AN AUDIT OF ADULT VACCINATION IN HIV-POSITIVE PATIENTS ATTENDING A TERTIARY CENTRE HIV CLINIC.

BY

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DECLARATION

I, Mitchell Tanaka Muchichwa, declare that this research report is my own, unaided work. It is being submitted in partial fulfilment of the requirements for the Degree of Master of Science in Medicine (Field of Vaccinology) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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ABSTRACT

Background: People living with HIV (PLWH) have a greater risk of acquiring vaccine preventable diseases (VPDs) and of developing severe disease due to impaired immune responses. The risk of acquiring VPDs among PLWH is greater in adults aged 15-49 years as a result of common infections found in occupational, social and travel settings. At the same time, studies have demonstrated low vaccination coverage among this population. For this reason, international and local guidelines for the vaccination of HIV-infected adults have been drawn up to address challenges in immunization in the HIV setting. However, there is little evidence on the compliance to these guidelines and on the knowledge and attitudes of PLWH to vaccination for VPDs.

Aim: The aim of the study was to investigate vaccination uptake, knowledge, and acceptance of vaccination among PLWH.

Methodology: In-depth interviews and retrospective file reviews among PLWH attending the Charlotte Maxeke Johannesburg Academic Hospital HIV Clinic over a 1-month period.

Results: Among the 107 PLWH who were recruited and interviewed, it was found that 24.3% had received at least one vaccine following their HIV diagnosis. The majority of participants (76.6%) had a history of tuberculosis (TB), which was the most common vaccine-preventable disease among the sample. Influenza vaccination had the highest uptake rate at 76.9%. Overall, 65% of participants believed that vaccines could prevent diseases, while 41.1% thought vaccines were harmful. Interestingly, 56% did not believe that vaccines worsened their HIV condition. Furthermore, 67.2% of participants expressed their willingness to accept a vaccine if it was recommended by their healthcare provider. The most significant factors associated with vaccine uptake were awareness of the influenza vaccine and the willingness to accept a vaccine after a recommendation.

Conclusion: Our study revealed poor adherence to the vaccination guidelines for PLWH in South Africa. Only four vaccines against influenza, hepatitis B, shingles and pneumococcal diseases had been taken and commonly known among this population.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral Therapy
BHIVA	British HIV Association
CDC	Centres for Disease Control and Prevention
CFR	Case Fatality Rate
CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
EACS	European AIDS Clinical Society
HAART	Highly Active Antiretroviral Therapy
HAV	Hepatitis A virus
HBV	Hepatitis B Virus
HIV	Human Immunodeficiency Virus
HIVMA	HIV Medicine Association
HPV	Human Papillomavirus
HZ	Herpes Zoster
IMD	Invasive Meningococcal Disease
IPD	Invasive Pneumococcal Disease
LMIC	Low- and Middle-Income Country
MMR	Measles – Mumps – Rubella
MSM	Men who have Sex with Men
MSW	Men who have Sex with Women
PCV	Pneumococcal Conjugate Vaccine
PLWH	People Living with HIV
SAHCS	South African HIV Clinicians Society

Tdap	Tetanus-Diphtheria- acellular Pertussis
VPD	Vaccine Preventable Disease
WHO	World Health Organization

1 CHAPTER ONE: BACKGROUND AND LITERATURE REVIEW

1.1 Background

Viral and bacterial diseases, despite many being vaccine preventable, continue to be significant contributors to morbidity and mortality among People Living with HIV (PLWH) (1,2). HIV is characterized by a gradual depletion of CD4+ T cells, cytokine dysregulation, and eventually immune dysfunction (3). As a result, PLWH have an increased risk of contracting opportunistic infections caused by viral, bacterial, and fungal pathogens encountered during daily life, which are often vaccine preventable (4). According to the World Health Organization (WHO), Vaccine Preventable Diseases (VPDs) are responsible for an estimated 1.5 million deaths among children annually (5). In the United States (US), it was found that approximately 40,000 to 50,000 adults die from VPDs each year (6)

This emphasises the utmost importance of consideration of vaccination against VPDs in PLWH, as the burden of HIV among adults remains a significant concern. The WHO estimated that 39 million people were living with HIV worldwide, in 2022, with the majority of these cases occurring among adult women (20.0 million) and men (17.4 million) aged 15 years and above (7). The burden of the epidemic has varied between regions, with countries such as South Africa (SA) housing one of the highest numbers of HIV cases (7.8 million) globally (8). At the same time, southern African countries, contribute significantly to the global burden of VPDs, accounting for approximately 34% of VPD cases in this region (9).

The challenge of VPDs continues to result in a substantial economic and clinical burden for many individuals worldwide. This burden has been shown to be unequally distributed, with at-risk populations suffering a greater deal (4). However, there is limited information on the level of compliance with, or knowledge and acceptance of, vaccination among PLWH, particularly in South Africa, which remains the epicentre of the HIV pandemic.

1.2 Epidemiologic burden of VPDs

A few studies have documented a significant decline in the burden of VPDs after the introduction of vaccines in the 20th century (10-12). Countries such as the US and China have experienced a 99% reduction in the incidence of diseases for some of the vaccines that have been recommended within their borders (11,12). This has led to a shift in disease burden, with a considerable number of VPD cases now reported among individuals who are immunocompromised (4,11). A systematic review conducted in the US revealed that the

prevalence of VPDs among at-risk populations ranged from 1.1% to 68.7%, with certain VPDs posing greater challenges than others (4).

Hepatitis B Virus (HBV) is recognized as one of the most prevalent VPDs among PLWH due to shared routes of transmission (1,13). A recent study conducted in 2022 revealed that approximately 2.6 million PLWH are currently infected with HBV, with the highest burden observed in sub-Saharan Africa (14). In South Africa, the prevalence of HBV among PLWH ranges between 0.4% and 23% (15). Only a few studies have reported a decrease in HBV infection among PLWH (16,17). For instance, a Korean study conducted in 2020 observed a decrease in HBV/HIV coinfection from 8.8% to 0% (16). Similarly, a Taiwanese study conducted in 2018 demonstrated a decrease in HBV prevalence from 16% to 4% among the population with HIV (17). However, it is important to note that these declines were primarily attributed to the introduction of universal HBV vaccination, rather than the direct vaccination of PLWH. Despite these efforts, evidence suggests that HBV remains a significant challenge for PLWH, with an estimated prevalence 20 times higher in this group than the general population (14,15).

Earlier studies from more developed countries had suggested that the use of Highly Active Antiretroviral Therapy (HAART) had resulted in dramatic reductions in opportunistic infections, such as Invasive Pneumococcal Disease (IPD) (18,19). This was demonstrated in a study conducted by Heffernan et al. (2005), which showed a 57% decline in IPD across all age groups among PLWH, following the introduction of HAART (18). In contrast, recent literature has clearly indicated that HIV remains a risk factor for IPD, despite the use of and adherence to HAART (20-22). A surveillance study conducted in South Africa by Nunes et al. (2011), found an increase in IPD incidence among HIV-infected women aged 25-44 years, with no impact of the antiretroviral treatment program observed on the burden of IPD (22). They also discovered that the risk of IPD in adults with HIV was consistently 33–34 fold greater compared to healthy adults throughout the study period. These findings were corroborated by another surveillance study in South Africa conducted by Meiring et al. (2016), which revealed that the incidence of IPD in HIV-infected individuals receiving treatment is 43 times higher than their uninfected counterparts (52 per 100 000 vs 1 per 100 000) (23).

Similarly, PLWH have twice the risk of morbidity and mortality from Human Papilloma Virus (HPV) than the general population. This increased risk is particularly significant in women (24). Although cancers caused by HPV are rare in the male population (approx. 1 per 100 000),

their incidence is elevated in HIV-infected men who have sex with women (MSW) (30 per 100 000) and even higher in HIV-infected men who have sex with men (MSM) (>100 per 100 000) (25). Wei et al. (2021), and other researchers, have shown a rising trend of HPV-related cancers among PLWH in both genders (25,26). These findings highlight the importance and necessity of HPV vaccinations in this population.

Interestingly, the association between HIV and susceptibility to meningococcal infections has been debated across different countries. Earlier studies, particularly those from Africa reported a lack of association between HIV and the risk of meningococcal infections (27,28). Contrasting findings were observed in another study conducted by Cohen et al. (2010) in South Africa, which showed that PLWH had an 11-fold higher risk of meningococcal disease compared to individuals without HIV (29). These results were further supported by a surveillance study conducted in New York, which found that the incidence of Invasive Meningococcal Disease (IMD) among PLWH was 3.4 cases per 100 000 persons, whereas it was only 0.34 cases per 100 000 persons among people without HIV (30). However, unlike the study by Cohen et al. (2010), this study reported a lower mortality rate among PLWH, with a Case Fatality Rate (CFR) of 10%, whereas Cohen and colleagues had reported a CFR of 20% among PLWH (29). Therefore, further studies are necessary to quantify the morbidity and mortality associated with meningococcal disease among PLWH.

In Africa, there are limited data on the burden of shingles among PLWH (15). Developed countries have observed a decrease in the overall incidence of shingles (4). A systematic review conducted in 2016 revealed that studies from sub-Saharan Africa, Asia, and Latin-America reported a decline in the incidence of shingles from 9.4% to 2.3% after ART initiation (31). Similar trends were observed for diphtheria, pertussis, and tetanus (32). However, the true burden of diphtheria, pertussis, and tetanus among PLWH remains unknown globally due to weak or absent surveillance systems.

1.3 Vaccination Coverage among PLWH

According to the WHO, vaccination is one of the simplest, safest, and most cost-effective public health measures that could be used to protect children, adolescents, and adults against harmful diseases and save an estimated 2.5 million lives annually (33).

Through analysis of current literature, it is difficult to infer trends in vaccination rates across studies, due to different study designs, modes of data collection, and varying study populations.

The most nationally representative study on hepatitis B vaccination, conducted in the United States, revealed that only 1 in 10 individuals living with HIV received the HBV vaccine within a year of ongoing HIV care. Additionally, over one third of patients receiving HIV care had not been vaccinated against HBV (34). A Texas study published in 2023 corroborated these findings, indicating that only 9% of PLWH had completed the full series of the HBV vaccine (35). Conversely, two studies conducted in Brazil and the United Kingdom (UK) reported slightly higher vaccination rates for the HBV vaccine among PLWH, with rates of 67.4% and 58.2%, respectively (36,37). This disparity may be attributed to the fact that both Brazil and the UK have free and universal healthcare systems that include comprehensive vaccination programs (38,39). In contrast, the healthcare system in the United States is more fragmented, with significant variations in access to medical aid and insurance coverage (40).

Research has illustrated the same for HPV vaccine coverage, with only one national study conducted in Mexico, which reported very high rates (90.1%) of the HPV vaccine among adults living with HIV compared to those not living with HIV (41). However, these results were not statistically significant ($p < 0.05$), indicating that the high rates may have been attributed to chance. Other studies have demonstrated low HPV vaccination rates (42,43) For instance, a multi-centre cohort study conducted in Canada among women attending HIV care found that only 13.2% of adult women had started HPV vaccination, and only 7.1% had completed the recommended three-dose series (44). Comparing HPV vaccine uptake rates is further complicated by the fact that vaccination efforts have primarily targeted young girls (45).

Significant variations in vaccination uptake have been observed for the influenza vaccine, with coverage rates ranging from 6.7% in newly diagnosed PLWH to 64% in middle-aged and older HIV patients (46,47). Countries such as Austria (11.9%) and Denmark (31.0%) have reported low uptake rates in the past 5 years, while countries such as Brazil (71.8%) and Germany (77%) have reported very high uptake rates (48-51). On the other hand, vaccine uptake against pneumococcal and meningococcal infections has been relatively low among PLWH (48,51,52). The highest coverage rate reported for the pneumococcal vaccine was 64.6% in a French study, while the lowest vaccination rate was found to be 4.4% among PLWH in a recent Danish study (48,52). The uptake rates for the meningococcal vaccine among PLWH have not been reported above 55% (51,53).

Similarly, a global HIV cohort consisting of 7,770 PLWH revealed that the uptake of COVID-19 vaccines varied significantly (54). Countries such as the US (72%), followed by Peru (69%),

and Brazil (63%), were the countries with the highest COVID-19 vaccination rates among PLWH in 2021. However, countries such as South Africa (18%), Uganda (3%), and Haiti (0%) were the countries with the lowest COVID-19 rates among PLWH in the same year (54).

Data for the vaccination rates of the separate or combined vaccines against tetanus, diphtheria, and pertussis among PLWH are lacking globally. One study conducted in Belgium, which examined vaccination coverage among at-risk groups, found that 30.3% of PLWH were vaccinated against diphtheria-tetanus and 3.5% were vaccinated against pertussis (55). Live viral vaccines, including measles-mumps-rubella, varicella, and zoster, are generally contraindicated for PLWH, and are only recommended to adults with CD4+ T cell counts above 200 cells/mm^3 This may explain the low coverage rates of measles vaccine reported in this population. In Brazil, two separate studies conducted by Ho et al. (2008), and Cunha et al. (2016), among PLWH receiving outpatient care, reported that only 3.47% and 16.2% of adult patients with HIV, respectively, received the MMR vaccine (36,50).

International and local guidelines have been developed to address the low vaccination rates among PLWH. These guidelines recommend essential vaccines that have been proven to be safe and effective for this population in various settings (15,56,57). These guidelines also emphasise the importance of healthcare worker collaboration in decision-making regarding vaccinating HIV-infected individuals (1,15).

1.4 Vaccination Guidelines

Internationally, evidence-based guidelines have been published since the early 2000s by advisory groups such as the WHO, which designed a protocol that could be used as a basis for developing national guidelines for various countries, depending on the epidemiological data in those regions (58). In 2015, the British HIV Association (BHIVA) published guidelines, that highlighted the use of new vaccines at that time against HPV, shingles (herpes zoster) and pneumococcus (57). Key updates were also related to the use of hepatitis B, meningococcal, and pertussis vaccines (57). Similarly, guidelines were issued by US-based organizations such as the US Centers for Disease Control and Prevention (CDC) and the HIV Medicine Association of the Infectious Disease Society of America (HIVMA). These guidelines provided recommendations for the use of influenza vaccine, Tdap vaccine, pneumococcal vaccine, meningococcal conjugate vaccine, hepatitis B vaccine, HPV vaccine, MMR and varicella vaccine for those with CD4 cell counts that are greater than 200 cells/mm^3 (59). Additionally,

in 2005, the European AIDS Clinical Society (EACS) published guidelines tailored for the European region. The published guidelines are similar in many of the recommendations for inactivated vaccines (56). Live vaccines have generally been contraindicated, and priority has been given to common VPDs in the region such as measles, *Haemophilus influenzae* type B, pertussis, and tetanus.

In 2018, the South African HIV Clinicians Society (SAHCS) published guidelines for the vaccination of HIV-positive adolescents and adults in South Africa (15). So far, these remain the only known guidelines published in the African region and include similar recommendations to those of the international guidelines. The guidelines advise individuals to receive vaccinations for influenza, pneumococcal disease, meningococcal disease, HPV, tetanus, diphtheria, and pertussis. Additionally, the guidelines also recommend vaccinations for hepatitis A and B, as well as live vaccines such as measles-mumps and rubella (15). However, there are some variations in the pertussis vaccine recommendations compared to the international guidelines. While the international recommendation suggests pertussis vaccination for adolescents and adults who have been in contact with a pertussis case and pregnant women living with HIV, regardless of their CD4 cell counts (56,57), the SA guidelines only recommend the pertussis vaccine for pregnant women living with HIV (15). Additionally, the SA guidelines do not recommend the zoster vaccine for PLWH due to limited epidemiological data supporting its use in Africa (15). In contrast, some international guidelines suggest the zoster vaccine for PLWH who have CD4 cell counts above 200 cells/mm³ (57,59).

1.5 Predictors of Vaccination

The reasons for the low vaccination rates among PLWH reported in many countries are likely multifactorial. A study investigating self-reported vaccination coverage in Germany found that only 1 in 5 participants reported full adherence to vaccination guidelines, while half (50%) had received at least one dose of each vaccine recommended (51). In that study, CD4 cell count had the strongest association to vaccine uptake, with CD4 cell count above 200 cells/mm³ being associated with higher vaccination coverage (51). These results were corroborated in a study conducted by Johnson et al. (2021), which found that participants with CD4 cell counts less than 200 cells/mm³ were approximately 9-fold less likely to be up to date on all vaccinations compared to those with CD4 cell counts above 200 cells/mm³ (60).

Several studies have demonstrated that many PLWH do not take vaccines due to lack of knowledge, awareness, or guidance from healthcare providers (50,51,55). Such predictors were strongly expressed in a cross-sectional survey at university hospitals in Belgium that revealed that amongst at-risk patients, adults living with HIV had the lowest vaccinations rates against pertussis (3.5%) and hepatitis B (24.2%) compared to patients with other chronic illnesses. However, they had slightly higher vaccination rates for diphtheria/tetanus and influenza at 30.3% and 43.8%, respectively (55). The reasons for low vaccination rates among the participants included lack of information (38%), forgetfulness (29%), unawareness of recommendations (89%), and not seeing the necessity (6%) (55). A study assessing the uptake and acceptability of COVID-19 vaccines among PLWH in Uganda found that 90.5% of participants reported that they trusted information about vaccination from their healthcare providers rather than other sources of information (62).

Subsequently, concerns about the safety and efficacy of vaccines among PLWH are still noted by some authors. In the UK, a study revealed that 23% of PLWH refused the influenza vaccine due to fear of adverse events (63). Other authors argue that vaccine recommendations are often based on data from clinical trials that exclude PLWH (64,65). However, several studies conducted in the post-ART era have shown no evidence of serious disease progression or triggers in loss of HIV viral load control due to vaccines (1,66,67). A large multicentre study of more than 30,000 HIV patients found no long-term negative effects on CD4 counts, HIV RNA levels, or disease progression after influenza vaccination. It was revealed that patients not receiving ART may experience slight increases in HIV viral loads and reductions in CD4 counts, but these have often normalized 2-6 weeks after vaccination (66).

The degree of immunosuppression constitutes an additional barrier to vaccination among PLWH. According to a study by Kerneis et al. (2014), vaccine-induced antibodies may wane faster in this vulnerable group than in the general population (68). An efficacy trial on the pneumococcal vaccine (PCV7) supported these findings by demonstrating that the vaccine efficacy of PCV7 was 85% among patients with HIV; however, this decreased to 25% in the first-year post-vaccination, which is not typical for healthy individuals (69). The study did not explore the interaction between the vaccine and ART, as the results were observed in both groups of patients, those on ART and those not on ART. Additionally, patients with CD4 cell counts below 200 cells/mm^3 were found to be at the highest risk for IPD in that study. Another study investigating the PCV7 vaccine among patients with HIV, noted that those receiving ART had achieved a more durable and highly functional immune response as compared to the ART-

naïve patients nine months after PCV7 administration (67). Vaccines provide either a full or partial protective effect, depending on disease progression (1). A review exploring the recommended vaccines among PLWH highlighted that patients with severe immune degradation (e.g. CD4 < 200 cells/mm³) exhibit the weakest responses to VPDs. It was suggested that administering vaccines soon after early HIV diagnosis would be ideal (1).

2. CHAPTER TWO: PROBLEM STATEMENT AND RATIONALE

2.1 Problem Statement

Sub-Saharan Africa, particularly Southern Africa, remains the region most affected by the HIV epidemic, accounting for 45% of the world's HIV cases (70). PLWH face an elevated risk of contracting VPDs, which can lead to further health complications and ultimately result in death (2,15,22,23,44,60,71,72,73,74). Several studies have emphasized the absence of data regarding the burden of VPDs among PLWH (4,36,47). Without this essential data, efforts and interventions directed at increasing vaccination and reducing morbidity and mortality among the population living with HIV, remain inadequate.

2.2 Rationale for the study

Vaccination of individuals with HIV has demonstrated remarkable efficacy in preventing severe or life-threatening illnesses associated with VPDs. This not only benefits the individuals themselves, but also has positive impacts on the overall population (4,76). By reducing the incidence of VPDs and their associated morbidity and mortality, vaccination leads to fewer treatment courses, shorter hospital stays, and decreased productivity loss (4). In light of these significant advantages, guidelines for vaccinating HIV-infected individuals have been established. However, there is limited information on the level of compliance, knowledge, and acceptance of vaccination among PLWH, particularly in South Africa, which remains the epicentre of the HIV pandemic.

The few studies that evaluated use of the guidelines are international investigations and they have indicated low vaccination rates among this population (1,60). Compliance with immunization guidelines among adults can be difficult to evaluate. However, if prioritized, barriers to receiving recommended vaccines among PLWH would be better understood and used to inform evidence-based strategies towards the fight against VPDs in PLWH.

2.3 Research Question

What is the uptake, knowledge, and acceptance of vaccination among adults living with HIV in South Africa?

2.4 Study Aim

The aim of the study was to investigate vaccination uptake, knowledge and acceptance of vaccination among PLWH.

2.5 Study Objectives

i) To explore a history of previous VPDs and a history of vaccination against relevant VPDs.

ii) To determine the knowledge and acceptance of vaccination.

iii) To explore the self-reported history of COVID-19 infection and vaccination history against COVID-19.

iv) To explore the association between vaccine uptake and the knowledge of vaccination, acceptance of vaccination and the patient demographics.

3. CHAPTER THREE: METHODOLOGY

3.1 Study design

For this study, a prospective cross-sectional audit and retrospective file review was conducted. The prospective component included patient interviews that provided self-reported information about the demographics, as well as vaccine uptake, knowledge, and acceptance among the participants. The retrospective file reviews enabled the verification, comparison, and coherence of crucial medical information, including HIV monitoring results and medical history, which were self-reported. Both interviews and file reviews were conducted throughout all operating days of the patient clinic from 01 June 2023 to 30 June 2023.

The research was conducted at the Infectious Disease Clinic situated in the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) in Parktown. CMJAH is one of the tertiary teaching hospitals located in the central Johannesburg area of the Gauteng Province. Gauteng is the most urbanized province in South Africa, with more than 94% of its population residing in urban areas (77). It has the fifth highest provincial prevalence of HIV, which stands at 17.6%, with the burden being highest among adolescent girls and young women, who account for 35% of HIV infections (78)

The CMJAH HIV Clinic serves as a referral facility for individuals residing in Johannesburg. Annually, the clinic accommodates an estimated 1800 patients seeking regular consultations, prescriptions, and routine monitoring (79).

3.2 Study population

The chosen participants were adults aged 18 years and older, encompassing all genders, who had been diagnosed with HIV/AIDS. These participants were approached during their designated waiting periods for consultation or the retrieval of medication. Once consent was obtained, an examination of their medical records was conducted either before or after the interviews took place. A comprehensive written consent was mandatory, and participants were required to be able to comprehend English, Zulu, or Tswana. Patients who were unable to provide consent or expressed their unwillingness to continue participating during the interviews were excluded from the study.

3.3 Sampling strategy

On average the Infectious Disease clinic receives approximately 60 - 80 patients a day, with some days accommodating TB patients with or without HIV. A convenience sampling method was employed to select potential participants, who were approached randomly and assessed for eligibility. Prior to the interview, patients willing to participate were provided with an information sheet and consent form (Appendix I), which outlined the study's purpose and time commitment. The interviews took place in a private consulting room or another secluded area, away from any queues, and lasted no longer than 10 minutes per participant. Over the course of one month, a total of 107 participants were recruited and interviewed, resulting in a daily recruitment rate of five or more patients.

3.4 Data collection

An interview guide was developed, based on a list of questions used in several vaccination coverage studies among adolescents and adults; this guide was then adapted to suit the current adult patient population (36,43,48,51,55,80,81). (Appendix II). The interview guide was reviewed and approved by the Human Research Ethics Committee (HREC). Following approval at the study site, the interview guide was pre-tested. The pre-test was conducted on two patients, two days before the start of data collection. The purpose of the pre-test was to assess the clarity and feasibility of the consent process, the duration of the interviews, and the overall comprehension of the questions and answers required.

The questions were mostly quantitative, encompassing a range of multiple-choice options. The questionnaire included questions pertaining to socio-demographic characteristics, medical and disease history, vaccination status, reasons for vaccination and non-vaccination, as well as knowledge-related information. A distinct section was incorporated to assess the insights and coverage of the COVID-19 vaccine among this population. HIV infection has been shown to be a risk factor for severe COVID-19 infection. Hence, it is crucial to examine the COVID-19 vaccination records and infection history of PLWH.

Information from the interviews was initially recorded on paper and subsequently entered into REDCap (Research Electronic Data Capture). REDCap is an online software for building and managing surveys and databases online. It requires authorised users and supports the confidentiality of data. The documented interview forms and consent forms have been securely stored in cabinets and will be retained for a duration of three year.

3.5 Data analysis

Data analysis was conducted using the STATA software version 17. Descriptive statistics were computed to fulfil objectives one, two, and three. In the case of continuous variables, the mean and standard deviation (SD) or the median and interquartile range (IQR) were determined. For categorical variables frequencies were listed, the total number and percentage of characteristics were calculated according to the availability of information. All the data were presented in tabular form.

The associations between the independent variables and vaccine uptake were tested to achieve objective four. This analysis was done using the t-tests for numeric variables and the chi-square test or fisher's exact test for categorical variables. A significance level of 5% was applied to all values, and the analysis was considered statistically significant if the p-value was less than 0.05. Additionally, logistic regression models were employed to further investigate associations and determine the probability of the outcome occurring. Odds ratios (OR) were calculated with 95% confidence intervals (CI). Similarly, statistical significance was considered when the p-value was less than 0.05, and only those variables meeting this criterion were included in the multivariable logistic regression analysis.

3.6 Ethical considerations

The research was approved by the University of the Witwatersrand Human Research Ethics Committee (Medical) under the reference number M221136 (Appendix III). The approval for conducting the study at the research site was also granted by the Head of Internal Medicine and the Chief Executive Officer at CMJAH (Appendix IV).

4 CHAPTER FOUR: RESULTS

4.1 Descriptive statistics of PLWH attending a tertiary centre clinic.

A total of 110 individuals provided their consent to participate in the interviews. Two participants had incomplete interviews and one experienced a sudden lack of interest, resulting in a total of 107 respondents. Most of the respondents were female, accounting for 67.3% of the total. The mean age of the participants was 47 ±10.43 years. In terms of education, the highest level attained by the respondents was secondary education, with 72.9% of them having reached this level. Overall, 18 individuals (16.8%) had completed tertiary education, while 11 (10.3%) had only completed primary education. More than half of the respondents (54.2%) reported being unemployed, and 95 (88.8%) had at least one child. Most of the respondents (83.2%) self-identified as heterosexual, while only 6 individuals (5.6%) reported being homosexual. These data are shown in Table 4.1.

The largest proportion of respondents (58.7%) had been living with HIV for a duration of between 11 to 20 years. Only 31 respondents (29.3%) were aware of their current viral load, and 12 (11.3%) were aware of their CD4 cell counts. According to the available records, CD4 cell counts were accessible for a total of 81 participants. Among those with available data, 26 participants (32.1%) had CD4 cell counts below 200 cells/mm³. An equivalent number of participants (32.1%) had CD4 cell counts ranging between 200 cells/mm³ and 500 cells/mm³, while the remaining individuals (35.8%) had CD4 cell counts above 500 cells/mm³. Regarding the HIV viral load, data was obtainable for 97 participants. Out of these, 74 individuals (76.3%) had an undetectable viral load of less than 50 copies/mL, while 14 participants (14.4%) had a viral load below 500 copies/mL. Additionally, 9 participants had a viral load above 500 copies/mL. It is worth noting that 106 respondents (99%) confirmed that they were undergoing antiretroviral therapy (ART) and had initiated it promptly or shortly after their diagnosis. However, only 38 respondents (36.2%) reported to be aware of the specific ART medication they were taking. These data are shown in Table 4.2.

In relation to a history of comorbidities, the most prevalent diagnosis was tuberculosis, which was found among 82 of the respondents, accounting for 76.6% of the sample. Shingles and hepatitis B were identified as the most frequent VPDs, occurring in 17% and 15% of the participants, respectively. Other VPDs, such as pneumonia and meningitis, were less common, affecting less than 10% of the respondents. Only 7 individuals (6.6%) had ever acquired

influenza that required hospital admission. Chronic hypertension was present in 31 respondents (30.1%), chronic kidney disease in 13 (12.8%), and diabetes in 10 (9.6%), with other chronic conditions occurring in less than 10% of the participants. The clinical characteristics of the study population are shown in Table 4.2.

The analysis focused on the outcome variable in two distinct groups: the vaccinated group and the unvaccinated group. The participants categorized as vaccinated were individuals who had received at least one adult vaccine recommended to them after their HIV diagnosis.

Table 4.1: Demographic characteristics of all study participants (n= 107)

Variables	Level	Total Cohort = 107		Vaccinated =26		Unvaccinated =81		P-value
		n	% / SD	n	% / SD	N	% / SD	
Age	(years)	47	±10.43	47.69	9.39	47.43	10.800	0.9125
Gender	Female Male	72 35	67.3% 32.7%	23 3	88.5% 11.5%	49 32	60.5% 39.5%	0.008
Education	Primary Secondary Tertiary	11 78 18	10.3% 72.9% 16.8%	2 17 7	7,7% 65.4% 26.9%	9 61 11	11.1% 75.3% 13.6%	0.299
Employment status	Employed Unemployed	49 58	45.8% 54.2%	13 13	50.0% 50.0%	36 45	44.4% 55.6%	0.621
Have Children	Yes No	95 12	88.8% 11.2%	26 0	100% 0.0%	69 12	85.2% 14.8%	0.036
Live with children	Yes No	63 31	67.0% 33.0%	18 8	69.2% 30.8%	45 23	66.2% 33.8%	0.778
Sexual Orientation	Heterosexual Homosexual Bisexual Prefer not to say.	89 6 1 11	83.2% 5.6% 0.9% 10.3%	21 1 0 4	80.8% 3.9% 0.0% 15.4%	68 5 1 7	83.9% 6.2% 1.2% 8.6%	0.704

Vaccinated= having received at least one recommended vaccine after HIV diagnosis
SD= Standard deviation
P-values were obtained by the Student's t-test, Pearson's X^2 and Fisher's exact test

Table 4.2: Clinical Characteristics of all study participants

Variables	Level	Total cohort = 107		Vaccinated =26		Unvaccinated =81		P-value
		n	%	n	%	n	%	
HIV duration	1 year and less 2 to 10 years 11 to 20 years 21 to 35 years	4 27 61 12	3.9% 26.0% 58.7% 11.5%	1 4 15 6	3.9% 15.4% 57.7% 23.1%	3 23 46 6	3.9% 29.5% 59.0% 7.7%	0.127
Knowledge of own viral load	Yes No	31 75	29.3% 70.8%	12 14	46.2% 53.9%	19 61	23.8% 76.3%	0.029
Knowledge of own CD4 cell count	Yes No	12 94	11.3% 88.7%	6 20	23.1% 76.9%	6 74	7.5% 92.5%	0.067
Last CD4 cell count/ mm^3	<200 200-500 >500	26 26 29	32.1% 32.1% 35.8%	5 9 5	26.3% 47.4% 26.3%	21 17 24	33.9% 27.4% 38.7%	0.269
Last viral load /mL	undetectable <500 >500	74 14 9	76.3% 14.4% 9.3%	14 8 1	60.9% 34.8% 4.4%	60 6 8	81.1% 8.1% 10.8%	0.010
Antiretroviral therapy	Yes No	106 1	99.1% 0.9%	26 0	100% 0.0%	80 1	98.8% 1.2%	1.000
Knowledge of ART medication name	Yes No	38 67	36.2% 63.8%	15 11	57.7% 42.3%	23 56	29.1% 70.9%	0.009
History of vaccine preventable conditions, TB and PCP/PJP	TB Pneumonia PCP/PJP Shingles Meningitis Hepatitis B Influenza Cervical cancer	82 9 5 18 8 16 7 3	76.6% 8.6% 4.8% 17.1% 7.6% 15.1% 6.7% 2.9%	17 1 1 3 2 3 2 1	65.4% 3.9% 3.9% 11.5% 7.7% 11.5% 7.7% 4.2%	65 8 4 15 6 13 5 2	80.2% 10.1% 5.1% 19.0% 7.6% 16.3% 6.3% 2.6%	-

Chronic medical Conditions	Hypertension	31	30.1%	9	34.6%	22	28.6%	
	Diabetes	10	9.6%	4	15.4%	6	7.7%	
	Asthma	3	2.8%	1	3.9%	2	2.6%	-
	COPD	3	2.9%	1	3.9%	2	2.6%	
	Heart failure	9	8.7%	2	7.7%	7	9.1%	
	Kidney disease	13	12.8%	1	3.9%	12	15.8%	
	Cancer	3	2.9%	1	3.9%	2	2.6%	

Vaccinated= having received at least one recommended vaccine after HIV diagnosis
ART, antiretroviral therapy; CD4, clusters of differentiation 4; COPD, chronic obstructive pulmonary disease; HIV, human immunodeficiency virus; PCP/PJP, *Pneumocystis jirovecii* pneumonia; TB, tuberculosis
P-values were obtained by the Pearson's X^2 and Fisher's exact test.

4.2 Knowledge/history and acceptance of vaccination

It is noteworthy that majority (56.7%) of the participants indicated a lack of awareness regarding the names of vaccines administered to children. Conversely, 45 respondents (43.3%) demonstrated knowledge of one or more names of vaccines administered to children. Out of the total respondents, 81 individuals (75.7%) possessed knowledge regarding receiving of childhood vaccinations either at birth or during subsequent years of childhood and 26 respondents (24.3%) lacked awareness of having received any childhood vaccinations. Only 26 out of the respondents (24.3%), reported having received at least one adult vaccine after HIV diagnosis. On the other hand, 81 participants (75.7%), had never received any adult vaccines following HIV diagnosis. Among those who had received at least one adult vaccine, the influenza vaccine had the highest uptake rate at 76.9%, followed by the hepatitis B vaccine at 19.2%. The shingles vaccine and pneumococcal vaccine were both only taken by one participant, each accounting for 4% of the total. No other adult vaccines were reported to have been taken.

Overall, 64 of the respondents (59.8%) reported to be aware of the influenza vaccine recommended to PLWH. Furthermore, 18 respondents (16.8%) were aware of the measles/mumps/rubella (MMR) and shingles vaccines as recommended vaccines and 15 (14.0%) were aware of the hepatitis B vaccine recommended for them. The remainder of recommended vaccines were known by less than 10% (Table 4.3).

Table 4.3: Knowledge/ history and acceptance of vaccination (n=107)

		Total cohort=107		Vaccinated = 26		Unvaccinated = 81		
Variables	Levels	n	%	n	%	n	%	P- Value
What childhood vaccinations are you aware of?	None 1 or more	59 45	56.7% 43.3%	10 15	38.5% 57.7%	49 30	60.5% 37.0%	0.053
Are you aware of having received any childhood vaccinations?	Yes No	81 26	75.7% 24.3%	21 5	80.8% 19.2%	60 21	74.1% 25.9%	0.489
Have you received any vaccine since being diagnosed with HIV (apart from COVID-19)	Yes No	26 81	24.3% 75.7%	-	-	-	-	-
Which adult vaccines have been received?	Influenza Hepatitis B Shingles Pneumococcal	20 5 1 1	76.9% 19.2% 3.8% 3.8%	-	-	-	-	-
Those aware of the following vaccines in adults	Pneumococcal Influenza Hepatitis B HPV M/M/R TDaP Shingles	5 64 15 4 18 6 18	4.7% 59.8% 14.0% 3.7% 16.8% 5.6% 16.8%	1 23 6 0 0 0 4	3.9% 88.5% 23.1% 0.0% 0.0% 0.0% 15.4%	4 41 9 4 18 6 14	4.9% 50.6% 11.1% 4.9% 22.2% 7.4% 17.2%	1.000 0.001 0.190 0.570 0.006 0.332 1.000
Do you think getting vaccinated is harmful to your body?	Yes No I don’t know	29 44 34	27.1% 41.1% 31.8%	7 14 5	26.9% 53.9% 19.2%	22 30 29	27.2% 37.0% 35.8%	0.217
Do you think getting vaccinated against disease will help to prevent that disease?	Yes No I don’t know	69 16 21	65.1% 15.1% 19.8%	16 4 6	61.5% 15.4% 23.1%	53 12 15	66.3% 15.0% 18.8%	0.881
Do you think that getting a vaccine could worsen your HIV?	Yes No I don’t know	18 60 29	16.8% 56.1% 27.1%	2 15 9	7.7% 57.7% 34.6%	16 45 20	19.8% 55.6% 24.7%	0.296

Have you ever been advised by your Dr/nurse to get vaccinated?	Yes No	30 76	28.3% 71.7%	14 12	53.9% 46.2%	16 64	20.0% 80.0%	0.001
If yes, Which vaccines have been recommended to you?	Influenza Hepatitis B Shingles Pneumococcal COVID-19	18 6 4 1 5	62.1% 20.7% 13.8% 3.5% 20.7%	-	-	-	-	-
If your DR/ nurse recommended a vaccine, would you accept it?	Yes No Not sure	72 17 18	67.3% 15.9% 16.8%	23 2 1	88.5% 7.7% 3.9%	49 15 17	60.5% 18.5% 20.9%	0.031
Which factors would affect your decision to vaccinate?	-Knowledge of vaccine	73	68.2%	18	69.2%	55	67.9%	0.899
	-Fear of side effects	54	50.5%	9	34.6%	45	55.6%	0.063
	-Availability of vaccine	21	19.6%	7	26.9%	14	17.3%	0.282
	-Family discussions	9	8.4%	4	15.4%	5	6.2%	0.216
	-Cost	30	28.0%	8	30.8%	22	27.2%	0.722
	-Mainstream media	28	26.2%	9	34.6%	19	23.5%	0.260
	-Social media	14	13.1%	4	15.9%	10	12.4%	0.741

Vaccinated= having received at least one recommended vaccine after HIV diagnosis
HPV, human papilloma virus; MMR, measles, mumps and rubella; TDaP, tetanus diphtheria, acellular pertussis
P-values were obtained by the Pearson's X^2 and Fisher's exact test.

Regarding knowledge and acceptance of vaccination, 29 respondents (27.1%) thought that getting vaccinated was harmful to their body. A total of 44 respondents (41.1%) did not think so and 34 (31.8%) did not know whether vaccines were harmful to their body. Interestingly, 69 of the respondents (65.1%) believed that getting vaccinated against a disease would help to prevent infection from that disease, as compared to 16 of the participants (15.1%) who believed that getting a vaccine will not prevent infection from that disease and 21 (19.8%) did not know.

More than half (56%) of the participants held the belief that getting a vaccine would not worsen their HIV, while 29 respondents (27.1%) did not know, and 18 respondents (16.8%) thought that getting a vaccine could worsen their HIV. Only 30 respondents (28.3%) reported receiving

advice from their healthcare provider to get vaccinated. Among those who received such advice, 18 respondents (62.1%) were advised to receive the influenza vaccine, six respondents (20.7%) were advised to get the hepatitis B vaccine, four respondents (13.8%) the shingles vaccine, five respondents the COVID-19 vaccine, and one respondent was advised to receive the pneumococcal vaccine. Among the entire sample, 72 respondents (67.3%) expressed their willingness to accept a vaccine if it was recommended by their healthcare provider. Conversely, 17 respondents (15.9%) indicated they would refuse to receive a vaccine even after such a recommendation, while 18 respondents (16.8%) remained uncertain about their decision.

In relation to the factors affecting decisions to vaccinate, the most frequently cited factor influencing the decision to vaccinate was knowledge/awareness of the vaccine, as reported by 73 of the participants (68.2%), while 54 respondents (50.5%) identified the fear of potential side-effects as another significant factor influencing their decision. The findings further revealed that cost (28%) and mainstream media (26%) were also influential factors impacting the decision to vaccinate, these results are shown in Table 4.3.

4.3. Knowledge/history and acceptance of COVID-19 vaccination

As illustrated in Table 4.4, a mere 32 participants (29.9%) acknowledged having experienced a COVID-19 infection, while the remaining 73 individuals (68.2%) claimed to have never contracted the disease. Notably, the findings revealed that a greater proportion of COVID-19 infections were reported by females (19%), in comparison with males (11%). Furthermore, a total of 69 respondents (64.5%) disclosed having received the COVID-19 vaccine, while 38 individuals (35.5%) had not yet been vaccinated. Higher vaccination rates were reported among females (39%), as opposed to males (25%).

Among the individuals who were vaccinated, 20 respondents (30.8%) stated that they had received the J & J vaccine, while 37 (56.9%) reported having received the Pfizer vaccine. Approximately 1% of the participants received the AstraZeneca and Moderna vaccines, and 10.5% were uncertain about the type of vaccine received. The majority (60%) of those vaccinated with the J&J vaccine only received one dose, while 40% received two or more doses. For the Pfizer vaccine, only 13.5% received one dose, while 86% received two doses or more. Participants who received the AstraZeneca and Moderna vaccines both received two doses or more.

Around half of the respondents (52.2%) experienced side effects from the vaccines, as reported by 36 participants. The most commonly reported side effects were headache (28%), fatigue (26%), drowsiness (26%), and muscle pains (17%). Furthermore, the most frequently reported reasons for getting vaccinated against COVID-19 were self-protection (65%) and work obligation (11%). On the other hand, among those who had not received any COVID-19 vaccines, the highest reported factor for not vaccinating was the fear of side effects (47.4%) (Table 4.4).

Table 4.4: Knowledge/history and acceptance of COVID-19 vaccination

Variables	Level	N (%)	Male / Female (Yes)	N (%)
Have you ever had COVID-19?	Yes No I don't know	32 (29.9%) 73 (68.2%) 2 (1.9%)	Male Female	12 (11.2%) 20 (18.7%)
Have you been vaccinated against COVID-19?	Yes No	69 (64.5%) 38 (35.5%)	Male Female	27 (25.2) 42 (39.3%)
If yes, which vaccines?	J&J Pfizer AstraZeneca Moderna Not sure	20 (30.8%) 37 (56.9%) 1 (1.5%) 1 (1.5%) 10 (14.5%)	-	-
How many received one dose of the vaccine?	J&J Pfizer AstraZeneca Moderna	12 (60%) 5 (13.51%) 0 (0.0%) 0 (0.0%)	-	-
How many received two vaccines or more?	J&J Pfizer AstraZeneca Moderna	8 (40%) 32(86%) 1(100%) 1(100%)		
Did you experience any side effects?	Yes No	36 (52.2%) 33 (47.8%)	Male Female	9 (8.4%) 27 (25.2%)
Which side effects were experienced?	Headache Arm pain Muscle pain Chills	10 (28.6%) 3 (8.8%) 6 (17.1%) 4 (11.4%)	-	-

	Fever Fatigue Drowsiness Nausea Lack of appetite	2 (5.7%) 9 (25.7%) 9 (25.7%) 2 (5.7%) 2 (5.7%)	-	-
What influenced you to vaccinate?	Self-protection Work obligation Fear of death Social Pressure Protection of others	42 (64.6%) 7 (10.8%) 3 (4.6%) 4 (6.2%) 3 (4.6%)		
What influenced you not to be vaccinated?	Fear of side effects No reason No trust Religious Not aware	18 (47.4%) 9 (23.7%) 6 (15.8%) 1 (2.9%) 2 (5.7%)	-	-

4.4 Association between vaccine uptake and the demographics in the sample of PLWH

There was no significant difference in the mean ages of respondents who had and had not received adult vaccinations recommended to them (47.69 ± 9.39 vs 47.43 ± 10.800, p = 0.9125). The chi-square test for association revealed significant association between vaccine uptake and gender (p=0.008) (Table 4.1), knowledge of viral load (p=0.029), as well as knowledge of ART medication (p=0.009) (Table 4.2). There were no significant associations between vaccine uptake and employment status (p=0.621), living with children (p=0.778) (Table 4.1), and last CD4 cell count (p=0.269) (Table 4.2). To test for associations among variables with low cell counts, the Fisher's exact test was used. Significant association was observed between vaccine uptake and whether the patients had children (p=0.036) (Table 4.1), and also the last viral load measure (p=0.010) (Table 4.2). The same test showed no significant association between vaccine uptake and education level (p=0.299), sexual preferences (p=0.704) (table 4.1), HIV duration (p=0.127), and knowledge of CD4 cell count (p=0.067) (Table 4.2).

4.5 Association between vaccine uptake and the knowledge and acceptance of vaccination

Table 4.3 demonstrates significant associations between vaccine uptake and the awareness of specific adult vaccines, namely the influenza vaccine (p=0.001) and the MMR vaccine (p=0.006). No significant association was found between vaccine uptake and the knowledge of

one or more childhood vaccines (p=0.053), knowledge of receiving any childhood vaccines (p=0.489), awareness of the pneumococcal vaccine (p=1.000), hepatitis B vaccine (p=0.190), HPV vaccine (p=0.570), Tdap vaccine (p=0.332), and shingles vaccine (p=1.000) administered to adults. Additionally, no significant association was observed between vaccine uptake and the perceived knowledge regarding the potential harm caused by vaccines (p=0.217), perceived knowledge of whether vaccines prevent disease (p=0.881), and perceived knowledge of vaccines' potential to worsen HIV infection (p=0.296) (Table 4.3).

In relation to the acceptance of vaccination, significant association was identified between vaccine uptake and the recommendation of a vaccine by a medical professional (p= 0.001), as well as the acceptance of a vaccine following a recommendation (p=0.031). However, no significant association was observed between vaccine uptake and other factors that could potentially influence individuals' decision to vaccinate (Table 4.3).

4.6 Logistic Regression models for associations

In a logistic regression analysis, variables with many missing values were adjusted and restricted to avoid a wider range of confidence intervals leading to an untrusted estimate of the odds ratio. The factors strongly associated with vaccine uptake are shown in Table 4.5. A recorded viral load of less than 500 copies/mL had the strongest association for receiving an adult vaccine after diagnosis with HIV (OR 10.67, 95% CI 1.03- 109.94) (p = 0.047) compared to those with a viral load above 500 copies/mL. Although there is a wide confidence interval, the odds ratio was significant, most likely because the sample size of this research was quite small, so it would be likely that the results with the highest Odds ratios would have wide confidence intervals because there's less data to accurately estimate the parameter. Participants who were female were 5 times more likely to receive an adult vaccine as compared to the male participants (95% CI 1.38 – 18.06) (p= 0.014). Additionally, those with no knowledge of their viral load were 0.36 times less likely to a receive an adult vaccine compared to those with knowledge of their viral load (95% CI 0.14 – 0.92) (p = 0.032). Similarly, participants with no knowledge of their ART medication were 0.30 times less likely to receive an adult vaccine compared to those with knowledge of their ART medication (95% CI 0.12 – 0.75) (p = 0.010).

Awareness of the influenza vaccine was significantly associated with a higher likelihood of receiving an adult vaccine (OR 7.48, 95% CI 2.08 – 26.89) (p = 0.002) in comparison to individuals who were unaware of the recommended influenza vaccine. The absence of a

recommendation from a healthcare professional was significantly associated with a lower likelihood of receiving an adult vaccine (OR 0.21, 95% CI 0.08 – 0.55) (P =0.001) when compared to receiving a recommendation from a healthcare professional to get vaccinated. Additionally, individuals who were uncertain about accepting a vaccine after receiving a recommendation had a lower likelihood of receiving an adult vaccine (OR 0.12, 95% CI 0.01 – 0.10) (P = 0.05) in comparison to those who were willing to accept an adult vaccine after receiving a recommendation (Table 4.5).

Table 4.5: Associations between vaccine uptake, knowledge/ acceptance of vaccination and the demographics in a univariable and multivariable logistic regression model of a sample of PLWH.

Vaccine Uptake	Unadjusted OR	P-value	[95% CI]	Multivariate aOR	P-value	[95%CI]
Gender						
Male	RC					
Female	5.00	0.014	1.38 – 18.06	3.03	0.119	0.75-12.19
Knowledge of Viral load						
Yes	RC					
No	0.36	0.032	0.14 – 0.92	0.60	0.379	0.19-1.85
Last Viral Load /mL						
>500	RC					
Undetectable	1.87	0.571	0.21 – 16.16	-		
<500	10.67	0.047	1.03 – 109.94	-		
Knowledge of ART name						
Yes	RC					
No	0.30	0.010	0.12 – 0.75	0.54	0.256	0.18-1.57
Awareness of the influenza vaccine						
No	RC					

Yes	7.48	0.002	2.08 – 26.89	4.14	0.041	1.06-16.17
Advised by Dr/nurse to get vaccinated						
Yes	RC					
No	0.21	0.001	0.08 – 0.55	3.74	0.014	1.31-10.68
If recommended a vaccine, would you accept it?						
Yes	RC					
No	0.28	0.113	0.06 – 1.35	-		
Not sure	0.12	0.050	0.01 – 0.10	-		

RC= Reference Category
Unadjusted OR = Odds ratios and P-values were derived using logistic regression models, has not been adjusted to account for other predictor variables to vaccine uptake.
Multivariate aOR = Odds ratios and P-values were derived using logistic regression models, adjusted for gender, knowledge of viral load, Knowledge of ART name, awareness of influenza vaccine, advised by DR/nurse to get vaccinated

The multivariate analysis incorporated significant variables. The findings revealed a significant association between awareness of the influenza vaccine and the probability of receiving an adult vaccine (odds ratio [OR] 10.49, 95% confidence interval [CI] 1.07 – 102.15) (p=0.041). Again, the wide confidence interval may have been attributed to the sample size. Furthermore, it was observed that a recommendation from a healthcare professional was significantly linked to receiving an adult vaccine (OR 3.74, 95% CI 0.00 – 0.44) (p=0.014). Gender, knowledge of viral load, and knowledge of ART medication did not exhibit a significant association with receiving an adult vaccine (Table 4.5).

4.7 Comparison between self-reported estimates and medical record results of clinical characteristics

Among the 107 participants, the clinic-recorded viral load was documented for 97 participants, only 31 participants indicated that they were aware of their viral load and provided a result. Out of the 31 participants that self-reported a viral load result, the clinic-recorded viral load was not documented for 2 participants. Due to the absence of clinically documented results for 2 participants, the analysis and comparison of medical records could only be carried out for 29 participants who self-reported their viral load. Among the 27 participants who reported having

an undetectable viral load, 21 (77.8%) accurately reported it, while 6 (22.2%) incorrectly claimed to have an undetectable viral load. Out of the 2 participants who reported a viral load below 500 copies/mL, 1 (50%) accurately reported it, while 1 (50%) mistakenly self-reported having a viral load below 500 copies/mL. None of the participants accurately reported having a viral load above 500 copies/mL. This implies that a total of 22 (75.9%) participants accurately reported their viral load, while 7 (24.14%) of participants incorrectly reported their viral load (Table 4.6).

Table 4.6: Accuracy of self-reported viral load results

Self-reported latest viral load= 31	Clinic-record viral load (latest result available to participant) = 97			
	Undetectable n (%)	<500 n (%)	>500 n (%)	**Total** n (%)
Undetectable	21 (72.4%)	3 (10.3%)	3 (10.3%)	27 (93.1%)
<500/ mm³	1 (3.4%)	1 (3.4%)	0 (0.0%)	2 (6.9%)
>500/ mm³	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	22 (75.8%)	4 (13.8%)	3 (10.3%)	29 (100%)

A total of 81 CD4 cell counts were documented in the clinical records, with only 12 participants reporting awareness of their most recent CD4 cell count and providing a result. Out of the 12 participants who provided their CD4 cell counts, one participant did not have a clinic recorded CD4 cell count documented. As a result, the analysis was conducted among 11 participants. Only, 1 (9.0%) participant accurately self-reported a CD4 cell count below 200 cells/mm³. Among the 5 participants who reported a CD4 cell count between 200-500 cells/mm³, 2 (18.2%) correctly reported the result while 3 (27.2%) incorrectly stated that their CD4 cell count fell within that range. Among the 5 participants who reported a CD4 cell count above 500 cells/mm³, 4 (80%) accurately reported the result while 1 (20%) incorrectly claimed to have a CD4 cell count above 500 cells/mm³ (Table 4.7).

Table 4.7: Accuracy of self-reported CD4-cell count results.

Self-reported CD4 cell count/mm³ =12	Clinic-recorded CD4-cell counts (latest result available to participant) = 81			
	<200	200-500	>500	Total
<200	1 (9.0%)	0 (0.0%)	0 (0.0%)	1 (9.0%)
200-500	3 (27.2%)	2 (18.2%)	0 (0.0%)	5 (45.5%)
>500	0 (0.0%)	1 (9.0%)	4 (36.4%)	5 (45.5%)
Total	4 (36.4%)	3 (27.2%)	4 (36.4%)	11 (100%)

In terms of vaccine-preventable conditions, TB and PCP/PJP, the accuracy of reporting varied. The results from table 8 reveal that influenza had the highest level of accurate reporting, with 6.7% of cases having been diagnosed with influenza, evident both from the self-reports and medical records which were confirmed by a nasal or throat swab test. When it came to TB, 76.6% of participants had a diagnosis recorded in their medical records, while 56.6% self-reported having been diagnosed. For pneumonia, 8.6% of participants had a recorded diagnosis, whereas 12.4% self-reported. When it came to PCP/PJP, 4.8% of participants had a recorded diagnosis, while 3.8% self-reported. Shingles had a recorded diagnosis rate of 17.14%, compared to a self-reported rate of 19.8%. Meningitis had a recorded diagnosis rate of 7.6%, compared to a self-reported rate of 8.5%. Lastly, hepatitis B had a recorded diagnosis rate of 15.1%, compared to a self-reported rate of 10.4% (Table 4.8).

Table 4.8: Accuracy of self-reported vaccine-preventable conditions, TB and PCP/PJP

Variable	Levels	Self-reported		Medical Record	
		n	%	n	%
TB	Yes	60	56.6%	82	76.6%
	No	46	43.4%	25	23.4%

Pneumonia	Yes No	13 88	12.4% 83.8%	9 96	8.6% 91.4%
PCP/PJP	Yes No	4 84	3.8% 79.3%	5 99	4.8% 95.2%
Shingles	Yes No	21 81	19.8% 76.4%	18 87	17.14% 82.8%
Meningitis	Yes No	9 88	8.5% 83.0%	8 97	7.6% 92.4%
Hepatitis B	Yes No	11 86	10.4% 81.1%	16 90	15.1% 84.9%
Influenza	Yes No	7 98	6.7% 6.7%	7 98	6.7% 6.7%

PCP/PJP, *Pneumocystis jirovecii* pneumonia; TB, tuberculosis

4.8 Associations between vaccine uptake and accuracy in self-reporting clinical characteristics

The association between vaccine uptake and participants' accurate self-reporting of viral load (p=0.76) and CD4 cell counts (p=0.82) did not show any significant association. Among those that accurately reported their viral load, only 8 (8.3%) received a vaccine after HIV diagnosis. Likewise, out of those that accurately reported their CD4 cell count, only 3 (3.2%) had received a vaccine after HIV diagnosis. These results are shown in table 4.9.

Table 4.9: The association between vaccine uptake and accuracy in self-reporting clinical characteristics

Variables	Vaccine-Uptake, post HIV diagnosis

	Yes n (%)	No n (%)	Total n (%)	P-value
Viral load /mL				
Accurate reporting	8 (8.3%)	14 (%)	22 (22.0%)	0.758
False reporting	3 (2.7%)	4 (4.3%)	7 (7.0%)	
Total	11 (11.0%)	18 (18.0%)	29 (29.0%)	
CD4 cell counts mm^3				
Accurate reporting	3 (3.2%)	4 (3.8%)	7 (7.0%)	0.819
False reporting	2 (1.8%)	2 (2.2%)	4 (4.0%)	
Total	5 (5.0%)	6 (6.0%)	11 (11.0%)	

Accurate reporting refers to self-reported results that had the same value as the medical records.
False reporting refers to self-reported results that were incorrectly reported based on medical records.
P-values were obtained using Fisher's exact test.

5 CHAPTER FIVE: DISCUSSION

People living with HIV have an increased risk of VPDs, compared to healthy individuals, which could lead to life-threatening complications and even death. To address this issue recommendations and guidelines have been established to increase adult vaccinations among this population. However, data evaluating uptake of these recommended vaccines are lacking globally.

This study, which is the first study on the vaccination coverage of all recommended vaccines among PLWH in South Africa, sought to describe the uptake, knowledge, and acceptance of vaccination, as well as the history of VPDs among PLWH in a tertiary centre clinic. In this convenience sample of 107 PLWH aged 18 years and above, vaccination rates were found to be relatively low, with only 24.3% of the participants reporting that they had received at least one adult vaccine after HIV diagnosis. A cross-sectional study conducted in Brazil reported a higher coverage rate of 60.5% among PLWH who had received at least one dose of a vaccine in 2016 (50).

In the current study, the only vaccines received after HIV diagnosis were those against influenza, hepatitis B, shingles and pneumococcal infections. Vaccination rates were comparable to previously reported rates for only influenza and pneumococcal vaccines (48,50,55). The study revealed that the influenza vaccine had the highest uptake, with 76.9% of participants reporting that they had received it after their HIV diagnosis. This could be attributed to the annual influenza vaccine campaigns that are conducted and also the ease of accessibility of this vaccine. Similar uptake rates were observed in the cross-sectional study conducted in Brazil, which reported a 71.8% uptake rate for the influenza vaccine among people living with HIV (50). On the other hand, coverage rates for the pneumococcal vaccine were found to be low in two studies (48,52). In this study, the uptake rate was 3.8%, while a Danish study investigating influenza and pneumococcal vaccine coverage reported an uptake rate of 4.4% for the pneumococcal vaccine (48).

The results from the current study highlight the female predominance of attendees at the clinic, as they made up 67.3% of participation; females were also 5 times more likely to receive a vaccine after HIV diagnosis compared to males. This observation aligns with the results of a previous study that explored gender differences in health settings, revealing that women were more active seekers of health care and paid more attention to health-related information than males (82). The majority of the participants were older than 40 years, with a mean age of 47

years, and there was no significant difference in the mean ages of respondents who had versus those who had not received adult vaccinations recommended to them (47.69 ± 9.39 vs 47.43 ± 10.800 years: p = 0.9125).

In the current study, a significant percentage (72.9%) of the participants had only reached secondary education and 54.2% were unemployed. This may indicate that HIV is still disproportionately higher among those of lower socioeconomic status, as a similar pattern was observed in a South African study that revealed that PLWH were associated with a 6% to 7% increased likelihood of unemployment and a 10% to 11% increased likelihood of being less well educated (83). However, this hypothesis warrants further investigation, as HIV patients with higher socioeconomic status may be accessing care from private healthcare facilities rather than the public sector where this study was carried out.

An increase in vaccine uptake was found to be strongly associated with certain clinical characteristics, such as measurement of viral load in the current study. Specifically, participants with a clinical recorded viral load of less than 500 copies/mL were 10.7 times more likely to receive a vaccine after HIV diagnosis. Prior research has demonstrated that CD4 cell count is a significant factor in increased vaccine uptake (51,60). Generally, individuals with CD4 cell counts above 200 cells/mm³ were observed to have received twice as many vaccines compared to those with CD4 cell counts below 200 cells/mm³ (51). This may be a reflection that individuals with CD4 cell counts above 200 cells/mm³ tend to seek regular health care services and have greater exposure to vaccine-related information. On the other hand, individuals with CD4 cell counts below 200 cells/mm³ may exhibit heightened hesitancy and fear towards their condition. This analysis may also highlight the hesitancy among HIV care providers when it comes to vaccinating immunocompromised patients or the lack of trust between immunocompromised individuals and their healthcare providers, as they may not have been in the healthcare system long enough for that trust to be established. However, in the current study, CD4 cell count did not show a significant association with increased vaccine uptake. Only 25.5% of individuals with CD4 cell counts above 200 cells/mm³ had received vaccines after HIV diagnosis.

As expected, the majority (76.6%) of the individuals living with HIV had a documented history of TB based on their medical records. Shingles (17.1%) and hepatitis B (15.1%) were also VPDs that commonly occurred among the individuals. This observation may explain why vaccines targeting shingles/zoster and hepatitis B were among the most well-known vaccines

among the participants. Similar findings were reported in a systematic review investigating the knowledge and vaccination status against hepatitis B. The authors of this review noted that individuals who had previous exposure to hepatitis B, such as an infection or having family or friends infected with the disease, possessed better knowledge about the disease and the vaccine, and were more inclined to receive the vaccine (80). Pneumonia (8.6%), meningitis (7.6%), and influenza requiring hospitalization (6.7%) were the least prevalent VPDs observed among the participants.

Previous research has indicated that people's attitude and acceptance of vaccines are influenced by their knowledge about the disease and their own vaccination status (80,81,84). In this study, knowledge and acceptance of vaccines were evaluated through a range of questions. Interestingly, all individuals who reported receiving a vaccine after HIV diagnosis had at least one child, while those without children had never received a vaccine and were unaware of the available vaccines. This finding is connected to participants who reported receiving childhood vaccinations. Among the participants who received a vaccine after their HIV diagnosis, a significant number were aware of having received childhood immunizations. This suggests that individuals who have already been exposed to vaccinations and possess knowledge about children receiving vaccines are more inclined to accept adult vaccines for themselves.

Another strong predictor of vaccination was knowledge of viral load and knowledge of ART medication. This study demonstrated that individuals with no knowledge of their viral load were 0.4 times less likely to accept an adult vaccine compared to those with knowledge of their viral load. Similarly, participants who were unaware of their ART medication were 0.3 times less likely to accept an adult vaccine compared to those who were aware of their ART medication. Limited research has been conducted on the association between HIV monitoring results and vaccine acceptance. Nevertheless, a report on the need for viral load testing has demonstrated that regular viral load tests and patient awareness regarding HIV monitoring contribute to prevention, enhance the quality of treatment, and improve individual health outcomes (85). This implies that individuals who possess a higher level of understanding about their HIV status are more likely to make informed decisions.

Previous studies have reported vaccine hesitancy as a prevalent issue among various populations, including among PLWH (86-88). It has been recognized that attitudes and acceptance of vaccination encompass several common factors, such as concerns about safety, religious beliefs, general mistrust, and health worries among PLWH (86-88). A systematic

review conducted in developing countries revealed that the dissemination of information is directly linked to enhanced knowledge, which in turn significantly influences vaccination rates (80). In the current study, a similar trend was observed, although the association, was not significant. In addition, individuals who were aware that vaccines do not pose harm to their bodies exhibited the highest rates of vaccine uptake (53.9%) and were more inclined to accept adult vaccines compared to those who believed vaccines were harmful to them (27.1%). This pattern was also evident among individuals who understood that vaccines aid in disease prevention, as well as in those who did not believe vaccines could exacerbate their HIV condition. These groups were more likely to accept vaccination compared to their counterparts.

The current study is consistent with other studies in terms of vaccine acceptance. It found that vaccine acceptance was positively influenced by a direct recommendation from a healthcare professional. Specifically, the study revealed that 67.3% of participants were more willing to accept a vaccine if it were recommended by their healthcare provider. This finding is consistent with a study conducted in the United States, which explored the willingness of PLWH to receive a COVID-19 vaccine. In that study, 61.5% of participants indicated their willingness to receive the vaccine if advised by their doctor. Numerous other studies have also emphasized the significance of healthcare provider recommendations and health education in promoting vaccine acceptance within this particular population (50,51,55,60)

Health education is an important factor in improving and increasing vaccination rates. It is observed that a significant number of PLWH are not aware of the vaccines recommended for them, and this lack of knowledge contributes to their growing mistrust and fear of vaccinations. PLWH are more inclined to heed advice from individuals they trust, particularly when it pertains to their health. Therefore, it is imperative for healthcare providers to offer comprehensive information regarding the significance of vaccines and address any misconceptions about their safety and potential side effects.

During the COVID-19 pandemic, surprisingly, only 29.1% of participants were known to have ever contracted COVID-19. However, a significant majority (64.5%) had received at least one dose of the COVID-19 vaccines. The motivations behind their decision to get vaccinated were further investigated, revealing that a majority (64.6%) of the participants aimed to safeguard themselves and their loved ones. This rationale is highly logical considering the extensive dissemination of COVID-19 vaccine information and education across various social, scientific, and health platforms. Moreover, the implementation of COVID-19 vaccine mandates

by numerous companies and schools played a crucial role in driving the high vaccine uptake rates, particularly among vulnerable groups such as PLWH.

Overall, the current research findings indicate that being aware of the influenza vaccine and receiving a recommendation from a healthcare professional are the most influential factors associated with receiving an adult vaccine after an HIV diagnosis. It is clear that having knowledge about diseases, vaccines, and HIV monitoring results significantly contributes to the uptake of vaccines among PLWH. Further research is needed to quantify the burden of VPDs particularly shingles/zoster, tetanus, diphtheria and pertussis among PLWH in the South African population. Local guidelines have already recommended vaccines for influenza, pneumococcal disease, meningococcal disease, HPV, tetanus, shingles/zoster, diphtheria, and pertussis. Additionally, the guidelines also suggest vaccinations for hepatitis A and B regardless of CD4 cell counts, as well as live vaccines like measles-mumps and rubella for those with CD4 cell counts above 200 cells/mm^3 (15). Investigating vaccination history is challenging due to the absence of vaccination cards or any other recording system for adult vaccines. However, it is crucial to establish targets in line with the vaccination guidelines and ensure reliable documentation of the vaccination system. Strategies need to be developed to provide guidance on the benefits of vaccines, the number of doses required, and the importance of completing vaccination schedules in both community and healthcare settings.

5.1 Limitations

There are some factors that may limit the generalizability and validity of this study. Firstly, the use of a cross-sectional study design means that the results may vary over time, and therefore one cannot establish a causal relationship between predictor variables and the outcome. Another significant limitation is that the current study relied on self-reporting. Although clinical characteristics could be confirmed, vaccination uptake rates could not be confirmed through hospital records, which may have led to an overestimation of vaccination rates. Furthermore, the current cohort was limited to one centre and consisted of only 107 participants, which may not accurately represent the entire population of PLWH in South Africa. Despite the reported low vaccination rates, the predominance of females in the study cohort could have led to an overestimation of vaccination rates, as females generally exhibit better health-seeking behaviours compared to males. Lastly, the use of convenience sampling may have introduced recruitment bias, as participants who declined to participate may have had lower vaccine uptake rates, potentially skewing the results.

5.2 Conclusion

This study reveals poor adherence to the vaccination guidelines for PLWH in South Africa. Only four vaccines, namely vaccines against influenza, hepatitis B, shingles and pneumococcal diseases had been taken and commonly known among this population. The data clearly demonstrates that PLWH are not adequately informed about the opportunity and benefits of vaccination. HIV is a life-long chronic disease. Thus, HIV management and care requires a multifactorial approach that includes prioritisation of vaccines. Interestingly, socio-demographic factors did not appear to significantly influence vaccine uptake based on this study. However, the importance of knowledge and acceptance was emphasized as crucial factors for improving vaccination coverage. The study highlights the need for further investigation into the burden of vaccine-preventable diseases (VPDs) at a population level and their coverage rates.

5.3 Recommendations

It is clear from this research that the acceptance of vaccines is directly linked to the advice given by doctors. This highlights the crucial role that healthcare providers in HIV care can play in addressing the obstacles to low vaccination rates among PLWH. Despite the fact that this study was conducted at a tertiary hospital clinic, the level of healthcare recommendations regarding the use of VPD vaccines, although relying on patient recall, was found to be low. This serves as evidence that interventions involving the collaboration between physicians and healthcare workers to widely disseminate vaccine education is strongly recommended. Two separate studies have demonstrated significant increases in vaccine coverage through vaccination campaigns and improved recordkeeping of administered vaccines for vulnerable adults (89,90). Therefore, it is necessary to establish vaccination targets based on the current recommendations, along with thorough recordkeeping and follow-up checks of administered vaccines among PLWH.

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APPENDIX I: Information Sheet and Consent Form

STUDY INFORMATION DOCUMENT

Study title: <u>An audit of adult vaccination in HIV-positive patients attending a tertiary centre HIV clinic.</u>

Introduction:

I **<u>Mitchell Muchichwa</u>** am doing research on vaccination uptake, knowledge and acceptance among people living with HIV.

Research is a process used in seeking new knowledge. In this study I want to learn about what vaccines you have received, which vaccines you know about and what your perceptions are about the various vaccines recommended to you. The purpose of the study is to provide information on the vaccination status of people living with HIV. To improve vaccination coverage among this population by increased awareness about guidelines and physician education.

Invitation to Participate: I am inviting you to take part in research that involves a brief interview to get the information stipulated above as well as your medical history.

What is involved in the study.

1. . This is a cross-sectional study conducted through interviews and patient file reviews.
2. The interviews will be conducted at Charlotte Maxeke Johannesburg Academic
3. Hospital (CMJAH) Infectious Diseases Clinic
4. The participants will be required to provide 10 minutes of their time for the interview.
5. Participation in the interview can only occur after the participant has signed the consent form.
6. Questions to be asked, will focus on the vaccination and medical history of the participant. As well as questions assessing knowledge and acceptance of vaccines.
7. 6No technical procedures (i.e., Blood samples) will be involved in the study.

Risks of being involved in the study: The risk of confidential data being leaked is minimal in the study, as confidential data will be de-identified, stored in a secure location and will not be shared with any other sources.

Benefits of being in the study: There is no direct benefit to the participant. However, the longer-term objective is the possibility of better vaccine recommendations from their health providers, which may assist in better health outcomes for the patients.

Participation is voluntary, that refusal to participate will involve no penalty or loss of benefits to which the Participant is otherwise entitled, as, for example, a hospital patient.

Reimbursements: There is to be no payment or cost associated with participation.

Confidentiality: Personal information will be treated in the strictest confidence and will only be available to the Principal Investigator (PI) and her supervisors.

The only exceptions - and all of them are rare, would be:

1. personal information may be disclosed if required by law
2. the Human Research Ethics Committees of the University may exceptionally require personal data to respond to a formal complaint, or for a compliance audit

Contact details of researcher/s: If you have any concerns or queries, you may contact any of the below:

Investigator:

Mitchell Muchichwa
Email : 1611725@students.wits.ac.za
Telephone : 0790522133

Supervisors:

Prof Feldman: Charles.Feldman@wits.ac.za
Doc Sarah Stacey: 083 393 7546
Doc Lyle Murray: 0607289421

This study has been approved by the Human Research Ethics Committee (Medical) of the University of the Witwatersrand, Johannesburg ("Committee"). A principal function of this Committee is to safeguard the rights and dignity of all human subjects who agree to participate in a research project and the integrity of the research.
If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

Thank you for reading this Study Information Sheet.

Date: October 2022

WITS UNIVERSITY

PARTICIPANT CONSENT SHEET

An audit of adult vaccination in HIV-positive patients attending a tertiary centre HIV clinic

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached here.
2. I was given time to read it, or had it read to me, in the language I best understand.
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory.
4. I believe I fully understand why the study is being conducted.
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time.
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained.
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study, I am free to speak to any of these contacts.

Contact details:

Principal Investigator: Mitchell Muchichwa, 0790522133 or 1611725@students.wits.ac.za

Supervisors :
Prof Feldman: Charles.Feldman@wits.ac.za
Dr Sarah Stacey: 083 393 7546
Dr Lyle Murray: 0607289421

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za. Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Witnessed by:

Name of Witness: _____
Signature: _____
Date: _____

APPENDIX II: Case Report Form

Demographic information

Please complete the survey below.

Thank you!

Interview date	_____

Background information

What is your name?	_____
What is your GT number?	_____
What is your age?	_____
What is your gender?	◯ Male ◯ Female ◯ Non binary ◯ Prefer not say ◯ Other
What is your highest level of education?	◯ Grades 1-7 ◯ Grades 8-12 ◯ Tertiary
Are you employed?	◯ Yes ◯ No
Occupation	_____
Do you have children?	◯ Yes ◯ No
How many?	_____
If yes, do your children live with you?	◯ Yes ◯ No
Do you have sex with:	◯ Men only ◯ Women only ◯ Men and Women ◯ Prefer not to say

HIV-associated medical history	
How long have you had HIV?	_____
Are you on ART?	◯ Yes ◯ No
For how long?	_____
Do you know the name of your ART medication?	◯ Yes ◯ No
Name of ART	_____
Do you know your viral load?	◯ Yes ◯ No
What is it currently/ at last visit	_____
Do you know your CD4 count?	◯ Yes ◯ No
What is it currently?	_____

_____

Have you ever had/been diagnosed with any of the following conditions	Yes	No	I don't know
Tuberculosis	◯	◯	◯
Pneumonia	◯	◯	◯
PCP/PJP	◯	◯	◯
Shingles/Zoster	◯	◯	◯
Meningitis	◯	◯	◯
Hepatitis B	◯	◯	◯
Influenza - requiring admission to hospital	◯	◯	◯
Cervical cancer (women)	◯	◯	◯

Do you have any of the following additional chronic medical conditions?	Yes	No	I don't know
Hypertension	◯	◯	◯
Diabetes	◯	◯	◯
Asthma	◯	◯	◯
COPD	◯	◯	◯

Heart failure	◯	◯	◯
Chronic kidney disease	◯	◯	◯
Cancer _____	◯	◯	◯

Knowledge/history and attitudes to vaccination

Please complete the survey below.

Thank you!

What childhood vaccinations are you aware of	_____
Are you aware of having received any childhood vaccinations yourself?	◯ Yes ◯ No
Which ones	_____
Are you aware of the need for the following vaccines in children?	☐ Tuberculosis ☐ Polio ☐ Rotavirus ☐ Pneumococcal ☐ Hep B ☐ HPV ☐ Measles ☐ Diptheria/pertussis/tetanus ☐ none
Have you received any vaccinations (apart from for COVID) since being diagnosed with HIV?	◯ Yes ◯ No
Please specify	_____

Are you aware of the following vaccines for adults?	☐ Pneumococcal ☐ Influenza ☐ Hep B ☐ HPV ☐ Measles/Mumps/Rubella ☐ Diptheria/pertussis/tetanus ☐ Shingles/Zoster ☐ none
Do you think getting vaccinated is harmful to your body?	◯ Yes ◯ No ◯ I don't know
Do you think that getting vaccinated against a disease will help to prevent infection from that disease?	◯ Yes ◯ No ◯ I don't know
Do you think that getting a vaccine could worsen your HIV?	◯ Yes ◯ No ◯ I don't know
Have you ever been advised by your doctor/nurse to get vaccinated (apart from for COVID-19) since being diagnosed with HIV?	◯ Yes ◯ No
Please specify	_____

If your doctor/nurse recommended a vaccine, would you decide to vaccinate?	◯ Yes ◯ No ◯ Not sure
Why?	_____
Which of the following factors would affect your decision to vaccinate or not?	☐ Knowledge of the vaccine ☐ Fear of side effects ☐ Availability of the vaccine ☐ Family discussions or advice ☐ Cost ☐ Mainstream media - TV, radio, newspapers and magazines ☐ Social media

Knowledge/history and attitudes to COVID-19 vaccination

Please complete the survey below.

Thank you!

Have you ever had COVID-19?	◯ Yes ◯ No ◯ Don't know
Have you been vaccinated against COVID-19?	◯ Yes ◯ No ◯ Don't know
how many doses?	_____
If yes, which vaccines?	_____
Did you experience any side effects of COVID-19 vaccination?	◯ Yes ◯ No ◯ I don't know
What side effects?	_____
What influenced your reason to vaccinate?	_____
What influenced your reason not to vaccinate?	_____

APPENDIX III: Human Research Ethics Committee Approval Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research and Innovation)

TO: Ms M Muchichwa
School of Pathology
Department of Virology
Medical School
University

E-mail: 1611725@students.wits.ac.za

CC: Supervisor: Professor C Feldman; Drs S Stacey and L Murray
<Charles.Feldman@wits.ac.za>
and <HREC-Medical Research Office@wits.ac.za>

FROM: Mr Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

DATE: 2023/03/30

REF: R14/49

PROTOCOL NO: **M221136** (This is your ethics application reference number. Please quote it in all enquiries, oral or written, relating to this study.)

PROJECT TITLE: *An audit of adult vaccination in HIV-postive patients attending a tertiary centre HIV clinic*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Ms M Muchichwa

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M221136

NAME: (Principal Investigator)	Ms M Muchichwa
DEPARTMENT:	School of Pathology Department of Virology Medical School University
PROJECT TITLE:	*An audit of adult vaccination in HIV-postive patients attending a tertiary centre HIV clinic*
DATE CONSIDERED:	2022/11/25
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>

SUPERVISOR:	Professor G Feldman; Drs S Stacey and L Murray
APPROVED BY:	CB Penny Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2023/03/30

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **November** and therefore reports and re-certification will be due in the month of **November** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

31/03/2023
Date

APPENDIX IV: Study Site Approval

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL
OFFICE OF THE CLINICAL DIRECTOR

Enquiries: *Ms N. Mzila*
Email: Nolwazi.Mzila@gauteng.gov.za
Tel: *011 488 3365*
Ref: *1/7/2*
Date: 01 May 2023

GP_202302_020

Dear Mitchell Muchichwa

RE: FIANL APPROVAL OF STUDY

TITLE: AN AUDIT OF ADULT VACCINATION IN HIV-POSITIVE PATIENTS ATTENDING A TERTIARY CENTRE HIV CLINIC

Permission is granted for you to conduct the above-mentioned study as described in your request provided:

1. Charlotte Maxeke Johannesburg Academic Hospital will not in any way incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall always be observed.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the HOD and Unit Manager or Sister in charge to agree on the dates and time that would suit all parties.

Kindly forward this office with the results of your study on completion of the research.

Supported / ~~Not Supported~~

Signed by:Jayshina Punwasi
Signed at:2023-05-02 11:22:50 +02:00
Reason:Witnessing Jayshina Punwasi

Dr J. Punwasi
Clinical Director

Approved / ~~Not Approved~~

Signed by:Gladys Magugudi Bogoshi
Signed at:2023-05-03 05:26:45 +02:00
Reason:Witnessing Gladys Magugudi Bo

Ms G. Bogoshi
Chief Executive Officer: CMJAH

Department of Internal Medicine

7 York Road, Parktown, 2193, South Africa •Telegrams 'Witsmed' •Fax: 488 4672 •Tel: 488 3840 •

Division of Infectious Diseases
Department of Internal Medicine
Charlotte Maxeke Johannesburg Academic Hospital
University of the Witwatersrand

21 December 2022

RE: An audit of adult vaccination in HIV-positive patients attending a tertiary centre HIV clinic

Dear Ma Muchichwa,

I am pleased to support your study investigating the knowledges and attitudes to vaccination of patients attending our clinic. You may interview patients attending their routine appointments at the clinic and review the files of patients who underwent investigation as part of their management by the infectious diseases unit over the relevant time period.

Approval must obtained from the Human Research Ethics Committee.

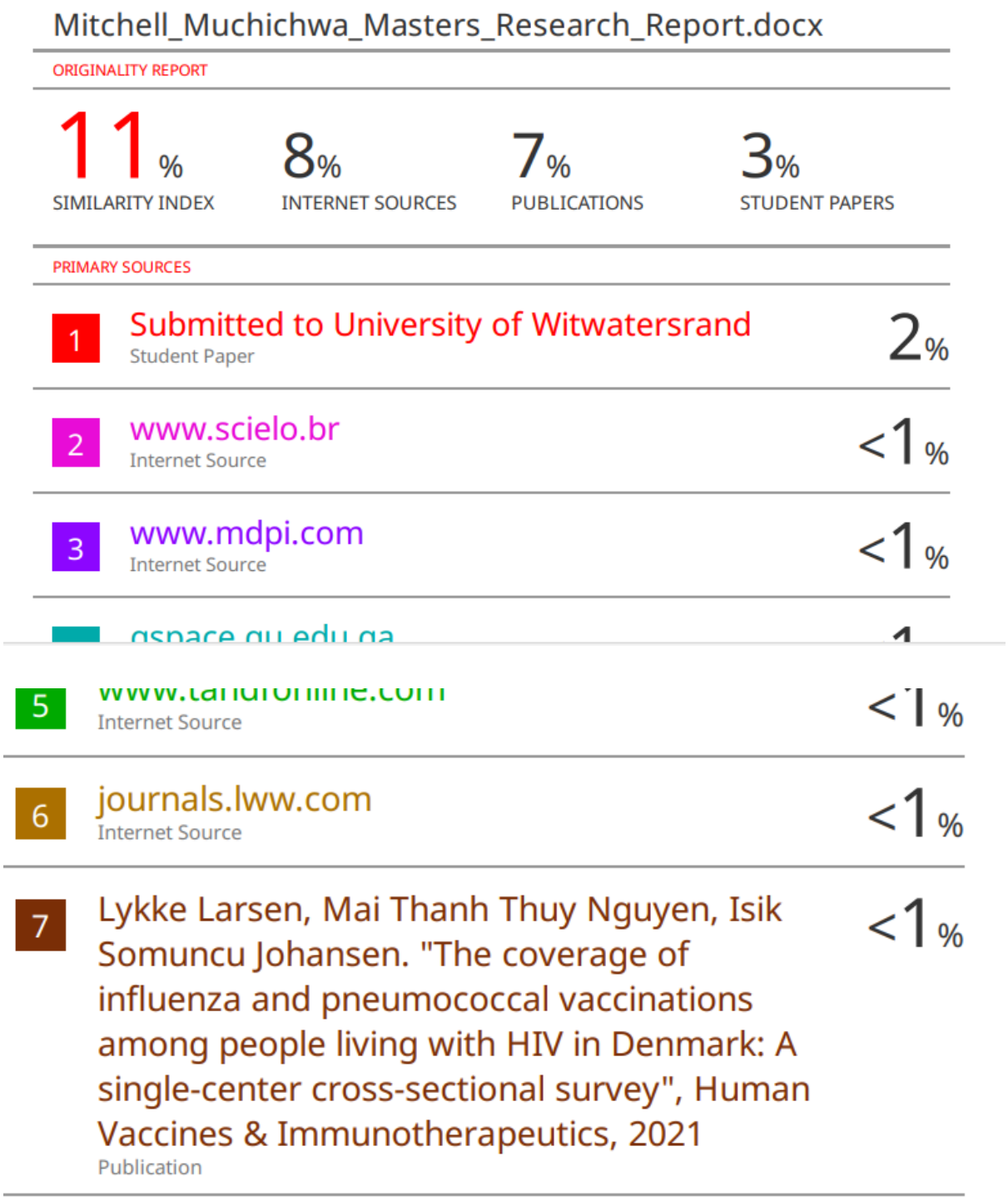
Confidentiality must be observed at all times.

I look forward with interest to the results of your study.

Yours sincerely,

Dr Sarah Stacey
FCP (SA) Cert ID (SA) DTM&H
Senior Consultant and Acting Clinical Head
Division of Infectious Diseases, Department of Internal Medicine
Charlotte Maxeke Johannesburg Academic Hospital
University of the Witwatersrand
email: sarahlynnstacey@gmail.com

APPENDIX VII : TURNITIN REPORT



Mitchell_Muchichwa_Masters_Research_Report.docx

ORIGINALITY REPORT

11%	8%	7%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Witwatersrand Student Paper	2%
2	www.scielo.br Internet Source	<1%
3	www.mdpi.com Internet Source	<1%
	gspace.qu.edu.qa	1
5	www.tandfonline.com Internet Source	<1%
6	journals.lww.com Internet Source	<1%
7	Lykke Larsen, Mai Thanh Thuy Nguyen, Isik Somuncu Johansen. "The coverage of influenza and pneumococcal vaccinations among people living with HIV in Denmark: A single-center cross-sectional survey", Human Vaccines & Immunotherapeutics, 2021 Publication	<1%