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Descriptive Analysis of Risk Factors and Trends in Healthcare-Associated Infections: A 5-Year Retrospective Surveillance Study in East Java, Indonesia (2019-2023)

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Abstract: Healthcare-Associated Infections (HAIs) remain a significant challenge in healthcare settings due to their impact on patient morbidity, mortality, and treatment costs. This study aimed to describe the trends and risk factors of HAIs using retrospective surveillance data from 2019–2023 at a public hospital in East Java, Indonesia. A total of 18,115 patients with invasive medical devices and 1,674 HAI cases were analyzed. Descriptive statistics, chi-square tests, and epidemiological indicators—point prevalence, incidence density, and device-associated infection rates—were used. The highest point prevalence occurred in 2021, reaching 112.02 per 1,000 patients (11.2%), with an incidence density of 3.11 per 1,000 patient-days and a device-associated infection rate of 7.94 per 1,000 device-days. These figures declined in 2023 to 77.18 per 1,000 patients (7.7%), 2.30 per 1,000 patient-days, and 6.42 per 1,000 device-days, respectively. Major risk factors included prolonged hospitalization, use of invasive devices such as catheters and ventilators, and comorbidities like diabetes mellitus and chronic diseases. The findings highlight the need for continuous monitoring, staff training, and optimized infection prevention strategies to reduce HAIs and enhance patient safety.

Keywords: Device incident; Healthcare associated infections; Hospital; Incidence density; Infection control; Point prevalence

Introduction

Healthcare-Associated Infections (HAIs) remain a major challenge in modern healthcare systems, increasing patient morbidity, mortality, and treatment costs, while also prolonging hospital stays (Fried, 2023). These infections, which are acquired during hospital care and are not present or incubating at admission, pose serious risks not only to patients but also to healthcare workers. In Indonesia, the burden of HAIs remains substantially higher than the global average, with an estimated incidence of 15.74%, largely due to limited infection control infrastructure, inconsistent adherence to hygiene protocols, and insufficient electronic surveillance systems across healthcare facilities. Although numerous studies have examined HAIs in Indonesia, most have been cross-sectional or limited to single-point prevalence surveys, providing only fragmented data. The novelty of this research lies in its five-year retrospective analysis of hospital-based HAI surveillance data that integrates point prevalence, incidence density, and device-associated infection indicators to identify patterns and associations between device use and infection rates. This study is particularly important because it provides comprehensive, multi-year evidence from a secondary hospital in East Java—an area where longitudinal HAI data remain scarce—and the findings are expected to inform the strengthening of infection prevention programs, promote the implementation of electronic surveillance

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systems, and guide future analytical and interventional studies in similar healthcare settings.

Despite global efforts to reduce HAIs, the burden remains particularly high in developing countries. In Indonesia, national surveillance data indicate a concerning HAI prevalence of 15.74%, substantially higher than the benchmark of less than 1.5% established by the Ministry of Health (Nurahmawati et al., 2024). Factors contributing to this high rate include limited infection control infrastructure, suboptimal adherence to hand hygiene practices, and inadequate surveillance systems. The economic and health impacts of HAIs in Indonesia underscore the urgent need for targeted interventions to enhance patient safety and healthcare quality (He et al., 2020). Moreover, existing studies in Indonesia often focus broadly on infection control without providing detailed epidemiological data specific to hospital settings, particularly regarding device-associated infections, point prevalence, and incidence density. Most previous studies on HAIs in Indonesia are limited to cross-sectional point prevalence surveys without longitudinal analysis of device-associated risk factors.

This study aims to describe the trends in HAI occurrences and to examine the risk factors associated with these infections. It does not seek to establish causal relationships or conduct inferential statistical testing, but rather provides an overview of the factors contributing to HAI rates. By analyzing existing surveillance data, the study provides essential insights into the prevalence and risk factors of HAIs, which can inform future prevention and control strategies in similar healthcare settings. Nasution et al. (2023) reported that inadequate human resources, heavy workloads, and poor work environments can hinder safety system implementation in hospitals, potentially increasing the risk of healthcare-associated infections (HAIs)

Conducting this research in Indonesia is particularly important due to the country's unique healthcare challenges, including overcrowded hospitals, resource constraints, and variations in infection control practices across regions (N. W. R. Handayani et al., 2023). By analyzing the incidence and risk factors of HAIs in an Indonesian hospital setting, this study aims to fill gaps in local epidemiological data and provide evidence-based recommendations to strengthen infection prevention and control programs, ultimately improving patient outcomes and healthcare system resilience.

Although this study is descriptive and does not seek to test causal relationships, the internal and external validity of the findings is an important consideration. The data collected from the hospital's HAI surveillance system were consistent and reliable over the study period, ensuring internal validity. Furthermore, the hospital where the study was conducted is representative of similar healthcare settings in East Java, which suggests that the findings could be generalizable to other regional hospitals. However, caution should be exercised when extending these results to hospitals with different infrastructures or patient populations.

Method

This study employed a retrospective observational descriptive design using secondary data from the hospital's Infection Prevention and Control (IPC) surveillance system collected over a five-year period (January 2019–December 2023). The research aimed to describe the point prevalence, incidence density, and device-associated infection rates of Healthcare-Associated Infections (HAIs) and to identify factors associated with their occurrence.

The study was conducted at a public hospital in East Java, Indonesia, where infection control activities are routinely implemented and monitored. The surveillance system involves Infection Prevention and Control Link Nurses (IPCLNs) in each inpatient unit, coordinated and verified by the IPC Committee. The study population consisted of all inpatients recorded in the surveillance database during the observation period. Inclusion criteria were: (1) patients who used at least one invasive medical device (urinary catheter, central venous catheter, or ventilator); and (2) a confirmed diagnosis of HAI according to definitions from the Indonesian Ministry of Health and the Centers for Disease Control and Prevention (CDC). Records with incomplete data or unclear infection classification were excluded.

Data sources included HAI surveillance forms, case registries, and monthly IPC reports compiled by the IPCLNs. Surveillance instruments were standardized according to national and international guidelines and included patient demographics, diagnosis, type and duration of device use, infection site and onset, microbiological findings, and clinical outcomes. Data collection was conducted retrospectively by extracting hospital records from January 2019 to December 2023 using Microsoft Excel. Each dataset was verified by the IPC Committee to ensure completeness and accuracy, and all patient identifiers were anonymized before analysis.

Descriptive statistical methods were applied to summarize infection characteristics and trends. The main epidemiological indicators were calculated as follows: (1) Point prevalence (%): (Number of HAI cases ÷ Total number of inpatients surveyed) × 100. (2) Incidence density (per 1,000 patient-days): (Number of new HAI cases ÷ Total number of patient-days) × 1,000.

(3) Device-associated infection rate (per 1,000 device-days): (Number of device-related HAI cases ÷ Total number of device-days) × 1,000.

Categorical variables such as infection type and hospital unit were presented as frequencies and percentages. Associations between risk factors and HAI occurrence were analyzed using the Chi-square test ($p < 0.05$). All analyses were performed using Microsoft Excel and SPSS version 12.

This study was approved by the Health Research Ethics Committee of Universitas Aisyiyah Yogyakarta (Approval No. 4350/KEP-UNISA/III/2025). Because anonymized secondary data were used without direct patient contact, informed consent was waived.

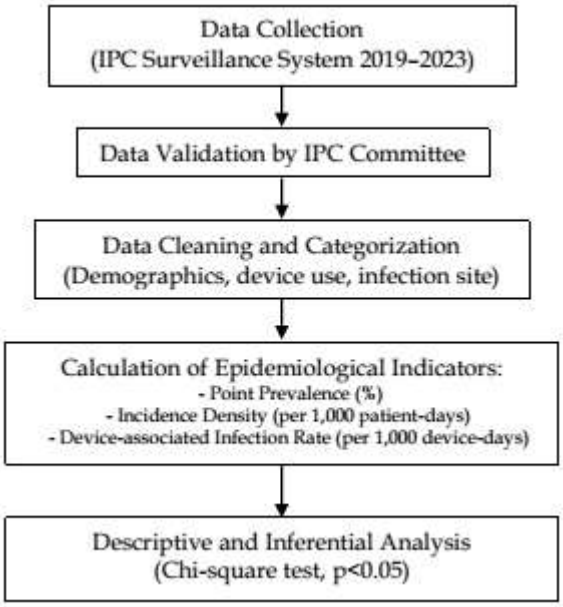

Figure 1. Study flow and data analysis framework

Results and Discussion

The results section presents the key findings of the study.

Analysis of Healthcare-Associated Infections (HAIs) Trends in the 2019-2023 Period

The number of Healthcare-Associated Infections (HAIs) in hospitals is an important indicator in HAI surveillance. As shown in this graph (Figure 2), the monthly HAIs detected from 2019 to 2023 reflect a fluctuating infection trend. An increase in cases in each period can correlate with a surge in patients and invasive medical devices. This data serve as a basis for evaluating the effectiveness of infection prevention strategies and improving HAI control policies in one of the hospitals in East Java.

Based on the analysis of data on the number of Healthcare-Associated Infections (HAIs) over the last five years (2019–2023), a pattern was found that showed an increase in cases in a certain period, as illustrated in Figure 1. In general, the number of HAIs tends to increase at the beginning of the year, especially in January to March, as well as at the end of the year in October to December. This surge is likely due to several factors, such as an increase in the number of patients due to seasonal changes, the spread of infectious diseases, and the intensity of invasive medical device use in hospitals.

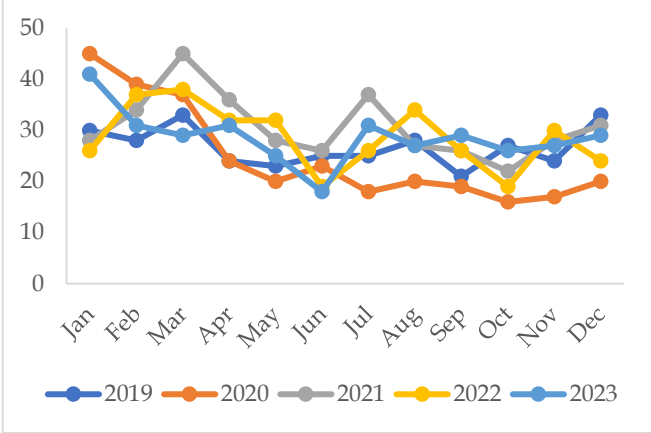

Figure 2. Number of HAIs 2019-2023

2020 was the period with the highest number of cases compared to other years, especially in January (45 cases) and March (37 cases). This phenomenon is believed to be associated with the COVID-19 pandemic, which resulted in a surge in hospitalizations and an increased risk of Healthcare-Associated Infections (HAIs). 2021 showed a similar pattern, with a peak of cases in March (45 cases), although the incidence rate tended to be more stable than the previous year. In 2022, cases fluctuated significantly in February (37 cases) and August (34 cases). Meanwhile, in 2023, the number of HAIs was relatively well controlled compared to previous years, although it still increased in January (41 cases).

Some factors contributing to the surge in HAIs include changes in environmental conditions that support the growth of pathogens, increased patient density in hospitals, and medical devices such as ventilators and catheters that can increase the risk of infection. In addition, the infection control policies implemented in each hospital also affect the incidence rate of HAIs (S. L. R. Nasution et al., 2023).

More optimal preventive measures are needed to reduce the incidence of HAIs, especially in periods where cases tend to increase (dos Santos Dantas et al., 2023). Efforts can include strengthening infection prevention protocols, increasing compliance with hand hygiene, routine sterilization of medical devices, and strict monitoring of patients at high risk of HAIs. In

addition, stricter surveillance policies and further analysis of specific risk factors can help hospitals develop more effective mitigation strategies (N. W. R. Handayani et al., 2023). With the right steps, the incidence rate of HAIs can be reduced so that the quality of healthcare services can be more assured (Suarmayasa, 2023).

Trend Analysis of Patients Installed with Medical Devices in Hospitals (2019-2023)

The use of invasive medical devices contributes to the prevalence and incidence of HAIs in one of the hospitals in East Java. As shown in Figure 3, this graph shows the number of patients with medical devices installed per month (2019–2023), which correlates with point prevalence, incidence density, and device-associated infection fluctuations. A rise in patients requiring medical devices, particularly during specific periods, may contribute to a higher risk of Healthcare-Associated Infections (HAIs) (Raoofi et al., 2023). Therefore, monitoring these trends is important for infection control strategies and healthcare improvements.

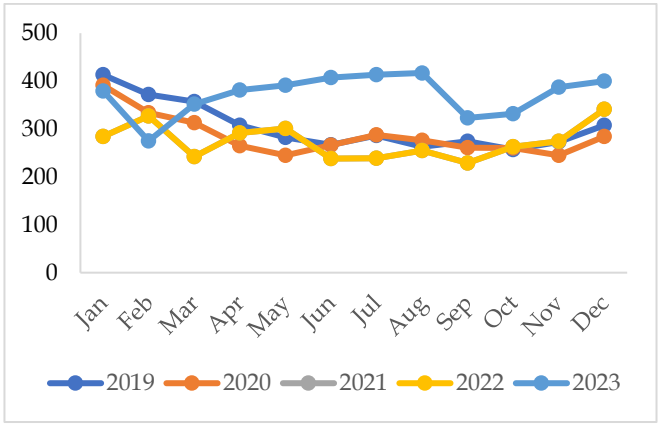

Figure 3. Number of patients with installed devices 2019-2023

Based on the analysis of the number of patients using medical devices from 2019 to 2023, it was found that there was a fluctuating pattern in their use in hospitals. In general, the number of patients who need medical equipment tends to be higher at the beginning of the year, especially from January to March. It increases again towards the end of the year, from October to December. The peak in medical device use was recorded in January in most years, with the highest numbers occurring in January 2019 (413 patients) and January 2023 (379 patients). In contrast, the number of patients using medical devices tends to decline in the middle of the year, with the lowest point generally occurring in March or September.

Some factors that may affect this trend include an increase in the number of patients requiring intensive care in certain periods, especially during infectious disease seasons. In addition, hospital policies and capacity in managing medical devices also contribute to this pattern (Keil et al., 2024). The year 2020, which was affected by the COVID-19 pandemic, showed a significant variation in the use of medical devices, likely due to an increase in the number of critically ill patients requiring respiratory support or other invasive medical devices (Sulistyorini et al., 2023).

To optimize the management of medical devices, hospitals need to improve their monitoring and equipment distribution systems to anticipate a surge in patients in a certain period. Strengthening policies on medical device use, strict monitoring of patients who use them over the long term, and more thorough resource planning can help improve healthcare efficiency (Mawo et al., 2025). With the right strategy, hospitals can ensure adequate equipment availability throughout the year while minimizing the risk of complications due to prolonged use of medical equipment (Haque et al., 2020).

Trends in the Number of Patients and Days of Medical Device Use per Month (2019-2023)

The following graph compares overall patient totals and the number of days of device use per month from 2019 to 2023, as illustrated in Figure 4, illustrating the association between the number of hospitalized patients and the use of invasive medical devices. This trend provides insight into the pattern of device use in hospitals and the potential risk of Healthcare-Associated Infections (HAIs). A clear understanding of this relationship enables hospitals to optimize strategies for managing medical devices and preventing Healthcare-Associated Infections (HAIs).

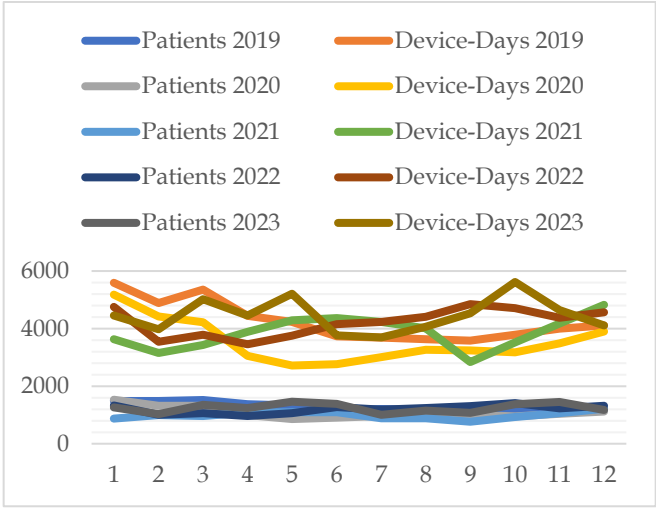

Figure 4. Comparison of total patients and installed devices in 2019 – 2023

Data analysis on the number of patients and the length of use of medical devices from 2019 to 2023 shows a relatively consistent pattern every year. In general, the number of patients tends to increase at the beginning and end of the year, while the middle of the year shows a slight decrease. This trend is also in line with the number of days of medical device use, which tends to be higher in months with an increase in the number of patients. The increase in the number of patients admitted to hospitals is directly proportional to medical equipment, especially for patients who require intensive care or assistive devices in the healing process (Moradi et al., 2024).

Differences in the number of patients and medical devices can be affected by various factors, such as seasonal changes, an increase in infectious diseases, and hospital policies in handling patients with specific medical device needs. For example, in 2020, there was a surge in the use of medical devices in certain months, which was most likely affected by the COVID-19 pandemic and the increasing number of patients requiring intensive care (Hernández et al., 2024). In addition, hospital capacity and policies related to the use of medical devices can also play a role in determining the duration of use of equipment by patients (Fresán-Ruiz et al., 2022).

To optimize patient care management and the use of medical devices, hospitals need to implement more effective monitoring systems (Teus et al., 2024). By understanding the patterns of increase and decrease in the number of patients and the need for medical equipment, healthcare facilities can allocate resources more efficiently. Measures such as improved infection prevention policies, strict monitoring of patients using medical devices in the long term, and better management of medical device inventory can help improve the quality of healthcare services (Bae et al., 2022). With proper planning, hospitals can anticipate a patient surge and ensure medical equipment is optimally available throughout the year (Wang et al., 2023).

Analysis of Point Prevalence, Incident Density, and Device Incidents (2019-2023)

The prevalence and incidence of HAIs in one of the hospitals in East Java showed significant fluctuations, with a noticeable decrease in 2023 compared to previous years. Despite the improvements, HAIs remain a major challenge. Focusing on invasive medical device management and training of medical personnel is essential for more effective control. Table 1 contains data on point prevalence, incidence density, and device-associated infection rates.

As shown in Figure 5, the prevalence and incidence of HAIs in one of the hospitals in East Java showed significant fluctuations, with a noticeable decrease in 2023 compared to previous years. Despite the improvements, HAIs remain a major challenge. A focus on invasive medical device management and training of medical personnel is essential for more effective control.

Table 1. Point Prevalence, Incidence Density, and Device Incidence (2019-2023)

Year	Spot Prevalence (%)	Incidence Density (per 1,000 Patient-Days)	Device Incidents (per 1,000 Device-Days)
2019	87.7	2.09	6.29
2020	86.93	2.3	7.02
2021	112.02	3.11	7.94
2022	104.41	2.38	6.78
2023	77.18	2.3	6.42

The display in the graph visualization is presented as below.

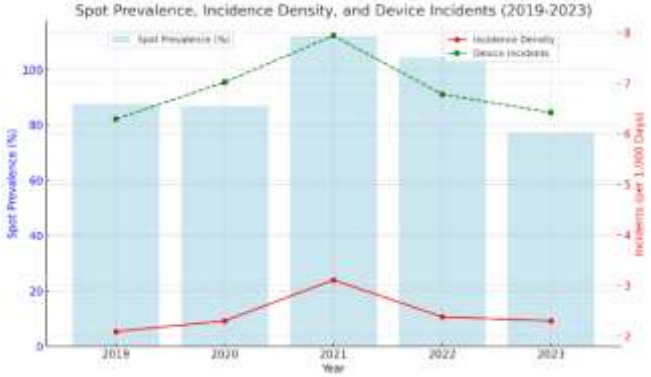

Figure 5. Point prevalence, density incidents and device incidents 2019-2023

The declining trend in HAI indicators suggests that infection prevention and control interventions have become more effective over time. The use of routine surveillance through IPC Link Nurses and improved adherence to hand hygiene protocols may have contributed to this improvement (S. Handayani et al., 2020). Previous research has shown that consistent monitoring and feedback are associated with significant reductions in HAI rates (Rodgers et al., 2021). In this study, the decrease in device-associated infections aligns with the gradual enhancement of hospital IPC training and the introduction of digital reporting tools. Strengthening electronic surveillance and staff accountability can therefore be seen as key strategies to

sustain infection control outcomes in similar healthcare settings (Dekker et al., 2022).

The point prevalence data show that in 2021, there was a significant spike of up to 12.02 per 1,000 patients, which may have been influenced by the increased number of patients hospitalized during the COVID-19 pandemic, which worsened clinical conditions and increased the risk of HAIs. In 2023, the point prevalence decreased sharply to 77.18%, reflecting more effective efforts in infection management, especially after the pandemic had subsided (Suryani et al., 2023).

Although the decrease in prevalence in 2023 is quite significant, the prevalence figures in 2020 (86.93%) and 2022 (104.41%) still indicate that HAIs remain a major problem that must continue to be considered in one of the hospitals in East Java (Sudarmo, 2016).

Density Incident Analysis

Incidence density shows fluctuations reflecting the number of new infections per 1,000 patient-days. In 2021, the highest incidence density of 3.11 per 1,000 patient-days was recorded, which may be related to an increase in hospitalizations and the use of invasive medical equipment during the COVID-19 pandemic.

Meanwhile, in 2022, the incidence density decreased slightly to 2.38 but stabilized again at 2.30 in 2023. These figures indicate that despite declining new infections, HAI management still requires further improvement.

Device Incident Analysis

Device incidence, which measures infections occurring in patients using invasive medical devices, remained high, with a peak recorded in 2021 (7.94 per 1,000 device-days). The use of invasive medical devices, such as urinary catheters, ventilators, and invasive surgical procedures, is a major factor contributing to the incidence of these infections. Although there was a decrease in 2023 to 6.42 per 1,000 device-days, this figure still indicates that infection control challenges persist in relation to the use of medical devices.

Risk Factors Affecting HAIs Incidents

The findings of this study indicate that several factors contribute significantly to the occurrence of healthcare-associated infections (HAIs). Prolonged hospitalization emerged as a key risk factor, as patients who remain in the hospital for extended periods, particularly those admitted to intensive care units—are more likely to acquire infections due to continuous exposure to invasive procedures and hospital pathogens. The use of invasive medical devices, such as urinary catheters and mechanical ventilators, also plays a critical role by providing potential entry points for microorganisms and facilitating cross-contamination between patients and healthcare personnel (Rotua et al., 2023). Moreover, patients with underlying comorbidities, including diabetes mellitus, cardiovascular diseases, and other chronic conditions, exhibit increased vulnerability to HAIs due to impaired immune responses and delayed recovery processes.

These findings align with previous studies showing that prolonged hospital stay, device utilization, and comorbidities are consistent predictors of HAIs across various healthcare settings (Menon et al., 2022). Therefore, integrated infection prevention strategies—encompassing strict adherence to aseptic techniques, rational use of invasive devices, and targeted monitoring of high-risk patients—are essential to reduce the burden of HAIs and improve patient safety outcomes in hospital environments (D. A. Purba et al., 2023).

HAI Control and Prevention Efforts

One of the hospitals in East Java has implemented various control measures to prevent HAIs, including strict antiseptic practices, supervision of invasive medical procedures, and ongoing training for medical staff. However, the data show that despite the decline in prevalence rates and incidence of HAIs, control efforts still need to be strengthened, especially in managing invasive medical devices that can increase the risk of infections (Sahputra et al., 2023).

The point prevalence analysis revealed a significant spike in 2021, reaching 12.02 per 1,000 patients. This sharp increase was likely influenced by the surge in hospital admissions during the COVID-19 pandemic, which exacerbated patients' clinical conditions and elevated the risk of healthcare-associated infections (HAIs). By 2023, the prevalence markedly declined to 77.18%, suggesting that post-pandemic improvements in infection prevention and control strategies had become more effective in reducing the overall burden of HAIs.

Although the reduction in 2023 was substantial, the prevalence rates in 2020 (86.93%) and 2022 (104.41%) still demonstrate that HAIs remained a persistent concern in the hospital setting. These data underscore the continued need for sustained infection prevention efforts, routine surveillance, and adherence to standardized protocols to mitigate the risk of infection transmission among hospitalized patients in East Java.

The incidence density rate, representing the number of new HAI cases per 1,000 patient-days, exhibited fluctuations over the five-year observation period. The highest incidence density was recorded in 2021 at 3.11 per 1,000 patient-days, likely associated with increased patient loads and greater utilization of invasive medical devices during the pandemic. In 2022, the rate declined slightly to 2.38, followed by a modest stabilization at 2.30 in 2023. Although these figures

reflect a gradual reduction in new infection cases, they also indicate that infection control practices require continuous reinforcement.

The analysis of device-associated infections, which measures HAIs among patients using invasive medical equipment, showed persistently high rates throughout the study period. The peak was observed in 2021, reaching 7.94 per 1,000 device-days, primarily linked to the extensive use of urinary catheters, ventilators, and other invasive procedures during critical care. While a decrease was noted in 2023 to 6.42 per 1,000 device-days, the rate remains indicative of ongoing challenges in infection prevention related to device use. This finding emphasizes the importance of continuous staff training, adherence to aseptic techniques, and implementation of evidence-based device management protocols to further reduce device-associated infection risks (S. L. R. Nasution et al., 2023).

The analysis identified several key risk factors contributing to the occurrence of HAIs in the hospital. The first factor is the length of hospital stay, as patients who undergo prolonged hospitalization are more likely to develop infections, particularly those admitted to ICUs where exposure to invasive procedures is frequent. The second factor is the use of invasive medical devices, such as urinary catheters and mechanical ventilators, which increase patients' susceptibility to infection by providing potential entry points for pathogens (Syahputri et al., 2023). Additionally, underlying comorbidities—including diabetes mellitus, cardiovascular disease, and other chronic conditions—were found to further elevate the risk of infection by compromising patients' immune responses and delaying recovery. These findings align with existing literature indicating that extended hospitalization, invasive procedures, and comorbidities are major determinants of HAI occurrence.

To address the ongoing risk of HAIs, the hospital in East Java has implemented a range of infection prevention and control measures. These include the consistent use of antiseptic procedures, close supervision of invasive medical interventions, and continuous education and training programs for healthcare personnel. Despite these efforts, the data indicate that infection rates remain substantial, particularly those associated with device use. This suggests that while infection control practices have improved, further strengthening is needed—especially in the monitoring and management of invasive medical devices. Continuous surveillance, adherence to aseptic protocols, and regular performance audits are therefore essential to sustain and enhance the effectiveness of infection prevention strategies within the hospital setting (Herawati et al., 2024).

The prevalence of healthcare-associated infections (HAIs) in the studied hospital reached its peak in 2021 at 12.02 per 1,000 patients, a surge largely influenced by the COVID-19 pandemic. The pandemic led to an increased number of patients requiring intensive care, many of whom depended on invasive medical devices such as ventilators, which are known to elevate the risk of HAIs. Research indicates that extensive use of these devices during this period contributed significantly to the rise in infection rates. However, by 2023, a notable decline in HAI prevalence to 77.18% was observed, reflecting improved infection control measures, including enhanced hand hygiene practices and stricter management protocols for invasive devices. A decrease in intensive care admissions post-pandemic also supported this reduction (Andrini et al., 2017).

In 2021, the prevalence of HAIs in the hospitals studied reached the highest figure over the past five years, namely 12.02 per 1,000 patients. It has been greatly affected by the COVID-19 pandemic, which has led to an increase in the number of patients requiring intensive care, especially those who require ventilators or other invasive medical devices. Large amounts of invasive medical devices during the pandemic exacerbate the incidence of HAIs (Wang et al., 2023). Furthermore, these medical devices increase the risk of infection in hospitals, especially in ICU patients (Fresán-Ruiz et al., 2022).

In 2023, there will be a decrease in the prevalence rate of HAIs to 77.18%. This decline was driven by more effective infection control policies, including improved hand hygiene and stricter management of invasive medical devices. Improved hand hygiene discipline contributed to a significant decrease in HAIs (Mouajou et al., 2022) . In addition, the decrease in intensive care patients after the pandemic also played a role in the decrease in HAIs.

Factors such as the long duration of hospitalization and the use of invasive medical devices are the main contributors to the increased risk of HAIs. Patients admitted for long periods in the ICU or requiring invasive procedures such as catheters or ventilators are more likely to be infected by hospital pathogens. Longer exposure to inadequately sterilized medical devices increases the risk of infection (Menon et al., 2022).

Studies show there is a seasonal pattern in the occurrence of HAIs. The spike in infection incidence generally occurs in the months with an increase in cases of infectious diseases. Research by Ghosh and Gupta as cited in (Chawla et al., 2023) showed that the infectious disease season was directly related to the high number of patients treated, increasing the risk of HAIs. In addition, hospital policies related to managing invasive medical devices and hand hygiene also affect the incidence rate of HAIs (Ruiz-Ramos et al., 2023).

The infection control efforts implemented, although effective, still need to be strengthened. The use of antiseptics and supervision of invasive medical procedures have shown good results, but major challenges still exist in the management of increasingly invasive medical devices. Menon et al. emphasized the importance of stricter supervision and a more systematic approach to hand hygiene and the use of invasive medical devices to further reduce the incidence of HAIs (Omar et al., 2020).

The main strategies that have proven effective in lowering the number of HAIs are improving compliance with hand hygiene and stricter management of invasive medical devices. Mouajou et al. (2022) showed that a more disciplined hand hygiene program could significantly reduce the incidence of HAIs. In addition, (C. E. Purba et al., 2021) more careful management of invasive medical devices with close monitoring can also significantly lower the risk of infection.

The results of this study show that the incidence rate of healthcare-associated infections (HAIs) in this hospital remains higher than the Indonesian national standard, which targets an HAI rate below 1.5% (Singkun et al., 2023). This finding aligns with previous studies indicating that the prevalence of HAIs in Indonesia generally exceeds that of developed countries, where the average ranges between 4.8% and 15.5% (Supriadi et al., 2023). The persistently elevated rates observed in this study highlight the ongoing challenges in infection prevention and control across Indonesian hospitals, particularly in managing invasive medical devices and maintaining strict adherence to infection control protocols. Although a decline in HAI rates was noted in 2023, these figures underscore the urgent need for sustained interventions, improved surveillance systems, and continuous training of healthcare personnel to achieve infection control standards comparable to international benchmarks (Duerink et al., 2006).

To reduce the number of HAIs in the future, hospitals should strengthen the management of invasive medical devices and hand hygiene and improve training for medical personnel. Mouajou et al. (2022) suggested that infection control policies supported by rigorous training and surveillance can significantly reduce the number of HAIs. In addition, it is important to utilize technology to monitor invasive medical devices to detect HAIs more quickly (Adawee et al., 2022).

Ongoing training for medical personnel is essential to improve understanding of hand hygiene procedures and the management of invasive medical devices. Mahaboob et al. (2024) revealed that training that is carried out regularly can increase the awareness of medical personnel about the importance of controlling HAIs. The use of monitoring technology can also speed up the early detection of HAIs and improve overall infection control (Cao et al., 2023).

This study used a retrospective method, prone to bias in recording and reporting infections. The limited sample size of one hospital in East Java may limit the ability to generalize results. Therefore, future research may consider using more structured prospective methods and involving more hospitals to produce more representative data.

Further research should expand the sample by involving several hospitals in Indonesia to get a more complete picture of the incidence of HAIs. In addition, the use of real-time data and stricter monitoring of invasive medical procedures will help overcome the limitations of this study.

Conclusion

This study analyzed the prevalence and incidence of healthcare-associated infections (HAIs) in a hospital in East Java from 2019 to 2023. The findings showed that HAI indicators fluctuated throughout the observation period, with the highest incidence density and device-associated infection rates recorded in 2021, coinciding with the peak of the COVID-19 pandemic. During this period, increased patient admissions and the extensive use of invasive medical devices contributed to a temporary rise in infection rates. By 2023, however, a substantial decline was observed, reflecting the positive effects of strengthened infection prevention and control measures implemented after the pandemic. The analysis confirmed that prolonged hospitalization, use of invasive medical devices such as urinary catheters and ventilators, and comorbid conditions including diabetes mellitus and cardiovascular diseases were major risk factors for HAIs (Suryantoro et al., 2023). Overall, these results emphasize the importance of sustained infection surveillance, rational management of medical devices, and continuous staff training to ensure long-term reductions in HAIs and enhance patient safety within hospital settings.

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Author Contributions

Conceptualization, A.A.; methodology, A.A.; formal analysis, A.A.; writing—original draft preparation, A.A.; writing—review and editing, E.M.R.; supervision, E.M.R. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

Adawee, M., Ellsworth, L., & Manarin, C. (2022). Utilizing technology to increase efficiency of infection prevention data collection: Our experience using electronic medical records for symptom surveillance. *American Journal of Infection Control*, *50*(2), 182–184. https://doi.org/10.1016/j.ajic.2021.09.021

Andrini, F., Supardi, I., Sudigdoadi, S., & Masria, S. (2017). Detection of Staphylococcus aureus's Strain Similarity on Surgical Ward Nurses's Hand and Nose and Post Operative Wound Infection Using Coa Gene Through PCR-RFLP Method. *Jurnal Ilmu Kedokteran*, *4*(2), 116. https://doi.org/10.26891/jik.v4i2.2010.116-122

Bae, S., Kim, Y., Chang, H. H., Kim, S., Kim, H. J., Jeon, H., Cho, J., Lee, J., Chae, H., Han, G., & Kim, S. W. (2022). The effect of the multimodal intervention including an automatic notification of catheter days on reducing central line-related bloodstream infection: a retrospective, observational, quasi-experimental study. *BMC Infectious Diseases*, *22*(1), 1–9. https://doi.org/10.1186/s12879-022-07588-9

Cao, Y., Niu, Y., Tian, X., Peng, D. Z., Lu, L., & Zhang, H. (2023). Development of a knowledge-based healthcare-associated infections surveillance system in China. *BMC Medical Informatics and Decision Making*, *23*(1), 209. https://doi.org/10.1186/s12911-023-02297-y

Chawla, H., Anand, P., Garg, K., Bhagat, N., Varmani, S. G., Bansal, T., McBain, A. J., & Marwah, R. G. (2023). A comprehensive review of microbial contamination in the indoor environment: sources, sampling, health risks, and mitigation strategies. *Frontiers in Public Health*, *11*, 1285393. https://doi.org/10.3389/fpubh.2023.1285393

Dekker, M., Jongerden, I. P., de Bruijne, M. C., Jelsma, J. G. M., Vandenbroucke-Grauls, C. M. J. E., & van Mansfeld, R. (2022). Strategies to improve the implementation of infection control link nurse programmes in acute-care hospitals. *Journal of Hospital Infection*, *128*, 54–63. https://doi.org/10.1016/j.jhin.2022.07.005

dos Santos Dantas, R. D., Flores, P. V. P., de Oliveira Aquino, A. C., Tomaz, C. P. R., de Melo Vellozo Pereira Tinoco, J., Cavalcanti, A. C. D., Flores, P. V. P., & Soares, S. S. S. (2023). Advanced Practice Nursing, leadership, and implementation of improvements to reduce health care-associated infections. *Online Brazilian Journal of Nursing* , *22*. https://doi.org/10.17665/1676-4285.20246717

Duerink, D. O., Roeshadi, D., Wahjono, H., Lestari, E. S., Hadi, U., Wille, J. C., De Jong, R. M., Nagelkerke, N. J. D., & Van den Broek, P. J. (2006). Surveillance of healthcare-associated infections in Indonesian hospitals. *The Journal of Hospital Infection*, *62*(2), 219–229. https://doi.org/10.1016/j.jhin.2005.08.004

Fresán-Ruiz, E., Pons-Tomás, G., de Carlos-Vicente, J. C., Bustinza-Arriortua, A., Slocker-Barrio, M., Belda-Hofheinz, S., Nieto-Moro, M., Uriona-Tuma, S. M., Pinós-Tella, L., Morteruel-Arizcuren, E., Schuffelmann, C., Peña-López, Y., Bobillo-Pérez, S., & Jordan, I. (2022). Device Exposure and Patient Risk Factors' Impact on the Healthcare-Associated Infection Rates in PICUs. *Children*, *9*(11). https://doi.org/10.3390/children9111669

Fried, E. D. (2023). Hospital-Acquired Infections. In *Patient Safety: A Case-based Innovative Playbook for Safer Care: Second Edititon* (pp. 183–198). https://doi.org/10.1007/978-3-031-35933-0_13

Handayani, N. W. R., Jayantiari, I. G. M. R., Adiyaryani, N. N., & Susiani, A. (2023). Exploration of Implementation for Countermeasures Against Tuberculosis in Tabanan District: A Qualitative Study. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 8180–8184. https://doi.org/10.29303/jppipa.v9i10.4652

Handayani, S., & Dewi, R. (2020). Faktor-faktor yang berhubungan dengan kepatuhan perawat dalam pelaksanaan hand hygiene. *Jurnal Ilmiah Kesehatan*, *9*(2), 155–162. Retrieved from https://jurnal.karyakesehatan.ac.id/JIKK/article/view/427

Haque, M., McKimm, J., Sartelli, M., Dhingra, S., Labricciosa, F. M., Islam, S., Jahan, D., Nusrat, T., Chowdhury, T. S., Coccolini, F., Iskandar, K., Catena, F., & Charan, J. (2020). Strategies to prevent healthcare-associated infections: A narrative overview. *Risk Management and Healthcare Policy*, *13*, 1765–1780. https://doi.org/10.2147/RMHP.S269315

He, H., Hu, C., Xiong, N., Liu, C., & Huang, X. (2020). How to transform a general hospital into an "infectious disease hospital" during the epidemic of COVID-19. *Critical Care*, *24*(1), 10–11. https://doi.org/10.1186/s13054-020-02864-z

Herawati, I., Hidayani, H., Jannah, M., Tohatta, N. M., Merren, R., Tattoo, S., & Putri, Y. (2024). Prevention of Pathogenesis of Infection in Postpartum Women Through Postpartum Care Culture. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 8655–8661.

https://doi.org/10.29303/jppipa.v10i11.8807

Hernández, F. L. C., Virguez, J. V., Vesga, J. F. G., Castellanos, M. L., Beltrán, G. R., Toquica, L. D. L., Gomez, C. N. S., Ríos, M. V. S., Bolívar, Y. R. C., & Sanchez, J. I. A. (2024). Effect of COVID-19 on infections associated with medical devices in critical care. *BMC Infectious Diseases*, *24*(1), 110. https://doi.org/10.1186/s12879-023-08934-1

Keil, V., Schaumburg, T., Buchta, F., Katrin Luz, J., Kolbe-Busch, S., Chaberny, I. F., & von Lengerke, T. (2024). Improving leadership skills of infection prevention and control teams by psychological empowerment: study protocol for a cluster randomised controlled trial (IP-POWER). *BMJ Open*, *14*(2). https://doi.org/10.1136/bmjopen-2023-083806

Mahaboob, L., Alrahbi, H., Sadanandan, S., & Vankudre, G. S. (2024). Efficacy of Structured Teaching Intervention on Knowledge Regarding Prevention of Nosocomial Infections among Nursing Students in University of Buraimi, Oman. *Universal Journal of Public Health*, *12*(2), 326–331. https://doi.org/10.13189/ujph.2024.120217

Mawo, F. H. M., & Molenaar, E. R. (2025). Strategi Pencegahan dan Pengendalian Infeksi Nosokomial : Literatur Review. *Jurnal Publikasi Kesehatan Masyarakat Indonesia*, *12*(1), 39. https://doi.org/10.20527/jpkmi.v12i1.22009

Menon, A., Durairajan, R., Durai, R., Paramasivam, N., & Narayanan, V. B. (2022). Exploration of 3D Printing of Anti-Infective Urinary Catheters: Materials and Approaches to Combat Catheter-Associated Urinary Tract Infections (CAUTIs) – A Review. *Critical Reviews in Therapeutic Drug Carrier Systems*, *39*(5), 51–82. https://doi.org/10.1615/CritRevTherDrugCarrierSyst.2022040452

Moradi, S., Najafpour, Z., Cheraghian, B., Keliddar, I., & Mombeyni, R. (2024). The Extra Length of Stay, Costs, and Mortality Associated With Healthcare-Associated Infections: A Case-Control Study. *Health Science Reports*, *7*(11), e70168. https://doi.org/10.1002/hsr2.70168

Mouajou, V., Adams, K., DeLisle, G., & Quach, C. (2022). Hand hygiene compliance in the prevention of hospital-acquired infections: a systematic review. *Journal of Hospital Infection*, *119*, 33–48. https://doi.org/10.1016/j.jhin.2021.09.016

Nasution, S. L. R., Maulina, F., & Girsang, E. (2023). Analysis of the Implementation of Infection Prevention and Control (PCU) Program in the Inpatient Room. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 356–363. https://doi.org/10.29303/jppipa.v9iSpecialIssue.4958

Nasution, S. W., Aprilia, S., & Ginting, C. N. (2023). Relationship Between Inhibiting Factors and the Implementation of the Occupational Safety and Health Management System. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 634–642. https://doi.org/10.29303/jppipa.v9iSpecialIssue.5989

Nurahmawati, Z., & Noor, S. (2024). Evaluasi program pencegahan pengendalian infeksi menggunakan model cipp di rumah sakit umum kota tangerang selatan. *Jurnal Keparawatan Widya Gantari Indonesia*, *8*(2), 208–223. https://doi.org/10.52020/jkwgi.v8i2.8596

Omar, I., Shirazy, M., Omar, M., & Chaari, A. (2020). Controlling nosocomial infection in adult intensive treatment unit: A quality improvement project. *International Journal of Risk and Safety in Medicine*, *31*(4), 267–273. https://doi.org/10.3233/JRS-190028

Purba, C. E., Nugroho, N., & Indrawati, R. (2021). Pengaruh Kerjasama Tim Terhadap Upaya Pengurangan Risiko Infeksi Di Unit Rawat Inap Rs. *Jurnal Health Sains*, *2*(4), 444–458. https://doi.org/10.46799/jhs.v2i4.145

Purba, D. A., Nasution, S. W., & Ginting, C. N. (2023). Analysis of Nurse Ability In Preventing Nosocomial Infections on the 6b Floor Using the Nvivo Method. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 344–349. https://doi.org/10.29303/jppipa.v9iSpecialIssue.4888

Raoofi, S., Kan, F. P., Rafiei, S., Hosseinipalangi, Z., Mejareh, Z. N., Khani, S., Abdollahi, B., Talab, F. S., Sanaei, M., Zarabi, F., Dolati, Y., Ahmadi, N., Raoofi, N., Sarhadi, Y., Masoumi, M., Hosseini, B. sadat, Vali, N., Gholamali, N., Asadi, S., … Ghashghaee, A. (2023). Global prevalence of nosocomial infection: A systematic review and meta-analysis. *PLoS ONE*, *18*(1), 1–17. https://doi.org/10.1371/journal.pone.0274248

Rodgers, E., Fridlay, G., Smart, H., & Penner, T. (2021). Abstracts from the 6th international conference on prevention & infection control (ICPIC 2021). *Antimicrobial Resistance & Infection Control*, *10*(S1), 1–140. https://doi.org/10.1186/s13756-021-00974-z

Rotua, M. Y., Pratama, I. H., & Novalinda Ginting, C. (2023). Relationship of Patient Safety Culture to Compliance with the Implementation of Standard Precautions by Nurses in the Inpatition of Royal Prima Hospital Medan. *Jurnal Penelitian Pendidikan IPA*, *9*(SpecialIssue), 570–575. https://doi.org/10.29303/jppipa.v9iSpecialIssue.5488

Ruiz-Ramos, J., Escolà-Vergé, L., Monje-López, Á. E.,

Herrera-Mateo, S., & Rivera, A. (2023). The Interventions and Challenges of Antimicrobial Stewardship in the Emergency Department. *Antibiotics*, *12*(10), 1522. https://doi.org/10.3390/antibiotics12101522

Sahputra, F., Girsang, E., & Napiah Nasution, A. (2023). Analysis of Implementation of Infection Prevention and Control at Royal Prima Marelan General Hospital. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11790–11795. https://doi.org/10.29303/jppipa.v9i12.5421

Singkun, S., Chaveepojnkamjorn, W., Ekcjariyawat, P., & Mongkolsomlit, S. (2023). Association Between Length of Stay and Healthcare-Associated Infections among Inpatients in a Secondary Health Care Hospital. *Universal Journal of Public Health*, *11*(6), 792–799. https://doi.org/10.13189/ujph.2023.110602

Suarmayasa, I. N. (2023). Pola Kuman Pada Manset Sphygmomanometer : Studi Deskriptif Di Rsd Mangusada. *Jurnal Riset Kesehatan Nasional*, *7*(2), 163–168. https://doi.org/10.37294/jrkn.v7i2.481

Sudarmo, Z. N. H. & dan L. M. (2016). Kepatuhan Penggunaan Alat Pelindung Diri (APD) untuk Pencegahan Penyakit Akibat Kerja. *Jurnal Berkala Kesehatan*, *1*(2), 88–96. Retrieved from https://myjurnal.poltekkes-kdi.ac.id/index.php/hijp/article/view/1336

Sulistyorini, E., & Palupi, F. H. (2023). Hubungan Pengetahuan Dengan Praktik Pencegahan dan Pengendalian Infeksi Dalam Pemberian Pelayanan Kebidanan Masa Pandemi Covid-19 Pada Praktik Mandiri Bidan. *Jurnal Formil (Forum Ilmiah) Kesmas Respati*, *8*(1), 11. https://doi.org/10.35842/formil.v8i1.464

Supriadi, I. R., Haanappel, C. P., Saptawati, L., Widodo, N. H., Sitohang, G., Usman, Y., Anom, I. B., Saraswati, R. D., Heger, M., Doevendans, P. A., Satari, H. I., Voor In ’t Holt, A. F., & Severin, J. A. (2023). Infection prevention and control in Indonesian hospitals: identification of strengths, gaps, and challenges. *Antimicrobial Resistance and Infection Control*, *12*(1), 6. https://doi.org/10.1186/s13756-023-01211-5

Suryani, D., Nuraeni, T., Buston, E., Fentia, L., Supriatin, S., Amaliah, L., & Anitasari, S. (2023). Hand Hygiene Effectiveness in Controlling the Spread of COVID-19: A Scoping Review. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 800–809. https://doi.org/10.29303/jppipa.v9i10.4686

Suryantoro, E., Udin, U., & Qamari, I. N. (2023). A bibliometric analysis using VOSviewer: Leadership in infection prevention and control. *Multidisciplinary Science Journal*, *5*(2). https://doi.org/10.31893/multiscience.2023022

Syahputri, N. A. W., Girsang, E., & Napiah Nasution, A. (2023). Analysis of the Use of Antibiotic Therapy in Surgical Patients at Royal Prima Marelan Hospital. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 11808–11817. https://doi.org/10.29303/jppipa.v9i12.5419

Teus, J. K., Mithen, L., Green, H., Hutton, A., & Fernandez, R. (2024). Impact of infection prevention and control practices, including personal protective equipment, on the prevalence of hospital-acquired infections in acute care hospitals during COVID-19: a systematic review and meta-analysis. *Journal of Hospital Infection*, *147*, 32–39. https://doi.org/10.1016/j.jhin.2024.02.010

Wang, L., Zhang, D., Liu, J., Tang, Y., Zhou, Q., Lai, X., Zheng, F., Wang, Q., Zhang, X., & Cheng, J. (2023). The mediating role of incentives in association between leadership attention and self-perceived continuous improvement in infection prevention and control among medical staff: A cross-sectional survey. *Frontiers in Public Health*, *11*. https://doi.org/10.3389/fpubh.2023.984847