

Factors Affecting Urinary Tract Infection in Foley Catheter Retained Patients in King Narai Hospital[†]

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Background: Catheter associated urinary tract infection (CAUTI) is the most common infection in hospital and may cause other complication that contribute to complexity and difficult treatment in addition to the increase of cost and longer hospital day.

Objective: 1) Determine the CAUTI occurrence rate, microorganism involved, and duration time to develop to CAUTI. 2) Analyze factors related to CAUTI among patient characteristics, underlying diseases, and abnormality of urinary tract. 3) Analyze risk factors related to CAUTI.

Materials and Methods: A prospective observational study of patients older than 15 years old who retained Foley catheter for more than two calendar days that were admitted at King Narai Hospital between April and July 2016 was done. Data were analyzed through descriptive and inferential statistics using SPSS program.

Results: Among 485 patients who retained Foley catheter for more than two calendar days, 269 patients were female (55.46%). Mean age was 64.75±16.68 years. Indication for retained Foley catheter were to monitor urine output in 65.15%, urinary retention in 12.58%, post operation in 7.42%, bed ridden in 4.54%, and bed sore in 5.98%. Mean duration time on Foley catheter was 16.81±14.96 days. Seventy-three patients had a history of prior admission within 60 days (15.05%). Out of 485 patients, 124 cases (25.57%) developed CAUTI. The incidence rate was 10.13 occurrence per 1,000 days. The incidence was 83 of 269 (30.86%) for women and 41 of 216 (18.98%) for men. Mean CAUTI detection was 9.87±11.62 days. The majority of CAUTI was caused by *E. coli* (ESBL) 31.45%, *E. faecium* 23.39%, *P. aeruginosa* (MDR) 13.75%, and *K. pneumoniae* (ESBL) 10.48%. The risk factors for CAUTI that were statistically significant were prior admission within 60 days (OR 3.38, 95% CI 2.31 to 4.89, p=0.005), duration time of retained Foley catheter (OR 2.03, 95% CI 1.47 to 3.46, p=0.008), using endotracheal tube (OR 2.83, 95% CI 0.44 to 4.38, p=0.006), female (OR 2.20, 95% CI 1.83 to 3.91, p=0.038), and CVA or bed ridden patients (OR 2.39, 95% CI 1.89 to 3.91, p=0.041).

Conclusion: The incidence rate of CAUTI in King Narai Hospital was 10.13 occurrence per 1,000 days. Female developed CAUTI 1.67 time more than male. The major organisms were *E. coli* (ESBL) 31.45% and *E. faecium* 23.39%. The risk factors of CAUTI were time on Foley catheter, prior admission within 60 days, using endotracheal tube, female, debility, and bed ridden patients.

Keywords: Catheter associated urinary tract infection (CAUTI), Risk factor, King Narai Hospital

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Urinary tract infections are the most common type of hospital acquired infection and the most are associated with indwelling urinary catheter, that is called, catheter associated urinary tract infection

(CAUTI) occurs around 40% of all infection in hospital⁽¹⁾ and about 80% of urinary tract infection occurs among catheterized patients⁽²⁾. In the United States of America, the CAUTI incidence range between 3.16 to 7.5 occurrences per 1,000 days⁽³⁾. Although the death rate of UTI patients is low in comparison to other infections in hospital, the use of Foley catheter may cause other complications that contribute to complexity and difficult treatment, which lead to increase cost and prolong hospital stay⁽⁴⁾.

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The survey in USA found the death rate of 2.3% due to CAUTI⁽⁵⁾. The infection control unit in Europe reported the CAUTI incidences was 6.3 occurrences per 1,000 days⁽⁶⁾. The survey of infection incidence in hospitals showed the CAUTI occurrences ranged from 20% to 45% of all infection cases⁽⁷⁾. The risk factors associated to gender, age, underlying disease, abnormality of urinary tract, time on Foley catheter, and technical care of Foley catheter⁽⁸⁾. These factors influenced the time on treatments, cost of treatment, severity of complication, and death rate⁽⁹⁾.

The objective of the present study were 1) to determine the CAUTI occurrence rate, time on Foley catheter, and factors related to CAUTI occurrence, 2) analyze associated among patient characteristic, underlying disease and abnormality of urinary tract, 3) determine microorganisms that cause CAUTI and drug sensitivity, and 4) analyze risk factors of CAUTI.

Materials and Methods

A prospective observational study in patients aged over 15 years that retained the Foley catheter for more than two calendars days in King Narai Hospital, Lopburi province, which is a secondary government hospital with a total of 536 beds in central part of Thailand, was done. Inclusion criteria were all patients that retained Foley catheter for more than two calendars days. Exclusion criteria were patients diagnosed with UTI before they retained the Foley catheter or patients that developed UTI more than two calendar days after the Foley catheter was removed. Data were collected from inpatients medical record between April and July 2016. The eligible patients were carefully followed up for developing of CAUTI by monitoring signs and symptoms, urine examination, and urine culture. The diagnosis of CAUTI was based on criteria from the Center for Disease Control and Prevention (CDC) and the National Healthcare Safety Network (NHSN)⁽⁹⁾, such as symptom at least 1 of the followings: fever greater than 38°C, suprapubic tenderness, cerebrovascular accident (CVA) tenderness. Laboratory showed urine cesarean section (C/S) greater than 10⁵ colony forming unit (CFU)/ml, with no more than two species of microorganisms. A positive urine C/S 10³ to 10⁵ CFU/ml with not more than two species of microorganisms and a positive urinalysis demonstrated by at least one of the following findings, 1) positive dipstick for leukocyte esterase, and/or nitrite, 2) pyuria urine of 3 or more white blood cells (WBC)/high power field (HPF) of spun urine, and 3) microorganism seen on gram stain of unspun urine. Determine uropathogen

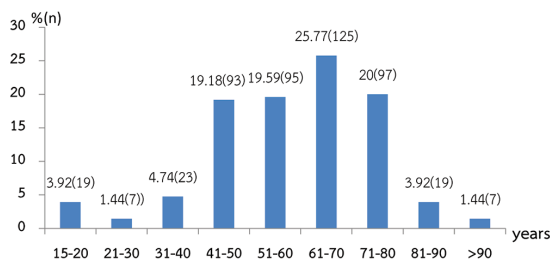


Figure 1. Age distribution of studied patients (n = 485).

microorganisms from urine C/S reported or positive blood culture with at least one matching to the urine culture. Study pattern of drug sensitivity from microbiology report, the same organism with different antimicrobial susceptibilities would determine as one organism. The follow-up of studied patients was terminated after removing Foley catheter after more than two calendar days or patients died.

Statistical analysis

All statistical analyses were performed using SPSS version 11.5 (SPSS Inc., Chicago, Illinois, USA). Data were analyzed through descriptive statistic (frequency, percentage, mean and standards deviation) for all variables concerning patients' characteristics, environment, microorganisms, and medication. Inferential statistics were applied using Chi-square test for association between categorical variables and multivariate logistic regression for identifying risk factors to CAUTI occurrences and death from CAUTI.

Results

The prospective observational study on patients over 15 years of age that retained the Foley catheter for more than two calendars days between April and July 2016 in King Narai Hospital was completed. Four hundred eighty-five patients were included and there were 216 males (44.54%) and 269 females (55.46%).

Age distribution of studied patient were in range 61 to 70 years for 25.7%, range 71 to 80 years for 20.0%, and 51 to 60 years for 19.5% as shown in Figure 1. Mean age was 67.7±16.6 years.

Comorbidities of patients were diabetes mellitus (DM) in 20.2%, CVA or senility in 15.6%, ischemic heart disease (IHD) or congestive heart failure (CHF) in 14.2%, bed ridden in 8.6%, and malignancy in 8.4% as shown in Figure 2.

Indications for retained Foley catheter are shown in Table 1. They were to monitor urine output in 65.1%, urinary retention in 12.5%, post operation in 7.4%, and bed sore and bed ridden in 5.9% and in

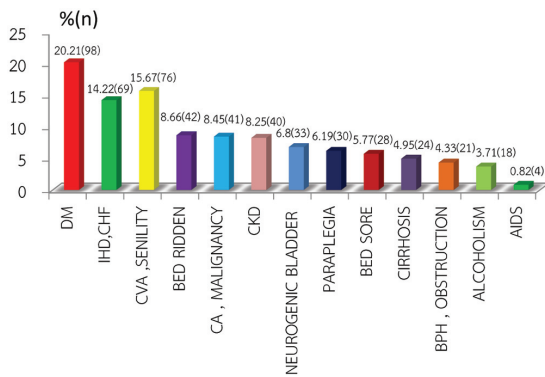


Figure 2. Percentage of the studied patients based on underlying disease (n = 485).

Table 1. Reasons for retained Foley catheter in studied patients (n = 485)

Indication	n (%)
Monitor urine output	316 (65.15)
Urinary retention	61 (12.58)
Post operation	36 (7.42)
Bed sore	29 (5.98)
Bed ridden	22 (4.54)
Unstable vital sign	13 (2.68)

4.5% respectively.

In the present study, 127 cases received major operation, which 50 cases were neurosurgery, 25 cases were debridement, 22 cases were orthopedic surgery, 16 cases were abdominal surgery 11 cases were urosurgery, and 3 cases were thoracic surgery.

Duration time on Foley catheter in the studied patients were 6 to 10 days in 26.8%, 11 to 15 days in 17.1%, 3 to 5 days in 15.6%, and 16 to 20 days in 8.8% (Figure 3). Mean duration time on Foley catheter was 16.8±14.9 days.

Out of 485 patients, 124 cases (25.57%) developed CAUTI. The incident rate was 10.13 occurrence per 1,000 days. The incident as 83 of 269 (30.86%) for women patients and as 41 of 216 (18.98%) for men patients.

Duration time before CAUTI developed were 3 to 5 days in 53.2%, 6 to 10 days in 14.5%, 11 to 15 days in 12.9%, 21 to 30 days in 8.8%, and 16 to 20 days in 4.8% (Figure 4). Mean CAUTI detection was 9.8±11.6 days.

Figure 5 showed causative pathogen of CAUTI from urine C/S. The majority of microorganisms caused CAUTI were *Escherichia coli* (extended-spectrum beta-lactamases, ESBL) in 31.4%,

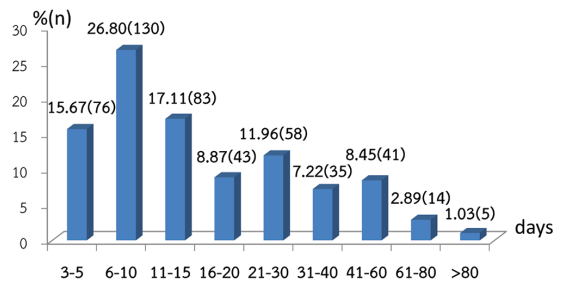


Figure 3. Duration of retained Foley catheter in the studied patients (n = 485).

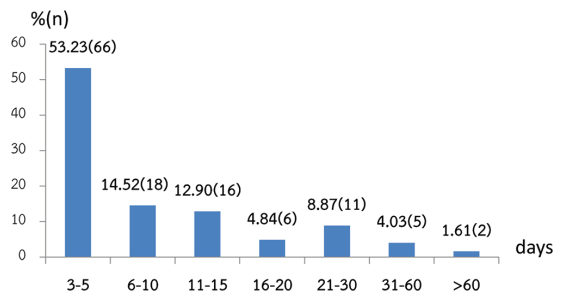


Figure 4. Duration of developing CAUTI in the studied patients (n = 124).

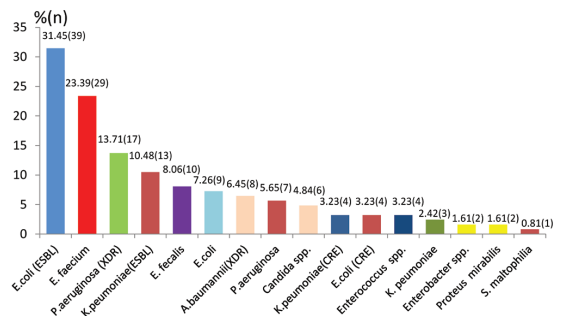


Figure 5. Microorganisms caused CAUTI from urine C/S (n = 124).

Enterococcus faecium in 23.3%, *Pseudomonas aeruginosa* (extensively drug-resistant, XDR) in 13.7%, *Klebsiella pneumoniae* (ESBL) in 10.4%, *Enterococcus faecalis* in 8.0%, *E. coli* in 7.2%, and *Acinetobacter baumannii* (XDR) in 6.5%.

The multivariate logistic regression revealed that factors affecting occurrence of CAUTI at p<0.01 were duration time on Foley catheter (OR 2.03; 95% CI 1.47 to 3.46, p=0.008), receiving endotracheal tube (OR 2.83; 95% CI 0.44 to 4.38, p=0.006), and patients with prior admittance in the last 60 days (OR 3.38; 95% CI 2.31 to 4.89, p=0.005). The multivariate logistic regression also revealed that factors affecting

Table 2. Risk factors affecting occurrence of CAUTI

Factors	p-value	Odds ratio	95% CI
Age >60 years	0.065	1.01	0.63 to 2.12
Time on Foley catheter	0.008**	2.03	1.47 to 3.46
Prior admission in 60 days	0.005**	3.38	2.31 to 4.89
Sex: female	0.038*	2.20	1.83 to 3.91
On ET tube	0.006**	2.83	0.44 to 4.38
CVA, bed ridden	0.041*	2.39	1.89 to 3.91
Urosurgery	0.072	0.40	0.08 to 0.98
Neurogenic bladder	0.074	0.25	0.06 to 1.32
DM	0.751	0.09	0.04 to 0.84
Bed sore	0.058	0.95	0.32 to 1.45

CAUTI=catheter associated urinary tract infection; CI=confidence interval; ET=endotracheal; CVA=cerebrovascular accident; DM=diabetes mellitus

* p<0.05, ** p<0.01

occurrence of CAUTI at p<0.05 were female (OR 2.20; 95% CI 1.83 to 3.91, p=0.038), and CVA or bed ridden (OR 2.39; 95% CI 1.89 to 3.91, p=0.041) as shown in Table 2.

The outcome of treatment in the studied patients were 301 patients were discharged (62.06%), 13 cases died from CAUTI (2.80%), 163 cases died from other cause (35.08%), and eight cases showed no improvement (1.72%).

Discussion

In most hospitals, CAUTI accounts for approximately 40% of all nosocomially acquired infection annually. This is plausible considering that 20% to 25% of patients admitted to an acute care hospital receive urinary catheterization during their stay⁽¹⁰⁾. The finding of the present study showed the incidence of CAUTI was 25.57%, thus an incidence rate of 10.13 occurrences per 1,000 catheter days. In Thailand, Danchaivijitr et al (2005)⁽¹¹⁾ found that the incidence rate ranged from 2.37 to 10.28 occurrences per 1,000 catheter days. The present study found that the incidence of CAUTI was more among female patients (30.88%) compared to male patients (18.98%). The CAUTI incidence was more among female patients than male patients by 1.63 time. Our findings are in accordance with the study of Greene et al (2012)⁽¹²⁾, which found the CAUTI incidence was more among female patients than male patients 2.1 to 3.8 time.

In the present study, the mean age of the CAUTI patients was 64.75±16.68 years. The occurrence of CAUTI increased as the age increased. The finding

is consistent to the study of Saint et al (2009)⁽¹³⁾ that found that old age patients were more susceptible to CAUTI than younger patients. The present study revealed the common co-morbidity disease were DM (20.21%), CVA (15.67%), bed ridden (8.66%), chronic kidney disease (CKD) (8.25%), and malignancy (8.45%). Most of the patients obtained neurosurgery (10.31%) and small number of urosurgery (2.27%). Patients with urinary tract abnormality such as neurogenic bladder (6.80%), benign prostatic hyperplasia (BPH), obstruction of urinary tract (4.33%), which differed from the study of Hugonnet et al (2004)⁽¹⁴⁾ that consisted of patients with neurogenic bladder (19.2%) and BPH (10.8%), had a CAUTI occurrence rate of 27.62%.

Most of the patients were catheterized for 6 to 10 days (26.8%) and 11 to 15 days (17.11%). The catheterization in the present study was longer than the study of Fakhri et al (2002)⁽¹⁵⁾ where most patients had duration between three and six days. In the present study, the majority of the CAUTI occurrences was three to five days (52.37%). In the past study, the bacteriurial growth in single catheter was around 1% to 5% and increased to 3% to 8% per catheter days⁽¹⁶⁾. Therefore, the longer time on Foley catheter, the higher risk of CAUTI. Ninety to one hundred percent of long-term catheterized patients would develop bacteremia and be asymptomatic⁽¹⁷⁾.

The present study also revealed that 73 patients (15.05%) who had prior admission in 60 days were the high-risk group to develop CAUTI and this factor related to health care associated infection.

The most common pathogens were *E. coli* (ESBL) in 31.45% and *E. faecium* in 23.39%, which in accordance with the study of Sader et al (2014) (18) that found *E. coli* in 40.27% and *E. faecium* in 23.61%, and Jacobsen et al (2008)⁽¹⁹⁾ that found 60% to 80% of gram negative bacteria and 20% to 40% of gram positive bacteria, such as *Enterococcus* spp., *Staphylococcus* spp.

Significant risk factors of CAUTI with p<0.01 were duration time on Foley catheter, prior admission in 60 days and patients that received an endotracheal tube. The longer the catheterization, the higher risk of infection⁽²⁰⁾. The prior admission factors related to health care associated infection. Patients on endotracheal tube also related to severity of disease. Significant risk factors of CAUTI with p<0.05 were female, CVA, and bed ridden patients, similar to prior study of Genao et al (2012)⁽²¹⁾, which found that debilitate patients were in the high-risk group for developing CAUTI.

In terms of outcomes, the mortality rate of CAUTI was approximately 2.8%, which is similar to the study of Burton et al (2011)⁽⁶⁾ that reported a mortality rate from CAUTI at 2.3%. While the mortality rate from other cause was 35.08%, the lower death rate of CAUTI compared to other infections in hospital. Although urinary catheter is an indispensable tools used in patients care, it can induce complications in the treatment process.

Conclusion

Among 485 catheterized patients, the incidence of CAUTI was 10.3 occurrence per 1,000 catheter days. The catheterized female patients developed CAUTI more than male patients at 1.67 time. The common pathogens were *E. coli* (ESBL) (31.45%) and *E. faecium* (23.39%). The mortality rate of CAUTI was 2.8%, while 35.08% caused by other factors. The risk factors of CAUTI were duration time on Foley catheter, prior admission in 60 days, using endotracheal tube, female, and bed ridden. Therefore, hospital guideline should follow “UTI bundle”⁽²²⁾, which mean to focus on the avoidance of catheter insertion, maintenance of sterility, product standardization, and early catheter removal. Therefore, catheterization should be reviewed daily and the catheter should be removed as soon as possible.

What is already known on this topic?

There are many factors potentially associated with the development of CAUTI, female gender, age, underlying diseases, abnormality of urinary tract, time on Foley catheter, and technical care of Foley catheter.

What this study adds?

In the present study, the authors found that patients who had history of prior admission in 60 days were risk factor of developing CAUTI, duration time of retained Foley catheter and using endotracheal tube, as well as female gender, debility, and bed ridden patients were factors related to CAUTI.

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Conflicts of interest

The authors declare no conflict of interest.

References

1. Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care-associated infections. *N Engl J Med* 2014;370:1198-208.
2. Weber DJ, Sickbert-Bennett EE, Gould CV, Brown VM, Huslage K, Rutala WA. Incidence of catheter-associated and non-catheter-associated urinary tract infections in a healthcare system. *Infect Control Hosp Epidemiol* 2011;32:822-3.
3. Saint S, Kowalski CP, Kaufman SR, Hofer TP, Kauffman CA, Olmsted RN, et al. Preventing hospital-acquired urinary tract infection in the United States: a national study. *Clin Infect Dis* 2008;46:243-50.
4. Hollingsworth JM, Rogers MA, Krein SL, Hickner A, Kuhn L, Cheng A, et al. Determining the noninfectious complications of indwelling urethral catheters: a systematic review and meta-analysis. *Ann Intern Med* 2013;159:401-10.
5. Burton DC, Edwards JR, Srinivasan A, Fridkin SK, Gould CV. Trends in catheter-associated urinary tract infections in adult intensive care units-United States, 1990-2007. *Infect Control Hosp Epidemiol* 2011;32:748-56.
6. Pratt RJ, Pellowe CM, Wilson JA, Loveday HP, Harper PJ, Jones SR, et al. epic2: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *J Hosp Infect* 2007;65 Suppl 1:S1-64.
7. Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clin Infect Dis* 2010;50:625-63.
8. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control* 2000;28:68-75.
9. Malpiedi PJ, Peterson KD, Soe MM, Edwards JR, Scott RD 2nd, Wise ME, et al. 2011 National and state healthcare-associated infection standardized infection ratio report [Internet]. 2013 [cited 2013 Nov 28]. Available from: https://www.cdc.gov/hai/pdfs/SIR/SIR-Report_02_07_2013.pdf.
10. Tambyah PA, Knasinski V, Maki DG. The direct costs of nosocomial catheter-associated urinary tract infection in the era of managed care. *Infect Control Hosp Epidemiol* 2002;23:27-31.
11. Danchaivijitr S, Dhiraputra C, Santiprasitkul S, Judaeng T. Prevalence and impacts of nosocomial infection in Thailand 2001. *J Med Assoc Thai* 2005;88 Suppl 10:S1-9.
12. Greene MT, Chang R, Kuhn L, Rogers MA, Chenoweth CE, Shuman E, et al. Predictors of hospital-acquired

- urinary tract-related bloodstream infection. *Infect Control Hosp Epidemiol* 2012;33:1001-7.
13. Saint S, Olmsted RN, Fakhri MG, Kowalski CP, Watson SR, Sales AE, et al. Translating health care-associated urinary tract infection prevention research into practice via the bladder bundle. *Jt Comm J Qual Patient Saf* 2009;35:449-55.
 14. Hugonnet S, Sax H, Eggimann P, Chevrolet JC, Pittet D. Nosocomial bloodstream infection and clinical sepsis. *Emerg Infect Dis* 2004;10:76-81.
 15. Fakhri MG, Watson SR, Greene MT, Kennedy EH, Olmsted RN, Krein SL, et al. Reducing inappropriate urinary catheter use: a statewide effort. *Arch Intern Med* 2012;172:255-60.
 16. Gokula M, Smolen D, Gaspar PM, Hensley SJ, Benninghoff MC, Smith M. Designing a protocol to reduce catheter-associated urinary tract infections among hospitalized patients. *Am J Infect Control* 2012; 40:1002-4.
 17. Trautner BW, Grigoryan L, Petersen NJ, Hysong S, Cadena J, Patterson JE, et al. Effectiveness of an antimicrobial stewardship approach for urinary catheter-associated asymptomatic bacteriuria. *JAMA Intern Med* 2015;175:1120-7.
 18. Sader HS, Flamm RK, Jones RN. Frequency of occurrence and antimicrobial susceptibility of gram-negative bacteremia isolates in patients with urinary tract infection: results from United States and European hospitals (2009-2011). *J Chemother* 2014;26:133-8.
 19. Jacobsen SM, Stickler DJ, Mobley HL, Shirtliff ME. Complicated catheter-associated urinary tract infections due to *Escherichia coli* and *Proteus mirabilis*. *Clin Microbiol Rev* 2008;21:26-59.
 20. Apisarnthanarak A, Thongphubeth K, Sirinvaravong S, Kitkangvan D, Yuekyen C, Warachan B, et al. Effectiveness of multifaceted hospitalwide quality improvement programs featuring an intervention to remove unnecessary urinary catheters at a tertiary care center in Thailand. *Infect Control Hosp Epidemiol* 2007;28:791-8.
 21. Genao L, Buhr GT. Urinary tract infections in older adults residing in long-term care facilities. *Ann Longterm Care* 2012;20:33-8.
 22. Venkatram S, Rachmale S, Kanna B. Study of device use adjusted rates in health care-associated infections after implementation of “bundles” in a closed-model medical intensive care unit. *J Crit Care* 2010;25:174-8.