

Identification of Risk Factors and Mapping of HIV/AIDS Spread Using Geographic Information Systems (GIS) Based on Patient Medical Records at the Baubau City Regional General Hospital

Izul Muslimah^{1*}, Sri Wahyuni², Mega Ermasari Muzuh³
^{1,2,3} Politeknik Baubau Indonesia

ARTICLE INFORMATION

Received: 23 February 2026
Revised : 17 March 2026
Accepted: 27 April 2026
DOI:

KEYWORDS

Kata 1; HIV/AIDS, Pemetaan Spasial, GIS

Keywords: HIV/AIDS, Spatial Mapping, GIS

CORRESPONDING AUTHOR

Nama : Sri Wahyuni, S.KM., M.Kes
Address: Jl. Gatot Subroto, Kel. BWI
E-mail : Srimarsl@gmail.com

A B S T R A C T

HIV is a virus that attacks the immune system, particularly CD4 cells, which play a crucial role in defending against infection. This study aims to map the distribution of HIV/AIDS cases in the work area of BLUD Baubau City Hospital from 2024 to June 2025, considering regional characteristics, gender, age groups, and risk factors. The study employed an exploratory qualitative approach with a case study design, using patient medical record documentation analyzed with ArcGIS 10.8 Geographic Information System (GIS) software. The results indicated that HIV/AIDS cases were most prevalent in densely populated urban areas, such as Wolio and Betoambari Districts, classified as high-intensity zones. In terms of gender, men accounted for more cases (35) than women (24). Regarding age groups, most cases occurred among the productive age group (25–49 years), totaling 30 cases. Contributing risk factors included population density, socioeconomic activity, unsafe sexual behavior, and low awareness of early testing and use of protective measures. In conclusion, GIS-based mapping facilitates the identification of priority areas for intervention and supports data-driven decision-making for HIV/AIDS prevention strategies at the local level.

INTRODUCTION

Human Immunodeficiency Virus (HIV) to date remains a major challenge in global health because it contributes significantly to increased morbidity and mortality rates, while also having complex socioeconomic impacts. According to (Adetokunboh & Are, 2024), The spread of HIV is dynamic and non-linear, so control efforts cannot be carried out uniformly. Effective prevention requires an evidence-based approach that takes into account epidemiological data and spatial distribution patterns, so that intervention policies are more targeted. Thus, HIV prevention strategies must be designed in a multidisciplinary manner, taking into account.

HIV risk factors are multifactorial and interact with each other. Risky sexual behavior, low condom use, and injecting drug use are the main contributors to transmission. Furthermore, sociodemographic factors such as education level, economic status, and cultural norms also exacerbate the vulnerability of the population. (Zulu et al., 2014) emphasizes that behavioral determinants influenced by social and economic structures play a dominant role in the increase in HIV cases. Therefore, identifying risk factors at the local level is crucial, as HIV epidemic patterns often vary between regions. This identification will help design interventions that are relevant to the specific conditions of the target population.

The distribution of HIV is not geographically homogeneous, but rather shows certain concentrations or forms hotspots in high-risk areas.. (Cuadros et al., 2013) Proving that the spatial mapping approach is capable of identifying priority areas for intervention more quickly and efficiently. Through this mapping, health resources can be allocated more proportionally, so that prevention and treatment efforts can be carried out in a targeted manner. Therefore, spatial analysis plays an important role in providing a comprehensive picture of the dynamics of HIV epidemics in various regions, especially those with high levels of mobility and vulnerability.

Geographic Information Systems (GIS) have proven to be an effective approach to support HIV spread analysis. (Vanmeulebrouk et al., 2008) in (Setton et al., 2008) emphasizes that GIS not only functions as a tool for visualizing case distribution, but also as a strategic instrument in decision-making, particularly in determining health service priorities.

Through data integration into digital maps, GIS is able to display HIV distribution trends and predict potential future case expansion. Thus, GIS plays a dual role, namely as a means of academic analysis and a practical instrument for public health program planning.

In addition to GIS technology, the use of electronic medical records is also an important source for understanding the development of the HIV epidemic.. (Ndisha et al., 2023) emphasizes that medical records provide detailed information about the diagnosis, treatment, and follow-up care of HIV patients. When this data is integrated with GIS, spatial analysis can be performed with greater detail, including patient demographics, disease progression patterns, and response to therapy. The combination of GIS and medical records enables the creation of a comprehensive database to support evidence-based health policy formulation.

At both the national and local levels, spatial analysis of HIV cases is also an important issue in Indonesia. (Chen et al., 2019) found that HIV transmission tends to be concentrated among productive age groups and in areas with high population mobility, such as urban areas or commercial centers. These conditions underscore the urgency of conducting research based on hospital medical records combined with GIS analysis to produce a more accurate spatial picture at the city level. With this type of analysis, intervention strategies can be focused on the most vulnerable groups and areas, thereby making prevention efforts more effective.

Based on this background, this study is titled “Identification of Risk Factors and Mapping of HIV/AIDS Spread Using Geographic Information Systems (GIS) Based on Patient Medical Records at the Baubau City Regional General Hospital.” With reference to the findings (Boyda et al., 2019) and also (Aturinde et al., 2019), This study is expected to identify HIV risk determinants in the local population of Baubau City, map the distribution of cases based on medical record data, and develop more targeted intervention recommendations. The results of this study are expected to be useful not only for hospitals as service providers, but also for public health policymakers in formulating HIV/AIDS prevention strategies at the city level.

METHOD

This type of research uses an exploratory qualitative approach that aims to explore in depth social phenomena that are still poorly understood, particularly those related to HIV/AIDS transmission patterns and risk factors in Baubau City. The research design chosen is Action Research, which is reflective and participatory in nature, allowing for continuous analysis and the generation of practical recommendations. The research subjects were the medical records of HIV/AIDS patients at the Baubau City Hospital, while the research objects included the spatial distribution patterns of the disease and the risk determinants that influence it. Data was obtained through medical record documentation, then analyzed using ArcGIS 10.8 Geographic Information System (GIS) software to map distribution trends, identify clusters, and understand the dynamics of the HIV/AIDS epidemic more comprehensively at the local level.

RESULTS & DISCUSSION

Mapping the Spread of HIV/AIDS in the Working Area of the Baubau City Hospital BLUD

The following is data on HIV/AIDS cases and disease mapping based on medical records at the Baubau City Regional General Hospital from 2024 to June 2025:

Table 1. Total Number of HIV/AIDS Cases in the Service Area of the Baubau City Regional General Hospital BLUD from 2024 to June 2025

No	subdistrict	HIV/AIDS cases
1	Wolio	17
2	Betoambari	15
3	Batupoaro	8
4	Kokalukuna	7
5	Murhum	5
6	Bungi	3
7	Lea-lea	2
8	Sorawolio	2

source: Secondary Data, 2025

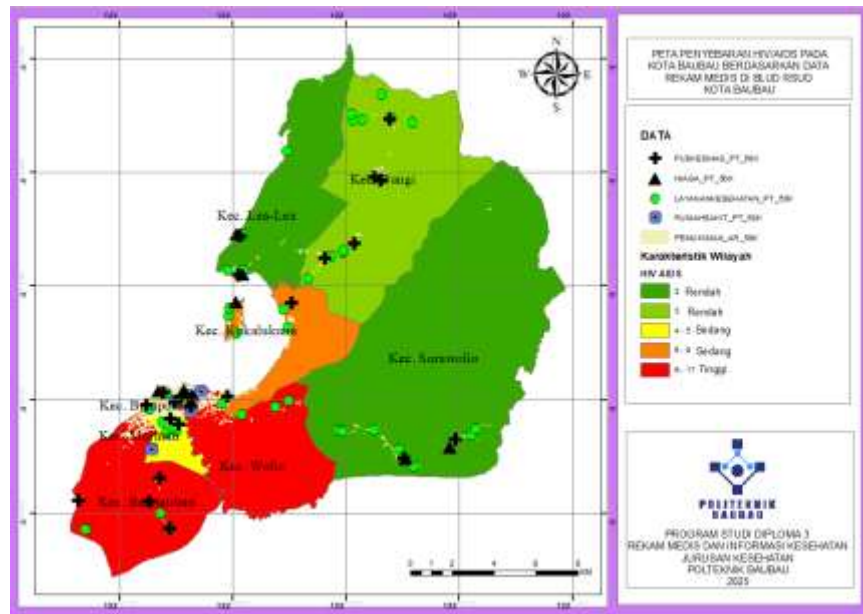


Figure 1. Map of HIV/AIDS Case Distribution in the HIV/AIDS Work Area of the Baubau City Hospital BLUD from 2024 to June 2025

Based on the data in Table 1 and the case distribution map, it is known that the number of HIV/AIDS cases in Baubau City shows variations in distribution between subdistricts, with a total of 59 cases. Wolio Subdistrict is recorded as the area with the highest number of cases, namely 17 cases, followed by Betoambari Subdistrict with 15 cases, Batupoaro Subdistrict with 8 cases, and Kokalukuna Subdistrict with 7 cases. Furthermore, Murhum District has 5 cases, Bungi District has 3 cases, while Lea-Lea and Sorawolio Districts each only recorded 2 cases. This data indicates that the spread of HIV/AIDS in Baubau City is not evenly distributed but concentrated in central urban areas with higher population density and socio-economic activity, such as Wolio and Betoambari. This finding aligns with research (Dwiguna et al., 2024) in Tabanan Regency, which found that urban areas with high population density tend to have more cases of HIV/AIDS, as well as research (Arif et al., 2016) in Jember Regency, which shows a concentration of cases in densely populated areas such as Kencong and Puger. The main risk factors in both studies include risky heterosexual behavior and limited access to health information and services. Thus, the pattern of HIV/AIDS spread in Baubau City is similar to other areas, where cases are more prevalent among socially and economically active groups of productive age. This situation underscores the need for prevention interventions based on region and age group, as well as the use of Geographic Information Systems (GIS) as a strategic tool in planning more targeted, efficient, and evidence-based health policies at the local level.

Mapping the Distribution of HIV/AIDS in the Working Area of the Babau City Regional General Hospital BLUD Based on Gender:

The following is data on HIV/AIDS cases and disease mapping by gender based on medical records from the Baubau City Regional General Hospital from 2024 to June 2025:

Table 2. Number of HIV/AIDS Cases by Gender in the Service Area of the Baubau City Regional General Hospital BLUD from 2024 to June 2025

No	Subdistrict	Male	Woman
1	Wolio	9	8
2	Betoambari	8	7
3	Batupoaro	4	4
4	Kokalukuna	4	3
5	Murhum	4	1
6	Bungi	3	

No	Subdistrict	Male	Woman
7	Lea-lea	2	
8	Sorawolio	1	1
Total		35	24

Source: Secondary Data, 2025

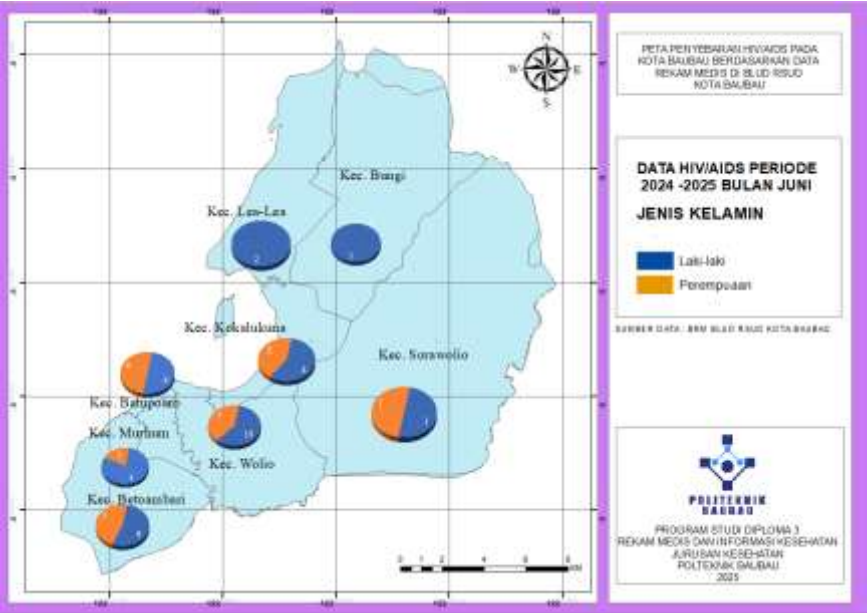


Figure 2. Map of HIV/AIDS Case Distribution by Gender in the Working Area of the Baubau City Hospital BLUD from 2024 to June 2025

Based on data and case distribution maps at the Baubau City Regional General Hospital BLUD for the period 2024 to June 2025, there were 59 cases of HIV/AIDS, with 35 cases in men and 24 cases in women. The highest distribution of cases was in Wolio District (17 cases) and Betoambari District (15 cases), while Sorawolio District recorded the lowest number (2 cases). The higher proportion of cases among men indicates a particular vulnerability in this group

This phenomenon is in line with reports (UNAIDS, 2023) which states that men of productive age, especially MSM, sex workers, and migrant workers, have a higher risk of HIV infection than the general population. (Global Report, 2023) highlighting that stigma and discrimination hinder access to health services for at-risk groups, while migrant workers face additional barriers related to mobility and limited information (Kwan et al., 2024). Research by Dwiguna et al. (2024) also shows a predominance of cases among men in the informal sector with risky sexual behavior, such as multiple partners and low condom use.

Therefore, HIV/AIDS control strategies in Baubau City need to take gender into account, with education and health promotion campaigns targeting men as a group key, especially in the regions with high prevalence, to reduce transmission and raise awareness of safe sexual behavior.

Pemetaan sebaran HIV/AIDS di Wilayah Kerja BLUD RSUD Kota Baubau Berdasarkan Umur

The following is data on HIV/AIDS cases and disease mapping based on age obtained from medical records at the Baubau City Regional General Hospital from 2024 to June 2025:

Table 3. Number of HIV/AIDS Cases by Age Group in the Working Area of the Baubau City Regional General Hospital BLUD from 2024 to June 2025

No	Subdistrict	Age Group				
		5-14	15-19	20-24	25-49	50 Years
1	Wolio			4	8	4
2	Betoambari			6	6	3
3	Batupoaro			3	4	1

4	Kokalukuna		2	5	
5	Murhum	1		3	1
6	Bungi			2	1
7	Lea-lea	1			1
8	Sorawolio			2	
Total		1	1	15	30
				15	15

Source: Secondary Data, 2025

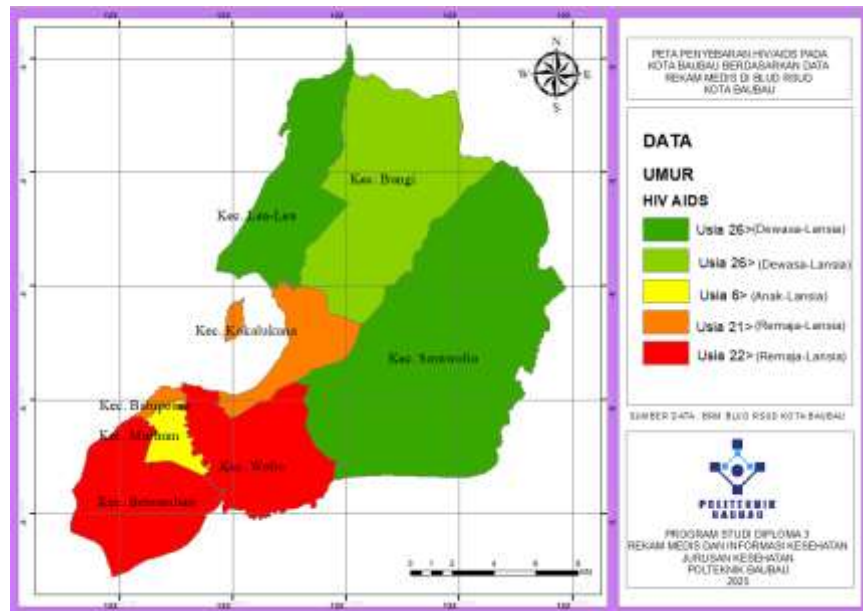


Figure 3. Map of HIV/AIDS Case Distribution Based on Age in the HIV/AIDS Work Area of the Baubau City Hospital BLUD from 2024 to June 2025

Based on Table 3, the mapping of cases in the working area of the Baubau City Regional General Hospital BLUD recorded 59 cases of HIV/AIDS in the period from 2024 to June 2025, consisting of 35 cases in men and 24 cases in women. The highest number of cases occurred in Wolio District (17 cases) and Betoambari District (15 cases), while the lowest number of cases was recorded in Sorawolio District (2 cases). Overall, cases among males were more dominant than among females.

This phenomenon is consistent with the findings (Dwiguna et al., 2024) in Tabanan Regency, which shows that the 30–39 age group has the highest rate of HIV infection, followed by the 40–49 and 20–29 age groups. They explain that HIV infection often begins in late adolescence, but symptoms or diagnosis only appear during productive age due to the long incubation period (5–10 years). This is reinforced by research (Hilman & Ndraha, 2019) at Koja Regional General Hospital, where the 30–39 age group (57.9%) accounted for the highest number of patients, followed by the 40–49 age group. Research (Prawira et al., 2020) The VCT Clinic at St. Antonius Hospital in Pontianak also reported that 82.76% of cases occurred in the 25–49 age group.

Overall, these findings confirm the need for age-based intervention strategies, particularly targeting the productive age group (25–49 years) who are socially and economically active and have high mobility and lifestyles. Education programs, VCT (Voluntary Counseling and Testing) services, safe sexual behavior education, and expanded access to protective equipment should be focused on this group to reduce the spread of HIV/AIDS in urban areas such as Baubau City.

CLOSING

Analysis of the characteristics of HIV/AIDS cases shows that the highest prevalence occurs in densely populated urban areas that are centers of socioeconomic activity, such as Wolio and Betoambari subdistricts, which are classified as high-prevalence areas (9–17 cases). In contrast, Sorawolio and Lea-Lea subdistricts have low prevalence. This pattern confirms the link between population density, social activity, and the risk of HIV/AIDS transmission. Based on gender, of the total 59 cases, 35 cases occurred in men and 24 cases in women, indicating that men are more vulnerable to HIV/AIDS transmission in Baubau City. Male dominance is evident in almost all subdistricts, with some areas such

as Bungi and Lea-Lea recording cases only among males. Based on age group, most cases were found among those of productive age (25–49 years) namely 30 cases. This group has high mobility and socioeconomic activity, making them more at risk of infection. There were 15 cases among older adults and 1 case among adolescents. The main risk factors contributing to the high number of HIV/AIDS cases in Baubau City include population density, socioeconomic activity, unsafe sexual behavior, and low awareness of testing and self-protection. Economically active men of reproductive age who engage in risky behaviors, such as having multiple partners or not using protection during sexual intercourse, are the most vulnerable group to HIV infection.

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to Mrs. Sri Wahyuni, S.KM., M.Kes as Supervisor I and Mrs. Mega Ermasari Muzuh, S.KM., M.Kes as Supervisor II for their guidance, direction, and motivation during the preparation of this work. The author also extends gratitude to family and friends for their unwavering support, prayers, and encouragement throughout the writing process.

DAFTAR PUSTAKA

- Adetokunboh, O. O., & Are, E. B. (2024). Spatial distribution and determinants of HIV high burden in the Southern African sub-region. *PLoS ONE*, *19*(4), 1–13. <https://doi.org/10.1371/journal.pone.0301850>
- Arif, A., Ariyanto, Y., & Ramani, A. (2016). Pemetaan Faktor Risiko Kejadian HIV dan AIDS di Kabupaten Jember Tahun 2015. *Artikel Ilmiah Hasil Penelitian Mahasiswa*, 1–7.
- Aturinde, A., Farnaghi, M., Pilesjö, P., & Mansourian, A. (2019). Spatial analysis of HIV-TB co-clustering in Uganda. *BMC Infectious Diseases*, *19*(1), 1–10. <https://doi.org/10.1186/s12879-019-4246-2>
- Boyda, D. C., Holzman, S. B., Berman, A., Kathryn Grabowski, M., & Chang, L. W. (2019). Geographic information systems, spatial analysis, and HIV in Africa: A scoping review. *PLoS ONE*, *14*(5), 1–22. <https://doi.org/10.1371/JOURNAL.PONE.0216388>
- Chen, M., Ma, Y., Chen, H., Dai, J., Luo, H., Yang, C., Dong, L., Jin, X., Yang, M., Yang, L., Song, L., Jia, M., & Song, Z. (2019). Demographic characteristics and spatial clusters of recent HIV-1 infections among newly diagnosed HIV-1 cases in Yunnan, China, 2015. *BMC Public Health*, *19*(1), 1–11. <https://doi.org/10.1186/s12889-019-7557-8>
- Cuadros, D. F., Awad, S. F., & Abu-Raddad, L. J. (2013). Mapping HIV clustering: A strategy for identifying populations at high risk of HIV infection in sub-Saharan Africa. *International Journal of Health Geographics*, *12*, 1–9. <https://doi.org/10.1186/1476-072X-12-28>
- Dwiguna, D. M. H., Adisanjaya, N. N., & Wasita, R. R. R. (2024). *Geographic Information System (GIS) -Based Mapping of HIV / AIDS Disease in Tabanan in 2021 Program Studi Perekam Informasi Kesehatan, Universitas Dhyana Pura, Bali*, 3(3), 203–208.
- Global Report. (2023). *People Living with HIV Stigma Index 2.0 Hear us Out: Community Measuring HIV-related Stigma and Discrimination*. 4–42. <https://www.stigmaindex.org/wp-content/uploads/2023/11/PLHIV-Stigma-Index-Global-Report-2023-2.pdf>
- Hilman, C. C., & Ndraha, S. (2019). Profil Penderita HIV / AIDS di RSUD Koja. *Jurnal Kedokteran Meditek*, *25*(2), 81–87. <https://doi.org/10.36452/jkdoktmeditek.v25i2.1730>
- Kwan, B., Torabzadeh, H. R., Akinwalere, A. O., Nguyen, J., Cortez, P., Abdullozoda, J., Yusufi, S. J., Alaei, K., & Alaei, A. (2024). Inclusion of Labor Migrants as a Potential Key Population for HIV: A Nationwide Study from Tajikistan. *Tropical Medicine and Infectious Disease*, *9*(12), 1–12. <https://doi.org/10.3390/tropicalmed9120304>

- Ndisha, M., Hassan, A. S., Ngari, F., Munene, E., Gikura, M., Kimutai, K., Muthoka, K., Murie, L. A., Tolentino, H., Odhiambo, J., Mwele, P., Odero, L., Mbaire, K., Omoro, G., & Kimanga, D. O. (2023). Leveraging electronic medical records for HIV testing, care, and treatment programming in Kenya—the national data warehouse project. *BMC Medical Informatics and Decision Making*, 23(1), 1–12. <https://doi.org/10.1186/s12911-023-02265-6>
- Prawira, Y., Uwan, W. B., & Ilmiawan, M. I. (2020). Karakteristik penderita infeksi HIV/AIDS di klinik voluntary counseling and testing Lazarus RS St. Antonius Pontianak tahun 2017. *Jurnal Cerebellum*, 5(4A), 1519. <https://doi.org/10.26418/jc.v5i4a.43017>
- Setton, E. M., Peter, C. P., Cloutier-Fisher, D., & Hystad, P. W. (2008). Spatial variations in estimated chronic exposure to traffic-related air pollution in working populations: A simulation. *International Journal of Health Geographics*, 7(2), 1–17. <https://doi.org/10.1186/1476-072X-7-39>
- UNAIDS. (2023). The Path That Ends AIDS. In *The Path That Ends AIDS* (p. 196). Join United Nations Programme on HIV/AIDS (UNAIDS).
- Vanmeulebrouk, B., Rivett, U., Ricketts, A., & Loudon, M. (2008). Open source GIS for HIV/AIDS management. *International Journal of Health Geographics*, 7, 1–16. <https://doi.org/10.1186/1476-072X-7-53>
- Zulu, L. C., Kalipeni, E., & Johannes, E. (2014). Analyzing spatial clustering and the spatiotemporal nature and trends of HIV/AIDS prevalence using GIS: The case of Malawi, 1994-2010. *BMC Infectious Diseases*, 14(1), 1–21. <https://doi.org/10.1186/1471-2334-14-285>