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Differences in The Number of CD4 Cells in HIV/AIDS Patients Before and After Tuberculosis Co-Infection Who Received Anti-Retroviral and Anti-Tuberculosis Therapy

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Abstract

Human Immunodeficiency Virus (HIV) is a virus that causes a decline in the immune system. HIV can develop into *Acquired Immune Deficiency Syndrome* (AIDS). This virus infects T-helper lymphocytes through the CD4 (Cluster of Differentiation 4) receptor, which serves as a key indicator of the immune system. Low CD4 levels can cause opportunistic infections such as tuberculosis, caused by the bacterium *Mycobacterium tuberculosis*. Treatment for HIV/AIDS patients coinfected with tuberculosis using antiretroviral therapy (ART) and anti-tuberculosis therapy (ATT) can increase CD4 cell counts.

Aims: This study aims to determine the differences in CD4 cells in HIV/AIDS patients before and after tuberculosis co-infection who received Anti-Retroviral (ART) and Anti-Tuberculosis (ATT) therapy for 6 months.

Study design: The research design used in this study was an analytical observational design with a cross-sectional approach.

Place and Duration of Study: This Study used secondary data from 92 HIV/AIDS patients at Budhi Asih General Hospital during the 2023-2024 period. This research was conducted at the Medical Laboratory Technology Department, Poltekkes Kemenkes Jakarta III from 21 February 2025 to 30 July 2025

Methodology: The research samples were all CD4 cell examination results from HIV/AIDS patients who experienced TB co-infection with ART and ATT therapy for 6 months. The sample size used the Slovin formula from a known population of HIV/AIDS sufferers based on data from the DKI Jakarta Provincial Health Service in 2022, which was taken by purposive sampling of 92 sufferers. Data analysis used the Wilcoxon statistical test.

Results: The results showed that the majority of patients were male, aged 25-49 years, 50%, and female, aged 25-49 years, 29.3%.
The proportion of HIV/AIDS patients before TB coinfection with ART therapy for less than 12 months, with CD4 counts indicating severe immunosuppression (<200 cells/mm3) was 48.9% of sufferers. The proportion of HIV/AIDS patients who received ART therapy and ATT therapy for 6 months, and had severe immunosuppression (CD4 cell count <200 cells/mm3) was 67.4% of patients.
Conclusion: The conclusion is that there was a significant difference between the number of CD4 cells in HIV/AIDS patients before and after tuberculosis co-infection, receiving ART and ATT therapy for 6 months

Keywords: Anti-Retroviral, Anti Tuberculosis, Cluster of differentiation 4, TB Co-Infection

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Introduction

Human Immunodeficiency Virus (HIV) is a virus that infects white blood cells, leading to a decline in the human immune system. The late-stage symptoms in HIV sufferers are Acquired Immune Deficiency Syndrome (AIDS), which is a group of symptoms that arise due to a decrease in the body's immune system caused by HIV[1].

In the immune system of HIV-infected individuals, the virus infects T-helper lymphocyte cells through Cluster of Differentiation 4 (CD4), which is found on the surface of These cells. The HIV virus, which binds to the CD4 receptor complex, can convert RNA genetic material into DNA and replicate, thereby damaging T-helper lymphocyte cells, decreasing the CD4 count, and resulting in a weakened immune system, commonly referred to as immunodeficiency. The HIV virus, which binds to the CD4 receptor complex, can convert RNA genetic material into DNA and replicate, thereby damaging T-helper lymphocyte cells, decreasing the CD4 count, and resulting in a weakened immune system, commonly referred to as immunodeficiency. CD4 is the most reliable parameter for measuring immunodeficiency and can serve as an early indicator of disease progression. CD4 is a marker found on the surface of human white blood cells, particularly lymphocytes. CD4 plays a crucial role as an indicator of immune system health.

A decrease in CD4 counts indicates a weakening of the immune system, as the number of white blood cells, specifically lymphocytes, which function to fight infections in the body, is also reduced. In healthy individuals, the number of normal CD4 cells ranges from 500 to 1,500 cells/mm³, whereas in individuals infected with HIV, the number of CD4 cells continues to decrease, leading to immunodeficiency. Individuals with immunodeficiency are more susceptible to various types of infection[5]. Previous research results stated that most HIV/AIDS patients had CD4 cell counts <200 cells/mm^3. The death of CD4 cells causes the decrease in CD4 cells. After an acute infection, an asymptomatic period follows, characterised by a significant decrease in the number of CD4 cells, particularly at an advanced stage. This is because a CD4 cell count <200 cells/mm3 carries a risk of opportunistic infections. Apart from that, it can be caused by other factors, such as environmental conditions and exposure to bacteria or fung[6]. According to the CDC, CD4 cell counts are categorised according to clinical classification, with three criteria: group A (asymptomatic, acute infection), B (symptomatic), and C (AIDS). The CD4 count measures the level of immunosuppression. CD4 count categories are based on the level of immunosuppression: CD4 cell counts >500 cells/mm3 normal or no suppression, CD4 cell counts 200-499 cells/mm3 moderate immunosuppression, and <200 cells/mm3 severe immunosuppression. Field[6].

Opportunistic Infections (OIs) are infections that take advantage of the weakness of the human body's defences, one of which is PLWHA (People with HIV/AIDS) who have a weak immune system, so they have a high chance of contracting Opportunistic Infections[7]. Based on previous research, the most common type of opportunistic infection in PLWHA is tuberculosis infection, an infection caused by Mycobacterium tuberculosis. This could be due to the large number of cases of tuberculosis, so that the spread of tuberculosis infection occurs more easily in people with immunodeficiency, such as PLWHA[8]. TB-HIV cases based on WHO data in 2022, there are around 167,000 people who died due to TB-HIV infection. The development of cases of TB patients who have HIV status in 2022 will increase to 80% from 76% in 2021[9]. In 2022, there will be 15,375 TB sufferers who are HIV positive[10].

In the pathogenesis of HIV/AIDS, macrophages play a crucial role. This is related because HIV-1 primarily targets CD4 T lymphocyte cells. CD4 cells and macrophages are the host's defence against Mycobacterium tuberculosis, so when HIV co-infection occurs, CD4 levels in the body start to become low. This results in the fact that when TB bacteria infect, there are no CD4 cells to help fight the agent that causes tuberculosis. Previous research by Pranaya stated that the highest CD4 cell levels in patients with HIV co-infected with pulmonary TB were in the group with CD4 lymphocyte levels <200 cells/μmL.[11]. Treatment for HIV/AIDS patients is by administering antiretroviral (ARV) drugs. ARV drugs work by inhibiting viral replication, thereby decreasing the virus in the blood circulation and increasing CD4 cells, which in turn helps the immune system. Research by Trisna et al. shows that the CD4 value in HIV/AIDS patients who receive ARV therapy will increase[12]. In PLWHA who receive ARV treatment, there is a risk of failure, which can occur due to a suboptimal immune response to therapy and clinical failure, which is characterised by the emergence of opportunistic infections[13].

The government's efforts to overcome TB co-infection in PLWHA are by administering a combination of antiretroviral (ARV) and anti-tuberculosis drugs (OAT). Management of TB patients with HIV is the same as that of other TB patients because the effectiveness of OAT in PLWHA is the same as in TB patients in general. TB patients who are HIV positive are still given OAT and ARVs, with OAT being administered first to reduce morbidity and mortality[14]. HIV patients with TB coinfection have a risk of developing IRIS, namely Immune Reconstitution Inflammatory Syndrome, especially when ARV treatment is started earlier than TB therapy. IRIS is a result of the process of enhancing the specific immune response against pathogens at the initiation of ARV therap[15]. During ARV therapy, the CD4 count is monitored as a parameter for the failure of ARV therapy; additionally, the CD4 count is influenced by the patient's clinical stage level.

Based on previous research by Atika et al. It was found that there was a statistically significant relationship between the initial CD4 count and changes in CD4 levels in PLWHA with TB co-infection[17]. As for other research by Trivania

et al., it stated that there was a difference between the CD4 count before and after ARV and OAT treatment in HIV patients with pulmonary TB co-infection. In the Trivania study, OAT treatment was initiated before starting AR[18]. In this study, CD4 counts were monitored in HIV/AIDS sufferers before TB coinfection with ARVs and CD4 counts after TB coinfection with ARV therapy, which was preceded by OAT therapy. Early use of ARV can have a risk of OAT drug interactions with ARVs, drug side effects, and the occurrence of IRIS. Monitoring the CD4 count before and after ARV and OAT therapy is for monitoring the immunological status of HIV/AIDS sufferers co-infected with tuberculosis. Based on the background description, researchers are interested in conducting research on differences in CD4 cell counts before and after TB co-infection in HIV/AIDS sufferers with ART and ATT therapy.

Research Problem

Giving anti-retroviral drugs (ART) to HIV/AIDS sufferers to inhibit virus replication, so that the virus in the blood circulation decreases, and then CD4 increases, so that the immune system will improve. In case of HIV/AIDS sufferers who receive ART treatment, there is a risk of failure, due to suboptimal immune responses to therapy and clinical failure, which is characterised by the emergence of opportunistic infections such as TB co-infection[13]. HIV/AIDS patients with TB co-infection have a risk of developing IRIS, namely Immune Reconstitution Inflammatory Syndrome, especially if ART treatment is started earlier than TB therapy. IRIS is a result of the process of enhancing the specific immune response against pathogens at the initiation of ARV therap[15]. During ART therapy, the CD4 count is monitored as a parameter for the success or failure of ART therapy. Additionally, the CD4 count is influenced by the patient's clinical stage level. Based on this problem, researchers are interested in conducting research on differences in the number of CD4 cells in HIV/AIDS sufferers before and after TB co-infection with ART and ATT therapy.

Research Focus

The research focused on the difference in the number of CD4 cells in HIV/AIDS patients at Budhi Asih Hospital who received anti-retroviral therapy (ART) before tuberculosis co-infection and after tuberculosis co-infection with ART and anti-tuberculosis therapy (ATT).

Research Aim and Research Questions

The Research Aim

The general aim of this research was to determine the difference between the number of CD4 cells in HIV/AIDS patients before and after tuberculosis co-infection with ART and ATT therapy.

The Research Questions

1. What is the frequency distribution of CD4 counts in HIV/AIDS sufferers with ART administration before TB coinfection, and after TB coinfection, and ART and ATT treatment, based on gender, age and duration of HIV/AIDS sufferers
2. Is there a difference between the number of CD4 cells in HIV/AIDS sufferers before and after tuberculosis co-infection with ART and ATT therapy?

Research Methodology

General Background

Research Ethics Clearance: This research uses secondary data from the HIV/AIDS Referral Hospital in DKI

Jakarta is RSUD Budhi Asih. Research permits are obtained through the PPID DKI Jakarta Health Service and Budhi Asih Regional Hospital. Information on ethical clearance (Ethical Clearance) was obtained from the Ethics and Research Committee of RSUD Budhi Asih No. 042/KEP-ETIK/III/2025, dated March 26, 2025.

Design, Subjects, and Research Variables: The research design employs an analytical observational approach with a cross-sectional design. The research subjects were secondary data from examination of CD4 levels of HIV/AIDS patients on ARV therapy before TB coinfection and after TB coinfection with ARV and OAT therapy. The research variable consists of the independent variable, namely the CD4 count of HIV/AIDS sufferers on ARV therapy before TB co-infection. The dependent variable is the number of CD4 cells in HIV/AIDS sufferers after TB coinfection with ARV and OAT therapy.

Data Collection and Measurement: The study population used all medical record data from CD4 level examination results in HIV/AIDS patients with ARV therapy before TB coinfection and after TB coinfection with ARV and OAT therapy at Budhi Asih Regional Hospital. HIV/AIDS patients undergoing combination ARV and OAT treatment for a minimum of 6 months.

Sampling Technique: The sampling technique employed in this study was purposive sampling, which involved selecting samples over a specific period of time according to the inclusion criteria: patients suffering from HIV-Co-infection with TB, whose CD4 counts were checked before and after consuming a combination of ARV and OAT.

This study used the following restriction criteria:

Inclusion criteria:

a. HIV/AIDS patients co-infected with TB.
b. Patients undergo a combination of ARV and OAT treatment for a minimum of 6 months.
c. There is CD4 medical record data before and after co-infection with ARV and OAT treatment that preceded ARV use.

The exclusion criteria in this study are: Patients who have other co-infections.

Sample / Participants / Group

Formulas And Equations

The minimum sample size using the Slovin formula from a population known to be HIV/AIDS sufferers from the DKI Jakarta Provincial Health Service in 2022 is:

$$onen = \frac{N}{1+(N.e^2)} \quad n = \frac{103}{1+(103.0{,}05^2)} \quad n = \frac{103}{1{,}26} \quad n = 81{,}7, \text{ set to } 82$$

Description:
n = Estimated Sample Size
N = Population Size
e = *error margin*

Based on calculations, the number of samples was increased by 10% to 92 samples. The sampling technique uses purposive sampling.

Instrument and Procedures

1. Prepare a recapitulation sheet of the analysed data
2. Submit a research permit for data collection at Budhi Asih Regional Hospital to the Director of Poltekkes Jakarta
3. Apply for permission to collect data to the Director of Budhi Asih Regional Hospital.
4. Apply for permission for an ethical review at Budhi Asih Regional Hospital, and complete the research permit data at Budhi Asih Regional Hospital.
5. Apply for research permits to the DKI Jakarta Health Service.
6. Carry out the process of collecting medical record data and laboratory examination results data in accordance with research criteria.
7. Conduct data processing and statistical testing in accordance with the findings of the research.

Data Analysis

Statistical analysis using the SPSS program consisted of univariate analysis, including categorical data on patient characteristics, frequency distribution of CD4 cell counts based on the period of use, and frequency distribution of CD4 cell counts among HIV/AIDS patients co-infected with TB who received OAT therapy.

Bivariate analysis of categorical data on differences in analysis results between CD4 levels before and after TB co-infection of HIV/AIDS patients with a combination of ARV and OAT therapy. Statistical data analysis used the Kolmogorov-Smirnov normality test. Hypothesis testing (CD4 cell count before and after TB co-infection in HIV/AIDS patients with a combination of ARV and OAT therapy) was carried out by comparing two paired groups using the dependent T statistical test with the non-parametric Wilcoxon test.

Research Results

Frequency Distribution of HIV/AIDS Sufferers Co-Infected with TB with ART and OAT Consumption Based on Gender and Age Groups.

Table 1, the results of the frequency distribution of HIV/AIDS sufferers coinfected with TB with ARV and OAT consumption based on gender and age groups are mostly suffered by men and women in the 25-49 year age group, 50% and 29.3% respectively, as shown in the following table:

Table 1. Frequency Distribution of HIV/AIDS Patients Coinfected with TB Based on Gender and Age

	Age Group						
Gender	**<4**	**5-14**	**15-19**	**20-24**	**25-49**	**>50**	**Total**
Man	2 (2,2%)	0 (0%)	3 (3.3%)	5 (5,4%)	46 (50%)	3 (3.3%)	59 (64,1%)
Woman	2 (2,2%)	3 (3.3%)	0 (0%)	1 (1,1%)	27 (29,3%)	0 (0%)	33 (35,9%)
Total	4 (4,3%	3 (3.3%)	3 (3.3%)	6 (6,5%)	73 (79,3%)	3 (3.3%)	92 (100%)

Frequency Distribution of CD4 Cell Counts Based on The Perio.ATT Use Before TB Co-Infection in HIV/AIDS Sufferers.

Table 2: The highest number of CD4 cells in HIV/AIDS sufferers on ARV therapy was in the category <200 cells/mm3 (severe immunosuppression), with a period of ARV use <12 months, as many as 45 (48.9%) sufferers, as in the following table :

Table 2. Frequency Distribution of CD4 Cell Counts in HIV/AIDS Patients Based on the period of ART use

	CD4 Cell Count			
Duration of ARV use	**< 200 Sel/mm³ (Severe immunosuppression)**	**200-500 Sel/mm³ (moderate immunosuppression)**	**>500 Sel/mm³ (Normal)**	**Total**
< 12 Months	45 (48,9%)	3 (3.3%)	0 (0%)	48 (52,2%)
12-36 Months	23 (25%)	4 (4,3%)	1 (1,1%)	28 (30,4%)
> 36 Months	12 (13%)	4 (4,3%)	0 (0%)	16 (17,4%)
Total	80 (87%)	11 (12%)	1 (1,1%)	92 (100%)

Frequency distribution of CD4 cell counts in HIV/AIDS sufferers after tuberculosis co-infection with 6 months of ARV and OAT therapy.

Table 3, It can be seen that the CD4 count in HIV/AIDS sufferers after tuberculosis co-infection with ARV and OAT therapy for 6 months from 92 samples was found to be highest in conditions of severe immunosuppression (CD4 cell count <200 cells/mm3) in 62 (67.4%) patients and in moderate immunosuppression conditions (CD4 cell count 200-500 cells/mm3) in 29 (31.5%) sufferers, as follows:

Table 3. Frequency Distribution of CD4 Cell Counts in HIV/AIDS Patients on ARV Therapy: TB Coinfection With OAT Therapy

CD4 Count Group	CD4 Before Co-infection	CD4 After Co-infection
<200 cells/mm³	80 (87%)	62 (67,4%)
200-500 cellsl/mm³	11 (12%)	29 (31,5%)
>500 cellsl/mm³	1 (1%)	1 (1,1%)
Total	92 (100%)	92 (100%)

Analysis of test results for differences in the number of CD4 cells in HIV/AIDS sufferers before and after TB co-infection with ARV and OAT therapy

The results of the *Kolmogorov-Smirnov* data normality test showed a significance value for the number of CD4 cells in HIV/AIDS sufferers on ARV therapy before TB co-infection was 0.000 ($p<0.05$), and the number of CD4 cells in HIV/AIDS sufferers on ARV therapy after TB co-infection with AOT therapy was 0.000 ($p<0.05$). The results of the data normality test are not normally distributed, so the results of the non-parametric *Wilcoxon test* can be seen in Table 4 below:

Table 4. Wilcoxon Test Results: CD4 Count of HIV/AIDS Patients Before and After TB Coinfection

Variabel	N	*p-value*
CD4 Before TB Co-infection	92	0.000
CD4 After TB Co-infection	92	

Based on Table 4, the number of CD4 cells before TB co-infection and the number of CD4 cells after TB co

Infection obtained a p-value of 0.000 ($p<0.05$).

Thus, it can be concluded that there are differences in the results of CD4 counts before and after TB co-infection in HIV/AIDS sufferers with ARV and OAT therapy.

Discussion

Based on table 1, the percentage of HIV/AIDS sufferers with tuberculosis co-infection is mostly suffered by men in the 25-49 year age group, 50% of sufferers. Previous research by Ramdan in 2023 resulted in a high number of HIV/AIDS sufferers in men aged 26-35 years. This shows that men have a greater chance of suffering from HIV/AIDS. This condition is also supported by many of them having risky sexual relations, coupled with the use of injected drugs. Women are often affected by their partner's behavior[62]. At this age, you are sexually and reproductively active and have a strong sex drive.

In this study, the majority were in the 25-49 year age group, which means they already have a job and are financially stable enough to have the opportunity to have unsafe sexual relations. Meanwhile, those aged 17-25 years tend not to have an understanding of the risks of HIV/AIDS, thereby reducing the risk of contracting HIV/AIDS[63].

Based on Table 2, the CD4 count of HIV/AIDS sufferers with ARV therapy was mostly in the group <200 cells/mm3 (severe immunosuppression), with a duration of ARV therapy <12 months for 48.9% of sufferers. These results are supported by research by Yunita et al in 2020, which found that the average number of CD4 cells in HIV/AIDS patients was found in the severe immunosuppression group (CD4 <200 cells/mm3) with ARV treatment <12 months. The length of ARV therapy can impact the CD4 count; ARV combination therapy can increase the patient's CD4 count, with the most effective duration of therapy being at least 18 months. The longer the ARV therapy, the greater the tendency for CD4 to increase[64]. In addition, the CD4 count in HIV patients on ARV therapy can be influenced by medication adherence, clinical stage, and the presence of opportunistic infections in HIV sufferers[65].

Based on Table 3, the CD4 count of HIV/AIDS sufferers after co-infection with tuberculosis with ARV and OAT therapy for 6 months was highest in conditions of severe immunosuppression (CD4 <200 cells/mm3), 67.4% of patients, and in conditions of moderate immunosuppression (CD4 200-500 cells/mm3), 31.5% of patients. There was an increase in the number of CD4 cells in conditions of moderate immunosuppression and a decrease in the number of CD4 cells in conditions of severe immunosuppression. This research aligns with the work of Cesia et al. In 2024, there was an increase in the number of CD4 cells in HIV-coinfected TB sufferers after treatment for 6 months. PLWHA with active tuberculosis often experience a decrease in CD4 counts; usually, CD4 counts increase again after starting anti-TB treatment. TB treatment functions to cure TB, also reduces deaths due to TB, and prevents the recurrence of infection. The increase in the number of CD4 cells can be caused by tuberculosis and HIV, using the same cellular immune response in their clinical response. The use of the drug is thought to increase the activation of T cells, thereby increasing the number of CD4 cells. The initial CD4 cell count and adherence to taking medication also influence the increase in CD4 cell count[67].

Based on Table 5, there are differences in the results of CD4 cell counts before and after TB co-infection in HIV/AIDS patients with ARV and OAT therapy. In line with research by Cesia et al in 2024, there was also a difference between CD4 counts before ARV and OAT therapy in HIV sufferers with pulmonary TB co-infection at Dr RSUD. Pirngadi, Medan City. The increase in the average number of CD4 cells before treatment was 131 cells, and the number of CD4 cells after treatment was 208. The conclusion in this study was that there was an increase in the number of CD4 cells before treatment compared to the number of CD4 cells after treatment.

The number of CD4 cells is a key indicator of the immune system's function. The number of CD4 cells in HIV/AIDS co-infected TB patients can increase significantly after the patient undergoes treatment[18]. Treatment with ARVs is to

maximise HIV replication, increase the number of CD4 cells and improve the sufferer's quality of life. The use of a combination of ARV and OAT therapy in HIV/AIDS sufferers co-infected with TB is known to reduce the rate of TB and reduce the frequency of TB, thereby increasing the CD4 count[68]. Based on research by Musdalifah et al in 2016, in HIV/AIDS sufferers with TB co-infection who were undergoing ARVs and OAT, sufferers who started ARVs earlier tended to increase their CD4 count higher compared to sufferers who delayed ARV therapy. HIV/AIDS sufferers who delay ARVs until the intensive phase of OAT treatment is completed may be at risk of dying more quickly[69].

Conclusions and Implications

The gender proportion of HIV/AIDS patients with TB co-infection at Budhi Asih Regional Hospital is more male, with the age group 25-49 years accounting for as many as 50% sufferers. Among females, the largest number was in the 25-49 year age group, at 29.3%. HIV/AIDS sufferers with TB co-infection on ARV therapy before TB co-infection with OAT, with severe immunosuppression (CD4 <200 cells/mm3), and with ARV use <12 months were 48.9% of sufferers. HIV/AIDS sufferers on ARV therapy after TB co-infection with ARV therapy and OAT with severe immunosuppression (CD4 <200 cells/mm3) are 67.4% of sufferers. There is a difference in the results of CD4 cell counts before and after TB coinfection in HIV/AIDS sufferers with ARV and OAT therapy, with a p-value of 0.000 ($p<0.05$).

The government's efforts to control TB co-infection in HIV/AIDS sufferers are the same as for TB patients in general. Case management continues to include OAT and ARVs, with OAT giving priority to reduce morbidity and mortality. HIV patients with TB co-infection have a risk of developing Immune Reconstitution Inflammatory Syndrome (IRIS), especially if ARV treatment is started earlier than TB therapy. For sufferers, compliance with taking ARV and OAT medications to increase the number of CD4 cells is maintained. Then it is necessary to carry out further research regarding CD4 cell levels in HIV/AIDS sufferers coinfected with MDR-TB before and after ARV and OAT treatment.

Suggestions for Future Research

- Further research regarding CD4 levels in HIV/AIDS sufferers coinfected with TB with ARVs and OAT is based on a 2-month treatment evaluation, a 5-month treatment evaluation and a 6-month evaluation.
- Further research regarding CD4 levels in HIV/AIDS sufferers coinfected with MDR-TB before and after ARV and OAT treatment.

Declarations

Author Contributions

DL contributed to designing the conceptualisation, writing the manuscript, reviewing, editing and analysing the data. ASM contributed to literature searches, writing (original draft preparation), methodology, and data analysis. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

Data available on request due to restrictions (e.g., privacy or ethical): The data presented in this study are available upon request from the corresponding author. The data are not publicly available because the data presented by the author is in accordance with the ethical review issued by Budhi Asih Regional Hospital.

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Institutional Review Board Statement

This research uses secondary data from the HIV/AIDS Referral Hospital in DKI Jakarta is RSUD Budhi Asih. Research permits through PPID DKI Jakarta Health Service and Budhi Asih Regional Hospital. Information on ethical clearance (Ethical Clearance) was obtained from the Ethics and Research Committee of RSUD Budhi Asih No. 042/KEP-ETIK/III/2025, dated March 26 2025.

Informed Consent Statement

This research entirely uses secondary data from patient medical records at Budhi Asih Regional Hospital. The research did not use respondents, it did not use informed consent.

Conflicts of Interest

This study declares there are no conflict of interest related to this study.

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