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A retrospective cross-sectional study investigating the prevalence of syphilis infection among patients tested at a Durban-based Hospital in KwaZulu-Natal.

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ABSTRACT

Background

Syphilis is a sexually transmitted infection (STI) caused by the spirochete *Treponema pallidum*, which can be transmitted congenitally by a pregnant mother to a fetus. Globally, syphilis remains a significant public health challenge due to its high transmissibility and severe complications when untreated, including neurological, cardiovascular, and systemic morbidity. Diagnosis involves the use of non-treponemal tests, including Rapid Plasma Reagin (RPR) and Venereal Disease Research Laboratory (VDRL) assays, followed by confirmatory treponemal tests. Penicillin is the antibiotic of choice, exerting its therapeutic effect by disrupting the bacterial cell wall synthesis.

Aim

To investigate the prevalence of syphilis among patients tested at a Durban-based hospital in KwaZulu-Natal.

Methodology

A retrospective cross-sectional study was conducted using routine laboratory data containing RPR and TPHA results from the National Health Laboratory Service (NHLS) for the period from January 1, 2023, to December 31, 2023. Permission to access and use the data was obtained from the NHLS Academic Affairs and Research Management System (AARMS). A total of 500 patient records were analysed using descriptive statistical methods.

Results

Results revealed that the prevalence of syphilis infection was 24% (122/500) from RPR screening results. Confirmatory TPHA testing showed that syphilis prevalence is highest among females (n=43; 59.7%) and adults aged 18-39 years (n=45; 62.5%), indicating a disproportionate burden among women of childbearing age.

Conclusion

The study disclosed a substantial prevalence of syphilis, with a noteworthy concentration of cases among women of childbearing age (18-39 years), further posing a risk of congenital transmission.

Recommendations

These findings suggest that targeted health interventions, including awareness and prevention programmes, are essential for these high-risk groups. Further studies should involve larger, multi-centre studies across KwaZulu-Natal rather than focusing on a single hospital to provide more representative data.

Keywords: *Syphilis; Sexually transmitted infections; prevalence; venereal, Reactive Plasma Reagin (RPR), Treponema pallidum, Treponema Pallidum Hemagglutination Assay (TPHA)*
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INTRODUCTION

Syphilis, a chronic and debilitating sexually transmitted infection (STI) caused by the bacterium *Treponema pallidum*, remains a persistent global public health challenge (Khaliq *et al.*, 2025). The World Health Organization (WHO) estimates approximately 36.4 million people globally were afflicted with syphilis in 2008, with 12 million new cases emerging annually (WHO, 2024). Syphilis is primarily transmitted through sexual contact and can also be transmitted congenitally from mother to child during pregnancy (Stoltey, 2015; Marinho de Souza *et al*., 2019; Peters *et al*., 2024). Untreated syphilis can lead to severe health consequences, including neurological issues, damage to the nervous system, and congenital syphilis (Shorer *et al.*, 2023; Sengar and Sing, 2024). These complications can have a significant impact on the quality of life of individuals affected, emphasizing the importance of prompt diagnosis and treatment.

The clinical manifestations of syphilis are diverse and can be divided into four stages: primary, secondary, latent, and tertiary (Centers for Disease Control and Prevention, 2025). The primary stage is characterised by a painless chancre that heals spontaneously within 3-6 weeks (Centers for Disease Control, 2025). Without treatment, the infection advances to secondary syphilis, characterised by disseminated rash affecting palms and soles, followed by latent and tertiary stages that may cause irreversible neurological, cardiovascular, and systemic complications (WHO, 2016; Shorer *et al.*, 2023). Laboratory diagnosis relies on a two-step process: non-treponemal screening tests, such as RPR or VDRL, followed by confirmatory treponemal tests, including TPHA (Tuddenham *et al.*, 2020). These tests are essential for confirming the diagnosis and monitoring the response to treatment. Risk factors for syphilis include unprotected sexual activities (Tuddenham *et al.*, 2020), multiple sexual partnerships, injection drug use, and compromised immune systems (Peeling *et al.*, 2017). These factors can increase the likelihood of transmission and acquisition of the infection. While penicillin provides highly effective treatment, the persistence of syphilis reflects ongoing challenges in prevention, screening, and healthcare access (WHO, 2025).

Syphilis prevalence varies substantially across geographic regions and population subgroups. Sub-Saharan Africa bears a disproportionate burden, with prevalence reaching 7.3% among people living with HIV and 10.6% in certain populations in Uganda (Mussa *et al*., 2024; Chitneni *et al.*, 2025). Country-specific estimates range from 0.9% in Tanzania and Zimbabwe to 3.0% in Zambia, with consistently higher rates among HIV-positive individuals (Farahani *et al.*, 2024). Globally, men who have sex with men (MSM) demonstrate elevated prevalence at 7.5%, while pregnant women in Ethiopia show rates of 2.32%, underscoring the need for robust antenatal screening (Geremew *et al*., 2021; Tsuboi *et al*., 2021).

Recent epidemiological trends (2015-2025) reveal an alarming resurgence of syphilis worldwide, particularly among individuals living with HIV, sex workers, MSM, and marginalized populations (Rosset *et al.*, 2025). Congenital syphilis cases have surged in sub-Saharan Africa and Latin America, indicating failures in prevention of mother-to-child transmission programs. In the United States, syphilis incidence increased steadily from 2008 to 2018, with peak prevalence among adults aged 25-49 years (Spicknall *et al*., 2021), suggesting concentration among sexually active populations rather than adolescents. In the Middle East and North Africa, prevalence ranges from 0.48% in the general population to 22.5% among MSM and transgender groups (El-Jamali *et al.*, 2024). Female sex workers in East Africa also have high prevalence rates due to socioeconomic and behavioural factors (Gedfie *et al.*, 2025).

South Africa faces a dual epidemic of HIV and syphilis, with significant implications for maternal and neonatal health. A systematic review by Hussen and Tadesse (2019) reported 2.87% syphilis prevalence among pregnant women in sub-Saharan Africa between 1999 and 2018 (Hussen *et al.*, 2019). More concerningly, a KwaZulu-Natal study identified 3.8% syphilis prevalence among pregnant women, with HIV status emerging as a significant predictor. HIV-positive pregnant women demonstrated 5.6% syphilis prevalence compared to 2.5% among HIV-negative women (Hoque *et al.*, 2021). This dual HIV–syphilis burden emphasizes the urgent need for integrated screening strategies and highlights the heightened vulnerability of pregnant women in regions with high HIV prevalence.

Despite national guidelines promoting dual HIV-syphilis testing in antenatal care, gaps persist in implementation, screening coverage, and timely treatment. KwaZulu-Natal, as the province with the highest HIV burden in South Africa, represents a priority setting for syphilis surveillance and control efforts. However, contemporary facility-level data

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on syphilis prevalence remain limited, hindering targeted interventions and resource allocation.

Retrospective analysis of routinely collected laboratory data provides essential empirical evidence to monitor the effectiveness of current screening programs, identify high-risk demographic groups, and inform evidence-based public health policies. Understanding local prevalence patterns and demographic distributions is fundamental to developing targeted prevention strategies and reducing syphilis-related morbidity, particularly congenital transmission. Additionally, by providing current facility-level surveillance data from an urban South African setting with high HIV prevalence, this research addresses critical knowledge gaps and contributes to the evidence base for strengthening syphilis prevention and control in the region.

This study therefore aimed to: (1) determine the prevalence of syphilis using RPR screening and TPHA confirmatory testing among patients at a Durban-based hospital in KwaZulu-Natal; (2) identify the age groups most affected by syphilis infection; and (3) examine gender-specific differences in syphilis prevalence.

RESEARCH METHODOLOGY

Study design and setting

This retrospective cross-sectional study was conducted at Addington Hospital in Durban, South Africa. The hospital is a state-owned facility, and pathology testing is facilitated by National Health Laboratory Services (NHLS). The study period spanned from January 1, 2023, to December 31, 2023. The review and analysis of extracted data were carried out between June 2024 and November 2024.

Data collection

Data were systematically collected retrospectively from NHLS electronic data records specifically for the hospital. A sample size of 500 patient cases tested for syphilis from the year 2023 was used for analysis, including all genders and ages. The study employed a simple random sampling technique to obtain the sample from the full dataset, ensuring that every record had an equal chance of being selected and reducing selection bias.

Inclusion and exclusion criteria

The study included patients who underwent syphilis testing using RPR and TPHA at Addington Hospital between January 1, 2023, and December 31, 2023, with complete test results available in anonymized format to ensure confidentiality. Cases were excluded if they contained incomplete or missing RPR or TPHA results, were from other years, or were duplicated.

Diagnostic criteria and case selection

For diagnostic criteria, non-treponemal test – the RPR and treponemal test - TPHA were used to screen, detect antibodies to confirm diagnosis, and monitor treatment. The analysed RPR and TPHA data were used to determine the prevalence of syphilis; precisely, RPR was used to report on prevalence, and TPHA was used to report the distribution of confirmed cases according to age and gender. Data were obtained from the Corporate Data Warehouse (CDW) through the application submitted on the NHLS, Academic Affairs Research Management System (AARMS) platform, covering the period from January 1, 2023, to December 31, 2023. The dataset was provided in Excel format without any identifying information to maintain confidentiality. Following ethical approval, a total of 500 patient records were included, and their results were analysed in the study.

Data analysis

Data were anonymised and analysed using Microsoft Excel for all descriptive and data tabulation purposes. The study employed a two-step serological algorithm for case identification and subsequent analysis.

a. Overall syphilis prevalence

To determine overall syphilis prevalence, results of the RPR test were calculated, where the ratio of the number of positive (reactive) RPR results was divided by the total number of patient records included in the study, expressed as a percentage:

Prevalence (%) = (number of positive RPR results/ total number of screened cases) X 100

b. Distribution analysis

The distribution of syphilis cases by age and gender was analysed using the results of the confirmatory test – the TPHA positive test result. This was solely to identify the most affected age group and gender, respectively.

- Stratification by age: confirmed cases were grouped into age categories (0-17 years; 18-39 years; 40-65 years; and >65 years).

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- Stratification by gender: the proportion of confirmed cases separately for male and female patients.

Since the analysis was descriptive (calculating prevalence, frequencies, and percentages), no inferential statistical tests (such as Chi-square or t-tests) were used to determine statistical significance. Results are presented as counts and percentages in the Results section, using tables and figures.

Ethical considerations

The study protocol was reviewed and approved by the Mangosuthu University of Technology Research Ethics Committee (MUTREC) (REF: RD5/26/2024) on 19 February 2024. and NHLS AARMS – Permission number PR2448953. Patient personal details were kept confidential to ensure ethical conduct of the research, including anonymity and privacy. No consent form was required for the study, as it was a retrospective type, and no patient contact was involved. Data was only accessible to the principal investigator and research supervisors; moreover, the collected data was used solely to fulfil the objectives of the study.

RESULTS

This section summarizes the results consequential from the retrospective dataset, highlighting the overall prevalence of syphilis and distribution across age and gender.

Participant Demographics

Demographically, among the 500 study participants, 333 (66.6%) were females, and 167 (33.4%) were males (Table 1). In brief, participants were predominantly aged 18–39 years (n = 223) and 40–65 years (n = 218). Females constituted the majority across most age categories, while the 0–17-year age group showed equal representation between sexes. While the study relied on routine laboratory data from a public hospital, the available demographic information was partial and did not include socioeconomic status. Nevertheless, published evidence indicates that public hospitals predominantly serve individuals from lower-income or uninsured groups. National data show that the majority of South Africans utilise public health facilities as their primary point of care and that medical aid coverage remains low, underscoring the public sector's role in serving financially marginalised populations (Statistics SA, 2023a; Statistics SA, 2024b; OECD, 2020; Statista, 2025).

Table 1: Participants' demographic characteristics

Age Groups	Number of Patients	Gender Distribution	
		Females	Males
0-17 years	10	5	5
18-39 years	223	159	64
40-65 years	218	133	85
>65 years	49	36	13
Total (Percentage)	**500 (100%)**	**333 (66.6%)**	**167 (33.4%)**

Prevalence of syphilis

To determine the prevalence of syphilis among patients tested at a hospital in Durban, the total number of positive cases was numerated against the total n=500 sample size. The results are shown in Figure 1, which shows the frequency of participants with syphilis as reported through RPR screening results.

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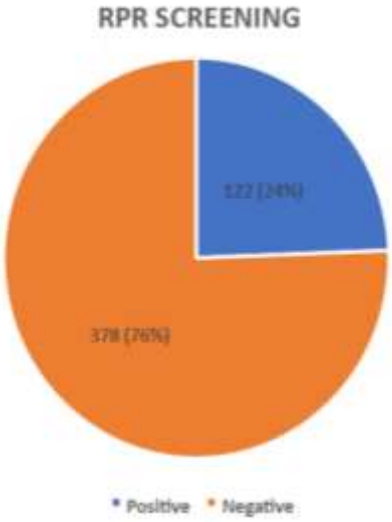

Figure 1: Prevalence of syphilis according to the RPR screening test.

Since RPR testing is performed as a screening test, and confirmation of the infection is achieved through TPHA testing, which involves serological analysis of the disease, the researchers continued to establish the definitive prevalence of syphilis cases based on the confirmatory results. The results are expressed in Figure 2.

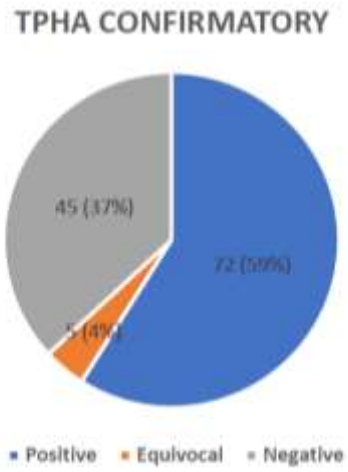

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Figure 2: TPHA results showing positive, equivocal, and negative results from the positive cases of the screening test procedure.

Distribution of syphilis cases according to age groups

After determining the prevalence of syphilis, the study further sought to identify the commonly affected age groups using TPHA confirmatory testing results. This was achieved by distributing the positive cases of the infection across different age groups: 0-17 years, 18-39 years, 40-65 years, and 65 years and above. Results are expressed in Figure 3.

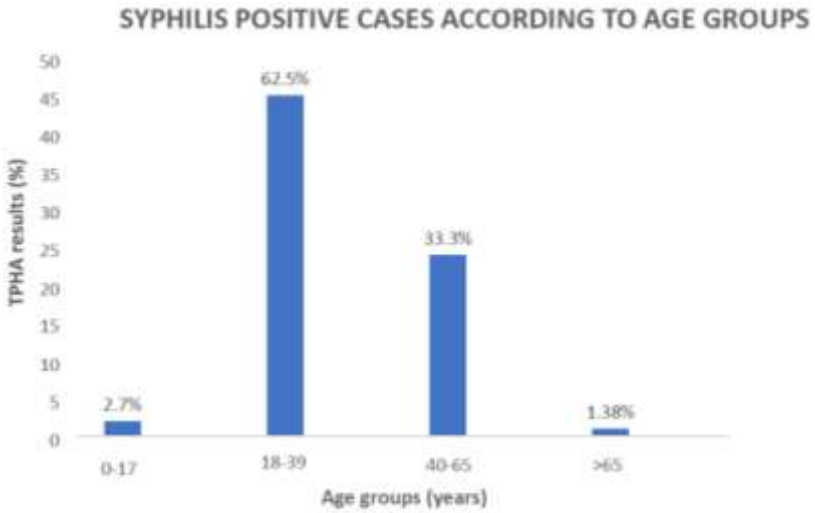

Figure 3: Distribution of confirmed positive syphilis results according to age groups.

Distribution of syphilis cases according to gender

Since syphilis is a sexually transmitted infection, comparing females and males to establish the gender with the most positive cases was essential as part of our study objectives. Two genders were compared using confirmed syphilis results as extracted from TPHA confirmatory testing data. Results are illustrated in Figure 4.

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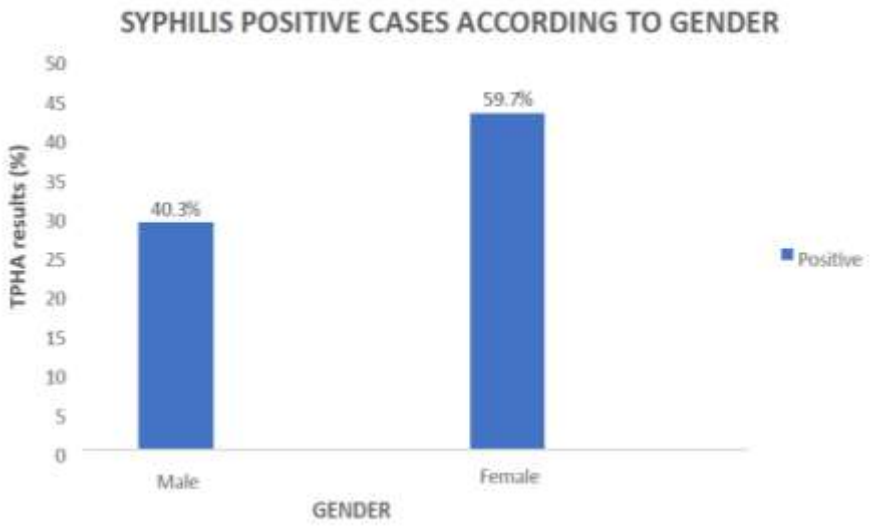

Figure 4 presents the distribution of syphilis infection by gender.

DISCUSSION AND ANALYSIS OF FINDINGS

This section interprets the study results, explores potential explanations for observed prevalence patterns, and evaluates their implications within the context of current screening and management strategies for syphilis.

Prevalence of syphilis

Among 500 individuals tested, as shown in Figure 1, 122 (24%) had a reactive result, indicating the presence of antibodies that suggest a syphilis infection. In contrast, 76% (n = 378) tested non-reactive, indicating the absence of detectable antibodies. These individuals are unlikely to have syphilis. Confirmatory testing using TPHA revealed that 72 of the 122 RPR-reactive individuals (59.01%) were positive for syphilis, whereas 45 (36.88%) tested negative, and 5 (4%) had equivocal results requiring further evaluation.

The results relate to the Malawian study by Singongo *et al*. (2024), which reported the syphilis prevalence of 4.9% and an incidence rate of 14.4 per 1,000 person-year, indicating that syphilis remains transmissible within communities. This sustained transmission specifies justification for the higher prevalence of 24% found in the present study, implying that certain populations may encounter higher exposure.

The observed prevalence underscores the utility of RPR as a cost-effective screening tool, particularly in resource-limited settings. However, its non-specific nature necessitates confirmatory testing with TPHA, which offers higher specificity for *Treponema pallidum* Egglestone *et al.*, 2000). This two-tiered approach aligns with global best practices for syphilis diagnosis and management (Kojima *et al*., 2018).

Distribution of syphilis cases according to age

The distribution of syphilis cases (Figure 3) among 72 individuals confirmed positive through TPHA results showed a significant variation across four age groups. The 18-39 years age group had the highest number of positive cases, accounting for 62.5% (n=45) of the total positive cases. This age group was followed by the 40-65 years age group, which had a notable number of positive cases, making up 33.3% (n=24) of the total. In contrast, minimal positive cases were observed in the 0-17 years (n = 2, 2.7%) and 65 years and above (n = 1, 1.4%) age groups.

Age remains a vital factor in syphilis prevalence across various populations. Age also plays a critical role in syphilis epidemiology. Younger adults, especially those aged 20–29, consistently show higher infection rates, largely due to risky sexual behaviours such as inconsistent condom use and multiple partners (Mundim de Oliveira *et al*., 2024). One

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study reported peak prevalence in the 25–34 age group (7.4%) and a secondary peak among older adults aged 60–90 (7%) (Mundim de Oliveira *et al*., 2024). These patterns suggest that while younger individuals are at greatest risk, older adults remain susceptible, possibly due to changes in sexual activity and inadequate protection. Conversely, in Nigeria, the highest rates of syphilis were observed in the elderly populations, where the 60-69 age group (11,1 %), followed by the 50-59 age group (2,7 %), tested positive for the disease (Chidi *et al*., 2024). Syphilis is common among older adults, particularly those aged 60 and above, likely due to reduced condom use or prolonged exposure to sexual risk factors. Overall, there is an indication that syphilis is not limited to conventionally high-risk younger populations; older adults also endure a significant burden. This highlights the necessity for age-comprehensive screening and prevention approaches that target differing risk profiles.

According to the study that was conducted by Mundim de Oliveira *et al* (2024), the age group most impacted by syphilis during pregnancy among Brazilian women was between 20 and 29 years old. Similar trends were observed in locations such as Macaé (Rio de Janeiro) and Americana (São Paulo), based on secondary data from the Municipal Epidemiological Surveillance (Gomes *et al.*, 2019). It is believed that this age group tends to engage in higher-risk sexual behaviours, such as having multiple partners, which increases the likelihood of infection transmission. This indicates that younger expectant women remain a significant risk group for syphilis, displaying behavioural and social influences that impact transmission. In essence, this highlights the need for directed educational awareness and coherent antenatal screening among women of childbearing age.

Distribution of syphilis cases according to gender

Figure 4 presents the distribution of syphilis infection by gender as confirmed by TPHA confirmatory positive syphilis results (n = 72). Categorically, results were analysed to determine the most affected gender. Clear gender differences were observed. Female participants exhibited a higher prevalence, with 59.7% (n = 43) testing positive compared to 40.3% (n = 29) among males.

These findings align with previous research indicating that women, particularly those of reproductive age or attending antenatal care, are disproportionately affected by syphilis. Precisely, studies from Ethiopia have reported a higher syphilis prevalence among women (3.6% in urban women and 1% in rural women) (Arega *et al.*, 2025). Contributing factors include increased risk of vertical transmission during pregnancy, limited healthcare access in rural areas, and socio-cultural influences that heighten vulnerability among women.

While women often exhibit higher prevalence in certain contexts, global evidence suggests that syphilis is frequently more common among men, particularly men who have sex with men (MSM), due to higher rates of unprotected sexual activity and multiple partners (Kojima *et al*., 2018). Recent studies report prevalence rates of 7.5% in men compared to 4.3% in women (Mundim de Oliveira *et al*., 2024), highlighting the complex interplay of behavioural, biological, and social determinants.

Across Sub-Saharan Africa, gender and age significantly influence syphilis prevalence. A meta-analysis of 44 studies estimated an overall prevalence of 2.87%, with men generally showing higher rates than women (Kojima *et al.*, 2018). However, regional variations exist, with East and Southern Africa reporting elevated prevalence among high-risk groups such as incarcerated individuals (WHO, 2016). These findings underscore the importance of tailoring public health interventions to demographic and contextual factors.

In summary, studies display syphilis prevalence as strongly associated with gender and age, with men and younger adults often experiencing the highest rates, although women remain disproportionately affected in certain settings. Contrarily, based on gender, females in the present study were mostly infected with the disease. These variations highlight the need for targeted, context-specific interventions to effectively address syphilis transmission and improve health outcomes.

Generalizability of the study findings:

This study utilized retrospective data from a single health system within KwaZulu-Natal, which may limit generalizability to other regions or populations. Factors such as healthcare access, socio-economic status, and cultural practices can influence syphilis prevalence and testing uptake. While the sample size (n=500) provides valuable insights, it may not fully capture variations across rural and urban settings or among high-risk groups such as MSM and commercial sex workers.

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Conclusion

This study, conducted at Addington Hospital, aimed to determine the prevalence of syphilis and identify the demographic groups most affected. Findings revealed a high prevalence among young adults aged 18–39 years (62.5%) and a greater burden among females compared to males. As syphilis is on the rise, strengthening screening programs, particularly for adolescents and young adults, is critical. There is a need for more studies to be conducted to address the growing public health challenge posed by syphilis.

Study limitations

Since this study was limited to a single hospital, the results cannot be applied to other settings. Additionally, the retrospective nature of the study limits the ability to draw causal conclusions. The study relied on routinely collected laboratory data, which restricted access to detailed clinical, behavioural, and socio-economic information that may influence syphilis risk. Consequently, factors such as sexual behaviour patterns, healthcare access, and socio-economic status could not be assessed.

Recommendations

The study recommends the implementation of awareness campaigns and providing self-testing kits for adolescents to reduce syphilis prevalence and mitigate its associated health risks. Future research should broaden its geographic scope by including data from multiple provinces to capture more comprehensive epidemiological trends. Longitudinal studies are needed to monitor syphilis incidence over time and evaluate treatment outcomes. Additionally, incorporating behavioural and socioeconomic data such as sexual practices, income levels, and healthcare access will help identify key risk factors and inform targeted interventions. Exploring co-infection patterns with HIV and other sexually transmitted infections is essential for developing integrated screening and management strategies that address overlapping health risks. To enhance external validity, future studies should utilize multi-centre data and stratify analyses by geographic location, socio-demographic characteristics, and behavioural risk profiles. Larger, more diverse populations across multiple healthcare facilities are needed to validate these findings and strengthen generalizability.

Implications for Screening and Management

The observed prevalence patterns emphasise the need for targeted screening strategies, particularly for sexually active young adults and women of reproductive age. Integrating syphilis testing into routine antenatal care and sexual health programs remains critical for reducing transmission and preventing adverse outcomes such as congenital syphilis. Additionally, interventions addressing behavioural risk factors among MSM and older adults should be prioritised.

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Conflict of interest

The author declares no conflict of interest.

Data Availability Statement

The data analysed in this study were obtained from the National Health Laboratory Service Academic Affairs Research Management System under permission number PR2448953. Due to patient privacy and confidentiality requirements, the raw data cannot be made publicly available.

Author Biography

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Author Contributions

Nomzamo Minenhle Ndebele was responsible for data collection, cleaning, and analysis, and prepared the initial draft of the manuscript. Phumzile Yvonne Sikosana and Khethiwe Nomcebo Bhengu provided supervision and critically reviewed manuscript drafts through to the submission stage.

List of Abbreviations

AARMS: Academic Affairs Research Management System
CDW: Corporate Data Warehouse
HPCSA: Health Professions Council of South Africa
HIV: Human Immunodeficiency Virus
KZN: KwaZulu-Natal
MSM: Men who have sex with men
NHLS: National Health Laboratory Service
SA: South Africa
STI: Sexually Transmitted Infection
TPHA: Treponema pallidum haemagglutination
WHO: World Health Organization
VDRL: Venereal Disease Research Laboratory

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