MINH
MALAHAYATI INTERNATIONAL JOURNAL OF NURSING AND HEALTH SCIENCE
ISSN 2620-9152 (Print)
ISSN 2621-4083 (Online)
DOI: 10.33024
Nomor: 79/E/KPT/2023

ARTICLE INFORMATION
Received: March, 5, 2026
Revised: May, 6, 2026
Available online: May, 6, 2026
at : https://e-jurnal.iphorr.com/index.php/minh

Effectiveness of gram staining and 10% KOH in detecting STIs from anal swabs of sexual assault victims

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

Abstract

Background: Sexually Transmitted Infections (STIs) significantly impact global reproductive health. Sodomy, defined as anal intercourse often involving coercion, poses a high risk for STI transmission.
Purpose: To analyze the effectiveness of Gram staining and 10% KOH examinations in detecting pathogens from anal swabs of sexual assault victims.
Method: This analytical observational study used a retrospective cross-sectional design. Medical record data from 33 sodomy victims at Dr. Pirngadi Regional Hospital, Medan (2022–2024), were analyzed using total sampling. The reporting of this section adheres to the STROBE.
Results: Most victims were male (57.58%), with the 11–20 year age group being most prevalent (69.70%). Gram staining identified Gram-negative diplococci in 17 individuals (51.52%), while 10% KOH detected yeast in 4 individuals (12.12%). McNemar's analysis yielded a p-value 0.0016 indicates that Gram staining is more effective for STI detection in this context than 10% KOH.
Conclusion: Gram staining is a more reliable diagnostic method for detecting STIs in anal swab samples compared to 10% KOH. The high prevalence of bacterial infections highlights the urgent need for early STI screening in sexual assault cases.

Keywords: Gram Staining; KOH 10%; Sexually Transmitted Infections (STIs); Sodomy.

INTRODUCTION

Sexually transmitted infections (STIs) remain a major public health concern in Indonesia, ranking among the top ten infectious diseases in developing countries (Cyr, 2020). Early detection is emphasized in the National Guidelines for STI Management as a critical measure to reduce morbidity (Darmawan, 2022). STIs are primarily transmitted through vaginal, anal, and oral sexual contact (Lovett & Duncan, 2019), but transmission can also occur via contaminated objects such as towels, thermometers, syringes, or through bodily fluids including blood, semen, and saliva. Vertical transmission from mother to child during childbirth has also been documented (Hudaifah & Sa'adah, 2024).

Globally, STIs contribute substantially to morbidity, mortality, and economic burdens, affecting reproductive health and quality of life (Septiati, 2024). Nearly 500 million new cases occur annually, many of which are preventable and treatable. In Indonesia, recent data highlight rising cases of HIV/AIDS and syphilis, with adolescents accounting for up to 21% of infections (Lovett & Duncan, 2019). Etiological agents include bacteria (e.g., Neisseria gonorrhoeae, Treponema pallidum), fungi (e.g., Candida spp.), viruses (e.g., herpes simplex virus, HIV), and parasites (e.g., Trichomonas vaginalis) (Adhata, 2022; Septiati, 2024). Men who have sex with men (MSM) are particularly vulnerable to infections such as chlamydia, gonorrhea, lymphogranuloma venereum, and syphilis (Rowley, Vander Hoorn, Korenromp, Low, Unemo, Abu-Raddad, & Taylor, 2019).

DOI: https://doi.org/10.33024/minh.v9i2.2771

Diagnostic methods play a pivotal role in STI detection. Gram staining enables identification of bacterial pathogens based on cell wall characteristics, distinguishing Gram-positive from Gram-negative organisms through differential dye retention (Maghfirah, Mardhatillah, Sastro, Malahayati, & Azkia, 2024; Nainggolan, 2024). Meanwhile, wet mount microscopy with 10% KOH facilitates visualization of fungal morphology, including hyphae, spores, and conidia (Rini & Rohmah, 2020).

The urgency of accurate diagnostic methods is heightened by the increasing incidence of sexual assault, a serious violation of human rights with profound physical and psychological consequences (Ghanem, Marrazzo, & Bloom, 2020; Ministry of Health of the Republic of Indonesia, 2023). Sodomy, classified as a criminal offense, is associated with anal trauma and elevated risk of STI transmission (Ministry of Health of the Republic of Indonesia, 2022). Evidence from Dr. Pirngadi Regional Hospital in Medan (2023) revealed that 67% of child sodomy cases were infected with Gram-negative diplococci, with boys comprising the majority of victims (Rahman & Sukmareni, 2025).

At the global level, the World Health Organization (WHO) identifies STIs as a priority, reporting over one million curable infections daily. In 2020, WHO estimated 374 million new infections among individuals aged 15–49, including chlamydia (129 million), gonorrhea (82 million), syphilis (7.1 million), and trichomoniasis (156 million) (Septiati, 2024; World Health Organization, 2025). In Indonesia, HIV/AIDS remains the most prevalent STI, with 25,665 cases reported in North Sumatra as of October 2023 (CNN Indonesia, 2023).

Given these challenges, this study aims to examine the relationship between Gram staining and 10% KOH in detecting sexually transmitted infections from anal swab samples of sexual assault victims at Dr. Pirngadi Regional Hospital, Medan, during 2022–2024.

RESEARCH METHOD

This analytical observational study employed a retrospective cross-sectional design and was conducted at the Forensic Medicine and Medicolegal Installation of Dr. Pirngadi Regional Hospital, Medan, North Sumatra. Data were extracted from medical records spanning a three-year period (2022–2024). The reporting of this section adheres to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

The study population comprised all victims of alleged sexual assault (sodomy) who underwent forensic examination at the hospital. Inclusion criteria were medical records containing complete documentation of Gram staining and 10% KOH examination results from anal swabs. Records were excluded if demographic data were incomplete, laboratory results were missing, or samples were noted as contaminated or insufficient for analysis.

A total sampling technique was applied, yielding 33 eligible cases. Independent variables were the diagnostic methods (Gram staining and 10% KOH examination), while dependent variables were the detection of STI-related pathogens (Gram-negative diplococci and yeast cells/hyphae). Descriptive variables included demographic characteristics such as age and gender.

Specimens were collected via swab following standard forensic protocols and processed in the hospital's clinical laboratory. Gram staining was performed using immersion oil microscopy at 100× magnification to identify Gram-positive bacteria (purple rods/cocci) and Gram-negative bacteria (red rods/cocci, specifically Gram-negative diplococci). The 10% KOH wet mount was examined at 40× magnification, with positivity defined by the presence of fungal elements such as yeast cells, hyphae, or pseudohyphae. To ensure diagnostic accuracy, slides were independently reviewed by two experienced laboratory technicians, with discrepancies verified by a senior pathologist. The interval between specimen collection and laboratory processing was closely monitored to preserve pathogen integrity.

Data analysis was conducted using statistical software. Descriptive statistics summarized demographic characteristics. McNemar's test was applied to compare detection efficacy between diagnostic methods on paired specimens. Given the small sample size (n = 33) and low cell counts in the KOH-positive group (n = 4), Fisher's exact test was used to validate results with frequencies <5. A post-hoc power analysis was performed to assess statistical robustness. Statistical significance was set at $p < 0.05$.

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

DOI: https://doi.org/10.33024/minh.v9i2.2771

Selection bias was minimized by including all eligible records through total sampling. Information bias was reduced by relying on standardized laboratory documentation. Nonetheless, the study acknowledges limited statistical power due to the small sample size, and findings should be interpreted as preliminary and context-specific.

Ethical approval was obtained from the Health Research Ethics Commission of Faculty of Medicine, Universitas Methodist Indonesia under the number 04/KEPK-FKUMI/EC/2025. All data were anonymized to protect victim confidentiality in accordance with the Declaration of Helsinki.

RESEARCH RESULTS

Table 1. Characteristics of the Respondents (N=33)

Variable	Results
Age (n/%)	
(Mean±SD)(Range)(Year)	(15.73±6.33) (1-40)
1-10	7/21.21
11-20	23/69.70
21-30	1/3.03
31-40	2/6.06
Gender (n/%)	
Male	19/57.58
Female	14/42.42
Gram Staining (n/%)	
Diplococcal infection	17/51.52
No diplococcal infection	16/48.48
10% KOH Staining (n/%)	
Yeast infection	4/12.12
No yeast infection	29/87.88

Table 1 indicates that respondents had a mean age of 15.73 years (SD = 6.33). The majority were aged 11–20 years, accounting for 23 cases (69.70%) of sexual assault involving sodomy. Most victims were male (57.58%). Seventeen individuals (51.52%) tested positive for Gram-negative diplococci, while 29 (87.88%) showed no evidence of yeast infection.

Table 2. Concordance and Discordance of Gram Staining and 10% KOH (n=33)

	10% KOH Positive	10% KOH Negative	p-value
Gram Stain Positive	2	15	0.0016
Gram Stain Negative	2	14	

Table 2 presents McNemar's test result of a p-value 0.0016, revealing a significant difference between Gram staining and 10% KOH.

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

DOI: https://doi.org/10.33024/minh.v9i2.2771

DISCUSSION

This study revealed that the majority of sodomy victims were male (57.58%), with the highest prevalence in the 11–20 year age group (69.70%). These findings are consistent with data from the Statistics Indonesia of North Sumatra, which report that adolescents account for 21% of STI cases, underscoring their vulnerability to sexual violence and subsequent health complications. Statistical analysis demonstrated a significant association between diagnostic method and infection detection rate ($p < 0.01$).

The superior effectiveness of Gram staining observed in this study reflects fundamental differences in bacterial cell wall structure. Gram-positive bacteria retain crystal violet due to their thick peptidoglycan layer, whereas Gram-negative bacteria, including the diplococci identified in 51.52% of victims, possess a thinner peptidoglycan layer and an outer lipid membrane, resulting in uptake of the counterstain (Riedel, Hobden, Miller, Morse, Mietzner, Detrick, & Mejia, 2019). The detection of Gram-negative diplococci is clinically significant, as these organisms are primary markers of gonorrhea infection. Such infections may present with purulent discharge and dysuria, though anal canal infections often remain asymptomatic (Ghanem et al., 2020). Early identification through Gram staining facilitates timely adherence to CDC treatment guidelines (Cyr, 2020), which emphasize updated regimens to address antimicrobial resistance and prevent complications such as pelvic inflammatory disease or infertility.

By contrast, 10% KOH wet mounts identified yeast infections in only 12.12% of cases. While KOH remains the standard for visualizing fungal morphology (Rini & Rohmah, 2020), its limited yield in this population highlights Gram staining as the more effective screening tool. The calculated positivity rate ratio further reinforces Gram staining as the preferred diagnostic method in sodomy-related STI cases.

These findings align with prior research at Dr. Pirngadi Regional Hospital, where 67% of pediatric sodomy victims tested positive for Gram-negative diplococci (Rahman & Sukmareni, 2025), suggesting an even higher risk among children. Globally, the high prevalence of STIs mirrors broader challenges, including antimicrobial resistance and the need for rapid point-of-care diagnostics (Unemo, Bradshaw, Hocking, de Vries, Francis, Mabey, & Fairley, 2017). The focus on anal swabs is particularly relevant given the rectal microbiome's complexity, which may increase susceptibility to secondary infections such as HIV (Tuddenham, Hamill, & Ghanem, 2022).

Clinical management must therefore integrate evidence-based guidelines. Comprehensive screening and prompt treatment for high-risk populations, including victims of sexual assault (Workowski, 2022). In this study, 17 individuals tested positive for Gram-negative diplococci, highlighting the urgent need for standardized therapeutic interventions. Nationally, these findings resonate with Indonesia's STI management guidelines and Minister of Health Regulation No. 23 of 2022, which stress early detection as critical to reducing morbidity from infections such as HIV and syphilis (Sitepu, 2021).

Finally, the predominance of young victims (69.70% aged 11–20 years) underscores the necessity of localized prevention strategies. Integrated approaches combining medical, psychological, social, and legal support are essential to protect children and adolescents from sexual violence and its health consequences (Rizqulloh & Adimas, 2023).

CONCLUSION

This study demonstrates that Gram staining detected sexually transmitted infection (STI) pathogens in 51.52% of anal swab samples, compared with only 12.12% using 10% KOH. This difference underscores the need for further evaluation with appropriate statistical methods. Clinically, the findings support prioritizing Gram staining in forensic medical examination protocols following sexual assault. The study's limitations include the small retrospective sample size, single-site setting, and absence of culture confirmation. Future research employing prospective designs, larger sample sizes, and additional diagnostic methods is essential to strengthen the evidence base.

FUNDING AND CONFLICTS OF INTEREST

This study did not receive external funding from public, commercial, or not-for-profit agencies. The authors declare no conflicts of interest.

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

DOI: https://doi.org/10.33024/minh.v9i2.2771

REFERENCES

Adhata, A. R. (2022). Diagnosis dan tatalaksana gonore. *Jurnal Medika Hutama*, *3*(02 Januari), 1992-1996.

CNN Indonesia. (2023). Kasus HIV/AIDS di Sumut Capai 25.665, Medan Tertinggi. Retrieved from: https://www.cnnindonesia.com/nasional/20231216184525-20-1038176/kasus-hiv-aids-di-sumut-capai-25665-medan-tertinggi/amp

Cyr, S. S. (2020). Update to CDC's treatment guidelines for gonococcal infection, 2020. *MMWR. Morbidity and mortality weekly report*, *69*.

Darmawan, R. (2022). Tinjauan Kriminologi atas Pelecehan Seksual Terhadap Santri yang Dilakukan Pekerja Dayah (Studi di Kabupaten Lhokseumawe). *Jurnal Ilmiah Mahasiswa Hukum [JIMHUM]*, *2*(3).

Ghanem, K. G., Marrazzo, J., & Bloom, A. (2020). Clinical manifestations and diagnosis of Neisseria gonorrhoeae infection in adults and adolescents. *UpToDate. Edn. Edited by TWP Waltham: UpToDate*.

Hudaifah, H., & Sa'adah, N. (2024). Literature review: Pelecehan seksual dilihat dari jenis kelamin dan gender, traumatik, dan hukum di Indonesia. *Sociocouns: Journal of Islamic Guidance and Counseling*, *4*(1), 16. Retrieved from: https://sociocouns.uinkhas.ac.id/index.php/sociocouns/article/view/125

Lovett, A., & Duncan, J. A. (2019). Human immune responses and the natural history of Neisseria gonorrhoeae infection. *Frontiers in immunology*, *9*, 3187.

Maghfirah, F., Mardhatillah, F., Sastro, M. S., Malahayati, M., & Azkia, S. A. (2024). Penyuluhan Hukum Tentang Hak-Hak Korban Kekerasan Seksual: Upaya Perlindungan dan Penegakan Hukum di Lingkungan Universitas Malikussaleh. *Jurnal Malikussaleh Mengabdi*, *3*(2), 324-332.

Ministry of Health of the Republic of Indonesia. (2022). *Peraturan Menteri Kesehatan Nomor 23 Tahun 2022 Tentang Penanggulangan Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome, dan Infeksi Menular Seksual*. Retrieved from: https://peraturan.go.id/id/permenkes-no-23-tahun-2022

Ministry of Health of the Republic of Indonesia. (2023). *Laporan Surveilans Enhanced Gonococcal Antimicrobial Surveillance Programme (EGASP) di Indonesia Tahun 2023*. RS Penyakit Infeksi Prof. Dr. Sulianti Saroso.

Nainggolan, R. (2024). Identifikasi Bakteri Diplococcus Gram Negatif dengan Pewarnaan Gram pada Sampel Swab Anal Kasus Sodomi Anak di RSUD Dr. Pirngadi Kota Medan Periode Mei 2022–Oktober 2023. Majalah Ilmiah METHODA, 14(1), 93-96.

Rahman, A., & Sukmareni, S. (2025). Penerapan Hukum Tindak Pidana Kejahatan Sodomi Terhadap Anak (Studi Analisis Putusan Nomor. 2658 K/Pid. Sus/2015). *Yustisi*, *12*(1), 459-471.

Riedel, S., Hobden, J. A., Miller, S., Morse, S. A., Mietzner, T. A., Detrick, B., & Mejia, R. (Eds.). (2019). *Jawetz, Melnick, & Adelberg's medical microbiology, 28e*. McGraw-Hill Education LLC.

Rini, C. S., & Rohmah, J. (2020). Buku Ajar Mata Kuliah Bakteriologi Dasar. *Umsida Press*, 1-108.

Rizqulloh, A., & Adimas, Y. (2023). Strategi Pencegahan & Penanganan Kekerasan Seksual terhadap Anak di Universitas Ichsan Satya. *Jurnal Solma, 12*(3).

Rowley, J., Vander Hoorn, S., Korenromp, E., Low, N., Unemo, M., Abu-Raddad, L. J., & Taylor, M. M. (2019). Chlamydia, gonorrhoea, trichomoniasis and syphilis: global prevalence and incidence estimates, 2016. *Bulletin of the World Health Organization*, *97*(8), 548.

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

DOI: https://doi.org/10.33024/minh.v9i2.2771

Septiati, Y. A. (2024). *Pengambilan Sampel Lingkungan dengan Metode Swab dan Cara Identifikasinya*. Penerbit NEM.

Sitepu, J. N. (2021). Bahaya dan pencegahan infeksi menular seksual. *Jurnal Visi Pengabdian Kepada Masyarakat*, *2*(2), 66-74.

Tuddenham, S., Hamill, M. M., & Ghanem, K. G. (2022). Diagnosis and treatment of sexually transmitted infections: a review. *Jama*, *327*(2), 161-172.

Unemo, M., Bradshaw, C. S., Hocking, J. S., de Vries, H. J., Francis, S. C., Mabey, D., & Fairley, C. K. (2017). Sexually transmitted infections: challenges ahead. *The Lancet infectious diseases*, *17*(8), e235-e279.

Workowski, K. A. (2021). Sexually transmitted infections treatment guidelines, 2021. *MMWR. Recommendations and Reports*, *70*.

World Health Organization. (2025). *Sexually transmitted infections (STIs)*. World Health Organization. Retrievedfrom: https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis).

Renatha N.H. Nainggolan*, Budi Darmanta Sembiring

Departemen Patologi Klinis, Fakultas Kedokteran, Universitas Methodist Indonesia
Corresponding author: *E-mail: nainggolanrenatha@gmail.com

DOI: https://doi.org/10.33024/minh.v9i2.2771