

REDUCING USE OF INDWELLING URINARY CATHETERS AND ASSOCIATED URINARY TRACT INFECTIONS

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CE 1.0 Hour

Notice to CE enrollees:

A closed-book, multiple-choice examination following this article tests your understanding of the following objectives:

1. Understand that catheter-associated urinary tract infections (CAUTIs) are among complications fundamentally linked to nursing care.
2. Recognize that duration of catheterization is the major risk factor for CAUTIs.
3. Describe how a nurse-based intervention can decrease CAUTIs.

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Background Use of indwelling urinary catheters can lead to complications, most commonly catheter-associated urinary tract infections. Duration of catheterization is the major risk factor. These infections can result in sepsis, prolonged hospitalization, additional hospital costs, and mortality.

Objectives To implement and evaluate the efficacy of an intervention to reduce catheter-associated urinary tract infections in a medical intensive care unit by decreasing use of urinary catheters.

Methods Indications for continuing urinary catheterization with indwelling devices were developed by unit clinicians. For a 6-month intervention period, patients in a medical intensive care unit who had indwelling urinary catheters were evaluated daily by using criteria for appropriate catheter continuance. Recommendations were made to discontinue indwelling urinary catheters in patients who did not meet the criteria. Days of use of a urinary catheter and rates of catheter-associated urinary tract infections during the intervention were compared with those of the preceding 11 months.

Results During the study period, 337 patients had a total of 1432 days of urinary catheterization. With use of guidelines, duration of use was significantly reduced to a mean of 238.6 d/mo from the previous rate of 311.7 d/mo. The number of catheter-associated urinary tract infections per 1000 days of use was a mean of 4.7/mo before the intervention and zero during the 6-month intervention period.

Conclusions Implementation of an intervention to judge appropriateness of indwelling urinary catheters may result in significant reductions in duration of catheterization and occurrences of catheter-associated urinary tract infections. (*American Journal of Critical Care*. 2009;18:535-542)

Urinary tract infections are the most common nosocomial infection in intensive care units.

Use of indwelling urinary catheters is common in intensive care units (ICUs).¹ Catheter-associated urinary tract infections (CAUTIs) increase as the duration of catheter use increases; the estimated risk for infection is at least 5% per day of catheterization.² Among all risk factors, increased duration of catheterization is the greatest for development of a urinary tract infection.³⁻⁵

Urinary tract infections account for 32% of all health care–associated infections and are the most common nosocomial infection in ICUs.⁶ Urinary catheters are used routinely in ICUs, usually for frequent and accurate monitoring of urinary output. Once inserted, catheters tend to remain in place after appropriate indications for their use end.⁷ Urinary infections in critically ill patients are associated with increased length of stay and mortality.⁸

Strategies to prevent CAUTIs have focused on catheter materials, drainage systems, insertion techniques, and use of anti-infective agents. Among all methods investigated, the most important intervention is limiting catheter use. Reducing CAUTIs

requires avoiding use of indwelling urinary catheters and removing catheters as soon as indications for their use are no longer present.⁹

Rush University Medical Center, Chicago, Illinois, participates in the National Healthcare Safety Network (NHSN) of the Centers for Disease Control and Prevention. The NHSN is a performance measurement system devoted to tracking hospital-acquired infections. Data are obtained by trained infection control professionals from an institution's infection control program who use standardized definitions and validated NHSN data collection protocols. The NHSN provides a national database to benchmark infection rates of similar hospitals and allows identification of unique institutional trends. NHSN data from the medical ICU (MICU) indicated that the

unit's monthly rates of CAUTIs in 2006 typically exceeded the NHSN 50th percentile and were greater than the 75th percentile for 2 of 12 months. The 75th percentile ranking indicated that 75% of units in our comparison group had lower rates of CAUTIs than we did. We viewed these findings as an opportunity to develop and test processes to reduce catheter-associated infections in our patients.

We decided to determine if we could reduce CAUTIs in the MICU by limiting use of indwelling urinary catheters. Our specific aims were as follows:

- Implement an intervention to limit use of indwelling urinary catheters by conducting daily evaluations of the appropriateness of catheter use
- Recommend removal of catheters when appropriate indications were not present
- Compare urinary catheter use and catheter-associated urinary tract infection rates before and after the intervention

Methods

Approval from the appropriate institutional review board was obtained before the study began. Informed consent was not required.

The research was done at Rush University Medical Center, a 613-bed, nonprofit, inner city academic medical center. The MICU was a 21-bed unit that provided critical and intermediate care to adults with primarily medical illnesses. Most common diagnoses included pneumonia, severe sepsis, neutropenic fever, gastrointestinal bleeding, and multi-organ failure. Mean length of stay was 5.2 days. The nurse to patient ratio was typically 1 to 2. On this unit, urinary catheters are inserted at the discretion of the physician or critical care nurse. Catheters are discontinued on order of a physician. The unit's nosocomial infection rates, including rates for CAUTIs, are compiled and posted monthly.

Before the intervention, a team of MICU clinicians reviewed current catheter practices, analyzed relevant publications, and developed criteria for use of indwelling urinary catheters (Table 1). This team consisted of 3 senior staff nurses, 2 advanced practice nurses, and the unit's medical director. Once criteria were defined, educational sessions on the

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Table 1
Indications for use of an indwelling urinary catheter

Appropriate indications	Inappropriate indications
Urinary tract obstruction	Incontinence without any of the appropriate indications
Urinary retention	Diuresis
Patient to undergo prolonged (>2 hours) procedure	Frequent, but nonessential, determination of urinary output
Recently underwent surgical/invasive procedure	Nurse's concern about patient's discomfort
Epidural catheter in place	Diarrhea, without any of the appropriate indications
Frequent monitoring (every 1-2 hours) of urinary output required	Patient's preference
Deep sedation/paralysis	
Stage III or IV skin ulcers	
Surgical repair of decubitus ulcer	
Movement intolerance due to terminal illness or severe impairment	

study objectives, rationale, methods, and expectations were provided by the investigators to MICU nurses and physicians. Appropriate indications for insertion or continuation of indwelling urinary catheters were emphasized.

The study population consisted of all consecutive patients admitted to the MICU from December 1, 2007, to May 31, 2008, who had an indwelling urinary catheter during their unit stay. During this time, all patients in the unit who had indwelling urinary catheters were identified each day by one of the nurse coinvestigators at nursing shift report. Patients with urinary catheters were evaluated by one of the study investigators on the day of MICU admission and daily thereafter by using the criteria for appropriate use of the catheters. Nurses assigned to patients with an indwelling catheter were consulted about the principal reason for catheter placement or continuation. Daily evaluations by the nurse investigators continued until a patient's catheter was removed or the patient was discharged from the unit. Results of daily screenings were presented by a nurse investigator during multidisciplinary morning rounds. Recommendations were made to discontinue indwelling urinary catheters in patients who were judged not to meet the defined criteria.

Data collected during the intervention phase included duration of catheterization, appropriateness of urinary catheterization, and reasons for inappropriate catheter use. Surveillance for CAUTIs was performed by nurse epidemiologists from the medical center's infection control department. Monthly summaries of total days of use of urinary catheters and CAUTIs were prepared by the nurse epidemiologist assigned to the MICU.

The hypothesis was that days of use of urinary catheters and number of CAUTIs would decrease during the intervention months compared with the

11 months before the intervention. Total days of use of catheters and monthly CAUTI rates before and during the intervention were compared by using unpaired *t* tests. Significance was set at $P < .05$.

Definitions

A CAUTI was defined as an infection in a patient with a urinary catheter who met the NHSN definition of a urinary tract infection¹⁰ (Table 2).

Urinary catheter device days were the total number of days of use of an indwelling urinary catheter. Condom catheters, suprapubic catheters, and nephrostomy tubes were excluded from counts, as were patients receiving intermittent catheterizations. Patients with urinary catheters were identified each morning from the charge nurses' unit nursing report sheet. Each patient with a catheter at that time was counted as 1 device day. Monthly catheter device days were the sum of the daily counts.

CAUTI rates were defined as the number of CAUTIs divided by the number of urinary catheter device days multiplied by 1000. CAUTI rates were computed monthly.

Inappropriate catheter days were the total number of days urinary catheters remained in place without acceptable indications according to study criteria listed in Table 1.

Results

During the 6-month intervention, 337 patients had indwelling urinary catheters for a total of 1432 days. Of the patients, 58% were women. The age range was 18 to 99 years, with a mean of 61 years.

Once inserted, catheters tend to remain in place after appropriate indications end.

Overall, 32% of the catheter device days were considered inappropriate.

Table 2
Definition of urinary tract infections: patient must meet at least 1 of the criteria

Criteria	Definition
1	Patient has at least 1 of the following signs or symptoms with no other recognized cause: fever, urgency, frequency, dysuria, or suprapubic tenderness <i>and</i> patient has a urine culture that shows growth of more than 100 000 microorganisms per milliliter of urine with no more than 2 species of microorganisms
2	Patient has at least 2 of the following signs or symptoms with no other recognized cause: fever, urgency, frequency, dysuria, or suprapubic tenderness <i>and</i> at least 1 of the following: <ul style="list-style-type: none"> • Positive test for leukocyte esterase and/or nitrite • Pyuria • Organisms evident on Gram stain of urine • At least 2 urine cultures with repeated isolation of the same uropathogen with at least 100 colonies per milliliter in nonvoided urine specimens • Fewer than 100 000 colonies per milliliter of a single uropathogen in a patient being treated with an effective antimicrobial agent for a urinary tract infection • Physician's diagnosis of a urinary tract infection • Physician-instituted therapy for a urinary tract infection
3	The patient has had an indwelling urinary catheter within 7 days before the sample was collected for culture <i>and</i> the culture shows growth of more than 100 000 microorganisms per milliliter of urine with no more than 2 species of microorganisms <i>and</i> the patient has no fever, urgency, frequency, dysuria, or suprapubic tenderness

Table 3
Urinary catheter device days and rates of catheter-associated urinary tract infections before and during the intervention period

Variable	Before intervention	During intervention
No. of device days per month ^a		
Mean	311.7	238.6
SD	56.4	30.2
No. of infections per 1000 device days ^b		
Mean	4.7	0
SD	2.5	0

^a Significant difference ($P = .01$) from before to after intervention period.

^b Significant difference ($P < .001$) from before to after intervention period.

Overall, 456 of the 1432 device days (32%) were considered inappropriate. Inappropriate days included 108 days in which urinary catheters placed in the emergency department or at an outside facility were removed on the first day of MICU admission because catheter continuation was judged inappropriate according to study criteria. If analysis was restricted to patients with catheters in place for 24 hours or more, 119 of 1095 device days (11%) were judged inappropriate. Reasons offered most commonly by nurses for catheter continuation against recommendation were incontinence, particularly in women, and concern for skin integrity. Other reasons included obesity, diuresis, and perceived patient discomfort. Three patients requested that the catheter be continued for their comfort or convenience.

Table 3 and Figures 1 and 2 summarize the outcomes before and after the intervention. Before the intervention, the mean number of urinary catheter

days was 311.7 d/mo. In comparison, mean catheter days during the intervention declined to 238.6 d/mo, a reduction of 73.1 d/mo. In the 11 months before the intervention, 15 CAUTIs occurred during 3429 device days or 4.7 per 1000 days. In the intervention phase, 0 CAUTIs occurred in 1432 device days. These differences were statistically significant.

Discussion

Nosocomial infections, including CAUTIs, are considered a clinical indicator of quality of care. Catheter-associated urinary tract infections were included in the list of largely preventable harms due to medical care developed by the Centers for Medicare and Medicaid Services.¹¹ CAUTIs were selected by the centers as a high-volume, high-cost health care problem with acceptable prevention strategies. CAUTIs were considered an avoidable complication, and unless patients had the infections at the time of hospital admission, secondary costs for CAUTIs would not be reimbursed by the centers.

As part of a campaign to reduce CAUTIs, the Centers for Disease Control and Prevention recommended use of urinary catheters only when indicated and prompt removal of the catheters when use was no longer appropriate. Situations justifying medical necessity for catheter placement were defined as relief of urinary obstruction, neurogenic bladder dysfunction and urinary retention, urological surgeries, and a need to obtain accurate measurements of urinary output in critical illness. Catheter use solely for the convenience of personnel providing patient care or as a substitute for nursing care of an incontinent patient was specifically discouraged.¹¹ Other prohibitions to placement

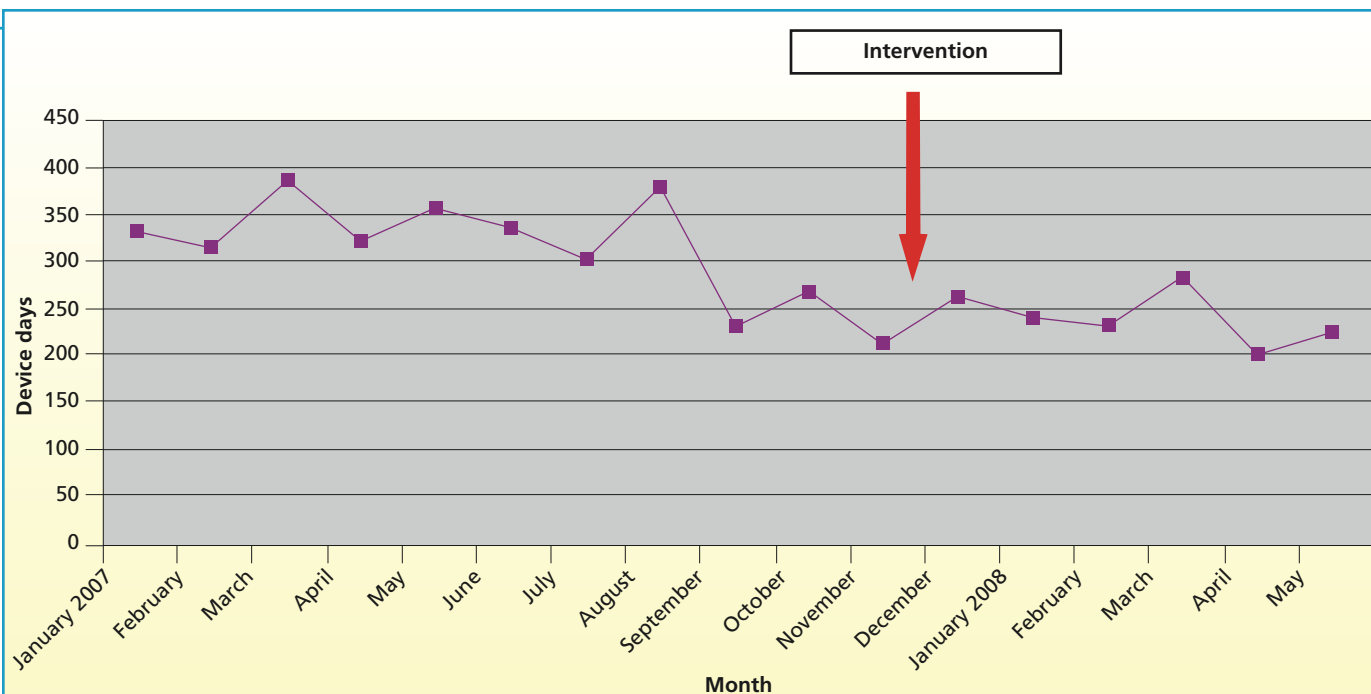


Figure 1 Number of urinary catheter device days by month.

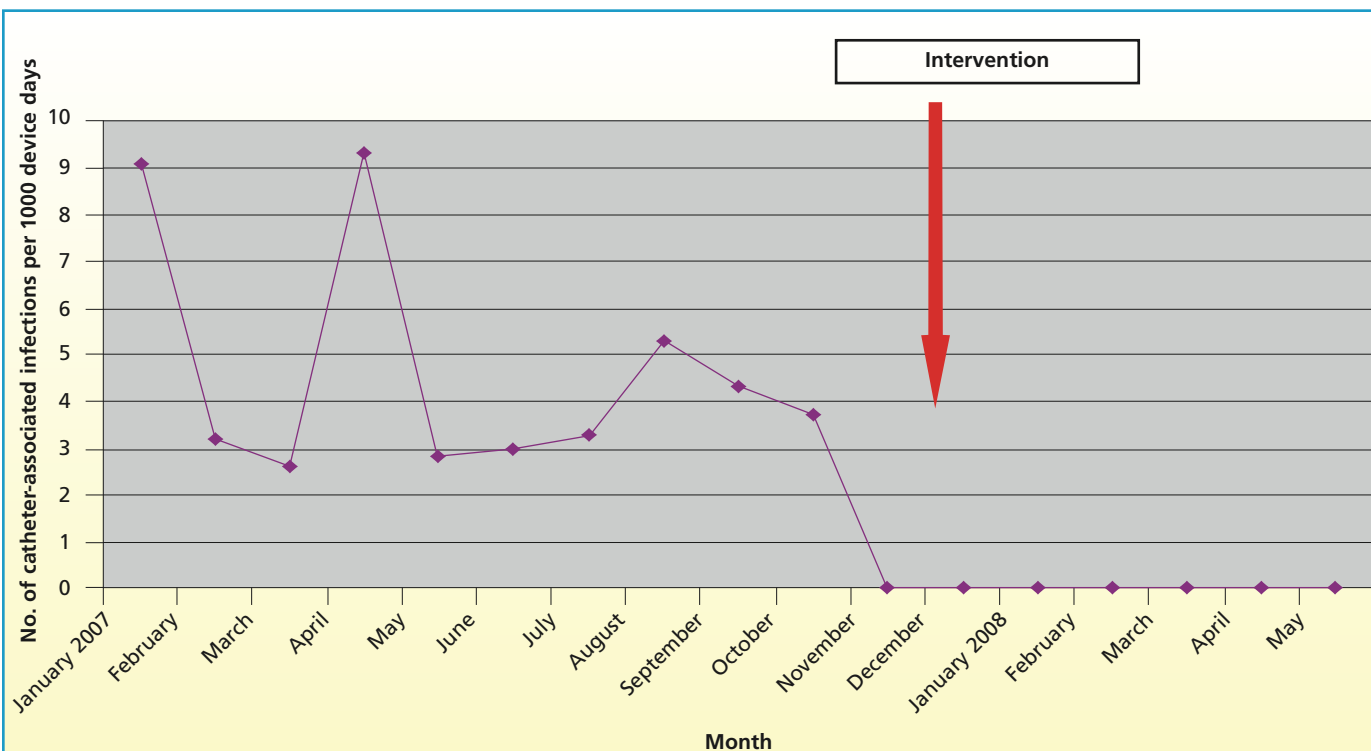


Figure 2 Rates of catheter-associated urinary tract infections by month.

and continuation of indwelling urinary catheters included incontinence without significant loss of skin integrity; frequent, but medically unnecessary, monitoring of urinary output; diuresis; and convenience of care. ICU patients may be exposed to risks

for CAUTIs without sufficient justification. In particular, catheters are often maintained in the absence of any clear indication, leading to a recommendation to review and define daily a purpose for catheter continuation.¹²

As noted in a recent Robert Wood Johnson Foundation summary,¹³ nurses' preferences and judgments weigh heavily in decisions on insertion and maintenance of urinary catheters. Physicians are often unaware that inpatients under their care

Once the intervention was implemented, there were no catheter-associated urinary tract infections (CAUTIs).

are catheterized or do not know why their patients have urinary catheters.¹⁴ Because urinary catheters are most often placed and maintained at the behest of nurses, nurses should be included in strategies to limit catheter use and CAUTIs. Successful strategies have included educating nursing staff to limit catheter use and providing monthly reports of CAUTI rates,¹⁵ daily reminders to physicians and nurses to remove unnecessary catheters,¹⁶⁻¹⁸ implementation of criteria-based catheter guidelines and daily determination of whether or not patients meet the criteria,¹⁹⁻²¹ and introduction of nurse-promoted protocols for discontinuing catheters.^{18,19} All strategies have resulted in a reduction in the duration of catheterization or in the number of CAUTIs or both.

Our results indicate that duration of urinary catheterization and occurrence of CAUTIs can be reduced by daily determinations by nurses of patients' need for the catheters. We selected our strategy for 2 reasons. First, it included recognition of the central role of nurses in decisions on placement and continued use of urinary catheters. In our unit, orders from physicians for catheter placement or removal usually formalize a decision already made by a nurse. Second, the strategy provided a daily reminder to nurses and physicians that a patient had a catheter

Urinary catheter device days and CAUTIs can be reduced by daily determinations of the need for the catheter.

and that this invasive device was associated with the potential for harm. We suspected that clinicians in the ICU, if not complacent about risks associated with urinary catheters, had been more invested in limiting use of devices with more publicized hazards such as central venous catheters and mechanical ventilators.

Although no CAUTIs were detected during the 6-month intervention, we do not consider elimination of CAUTIs a reasonable goal.

Indwelling urinary catheters will have a role in the management of selected patients with critical illnesses, and despite strict adherence to indicators, some CAUTIs will inevitably occur. Reasonable goals are to avoid overuse of indwelling urinary catheters and reduce CAUTI rates.

We recognize that adapting a strategy such as ours to reduce CAUTIs will require a marked shift in practice for most ICU nurses. Urinary incontinence is a nursing challenge, particularly in female, immobile, and obese patients. During the study period, nurses often were hesitant to remove catheters because they feared incontinence-related compromise to a patient's skin integrity. Less often, nurses thought that anticipated patient discomfort justified catheter use. During the study we emphasized the positive trends in reducing monthly unit device days and rates of CAUTIs. We thought that the reductions in infections provided an upside to catheter discontinuance that helped balance nurses' worries about risks of skin breakdown and the additional work necessitated by more frequent hygiene interventions and linen changes for patients.

Our unit's resource needs were affected by the changes in practice related to earlier removal of urinary catheters. Requirements for external catheters, linens, and bath and skin care products increased during the study period. We also required more frequent access to a bladder scanner to evaluate patients for urinary retention. We uncovered a need for a protocol to address urinary retention that included alternatives to simply reinserting an indwelling catheter.

Finally, we recommend further research in this area. In particular, we were constrained by a lack of evidence-based information on incontinence-associated risks and discomfort. Urinary incontinence is a component of assessments for the risk of pressure ulcers, although no valid and reliable measures are available for assessing urine-exposed skin, and analysis of existing evidence does not support a clear causative relationship between urinary incontinence and pressure ulcers.^{22,23} Patients' catheter-associated comfort or discomfort has rarely been investigated. We found limited and conflicting data in comparisons between infection risks of condom catheters and indwelling urinary catheters.²⁴ Investigations in these areas are sorely needed so relative risks and benefits of urinary catheters and alternatives to urinary catheters can be better assessed.

Our study has several limitations. Generalization of outcomes is limited by use of a single unit in a single institution and by restricting the study to indwelling urinary catheters only. Device days and infection rates were compared before and after the intervention rather than by using a concurrent control group, introducing the possibility that other factors influenced outcomes. We did not have accurate information in the period before intervention to calculate mean duration of catheterization, and we

cannot make conclusions about any effect on duration of catheterization. The indications used to determine appropriateness of catheter use were consensus opinions and were not evidence based. Subjectivity was involved in the daily evaluation of the appropriateness of catheter use. When differences of opinion occurred, the evaluators gave the most weight to judgments of nurses who were providing direct patient care.

Conclusion

This study was a before-and-after evaluation of a low-technology intervention to reduce duration of urinary catheterization and occurrence of CAUTIs in an MICU. CAUTIs are among complications fundamentally linked to nursing care and most likely constitute a measure of the performance of nursing care. Our results indicate that reductions in CAUTIs can be realized through a nurse-based intervention to avoid unnecessary catheter placement and limit duration of catheter use.

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FINANCIAL DISCLOSURES

None reported.

eLetters

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CE Test Test ID A091806: Reducing Use of Indwelling Urinary Catheters and Associated Urinary Tract Infections.

Learning objectives: 1. Understand that catheter-associated urinary tract infections (CAUTIs) are among complications fundamentally linked to nursing care. 2. Recognize that duration of catheterization is the major risk factor for CAUTIs. 3. Describe how a nurse-based intervention can decrease CAUTIs.

1. Which of the following is the greatest risk factor for catheter-associated urinary tract infections (CAUTIs)?

- a. Closed drainage system
- b. Duration of catheterization
- c. Female sex
- d. Older age

2. Which of the following is the estimated risk for infection per day of urinary tract catheterization?

- a. 5%
- b. 10%
- c. 15%
- d. 20%

3. Which of the following is the most common nosocomial infection in ICUs?

- a. Bloodstream infections
- b. Urinary tract infections
- c. Pneumonia
- d. Surgical site infections

4. Which of the following is the most important intervention to prevent CAUTIs?

- a. Using the smallest gauge catheter possible
- b. Limiting catheter use
- c. Using barrier precautions for insertion
- d. Performing antiseptic cleaning of urinary meatus

5. Which of the following performance measurement systems, devoted to tracking hospital-acquired infections, provided data that was viewed as an opportunity to develop and test processes to reduce CAUTIs in this research study?

- a. National Electronic Disease Surveillance System
- b. Exposure Prevention Information Network
- c. National Healthcare Safety Network
- d. Agency for Healthcare Research and Quality Patient Safety Network

6. Which of the following is one of the most common reasons offered by nurses for catheter continuation against recommendation?

- a. Diuresis
- b. Obesity
- c. Incontinence
- d. Perceived patient discomfort

7. What was an appropriate indication for indwelling urinary catheter use in this study?

- a. Deep sedation/paralysis
- b. Convenience of care
- c. Nurses' concern about patient discomfort
- d. Patient preference

8. What was an inappropriate indication for indwelling urinary catheter use in this study?

- a. Urinary tract obstruction
- b. Urinary retention
- c. Diuresis
- d. Stage III pressure ulcer

9. Compared with the mean number of urinary catheter days (311.7 d/mo) before the intervention, what was the mean number of catheter days during the study intervention?

- a. 100.7 d/mo
- b. 138.7 d/mo
- c. 200.7 d/mo
- d. 238.7 d/mo

10. How many CAUTIs occurred in 1432 device days in this study's intervention phase?

- a. 0
- b. 5
- c. 10
- d. 15

11. Which of the following is correct about evidence-based information on incontinence-associated risks and discomfort?

- a. Valid and reliable measures are available for assessing urine-exposed skin.
- b. Analysis of existing evidence supports a clear causal relationship between urinary incontinence and pressure ulcers.
- c. Patients' catheter-associated comfort has frequently been investigated.
- d. There is limited and conflicting data in comparisons between infection risks of condom catheters and indwelling catheters.

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Reducing Use of Indwelling Urinary Catheters and Associated Urinary Tract Infections

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