Impact of HICPAC Guideline Adherence on Catheter-Associated Urinary Tract Infection Rates: Evidence from a District Hospital in Indonesia

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Abstract

Urinary tract infections (UTIs) are among the most common nosocomial infections, particularly affecting hospitalized patients with indwelling urinary catheters. The implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines aims to reduce the incidence of UTIs through stringent infection control measures in hospital settings. This study aimed to examine the association between the implementation of HICPAC guidelines and the incidence of catheter-associated urinary tract infections (CAUTIs) among inpatients at Permata Hati General Hospital, Muara Bungo Regency, in 2024. A quantitative study using a quasi-experimental design was conducted at Permata Hati General Hospital from October 2024 to February 2025. The study population consisted of nursing staff and all inpatients with urinary catheters. A total of 68 respondents were included, divided equally into two groups: 34 patients before and 34 after the implementation of HICPAC guidelines. Data were collected through medical record reviews and structured questionnaires. Statistical analyses were performed using the Chi-square and Wilcoxon tests. The results showed a statistically significant association between the implementation of HICPAC guidelines and a reduction in CAUTI incidence ($p = 0.040$). Additionally, significant improvements were observed in nurses' knowledge, attitudes, and practices following the socialization and application of the guidelines. In conclusion, effective implementation of HICPAC guidelines significantly reduces the risk of CAUTIs in hospitalized patients. Hospitals are encouraged to strengthen nurses' adherence to infection control protocols to minimize the incidence of these infections.

***Keywords:* Catheter Associated Urinary Tract Infection, HICPAC Guidelines, Infection Control, Hospitalized Patients, Urinary Catheters**

INTRODUCTION

Healthcare-associated infections (HAIs) are defined as infections acquired in healthcare settings that were not present or incubating at the time of a patient's admission. According to the Centers for Disease Control and Prevention (CDC), HAIs are classified into six major categories: catheter-associated urinary tract infection (CAUTI), central line-associated bloodstream infection (CLABSI), surgical site infection (SSI), ventilator-associated pneumonia (VAP), hospital-acquired pneumonia (HAP), and infections caused by Clostridium difficile (Monegro et al., 2023). In 2014, the Centers for Disease Control and Prevention (CDC) reported the results of a prevalence survey on healthcare-associated infections (HAIs) conducted among 11.282 patients across 183 hospitals in the United States. The findings revealed that approximately 4% of hospitalized patients experienced at least one HAI (Magill et al., 2014). Meanwhile, another study reported that the overall prevalence of healthcare-

associated infections (HAIs) in Southeast Asia was 21.6%, with Indonesia recording the highest prevalence rate at 30.4% (Goh et al., 2023).

Catheter-associated urinary tract infections (CAUTIs) are the most frequently reported type of nosocomial infection, according to data from the National Healthcare Safety Network (NHSN). Although CAUTIs are considered among the most preventable healthcare-associated infections, they continue to represent a significant public health challenge (Gould et al., 2009). The incidence of catheter-associated urinary tract infections (CAUTIs) in the United States is estimated at approximately one million cases annually, accounting for up to 40% of all hospital-acquired infections and 23% of infections in intensive care units (ICUs). CAUTIs are also recognized as the leading cause of secondary bloodstream infections. Evidence suggests that CAUTIs increase morbidity and mortality rates by 2.8 times and extend hospital stays by an additional 1 to 3 days. The burden of CAUTIs also translates into substantial healthcare costs, with annual expenditures estimated to range from USD 115 million to USD 1.82 billion. In Australia, the cost of care for patients with CAUTIs has been projected to be nearly twice as high compared to patients without CAUTIs (Werneburg, 2022).

In recent years, hospitals have increasingly prioritized the issue of healthcare-associated infections (HAIs) due to their wide-ranging impacts. HAIs affect not only individual patients but also the broader community, as they have been linked to the emergence of drug-resistant infections. Identifying patients with risk factors for HAIs and antimicrobial resistance is a critical step in preventing and minimizing the spread of these infections (Habboush et al., 2024).

The Infectious Diseases Society of America (IDSA) and the Centers for Disease Control and Prevention (CDC) have both issued guidelines for the prevention of catheter-associated urinary tract infections (CAUTIs). IDSA published its guidelines in 2010, while the CDC initially released its CAUTI prevention guidelines in 1981, which were subsequently updated in 2009. In 2017, the Healthcare Infection Control Practices Advisory Committee (HICPAC) revised the CDC guidelines based on the latest evidence and research findings. These updated recommendations address six key areas: appropriate indications for urinary catheter use, proper catheter insertion techniques, correct catheter maintenance practices, quality improvement initiatives, administrative support, and surveillance implementation. Each component is accompanied by recommendations graded according to the strength and quality of the supporting scientific evidence (Daniels et al., 2014).

Studies have demonstrated that the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) recommendations significantly reduces the

incidence of catheter-associated urinary tract infections (CAUTIs) in intensive care units. A study by Asepty (2020) reported that adherence to HICPAC guidelines decreased the risk of CAUTIs by a factor of 3.902 compared to settings without guideline implementation. Similarly, research conducted by Dublynn and Episcopia (2019) reported a substantial 51.7% reduction in CAUTI rates, based on initial data from the National Healthcare Safety Network (NHSN), following HICPAC-based interventions. In addition, the urinary catheter utilization ratio declined from 15.7 to 10.7. In Indonesia, a comparable study by Sitepu and Putra (2019) showed a significant decrease in CAUTI cases from 11 cases (84.6%) before implementation to 2 cases (15.4%) after applying HICPAC guidelines ($p = 0.02$). This reduction was also associated with a considerable decline in annual healthcare costs, from USD 135.945 to USD 25.175 (Rhee et al., 2016).

Based on the aforementioned discussion, the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines not only contributes to the reduction of catheter-associated urinary tract infections (CAUTIs) but also has long-term impacts on decreasing healthcare costs and reducing the length of hospital stays. Therefore, this study aims to examine the association between the implementation of HICPAC guidelines and the incidence of urinary tract infections among inpatients with urinary catheters at Permata Hati General Hospital, Muara Bungo Regency.

METHODS

This study employed a quantitative research design with an ambispective quasi-experimental approach. Patients recruited prior to the intervention were assigned to the control group, while those recruited after the intervention constituted the intervention group. The intervention consisted of the implementation of the HICPAC guidelines, structured in the form of a checklist.

The study was conducted at Permata Hati General Hospital, Muara Bungo Regency, from October 2024 to February 2025. The study population comprised nursing staff and all inpatients using urinary catheters during the study period. Participants were selected through purposive sampling, with inclusion criteria including: hospitalization for at least 48 hours, current use of a urinary catheter, and provision of informed consent. A total of 68 respondents were included, consisting of 34 patients assessed before and 34 patients assessed after the implementation of the HICPAC guidelines.

Data collection methods varied between groups. For the pre-intervention group, data on CAUTI incidence were obtained from routine surveillance conducted by the Infection Prevention and Control Team and through medical record reviews. For the post-intervention group, CAUTI incidence was monitored prospectively using dipstick urinalysis in symptomatic patients or prior to catheter removal. Data on nurses' knowledge, attitudes, and practices were collected before and after training and dissemination of the HICPAC guidelines, using a structured questionnaire.

Data analysis was conducted in two phases. Univariate analysis was used to describe respondent characteristics and the distribution of study variables, presented in frequency tables. Bivariate analysis was performed to examine the relationships between variables, employing paired t-tests or Wilcoxon tests for continuous data and Chi-square tests for categorical data. Normality testing was conducted prior to the paired t-tests. A significance level of $p \leq 0.05$ was used for all statistical tests. This study received ethical approval from the Health Research Ethics Committee of Universitas Sari Mutiara Indonesia (Approval No. 3366/F/KEP/USM/IV/2025).

RESULTS

The characteristics of patients and nurses in this study are presented in Tables 1 and 2 below:

Table 1. Characteristics of Inpatients Using Urinary Catheters at Permata Hati General Hospital

Characteristics	Mean	Median	Mode	Minumum	Maximum
Age (years)	60,13	63,50	55	19	94
Characteristics		**n**			**%**
Sex					
Male		39			57,4
Female		29			42,6
Total		**68**			**100**
Hospital Unit					
Emergency Department (ED)		28			41,2
Intensive Care Unit (ICU)		40			58,8
Total		**68**			**100**
Urinary Nitrite Test					
Negative		61			89,7
Positive		7			10,3
Total		**68**			**100**
Catheter Associated Urinary Tract Infection (CAUTI)					
No Cauti		58			85,3
Cauti		10			14,7
Total		**68**			**100**

Based on Table 1, the results of this study showed that the mean age of patients using urinary catheters was 60.13 years, with the youngest patient aged 19 years and the oldest aged 94 years. The majority of catheterized patients were male, comprising 39 patients (57.4%), while female patients accounted for 29 patients (42.6%). Most patients were hospitalized in the

Intensive Care Unit (ICU), totaling 40 patients (58.8%), while 28 patients (41.2%) were admitted to the Emergency Department (ED).

The most common diagnoses leading to catheter insertion were decreased consciousness due to stroke and acute coronary syndrome (ACS), each recorded in 11 patients (16.2%). The least common diagnosis was gastroenteritis (GE), found in 1 patient (1.5%). Most patients had normal leukocyte counts (38 patients, 55.9%), while 30 patients (44.1%) exhibited elevated leukocyte levels, which may indicate an infection.

Regarding urinary nitrite results, the majority of patients tested negative (61 patients, 89.7%), while 7 patients (10.3%) tested positive, potentially indicating urinary tract infections. Most patients had catheterization durations of 2 days (54.4%), with the longest duration recorded at 10 days (1.5%). Finally, among the 68 patients, 10 patients (14.7%) developed catheter-associated urinary tract infections (CAUTIs), while 58 patients (85.3%) did not develop CAUTIs.

Table 2. Characteristics of Nurse Respondents at Permata Hati General Hospital

Characteristics	Mean	Median	Mode	Minumum	Maximum
Age (years)	26,97	27,00	27	28	39
Characteristic		**n**		**%**	
Sex					
Male		6		17,5	
Female		28		82,4	
Total		**34**		**100**	
Profession					
Nurse		34		100	
Total		**34**		**100**	
Unit					
Emergency Department		14		**41,2**	
Inpatient Ward		13		**38,2**	
Intensive Care Unit		7		20,6	
Total		**34**		**100**	

Based on Table 2, the results showed that the mean age of nurses was 26.97 years, indicating that most nurses were still within the early productive age range. The age of nurses ranged from 28 years (youngest) to 39 years (oldest). The majority of nurses were female, totaling 28 (82.4%), while only 6 nurses (17.6%) were male. All respondents were nurses (n = 34, 100%). Fourteen respondents (41.2%) worked in the Emergency Department (ED), which handles high-acuity cases; 13 respondents (38.2%) worked in the inpatient unit, providing longer-term patient care; and 7 respondents (20.6%) worked in the Intensive Care Unit (ICU), managing critically ill patients.

The knowledge, attitudes, and practices (KAP) of nurses before and after the socialization and implementation of the Healthcare Infection Control Practices Advisory

Committee (HICPAC) guidelines at Permata Hati General Hospital, Muara Bungo Regency, are presented in Table 3 below:

Table 3. Nurses' Knowledge, Attitudes, and Practices Before and After the Socialization and Implementation of Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines at Permata Hati General Hospital, Muara Bungo, 2024

	N	Variabel		Mean	p-value
HICPAC	34	Knowledge	Before	9,68	0,000
			After	18,29	
		Attitudes	Before	6,62	0,000
			After	8,68	
		Practices	Before	9,50	0,000
			After	20,00	

Based on Table 3, the results indicate a significant improvement in nurses' knowledge, attitudes, and practices following the socialization and implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines at Permata Hati General Hospital, Muara Bungo Regency.

For the knowledge domain, the mean pre-intervention score was 9.68, which increased to 18.29 post-intervention. A p-value of 0.000 indicates that this improvement is statistically highly significant, suggesting that the HICPAC socialization successfully enhanced nurses' understanding of infection prevention and control.

In terms of attitudes, the mean pre-intervention score was 6.62, rising to 8.68 after the intervention, with a p-value of 0.000. This result demonstrates that nurses became more receptive and developed greater awareness of the importance of infection control protocols.

For the practice domain, a significant improvement was also observed: the mean practice score increased from 9.50 before the intervention to 20.00 afterward, with a p-value of 0.000. This finding indicates that nurses not only understood the importance of infection prevention but also applied the guidelines effectively in their daily clinical practices.

Overall, these results suggest that the socialization and implementation of the HICPAC guidelines were highly effective in enhancing nurses' awareness, acceptance, and practice of infection control measures.

The association between the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines and the incidence of urinary tract infections among inpatients using urinary catheters in this study is presented in Table 4 below:

Table 4. Association Between the Implementation of Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines and Urinary Tract Infections Among Inpatients Using Urinary Catheters at Permata Hati General Hospital, Muara Bungo, 2024

HICPAC	CAUTI				Total		P-value
	No Cauti		Cauti				
	n	%	n	%	N	%	
Before HICPAC	26	38,2	8	11,8	34	50,0	
After HICPAC	32	47,1	2	2,9	34	50,0	0,040
Total	**58**	**85,3**	**10**	**14,7**	**68**	**100**	

Based on Table 4, the findings indicated that the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines was significantly associated with a reduction in the incidence of catheter-associated urinary tract infections (CAUTIs) among inpatients at Permata Hati General Hospital, Muara Bungo Regency.

Prior to the implementation of the HICPAC guidelines, among 34 patients with urinary catheters, 26 patients (38.2%) did not develop CAUTIs, while 8 patients (11.8%) were diagnosed with CAUTIs. Following the implementation, among another group of 34 catheterized patients, the incidence of CAUTI decreased markedly, with 32 patients (47.1%) remaining infection-free and only 2 patients (2.9%) developing CAUTIs.

In total, among the 68 patients included in the study, 58 patients (85.3%) did not experience catheter-associated infections, while 10 patients (14.7%) were diagnosed with CAUTIs. Statistical analysis yielded a p-value of 0.040, indicating a statistically significant association between the implementation of HICPAC guidelines and the reduction in CAUTI incidence among hospitalized patients with urinary catheters.

DISCUSSION

Association Between the Implementation of Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidelines and the Incidence of Urinary Tract Infections Among Inpatients Using Urinary Catheters at Permata Hati General Hospital, Muara Bungo Regency

Catheter-associated urinary tract infection (CAUTI) is one of the most common nosocomial infections occurring in healthcare facilities. The primary risk factors contributing to CAUTI include prolonged urinary catheter use, improper catheter insertion techniques, and the clinical condition of patients, such as the presence of comorbidities like diabetes mellitus (DM) and immobilization (Saint et al., 2021).

Diabetes mellitus is a chronic disease that can increase the risk of infections, including catheter-associated urinary tract infections (CAUTIs). Patients with diabetes mellitus have elevated blood glucose levels, which can impair immune system function, cause neutrophil dysfunction, and enhance bacterial adhesion to the bladder wall and urinary catheter surfaces

(Flores-Mireles et al., 2023). Furthermore, hyperglycemia creates an environment conducive to the growth of pathogenic microorganisms, including Escherichia coli, which is the primary causative agent of catheter-associated urinary tract infections (CAUTIs).

Patients with diabetes mellitus who underwent urinary catheterization were still at risk of developing urinary tract infections despite the implementation of prevention protocols recommended by the Healthcare Infection Control Practices Advisory Committee (HICPAC). This finding suggests that intrinsic patient factors, such as impaired immune responses and bladder dysfunction due to diabetic neuropathy, may contribute significantly to the development of catheter-associated urinary tract infections (CAUTIs) (Hooton et al., 2022).

Immobilization or limited mobility, such as in patients with spinal cord injuries, stroke, or other critical conditions, is also a significant risk factor for catheter-associated urinary tract infections (CAUTIs). Immobilized patients often experience urinary stasis due to an inability to void spontaneously, necessitating prolonged catheter use. Urinary stasis can promote bacterial colonization and biofilm formation on the catheter surface, ultimately leading to infection (Kassakian et al., 2021).

Patients who experienced immobilization due to spinal trauma also developed catheter-associated urinary tract infections (CAUTIs) despite adherence to HICPAC protocols. This condition may be attributed to impaired natural bladder cleansing mechanisms, alterations in the urogenital microbiota, and the potential colonization of multidrug-resistant bacteria due to repeated antibiotic use (Meddings et al., 2022).

The findings of this study demonstrate that the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines contributed significantly to the reduction of catheter-associated urinary tract infections (CAUTIs) among inpatients at Permata Hati General Hospital, Muara Bungo Regency. Before the implementation of HICPAC guidelines, 8 out of 34 catheterized patients (11.8%) developed CAUTI. After the implementation, the incidence decreased to only 2 patients (2.9%). Overall, among the 68 patients observed, 58 patients (85.3%) did not develop infections following catheterization, while 10 patients (14.7%) developed CAUTI. Statistical analysis revealed a p-value of 0.040, indicating a significant association between the implementation of HICPAC guidelines and the reduction in urinary tract infection incidence among catheterized inpatients. These findings are consistent with the study conducted by Sitepu (2019), which found that the implementation of HICPAC guidelines reduced the incidence of nosocomial infections, including catheter-associated urinary tract infections (CAUTIs), by improving nurses' compliance with standard urinary catheter insertion procedures. Additionally, research by Sari

et al., (2022) demonstrated that continuous education and training programs for nurses significantly enhanced awareness and skills in infection prevention, thereby substantially reducing the risk of CAUTIs.

The reduction in CAUTI incidence following the implementation of the HICPAC guidelines can be attributed to several key factors. First, there was an increase in nurses' adherence to hand hygiene protocols and aseptic techniques during catheter insertion and maintenance. Second, the implementation of early catheter removal procedures when no longer clinically indicated significantly reduced patients' exposure to infection risks. Third, comprehensive education and training provided to nurses on infection prevention after the guideline implementation also contributed to the observed decline in CAUTI cases (Widodo et al., 2022).

Statistical analysis in this study revealed a significant difference in the incidence of CAUTI before and after the implementation of the HICPAC guidelines, with a p-value < 0.05, indicating the effectiveness of the intervention. Prior to implementation, the incidence of CAUTI was notably higher compared to the post-implementation period. These findings are consistent with previous studies by healthcare experts, which have demonstrated that the application of evidence-based prevention protocols can significantly reduce the incidence of catheter-associated urinary tract infections (Sitorus dkk, 2019).

If not promptly and appropriately managed, catheter-associated urinary tract infections (CAUTIs) can progress to serious complications such as prostatitis, cystitis, gram-negative bacteremia, endocarditis, sepsis, and even meningitis. Each year, more than 13,000 deaths are reported to be associated with CAUTI cases (CDC, 2022). CAUTI also contributes to an increased length of hospital stay, typically extending hospitalization by approximately 2 to 5 days. In addition, it is associated with higher morbidity, mortality, and healthcare costs. Another notable impact experienced by patients with CAUTI is increased discomfort during hospitalization (Waluyo et al., 2022).

Furthermore, the study results demonstrated a significant improvement in nurses' knowledge, attitudes, and practices following the socialization and implementation of the HICPAC guidelines. The mean knowledge score increased from 9.68 to 18.29, with a p-value of 0.000, indicating a highly significant improvement in understanding. The mean attitude score increased from 6.62 to 8.68, and the mean practice score increased from 9.50 to 20.00, both also with p-values of 0.000. These improvements suggest that nurses not only enhanced their understanding of infection prevention but also successfully applied this knowledge in their daily clinical practice.

These findings are consistent with the study conducted by Sitepu (2019), which found that the implementation of HICPAC guidelines reduced the incidence of nosocomial infections, including catheter-associated urinary tract infections (CAUTIs), by improving nurses' adherence to standard urinary catheter insertion procedures. Additionally, research by Sari et al. (2022) also demonstrated that continuous education and training programs for nurses significantly enhanced awareness and skills in infection prevention, thereby substantially reducing the risk of CAUTIs.

Overall, the findings of this study indicate that the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines is an effective strategy for reducing the incidence of catheter-associated urinary tract infections (CAUTIs) and for enhancing nurses' awareness and compliance with infection control practices. Therefore, hospitals are encouraged to continuously implement and strengthen adherence to HICPAC protocols to maintain the quality of healthcare services and reduce the incidence of nosocomial infections, particularly CAUTIs.

The significant association between the implementation of HICPAC guidelines and the reduction in urinary tract infection incidence among inpatients using urinary catheters can be explained by the effectiveness of the infection prevention measures. HICPAC guidelines emphasize appropriate indications for urinary catheter placement, aseptic insertion techniques, proper catheter care, and regular monitoring to prevent bacterial colonization and biofilm formation on catheter surfaces. Hospital data revealed that improved compliance with HICPAC standards significantly reduced the incidence of CAUTIs, attributed to minimizing unnecessary catheterization duration and enhancing nurses' adherence to hand hygiene and medical equipment disinfection. Moreover, previous studies have shown that the implementation of HICPAC protocols, combined with ongoing nurse education programs, contributes to improved patient care quality, shorter hospital stays, and reduced healthcare costs associated with nosocomial infections. Thus, strict adherence to infection control guidelines plays a crucial role in decreasing the incidence of catheter-associated urinary tract infections in healthcare settings. Comorbidities such as diabetes mellitus (DM) and immobilization remain significant risk factors for CAUTI, even when preventive protocols are implemented. Therefore, individualized patient management, close monitoring of catheter use duration, and additional interventions such as nurse education on early infection detection are recommended as effective strategies to further reduce CAUTI rates in healthcare facilities.

CONCLUSIONS

This study demonstrated that the implementation of the Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines was associated with a reduction in the incidence of catheter-associated urinary tract infections (CAUTIs) among inpatients using urinary catheters at Permata Hati General Hospital, Muara Bungo. In addition, a significant improvement was observed in nurses' knowledge, attitudes, and practices regarding CAUTI prevention before and after the implementation of HICPAC guidelines. Future research is recommended to incorporate both primary and secondary data sources and to further explore the effectiveness of HICPAC guideline implementation. Healthcare personnel should continue to enhance their understanding and adherence to HICPAC protocols to reduce CAUTI incidence. Hospitals are encouraged to closely monitor catheter use duration, identify and address patient risk factors, provide adequate hygiene facilities, and conduct regular training and surveillance programs to support patient safety initiatives.

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