

**Effect of Nursing Care Guidelines on the Incidence of Urinary Tract Infection among Patients with Urinary Catheter****Ola Abd El Aty Ahmed<sup>\*1</sup> and Samir Azazy<sup>2</sup>**<sup>1</sup>Medical Surgical Nursing, Department, Faculty of Nursing, Ain Shams University, Cairo, Egypt<sup>2</sup> Surgical Urology Department, Faculty of Medicine, Ain Shams University, Cairo, Egypt<sup>\*</sup>[ola.ahmed22@gmail.com](mailto:ola.ahmed22@gmail.com)

**Abstract:** Urinary tract infection (UTI) is the most common and important complication of the use of indwelling catheters. Implementation of nursing care guidelines might help to minimize the risk of this complication. The aim of this study was to measure the effect of nursing care guidelines on the incidence of UTI among catheterized patients. The study was carried out at the internal medicine moderate care unit of Ain Shams University Hospital using a quasi-experimental research design. The study included 60 adult patients in need for urethral catheterization for more than seven days, and free from any manifestations suggestive of UTI on admission. They were equally divided into a study group for implementation of the developed nursing care guidelines, and a control group receiving the unit routine care. A patient assessment sheet was used for data collection; it included patient socio-demographic data, medical history, patient assessment, and laboratory investigations. The nursing care guidelines were developed after reviewing related literature, and implemented to study group patients. Patients were followed-up daily for assessment of any manifestations of UTI, vital signs, catheter care, and one week of follow-up culture sensitivity testing. The results demonstrated similarity of the two groups in all characteristics. Post guidelines hematuria was higher in the control group compared to the study group ( $p=0.002$ ). They also had higher mean temperature and respiration ( $p<0.001$ ). Positive urine culture was higher in the control group (86.7%) compared to 43.3% in the study group ( $p<0.001$ ). The study concludes that the incidence rate of UTI among patients with urinary catheterization can be decreased through application of nursing care guidelines. Therefore, it is recommended to implement these developed guidelines in the study setting and in other similar settings. Further study with larger sample size is proposed to assess the impact of the guidelines on recovery, mortality, and length of hospital stay.

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**Keywords:** Nursing Care; Incidence of Urinary Tract Infection; Patient; Urinary Catheter

### 1. Introduction

Urinary catheterization is the insertion of a catheter through the urethra into the bladder or, less commonly, the insertion of a suprapubic catheter through the anterior abdominal wall into the dome of the bladder for the withdrawal of urine (Warren, 2005). Urinary tract infection (UTI) is the most common and important complication of the use of indwelling catheters (Nicolle, 2005).

Indwelling catheterization has a number of indications. It is used to accurately monitor the urinary output of critically ill patients, increase the comfort of terminally or severely ill patients. Catheterization also helps to manage skin damage caused by incontinence, when all other methods of managing urinary incontinence have failed. Its indications also include maintaining a continuous outflow of urine for patients undergoing surgical procedures, as part of standard preoperative preparation, maintaining a continuous outflow of urine for patient with voiding difficulties because of neurological disorders that cause paralysis or loss of sensation affecting urination, and providing immediate treatment of acute urinary retention

(Baxter, 2004).

The use of an indwelling urinary catheter is the most significant risk factor for the development of a urinary tract infection (UTI) (Hazelett *et al.*, 2006). Its incidence reaches as high as 50% of patients catheterized inappropriately (Gokula *et al.*, 2004). The longer the duration the catheter is in place the higher is the risk (Bissett, 2005). Other risk factors include the poor quality of catheter care, lack of maintenance of a closed urinary system, and patient susceptibility to infection. Thus, critically ill patients (Huang *et al.*, 2004), frail older people (Head, 2006), and patients receiving immunosuppressant therapy (Saint *et al.*, 2006) are at higher risk.

Bacteria colonize the internal and external surfaces of indwelling catheters and form biofilms (Davenport and Keeley, 2005). The spectrum of infecting organisms isolated from catheter-associated urinary tract infection is wide and varies with patient population. *Escherichia coli* is the most commonly isolated gram negative bacteria, and is frequently the initial infectious organism (Nicolle, 2005).

The most effective preventative strategy developed to date is the use of a closed drainage

system. The next most effective strategy is to remove the catheter as soon as it is no longer needed. The period of catheterization should be for as short as possible (Department of Health, 2003). In addition to these two measures, strict attention to infection control practices, especially ensuring gravity-dependent drainage of urine, can also decrease the risk of infection (Cornia *et al.*, 2003). The advantage of the suprapubic catheter use is that it reduces the risk of infection. This is because the insertion site is further away from the perineal area with its high bacterial that increases the chance of infection (Addison, 2000).

A professional who undertakes the process of catheterization must be competent with insertion and manipulation of the urinary catheter's system, trained in aseptic techniques to improve patient outcomes (Ribby, 2006). He/she must be able to assess the need for urinary catheterization and only use indwelling urethral catheters after considering all other alternative methods of management. In addition, he/she should be able to maintain a documentation on the need for catheter insertion, care and removal (Pratt *et al.*, 2007).

### Significance of the study

Catheter associated urinary tract infection (CAUTI) is a significant problem for the millions of persons who receive urinary catheters each year. In the internal medicine departments, many patients are catheterized for long periods, thus increasing the risk of acquiring urinary tract infection (UTI). These patients are in need for special nursing care to minimize their risk of acquiring the infection and developing its complications. This might be achieved through implementation of nursing care guidelines to these patients.

### Aim of the study

The aim of this study was to measure the effect of nursing care guidelines on the incidence of urinary tract infection among catheterized patients. The research hypothesized that the percentage of patients with culture positive urine specimens will be lower among patients whose nursing care follows these guidelines, compared to control group patients.

## 2. Subjects and Methods

### Research design:

A quasi-experimental research design was used with a study or intervention group and a control group.

### Setting:

The study was carried out at the internal medicine moderate care unit of Ain Sham University

Hospital.

### Subjects:

The study participants consisted of male or female patients attending the abovementioned unit with the inclusion criteria of being adult (18 years or older), in need for urethral catheterization for more than seven days, and free from any manifestations suggestive of urinary tract infection on admission. Patients with a urinary catheter in place at the time of admission were excluded.

### Sampling:

A consecutive sample of sixty patients fulfilling these criteria was recruited. They were equally divided into a study group for implementation of the guidelines, and a control group receiving the unit routine care. The sample size was calculated to show a decrease of the incidence of culture positive urine specimens from 75% or higher in the control group, to 30% or less in the study group, with a 95% level of confidence and 80% study power. Accordingly, the required sample size is 22 patients per group. This was increased to 30 patients per group to account for a dropout rate of about 25%.

### Data collection tool:

A patient assessment sheet was developed by the researchers for data collection. It comprised the following four sections:

**Section I:** Socio-demographic data: patient's age, sex, level of education, job status, marital status, and smoking.

**Section II:** Medical history: mobility status and level of consciousness, diagnosis and chronic illnesses, as well as the symptoms and signs of urinary tract infection upon admission for exclusion.

**Section III:** Patient assessment, which included:

- Daily assessment of the symptoms and signs of urinary tract infection
- Assessment of urinary catheter: included date of insertion, catheter size, type, lumen, indication for catheterization, and frequency of urinary catheter care provided.

**Section IV:** Laboratory investigations sheet: to record urine culture results.

### Nursing care guidelines:

The researchers developed these guidelines after reviewing related literatures (Basavanthappa 2005; Craven and Hinle, 2007; Daniels *et al.*, 2007; Timby and Smith, 2007; Taylor *et al.*, 2008). It included the steps of nursing care for urinary catheterization from insertion to removal. It also emphasized basic knowledge areas that the patient needs to know about urinary catheterization such as

the process of catheter insertion, steps of urine sample collection, care of the urinary catheter, and evacuation of the urine. It also involved some advices to the patient and/or family to prevent urinary tract infection such as consuming large quantities of water, taking lemon juice to increase urine acidity, hanging of the urine collection bag below the urinary bladder level, and emptying the urinary bag every eight hours or as needed in a special receptacle used individually.

#### **Content validity:**

The validity of the study tool and the nursing guidelines was done through experts' opinions. Seven experienced professionals in the medical surgical nursing discipline, as well as in medicine reviewed the materials for comprehensiveness and relatedness. After rigorous revision by the experts, the tool and guidelines were finalized based on their recommendations.

#### **Pilot study:**

This was carried out to test the feasibility and practicability of the study tool on six patients representing 10% of the total study sample. It has also provided an estimate of the time needed to fill out the tool. As the tool did not need any change, the six patients selected for the pilot study were included in the main study sample.

#### **Fieldwork:**

Patients attending the study setting and fulfilling the eligibility criteria were asked to participate in the study. Those who gave their consent were subjected to interviewing using the study tool. A urine sample was taken and analyzed to ensure they are free from urinary tract infection. They were then randomly assigned to either the study or the control groups in pairs. In the patients assigned to the study group, the developed nursing guidelines were applied. In the control group, patient received the unit routine care. Then, a urine sample was collected from each patient in both groups and sent to the laboratory for culture and sensitivity testing. Patients in the study group received educational sessions aimed at improving their knowledge and skills related to catheter care. This included practical training on metal cleaning with soap and water. The number of sessions was fifth: two before insertion, and three after insertion of the catheter.

Patients were followed-up daily for assessment of any manifestations of urinary tract infection, as well as the vital signs, and catheter care. This was done for patients in both groups using the study tool (section III). After one week of follow-up, a second urine sample was collected and sent to the laboratory

for culture sensitivity testing. The data collection lasted for six months during the year 2010.

#### **Administrative design and ethical considerations:**

An official permission was obtained from the director of Ain Shams University hospital and the head of the internal medicine department to conduct this study. The aim of the study and procedures were explained to them to attain their cooperation. A verbal informed consent was obtained from the patient (or responsible family member if unconscious patient) to ensure willingness to engage in the study after explaining its purpose. They were informed about their rights to refuse or withdraw at any time with no consequences on their care. The study interventions could not have any harmful effect on participants. Confidentiality of the information was ensured.

#### **Statistical analysis:**

Data entry and statistical analysis were done using SPSS 14.0 statistical software package. Quantitative continuous data were compared using Student t-test for comparisons between the two groups. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. Statistical significance was considered at p-value <0.05.

### **3. Results**

Table 1 show that patients in the study and control groups were similar in their socio-demographic characteristics. The majority of both groups were above 40 years age, with almost equal sex distribution. About three-fourth or more of them were illiterate and married. Slightly more patients in the control group were working (60.0%) and smoking (43.3%), compared to 50.0% and 30.0% respectively in the study group.

As regards physical condition, about a half of the patients in the study and control groups were oriented, and slightly more than half of them were bed ridden (Table 2). The most common diagnoses were diabetes mellitus and hypertension, in addition to renal diseases. As the table shows, more patients in the control group had renal and neurological diseases, whereas more patients in the study group had cardiac diseases. These differences were statistically significant.

Table 3 shows no significant differences between patients in the study and control groups as regards catheter type, lumen, or the indication for catheterization. However, a statistically significant

difference was revealed between the two groups as regards the catheter care provided ( $p < 0.001$ ). It is evident that the majority of patients in the study group had regular daily care (90.0%), compared to only 10.0% of those in the control group.

Concerning the symptoms of urinary tract infection (Table 4), the most common was the strong urine smell in the study group (20.0%), and hematuria in the control group (50.0%), which was statistically significantly higher among them compared to the study group ( $p = 0.002$ ). The pelvic discomfort and cramps were also higher among patients in the control group, but the difference was of borderline statistical significance ( $p = 0.05$ ). As for the vital signs, the means of body temperature, pulse, respiration, and blood pressure were higher among patients in the control group compared to study group patients, but only the temperature and respiration reached statistical significance ( $p < 0.001$ ).

Table 5 displays the results of urine culture, and demonstrates that the majority of patients in the control group (86.7%) had positive culture, compared to less than half (43.3%) of those in the study group; this difference was statistically significant ( $p < 0.001$ ). As for the types of organisms isolated, E-coli was high in both groups, whereas Klebsiella was much higher among patients in the control group (46.2%), compared to 15.4% in the study group. However, the difference was of borderline statistical significance ( $p = 0.08$ ).

Regarding outcomes, Table 6 shows a higher recovery rate among patients in the study group (76.7%) compared to the control group (66.7%). Conversely, the mortality was higher in the control group (23.3%), compared to the study group (10.0%). Moreover, the length of hospital stay was higher among patients in the control group. However, these differences were not statistically significant.

**Table 1: Comparison of the socio-demographic data of patients in the study and control groups**

	Study group (n=30)		Control group (n=30)		X <sup>2</sup> p-value
	No.	%	No.	%	
Age (years):					
<=40	7	23.3	3	10.0	2.02 0.364
41-60	17	56.7	21	70.0	
61+	6	20.0	6	20.0	
Sex:					
Male	14	46.7	15	50.0	0.07
Female	16	53.3	15	50.0	0.80
Level of education:					
Educated	9	30.0	6	20.0	0.80
Illiterate	21	70.0	24	80.0	0.37
Job status:					
Working	15	50.0	18	60.0	0.61
Not working	15	50.0	12	40.0	0.44
Marital status:					
Unmarried	5	16.7	3	10.0	Fisher 0.71
Married	25	83.3	27	90.0	
Smoking:					
Yes	9	30.0	13	43.3	1.15
No	21	70.0	17	56.7	0.28

**Table 2: Comparison of the physical status and diagnoses of patients in the study and control groups**

	Study group (n=30)		Control group (n=30)		X <sup>2</sup>	p-value
	No.	%	No.	%		
Level of consciousness:						
Oriented	14	46.7	15	50.0	3.96	0.14
Confused	12	40.0	6	20.0		
Comatose	4	13.3	9	30.0		
Activity:						
Mobile	12	40.0	13	43.3	0.07	0.79
Bed ridden	18	60.0	17	56.7		
Diagnoses: <sup>(@)</sup>						
Diabetes	21	70.0	25	83.3	1.49	0.22
Hypertension	21	70.0	23	76.7	0.34	0.56
Renal disease	6	20.0	14	46.7	4.80	0.03*
Liver disease	1	3.3	3	10.0	Fisher	0.61
Respiratory disease	2	6.7	2	6.7	0.0	1.00
Cardiac disease	7	23.3	0	0.0	Fisher	0.01*
Neurologic disease	4	13.3	11	36.7	4.36	0.04*

(\*) Statistically significant at  $p < 0.05$

(@) Not mutually exclusive

**Table 3: Comparison of the urinary catheterization and care among patients in the study and control groups**

	Study group (n=30)		Control group (n=30)		X <sup>2</sup> p-value
	No.	%	No.	%	
Catheter type:					
Indwelling catheter	19	63.3	22	73.3	0.69
External catheter	11	36.7	8	26.7	0.41
Catheter lumen:					
Single	10	33.3	7	23.3	0.74
Double	20	66.7	23	76.7	0.39
Indications for catheterization:					
Measure urinary output	19	63.3	18	40.0	0.07
Relieve incontinence	11	36.7	12	40.0	0.79
Catheter care provided:					
Once daily	27	90.0	3	10.0	38.40
Irregular	3	10.0	27	90.0	<0.001*

(\*) Statistically significant at p&lt;0.05

**Table 4: Comparison of the post-guidelines urinary symptoms and vital signs among patients in the study and control groups**

Item	Study group (n=30)		Control group (n=30)		X <sup>2</sup> test	p-value
	No.	%	No.	%		
Symptoms of infection: <sup>@</sup>						
Burning sensation	2	6.7	2	6.7	0.0	1.00
Strong smell urine	6	20.0	6	20.0	0.0	1.00
Pelvic discomfort/ cramps	1	3.3	7	23.3	Fisher	0.05
Cloudy urine	5	16.7	3	10.0	Fisher	0.71
Hematuria	4	13.3	15	50.0	9.32	0.002*
Temperature	37.3±0.4		39.4±1.5		t=7.41	<0.001*
Pulse	81.7±8.5		86.4±10.2		t=1.94	0.057
Respiration	17.5±3.3		20.4±2.4		t=3.89	<0.001*
Blood pressure:						
Systolic	135.3±22.5		144.6±28.5		t=1.40	0.166
Diastolic	85.7±16.4		89.6±15.3		t=0.95	0.345

(\*) Statistically significant at p&lt;0.05

(@) Not mutually exclusive

**Table 5: Comparison of the results of urine culture among patients in the study and control groups**

Item	Study group (n=30)		Control group (n=30)		X <sup>2</sup> test	p-value
	No.	%	No.	%		
Urine culture:						
Negative	17	56.7	4	13.3	12.38	<0.001*
Positive	13	43.3	26	86.7		
Isolated organisms (+ve):						
<i>Bacilli</i>	2	15.4	1	3.8	Fisher	0.25
<i>E-Coli</i>	8	61.5	10	38.5	1.86	0.17
<i>Staphylococci</i>	1	7.7	3	11.5	Fisher	1.00
<i>Klebsiella</i>	2	15.4	12	46.2	Fisher	0.08

(\*) Statistically significant at p&lt;0.05

**Table 6: Comparison of the condition on discharge and length of hospital stay among patients in the study and control groups**

Item	Study group (n=30)		Control group (n=30)		X <sup>2</sup> test	p-value
	No.	%	No.	%		
Recovery	23	76.6	20	66.7	1.95	0.38
Transfer to another unit	4	13.3	3	10.0		
Death	3	10.0	7	23.3		
Length of stay (Mean±SD)	8.7±1.7		9.1±1.9		t=0.86	0.39

**Table 7: Relation between catheter type and urine culture findings among patients in the study and control groups**

	Culture +ve		Culture -ve		Test p-value
	No.	%	No.	%	
Study group:					
Indwelling catheter	13	68.4	6	31.6	Fisher <0.001*
External catheter	0	0.0	11	100.0	
Control group:					
Indwelling catheter	19	86.4	3	13.6	Fisher 1.00
External catheter	7	87.5	1	12.5	

(\*) Statistically significant at p&lt;0.0



Table 7 points to a statistically significant relation between the type of catheter and the urine culture result ( $p < 0.001$ ). It is evident that none of the patients with external catheter in the study group had a positive culture, compared to 68.4% of those with indwelling catheter. On the other hand, no such relation could be demonstrated among patients in the control group.

#### 4. Discussion

The present study was carried out to test the hypothesis that the culture positive urine specimens will be lower among patients whose nursing care follows developed guidelines, compared to control group patients. The study findings lead to acceptance of this hypothesis since the percentage of patients with positive urine culture in the study group was about half of those in the control group and the difference was statistically significant. Therefore, the application of the developed guidelines was successful in lowering the occurrence of urinary tract infections among catheterized patients.

In order to attribute these findings to the study intervention, the two groups – study and control – ought to have similar demographic characteristics, and as well must have analogous related risk factors. In the present study, patients in the study and control groups had similar age and sex distribution. This is of great importance since urinary tract infections, particularly those related to catheterization are known to be affected by patient age (Wilde *et al.*, 2010) and gender (Talaat *et al.*, 2010).

The level of illiteracy was high in both groups, about three-fourth or more. Smoking was also highly prevalent among them. These two characteristics are of importance, as they may constitute risk factors for urinary tract infection (Coyne *et al.*, 2009; Scott, 2010).

About half of the patients in the study and control groups were oriented, and slightly more than half of them were bed ridden, with no significant difference between the two groups. The similarity in these conditions was essential as confused or comatose patients, or those who are bed-ridden are more prone to urinary tract infections as previously demonstrated (Toshie, 2006; *et al.*, 2008).

Meanwhile, renal and neurological diseases were more prevalent among patients in the control group, while the study group patients had more heart diseases. These differences could affect the susceptibility to urinary tract infections. However, no significant difference was revealed between the two groups as regards the prevalence of diabetes mellitus, which is the most important risk factor in this disorder (Yilmaz *et al.*, 2008).

In order to exclude any confounding effect on

the present study intervention, similar catheters were used for patients in the study and control groups, and there were no statistically significant differences between them regarding the catheter type, lumen, or the indication for catheterization. Most of the catheters used were indwelling catheters. The risks associated with external versus internal catheters have been documented (Newman, 2008).

Based on the guidelines, almost all the patients in the study group had regular daily care, compared to only few of those in the control group, and difference was statistically significant. This is expected as it is part of the intervention, and it was hypothesized that this will lead to lowering the rate of catheter-related urinary tract infection. This was actually shown by the results of the study, both clinical and laboratory.

The only urinary tract infection symptom that demonstrated a statistically significant difference between the present study groups was that of hematuria, which was higher among control group patients. The lack of significant differences between the two groups in the other symptoms could be due to the fact that bacteruria is often symptomless as shown in previous studies (Cope *et al.*, 2009; Drekonja *et al.*, 2010). Meanwhile, the body temperature and respiration rate were significantly higher among patients in the control group. These signs are indicative of infection, which demonstrates objectively that the study intervention was effective in decreasing the rate of urinary tract infections among patients in the study group.

The most objective proof of the success of the present study guidelines in lowering the rate of urinary tract infections was the results of urine culture. This turned to be positive in the majority of patients in the control group, compared to less than half of those in the study group. The findings are in congruence with Peter *et al.* (2008) who have suggested guidelines on management and prevention of catheter-associated urinary tract infections and showed similar success. On the same line, Willson *et al.* (2009) reported about the success of nursing interventions to reduce catheter-related urinary tract infection.

According to the present study results, E-coli infection was high in both groups, but Klebsiella was much higher among patients in the control group. The findings are in agreement with Aly *et al.* (2008) who reported that Klebsiella spp and Escherichia coli were among the most frequent organisms detected by culture in confirmed nosocomial infections. The findings are also in congruence with the study of Yilmaz *et al.* (2008)

Although the clinical and laboratory findings of the current study demonstrated significantly better

outcomes among patients in the study group, other parameters were also better but did not reach statistical significance. Thus, the recovery and mortality rates were better among patients in the study group, with shorter length of hospital stay, but these differences were not statistically significant. The lack of significant differences in these outcomes might be due to the small sample size, which was calculated based on the rate of infection rather than prognosis and hospital stay.

The present study results showed a statistically significant relation between the type of catheter and the urine culture results, with a higher rate of infection with indwelling catheters. This is in agreement with Bhatia *et al* (2010) who clarified that indwelling catheters confer a higher predisposition to bacteriuria. However, this relation was only demonstrated among patients in the study group. This may imply that the guidelines used in the present study are more effective with external catheters.

### Conclusion and Recommendations

The study findings lead to the conclusion that the incidence rate of urinary tract infection among patients with urinary catheterization can be decreased through application of nursing care guidelines. This is demonstrated by better clinical symptoms and signs and laboratory results. Although the application of the guidelines was associated with better recovery, lower mortality, and shorter length of hospital stay, these differences were not statistically significant probably due to the sample size, which might be considered a limitation of this study.

Based on these findings, it is recommended to implement these developed guidelines in the study setting and in other similar settings. Daily reminders from nurses to physicians to remove unnecessary urinary catheters are of great importance in decreasing infection rates. Condom catheters should be considered in men. Nurses should be encouraged to attend specific meetings as workshops and seminars held for urinary tract infection prevention to be acquainted with the most recent advances and skills in this area. Further study with larger sample size is proposed to assess the impact of the guidelines on recovery, mortality, and length of hospital stay. Further study with larger sample size is proposed to assess the impact of the guidelines on recovery, mortality, and length of hospital stay.

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