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Prediction Model of Human Immunodeficiency Virus Status at Abdoel Wahab Sjahranie Hospital, Samarinda

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Abstract
Introduction: HIV is a serious global health problem that requires immediate attention due to its increasing prevalence. Indonesia having one of the highest numbers of cases, while East Kalimantan was one of the provinces with a high number of cases. The availability of HIV testing and counseling services at RSUD Abdoel Wahab Sjahranie enabled the researchers to analyze factors that influence HIV occurrence. This study aimed to find a prediction model for HIV status.
Methods: This cross-sectional study used secondary data from 7,589 individuals from the Voluntary Counseling and Testing (VCT) Clinic of RSUD Abdoel Wahab Sjahranie from June to December 2023. Data were collected from January to March 2024. The data were analysed using the logistic regression method.
Results: It was shown that age, injection drug use, and types of sexual behavior were significantly associated to HIV status. The obtained binary logistic regression model is: HIV status = -4.729-0,032 (age) + 6,862 (injection drug use) + 6,173 (type of sexual behavior). This model could explain 53.8 percent of the variation in HIV status based on the independent variables, with injection drug use as the dominant variable. Injection drug use and risky sexual behavior were significant factors of HIV status.
Conclusion: Injection drug users were at greater risk of HIV infection, with the highest odds ratio, followed by persons with risky sexual behavior. Further intervention efforts through expanding service coverage and diagnostic testing for key populations to prevent HIV transmission is needed.

Keywords: HIV status; injection drug use; sexual transmitted infection; sexual behavior.

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Introduction

Human immunodeficiency virus (HIV) is defined by the Centers for Disease Control and Prevention (CDC) as an infection that targets the immune system.[1] By targeting CD4 cells, which are white blood cells, HIV reduces the body's resistance to opportunistic infections.[2] HIV can infect anyone, including infants, adolescents, and adults. In its final stage, the severe illness known as acquired immunodeficiency syndrome (AIDS), which is brought on by the human immunodeficiency virus (HIV), causes the body to lose all of its defenses against infections. HIV is therefore a serious

worldwide health issue that requires immediate attention.[3] According to World Health Organization (WHO), an estimated 40.0 million people were living with HIV at the end of 2023. Africa had the highest prevalence with 26.0 million cases, followed by the Americas and Southeast Asia, both with 4.0 million cases.[4] The Indonesian Ministry of Health (Kemenkes RI) projected that the total number of HIV cases in Indonesia will increase from 329.5 thousand in 2022 to 377.6 thousand in 2023.[6,7]

East Kalimantan province plays a significant role in Indonesia's high HIV prevalence. The region experienced an increase in new HIV infections from 1,100 in 2021 to 1,300 in 2022. Overall, East Kalimantan has recorded 11,300 HIV cases, ranking it within the top ten Indonesian provinces for new infections. Within the province, Samarinda reported the highest number of new cases (447), followed by Balikpapan (338) and Kutai Kartanegara (172). According to the Head of the East Kalimantan Health Office, HIV transmission in the region is primarily driven by risky sexual practices and the use of injectable drugs.[8]

The HIV virus can remain in the body of the infected person permanently. If left untreated, the virus can be transmitted to others because people living with HIV can appear healthy and do not show any symptoms.[9] HIV can cause physical problems in the form of opportunistic infections due to a weakened immune system in people living with HIV (PLHIV). *Cryptococcal meningitis* and toxoplasmosis are two complications that can cause death in PLHIV. Furthermore, PLHIV faced psychological and social problems as a result of differential treatment, stigma, and discrimination from family, community, and healthcare workers. This can also trigger mental health issues for people living with HIV, such as depression.[9–11] Despite the serious impact, there are efforts that can be made to prevent HIV.

Efforts to prevent HIV include using condoms for both men and women during sexual intercourse, stopping the use of injectable drugs for drug users, and circumcision for men.[12] Additionally, HIV can be prevented through early HIV testing, reducing risky sexual behavior, and promptly initiating treatment if infected with HIV.[13,14] Through a variety of media, numerous attempts have been made to educate the public about HIV transmission and prevention. But in fact, HIV cases were still rising suggesting that these initiatives have not been totally successful.[15] Therefore, a proper analysis is needed to determine the most influential factors of HIV status. One of the analyses that can be used is statistical testing. Statistics play an important role in analyzing problems to solve them and to make decisions.[16] One option for statistical testing to ascertain the structure of the relationship between variables with a cause-and-effect relationship is binary logistic regression analysis.[17] Binary logistic regression can be used to model the most influential determinants with the dependent variable.[18] Several previous studies conducted by Agustina and Barokah (2021) in Yogyakarta and Masriyani et al. (2019) in Aceh showed that the binary logistic regression method could predict sexually transmitted infections, including HIV. The result of model is expected to provide specific information, including on the determinants of HIV status, which can be used as a consideration in the implementation of health services and the improvement of preventive efforts related to HIV, from the community level to the competent authorities.[19,20]

Many factors can cause HIV, including sociodemographic factors, behavioral factors, and a history of sexually transmitted diseases.[21] Some studies showed that individuals of productive age have a 1.47 times higher risk of being infected with HIV compared to individuals of non-productive age.[22,23] Based on gender, men have a 1.773 times higher risk of being infected with HIV compared to women.[24] A study by Murtono et al. (2018) showed that a history of sexually transmitted infections increased the risk of HIV infection by 4.36 times.[25] Another study stated that injecting drug users (IDU) were associated with HIV infection.[26] According to the research of Halim et al. (2019), risky sexual behavior, such as not using condoms, having multiple partners, and anal sex, increased the risk of HIV infection

by 3.2 times.[27] With the known risk factors, proper handling; from screening to treatment, is certainly necessary for HIV patients. The Abdoel Wahab Sjahranie Regional General Hospital (RSUD Abdoel Wahab Sjahranie) is one of the health facilities that plays a role in managing HIV in East Kalimantan. RSUD Abdoel Wahab Sjahranie, located in Samarinda city, is a referral hospital owned by the East Kalimantan Government and has sophisticated facilities, including counseling and referrals for HIV testing as stated in the studies by Zahro et al. (2017) and Thamrin et al. (2023), which utilized the VCT clinic and the laboratory of Abdoel Wahab Sjahranie General Hospital to assess risk factors and the utilization of services by the community.[28,29]

Based on the description provided, it has been proven that age, gender, sexually transmitted infections, injecting drug use, and types of sexual behavior influence HIV status. However, the use of secondary data, especially data from the Voluntary Counseling and Testing (VCT) Clinic of RSUD Abdoel Wahab Sjahranie, is still limited. Therefore, an analysis will be conducted to see the factors related to HIV status at RSUD Abdoel Wahab Sjahranie using binary logistic regression analysis.

Methods

This study is a cross sectional study on secondary data from the Voluntary Counseling and Testing (VCT) Clinic of RSUD Abdoel Wahab Sjahranie to analyze the determinants that were related to HIV status. Secondary data were in the form of HIV examination results for the period of June - December 2023, obtained from the VCT Clinic of Abdoel Wahab Sjahranie Regional Hospital. Data were collected from January to March 2024.

The study population refered to all individual data of those who underwent HIV testing and were recorded at the VCT Clinic of Abdoel Wahab Sjahranie Regional Hospital between July and December 2023. A total of 7,589 individual data were obtained. Sampling was done based on the inclusion and exclusion criteria of the study. The inclusion criteria were individuals recorded at the VCT Clinic of Abdoel Wahab Sjahranie Regional Hospital with complete examination data, including respondent characteristics (age and gender), HIV risk factors, and examination results for individuals aged > 15 years. According to the categorization by BPS (Statistics Central Bureau), which indicates that the productive age starts from 15 years old, which might influence the activities and behaviors related to HIV.

The exclusion criteria were individuals with inconclusive examination results (HIV test results that did not provide a definitive answer, or could not be confirmed whether someone is infected with HIV or not, as some results in the rapid tests (R1, R2, and R3) are positive while others are negative), incomplete examination data, and data for individuals with > 1 examination. After data cleaning, the number of samples obtained that met the criteria were 6,532 individuals. The data were analyzed using multivariate binary logistic regression to predict the factors that influence HIV status.

Results

Individual Characteristics and risk factors

The individual characteristic data presented in the table 1 includes age, gender, sexually transmitted infections, injection drug use, and type of sexual behavior. Most of the subjects (99.2%) did not have a history of STIs. Regarding the other risk factors, 99.9% are non injection drug user dan 99.2% had no STI and 98.9% of the subjects had non-risky sexual behavior (98.9%).

Table 2 shows that the majority of the individuals' HIV status after undergoing HIV testing was non-HIV positive (99.1%). This occurred because most of the HIV tests were performed on the general population or community groups whose risk factors had not been further investigated. The general population consisted of individuals who underwent HIV testing due to medical procedures, such as surgery. Meanwhile, among the population with risks, the majority were in the high-risk partner group and men who have sex with men.

The bivariate analysis in Table 2 shows the distribution of HIV status among the study participants. The results indicate that the vast majority of individuals (99.1%) tested HIV negative.

The results presented in Table 3 indicate that the variables of age, injection drug use, and type of sexual behavior had a significant association to HIV status. The logit model that was formed is as follows:

$$HIV\ Status = -4{,}729 - 0{,}032\,(age) + 6{,}862\,(injection\ drug\ use) + 6{,}173\,(type\ of\ sexual\ behavior)$$

Additionally, there are odds ratio values between one category and another based on the Exp(β) value, with the following elaboration that injection drug users tend to have a 921.47 times higher risk of being HIV positive. Individuals with risky sexual behavior tend to have a 479.66 times higher risk of being HIV positive and for every 1-year increase in age, the tendency for being HIV positive decreases by 0.968 times.

These results indicate that injection drug use and risky sexual behavior are major risk factors for HIV positivity, while increasing age has a protective effect. The logit model presented provides a quantitative assessment of the relationship between these key determinants and HIV status.

The Nagelkerke R Square value from the coefficient of determination test was used to evaluate the explanatory power of the predictor variables within the model. The result showed a Nagelkerke R Square of 0.538, meaning the predictor variables in the model explained 53.8 percent of the variance. The other 46.2 percent of the variance was likely due to variables not included in the model, which demonstrated a classification accuracy of 99.3 percent. The predictive strength of the model might be improved by incorporating factors such as condom use behavior, data for which was unavailable at the study location.

In other words, the set of predictor variables in the model (age, injection drug use, and type of sexual behavior) collectively account for 53.8 percent of the variability in the outcome variable (HIV status). The remaining 46.2 percent of the variability is attributable to other factors not captured by the current model. The model's classification accuracy is high, at 99.3 percent, indicating that it effectively predicts the HIV status of the study participants.

This is likely because Table 1. Characteristics and risk factors (n=6,532)

Individual characteristics	**Mean.**	**Min.**	**Max.**	**Frequency**	**Percentages**
Age	45.4	15	93		
Gender					
Male				3,232	50.5
Female				3,300	49.5
Sexually transmintted infection (STI)					
Has STI				52	0.8
No STI				6,480	99.2
Injection drug user					
User				4	0.1
Non – user				6,528	99.9
Type of sexual behavior					
Risky				69	1.1
Non – risky				6,463	98.9

Table 2. Distribution by HIV Status (n = 6.532)

No	**HIV Status**	**Frequency**	**Percentage (100%)**
1	Positive	56	0.9
2	Negative	6,476	99.1

Multivariate Analysis

Table 3. Results of Multivariate Analysis on Determinants of HIV Status

No	Variables	β	*Wald*	*p-value*	Exp(β)
1	Age	-0.032	5.550	0.018*	0.968
2	Injection drug use	6.826	33.026	< 0.001*	921.472
3	Sexual behavior	6.173	398.883	< 0.001*	479.661
	Constant	-4.729	67.457	< 0.001*	0.009

Discussion

Characteristics of Respondents

The research results in Table 1 show that the average age of individuals who undergo HIV testing is 45.37 years, which is still classified as productive age, According to the categorization by BPS, which states that the productive age range is between 15 and 65 years.[30] Generally, individuals at productive age have a wider social circle because they are involved in many activities, like work or any activities and make possibility to meet new people. In addition, individuals of productive age also exhibit sexual interest, which increases the possibility of engaging in risky sexual activities. This condition increases the risk of HIV infection by 1.47 times in individuals of productive age.[22,23,31]

Based on gender, the majority of individuals who undergo HIV testing are female (50.5%). Both males and females are equally at risk of being exposed to HIV. However, most HIV cases found in women were not because of their own behavior, but rather due to exposure from their husbands or partners who frequently visited commercial sex workers or were homosexual.[32] Based on sexually transmitted infections, the majority of individuals who underwent HIV testing did not have a history of sexually transmitted infections (99.2%). A history of sexually transmitted infections would increase the risk of HIV infection by up to 4.36 times. Sexually transmitted infections serve as an entry point for HIV. Genital lesions caused by infections in the genital area will increase the likelihood of HIV transmission through unprotected sexual intercourse.[25] These lesions become an entry point for the HIV virus through the medium of blood, semen, and vaginal fluids due to unsafe sexual practices.

Regarding injecting drug use (IDU) as a basis for testing, the vast majority of people undergoing HIV tests (99.9%) were not individuals who used injected drugs. However, injecting drug users represent a key population at high risk for HIV transmission and other bloodborne illnesses. This elevated risk is due to unsafe injection practices, such as reusing or sharing syringes, which increases their likelihood of HIV infection by 2.09 times.[23,33,34] Although the majority (98.9%) of people underwent HIV tests were classified as having non-risky sexual behavior (when considering this as a factor), the Indonesian Ministry of Health (2017) highlighted several groups with a greater vulnerability to HIV infection, referred to as key populations.[35] Female sex workers (FSW), men who have sex with men (MSM), injecting drug users (IDU), transgender people, and sex workers' clients (both FSW and transgender) were among these key populations that had been identified as being at higher risk.

Multivariate Analysis

The results of the multivariate analysis showed that injecting drug users had a risk of having HIV-positive status up to 921.47 times higher. This is supported by the research of Rama, Aryawati, and Angelina (2024) in Bandar Lampung and Jose et al. (2020) in Thailand, which showed that injecting drug use was associated with the occurrence of HIV.[36,37] The main factor influencing HIV infection in injecting drug users was the behavior of sharing needles. Generally, one syringe could be used by 2 to 15 drug users. Even if the unsterile syringe is used only once, it can potentially transmit the virus, which may develop into HIV.[38,39] In addition, it is often the case that injecting drug users who have been infected with HIV continue to have sexual intercourse with their regular or casual partners without using condoms.

A survey by the United States Agency for International Development (USAID) also revealed that many injecting drug users use drugs outside of their homes, which results in having multiple sexual partners, including sex workers if they are not with their partners..[40]

Other risk factors that are closely related to HIV infection are sexual behaviors. Sexual behavior, especially those leading to sexual intercourse, can cause various problems, such as unwanted pregnancy, abortion, and sexually transmitted diseases and/or infections, including HIV. Unsafe sexual behavior is referred to as risky sexual behavior.[41] The research results show that individuals with risky sexual behavior tend to increase the likelihood of having HIV-positive status up to 479.661 times higher. Another study conducted by Angraini et al. (2020) in Demak also showed that someone with risky sexual behavior is 3.235 times more susceptible to HIV infection.[42] Engaging in anal intercourse with both same-sex and opposite-sex partners and having multiple sexual partners without the use of condoms are examples of risky sexual behavior.[5] In this study, the types of risky sexual behavior were categorized based on population groups. High-risk partners, transgender people, males who have sex with men (MSM), female sex workers (FSW), high-risk partners, and sex worker clients are among the population groups.[43]

High-risk partners are a group of individuals who are partners of high-risk groups, including partners of male/female sex workers, MSM partners, transgender partners, partners of injecting drug users, and sex worker clients. This causes high-risk partners to be vulnerable to HIV infection, even though they are actually part of the general population (do not have risky behavior because they only have one partner).[44,45] This is supported by data compiled by the Indonesian Ministry of Health, which showed that 35 percent of housewives were HIV positives. This exposure is mostly obtained from husbands who regularly visit commercial sex workers, as well as husbands who turn out to be homosexual.[32] Men who have sex with men (MSM) are men who engage in sexual activity with other men. MSM can also be defined as men who engage in anal sex.[45] Due to their engagement in anal sex, men who had sex with men (MSM) were at a 5.89 times greater risk of being infected with sexually transmitted diseases (STDs), including HIV, when compared to other men, even those who identify as bisexual.[46]

The anus is very different from the vagina, which has multiple protective layers against viral infections, as the anus only has a thin single layer. Additionally, the anus does not produce natural lubricants like the vagina, making it more prone to injury during sexual activity. These injuries can facilitate virus entry and infection.[47,48] This situation is exacerbated by the low usage of condoms, which is highly effective in preventing HIV transmission.[44] According to the 2023 Executive Report on HIV and Sexually Transmitted Infections (STIs), the MSM population had the highest prevalence of people living with HIV (PLHIV), accounting for 104.6 thousand cases or 27.7% of the total population.[6] Based on the modeling from this study, supported by other research, more attention is needed for HIV control, especially among people who inject drugs and high-risk sexual behavior groups. Some efforts have been made, including by WHO and the Ministry of Health, recommending needle and syringe programs as an HIV control strategy for people who inject drugs, as well as providing education for high-risk populations. However, the difficulty in reaching these populations, whose behaviors are often considered deviant by society, has hindered efforts to provide them with health services, particularly for HIV/AIDS prevention and management. Therefore, other approaches are needed that go beyond a single sector and involve various stakeholders to effectively reach and provide services and testing to these populations.

The study also found that as individuals' age increases, the risk of being PLHIV decreases. Increasing age tends to influence an individual's decision-making behavior. As people get older, they tend to become wiser in their decisions, likely due to the accumulation of knowledge and experience. This knowledge can be gained through formal education or informal

channels, such as health education from professionals and social media. A study by Aisyah, Syafar, and Amiruddin (2020) in Pare-Pare showed an increase in individual knowledge after receiving HIV education through social media.[49] Even receiving information through social media can provide a new cognitive foundation for knowledge about HIV. This can help individuals control their desires, including those related to sexual interests and other high-risk behaviors that can lead to HIV infection. If individuals are already in high-risk populations for HIV, increased self-control or self-awareness due to age can be a supportive factor for them to abandon such behaviors, even without direct intervention due to the difficulty in reaching these populations.

Conclusion

According to the analysis's findings, HIV status at Abdul Wahab Sjahranie General Hospital in 2023 can be predicted by 53.8 percent based on factors such as age, intravenous drug use (IDU), and sexual behavior types, with IDU being the most important factor. Therefore, in order to provide accurate information for early prevention measures and to develop strategies to enhance the control of infectious diseases, particularly HIV, more research is required to investigate other variables not included in this study.

Ethics approval

Ethical approval for this research was granted by the Health Research Ethics Committee at RSUD Abdoel Wahab Sjahranie Samarinda on February 25, 2024, as indicated by ethical clearance number 366/KEPK-AWS/II/2024.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available as this data belongs to Abdul Wahab Sjahranie Hospital and is used for research purposes only. The secondary data has not been granted permission to be published for any purpose other than research, but are available from the corresponding author on reasonable request.

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