, DOT can achieve cure rates of up to 95% even in the poorest countries; prevent new infections by curing infectious patients and prevent the development of drug resistance by ensuring that the full course of TB treatment is adhered to (WHO, 2015). However, the researcher has observed that the concept of DOT is not understood and accepted by some health workers. They do not understand why TB patients need to be observed when taking medicine, when patients with different medical conditions are able to take medicine by themselves.

Demographic and Health Overview

Namibia is one of the largest and least populated countries in Southern Africa, with a population of 2.5 million in 2018 and a surface area of 824 300 km^2. Namibia is a relatively arid country with the Namib Desert along its west coast and the Kalahari Desert in the east. Because of this, the country has a low population density of three people square kilometre, with large population clusters along the northern border regions, where rainfall is more plentiful

(The World Bank, 2018). Namibia has experienced rapid urbanisation, as evidenced by the increase in the proportion of the population living in urban areas from 28% in 1991 to 50% in 2018.

Children under the age of 15 years' account for 37% of the population, whilst those between 15 and 24 years represent 20.3%, those between 25 and 54 years represent 34.7%, those between 55 and 64 years represent 4.5% and those 65 years and over represent 3.9% (National Planning Commission and United Nations Population Fund, 2018). The fertility rate stood at 3.2 births per woman in 2017. The overall life expectancy at birth was 64 years, with the average life expectancy for males at 61 years and 66 years for females (NPC and United Nations Population Fund [UNPF], 2018).

Namibia is classified as an upper-middle-income country with a gross national income (GNI) per capita (population) of $10 320. Namibia's total health expenditure as a percentage of gross domestic product (GDP) was the highest together with South Africa for this group of comparable countries in Africa (MoHSS, 2017).

Description of the Health and District Health Systems

The MoHSS is the manager and provider of public health services in Namibia. It operates a four-tiered health system, consisting of PHC sites, district hospitals, intermediate hospitals and a referral hospital. Clinics are staffed by nurses and pharmacy technicians or assistants. When a patient's needs exceed their scope of practice or available resources, clinics refer patients to health centres, which are staffed by doctors, pharmacists and nurses. When patients require more care than can be provided in a primary care setting, they are referred to district hospitals.

If a patient needs to be seen by a specialist, district hospitals refer the patient to intermediate hospitals. Finally, intermediate hospitals refer the most medically complex patients to the Central Hospital in Windhoek when necessary. The private sector is sizeable,

with 844 private health facilities, 72% of the doctors and a little less than 50% of registered nurses (MoHSS, 2017). Only 18% of the population is covered by medical aid funds. As a result, the remaining 82% of the population are covered by the public health system or out-of-pocket (OOP) expenditure in the private sector (MoHSS, 2017).

On average, in rural areas, there are about 5780 people per primary health care (PHC) clinic and 58 825 people per district hospital. Hospitals, however, suffer from overcrowding and long wait times, as a large number of people bypass clinics and health centres closer to home and go directly to hospitals that are perceived to offer a higher quality of care (MoHSS, 2017).

Strength and Weaknesses of the Current District Health System

Namibia has developed a disseminated healthcare system to meet the geographic spread of its population, which requires a focus on integration and coordination across its four tiers. The growing healthcare demands are complicated by a shortage of workforce, including specialised services. Some progress has been made through the creation of public–private partnerships. Namibia's ranking as an upper-middle-income country has contributed to decreasing donor support to national programmes (MoHSS, 2017).

The impact of decreasing donor support is more apparent now in the face of the country's economic downturn. Implementation of key health initiatives, such as surveillance, supplementary immunisation activities, responses to non-communicable diseases and others, is constrained by limited budgetary allocation (MoHSS, 2017). Namibia still faces challenges for providing equitable, person-centred PHC. In HIV prevalence, Namibia still ranks as the sixth highest in the world (MoHSS, 2017). Similar to many other countries, Namibia is undergoing an epidemiological transition from communicable diseases to non-communicable diseases (NCDs), and for some time will continue to face this double burden of disease as seen with the recent outbreaks of Hepatitis E and the fact that NCDs accounted for 43% of deaths

in 2014 (MoHSS,2018). In addition, inequity remains a pressing challenge for Namibia overall. In 2010, Namibia had one of the highest income inequalities in the world, which is reflected in the lingering disparities in health access and outcomes seen across income groups, races and geographic locations (WHO, 2018).

The MoHSS is experiencing high staff turnover in certain operational areas because of a lack of clear career progression (WHO, 2018). This results in the ongoing need for training of newly recruited staff (WHO, 2018). Staff who have retired are not replaced because of limited budgetary allocation. The MoHSS staff are generally overstretched with heavy workloads and demands, which may affect programme delivery (WHO, 2018). This attitude may be as a result of a lack of knowledge that could be attributed to a lack of training in TB care (WHO, 2018).

With this in mind, the below mentioned literature review was conducted to enhance the focus on the research topic, including study research approaches used by other researchers, that is useful to this study. This provided important facts and background information on TB DOT services and HIV ART therapy and assessment of successful TB treatment outcome and its associated factors among TB/HIV co-infected patients in //Karas Region Keetmanshoop; to get an idea on how to proceed with the research project; and to search for information about the conceptual basis of the study.

Henceforth, selected articles relating to successful TB treatment outcome and its associated factors among TB/HIV co-infected patients are evaluated and will be discussed below by the researcher. The keyword search for this study was TB/HIV co-infection and successful TB outcomes.

1. Nglazi et al. (2015), provide critical statistics that 1.5 million deaths were attributed to TB, which 26% were due to HIV-associated TB (WHO, 2016). Furthermore, they stated that

TB/HIV Co-infection constitutes several problems including diagnostic and therapeutic challenges in the healthcare settings.

2. Mollel et al. (2019), correspondingly provided crucial information that HIV and tuberculosis (TB) are leading infectious diseases, with a high risk of co-infection, and that the risk of TB in people living with HIV (PLHIV) is high soon after sero-conversion and increases as the CD4 counts are depleted.

3. WHO (2018), and Frontières MS, Partnership ST. OUT OF STEP (2017), and Kebede (2017) provided substantive information that, collaborative TB/HIV activities and management of comorbidities are the key components of the 'End TB Strategy'.

4. Tesfaye et al. (2018), are also of the same view and provided information, that these two infectious diseases have a bidirectional relationship that poses a dual public health burden to resource-limited countries and that TB-HIV co-infected people are experiencing "double trouble" that puts them at high risk of mortality, rapid disease progression, and development of other opportunistic infections.

5. Health FMO (2017), and Kebede (2017), underscored the point that to reduce the dual burden of TB/HIV among people living with HIV, it is recommended to scale up the three I's, which are Intensified TB case-finding, Isoniazid Preventive Therapy (IPT), and Infection control for TB in all congregate settings and health facilities providing HIV care.

6. Health FMO (2017), and Health FMO (2018), provided information on the role of therapeutic management, which ART should provide to all TB/HIV co-infected patients regardless of CD4 count or WHO stage. Additionally, they also provided information that, ant-tuberculosis treatment should be provided first, followed by ART within the first 8 weeks of treatment.

7. The Federal Democratic Republic of Ethiopia MoH (2016), and Health FMO (2018), also provided information that, equally Co-trimoxazole prophylaxis (CPT) should be provided to all TB-HIV co-infected patients, regardless of their CD4 count.

8. Kefale and Anagaw (2020), provided information that details, TB/HIV co-infected patients with Smear positive PTB have a higher chance of successful TB treatment outcome.

9. Gebremariam et al. (2016), and Gesesew et al (2016), provided information that TB/HIV co-infection patients with extra pulmonary TB had a higher chance of mortality during TB treatment than pulmonary TB patients.

10. Health FMO (2017), and Kebede (2017), provided information that focused on prevention of reactivation of latent TB, in order to prevent the reactivation of latent TB, after excluding the presence of active TB infection, they stated that IPT should be given to all people with HIV at least for six months.

11. Tilahun et al. (2019), reiterated the same sentiments, and provide information that Immuno-compromised individuals with latent tuberculosis infection (LTBI) are at an increased risk for tuberculosis reactivation compared with the general population.

12. Whilst Tola et al. (2019), argued and provide different views, that the administration of CPT can reduce the chance of co-morbidities such as pneumonia with pneumocystis, toxoplasmosis and other bacterial infections, which may then be related to a higher rate of cure and treatment completion and a lower rate of deaths.

13. Djimeu and Heard (2019), provided detailed information that explicitly focus on co-diagnosis of HIV and tuberculosis presents a treatment dilemma. Starting both treatments at the same time can cause a flood of immune response called immune reconstitution inflammatory syndrome (IRIS) which can be lethal. Furthermore, Djimeu and Heard (2019), stated that the choice of start time for HIV treatment initiation should be based on other factors

including potential drug interactions, overlapping side effects, a high pill burden and severity of illness rather than CD4 threshold and present timeframes.

However, they cautioned against overgeneralizing, stating that the result of this replication is aligned with more recent studies that show no evidence that early initiation of HIV treatment reduces mortality for any patient.

14. Ramos de Sá et al. (2020), are of the same view, but from a different study provide similar information stating that TB and AIDS was the leading causes of infectious disease deaths worldwide. Furthermore, Ramos de Sá et al. (2020) stated that, in some TB-HIV co-infected individuals treated for both diseases simultaneously, a pathological inflammatory reaction termed immune reconstitution inflammatory syndrome (IRIS) may occur.

15. Shamu et al. (2019), provided empirical information detailing and demonstrating the importance of demographic factors (gender, economic status, family TB history, and location) and HIV factors in explaining TB knowledge and testing. Furthermore, concluding and recommending the extension of community TB testing services to increase.

16. Aturinde et al., (2019), also suggested that HIV is equally the most important risk factor in the progression of TB from the latent to the active status. Furthermore, to manage this double epidemic situation, an integrated approach that includes HIV management in TB patients should be implemented in countries endemic with both diseases. Moreover, to enable targeted intervention using the integrated approach, areas with high disease prevalence rate for TB and HIV need to be identified first.

17. Zeleke et al. (2020), provided insightful information, that Anti-tuberculosis drug-induced hepatotoxicity is a common serious adverse drug reaction. Co-infection of TB with HIV is common and liver disease is becoming a leading cause of death which might be caused by HIV itself, hepatitis viruses, systemic opportunistic infections (OIs), malignancies, and drug-induced hepatotoxicity. Furthermore, they continue on to state that TB and HIV infections

have epidemiological synergy where HIV patients have increased risk of developing active TB and higher rates of TB relapse and treatment failure.

18. Letang et al. (2019), provided information that despite wide antiretroviral scale-up during the past two decades resulting in declining new infections and mortality globally, HIV-associated tuberculosis remains as a major public health concern. However, the researchers provided information on the on several challenges exist regarding diagnosis, global implementation of latent tuberculosis treatment, management of active tuberculosis, delivery of optimal patient-centered TB and HIV prevention and care in high burden countries.

19. Rossetto et al.(2019), provided insightful information with regards to TB/HIV Co-infection especially in locations with a high rate of tuberculosis (TB) and HIV infection, furthermore they provides strategies such as estimation approach ,stating that estimation approach is important in order to identify, from the surveillance data, the risk factors for hospitalization and death in co-infected patients, these strategies will prevent negative outcomes such as opportunistic infections, hospitalizations and death.

20. Chem, Van Hout, and Hope (2019), also echoed the same sentiments that multidrug-resistant tuberculosis (MDR-TB) in HIV endemic settings is a major threat to public health. Furthermore, MDR-TB is a substantial and underreported problem in sub-Saharan Africa, with recognised cases projected to increase with advancement in diagnostic technology. They concluded that there was paucity of review evidence on treatment completion and antiretroviral (ART) uptake among MDR-TB patients with HIV in sub-Saharan Africa.

21. Kaplan et al. (2018), provided useful information that in sub-Saharan Africa, the increase in the tuberculosis (TB) epidemic has been shown to strongly correlate with the increase in HIV-prevalence. They went on to state that TB was driven predominantly by a rise in HIV-positive TB cases among patients with severe immune suppression.

22. Engelbrecht et al. (2017), provided information from a cross sectional study design point of view that, HIV leads to progressive immunodeficiency and increased susceptibility to infections. Unlike many other infectious diseases that only manifest when the CD4 count falls below 200/mm^3, the risk of TB was already increased during the first year of HIV infection. As a result, TB may be diagnosed long before HIV in co-infected patients. However, reciprocal benefits exist for integrating TB and HIV/AIDS services, as adequate TB control contributes to AIDS care, and the prevention of HIV transmission leads to improved TB control.

It is anticipated that findings from this study will contribute to the body of knowledge that informs TB/HIV program planners, decision makers, and project implementers by providing predictors of TB/HIV co-infection. Therefore, the main goal of this study was to assess the successful TB outcomes and its associated factors among TB/HIV co-infected patients in Keetmanshoop District, Namibia. Having TB is an emotionally devastating experience for patients and their families. There is a cyclical relationship between stigma HIV and TB; people who experience stigma and discrimination are marginalised and made more vulnerable to HIV and TB, while those living with HIV are more vulnerable to experiencing stigma and discrimination.

Considerable stigma is attached to the disease, owing to the link between TB and HIV infection (UNAIDS, 2017). This stigmatisation is often one of the problems preventing TB patients from completing their treatment this needs to be solved through communication. In many cultures including Namibia the social stigma of TB contributes to abandonment of treatment and also discourages patients from seeking professional care, measuring TB stigma at the community level is crucial to shift societal treatment of people with TB (UNAIDS, 2017).

According to UNAIDS (2017), stigma in the population is also known as social stigma, public stigma or cultural stigma. Community attitudes toward people with TB influence their support for public policies designed to ease their financial, social, and physical burdens

(UNAIDS,2017). People with more accepting views toward PWTB are more likely to support the use of public monies for TB research and anti-discrimination efforts. Stigma and discrimination also makes people vulnerable to HIV. Those most at risk to HIV (key affected populations) continue to face stigma and discrimination based on their actual or perceived health status, race, socioeconomic status, age, sex, sexual orientation or gender identity or other grounds (UNAIDS ,2017).

Stigma and discrimination manifests itself in many ways. Discrimination and other human rights violations may occur in health care settings, barring people from accessing health services or enjoying quality health care (UNAIDS, 2017). Some people living with HIV and other key affected populations are shunned by family, peers and the wider community, while others face poor treatment in educational and work settings, erosion of their rights, and psychological damage. These all limit access to HIV testing, treatment and other HIV services (UNAIDS, 2017).

Hence, Redwood and Mitchell, (2018), stated that stigma in the general population can be influenced by social characteristics, knowledge, national epidemiological context and structural drivers of TB stigma. Some authors have argued that lack of understanding of TB transmission increases TB stigma. However, in some settings an increased understanding of the treatability of TB reduced stigma. However, levels of TB knowledge often have no consistent relationship with levels of TB stigma. Indeed, TB stigma can even increase with levels of education and social class (Redwood &Mitchell, 2018).

At the national level, TB stigma was correlated with incarceration rates (Redwood & Mitchell, 2018). This suggests that a country's general approach to blaming and punishment can also "paint" the country's view of people living with HIV and AIDS and people with TB (PWTB) thereby hampering the successful TB treatment outcome and its associated factors among TB/HIV co-infected patients (Redwood & Mitchell, 2018). The reason for this stigma

is a lack of knowledge and information about the disease in the community. Some patients and community members believe that TB and AIDS are the same and that both cannot be cured. It is here that health workers have to correct the misinformation, as stigma it can lead to failure to cope and feelings of inferiority and exclusion, and this can weaken the chances of treatment adherence (Redwood & Mitchell, 2018). Thus, lack of communication and understanding between health workers and patients may often lead to lower participation in treatment programmes.

Good communication is therefore vital in efforts to motivate patients to adhere to and complete treatment (Redwood & Mitchell, 2018). Social stigma attached to the disease which makes patients feel that they should hide their condition. The association between TB and HIV/AIDS results in a dual stigma and if not handled well through education, it may have a negative effect on health-seeking behaviour as well as completion of treatment. It is the health worker's responsibility to give patients correct and relevant information about the disease so as to allay fear and discontent.

DOT also has its critics. The critics of DOT say that it affects the TB patient's private life and should therefore be conducted with sensitivity. If treatment takes place at home, the privacy of the patient and his family is jeopardised, whereas if treatment takes place at a clinic or a hospital there may be stigma or discrimination (Sahile et al., 2018). Many TB patients hide their illness from their employers, friends and family members; some interpret supervised treatment as the systems mistrust of them. These feelings are compounded by the manner in which health professionals inform them of their diagnoses. A lack of empathetic attitude exhibited by members of health care team appears to have a negative impact on the patient's subsequent relationship with the clinical staff (Sahile et al., 2018).

The Gap

This literature review has demonstrated that assessment of successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in Keetmanshoop District of the //Karas Region, setting remains underrepresented in study design, sampling, and in the overall number of publications documenting successful TB treatment outcome trends. The number of resources available to control TB in the urban //Karas Region of the Keetmanshoop District setting may differ dramatically compared to other districts, greatly limiting the applicability of published urban-setting research to this setting and drawing much needed attention to this significant gap.

Data on the host, environment, and associated factors of TB treatment outcomes are growing however, it continues to disproportionately represent these cohort of people in their respective settings creating a further impetus for more studies. Understanding TB treatment tendencies and outcomes both successful and unsuccessful in this cohort of people residing in Keetmanshoop District of Namibia settings will broaden the depth of understanding surrounding these persons whom are at greater risk of being infected with *Mtb* and may better assist all Namibian-based TB Control Programs move toward elimination of TB and reaching and surpass the WHO target.

The analysis of the TB treatment outcomes research is also somewhat similar and standardised, identifying another gap this research intends to assist in addressing a majority of the articles reviewed analyzed data using *chi*-square and multi-variate analysis regression techniques. Using *chi*-square and multi-variate analysis to explore host, environment, associated factors -related independent variables, covariates and the relationship to TB treatment outcomes will help close these gaps as *chi*-square, multi variate analysis accounts for and provide considerable information about how each of the groups performed in the study.

This lushness of detail will allow to understand the results and thus to come-up with more detailed information from this statistic than from many others. Additionally, the detailed information that can be derived from the test, will assesses whether an association exists between the two variables by comparing the observed pattern of responses in the cells to the pattern that would be expected if the variables were truly independent of each other. Additionally, these inconsistencies may indicate that TB treatment outcomes is a localized phenomenon likely influenced by the individuals receiving treatment (host), their area of residence (environment), as well as their perceived severity of being infected and the risk of developing transmissible disease along with disease-related sequellae (agent).

Studying, the factors associated with TB treatment outcomes could assist in closing this gap in knowledge but may also help better target specific, necessary treatment outcomes improving interventions in this cohort of people.

Summary and Conclusion

This present literature review was conducted to determine what was currently known about successful TB treatment outcome trends in the //Karas Region of the Keetmanshoop District setting as TB Control Programs are increasingly pressured to address the pool of latently infected persons. To move Namibia towards total elimination in the face of declining rates of active chronic disease, characterizing TB treatment outcome trends in a variety of settings using a variety of samples will likely achieve a more thorough understanding of the gaps that exist in practice that may prolong the move toward elimination.

This literature search revealed that the //Karas Region of the Keetmanshoop District setting is entirely underrepresented in current research leaving TB Control Programs serving this setting reliant upon implementing treatment outcomes improving interventions that have been extrapolated from research done in the urban, resource rich setting. This research will add to the evidence currently available on the predictors of TB outcomes. Hence, this chapter has

covered the relevant literature studied and provided an overview of the research problem. The role of health workers in TB management through DOT, as well as the importance of DOT including HIV stigma, was discussed. Factors that may influence health workers to practise or not to practice DOT was also discussed. The next chapter covers the research methods that was used during the study. Many host-related LTBI treatment completion factors have been explored. Multiple studies have noted inconsistencies in using sex as predictors of TB treatment outcomes research.

Unlike sex, researchers tend to find age-related associations with TB treatment outcomes often however, the valid research published showing no association cannot be ignored. Marital status is understudied but too is thought to be a predictor of TB treatment outcome, hence in this this study marital status is also assessed. Exploring these factors, as is proposed by this dissertation research, will assist in filling the gap that currently exists surrounding this demographic.

Environment-related TB treatment outcomes factors are less well studied however, consistent trends have emerged. Persons traveling greater distances or spending more money to travel to TB treatment facilities or health centres are consistently reported to be at greater risk of delaying TB medical evaluation or not completing TB treatment compared to their counterparts, which in turns to more deaths, and more default and poor treatment outcomes. Likely with greater distances to travel in the rural setting it is unfortunate that virtually no studies have been published examining this phenomenon but instead, have focused solely on urbanites.

A retrospective study using *chi*-square and multi-variate analysis to identify potential predictors of TB treatment outcome is a novel approach to addressing the gap that currently exists in the literature. Additionally, intending to describe TB treatment outcome trends is a unique approach that has thus so far failed to be adequately covered in the literature. The rural

setting differs significantly in structure and resource availability from the urban setting and thus, studying TB treatment outcome trends in this context will not only add to the body of knowledge but may also be critical to shaping appropriate public health interventions in this setting.

The methodology for addressing this gap in knowledge is detailed in Chapter 3 where the rational for the study design, the data sources, the variables of interest, and the planned analysis used to quantify treatment completion and identify predictors of successful completion and unsuccessful outcomes are described.

CHAPTER 3: Research Methods

Introduction

The main purpose of this research was to assess the epidemiology of successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in Keetmanshoop District of the //Karas Region, Namibia. This region consistently accounts of over, 70% of the active TB disease and coinfection burden in Namibia (MoHSS, 2020). The high rate is likely due to reactivation, loss to follow-up, geographic location of residence and distance to the health center, gender, TB medication interaction, and unemployment.

Monitoring the TB outcome rate among TB and HIV coinfected cohorts can reduce the risk of reactivation and may improve active TB disease rates and increase TB outcomes over time in the district (Blount et al., 2016; Pareek et al., 2016). I sought to determine what independent variables predicted unsuccessful outcomes for TB treatment. Similar research has shown that TB treatment outcomes could be influenced by host, environment, and agent factors (Coly & Morisky, 2004; Hirsch-Moverman et al., 2008; Malangu & Yamutamba, 2016; Parsyan et al., 2007).

Identification of variables that influence the TB outcomes rate could promote the development of targeted interventions in a resource-limited setting like Keetmanshoop. Few researchers have focused, though on the identification of these potential predictors in the Keetmanshoop District according to my review of literature. This retrospective cohort study was consistent in research design and had an overarching goal similar to that of comparable work conducted in the high-incidence or international TB setting (Johnson et al., 2016; Malejczyk et al., 2014; Parsyan et al., 2007).

I made modifications to account for the level of data available for testing the hypotheses in question, for making interpretations, and for drawing conclusions. Lastly, in this chapter, I describe the study design, the sample size, the source of the data, the relevant variables, data

cleaning and management procedures, and the analytical methods. I also address ethical concerns related to this research.

Research Design and Rationale

I used a quantitative approach. It involved objective systematic process for generating numeric information about a situation across time. I used the quantitative method because it is a formal, objective, rigorous, and systematic process in which numerical data are used to obtain information about the world (Grove et al., 2015). The University of New Castle Australia (2019), stated that research methods are the strategies, processes, or techniques used in the collection of data or evidence for analysis to uncover new information or create better understanding of a topic. Sileyaw (2019), further indicated that a research design is a plan and procedure that is adopted by the researcher to answer the RQ in a valid, objective, accurate, and economic manner.

Moreover, I selected a quantitative method and design to provide empirical evidence that can inform a public health approach to addressing the TB treatment outcome among TB/HIV-coinfected individuals in the study area. The quantitative research approach can be seen as beingis scientific in nature and offers a number of benefits for researchers. The use of statistical data, tables, and figures to analyze data and report findings reduces the time and effort needed by the researcher to describe the results.

As, Bryman (2001), and Grove et al. (2015), noted, the quantitative research places emphasis on numbers and figures in the collection and analysis of data. These can be calculated and conducted by a computer through the useusing of athe Statistical Package for Social Science (SPSS) (Connolly, 2007; Gorard, 2001) on a computer, which saves lot of energy and resources (Connolly, 2007; Gorard, 2001). Second, the use of scientific methods for data collection and analysis makes generalization possible with this type of approach. The interaction made with one group can be generalized (Connolly, 2007; Gorard, 2001). In this

study, I focused on the assessment of successful TB treatment outcome and its associated factors among TB/HIV-co-infected patients in Keetmanshoop in //Karas Region, Namibia. I examined relationships among variables to determine the effectiveness of treatments or interventions on the selected health outcome (see Grove et al., 2015).

I obtained the data from the HIS database without manipulating the variables. A retrospective, longitudinal design was appropriate for this study because the effect of TB treatment outcome can only be realized over a long period of time. One of the disadvantages of longitudinal design is the time required for the repeated observations to be completed. In order to address this shortcoming, secondary data were collected during the period between 2016 and 2020. Retrospective design enables for the formulation of hypothesis, and about possible association between a treatment completion variable and exposure, it also allowed for to further investigate the potential relationship.

Groove, et al. (2015), defined a research design as a plan of how the researcher intends to conduct the study in a coherent and logical way, it constitutes the blueprint for the collection, measurement, and analysis of data (p.211). This was a retrospective cohort study using a secondary dataset. My aim was to describe the epidemiology of TB treatment outcome and determine if certain host, environment, and agent and/or associated factors are predictive of TB treatment outcomes. Several researchers have used this method and found to be effective. It is evident from the literature review that a majority of the researchers used a retrospective, longitudinal design to assess the effect of DOTS programs on treatment outcomes that using secondary data (Asres, Jerene & Deressa, 2018; Engelbrecht et al., 2017; Moses et al., 2019; Ketema et al.,2019; Wen et al., 2019).

It is evident from the literature review that a majority of the researchers used a retrospective, longitudinal design to assess the effect of DOTS programs on treatment outcomes that using secondary data, because it reduces time constraints and maximize sample

size. It that reduces time constraints and maximize sample size. Collectively, these studies demonstrated the value of the cohort method to investigating TB treatment outcomes and its associated factors.

This retrospective cohort study identified three cohorts of TB subjects based on (1) age when diagnosed with TB (2) the time of entering the district and (3) outcome status. The study followed the subjects from receiving medical treatment through DOTS shortly after being diagnosed and evaluated in Keetmanshoop District to the expected time of completing TB treatment and outcome during the study period under review. The primary dependent variable was TB treatment outcomes status among categories of adult patients both males and females. Independent variables included demographic characteristics (i.e., age, sex), gender, marital status, adverse TB drug interaction geographical area, and physical distance from residence to TB treatment facility, urban or rural resettlement.

The reason for selecting these factors was that many had been shown to influence TB treatment outcomes from research conducted in the high-incidence TB setting, poor or limited resource settings, the international setting, and in the urban global setting. These independent variables were assessed individually and collectively for their impacts on TB treatment outcomes. The retrospective cohort design fit this research well due to the limited change in day to day TB/HIV coinfected enrolees to the TB program, weekly, and month-to-month enrolees to the TB program and year-to-year enrolees in the //Karas Region of the Keetmanshoop District and should be useful for application to future enrolee trends.

Additionally, since TB resources are scarce in the Keetmanshoop District, the retrospective nature of this study did not impose extra burden compared to other study designs as the data for analysis had already been collected. This was an institutional base retrospective cohort study of all available secondary data from the health information HIS data base of TB/HIV co-infection cases registered annually by the TBLCP control programme of the

Ministry of Health of Keetmanshoop TB clinic and the HAART CDC clinical records at the Keetmanshoop.The reason for selecting these factors was that many had been shown to influence TB treatment outcomes from research conducted in the high-incidence TB setting, poor or limited resource settings, the international setting, and in the urban global setting. These independent variables were assessed individually and collectively for their impacts on TB treatment outcomes (Oga-Omenka et al., 2020).

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Methodology

Population

Population is a particular set of individuals or elements that possess the characteristics that are intended to answer the research question (Grove et al., 2015). All the TB/HIV co-infected patients both male and female between the ages of 18 and 65 years who registered in the public TB clinic and HAART also known as the CDC clinic Keetmanshoop Health District is found in the //Karas Region of southern Namibia was the source of population.

The study targeted HIV patients diagnosed with active TB disease. The accessible population was all PLWHA diagnosed with active TB disease and put on anti-TB treatment

regimens in the selected health facilities during the period extending from January 2016 to December 2020.

Sampling and Sampling Procedures

According to Majid (2018), the term sample is the process of selecting a statistically representative sample of individuals from the population of interest, who are studied as representatives of a given population (Guetterman, 2015). For this study a systematic random sampling approach was conducted as it equally ensures representativeness of the population, every second patients file or data from MoHSS HIS dataset that is coinfected with TB/HIV from 2016-2020 was selected.

Sample Size Determination and Sampling Technique

A G*Power analysis Faul (2014), was used to estimate the minimum sample size required for evaluating the first research question involving the treatment completion rate among three study groups. The formula to calculate the degrees of freedom, a component of the sample size calculation, was (rows -1) x (columns - 1) where treatment outcome status succefull (cured, completed,) represented the rows and unsuccessful (died, failure, miss to failure) represented the columns.

To detect a 10% of difference among groups using chi-square test and two degrees of freedom at an alpha level of 0.05 and a power of 0.80, assuming that this study would need 200 subjects. To detect a 20% difference among groups using the same aforementioned parameters this study would need at least 229 subjects, however this study was limited to 200 which in itself its fairy representable. To assess the impact of various treatment outcome rates, Table 1 shows the samples size needed for different rates.

Table 1

Minimum Sample Size for Chi-Square Analysis, Goodness-of-Fit Tests, and Contingency Tables

Treatment completion rate in each group	Alpha	Power	Detectable difference among three study groups	Sample size
10%	0.05	80	77	16
	0.05	90	77	21
20 %	0.05	80	33	87
	0.05	90	33	114
30 %	0.05	80	07	1,821
	0.05	90	07	2,392
24.5 %	0.05	80	20	229
	0.05	90	20	300
28.5 %	0.05	80	10	841
	0.05	90	10	300
40 %	0.05	80	14	521
	0.05	90	14	684

Nonetheless, the sample size was calculated using a single population formula with 95% confidence interval (CI), a 5% margin of error and taking the proportion of successful treatment outcomes among TB/HIV co-infected patients from previous studies. The sample size that was targeted by the researcher was 200 which after adding 10% for non-response was 220, an overall sample size of 220. During the sampling a 5% non-response rate was considered in this study, also an addition of a 10% non-response rate for missing data Bagiella and Chang (2019), and a regression diagnostic to identify any influential and extreme outliers (Bagiella &Chang, 2019).

Therefore, the differences between groups became apparent, and it allowed for obtaining samples from minority/under-represented populations (Elfil & Negida, 2017). This study used all eligible subjects with limiting to the minimum sample size. It was expected that even if the database could only provide 33 subjects, it would have 80% power using survival

analyses to detect the 20% difference at 0.05 significance level and a hazard ratio not equal to one indicating that association was better in one or two of the groups.

Inclusion Criteria

All the complete medical records of the TB/HIV co-infected adult male and female patients who registered in the hospitals from first January 2016 to 31st December 2020 was included. Records of all individuals, male and females aged 18-65 years was included. However, articles that describe Andersen's (1995), behavioural model of health care utilization, published in 1995 and below 2015, was cited because the articles are highly relevant to the current study and clearly states facts that are relevant and appropriate (Blumenthal et al., 2015). Clinical or laboratory findings of TB and have and outcome either cured, completed treatment, died, default, failure, miss to follow-up were included. Lastly, patients who was on TB-DOT and ART therapy treatment for at least one month at Keetmanshoop District Health facilities was included.

Exclusion Criteria

The exclusion criteria of the study were files of patients with incomplete medical records (unknown HIV status and unknown treatment outcome). In addition, medical records of the transferred out patients was also excluded since the TB treatment completion is not known. Excluded was the HIV and TB negative individuals including individuals aged below 18 years and above 65 years as well as patients on TB DOT treatment at districts other than Keetmanshoop Health District. Patients who started the treatment outside //Karas Region was also excluded in this study because they might have started the treatment under totally different conditions.

Procedures for Data Collection

With written informed consent obtained and approval from the Walden University IRB and MoHSS research council data, was collected from the HIS data base of the MoHSS.

Demographic and clinical characteristics of patients was obtained from the National TB Surveillance System for Namibia, MoHSS. Covariates consistently used in published literature included age, sex, employment status, geographic location, distance to the health centre and adverse drug reaction. The TB registers and HIV registers in the TB clinics and HAART of these health facilities were also used to record all relevant information for the treatment and monitoring of TB patients. Data was extracted from different medical files, arranged monthly and yearly. The data search was carried out manually. The data was collected in three parts.

The first section was focusing on the demographic characteristics of patients including sex, age and geographic location. The second section was focusing on the clinical characteristics of patients such as TB disease category, adverse TB drug reaction treatments and phase of TB treatment. The third section was based on final TB treatment outcome whether the patients were cured, completed treatment, lost to follow-up, defaulted and dead.

The data collected for this study was resisted to the scope, which is the proportion of TB and TB/HIV co-infected patients who have successful TB treatment outcome after TB treatment. It was not intended to show case the relationship between HIV patients and other co-morbid conditions or diseases. For this purpose of the study, only the TB/HIV data was collected during the data collection exercise. It is of significance to mention that the Keetmanshoop TB Clinic at Keetmanshoop offers outpatient and inpatient TB diagnostic, treatment, and monitoring services for both rural and urban patients.

Whilst the ART clinic offers ART treatment for the greater population of //Karas Region. Due to its location within the Region Keetmanshoop Tseiblaagte TB clinic is the main referral clinic, the Keetmanshoop Tseiblaagte TB and HAART clinic is the largest TB treatment and HAART clinic in //Karas Region. Hence, this design enables for the observing changes in the characteristics of the subject's relative to an external factor or treatment.

Electronic Disease Notification System

Data for this research was derived from ePMS also known as the HIS system are the only system nationwide secure platform housing medical information. As of 2017 the new release of HIV ePMS became known as Quantum ePMS, due to the quantum leap the electronic patient monitoring system made from its predecessor. All the necessary documents (TB treatment registry, monthly cohort form, and follow up form) of the TB patients were also assessed using a pre-tested structured data extraction format which was developed by considering the variables to be studied from.

This included the TB register, both booklet and electronic, at the TB clinics of the health facilities where all patients diagnosed with active TB disease are put on anti-TB treatment regimens and monitored throughout the course of the treatment. All the complete medical records of the TB/HIV co-infected patients who was registered in the hospitals under study from 2016 to 2020 was included. Moreover, no personal identifier was used by me on the data collection form.

The main data source from each center was the HIS now rename as District Health Information Management System (DHIMS), these terms will be used interchangeably throughout this document, however they are having the same meaning. DHIMS database supported by the routine NTBLCP standardized facility reporting and recording forms, and ART Patient Management Monitoring (PMM) registers. Information on the socio-demographic variables, type of TB patient, site of diagnosis, date of diagnosis, sputum smear results, HIV status, Co-trimoxazole presumptive therapy, ART regimen, CD4 count (baseline and the most recent), duration of TB treatment and treatment outcome was extracted from the records. Data collection was done manually.

The TB, ART and pre-ART health facility registers and patient treatment cards was provided by the facility and the information seen was exported to the extraction sheet. Where

there was incomplete information, LGA TB registers, TB suspect's registers, patient's sputum follow up registers and ART clinic laboratory records register was used as supportive registers. The checklist was used to extract relevant information from the records kept in the ePMS data base in each of selected facilities to determine TB treatment success rates. The items in this checklist was the treatment outcome variables outlined in the facility TB register including number of TB patients who was enrolled, cured, completed treatment, died, failed, miss/loss to follow-up defaulted.

TB treatment success rate was defined as the proportion of new smear-positive TB cases registered under DOTS in a given year that successfully completed treatment, whether with bacteriologic evidence of success ('cured') or without ('treatment completed') (WHO,2016). Records of TB patients who completed their treatment in the years (2016-2020) in the Keetmanshoop District were included for record review, and the TB registration book was used for the sampling frame.

The instrument for the data collection was the HIS and individual patient's hospital records and hospital registers from the period 2016 through 2020. Each treatment center maintains both patient records and hospital registers that contain information on all the patients. The Monitoring and Evaluation (M & E) Unit of each center collates information on the DOTS, ART program keep a copy and send one copy to the Regional Health Directorate at the Keetmanshoop State hospital.

The M & E personnel in each center gives a unique code to each patient and transfers all patient information from the patient's hospital record into the hospital registry without any patient identifiers. The code book is then kept by a senior M & E officer separately from the hospital register. The M & E officers come to the treatment area periodically (weekly or biweekly) to update their information. All data for this study was collected from the de-identified information recorded in the hospital registers from each center and ePMS data base.

To ascertain accuracy, checking randomly for few entries in the registry against patients' clinic records to ascertain accuracy in data entry. This was done at a minimal level to prevent compromising patient identity. The covariates that was tested in this study was age, gender, HIV status, TB case category, marital status, education, and geographic location and the outcome variable was treatment completion.

Instrumentation and Operationalization of Constructs

Since this was a secondary database research, it did not have its own study instrument for data collection. Ministry of Health's data are collected using standardized, nationally developed formal instruments (CDC, 2011). The Keetmanshoop District state TB Program uses these standard forms to collect TB and HIV medical evaluation information on these cohort of people and these were used to produce the dataset for this research.

The Keetmanshoop District TB Follow-up Worksheet is available only through the secure CDC application but includes pre medical evaluation results, post medical evaluation findings, TB and HIV treatment initiation data, and treatment completion and outcomes data. The Ministry of health TB Follow-up Worksheet has been and currently still is used nationally to ensure consistency in the reporting of TB medical evaluation findings.

For this dissertation, and based on the above, the instrument for this study was thus further validated through those stringent measures. Furthermore, State clinics TB Program has been relying on this form for data collection related to this research for over a decade. The revised version of the TB Follow-up Worksheet card used for this research can be found in annexure D at the end of this dissertation. Moreover, the data analyzed for this study were submitted from 4 different public health centres and submitted to the regional centre at the Keetmanshoop hospital specializing in the diagnosis and treatment of TB and HIV disease.

All State Health centres including the Keetmanshoop Health District utilized the standardized, nationally developed TB treatment and adverse TB reaction form to record pre

medical findings, post-arrival screening results, treatment decision, and final disposition or outcome. Dispositions include “no exposure, not infected”, “TB exposure, no evidence of infection”, “TB infection, no disease”, “TB, TB disease”, and “TB, inactive disease”, cured, treatment completed, died, default, and LTFU. The dataset used for this research was derived from Ministry of Health standard reports and exports for data entered for the “Keetmanshoop” District.

Outcome Measurements

The Namibian NTLCP guideline (2), adopted from WHO, was used for the clinical case and treatment outcome definitions (6). These outmes include:

1. Cured: TB patient who was smeared positive at diagnosis, who completed 6 or 8 months of treatment and who is smear negative at the end of sixs or seven month of treatment and at least one previous occasion.

2. Treatment completed: TB patient who was smeared positive at diagnosis and who completed treatment but in whom smear examination results are not available at the end of treatment, or all smear negative and extra-pulmonary TB patients who completed treatment.

3. Successful Treatment: The sum of cured and treatment completed.

4. Failure: A smear positive patient who while on Category 1 treatment remained, or became smear positive again five months or later after commencement of treatment.

5. Defaulted: A patient who has been on treatment for at least four weeks and whose treatment was interrupted for eight or more consecutive weeks.

6. Transfer Out: A TB patient already registered for treatment in one district or region who is transferred to another region or district and whose treatment is not known.

7. Died: TB patient who dies for any reason during the course of anti-tuberculosis chemotherapy. Worth mentioning the regimen for the treatment of drug susceptible TB is for a period of six months and the treatment outcomes are given at the completion of the treatment

regimen. TB Patients at the commencement of treatment are subjected to follow-up microscopy tests after diagnosis at month two, month five and month six (Global Tuberculosis Report, 2019).

During the period of treatment to confirm that there was a conversion of the TB patient status during that period. Laboratory tests to confirm whether or not a patient has been cured of the disease was used. Irrespective of the result of the outcomes of the microscopy tests, a TB patient cannot be declared cured or otherwise, until all the follow-up tests was conducted till the end of treatment. On the other hand, for TB patients with smear negative result at diagnosis but who was confirmed to be symptomatic to TB by a medical officer, treatment outcome was also given at the end of the completion of the treatment regimen (WHO, 2017).

Primary Dependent Variable

The primary dependent variables for this study was the economic status, TB treatment, drug side effect, ART), residence, marital status, treatment side effects, was collected as independent variables of the study by me. Furthermore, treatment completion was measured as the number of days of treatment or number of doses completed. For a person to be described as having completed treatment, they must have continued their treatment for 168 days (six months with 28 days in each month) or have taken 168 doses of their medication.

Since the outcome variable was measured in days on treatment, for the purpose of this study, the outcome variable was dichotomized into < 168days/doses for those who did not complete treatment and ≥168 days/doses for treatment completion. The variable was then coded as 1 = Yes (treatment completed) and 0 = No (treatment not completed).

Independent Variables

Age. Age was recorded as the number of years from birth till the day treatment started. The variable age was divided into five useful categories. The five categories was recorded as follows: 1 = 18 to 24 years, 2 = 25 to 35 years, 3 = 36 to 45 years, and 4 = 46 -55 years, 5=56-

65. Gender. Gender was recorded as a dichotomous variable: 1 = male and 2 = female and 3=other.

TB-case category. All cases that was registered for TB treatment for the first time and have not been on any previous anti-TB medication will be referred to as new cases. All other cases that are taking treatment for the second time including those that have defaulted, retreatment cases, and cases that have failed treatment are described as nonnew. Therefore, the independent variable TB-case category was dichotomized into the following: 1= new cases and 0 = non-new cases. Adverse TB treatment was describe as 1=Yes and 2=No.

Covariates

Marital status. Marital status was described as either being married or not married at the time of registration. The variable was recorded as a dichotomous variable: married= 1, not married = 2, divorced=3 and others=4.

Geographic location. In this study geographic location was known and define as //Karas region one of the 14 regions of the country (Southern Namibia, health districts namely Keetmanshoop urban, Tses rural, Berseba rural and Koes rural) from where patient data was collected and where patients are assumed to reside during the course of treatment. The variable was measured at the nominal level of measurement. Data for this study was collected from two (02) health centres in Keetmanshoop Health District, Keetmanshoop TB clinic and CDC ART/HAART. Therefore, the covariate geographic location was dichotomized into: rural = 1=Keetmanshoop urban, 2= Tses rural, Berseba=rural, 4=Koes rural and 5=others.

Variable Measurement

The response variable for this study was the occurrence of TB/HIV co-infection. The predictor variables were include socio-demographic and economic characteristics (age, sex, employment status, residence, and marital status) and clinical related characteristics (WHO clinical stage, functional status). Furthermore, clinical case and treatment completion

definitions according to the standard definitions of NTLCP, WHO guidelines and that of the study operational definition. Treatment completion was divided into fail, completed treatment, defaulted/interrupted, died, and not evaluated. Successful outcome was considered for TB patients who were cured (i.e., negative smear microscopy at the end of the treatment and on at least one previous follow-up test) and/or completed treatment or sum of cases that cured and completed treatment (Sinshaw et al., 2017).

In this study unsuccessful outcomes were considered for TB patients and resulted in treatment failure, default, miss to follow-up or death by the researcher. Patients with documented treatment completion and resolution of symptoms, but not sputum smear microscopy available at the end of treatment was considered as having completed treatment (Sinshaw et al., 2017).

Chuang et al. (2015), found that patients with clinical and/or bacteriological signs of continued active disease or deterioration requiring a treatment change was considered as failed patients. A dead patient is a patient who died for any reason during treatment. A patient whose treatment outcome was unknown (including former "transfer out") will be considered as not having been evaluated (Chuang et al., 2015).

Data Analysis Plan

According to Boeren (2018), data analysis is the process of evaluating data using the logical and analytical reasoning to carefully examine each component of the data collected or provided in a coherent fashion so that the researcher can discern patterns and relationship, by systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data.

Double data entry was employed to guarantee data reliability. Data analysis was extracted, checked for errors edited, cleaned, coded and entered into SPSS Version 25 for windows for analysis. Descriptive analyses for main study variables, $\chi 2$ square tests, logistic

regression analysis, and multiple logistic regressions was performed. A chi-squared test of association was used to determine significant differences between TB-only and TB/HIV coinfection patients. Bivariate logistic regression model was used to identify significant factors associated with TB treatment outcomes in all TB patients. Statistical significance was set at a p- value of 0.05 at 95% confidence level.

Furthermore, multiple logistic regressions were used to determine the influence of the independent variables of age, gender, marital status, HIV status, geographic location, and TB category on the dependent variable of treatment outcomes. The choice for using a quantitative retrospective research design was to help me to establish whether a relationship existed between the dependent and independent variables. Thus, keeping with the focus of this study on successful TB treatment completion and its associated factors among TB/HIV co-infected patients.

Data was summarize using descriptive statistics for the clinical and demographic characteristics, frequencies, percentages to describe clinical factors and treatment associated factors and TB treatment completion. Binary logistic regression was calculated at 95% confidence intervals to evaluate the crude association between each exposure variable and completion variable. Furthermore, the continuous variable age was recoded into age groups for the purpose of the analysis. The treatment outcomes were also recoded into two groups, successful and unsuccessful TB treatment outcomes these two was grouped individually as for successful was treatment competed and cured, whilst for unsuccessful was failure, died, and miss/loss to follow-up.text.

Data Cleaning

The dataset required minimal cleaning as routine data quality checks performed by the Ministry of Health ensured accuracy and a high percentage of variable completion. Coding of variables was required for text fields including gender, treatment outcomes and age as

described in Chapter 3. Age was collapse into five categories because it greatly simplifies the statistical analysis for SPSS and leads to easy interpretation and presentation of results (How-to Guide for IBM® SPSS® Statistics Software, 2020).

Furthermore, in the dataset age is provided on a continuous scale, however, it was included as a continuous variable and divide into groups as a categorical variable. Also grouping age helped with data presentation, notably in tables, which further leads to a comparison of groups of individuals with high or low values of the measurement, leading in the simplest case to a t test or $\chi 2$ test and an estimate of the difference between the groups (with its confidence interval) (How-to Guide for IBM® SPSS® Statistics Software, 2020).

Additionally, age in its continuous form ensures a more parsimonious model in regression analyses with only one coefficient for interpretation which can identify significant trends between age and the outcome variable where they exist (How-to Guide for IBM® SPSS® Statistics Software, 2020). This approach assumes a relationship between the dependent variable and age that is the same across ages. In the case of age, there are many occasions where this relationship is non-linear. By dividing age into categories, comparisons can be made between age groups and explore non-linear relationships, it also allows for, cross-tabulation and regression with dummy variables (How-to Guide for IBM® SPSS® Statistics Software, 2020).

Lastly, grouping age also gives an understand with regards to the direct relationship between age and successful TB outcome between age groups and gender, and it recognises changes that occur with age when considering other relationships and factors in the study. All other variables were in their original coding form or TB Program coding tool. Frequencies for missing values for all study variables yielding 100% completion for all data elements were run.

Threats to Validity

Shah et al. (2020), stated that validity refers to how accurately a method measures what it is intended to measure. Validity was assessed by checking how well the results correspond to established theories and other measures of the same concept. Additionally, in order to ensure that the research instrument is indeed valid, a thorough literature review was conducted, where information was gathered from various relevant peer reviewed sources. The research instrument was reviewed by the research Chair, Second Committee Member and TB experts from the national TB control programme, as well as by colleagues, in order to ensure content validity (Patino &Ferreira, 2018).

To measure validity, the questions for the research questionnaire were constructed from relevant literature reviews. The questions were framed to include items that covered the research objectives of this study. This verification added to the validity of the results and study.

External Validity

The dataset used for this dissertation research was dependent upon health care provider interpretation of diagnostic, radiologic, and risk-factor evaluations on TB treatment outcomes and its associated factors among TB/HIV Co-infected patients in Keetmanshoop Health District. This suggest that, tools used to diagnose latent TB infection only detect the presence of an immune response to *Mtb* (Ling & Flynn, 2010), differences in diagnosis patterns may exist. An additional threat to external validity was related to the relatively new application of HIV Quantum and ePMS data base.

This legacy ePMS (LePMS) was the first step toward longitudinal patient tracking, but it was not without some shortcomings, including: duplication of patient records, inability to transfer the patient medical history from one facility hosting computer to another facility the patient has moved to. Lack of standardized reports, which made it difficult for facility staff to consistently generate accurate reports (IntraHealth Namibia, 2019). As such, patients evaluated

toward the beginning of the study period with an ePMS only may have been misdiagnosed. Another issue is TPT is underreported in Namibia due to incomplete data collection for PLHIV in whom TB has been excluded or is suspected because data, from symptom screening to treatment, is captured piecemeal across two electronic and three paper data registries. These registries include: the electronic patient management system (ePMS) (captures HIV and TPT data, but not active TB data) and the electronic TB register (ETR) (captures active TB data); as well as the paper patient HIV care booklet, TB register, and TPT register (formally IPT register).

Both electronic and paper databases are susceptible to incomplete data entry, and ePMS and ETR are prone to transcription errors when entering data located in paper registers. As well, data concurrence across registers can be inconsistent, and implementation of TPT in Namibia at the facility level is also thought to be highly variable.

Internal Validity

The conclusions drawn in this research may be threatened by inconsistencies in the implementation of TB treatment recommendations across dominions in Keetmanshoop Health District and //Karas Region. Additionally, although completing at least 90% of prescribed doses of TB treatment may be believed or judged as successful completion and outcome.

Another issue that can raise threats to internal validity is the health care provider discretion, it has the potential and may also be used to determine treatment completion/outcomes potentially impacting this research by producing variance in discharge diagnoses and potential outcomes. Other unmeasured factors may also influence treatment outcomes in the study population and will likely not be captured directly by this research. For example, persons with known direct contact to someone with TB may be more likely to accept and complete treatment due to their experiences (Priest, 2004). Lastly, familial support and other household factors may too influence TB treatment completion as persons with greater

support have been shown to complete treatment at higher rates Priest (2004), however, these potential data points are not collected in the ePMS data base system.

The internal validity of this research may also be influenced by the secondary nature of the data being analyzed. The data in this study was collected for a different purpose and only the previously collected data will be available for analysis. Although the Keetmanshoop Health District state TB Program does perform data quality checks at the time of data entry, for the purposes of this research, the data cannot be validated nor can additional follow-up information be collected health care workers has to wait for another visit or pill fill-up forgetting to ask the forgotten or follow data.

Missing data and selection bias was addressed in the data clean-up process. True infection status was verified by reviewing HIS records and individual treatment cards TB Follow-up Worksheets for each patient included in the study sample to ensure each was appropriate for inclusion. Retrospective cohort studies inherently have threats to internal validity.

This study design lacks a comparison or control group, includes subjects that may mature overtime influencing analyzed variables and participant outcomes, and may suffer from high rates of attrition (Gordis, 2008). Although no control group was used in this research, assessments and evaluations were made between TB treatment regimens, and area of residence potentially assisting in overcoming this limitation.

Maturation was also likely not an issue in this research due to the relatively small window of time each person had to experience the event. With the longest available TB treatment duration spanning 6 months, it was anticipated that participant characteristics did not change greatly during this time in such a way that influenced the outcome. Lastly, high rates of attrition may have occurred in this research however, this would help demonstrate why this research was necessary. High rates of unsuccessful TB treatment outcomes may indicate that a

large reserve of persons latently infected with Mtb remain at risk of developing active TB and possibly transmitting disease to others.

Reliability

According to Dawson et al. (2018), reliability refers to how consistently a method measures something over time including its stability and it tells us the extent to which the results can be reproduced when the research is repeated under the same conditions. The validity and reliability of the data was evaluated by the MoHSS ePMS data base, which was the source of the secondary data that I used in the analysis.

Therefore, based on the ePMS data base of the MoHSS the data was reliable and posed a minimal threat to the validity of the study. Additionally, the CDC has designed procedural methods that justify the respondents' participation and dropout rates from DOTS and HIV programmes.

Ethical Procedures

Information and data related to this research was not requested until after Walden University IRB and Ministry of health approval was sought and obtained. Despite the requested dataset being de-identified, its original proximity to health information protected under the Health Information Portability and Accountability Act (HIPAA) heightened measures to protect the data.

Hence, ethical approval and clearance was obtained from the Ministry of Health and Social Services, Namibia [MoHSS], directorate: health information and research, division: research ethics and coordination, Ref: 17/3/3/MES. A legal permission letter was obtain from the MoHSS, department of the human ethics committees for the selected public health centres and data bases. The approval for the data use agreement form from both Walden University and MoHSS research committee to use their data sets was also sought. Confidentiality of the participants' information was maintained by giving participant's code number only known by

the researcher. This approach ensured research participants were not identifiable from the research data file.

All data collected for this research were stored in an electronic manner that required security-only access such as a password to the storage device and data file. Beyond the small possibility of a data breach, participation data in this research came with no known risk. A data breach would likely only take place if the de-identified dataset associated with this research was linked back to the original ePMS data source from which dataset producing reports were run.

HIS data platform is accessed through secure networks of the MoHSS, the dataset was also stored on a separate encrypted, backed-up secure laptop, in the event of a data breach. No breaches were identified, to add greater security, the research dataset was only accessible to the dissertation research principal investigator only. Passwords to the laptop and the excel file were not shared with others nor were the passwords the same to access the laptop or file. The Walden University IRB approved all aspects of the study protocol. Importantly since the data collection was conducted during COVID-19 pandemic all the protocols, guidelines relating to COVID-19 was strictly followed.

Summary

In Chapter 3, described the research methodology employed in conducting this research. This dissertation study made the same assumptions of those consistent with performing chi-square analysis. The researcher used quantitative retrospective in this study with secondary data from HIS data base. The various threats to validity was elucidated, as well as and the how their effect on the outcome variable can be mitigated was outlined. The steps taken to maintain patient confidentiality and maintain ethical research standards was discussed. This study was limited in terms of design and data specificity. The retrospective nature of this study involved no control group for comparison. Data related to treatment initiation and

outcome were recorded in month, day, and year format however, persons initiating TB and HIV treatment in this sample were likely only monitored for treatment adherence monthly and when they come for follow-up. This approach limited the units of measurement to year instead of the more ideal unit in days or weeks or monthly.

Regardless, findings from this study may inform Keetmanshoop public health officials of the potential TB treatment succefull outcomes and unsuccessful outcomes which may promote intervention development to improve rates and decrease future active disease burden. The aim of this study, the design, and data analysis was to describe the epidemiology of TB treatment outcome and its associated factors among TB/HIV Co-infected patients in the //Karas Region Keetmanshoop.

By assessing successful and un-successful treatment completion outcomes rates, these statistics can be used to improve planning, surveillance and risk assessment in TB and HIV patients. Also appropriately deploy limited resources that promote the greatest impact. Likewise, identifying the factors associated with TB treatment outcomes may better position the program to respond to the threat of untreated TB in the face of further declining TB resources and increasing unsuccessful outcome rates. In so doing ultimately improving the population's health and prompting social change. The results of this research, and the analysis are presented in Chapter 4 and discussed in further detail in Chapter 5. The following chapter will move on to discuss the analysis of data and results of the findings.

Chapter 4: Results

Introduction

In this chapter I present the results of the analysis of this retrospective cohort study of TB treatment outcomes among TB/HIV co-infected patients in Keetmanshoop, //Karas Region, Namibia. I also present findings on the potential associated factors that may contribute to TB treatment outcomes. The used data used in this analysis was obtained from the Ministry of Health (MoH), Keetmanshoop Health District Tuberculosis Program and HIV program database. I received Walden IRB approval for the study under approval number 03-23-21-0560484.

The general objective of this study was to determine the treatment success rate and associated factors among TB patients in //Karas Region, the region with the largest burden of TB in Namibia (MoHSS, 2019). This chapter includes the results of detailed statistical analysis that addresses TB treatment outcomes and possible contributing factors to noncompletion in adult patient enrolled in the TB clinic and ART clinic Keetmanshoop Health District from 2016 through 2020. I use SPSS Version 25 to analyze data.

Multivariate and *chi*-square analyses determined with 95% confidence intervals were performed. I used through *chi*-square tests to examine the association between key variables such as gender, marital status, employment status, geographical location, and distance to the health center. Due to unavailable data for education status and income variables, I later modified the RQs to best analyze the data. RQs and their corresponding hypothesis are as follows:

RQ 1: Is there an association among successful TB treatment outcomes and associate treatment factors when adjusting for, treatment outcomes and adverse TB drug reaction?

$H_0$1: There are no statistically significant differences in association among successful TB outcomes and associated treatment factors when adjusting for adverse TB drug interaction,

$H_1$1: There are statistically significant differences in the successful TB treatment outcomes and when adjusting for TB drug interaction.

RQ2: Does gender predict the likelihood of treatment completion among TB patients in Namibia when adjusting for marital status?

$H_0$2: There is no difference in the odds of TB treatment completion between men and women among TB patients in Namibia when adjusting, marital status.

*H*1: The odds of treatment outcomes are different for men and women among TB patients in Namibia when adjusting marital status.

RQ3: Is there an association among TB-case category and TB treatment outcomes among TB patients in Namibia when adjusting for geographic location and distance?

H_0*3*: There is no association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting geographic location and distance.

H_1*3*: There is an association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting for education, marital status, and geographic location.

According to Becker et al. (2015), adding control variable helps to produce a more conservative test of hypotheses and reveals the true relationships or association among variables. To better understand the effects of an independent variable, additional variables, such as age group, distance to the health facility, and geographical location were added to the study variables. In this chapter, I present and describe in detail the results of the analyses of data obtained from the national TB/HIV data set from the MoHSS. The descriptive statistics for the sample and the findings from the binary logistic regression analysis and *chi*-square are presented. In the final section, I summarize the answers to the RQ based on the statistical findings.

Data Collection

I obtained data for this study from the HIS database with the assistance of TB program coordinator after gaining Walden IRB approval to conduct the study. Only authorized personnel from Namibia Health Services have access to the HIS database with a secure password. The initial dataset extracted by the TB program coordinators in Namibia contained comprehensive information for the entire District. I attain the appropriate dataset. Evaluation of the data indicated a small portion of missing entries. The data sample only included cases recorded between 2016 and 2020.

Based on the sample size calculation indicated in Chapter 3, the study required a minimum of 200 participants. The initial data size requested from the Namibia Health Service was between 150 and 200 participants. Namibia Health Services representatives assisted me in systematically selecting a total of 200 cases from the database. The participants included only adults age 18-65. The final smple size that was included in the analysisis was 200 cases.

Results

Descriptive Statistics of Participant Characteristics

I performed a descriptive statistics analysis with SPSS IBM (Version 25) to examine the demographic characteristics of the participants. Table 2 displays a summary of the characteristics of the participants in the study. The statistical results show that, among the 200 TB/HIV coinfected patients, 36.5% were female patients and 59.6% were male patients. In addition, 1.32% fell within the age range 18 years, 35.53% within 19-30 years, 23.68% within 31-42 years, 19.74% within 43–54 years, 11.84% within 55-64 years, and 7.89% within 65 years. The *SD*. was =1.315, for male, 1.153. Figure 4 shows the age group distribution for females and Figure 2 shows the age group distribution for males.

Figure 5

Ages of Female Respondents

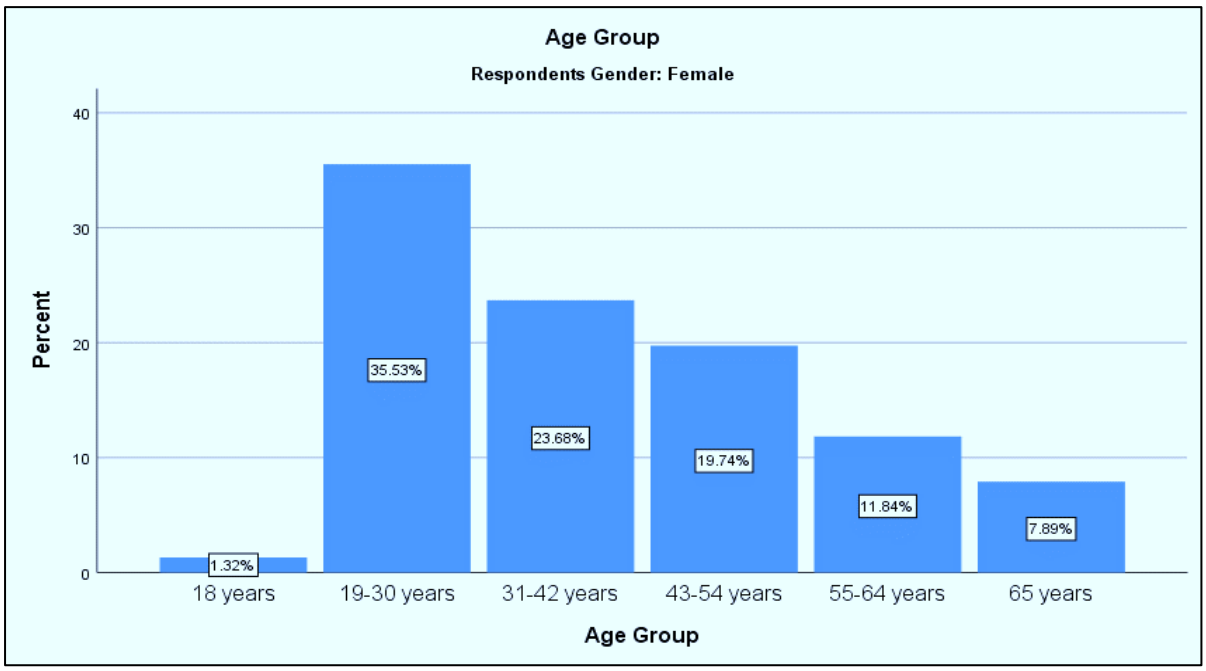


Figure 6

Ages of Male Respondents

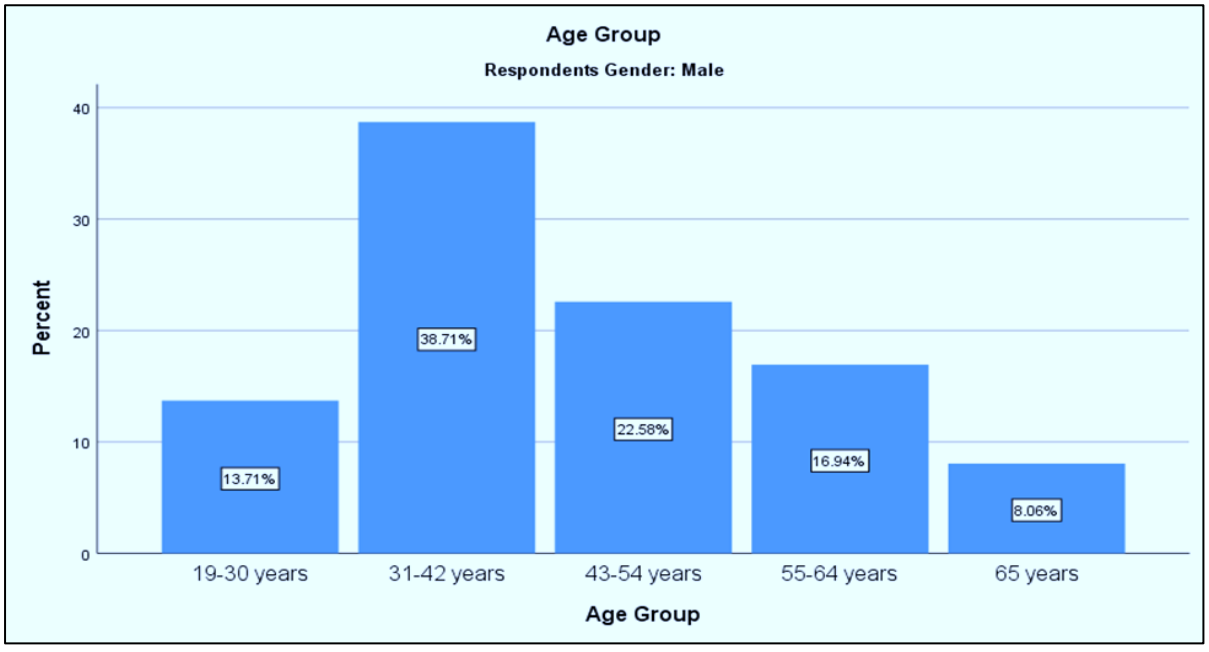


Table 2

Demographic Characteristics of TB Patients Coinfected With HIV in Keetmanshoop District, Karas Region, From 2016 to 2020

Variable	Frequency	%
Gender	76	100
Female	76	100
Male	124	100
Age group (female, yrs.)		
18	1	1.3
19-30	27	35.5
31-42	18	23.7
43-54	15	19.7
55-64	9	11.8
65	6	7.9
Age group (male, yrs.)		
19-30	17	13.7
31-42	48	38.7
43-54	28	22.6
55-64	21	16.9
65	10	8.1
Year respondent registered with TB and HIV status (female)		
2016	25	32.9
2017	14	18.4
2018	16	21.1
2019	13	17.1
2020	8	10.5
Year respondent registered with TB and HIV status (male)		
2016	19	15.3
2017	30	24.2
2018	19	15.3
2019	29	23.4
2019	27	21.8
Marital status (female)		
Married	30	39.5
Not married	43	56.6
Divorced	2	2.6
Other	1	1.3

(*table continues*)

Variable	Frequency	%
Marital status (male)		
Married	37	29.8
Not married	77	62.1
Divorced	10	8.1
Geographic location (female)		
Keetmanshoop urban	42	19.7
Tses rural	15	19.7
Berseba rural	14	18.4
Koes rural	5	6.6
Geographic location (male)		
Keetmanshoop urban	86	69.4
Tses rural	26	21.0
Berseba rural	8	6.5
Koes rural	3	2.4
Other	1	8
Distance to health center (female, km)		
5-10	40	52.6
30-80	14	18.4
85-120	13	17.1
125-180	2	2.6
Distance to health center (male, km)		
5-15	88	71.0
30-80	20	16.1
85-120	5	4.0
125-180	6	4.8
Employment status (female)		
Yes	25	32.9
No	49	64.5
Employment status (male)		
Yes	60	48.4
No	64	51.6

From the Table 2 and figures 6 and 7, it is evident that there are more males (124%) then females (76%) participated in this study. Female respondents that reacted adversely to TB treatment and stated yes 31.6 % (n=24), and 68.4% (n=52) stated no. Male respondents that reacted adversely to TB treatment and stated yes 27.4% (n=34), and those that stated no 72.6 % (n=90). In addition, in 2016 females that was diagnosed and registered for TB/HIV was 32.9%, in 2017 was 18.4%, in 2018 was 21.1%, in 2019, 17.1% and in 2020 was 10.5%. For males in 2016 was 15.3%, 2017 24.2%, 2018, 15.3%, 2019 23.4%, in 2020 was 21.8% in the Keetmanshoop District of the //Karas Region.

Additionally, females 39.5 % =married, not married = 56.6%, for males =29.8 % was married and 62.1% = not married. Others, respondent's marital status females 1.3 % can be

attributed to common phenomena called “vat en sit” or cohabitation, where two individuals live together but are not married, is becoming increasingly popular in South Africa and Namibia. Cohabitation before marriage – or in place of marriage – has increasingly become a convenient arrangement for unmarried couples to share the costs of living while, for others, it’s the perfect way to test a relationship before making a big commitment (Baloyi, 2017).

A direct translation of the colloquial Afrikaans term “vat en sit” is “take and sit down”, meaning to take a partner and settle down together without the formalities that come with marriage (Baloyi, 2017). With the financial costs of weddings today, many young couples live together before or after their engagement, or before or after lobola has been paid, or before the couple’s union has been sealed in matrimony (Baloyi, 2017). There are, however, real financial risks with “vat en sit”, given that cohabitation is not legally recognised as a form of marriage. For example, for many couples where lobola has been paid, there is a common misconception that the payment of lobola equates to the formalisation or legalisation of the marriage (Baloyi, 2017).

This can lead to a considerable difference in the way assets are dealt with in the event of a death or divorce, given that couples in domestic partnerships are not afforded the same legal rights, duties and protection of an agreement in law, should they wish to separate (Baloyi, 2017). Geographical location, females that reside in Keetmanshoop urban area = 55.3%, Tses rural=19.7%, Berseba rural = 18.4, Koes rural= 6.6%. Males that reside in in Keetmanshoop urban area = 69.4, Tses rural =21.0%, Berseba rural = 6.5% Koes rural= 2.4% respectively. Female respondents that reacted adversely to TB treatment yes 31.56, no 68.42%.

Males that reacted adversely to TB treatment yes= 27.42%, no=72.58%. It is evident from the Table 2 women were the majority that reacted adversely to TB drugs. Female respondent’s status of employment 36.5 % (n=76), *SD*. = 2.64492, Mean=2.0658. Male respondent’s status of employment 59.6% (n=124) *SD*. =.50177, mean=1.5161,

Maximum=64.00. Female distance to health centre *SD*. =1.28555, mean=1.9737, maximum=6, minimum=1. Male Distance to Health Centre 59.6% (n=124), *SD*. =1.07675, mean=1.5565, maximum=5.00, minimum=1.Female treatment category of patients 36.5 % (n=76), *SD*. = .71916, mean=1.4474, maximum=3.00, minimum=1. Female respondent's marital status *SD*. =.60117, mean=1.6579, maximum=4.00, minimum=1. Male respondent's marital status *SD*. = .77915, mean=1.8629, maximum=4.00, minimum=2.00. Respondents gender female *SD*. =.00000, mean=1.0000, maximum=1.00, minimum=1.00. Respondents gender female *SD*. =.1.000, maximum=1.00, minimum=1.00. Respondents gender female *SD*. = .00000, mean=2.0000, maximum=2.00 and minimum=2.00.

Female distance to health centre for females that live in radius of 5-15 kilometres 52.6% (n=40), 80-100 kilometres 18.4% (n=14), 120-146 17.1 % (n=13), 130-150 kilometres 2.6% (n=2), 160-170 kilometres 9.2 %(n=7). Males, distance to health centre for males that live in an urban area radius of 5-15 kilometres 71.1 % (n=88), 80-100 kilometres 16.1 % (n=20), 120-146 kilometres 4.0% (n=5), 130-150 kilometres 4.0% (n=5), 160-170 kilometres 4.8% (n=6).

Figure 7

Marital Status of Female Respondents

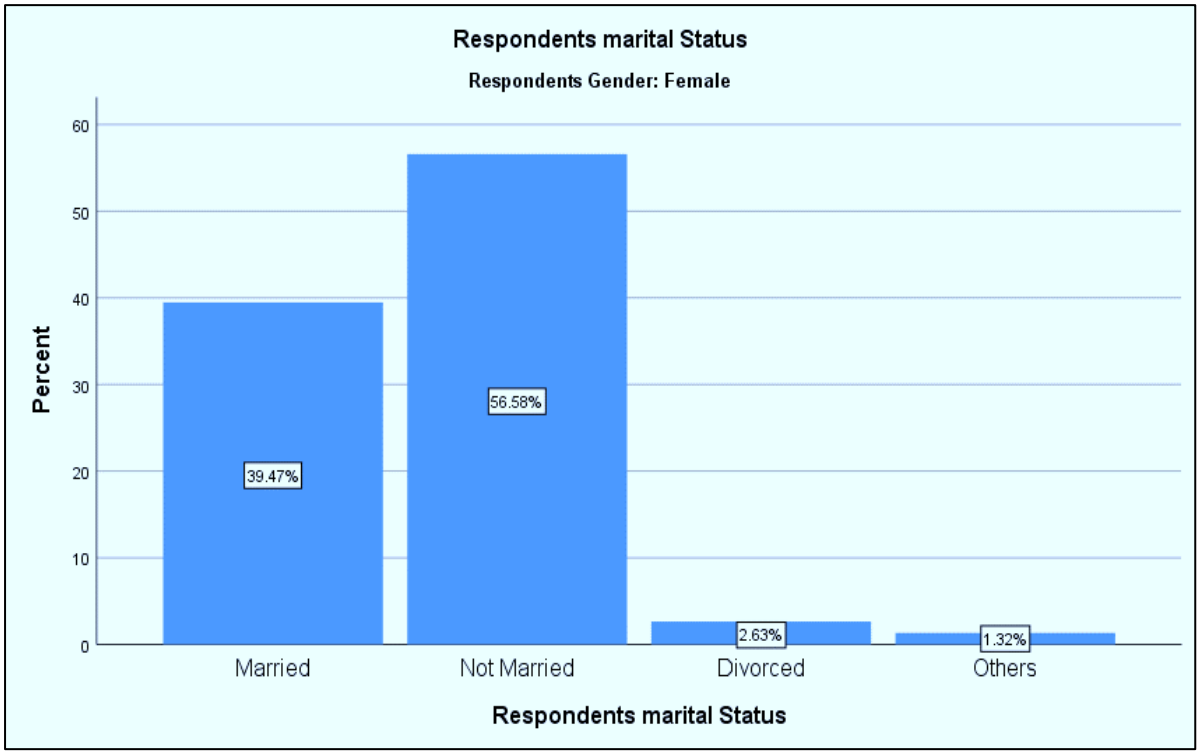


Figure 8

Marital Status of Male Respondents

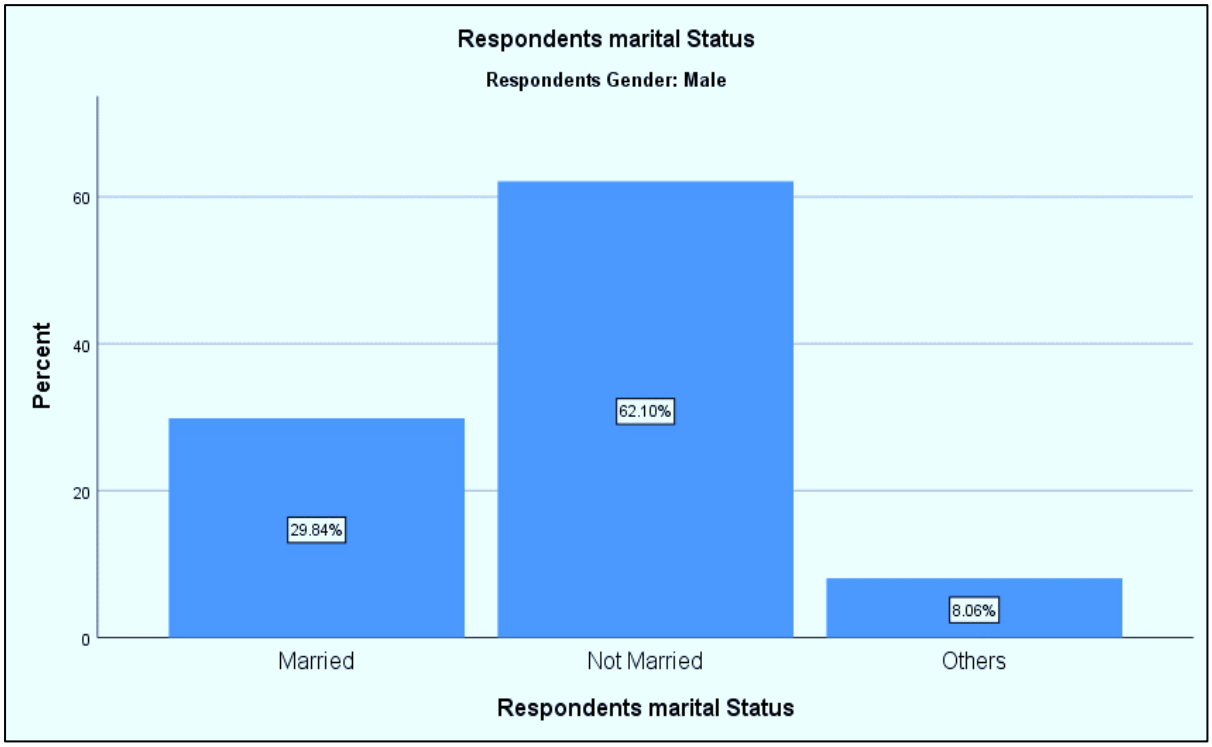


Figure 9

Percentage of Male Respondents With an Adverse Reaction to TB Treatment

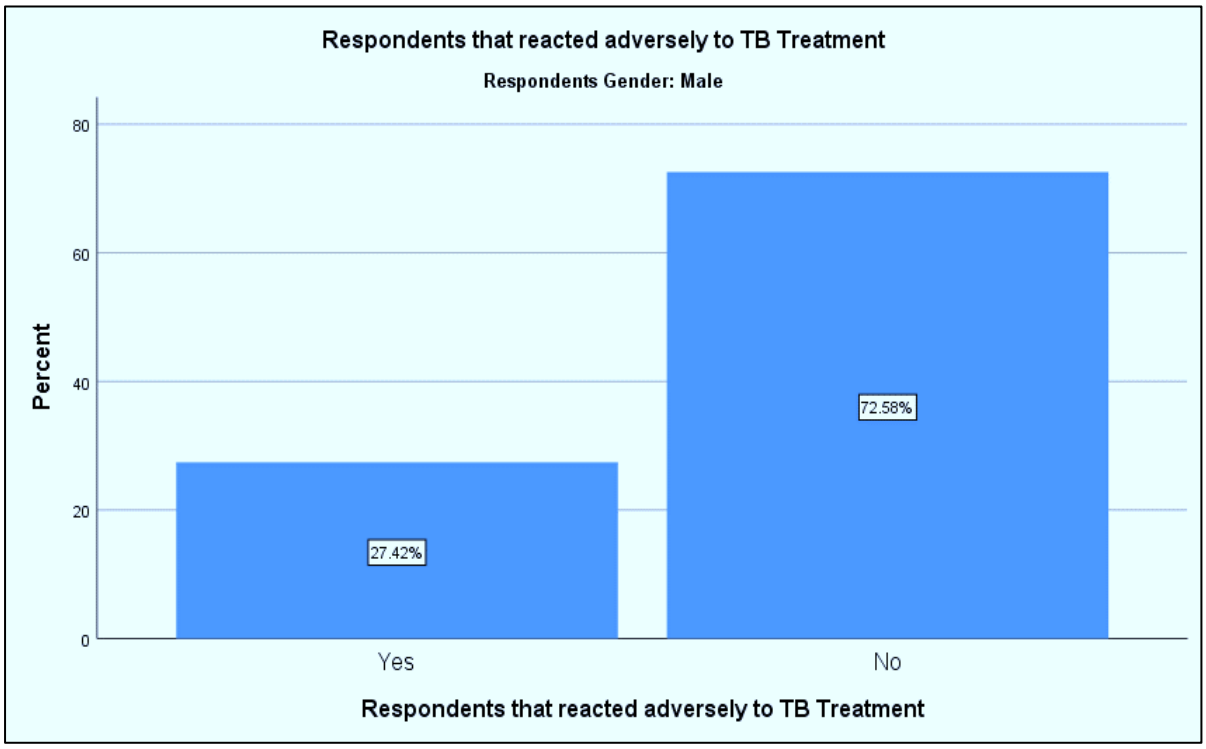


Figure 10

Percentage of Female Respondents With an Adverse Reaction to TB Treatment

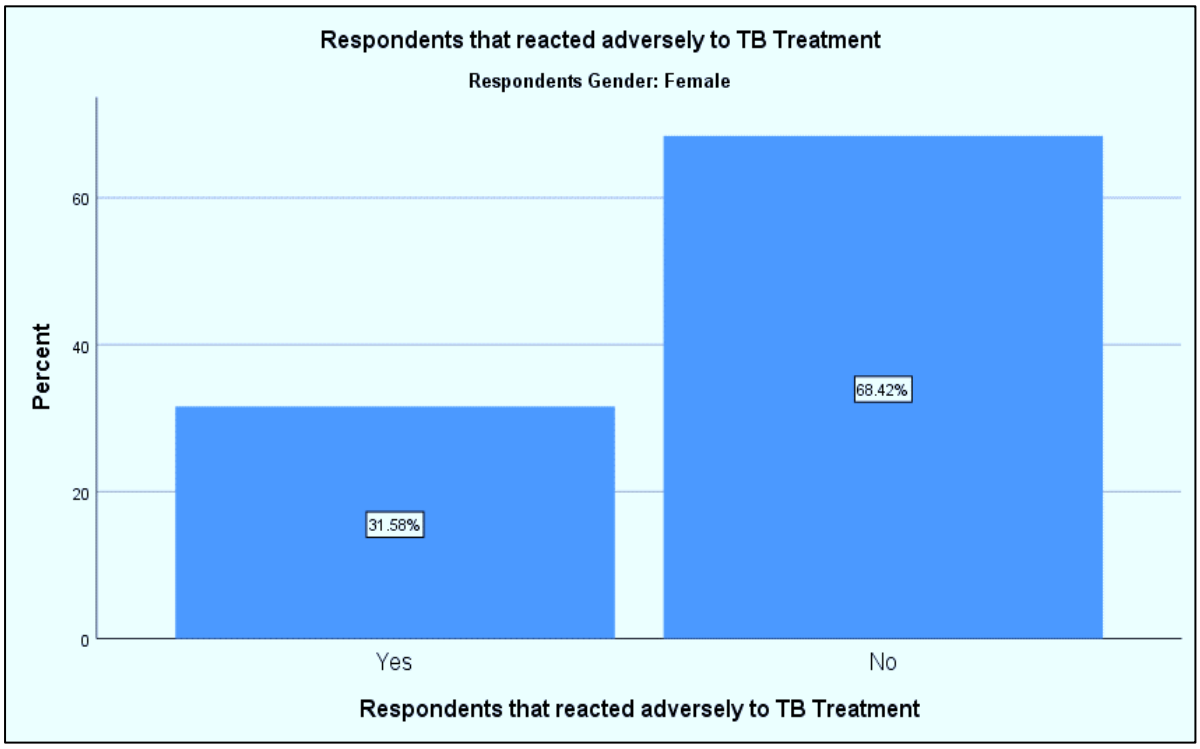


Table 3

Clinical Characteristics of TB Patients Coinfected With HIV in the Keetmanshoop District, Karas Region, Namibia, From 2016 to 2020

Variables	Categories	Frequency	%
Gender	Female	76	100
	Male	124	100
Phase when death was recorded			
	Initiation	150	75
	Continuation	50	25
TB Classification			
	Smear positive	110	64.5
	Smear negative	46	22.3
	Extra pulmonary	25	12.1
	Suggestive	19	9.2
Category of patients			
	New	139	67.5
	Default	25	12.1
	Relapse	36	17.5
Respondents that reacted adversely to TB treatment			
	Yes	58	29.5
	No	141	70.5

From table 3 above clinical characteristics of TB patients co-infected with HIV in the Keetmanshoop district of the //Karas Region, Namibia from 2016 to 2020, above it is evident that 75% (n = 150) deaths was recorded during the initiation phase, whilst the *SD*. =.434, mean=1.25, maximum= 2, minimum=1 and in the continuation phase the deaths recorded was 50% (n=25), this indicates that more people are dying during the continuation phase. With regards to TB classification smear positive 64.5% (n=110) takes up the majority of TB and smear negative 22.3% (n=46), extra pulmonary TB takes up about 25% (n=12.1), suggestive 19% (n=9.2), *SD*. =1.0002, mean=1.77.

Category of patients new 139 (n=67.5), default and relapse 36% (n=17.5), *SD*. =.783, mean=1.80, maximum =4, minimum=1. Respondents that reacted adversely to TB treatment those that responded yes are 58% (n=29.5), those that responded no 141% (n=70.5). Whilst the *SD*. =1.438, and is mean=1.80. Although the number of respondents that stated no to adverse TB reaction are less than those who stated yes, these statistics are very worrisome, patients feel overwhelmed by the number of tablets to be swallowed, and by the long duration of TB treatment protocol, which is why they decide to stop treatment (Chanda & Gosnell, 2006, p. 10). This situation requires that patients should be given proper information and education so that they understand why the treatment takes so long.

World-wide, nearly 90% of the cases of TB and 48% of cases of drug-resistant TB are cured. However, in reality, treatment is not quick or easy. The length of treatment and side effects from drugs used to pose huge problems for TB patients and global efforts to tackle the disease. TB treatment last for at least for six months Treatment usually a mixture of four antibiotics isoniazid, rifampicin, pyrazinamide, and ethambutol (WHO, 2020). With any medication, it is possible to experience side effects. TB treatment is not as long as the lifelong treatment for diseases such as hypertension and diabetes, amongst others. It is therefore very

important to consider the socioeconomic conditions that frame the patient's life holistically when emphasising DOT. A TB programme that simply focuses on the act of observing the patient taking medication without taking into account the economic and social factors associated with the treatment is likely to fail. Patients may be forced to stop treatment because they cannot travel to the clinic every day for DOT, either because they lack resources or because the family has refused to support them. Moreover, it happens that patients sometimes may not be able to tell the family that they have TB, because of the social stigma and therefore cannot ask for support. Finally having TB is an emotionally devastating experience, especially when combine with HIV/AIDS when many people link these two diseases. TB treatment takes a long time and it also has side effects; hence, there is a need to encourage and support TB patients to complete their treatment with incentives.

Treatment Outcome of TB- HIV Co-infected Patients on anti-TB Therapy

A treatment success rate of 85% of the detected infectious cases is an important yard stick adopted for TB control by WHO assembly in 1993. There is therefore need to intensify efforts to ensure that the country surpass the 85% target by minimizing unfavourable treatment outcomes such as failure, death, miss/loss to follow-up. TB treatment outcomes results by gender is depicted in the Table 4, and subsequently also depicted in Figure 10 above and figure 11below.

Table 3

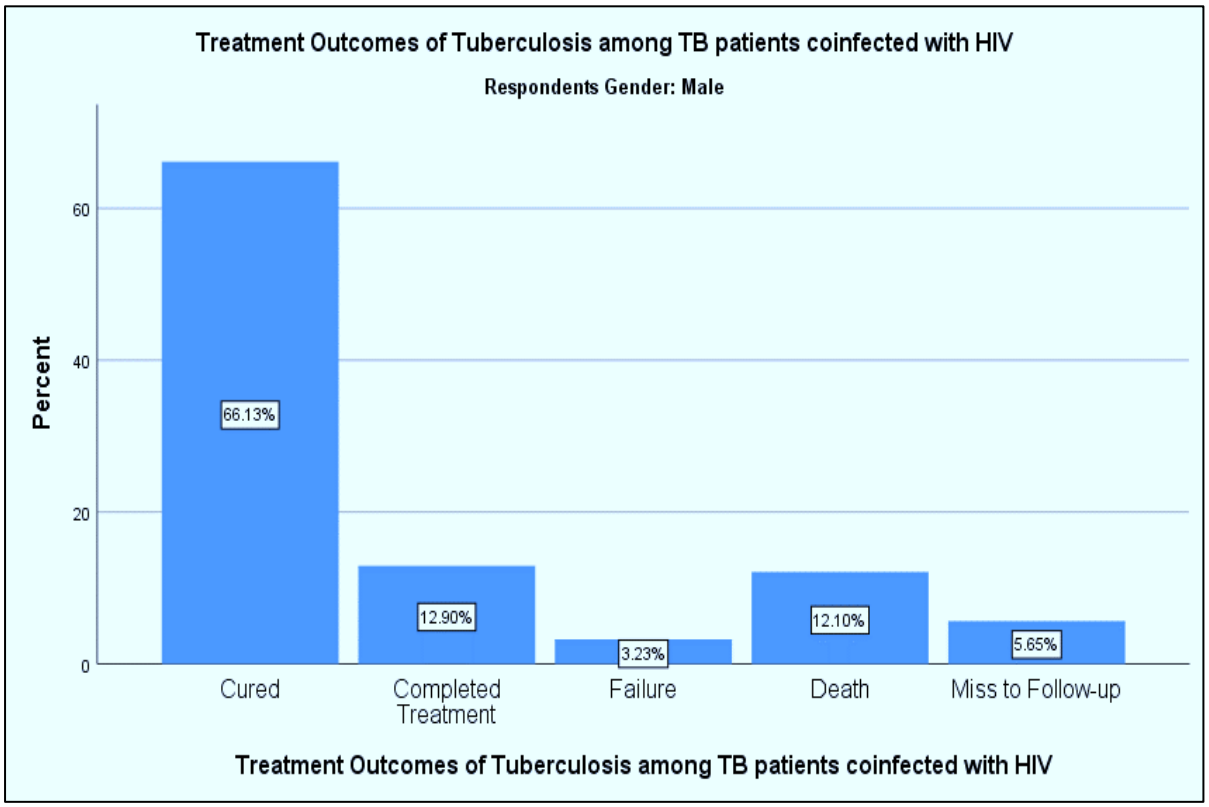
Treatment Outcome Among Smear-Positive TB Patients in Keetmanshoop District, Karas Region, Namibia (According to WHO Standard Criteria)

	Treatment Outcomes		N	%	Total
Gender (female)	Successful	Cured	47	61	76
		Completed treatment	14	18.4	
	Unsuccessful	Failure	3	3.9	
		Death	9	11.8	
		Miss/loss to Follow-up	3	3.9	
Treatment Outcomes					
Gender (male)	Successful	Cured	82	66.1	124
		Completed treatment	16	12.9	
	Unsuccessful	Failure	4	3.2	
		Death	15	12.1	
		Miss/loss to follow-up	7	5.6	

From the above table it is testimony that among the TB-HIV co-infected patients, 129 (60.0%) were cured, 30 (14.4%) had completed their treatment, 7 (3.4%), had treatment failure, 24 (11.5%) died, and the remaining 10 (4.8%) were lost to follow up. Overall, 159 (79.5%) of the TB-HIV co-infected patients had successful TB treatment outcome whereas, the remaining (41%) of the patients had unsuccessful TB treatment outcome. Additionally, the *SD*. =1.197, variance=1.432, mean=1.76, median=1.00, and the mode =1. It is evident from the table above that the treatment outcome rate cure for more males is higher than that of the females.

Figure 11

TB Treatment Outcomes for Male Respondents



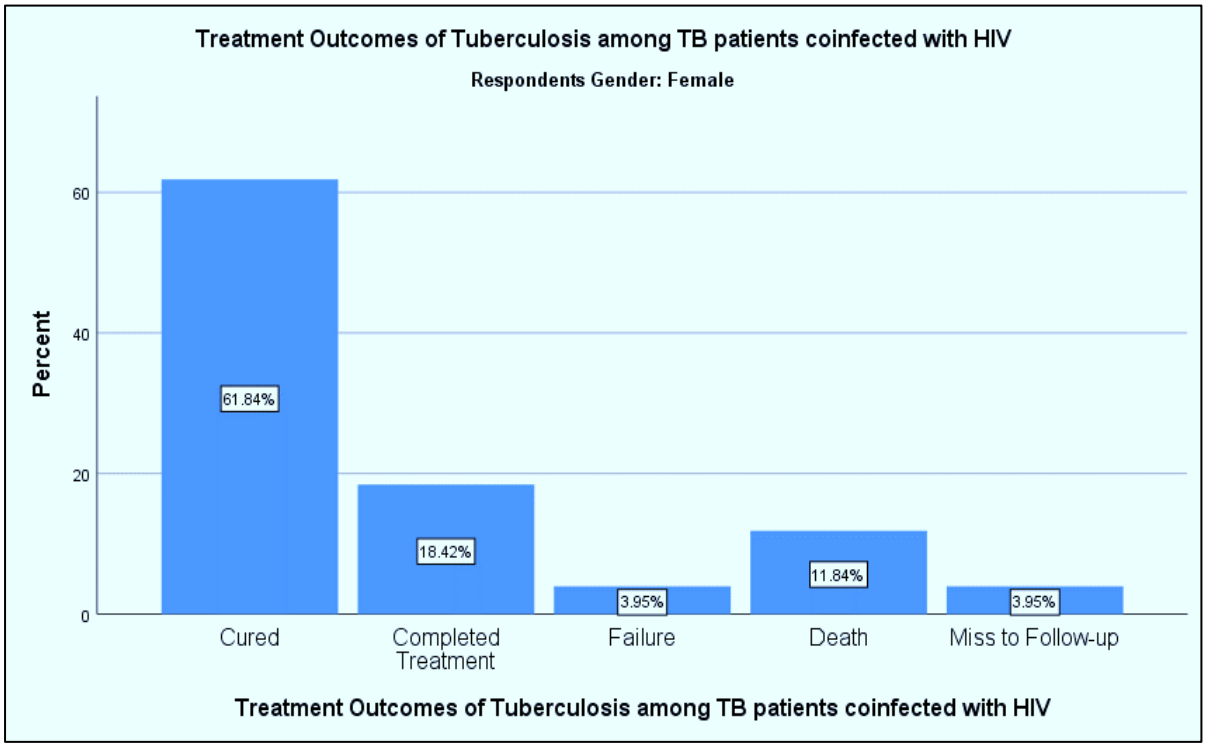
Explanations for the sex differences in TB rates are complex and subject of debate, but tend to include possible differences in biology, in risk-exposing behaviours and occupations, in transmission dynamics, or in health services access, use, diagnostic and reporting practices (WHO,2015). Additionally, the prevalence-to-notification ratio is held to indicate a gap in diagnosis and reporting, and greater ratios among men imply women access diagnostic and treatment services more efficiently. Evidence from related HIV literature, and research from around the world consistently reporting men using health services less than women for most illnesses, supports a view of men accessing TB-related health services poorly.

Among patients registered with general practice in the UK primary care, men's crude consultation rates were found to be 32% lower than for women (Chikovore et al., 2020). In Europe, sex differences in use of primary care services ranged from approximately 5% in the Czech Republic and Austria to approximately 18% in Cyprus and Greece (Chikovore et al.,

2020). However, some argue women may be accessing services more but only during the reproductive years (Chikovore et al., 2020).

Figure 12

TB Treatment Outcomes for Female Respondents



Finally, the differences in TB outcome rates have also been attributed to biological phenomena. It has been suggested that the propensity to develop disease after infection with *M tuberculosis* (progression rate) may be greater in women of reproductive age than in men of the same age, whereas men have higher rates of progression when older (WHO,2015). Co-morbid conditions such as HIV infection, diabetes, and cirrhosis, could also affect the rate at which TB occurs, and their prevalence could vary by gender (WHO, 2015).

Table 5

Multiple Logistic Regression Analysis of Associated Risk Factors and TB Treatment Outcome Among Smear-Positive TB Patients in Keetmanshoop District, Karas Region

						95.0 % confidence interval for B	
Variables	B	S.E	t	Sig	Exp (B)	Lower	Upper
Respondents treatment outcomes	-.001	.029	-.057	.960	484	-.058	.058
Respondents Gender	-.010	.182	-.057	.954	-.004	-.370	-.349
Respondents status of employment	-.060	.052	-1.158	.248	-.085	-.162	.042
Respondents marital Status	.081	.121	.671	.503	.049	-.157	-319
Geographic Location of Respondents	.099	.111	.891	.374	.073	-.120	.318
Distance to Health Centre	-.018	.031	-.571	.569	-.046	-.079	.044

a. Dependent Variable: Respondents treatment Outcomes of TB cases according to HIV Status in //Karas Region Keetmanshoop, Namibia, *level of significance $p < 0.05$

Results for Research Questions 1

In order to answer the research questions, *chi*-square analysis was performed. The results of the *chi*-square are shown in Tables below and discussed in subsequent sections. The results of the *chi*-square regression are shown in Tables below and discussed in subsequent sections. As stated earlier, due to missing data and variables from the data capturing tool the initial research questions were modified to include variables such as, drug reaction, distance to the nearest health centre/clinic, geographical location and (place of residence).

RQ 1: Is there an association among successful TB treatment outcomes and associate treatment factors when adjusting for, adverse TB drug reaction?

$H_0$1: There are no statistically significant differences in association among successful TB outcomes and associated treatment factors when adjusting for adverse drug interaction.

$H_1$1: There are statistically significant differences in the successful TB treatment outcomes and when adjusting adverse drug interaction. *Chi*-square test analysis was conducted to examine the effect of each study variable on treatment outcomes.

The bivariate analyses relied on two statistical assumptions: (a) the data are randomly drawn from a population, and (b) the application of the *chi*-square test to a small sample could lead to an unacceptable rate of Type II errors (Bolboacă et al., 2011). The sample size was sufficiently large, so it is concluded that the study data met statistical assumptions related to bivariate analyses. The corresponding results are presented in Table 6 below.

Table 4

Chi-Square Test Analysis of Variables for Treatment Outcomes and Associated Factors

Gender	Value	df	Asymptotic Significance (2-sided	Total
Respondents that reacted adversely to TB Treatment* Treatment Outcomes				
Female	3.649[a]	4	.456	76
Male	6.228[b]	4	.183	124
Respondents Gender * Respondents marital Status				
Female	8.710[a]	3	.456	76
Male	6.228[b]	4	.183	124
Distance to Health Centre * Geographic Location				
Female	123.333[a]	3	.033	76
Male	6.228[b]	4	.183	124
Distance to Health Centre * Geographic Location				
Female	123.333[a]	12	.000	76
Male	204.460[b]	16	.000	124

The results of the *chi*-square test measured the significance of each variable in the study. From the above table, the categorical variable treatment outcomes status included cell frequencies greater than five and the two variables were independent of one another, making the use of *chi*-square valid. Additionally, no extreme values were identified, there were no overlaps in variables, data discrimination was not an issue, data were not analyzed after sorting, and the data were not structured in a manner that allowed for many processes to approach the natural limit (Buthman, 2018). The results in table 6 shows that overall value for female group were 3.649^a , p =.456, and for the male group p=.183 did not demonstrate a significant

association between treatment completion among the study participants as indicated by their respective *p* values. Moreover, their difference is not statistically significant. Therefore, the null hypothesis failed and is rejected and concluded that there is no statistical significant association between TB treatment outcomes and adverse drug interaction.

Results for Research Question 2

RQ2: Does gender predict the likelihood of treatment outcomes among TB patients in Namibia when adjusting for marital status?

$H_0$2: There is no difference in the odds of TB treatment outcomes between men and women among TB patients in Namibia when adjusting, marital status, and geographic location.

*H_1*1: The odds of treatment outcomes are different for men and women among TB patients in Namibia when adjusting for education, marital status, and geographic location. *A chi*-square is conducted and the test the results are to answer the research question; does gender predict the likelihood of treatment completion among TB patients in Namibia when adjusting for marital status. Also 3 cells (37.5%) have expected count less than 5. The minimum expected count is .76, making it valid. The results are follows as for respondent's marital status the *p*. =.033, this is not statistically significant.

The null hypothesis is rejected there is no statistical significant association between TB treatment outcomes and gender in TB treatment outcomes. Marital status did not significantly predict the odds of treatment outcomes $p = .033$, were not statistically significant therefore, the null hypothesis is rejected and concluded that there is no statistical significant association between marital status, and TB treatment outcomes in Namibia.

Results for Research Question 3

RQ3: Is there an association among TB-case category and TB treatment outcomes among TB patients in Namibia when adjusting for geographic location and distance?

$H_0$3: There is no association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting geographic location and distance.

$H_1$3: There is an association among TB treatment outcomes and TB case category among TB patients in Namibia when adjusting for education, marital status, and geographic location. The results are as follows, p =.000 were computed as output, that means that the results were highly significant (very unlikely to have occurred by chance) alone. Additionally, the p of .000 means the results highly significant, however reporting p as.000 is generally discourage upon when reporting results, because it suggests there was absolutely no (zero) chance of getting these results if the null hypothesis was true. That is why it is reported as p<.001 instead of p=.000. In this study the p value is p <. 001. Therefore, the null hypothesis is rejected and concluded that there is no statistical significant association.

Assumption Testing

Logistic regression results can only be reliable only when some assumptions are not violated. To ensure how reliable the results from the logistic regression are, the assumption of multicollinearity and the linearity of the logistic analysis were tested.

Table 5

Multicollinearity Diagnosis

	Collinearity Statistics	
Predictors	Tolerance	VIF
Respondents status of employment	.934	1.071
Respondents marital Status	.710	1.409
Geographic Location of Respondents	.445	2.247
Year respondent registered For TB and HIV	.671	1.489
Respondents that reacted adversely to TB Treatment	.955	1.047
Distance to Health Centre	.440	2.275
Treatment Outcomes of Tuberculosis among TB patients coinfected with HIV	.984	1.017

From the Table 7 above, the assumption of multicollinearity assumes that independent variable (predictors) should not be too highly correlated. According to Field (2014) SPSS does

not actually have an option to test for multicollinearity diagnostics in logistic regression, the best alternative is to get the statistics results on collinearity diagnostics tolerance and VIF by simply running a linear regression analysis using the same variable and thus tolerance value less than 0.1 and VIF value greater than 10 indicates there is an issue of multicollinearity between the predictors.

The results for the test are shown in Table 7 above. As indicated the assumption of multicollinearity was not violated because none of the values of tolerance for various variable is 0.1 and likewise none of the values for VIF for variables were greater than 10. Linearity of the logit: Logistic regression does not assume a linear relationship between the dependent and independent variables (Chao-Ying et al., 2002), but it does assume that the independent variables are related linearly to the log odds. The test will underestimate the strength of the relationship and the alternative hypothesis will be rejected as the relationship is not significant if this assumption is violated. As indicated in Table 6, the H-L goodness of fit test shows that the data perfectly fits well into both models and thus the assumption of linearity was not violated.

Summary

In this chapter the analysis and results of the secondary data on TB patients between the years 2016 and 2022 from the Namibia Health Services (NHS), HIS now known as District Health Information Management System (DHIMS) database to answer the study research questions are presented. Initial effort concentrated on dataset preparation with a participant of 200 patients. I examine three RQs and their attendant hypotheses.

RQ1 encompassed one independent variables (adverse drug reaction), one categorical variable (treatment outcomes) and three covariates (marital status, age, employment status and gender). RQ2, encompassed two independent variables (distance to health centre, geographical location), one categorical variable (treatment outcomes) and three covariates (marital status,

age, and gender). I conducted a *chi*-square anlysis to examine the effect of each study variable on treatment outcomes followed a binary logistic regression analysis to test hypotheses associated with each research question.

The results from the *chi*-square test shows that TB treatment outcomes, marital status, employments status, gender and adverse TB treatment outcomes of study participants did not demonstrate a significant association between treatment completions among the study participants.

However, patient location geographic location and distance demonstrated a significant association between the treatment outcomes. RQ1, there is no association between treatment outcomes and associate treatment factors when adjusting for, adverse drug reaction. In RQ2, the aim was to examine the association between does gender predict the likelihood of treatment completion among TB patients in Namibia when adjusting for marital status. In RQ3, the aim was also to assess if there an association among TB-case category and TB treatment outcomes among TB patients in Namibia when adjusting for geographic location and distance?

In Chapter 5, discussion and interpretation of the study results in relation to findings in literature are provided, the implications of the findings of this investigation for effecting for positive social change as related to Namibian TB management program, discussion of the limitations of the study, recommendation for future study or research, and conclusions as pertain to the findings of the study are provided.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to assess TB treatment outcomes and associated factors and determine possible factors that hinder TB management in Namibia. Moreover, the specific purpose of this study (i) was to assess the TB treatment outcomes of patients registered for anti-TB treatment in Keetmanshoop District of the //Karas Region. Previous research (Jahanmehr et al., 2015; Khan, 2016), identified factors such as poverty, inadequate health care infrastructure, noncompliance to treatment schedule, overcrowding, lack of education, and lack of commitment on the part of national control program as factors leading to an increase in TB cases and unsuccessful treatment outcome. I sought to expand on this research.

I used a quantitative retrospective study design to analyze secondary data obtained from the DHIMS database for Keetmanshoop District in the //Karas Region. Statistical analyses were conducted to examine relationships between the variables and to test hypotheses with each RQ. In this chapter, I interpret the study findings. Then discussion of the limitations of the study, recommendations for future study or research, conclusions and acknowledgement are provided.

Discussion

Sub-Saharan Africa at large and Namibia, in particular, are confronted with a devastating HIV/TB-co-epidemic. Little is known, however, of the creation and dynamics of double coinfection in the context of these intertwined epidemics and the impact of this double coinfection on the social connotations of TB (WHO, 2020). In the current study I addressed this research gap by assessing the outcomes of HIV positive patients registered with for anti TB treatment in //Karas, the Region with the largest burden of TB in Namibia (MoHSS, 2020).

The results of the analysis clearly indicate that the link between both illnesses is reflected in an additional layer of unemployment, and distance to the health centere, both factors that have previously been linked to HIV and TB status. In addition, I explored the link

between this double coinfection with TB. As expected, the link between the epidemics and the associated factors has resulted in a large pool of people coinfected with TB and HIV.

To the best of my knowledge, this is the first quantitative study to demonstrate the empirical link between the interwovenness of HIV and TB and the associated factors of TB with the associated outcome as an important mediating variable. The results offer an evidence-based explanation of why TB and HIV-prevalence is surging in marginalizsed communities during the past decade (WHO, 2020). It is thus evident that the co-epidemic and its repercussions for the stigmatization of HIV and TB impact the behavior of those affected.

The treatment success rate for the Keetmanshoop District was 79.5% slight improvement. However, this percentage of success rate was below the WHO's target, which is >90% (WHO, 2019). Keetmanshoop Health District in the //Karas Region had implemented the TB/HIV integrated activities to tackle co-infection in that region of the country. Implementation of these activities also addresses areas of mutual interest for control programs of the two diseases and ultimately contributes immensely to address this dual epidemic that has had a tremendously negative impact on TB treatment outcomes.

The challenges created by the twin epidemic of TB and HIV co-infection continues unabated in the Keetmanshoop District.To address this issue, I assessed TB treatment outcomes and associated of successful treatment outcomes, knowledge which is key to the performance of the national TB program. Researchers recognize that both TB and HIV contributes to each other's progress and that dual infection affects the successful outcome of TB treatment. Successful TB treatment, which ranges from 28.9% in Ethiopia, (Fiseha et al. (2015), to 84.17% in India, and 86.0% in Malawi (Tripathi & Kapadia, 2015). The overall successful TB treatment outcome in this study was 79.5%.

This result is higher than studies conducted in Ethiopia, 77.3%, Sinshaw et al. (2017), Ghana, 68.46%, Agyare et al. (2021), and Kenya, 66.8% (Kimani et al. (2021), Zambia, 57 %

Nanzaluka et al. (2019) and Nigeria 67.4% Sariem et al. (2020), America, 75.9% Torres et al. (2019, Portugal, 73, 3%, Oliveira et al. (2021), Malaysia, 57.9%, and Selimin et al. (2021), respectively.

This successful TB outcome observed in this study may be due to gender, unemployment, geographical location, distance to the health center and adverse TB drug interaction. The factors associated with the observed difference warrant further investigation. Even though it was not significant in this study, chemoprophylaxis, such as CPT, may play a role in preventing other to opportunistic infection (OIs) and death and increase successful TB outcome.

Though WHO and Namibian National guidelines recommend that all HIV-infected patients diagnosed with TB should receive CPT, there are incongruities. The possible explanation for this discrepancy might be associated with how CPT is administered, there are inherent problems with this, TPT is underreported in Namibia due to incomplete data collection for PLHIV in whom TB has been excluded or is suspected because data, from symptom screening to treatment, is captured piecemeal across two electronic and three paper data registries.

These registries include: the electronic patient management system (ePMS) (captures HIV and TPT data, but not active TB data) and the electronic TB register (ETR) (captures active TB data); as well as the paper patient HIV care booklet, TB register, and TPT register (formally IPT register) (Roscoe ,2020). Both electronic and paper databases are susceptible to incomplete data entry, and ePMS and ETR are prone to transcription errors when entering data located in paper registers. Also, data concurrence across registers can be inconsistent, and implementation of TPT in Namibia at the facility level is also thought to be highly variable (Roscoe et al., 2020). In addition, the handling of transfer out cases, as various studies indicated earlier may have also an effect on the reduction of the successful treatment outcome. But, in

this study, I did not include transferred out as one of the TB treatment outcome. Successful TB treatment outcome may also be affected by the presence of more deaths, defaulters, and miss to follow-up and treatment failure. It is evidenced by the studies conducted in Ethiopia were factors such as being residing in outside the Gondar town [AOR = 0.44, 95%CI: 0.25-0.80], having less than the mean baseline weight (<43.7 kg) at initiation of TB treatment [AOR = 0.51, 95% CI: 0.29-0.89], being in the bedridden condition (functional status) [AOR = 0.23, 95% CI: 0.1-0.23], and experiencing anti-TB treatment side effect [AOR = 0.35, 95% CI: 0.12-0.98] were the factors that resulted the patient in treatment failure (Sinshaw et al.,2017).

This study revealed that, 129 (60.0%) were cured, 30 (14.4%) had completed their treatment, seven (3.4%), had treatment failure, 24 (11.5%) died, and the remaining 10 (4.8%) were LTFU. Overall, 159 (79.5%) of the TB-HIV co-infected patients had successful TB treatment outcome whereas, the remaining (20.5%) of the patients had unsuccessful TB treatment outcome. The successful TB treatment outcome found in this current study is nearly in agreement with studies conducted in countries like in Malaysia; 77.20%, Arsad and Ismail (2020), in Ethiopia 81.4%, Fekadu et al. (2020), and Cameroon 78.6% Tanue et al. (2019). However, it is lower than the target successful TB treatment outcome (85%) recommended by the WHO (WHO, 2018).

Furthermore, the successful outcome of TB treatment found in Eastern Ethiopia was 86.8% Tola et al. (2019), Thailand 81.3% Charoensakulchai et al. (2020), Ghana 88.1% Hayibor et al. (2020), South Africa 88.7% Jacobson et al. (2015), which are higher than the outcome found in this current study. Of course, the current finding showed substantial improvement compared to the two studies conducted in Ethiopia that ranges from 28.9 to 70.8% Belayneha et al.,2015; Fiseha et al., 2015).

The variation between my findings and results of others might be due to the presence of TB and HIV drug-drug interaction, employment status, geographical location, and distance

to the health facility. In addition, a patient who is on TB-ART co-treatment will have higher pill burden and most likely will experience more side effects compared to those patients who are infected with TB only. These factors may lead to unsuccessful TB treatment outcome (Balcha et al., 2015).

In addition, the substantial figures of miss-to follow-up, failure and death recorded, and socio-economic such as unemployment, distance to health care centre and geographical location (place of residing), in the Namibian context such conditions of the society in my case may contribute for the poor treatment outcome which results in unsuccessful treatment outcomes. These may support the reasons for many countries that are failing to achieve adequate successful TB treatment outcomes including Namibia. In this study, patients who had treatment side effect showed unsuccessful TB treatment outcome compared to those who had not experience the treatment side effect.

This is in line with various studies in which they found that being co-infected with TB/HIV is significantly associated with unsuccessful treatment outcome. Several studies showed that PTB patients with HIV positive were strongly associated with unsuccessful treatment outcome. This study also showed a similar finding. A study in Kelantan showed that HIV was strongly associated with unsuccessful treatment outcome. Other studies also showed a similar finding (Atekem et al., 2018; Wang et al., 2009).

HIV tends to weaken the immune system. Thus, latent TB infection can quickly progress to TB disease. Therefore, all PTB patients are required to perform HIV screening to determine patient risk for poor outcomes and close monitoring. Awareness of the importance of complying with the treatment course is vital for successful treatment. Low socioeconomic factors such as unemployed are also associated with poor outcomes. The unemployed patients

were at high risk for defaulting and not complying with medication, which resulted in with unsuccessful treatment outcomes.

A possible justification for this finding might be that most of the time was used for seeking a job, transport to visit the health centre and food. There was no time to seek healthcare and because of this, they ended up with default in treatment or decide not to turn-up for their medication and/or follow-up. This study showed unemployed had a significant association with unsuccessful treatment outcomes. The treatment facility needs to focus on these groups to ensure good results in their treatment course. Similarly, most HIV-infected TB patients in many developing countries still cannot access ART primarily due to economic barriers and limited coverage.

So these findings highlight and shed more a light on the importance of expanding and improving delivery of ART services as a priority and reconsideration of the program guidelines for ART initiation in HIV-infected TB patients. In the multivariate logistic regression analysis, patient's gender, adverse TB drug interaction, distance to the health centre, and unemployment were significantly associated with unsuccessful TB treatment outcome. This implies that it needs further reconsideration of the guidelines and the collaborative activity from sectors and other stakeholders to improve the successful treatment outcome.

Reasons might vary and possible reason might be that while men are notified as having higher incident TB (5.4 million in 2015), and have higher mortality (16.5% vs 15%), there is a wide-ranging variation in gender differences geographically, and mortality is roughly equal in areas of highest HIV co-infection in most low income countries including Namibia, especially in the //Karas Region Keetmanshoop District. Difference commonly attributed to are biological and epidemiological characteristics as well as socioeconomic and cultural barriers in access to health care (WHO, 2015). According to the 2000 census, women have less literacy, fewer years of formal education, and higher rates of unemployment in the study area. These indicators are

comparable to the state and nationwide rates (WHO, 2015). Also men are more likely than women to have had some formal education, doing odd jobs and to be from a higher socioeconomic level (as determined indirectly by household characteristics), but they were also more likely to have lived in a shelter, been imprisoned, or to report using alcohol or drugs.

Men were also more likely than women to have severe clinical symptoms such as weight loss and haemoptysis at diagnosis, hence high death rates. It is uncertain whether, in settings where there are low levels of HIV, women are biologically less susceptible to TB infection and reactivation or whether gender differences in TB incidence may reflect gender-specific sociocultural factors influencing TB exposure and/or access to healthcare (Weis et al., 2008; Horton et al., 2016).

Most gender-specific TB research has focussed on differences in women's access to healthcare and subsequent delays in seeking health services, with one study finding the status of being a married woman, a housewife or being a woman as being significantly associated with diagnostic delays. However, there is evidence that women, once enrolled in healthcare, are more likely than men to adhere to the full course of treatment resulting in better treatment outcomes.

However, there are limited and sometimes conflicting data on gender differences in TB treatment responses and there may be specific factors, affecting either gender, influencing responses to treatment (Allotey & Gyapong, 2008; Gichangi et al., 2016; Feng et al., 2012). Additionally, it is evident that more males died the reason might be that the higher rates of pulmonary TB among the men in this study are partially explained by the local transmission dynamics, particularly in crowded, poorly ventilated or nosocomial settings, geography, distance, and unemployment. Men are more likely to report risk factors that have been associated with exposure to TB such as imprisonment or prior residence in a shelter. Men also

reported more frequent use of alcohol and tobacco, behaviours that may influence the rate at which TB infection progresses to active disease and death eventually (Chikovore et al.,2020).

There are significant differences in the outcomes of anti-TB treatment between men and women as depicted in the graphs and figures. Although women were just as likely as men to be treated with DOTS, men were more likely to default and miss/loss to follow –up during and from treatment. The behaviour patterns of non-adherent male patients have been amply described (Chikovore et al., 2020).

As Chikovore et al. (2020) detailed that, men were more likely than women to require retreatment, probably because of defaulting from treatment. Men also had a higher probability of death due to other causes and of death due to all causes. This higher probability of death due to TB among men has been confirmed elsewhere. Also, outside the healthcare system, men are deterred from seeking healthcare because this behaviour is experienced or seen as a weakness. This is significant where men who display lack of control face ridicule and social devaluation from peers, women and even children (Chikovore et al., 2020).

Men thus consciously or unwittingly suppress illness avoiding or compensating for appearing to be feminine or not in control. One way they do this is by deeming themselves naturally stronger physically than women (Chikovore et al., 2020). Men also overlook illness while striving to fulfil duties of providing for and inspiring families, a responsibility many nevertheless increasingly find hard to achieve (Chikore et al., 2020).

Thus driving the unsuccessful TB outcomes higher. On the African continent, including Namibia the male breadwinner role emerged as a creation from the colonial past, with the entire colonial process resulting in ‘missing men who occupy marginal positions within households and communities, and failure to achieve the socially valued masculine grade prompts in men intensified efforts to demonstrate possession of the attributes, or a resort to more accessible versions, and pursuit of these in extremis no matter the health implications

(Chikovore et al., 2020). As recounted in a systematic review on healthcare seeking for depression found that, in addition to engaging in other 'escape' behaviours, namely risk-taking, anger-fuelled conflict, and increased work hours, men used short-term strategies of turning to substance and alcohol use (Chikovore et al.,2020). They additionally concealed distress, re-emphasised strength and resorted to performing masculinity publicly or adhering to traditional concepts of masculinity (Chikovore et al., 2020).

Depression, alcoholism, danger and death thus became common in men Chikovore et al. (2020), resulting in more deaths due to TB. These complexly intersecting factors trigger responses to illness such as waiting until symptoms are unbearable or life-threatening. Waiting can entail outright avoidance or putting off of healthcare seeking Chikovore et al. (2020), or pursuit of distractions, possibly ones that reaffirm valued masculine traits, like working intensively or socialising and drinking excessively to fend off illness (Chikovore et al.,2020).

Studies have described men's preference for using traditional medicine and alternative forms of treatment, and for seeking healthcare first from places other than where they can be diagnosed formally (Chikovore et al., 2020). In avoiding healthcare, men may use socially appropriate alibis such as being unable to spare time owing to work demands. Illness responses often taken as evidence of men's stoicism and irresponsibility are likely outcomes of interactional dynamics involving structural factors and social roles (Chikovore et al., 2020). Men's role as bread earners also forces some to seek 'fast cures' from sources, often private (eg, drugstores, unqualified practitioners, traditional healers) that offer highly variable or poor quality care (Chikovore et al., 2020).

Summary of Findings

The summary of findings in this subsection represents the analysis of secondary data obtained from HIS dataset for TB/HIV coinfected patients between 2016 and 2020 in the Keetmanshoop District. The study required a minimum of 100 participants, and a total of 200

participant records were obtained. The results of my analyses indicate that the majority of participants among the 200 TB/HIV coinfected patients, 36.5. % were female patients and 59.6% were male patients. In addition, 1.32 % fell within the age range of 18 years, 35.53% within 19-30 years, 23.68% within 31-42 years, 19.74% within 43–54 years, 11.84% within 55-64 years, and 7.89% within 65 years. The *SD*.was =1.315, for male, and for female was, 1.153.

However, the logistic regression analysis of the data failed to establish any significant predictive ability for geographical location and distance, on TB treatment completion. Logistic regression analysis of the data did confirm that associated factors such as being male or female, employment status, adverse reaction to TB treatment, geographical, location, and distance to the health centre facility location are significant predictors of TB treatment outcomes, and distance to the health centre have a negative relationship with treatment outcomes.

The odds ratio of treatment outcomes with respect to males then opposed to female's number of males was significantly higher among females with regards to TB treatment outcomes. The *chi*-square analysis of the data failed to establish any significant predictive ability for TB treatment outcome, geographic location and distance. The *chi*-square analysis did not confirm that distance to the health centre and geographic location (place of residence) are significant predictors of TB treatment outcomes, rural locations have a negative relationship with treatment outcomes.

Interpretation of the Findings

The study was designed to assess if there is an association between TB treatment outcomes and associated factors, such as adverse drug interaction, marital status, gender, geographical location and distance to the health facility in TB/HIV coinfected patients in the Keetmanshoop Health District of the //Karas Region, in Namibia. It is hypothesized that there was no association among successful TB outcomes and associated treatment factors when

adjusting for adverse drug interaction, marital status, gender, age, employment status, geographical location and distance. The results indicated that the null hypothesis was rejected and thus treatment outcomes had no significant statistical association with adverse drug interaction, employment status, gender, marital status. It is hypothesized that there was no association between the geographical location and distance to health centre health facility and TB treatment completion in Namibia, controlling for age, marital status, and gender. The results of the study indicate that health facility location p = .001 significantly predicts the odds of treatment outcomes among TB patients.

The odds ratio for treatment completion with respect to TB treatment outcomes was statistically not significant among males and females, males. The overall value for female group were 3.649^{a} , p =.456, and for the male group p=.183. Therefore, the null hypothesis is rejected, that there is no significant statistical association between TB treatment outcomes and adverse drug interaction. As for respondent's marital status the p. =.033, this is not statistically significant. Therefore, the null hypothesis is rejected and it is concluded that there is no significant statistical association between TB treatment outcomes and gender in TB treatment outcomes. Marital status did not significantly predict the odds of treatment outcomes p = .033, were not statistically significant therefore, I fail to reject the null hypothesis and conclude that there is no significant statistical association between marital status, and TB treatment outcomes in Namibia.

A, p =.000 were computed as output, that means that the results were highly significant (very unlikely to have occurred by chance) alone. Additionally, the p of .000 means the results are highly significant, however reporting p as.000 is generally discourage upon when reporting results, because it suggests there was absolutely no (zero) chance of getting these results if the null hypothesis was true. That is why it is reported p<.001 instead of p=.000. In this study the

p value is $p < .001$. The null hypothesis is rejected and concluded that there is no significant statistical association.

Interpretation of the Findings with Relation to the Literature

The first research question examined the association between outcomes and adverse TB drug interaction, controlling for age, marital status, and gender and employment status. The odds ratio from the logistic regression analysis was not significant. The results from the logistic regression indicated that treatment completion had no significant association with employment status, marital status, age, and drug interaction. This finding agrees with results found in several previous studies. Previous research conducted by Danso et al. (2015), with 40 participants found no association between patients' sex, marital status, education level, employment status (occupation), and age.

However, the results of this study is difficult to generalize because the sample size was limited and the study participants were from one district out of 21 districts in Eastern Region. Ansa et al. (2015), conducted a similar study with 40 participants and found no association between sex, age, lack of medical insurance, education level, marital status, medication compliance, and treatment completion. Another study conducted by Osei et al. (2015), in the Hohoe District with a sample of 73 participants also found no association between education level [OR = 5.06, p = 0.199], employment [OR = 2.87, p = 0.420], and treatment completion.

The only limitation to these studies is that they were undertaken in only one or two districts with one or two health facilities, which is limited in generalizing to the general population of Ghana. Gyimah and Darko-Gyeke (2019), found an association between marital status, employment, and treatment completion, indicating that patients who had no means of income are likely not to complete their treatment due to the cost of TB treatment. The second research question examined the association between the health facility location, geographical location and distance, and TB treatment outcomes in Namibia, controlling for age, marital

status, and gender. The results from the logistic regression analysis indicated that health facility location significantly predicted the odds of treatment completion among TB patients. Danso et al. (2015), found that the location of a health facility influences treatment completion and outcomes.

According to Danso et al. (2015), study conducted in Suhum Kraboa Coaltar District in the Eastern Region of Ghana, due to lack of appropriate laboratory infrastructure and health facility in rural locations, approximately 71% of TB patients are unable to complete their treatment. Kasu (2015), conducted a study in the Akatsi District and confirmed that number of trained health care staff does influence TB treatment completion. Kasu (2015), found that rural settings had fewer trained health care staff and TB treatment completion was low compared to locations with more trained health care staff. Kasu (2015), indicated that training more staff is important to help improve the treatment of TB and recommended opening additional TB diagnostic centers in all rural districts.

These findings were further supported by Salifu et al. (2017), who found an association between health facility location, and treatment completion, indicating that treatment completion increased in proportion to an increase in trained health care workers and close proximity. Thus, locations with more trained health care workers allowed patients to adhere to the duration of treatment. Salifu et al. (2017), concluded that to better prevent and control TB alongside adherence to full treatment course by patients in the rural setting, availability of more trained health care workers providing continuous education and counseling is important and will help sustain the TB program.

Gyimah and Darko-Gyeke (2019), also agreed that health facility location is a factor that influences TB treatment completion and suggested that to improve treatment in rural areas, strategic measures should be adopted to channel resources (financial and personnel) to these areas. Gyimah and Darko-Gyeke (2019), indicated challenges facing the TB program are

related to patients and the health system. Whilst in this study the lost to follow-up in females is 3.95% and males 5.65%, combined 9.6%. LTFU is a serious issue in the field of TB since it can lead to TB outbreaks and drug resistance. This can be attributed to age, gender, education, and distance to health centre (residence), financial factors, migration, and social stigma (Lin, 2019). Individual factors play a role in the process of being LTFU from treatment. Sometimes, the results may contradict between different studies, probably due to the cultural, social, and other variations of the study settings.

Among the various sociodemographic characteristics, age is a recognized factor associated with LTFU. Studies from India, Brazil, and China revealed that elderly patients have higher LTFU Viana et al., 2018; Patra et al., 2013; Lin et al., 2017), whereas studies from Norway, Botswana, and South Africa suggested that adolescents have significant risk (Enane et al., 2016; Jensenius et al., 2016; Moyo et al., 2015). One study from the UK even suggested a wider range of age of 15–44 years as a high-risk group for LTFU (Millet et al., 2013). Regarding gender, studies uniformly suggest that higher LTFU was found in males, as seen in Kenya, Ethiopia, Georgia, and Uzbekistan (Dangisso et al., 2014; Gadoeve et al., 2015; Kuchukhidze et al.,2014).

Residence plays a role in the mechanism of LTFU. In Pakistan, the rural residence is associated with LTFU Javaid et al. (2017), whereas in Uzbekistan, the urban residence is associated with LTFU (Gadoev et al., 2015). This may be caused by access to the treatment center since being far from the treatment center is also associated with LTFU (Bemba et al., 2017). Transportation should be improved to increase accessibility toward the treatment center. Alternatively, they could be built in the hard-to-reach areas. Both approaches include challenges, and ultimately, these challenges may be what cause LTFU. Financial factors should also be considered while giving treatment, and programs without such considerations will likely to result in high LTFU. A study from Uzbekistan found that joblessness contributes

toward LTFU (Gadoev et al., 2015). This is confirmed by a study from China which found that pre-school children, unemployed laborers, and retirees have a higher rate of LTFU (Li et al., 2017). Patients with low income have financial constraints to complete treatment leading to LTFU as seen in India Deshmukh et al. (2015), a lower middle-income country. A similar phenomenon has been observed in South Korea, a high-income country (Park et al et al.,2016). Therefore, regardless of the country, patients with low income still have barriers against treatment completion.

There are also certain disease-specific factors that are associated with LTFU. Those who were previously LTFU tend to be LTFU again. This was confirmed by studies conducted in Brazil Viana et al. (2018), Kenya Masini et al. (2016), Uzbekistan Gadoev et al. (2015), and Korea Park et al. (2016), caution should be taken while planning treatment for such patients. Studies from Nigeria and Ethiopia both point out that smear-negative TB patients were more likely to be LTFU (Dangisso et al., 2014; Ogbudebe et al., 2016).

However, the opposite was observed in the UK where smear-positive pulmonary TB patients were more likely to be LTFU (Mallett et al., 2013). Researchers also found that patients with extra pulmonary TB were more likely to be LTFU (Ade et al., 2014; Enane et al., 2016). Drug side effects, Studies from the USA and India have found that drug side effects are associated with LTFU (Kwara et al., 2008; Tupasi et al., 2016). The researchers from the Philippines take one step further regarding this concept, stating ‘patients’ self-rating of the severity’ as an associated factor (Tupasi et al.,2016).

Indeed, some side effects, such as hepatitis, of the anti-TB drugs are already severe. However, some side effects, such as vomiting, might need self-rating since different patients may perceive differently. It would be interesting to research which kind of patient rates which side effect as severe. Co-morbid diseases such as diabetes mellitus and human immunodeficiency virus (HIV) infection also cause hindrance against TB treatment conditions

(Enane et al., 2016; Masini et al., 2016; Mi et al., 2013). Similarly, study from South-East Nigeria found a loss to follow-up rate of 8.5%, and this negatively impacted on the treatment success rate in that study (Gust et al., 2016). TB is a highly infectious disease; hence, a single patient LTFU is a potential source of TB spread in the community and also at risk of developing multidrug-resistant TB (Mindachew et al., 2016). Hence, it can be said that the rate observed in Keetmanshoop District is a cause for concern. Many reasons could account for the reported rate of LTFU. One is the poor accessibility of some of the facilities.

Another contributing factor to LTFU is the lack of incentives and or enablers given to the patients to facilitate their continuation of therapy. Incentives are forms of assistance which could be financial or otherwise or some form of social support given to patient to encourage them to complete treatment and to help to ease the economic burden which the disease confer on the sufferer (Jacobson et al.,2016). The role of incentives in facilitating treatment adherence and completion and outcomes has been extensively studied. In a study in six Russian Regions, provision of social support to people with TB significantly reduced the rate of treatment default (Ayele et al., 2016).

Social support services include incentive food packages, psychological and career counselling, and/or vouchers for transportation (Mindachew et al., 2016). This could be provided by the governmental and non-governmental organisations, civil service organisations and other donor agencies providing support for TB control programmes. For instance, a pilot community-based social support programme in Ukraine, one of the top 20 highest drug-resistant tuberculosis burden countries in the world, was designed by the Ukraine Red Cross Society in 2010.

The Ukraine pilot study demonstrated that provision of social support reduced treatment default (Mindachew et al., 2016). Social and materials support from families and significant others like friends is also a form of social support which should be promoted. This

may include nutritional, financial and material support. Social support has a way of positively impacting on patient self-esteem and societal acceptance. Similarly, another study from the United States found that increasing incentives is associated with improved adherence to therapy among TB patients residing in inner cities (Codecasa et al., 2013).

A similar study from China showed that economic burden might act as a barrier and indicated that loss of employment together with extra food demand and transport expenses over time cause a serious financial problem to patients and their immediate family (Gebreweld et al., 2018). The finding of this study points that even though free TB treatment is available, financial problems can still affect treatment adherence (e.g. costs of transportation, and nutrition).

The WHO-TB treatment guideline (2020), recommends that patients may receive incentives in order to encourage them to be compliant with treatment. However, the respondents reported that they do not receive any incentives and suggest it would be supportive if they were provided with some form of assistance. The TB medication demands patients to consume extra food especially protein-rich foods to restore their health, which often goes beyond their financial ability (Gebreweld et al., 2018). From this study, it is clear that lack of food is an important barrier to treatment adherence. In a similar study, Mabunda and Bradley state that lack of food was reported to be the main barrier for treatment adherence because "one cannot take treatment on an empty stomach" (Gebreweld et al., 2018).

To address this issue, collaboration with different sectors would be helpful, such as liaising with governmental and non-governmental organizations for providing food aid to patients. Previous studies have shown that family and community support act as a main enabler for treatment adherence Wouters et al. (2020), and lack of access to such support systems as one of the major causes of non-adherence among TB patients (Wouters et al., 2020).

In a systematic review on the prevalence of TB/HIV co-infection in China, HIV/TB coinfection prevalence ranged from 2.9% to 72.3%. TB is the most common single presenting illness among people living with HIV (Abossie et al., 2017). Cure rates among dually co-infected people is slightly lower when compared with those without HIV especially when there is delay in starting antiretroviral therapy (MoHSS, 2015). There is a need to intensify 'the Three I's for HIV/TB' which are (1) intensified case finding for TB, (2) isoniazid preventive therapy (IPT) and (3) infection control. This will reduce the burden of TB among people living with HIV (Abossie et al., 2017).

Although a number of socio-demographic characteristics are known to be associated with TB treatment outcomes, the focus in our study was on facility-based characteristics. This is in tandem with findings from a similar study which found that TB/HIV patients who received care at the public tertiary hospital had higher risks of achieving unsuccessful TB treatment outcomes (MoHSS, 2015). A likely reason is that TB patients at the tertiary facilities may be more severely ill than those accessing care at the secondary or primary health facility, thus, comorbidities may be responsible for the increased unsuccessful outcomes, exacerbated by unemployment, distance to the health centre and geographical location (MoHSS, 2015).

In addition, those attending the tertiary centres are more likely to have complications such as pleural effusion, empyema, respiratory failure all of which may contribute to poor treatment success rate and overall outcome. Other reasons for the poor treatment outcome indicators could be varied. The need to explore issues affecting treatment programmes at various DOTS centres cannot be over emphasised.

Some of the questions that need to be asked are (1) who are the partnering agencies for the areas studied? (2) is the drugs supply adequate and up to date? (3) is there likelihood of expired drugs? (4) what is the attitude of health workers to treatment programmes? (5) what are the qualifications of the health care workers? (6) is there any preventable event that may

cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer (Tariq et al., 2021). Because, such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use (Tarig et al., 2021). Among these question, medication errors, sentimental events, adverse drug reactions, adverse drug events, and medication misadventure, should also be taken in consideration (Tariq et al., 2021).

These events are undesirable and unexpected; they may or may not be independent of preexisting pathology; and might be due to human or system error, idiosyncratic, or immunologic response (Tariq et al., 2021). Additionaly, these events stand-alone or in combination causes significant morbidity or mortality adding to unsuccessful TB treatment outcomes, however this events are possibly preventable (Tariq et al., 2021). Considering, that two of the most common causes of death are related to healthcare-related events.

All these are important questions to be explored in future studies as it appears that good quality of care does not seem to translate to better outcome (Kruk et al., 2018). Poor-quality health systems result in more than 8 million deaths per year in LMICs, leading to economic welfare losses of $6 trillion in 2015 alone (Kruk et al., 2018). Additionally, an estimated 5 million deaths per year in LMICs are the result of poor quality care, with a further 3.6 million the result of insufficient access to care (Kruk et al., 2018). In, conclusion quality care should not be the purview of the elite, or an aspiration for some distant future; it should be the DNA of all health systems.

Traditionally and as it was in my study, research on quality of TB care has mostly relied on knowledge-assessment questionnaires, direct observation of providers, recall-based patient surveys and chart abstraction (e.g. prescription audit). However, these methods may not reflect

actual practice. Measuring and defining effectiveness, and outcomes unfortunately, remains difficult because patients can be misdiagnosed, undertreated or over treated depending on their specific condition (Donabedian, 1966; Donabedian, 1985). For instance, a patient who received antibiotics is considered over treated if he had viral pharyngitis, but not pneumonia. Worse, patients can be simultaneously misdiagnosed, undertreated and over treated. Low quality of care is harmful for individual patients, the broader population, and the health system if, for example, the proper management of contagious conditions such as TB is delayed, the overuse of antibiotics leads to antimicrobial resistance, and unnecessary procedures and medicines lead to increased costs of care (Kwan et al., 2019). To measure such deficits in care is largely due to the increasing use of standardised patients (SPs) as a method to measure healthcare quality (Kwan et al., 2019).

A better approach may be the use of standardised or simulated patients (SPs) which eliminate bias. Because the use of people recruited from the local community to present the same case to multiple providers in a blinded fashion-is increasingly used to measure the quality of care in low-income and middle-income countries (Kwan et al., 2019). This method is fundamentally different from other proposed quality measures, both in the richness of the data and its ability to avoid typical biases or confounding issues arising from patient sorting and case mix (Kwan et al., 2019).

SP protocols have now been developed for a range of medical conditions and implemented in multiple countries including Namibia ,around the world and have proven to be a better fit for studies where researchers are interested in (1) understanding clinical practice (rather than knowledge, which are better measured through medical vignettes) and (2) quantifying the extent of overtreatment and under treatment (currently the only method that produces reliable estimates) based on specific tracer conditions (Kwan et al.,2019). Another explanation is the influence of patient-level factors which are stronger predictors that mediate

the relationship between quality of care and treatment outcomes (Fang, Liu, & Fang, 2019). These are just some of the advocated topics for future studies.

Strengths of the study

This study's strengths include: (1) its theoretical foundation in literature, (2) its large-scale quantitative design, (3) the availability of well-developed research instrument to measure and test different types of questions and hypothesis (TB, HIV), and (4) the availability of information on an understudied population, namely active HIV adults coinfected with HIV and TB in a vulnerable health system burdened by the HIV/TB co-epidemic. Also the strength of this study lies in the use of the complexity theory in healthcare and model which is concerned with functionality and changes within a given healthcare system, beginning from the assumption that the field of healthcare delivery has become increasingly complex (Kannampallil et al., 2011; Kernick, 2004).

To the best of my knowledge, this is the first study to quantitatively disentangle the complex interrelationships between the interlinked nature of the epidemics, the interlinked nature of the associated factors, the distinct HIV- and TB-related factors, and the resulting management strategy. I empirically tested and confirmed the theory-building findings of previous in-depth qualitative and quantitative studies on this topic.

Limitation of the study

The limitations of the study are related to the inherent limitation of a retrospective study design and use of secondary data, which includes challenges with data quality and the likely misalignment between the secondary dataset and current research questions.Variables explored for inferential statistics were facility-based, limiting the inclusion of population/individual such as comorbidities asthma, income level, education level, nutrition behavioural factors (knowledge and attitude about TB), and other possible risk factors, such as malignancies, alcohol and drug abuse, and smoking (both active and passive) are not captured in the TB

registered. Evidence shows that smoking is an important factor in increased TB morbidity and mortality and reduced effectiveness of ART, thereby hinder the treatment outcomes (Jackson-Morris et al., 2015). Further, limitations related to the TB program monitoring and reporting system includes difficulties in linking multiple paper-based registers within the health care facilities, especially the presumptive TB register, laboratory register, and the facility TB register. Also, the TB reporting is only among patients who commenced treatment with assigned LG TB number, therefore, initial LTFU (that is, individual with confirmed TB who did not initiate treatment) are automatically not reported.

The inherent weakness in the study design (secondary data and retrospective study) includes insufficient information or variables to address the current research objectives and data existing in a different format or measurement not aligning to present the research work (Johnston, 2014; Laureate Education, Inc. [video], 2013). There was unavailability of data on some variables considered in the initial study which resulted in modification of the research questions. According to WHO it is important to identify comorbidities in people diagnosed with TB in order to improve diagnosis and management. There were also missing values of the predictor variables. However, the risk of incomplete data was minimised by having multiple source of information (registration and card) for independent and dependent variables and by limiting the objective to those important variables that could be collected from the sources.

Unique limitations for an inventory study in a situation like Keetmanshoop include the lack of unique identification numbers which makes it difficult to match patients between different levels of registration, and secondly, patient movement and self-referral make it equally challenging to match patients.The data analyzed included TB and HIV cases reported from 2015 to 2020, while the researcher collected the data in 2021, therefore, there was the possibility that the health care workers who reported or captured the TB and HIV cases in 2015 were not the same as the health care workers interviewed that caputured the data in 2020. The

study was only conducted in Keetmanshoop which is not representative of Namibia (the peculiarities of Keetmanshoop include population and ethnicity density, a low proportion of private health care facilities, low socioeconomic and educational status of people, high unemployment rate, high burden of TB and HIV infection and the health care worker/population ratio).

The study used all forms of TB. Comorbid conditions such as diabetes, smoking, malnutrition, and chronic lung disease are highly prevalent in the general TB population (Narasimhan et al, 2013). These comorbidities are said to influence TB treatment outcome. This study did not consider these comorbidities among TB patients. Inclusion of these comorbidities might have influenced the study findings. Despite this limitation, the study brought out new findings on the assessment of succesfull TB treatment outcomes and associated factors. Although these limitations exist, this studies strength was using the large sample size of 200 TB/HIV coinfected patient on ART treatment and the use of systematic sampling. Even though the study did not include data from all regions in Namibia which makes the research to be only limited to these District.

However, due to its sample size and systematic sampling it improved the internal and external validity of the study. The study design was appropriate for the research questions to highlight the significant findings related to successful and unsuccessful TB treatment outcome among TB/HIV on ART. The study findings can be generalized to TB/HIV patients on ART with associated risk factors in the Keetmanshoop District and perhaps other Districts with similar problems. The study has also shown consistent results with other studies. The need for future studies to be designed to include more factors that are missing in this study is conspicuous.

Recommendations

Following recommendations are put forward to improve treatment outcome rates in the study area:

1. Develop and frequently review a standard operating procedure that can be easily followed (not just the bulky manual that is currently in use). This will help to benchmark and streamline practice in all DOTS centres in the country.

2. Provide regular and up-to-date training to all staff of the DOTS centre. The standards of care for TB are constantly changing as is the guideline, hence, to keep the staff at par with the best practices, training and stepdown training must be integrated into the TB guideline.

3. Providing of incentives in the form of financial assistance to patient to encourage them to complete treatment and to help to ease the economic burden which the disease confer on the sufferer (Jacobson et al., 2016). Because it has been proven that the role of financial incentives in facilitating treatment adherence and completion and outcomes has been extensively studied.

4. Providing social support services or incentives in the form food packages, psychological and career counselling, and/or vouchers (Mindachew et al., 2016). This could be provided by the governmental and non-governmental organisations, civil service organisations and other donor agencies providing support for TB control programmes.

5. Employing TB/HIV coinfected people in areas of building of fishponds (aqua-culture), planting of fruits and vegetables, chickens for its meat and, eggs, goats for its meat and milk for consumption and selling. Through this they will get the much needed nutrition, finance and sustain the project. Thereby increasing the successful TB outcome rate.

6. Building of more health care centres in rural areas and intensify outreach programs in the district, this will improve the successful outcomes rate because distance will no longer be barrier.

7. Fewer variables existing in the national TB surveillance system resulted in some factors important to the study not being included in the analysis as anticipated, thus resulting in the study missing out on important associations. It is recommended that the National TB Surveillance System captures all other important variables on different TB management to allow for data analysis important for assessment and evaluation of progress towards related control efforts.

8. In future research, the use of a more inclusive study design to explore the association between both facility- and population-related factors like socio-demographic variables, clinical characteristics, drug regimen and laboratory findings. Last but not least, the initiative stresses the need for a multisectoral approach in addressing the specific needs of people living with HIV/TB co-infection (WHO, 2018).

Implications

Health stakeholders can use the significant findings that arise from the study to influence positive social change with an impact on the lives of patients, families, and communities. This study showed significant findings that several multifaceted factors are associated with both successful TB outcomes and unsuccessful TB outcomes among TB/HIV coinfected patients on ART in Keetmanshoop District of the of the //Karas Region in Namibia.Furthermore, the findings also support and is in tandem with Walden's mission by providing recommendations to professional practice including management and positive social change implications. Relevant to knowing the association between successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in Keetmanshoop District of the //Karas Region, Namibia.

The aim was to assess successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in Keetmanshoop District of the //Karas Region, Namibia. This study suggests that the individual and family level support structures should be intensified and

improved including technical support, competencies and skills associated to TB treatment. Because there is a need for both TB and HIV supportive preventive practices at his level. At the organizational level, critically analyze and synthesize HIV and TB studies including monitoring and evaluating to establish critical issues and indicators that may explain the driving forces of the epidemic and trends. Health systems adapt to people's needs and that the diagnosis of TB and HIV be facilitated by outpatient consultations when appropriate, bringing diagnostic services (including rapid testing) closer to the patients and with due attention paid to airborne infection control measures (WHO, 2020). Although this could be a challenge for health systems with vertical delivery of services, such as having two separate vertical national TB and HIV programmes (WHO, 2020).

However, this will help active TB detection measures and diagnosing latent TB infection in HIV services which will contribute to the early identification of infectious cases, thus preventing the unnecessary exposure to TB for PLHIV and increasing access to effective TB treatment WHO (2020), and increase the TB outcome rate in this cohort. This will inform the healthcare decision makers with findings of the three research questions and hypothesis to place more value in their deliberations and in their interactions with stakeholders for sustainable financing initiatives and management of TB for successful TB outcome rates among these cohort of people.

At societal or policy level, it will help to bring changes in the system of implementation; tailoring of programs and finding the best solutions to TB epidemic control and prevention strategies, which is the most burdensome health problems in the Keetmanshoop District of the //Karas Region. At his level incentives for people coinfected with TB should also be implemented to increase the successful TB outcome rates among TB/HIV coinfected cohort. At national level, national co-ordinating body for collaborative TB /HIV activities should have clear and consensus-based terms of reference (ToR). The important areas of responsibility that

should be considered are: governance and coordination at national and sub-national levels, resource mobilization, provision of general policy and programme direction for the management of activities, capacity-building including training, ensuring coherence of communications about TB and HIV, ensuring the involvement of civil society non-governmental and community organizations, and individuals (Global Health and the Future Role of the United States, 2017).

Also, at national level, develop medium and long-term joint strategic planning to successfully and systematically scale up collaborative TB/HIV activities nationwide and deliver integrated TB and HIV services, preferably at the same time and location with due consideration to prevention of TB transmission, this will increase the successful TB outcome rate and decrease the unsuccessful TB outcome rate.

Correspondingly, at national level strengthen surveillance, surveillance is essential to inform programme planning and implementation WHO (2020), data from this will better inform planning and management of programmes going forward in the future. However, surveys should follow nationally recommended guidelines. The surveillance of active TB disease among coinfected individuals with HIV, whenever feasible, will be useful to inform programmes, and it also affords critically important individual benefits to both people diagnose with TB and those living with HIV, including better access to testing, early case detection and rapid initiation of treatment (WHO, 2020).

Rates of TB among people newly enrolled in HIV care and/or among those initiating ART could be monitored based on analysis of routine programme data. Hence, at the national level, national co-ordinating bodies are needed at all levels of the health system to ensure strong and effective collaboration between TB-control programmes and HIV programmes to offer a platform for co-ordination and synergy among stakeholders. Representation of people at risk of or affected by both diseases is essential to ensure effective implementation of integrated

services and programme success (WHO, 2020). The dually infected TB/HIV patients on ART that have multimorbidity and unsuccesful TB treatment outcome will need patient family centered care. The health managers need to advocate for patient centered care at all healthcare family levels, including the patient, family, and healthcare teams, the patient should be seen and treated holistically. Furthermore, the study showed that unsuccessful TB treatment outcomes in TB /HIV patients on ART was associated with distance, unemployed, and geographic location (residence). The health workers managing patients have to think about these cohorts in planning programs and make sure these cohorts are given appropriate nonclinical care and socio-economic help including incentives at the TB/HIV clinics.

The TB and HIV programs should implement patient health family centered care at the health facility and community levels in line with universal health coverage principles described by WHO under the sustainable development goals. The TB and HIV programs should screen and treat all TB/HIV patients with advanced HIV disease who have other comobidities, cluding GIT, nutritional, respiratory, neurological, and infections, musculoskeletal, renal, cardiovascular, asthma, alcocohol consumption, smoking ciggaretes, using of drugs, and nutritional deficiency.

An estimated 10% of TB deaths are attributable to problematic alcohol use globally. With regards to alcohol has been shown to alter the intestinal absorption of second-line antituberculosis medications, however, the pathway to bioavailability is further complicated by protein binding and first pass metabolism which may also prove to be affected by alcohol use.

Heavy alcohol use impacts retention in care and is associated with missed DOT visits, with one study showing that MDR TB patients who consumed alcohol during treatment on average missed 18 more intensive phase doses (Duraisamy et al., 2014). Additionally, alcohol has been shown to inhibit phagocytic and bactericidal activity of macrophages Liang et al. (2014), decrease the number and function of dendritic cells Jasenosky et al.(2015), and

neutrophils Simet and Sisson (2015), and modulate T cell function Jasenosky et al. (2015), B cells, cytokine production and the interferon gamma pathway, in vitro and in vivo data support the impact of alcohol on the immune system as a biological mechanism for poor TB clinical outcomes in those who drink alcohol.

Furthermore, chronic heavy drinking is associated with inhibition of phagocytosis and decreased production of growth factors amongst innate immune cells in a dose and time dependent manner, suggesting that chronic alcohol use has a greater detrimental effect on the immune response to TB. While these models support the concept that problem alcohol users who consistently take their medications will have worse treatment outcomes than those without problem alcohol use (Meyers et al., 2018).

Another hypothesized biological mechanism to explain the harmful impact of problem alcohol use on TB clinical outcomes is alcohol's influence on the pharmacokinetics (PK) and pharmacodynamics (PD) of TB drugs. A recent meta-analysis concluded that studies with lower default rates did not differ significantly in microbiologic failure, acquired drug resistance, or relapse compared to studies with higher default rates, suggesting that rather than adherence, the bioavailability of antituberculosis medications plays an important role in TB outcomes (Meyers et al., 2018).

While a study of patients with slow clinical response to treatment, failure or early relapse found that alcohol use was associated with higher rifampin serum concentrations (Meyers et al., 2018). A detailed analysis of the PK and PD of all four TB drugs in patients with problem alcohol use will allow for an improved understanding of which TB drugs are most impacted, leading to optimized dosing and treatment duration or possible substitutions for individual drugs that are consistently performing poorly in this population at high risk for resistance and treatment failure. Globally, an urgent need exists to identify modifiable drivers of poor TB treatment outcomes in the Keetmanshoop District and Namibia at large (Meyers et

al., 2018). The TB Treatment and Alcohol Use Study (TRUST) is a tool that can be used, and has two specific aims. The first is to assess whether poor TB treatment outcomes, measured as delayed time-to-culture conversion, are associated with problem alcohol use after controlling for non-adherence. The second aim is to compare the PK of anti-tuberculous medications in those with and without problem alcohol use, and to determine whether these PK changes are associated with delayed culture conversion, higher treatment failure/relapse rates, or with increased toxicity.

TRUST aims to change the approach to optimizing drug dosing for TB, with the potential to improve therapeutics for patients with co-morbid problem alcohol use. For instance, higher doses of isoniazid and rifampin have been demonstrated to be well-tolerated in clinical trials (Pelequine et al., 2017; Kitiyar et al., 2007). Alternatively, if one of the first line drugs is found to consistently underperform, consideration could be given to substituting an alternative TB medication such as a fluoroquinolone; this substitution has been shown to be non-inferior to standard therapy.

TRUST tool may inform blanket regimen modification for problem alcohol users, or tailored modifications based on a risk profile of those at risk of low PK or delayed PD based on prediction model this will increase the succesfull TB outcome rate.Additionally the programs should also endeavor to identify patients who are single, separated, divorced, same sex marriagescohabiting (vat n sit) relationship, students both at secondary and tertiary school, unemployed, those that stay far from the health centres with EPTB, PCD or HIV, and who started ART after TB treatment and ensure they get appropriate care. Sexual contacts of people with HIV may have HIV and TB.

The HIV programs should screen for HIV among all sexual contacts of TB/HV patients, which helps identify new HIV patients early and start treatment before they get TB. Screening household contacts of all TB/HIV patients for TB is already a practice in Namibia that should

continue. Finally, this results can promote social change in TB/HIV coinfected cohorts through better risk assessment, risk stratification, and identify effective surveillance, management strategies and policies to strengthen the control of TB/HIV programs in the Keetmanshoop District.

Conclusion

Low successful TB treatment outcomes remained and continue to be problematic in the Keetmanshoop District over the study period, among the TB-HIV co-infected patients. However, this study contributed to new knowledge, confirmed the findings from previous studies, and presented findings that differed from the findings of other studies about assessment of successful TB treatment outcomes and associated factors in TB/HIV coinfected adult patient on ART treatment.

This study found an overall treatment success rate of 79.5%, which was lower compared to the national average treatment success rate of 87.0% and 90.0% target for WHO, and the target set by Global Plan to Stop TB 2011–2015. Even with a slight improvement, it was below the target set by the WHO. The proportion of patients who died is still considerable. Death, treatment failure, default and loss to follow-up, adverse reaction to TB treatment, marital status, employment status, distance to the health facility and geographical location were found to contributing to the high unsuccessful TB treatment outcome. Based on the existing literature, no TB/HIV study brought out this critical finding. The policymakers and practitioners should use this new knowledge to guide the management of TB among TB/HIV patients on ART to prevent unsuccesfull TB outcomes.

On a positive note is that the overall TB treatment success rate among the TB-HIV co-infected patients in this study was higher compared with many previous studies. Strategies that focus solely on effective case management of TB have not yielded the desired results of reducing TB's burden of disease in Namibia among TB/HIV coinfected patients. There appears

to be a shift in direction per the current TB policy prescriptions as it appears to commit to addressing the structural drivers; however, the projected budgetary allocations towards addressing these specific drivers do not reflect this level of commitment. Thus, funding allocation and other tangible commitments need to be pursued especially in areas related to poverty reduction, unemployment, distance to health care facilities and geographical location and micro-level drivers and socio-economic issues. The findings of this study further suggest the need to rethink current approaches and incorporate interventions that address upstream processes contributing to the persistence of this preventable and curable disease.

All these findings highlight the need for implementation of patient family centered and holistic care at the health facility and community levels. More studies are needed to understand further the individual multimorbidities and risk factors associated with unsuccessful TB outcomes and how patient family centered and holistic care can be delivered to improve successful TB outcomes among TB/HIV patients on ART in //Karas Region of the Keetmanshoop District in Namibia.

Lastly, this study contributes to the already existing body of knowledge with regard to factors that affect TB treatment outcomes. The increased unsuccessful outcome among TB/HIV patients requires urgent public health interventions to improve the evaluation policy and control framework. Prospective cohort studies are necessary to further explore the potentially modifiable predictors of treatment failure.

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Appendix A: Approval Letter to Conduct Research

REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

Ministerial Building
Harvey Street
Private Bag 13198, Windhoek

OFFICE OF THE EXECUTIVE DIRECTOR

Tel: No: 061 -203 2507
Fax No: 061-222 558
Andreas.Shipanga@mhss.gov.na

Ref: 17/3/3/WES
Enquiries: Mr. A. Shipanga

Date: 28 May 2021

Mr. Esland Shilongo
PO Box 4337
Walvis Bay
Namibia

Dear Mr. Shilongo

Re: Assessment of successful TB treatment outcomes and associated factors in TB/HIV co-infected patients in Keetmanshoop District of the //Karas Region, Namibia

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**
   - 3.1 The data to be collected must only be used for academic purpose;
   - 3.2 No other data should be collected other than the data stated in the proposal;
   - 3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
   - 3.4 A quarterly report to be submitted to the Ministry's Research Unit;
   - 3.5 Preliminary findings to be submitted upon completion of the study;
   - 3.6 Final report to be submitted upon completion of the study;
   - 3.7 Separate permission should be sought from the Ministry for the publication of the findings.
4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,

EXECUTIVE DIRECTOR
MINISTRY OF HEALTH AND SOCIAL SERVICES

BEN NANGOMBE
EXECUTIVE DIRECTOR

All official correspondence must be addressed to the Executive Director.

My NAMIBIA MY COUNTRY, MY PRIDE

16165

Appendix B: Safety Yellow Form for Reporting Adverse Drug Reactions and Medicine Use/Product Problems

Republic of Namibia

For reporting ADRs and medicine use /product problems

A. Patient Information TIPC			
Patient identifier(initials/code)		*Sex*	*M_____F_____*
Age at the time of event		*Weight in kgs*	

B. Adverse Event/Product problem/Error (*tick where appropriate)*

1. Event/Reaction		2.Type of Event/Reaction	
Event/Reaction to ARV/TB/ACT/New medicines/Product		*Adverse Event*	
Serious events with other medicines/Products		*Product problem (e.g. defects/malfunctions)*	
		Product use error (e.g. medication error)	

3. Outcomes attributed to adverse event (tick where appropriate)			
Death (Date:_____/_____/_____)		*Disability or Permanent damage*	
Life-threatening		*Congenital anomaly/ Birth defect*	
Hospitalisation/prolonged hospital stay		*Other serious (important medical events)*	
Required intervention to prevent permanent impairment/damage e.g. use of devices		***4. Date of the Event***	
		5. Date of this report	

6. Describe the Event, Product problem or Product use error and Actions taken

7. Relevant tests/Laboratory investigations done (include dates)

8. Other relevant history, including pre-existing medical conditions (allergies, pregnancy, smoking, alcohol use, liver, kidney problems, race etc)

C. Suspect Product (obtain as much information as possible from product label/packaging)

Name		*Dose/amount*	
Strength		*Frequency*	
Manufacturer		*Route*	
Date of use (From/to or best estimate of duration):			
Event stopped after stopping use? (Yes/No)		*Event stopped after dose was reduced?(Yes/No)*	
Event reappeared after reintroduction (Yes/No)			
Lot number	*Expiry date*		

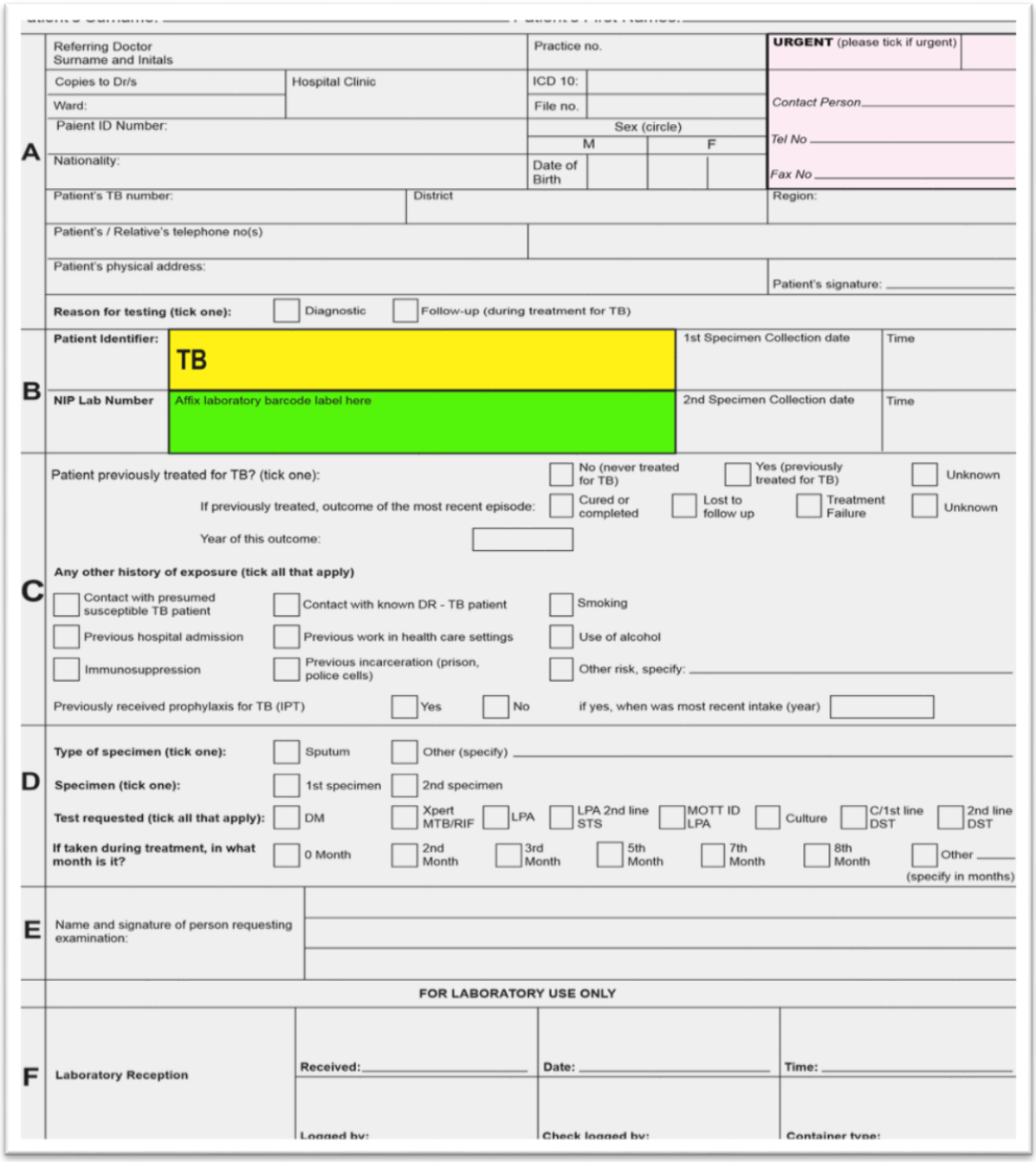
D. Other products taken by the patient within the last 3 months prior to the reaction

Product name 1		*Product name 3*	
Dosage and dates		*Dosage and dates*	
Product name 2		*Product name 4*	
Dosage and dates		*Dosage and dates*	

E. Information about the reporter

Names		*Profession*	
Telephone		*Fax*	
Region		Email	
Health Facility			

Appendix C: Namibian Istitute of Pathology Request Form for Bacteriological examination for TB



A

Referring Doctor Surname and Initals		Practice no.	**URGENT** (please tick if urgent)
Copies to Dr/s	Hospital Clinic	ICD 10:	*Contact Person*
Ward:		File no.	*Tel No*
Paient ID Number:		Sex (circle) M F	*Fax No*
Nationality:		Date of Birth	
Patient's TB number:	District		Region:
Patient's / Relative's telephone no(s)			
Patient's physical address:			Patient's signature:

Reason for testing (tick one): ☐ Diagnostic ☐ Follow-up (during treatment for TB)

B

Patient Identifier:	TB	1st Specimen Collection date	Time
NIP Lab Number	Affix laboratory barcode label here	2nd Specimen Collection date	Time

C

Patient previously treated for TB? (tick one): ☐ No (never treated for TB) ☐ Yes (previously treated for TB) ☐ Unknown

If previously treated, outcome of the most recent episode: ☐ Cured or completed ☐ Lost to follow up ☐ Treatment Failure ☐ Unknown

Year of this outcome: ☐

Any other history of exposure (tick all that apply)

☐ Contact with presumed susceptible TB patient ☐ Contact with known DR - TB patient ☐ Smoking

☐ Previous hospital admission ☐ Previous work in health care settings ☐ Use of alcohol

☐ Immunosuppression ☐ Previous incarceration (prison, police cells) ☐ Other risk, specify: _____

Previously received prophylaxis for TB (IPT) ☐ Yes ☐ No if yes, when was most recent intake (year) ☐

D

Type of specimen (tick one): ☐ Sputum ☐ Other (specify) _____

Specimen (tick one): ☐ 1st specimen ☐ 2nd specimen

Test requested (tick all that apply): ☐ DM ☐ Xpert MTB/RIF ☐ LPA ☐ LPA 2nd line STS ☐ MOTT ID LPA ☐ Culture ☐ C/1st line DST ☐ 2nd line DST

If taken during treatment, in what month is it? ☐ 0 Month ☐ 2nd Month ☐ 3rd Month ☐ 5th Month ☐ 7th Month ☐ 8th Month ☐ Other _____ (specify in months)

E

Name and signature of person requesting examination:

FOR LABORATORY USE ONLY

F

Laboratory Reception	**Received:**	**Date:**	**Time:**
	Logged by:	**Check logged by:**	**Container type:**

Appendix D: New (Modified) TB/HIV Tretment/Tool

Republic of Namibia

Ministry of Health and Social Services

National Tuberculosis and Leprosy Programme

Health facility name:		Health facility code:	District:
Patient NAME:		Patient SURNAME:	Reg No:
Date of birth:	Age:	Sex: ☐ Female ☐ Male	Nationality:
Occupation (current or previous):		Risk category (1)	Phone number:
Physical address:		Diagnosed from: Public/Private (TICK)	Referred from (2):
Name CBTBC organisation:		Name(s) DOT provider(s):	DOT Code:

DOT code: (1) Health facility (2) Workplace (3) Community Health Worker (4) Guardian, neighbour, close relative (5) Other

DIAGNOSTIC CLASSIFICATION

	TB			*EPTB (Specify)*		
	acteriologically positive	Bacteriologically negative	putum not tested	Bacteriologically positive	Bacteriologically negative	Specimen not Done
New						
Previously treated	elapse					
	AF					
	ALFU					
	LO					
Unknown treatment history						

If previously treated number of treatment episodes (4): _____ Year of most recent treatment outcome: _____

PRE-TREATMENT RESULTS

Test	Diagnostic specimen *(tick)*		Result *(tick all applicable)*						ate
	putum	ther *Specify)*							
Xpert *(mandatory)*			o MTB	TB/Rif Sen.	MTB /Rif Res.	MT B/ Rif indeterminate	X pert error results	pert not done	

1st line LPA *(if performed)*			o MTB	TB detected	Rifampicin Sen. Rifampicin Res.	INH Sen. INH. Res.		
2nd line LPA *(if performed)*			o MTB	TB detected	FQN Sen. FQN Res.	Inject. Sen. Inject. Res.		
Culture *(if performed)*			G6W	TB	MOT T	Co ntaminated	Other	

Histology *(if*									

HIV STATUS AND ANTI-RETROVIRAL THERAPY

HIV status: Known HIV status HIV test done at TB diagnosis ted	**Result:** Positive Negative ne		Date tested:
ART: Already on ART Initiated on ART Not	HIV Unique No: _____- - _____		Date initiated:
ART regimen- Before TB treatment: After initiating TB treatment:	**CD4 count: Partner HIV** Latest CD4 count: **Known:** Date: No		**Partner tested:** Yes No
Patient Received TPT before: Yes No	If TPT received , most recent year:		
CPT: Yes No	Diabetic: Yes No own	Tested *te result)*	Date

Transfer in Yes/No Date of diagnosis…….

On TB treatment: Yes / No *(please circle)* Date TB treatment started: …… …...

Date treatment ended……

Date moved to DR TB register: …….

(new modified TB/HIV treatment card continue)

INITIAL PHASE OF THERAPY

Cured	Treatment completed	Treatment failed	Died on Rx	Died before Rx	LTFU before Rx	LTFU on Rx	Not evaluated	Moved to DR TB register

Month/	*Sign with initials for date of DOT or date medicines are collected. Draw a horizontal line for dates that are taken as DOT or Self Administered Treatment (SAT) at home*																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

CONTINUATION PHASE OF TUBERCULOSIS CHEMOTHERAPY

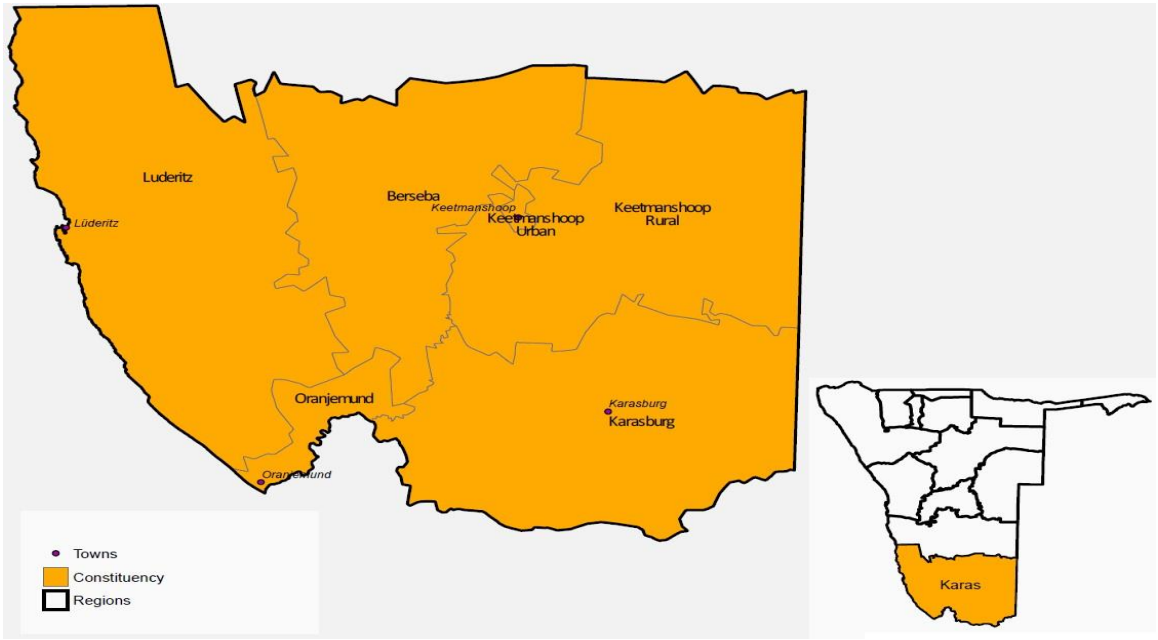
MEDICINES AND DOSAGE	**ADULT**		**H 300mg**		**Pyridoxine 25mg**	
	CHILD		**H 100mg**		**Cotrimoxazole 480mg**	
	R 450mg		**E 400mg**			
	R 150mg		**E 100mg**			

Month/	*Sign with initials for date of DOT or date medicines are collected. Draw a horizontal line for dates that TB medicines are issued for -based DOT.*																													
	1	2	3	4	5	6	7	8	9	1	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

(new TB/HIV treatmen card continue)

TB TREATMENT OUTCOME AND DATE (tick and indicate date of outcome)														
Medicin &	Adult FDC		R 150mg		R 450mg		H 300 mg		E 400mg		S inj. mg			
	Child FDC		Z 400mg		Pyridoxine		H 100mg		E 100mg		Cotrimoxazol 480mg			

Appendix E: //Karas Region MapWith Selected Towns and Villages



Appendix F: Map of Namibian Showcasing Regions and Towns