

## Effect of Urinary Catheter Replacement before Urine Specimen Collection on Clinical Outcomes among Critically Ill Patients

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### Abstract

**Background:** Catheter-associated urinary tract infections (CAUTIs) are common healthcare-associated infections in critically ill patients with indwelling urinary catheters. Prolonged catheterization promotes bacterial colonization and biofilm formation, potentially compromising urine culture accuracy and patient outcomes. **Aim of the study:** to evaluate the effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patients. **Setting:** The current study was conducted at in the General Intensive Care Unit at Sohag University Hospital, Egypt. **Sample:** A purposive sample of 60 critically ill adult patients with indwelling urinary catheters was recruited in the study. **Design:** A Quasi-experimental design was used. **Tools:** I-Demographic and clinical Data Sheet; II- Urinary Tract Infection Assessment sheet and III- Patients' Outcomes Assessment sheet. **Results:** The findings demonstrated statistically significant differences between the intervention and control groups regarding several clinical outcomes. Patients in the intervention group had a lower incidence of sepsis, a shorter ICU length of stay, and lower incidence of recurrent urinary tract infections than those in the control group ( $P = 0.001$ ,  $P = 0.001$ , and  $P = 0.004$ , respectively). **Conclusion:** Urinary catheter replacement before urine specimen collection was associated with improved clinical outcomes among critically ill patients as lower incidence of sepsis and recurrent urinary tract infections and a shorter ICU length of stay. **Recommendation:** Urinary catheter replacement before urine specimen collection may be considered as part of an evidence-based urinary catheter management protocol for critically ill patients requiring urine culture, particularly when clinically indicated.

**Keywords:** Critically ill Patients; Patients outcomes; Urinary catheters and Urine specimen collection.

### Introduction

Catheter-associated urinary tract infections (CAUTIs) are among the most common healthcare-associated infections, particularly among critically ill patients who frequently require indwelling urinary catheters for close monitoring of urinary output and management of specific clinical conditions. It is associated with increased morbidity, prolonged hospitalization, higher healthcare costs, antimicrobial exposure, and an increased risk of secondary bloodstream infections. Although many CAUTIs are preventable, the use and duration of indwelling urinary catheterization

remain major modifiable risk factors for their development (Jones et al., 2023).

The correct way to diagnose a urinary tract infection (UTI) depends a lot on getting the urine sample for lab testing and culture. Looking at urine under a microscope and doing a urine culture are still ways to find bacteria in the urine to figure out what kind of germs there are and decide which medicines to use. Getting urine samples from people who have a long-term urinary catheter can be hard because having a catheter for a long time can lead to bacteria growing on the catheter and forming a

layer of germs on it. Because of this the urine taken from a catheter that has been in place for a while may not show what is really going on in the patient's urinary tract right now. This can make it harder to understand the lab results in patients who are critically ill (**Brubaker et al., 2023**).

Many strategies have been put in place to stop CAUTIs and make outcomes better for patients who need catheters. These strategies are to avoid putting in catheters when they are not needed to check if a catheter is still required, to use proven methods for removing catheters and to keep the time a catheter is used as short as possible. In some hospitals nurses have taken the lead in removing catheters. These nurse-led protocols help remove catheters when the set clinical rules are satisfied and they lower the chance of complications linked to catheters (**Jones et al., 2023**).

In addition to minimizing unnecessary catheterization, appropriate management of an existing urinary catheter is essential for reducing catheter-related complications. Urinary catheter replacement before obtaining a urine specimen has been proposed as a strategy for reducing the potential influence of bacterial colonization and biofilm formation associated with prolonged catheterization and for obtaining a specimen that may more accurately represent the patient's current urinary tract condition (**Xie et al., 2021**). However, the practice of routinely exchanging urinary catheters remains controversial. Some recommendations support catheter replacement in selected clinical circumstances, particularly when a catheter has been in place for an extended period or when catheter-associated infection is suspected, whereas other guidelines caution against unnecessary catheter manipulation because catheter removal and reinsertion may cause urethral trauma, discomfort, and additional infection risk (**Westgeest et al., 2024**).

The presence and prolonged use of an indwelling urinary catheter are important risk factors for catheter-related complications. A substantial proportion of urinary catheterizations may be unnecessary, and prolonged catheterization may occur without a continuing evidence-based indication (**Schweiger et al., 2020**). Therefore, clinical

decisions concerning catheter insertion, maintenance, replacement, and removal should be individualized according to the patient's clinical condition and supported by evidence-based practice.

Catheter-associated urinary tract infections may have serious consequences for critically ill patients, including recurrent urinary tract infections, sepsis, prolonged ICU hospitalization, and increased healthcare resource utilization. These consequences highlight the importance of identifying practical and evidence-based approaches to urinary catheter management in critical care settings. Nevertheless, limited evidence is available regarding the clinical effect of exchanging an indwelling urinary catheter before urine specimen collection, particularly among critically ill patients (**Kelly et al., 2024**).

Despite the importance of appropriate urinary catheter management, the specific effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patient's remains insufficiently investigated. Evidence is limited regarding whether this practice may reduce UTI manifestations, recurrent urinary tract infections, sepsis, ICU length of stay, and mortality. This evidence gap provided the rationale for the present study, which aimed to evaluate the effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patients

### Significance of the Study

Catheter-associated urinary tract infection represents an important clinical problem among critically ill patients because of its association with prolonged hospitalization, recurrent infection, sepsis, increased antimicrobial use, and other adverse clinical outcomes. Critically ill patients are particularly vulnerable to catheter-related complications because they frequently require indwelling urinary catheters and prolonged urinary catheterization for continuous monitoring and management of their clinical condition (**Westgeest et al., 2024**)

Obtaining an appropriate urine specimen is an essential component of the diagnosis and management of suspected urinary tract infection. However, prolonged catheterization may be associated with bacterial colonization and biofilm formation, which can complicate the interpretation of urine culture results and clinical decision-making. Therefore, appropriate urinary catheter management and evidence-based strategies for urine specimen collection are essential components of safe critical care practice (Brubaker et al., 2023).

Urinary catheter replacement before urine specimen collection is a relatively simple clinical intervention that may potentially reduce the influence of colonization and biofilm associated with an established catheter. However, evidence regarding the clinical effectiveness of this practice, particularly its effect on patient outcomes among critically ill patients, remains limited. According to records obtained from the General Intensive Care Unit at Sohag University Hospital, approximately 760 patients underwent urinary catheterization during 2025. This high variability highlights the rational importance of identifying interventions that can enhance catheter-related care and patient outcomes.

Findings from the current observations can also provide locally applicable evidence to guide future clinical protocols and healthcare quality improvement projects within critical care settings. The significance of the current study lies in assessing whether urinary catheter replacement prior to urine sample series is associated with improved scientific outcomes in critically ill patients. The findings may provide useful evidence for critical care nurses and other healthcare professionals when developing or updating evidence-based urinary catheter management protocols. Furthermore, the study may contribute to reducing catheter-related complications, recurrent urinary tract infections, sepsis, and ICU length of stay, thereby supporting patient safety and quality of critical care.

### **Aim of the study**

The aim of this study was to evaluate the effect of urinary catheter replacement before urine specimen collection

on clinical outcomes among critically ill patients.

### **Research hypotheses:**

H1: Critically ill patients who undergo urinary catheter replacement before urine specimen collection will demonstrate lower frequencies of urinary tract infection manifestations than the control group.

H2: Critically ill patients who undergo urinary catheter replacement before urine specimen collection will have a lower occurrence of sepsis compared to the control group.

H3: Critically ill patients who undergo urinary catheter replacement before urine specimen collection will have a lower occurrence of recurrent urinary tract infection than the control group.

H4: Critically ill patients who undergo urinary catheter replacement before urine specimen collection will have a lower ICU length of stay compared to the control group.

### **Methods**

#### **Research Design**

A quasi-experimental, two-group pretest-posttest design was utilized to evaluate the effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patients. A randomized controlled design was not feasible because of clinical and organizational constraints within the ICU setting. Therefore, a quasi-experimental design was considered the most appropriate approach.

#### **Setting**

The study was conducted in the General Intensive Care Unit of the Anesthesia Department at Sohag University Hospital. The General ICU consists of two large rooms, each containing six beds, and one small room containing two beds, with a total capacity of 14 beds. The unit provides comprehensive critical care services for adult patients with various medical and surgical conditions requiring intensive monitoring, supportive therapy, and specialized nursing care.

**Sample:**

A Purposive sample of 60 significantly ill adults admitted to the general intensive care unit (ICU) were recruited to participate in viewing. Patients were eligible for inclusion if they were adults aged 18–65 years and had an indwelling urinary catheter at enrollment. Patients were excluded if they had neuromuscular diseases, were pregnant, underwent current urological surgery or kidney transplantation, intestinal transplantation or intestinal thermal therapy, or stenting. Eligible patients were assigned to two equal groups, each consisting of 30 patients. The intervention group underwent urinary catheter replacement before urine specimen collection, whereas the control group received routine urinary catheter care and urine specimen collection according to the usual hospital practice.

**Sample Size Calculation:**

The required sample size was calculated using the following formula:  $n = Np(1 - p) / [(N - 1)(d^2/z^2) + p(1 - p)]$ , where  $n$  represents the required sample size,  $N$  represents the population size,  $z$  represents the standard normal deviate corresponding to the desired confidence level (1.96 for a 95% confidence level),  $p$  represents the estimated proportion of the population with the characteristic of interest (0.50 when the population proportion is unknown), and  $d$  represents the tolerated margin of error (0.05). The calculated minimum sample size was 50 patients. To compensate for possible attrition and incomplete follow-up, 10 additional patients were recruited. Therefore, the final study sample consisted of 60 patients, with 30 patients allocated to each group.

**Tools of Data Collection:**

Three tools were used to collect the required data. The first and third tools were developed by the researchers after reviewing the relevant literature, whereas the second tool was adapted from an established evidence-based source.

**Tool I: A Demographic and Clinical Data Sheet**

This tool was developed by researchers to collect the baseline demographic

and clinical characteristics of the studied patients. It included age, sex, medical diagnosis, past medical history, Acute Physiology and Chronic Health Evaluation II (APACHE II) score (Knaus et al., 1985), Glasgow Coma Scale (GCS) score (Teasdale & Jennett, 1974), Patient's vital signs, duration of the current urinary catheterization, and ICU length of stay.

**Tool II: Urinary Tract Infection Assessment Sheet**

This tool was adapted from the Bath and North East Somerset Clinical Commissioning Group (CCG, 2018) and was used to systematically assess clinical manifestations suggestive of urinary tract infection among critically ill patients. It consisted of two main domains. Domain I: Local Urinary Signs and Symptoms, which included dysuria, urgency, frequency, suprapubic tenderness, hematuria, polyuria, and loin pain. Domain II: Systemic Signs and Symptoms, which included abnormal body temperature, tachycardia, tachypnea, hyperglycemia, abnormal white blood cell count, and new-onset confusion or agitation. **Scoring system:** Each sign or symptom was scored as 1 when present and 0 when absent. The scores were recorded individually to document the presence or absence of UTI-related manifestations. When two or more local and/or systemic signs and symptoms suggestive of urinary tract infection were present according to the assessment criteria adapted from Bath and North East Somerset CCG (2018), a urine specimen was collected for culture and sensitivity testing. A positive urine culture together with compatible clinical findings was used to support the diagnosis of urinary tract infection.

**Tool III: Patients' Outcomes Assessment Sheet**

This tool was developed by the researchers based on a review of the relevant literature to assess the clinical outcomes of the studied patients. The primary outcome was the incidence of urinary tract infection. The secondary outcomes included sepsis occurrence, ICU length of stay, recurrent urinary tract infection, and mortality. The tool consisted of five domains. Domain I: Clinical

Progression, in which patients were classified as improved when their clinical condition showed improvement during the follow-up period, deteriorated when their clinical condition worsened, or died when death occurred during the study period. Domain II: Occurrence of Sepsis. Sepsis was assessed according to the Sepsis-3 criteria developed by **Singer et al. (2016)**. Domain III: ICU Length of Stay, which was recorded as the total number of days from ICU admission until discharge or death. Domain IV: Recurrent Urinary Tract Infection, which was recorded when a new episode of UTI occurred after the initial episode had been treated or resolved according to the predefined diagnostic criteria. Domain V: Mortality, which was recorded as alive or deceased at the end of the follow-up period. Scoring system: This tool did not use a cumulative numerical score. Clinical progression was recorded categorically as improved, deteriorated, or died; sepsis and recurrent UTI were recorded as present or absent; ICU mortality was recorded as alive or deceased; and ICU length of stay was recorded as the actual number of days.

#### **Tools Development and Validation:**

The study tools were developed and prepared after an extensive review of the relevant literature. Tool I (Demographic and Clinical Data Sheet) and tool III (Patients' Outcomes Assessment sheet) were developed by the researchers specifically for the present study. Tool II (Urinary Tract Infection Assessment Sheet) was adapted from the Bath and North East Somerset Clinical Commissioning Group (**CCG, 2018**).

The tools were reviewed by a panel of five experts, including two medical staff members and three critical care nursing staff members from Sohag University, to assess their face and content validity. The experts evaluated the tools for clarity, relevance, completeness, and applicability to the study objectives. Their recommendations were considered, and the necessary modifications were made before the final versions of the tools were prepared.

The reliability of Tool II (Urinary Tract Infection Assessment Sheet), which was

adapted from Bath and North East Somerset CCG (2018), was assessed using Cronbach's alpha coefficient and yielded a value of 0.87, indicating good internal consistency. Reliability testing was not applicable to tools I and III because they were designed to collect factual demographic, clinical, and outcome data rather than measure a latent construct.

#### **Ethical Considerations:**

The Faculty of Nursing at Sohag University and the Research Ethics Committee both gave permission for the research to be carried out (approval number 290). The study followed the principles for clinical research. Written informed consent was obtained from each patient who agreed to take part. For patients who could not give consent due to their serious condition, written consent was taken from their legally authorized representatives. Every participant was told about the purpose of the study, what the procedures would involve, any benefits or risks and that they could refuse to join or leave the study at any time without giving a reason. This decision would not affect the care they received. Confidentiality and anonymity were protected throughout the study. All data collected were stored securely. Only members of the research team had access to the data. Patient privacy was respected during all assessments and any procedures related to catheter use.

#### **Pilot Study:**

A pilot study was carried out on ten percent of the total sample (6 patients) who met the predetermined eligibility criteria. The pilot study was conducted to assess the feasibility and applicability of the study tools and procedures, evaluate the clarity of the instructions and items, estimate the time required for data collection, and identify any potential difficulties in implementing the study procedures. Based on the pilot study findings, minor modifications were made to the wording of some items to improve their clarity. The six patients who participated in the pilot study were excluded from the main study sample to avoid potential bias and duplication of data.

## Operational Definitions

**Urinary Tract Infection (UTI):** In the present study, UTI was considered present when the patient exhibited two or more local and/or systemic signs and symptoms suggestive of urinary tract infection according to the assessment criteria adapted from Bath and North East Somerset CCG (2018), together with a positive urine culture result.

**Recurrent Urinary Tract Infection:** In the present study, recurrent UTI was defined as the occurrence of a new episode of urinary tract infection after resolution of the initial infection, confirmed according to the same diagnostic criteria used for the initial episode.

**Sepsis:** Sepsis was defined according to the Sepsis-3 criteria as life-threatening organ dysfunction resulting from a dysregulated host response to infection (Singer et al., 2016).

**Clinical outcomes:** In the current study, clinical outcomes were operationally defined as measurable patient-related outcomes recorded during the follow-up period, including the incidence of urinary tract infection, occurrence of sepsis, ICU length of stay, recurrent urinary tract infection, mortality, and clinical progression. These outcomes were evaluated using the Patients' Outcomes Assessment Sheet (Tool III).

## Data Collection Procedure

The study was conducted over six months, from December 2025 to June 2026. Data collection and intervention implementation were organized into three sequential phases: the preparatory phase, implementation phase, and evaluation phase.

### I. Preparatory Phase

Before the researchers started looking for patients, they made sure all the necessary preparations were done first. These included obtaining the required administrative and ethical approvals, reviewing the relevant literature, developing and validating the study tools, conducting the pilot study, preparing the required equipment and supplies, and training the research team on the standardized study procedures.

### ▪ Training of the Research Team:

The principal researcher and a trained assistant, who is a critical care nurse received training on the study procedures. The training covered screening and recruitment baseline assessment, urinary catheter replacement, urine specimen collection, infection prevention and control measures, completion of the study tools, documentation and follow-up assessment. To ensure consistency, in data collection the principal researcher and the assistant independently assessed ten percent of the pilot patients. An agreement rate exceeding ninety percent was achieved, indicating inter-rater consistency.

## II. Implementation Phase:

The implementation phase began after obtaining informed consent and continued throughout the seven-day follow-up period for each participant.

### Step 1: Patient Screening and Recruitment

Upon admission to general ICU, the researcher screened patients who might be eligible based on the predetermined inclusion and exclusion criteria. The researcher checked the patient's records and spoke with the attending physician if needed to confirm if the patient met the requirements. If a patient was eligible or if the patient could not give consent the authorized representative was contacted. The researcher then explained the study clearly, including the purpose of what would be involved possible benefits, possible risks and that participation was completely voluntary. Written informed consent was obtained before any study-specific procedures were performed.

### Step 2: Baseline Assessment

After enrollment, baseline data were collected for all participants using tool I and tool II.

**Medical Record Review:** The researcher reviewed the patient's medical record to obtain demographic and clinical information, including age, sex, medical diagnosis, past medical history, APACHE II score, and duration of the current urinary catheterization. The

APACHE II score was obtained/calculated within the first 24 hours of ICU admission.

**Direct Clinical Assessment:** The researcher assessed and recorded the patient's vital signs, including body temperature, heart rate, respiratory rate, and blood pressure. The patient's level of consciousness was assessed using the Glasgow Coma Scale.

**Baseline UTI Assessment:** Tool II was completed at baseline to document the presence or absence of local and systemic clinical manifestations suggestive of UTI. Information was obtained through direct patient assessment, review of nursing documentation, and consultation with the assigned healthcare team.

### Step 3: Group Allocation:

Because randomization was not feasible, participants were allocated sequentially into two groups to maintain equal group sizes. The first 30 eligible participants were assigned to the control group, and the subsequent 30 eligible participants were assigned to the intervention group. The control group received routine urinary catheter care according to the existing hospital protocol, whereas the intervention group underwent urinary catheter replacement before urine specimen collection according to the study protocol.

### Step 4: Baseline Urine Specimen Collection

A baseline urine specimen was collected from all participants according to their assigned group. **For patients in the control group**, the urine specimen was collected from the existing indwelling urinary catheter according to the standard unit procedure. The catheter tubing was clamped for approximately 15–30 minutes, the sampling port was disinfected and allowed to dry completely, urine was aspirated using a sterile syringe, and the specimen was transferred into a sterile specimen container according to recommended urine specimen collection procedures (Clinical and Laboratory Standards Institute [CLSI], 2024). **For patients in the intervention group**, their urinary catheter had replaced before the urine specimen was taken. A new sterile catheter was put in with a sterile technique, and the urine specimen

was taken from the sampling port of the new catheter after urine flow had started. Every urine specimen was marked with the patient's study identification number, the date and the time of collection. The urine specimens were moved quickly to the hospital laboratory for culture and sensitivity testing within thirty minutes of collection following CLSI recommendations (CLSI, 2024). (CLSI, 2024).

### Step 5: Urinary Catheter replacement Procedure for the Intervention Group

For patients allocated to the intervention group, urinary catheter replacement was performed by the researcher in collaboration with the assigned nursing staff while adhering to standard infection prevention and control precautions. **The procedure was performed as follows:**

- **Preparation and positioning:** All required equipment was prepared, including a sterile catheterization kit, an appropriately sized sterile urinary catheter, sterile lubricant, sterile drainage bag, antiseptic solution, sterile gloves, sterile syringe, and specimen container. The patient was positioned appropriately, and privacy was maintained.

- **Hand hygiene and aseptic technique:** Hand hygiene was completed before the procedure and sterile gloves were used. The standard aseptic approach was modified in a manner that maintained the era of catheter occupation techniques in line with current evidence-based recommendations all the way to the prevention of catheter-related urethral contamination (Patel et al., 2023).

- **Removal of the dominant catheter:** The catheter balloon was converted to a fully deflating one using a sterile syringe, and the current catheter was converted to a slow deflating one.

- **Perineal cleaning:** The perineal space was cleaned using antiseptic solution and aseptic process in accordance with the clinic's urinary catheterization policy.

- **Insertion of new catheter:** A new sterile catheter of appropriate size was lubricated, gently inserted into the urethra until urine was determined and then ballooned with the recommended amount of sterile water according to the manufacturer's instructions.

▪ **Connection to drainage device:** The new catheter was connected to a sterile closed drainage device. The drainage bag is held during the expansion of the bladder to facilitate gravity drainage and reduces the possibility of backflow according to CAUTI prevention guidelines (Patel et al., 2023).

▪ **Urine sampling:** Urine samples were collected aseptically from the sampling port after the new catheter was inserted and the urine float was adjusted. The sampling port was disinfected, and the sterile system was changed to that used to enhance the sample.

▪ **Specimen handling:** The sample was placed in a sterile container without delay, classified with study identification dose, date and time of series, and transported to the laboratory within 30 minutes for routine and sensitivity testing.

▪ **Documentation:** The date and time of catheter replacement, catheter size and type, urine specimen collection time, and any procedure-related observations or complications were documented using the study documentation form.

#### **Step 6: Routine Care for the Control Group**

Patients in the control group received routine urinary catheter care according to the existing hospital protocol. Routine care included daily catheter hygiene, maintenance of a closed drainage system, appropriate positioning of the drainage bag, and other standard catheter-care measures. Urine specimens were collected from the existing indwelling urinary catheter using the standard sampling-port technique without prior catheter replacement, unless catheter replacement was clinically required according to the hospital policy. All routine care provided to control group patients was documented by the researcher.

#### **Step 7: Daily Follow-up and Monitoring**

All participants were followed daily for seven consecutive days after enrollment, ICU discharge, or death, whichever occurred first. The researcher assessed patients in both groups to monitor their clinical condition and identify

any evidence of UTI or other relevant clinical outcomes.

▪ **Vital Signs:** Temperature, heart rate, respiratory rate, and blood pressure were assessed and recorded twice daily, in the morning and evening, using the standard ICU monitoring equipment.

▪ **Assessment for UTI:** tool II was completed daily to identify local and systemic manifestations suggestive of UTI. The assessment was based on direct patient observation, review of nursing documentation, and consultation with the assigned nurse and physician when required. If a patient developed two or more local and/or systemic signs and symptoms suggestive of urinary tract infection according to tool II, an additional urine specimen was collected for culture and sensitivity testing. A positive urine culture together with compatible clinical findings was used to confirm the diagnosis of urinary tract infection.

▪ **Urine Culture:** For patients in the control group, urine specimens were collected from the existing catheter according to the study protocol and clinical indications. For patients in the intervention group, urine specimens were collected from the newly replaced catheter. When a patient developed clinical findings suggestive of UTI during follow-up, urine culture was obtained promptly according to the study protocol. All specimens were handled using aseptic technique, labeled appropriately, and transported to the laboratory within 30 minutes of collection.

#### **Step 8: Assessment of Clinical Outcomes**

Throughout the seven-day follow-up period, the researcher recorded the occurrence of the predefined clinical outcomes for both groups. The following outcomes were assessed: Occurrence of UTI; Occurrence of sepsis; Recurrent UTI; ICU length of stay and Mortality. The patient's clinical progression was also documented as improved, deteriorated, or died during the follow-up period.

### **III. Evaluation Phase**

At the end of the seven-day follow-up period, participants in both groups were

reassessed using the study tools. The final assessment included evaluation of: Clinical manifestations of UTI; Urine culture results; Occurrence of sepsis; Occurrence of recurrent UTI; ICU length of stay and Mortality. The outcomes of the intervention and control groups were then compared to determine the effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patients.

### Statistical Analysis

Data was. Put into the system using the Statistical Package for the Social Sciences, which is called SPSS and the version used was 26. The data was also. Looked at carefully using SPSS version 26. Descriptive statistics were used to summarize the study variables and included frequencies, percentages, means, and standard deviations. The Chi-square ( $\chi^2$ ) test was used to compare categorical variables between the intervention and control groups. When the assumptions of the Chi-square test were not met, the Fisher's exact test was used as appropriate. For continuous variables, the independent-samples t-test was used to compare the means of the two independent groups when the data were approximately normally distributed. For continuous variables that did not meet the assumptions of normality, an appropriate non-parametric test, such as the Mann–Whitney U test, was used. A two-tailed P value < 0.05 was considered statistically significant, whereas P < 0.01 was considered highly statistically significant

### Results:

**Table (1):** presents the demographic characteristics of the studied patients in the intervention and control groups. Patients aged 40–50 years represented 36.7% of the intervention group and 50.0% of the control group. No statistically significant differences were found between the two groups regarding age or sex distribution (P = .79 and P = .25, respectively).

**Table (2):** shows that there is no statistically significant differences that were observed between the two groups regarding medical diagnosis, type of ICU admission, past medical history, or duration of mechanical

ventilation (P > .05), indicating comparable baseline clinical characteristics. Concerning medical diagnoses, 53% of intervention group and 36.7% control group respectively had respiratory disorders, 26% and 40% of both groups respectively had a general medical diagnostic, 20%, & 23.3% of them had cardiovascular disease respectively. The mean duration of mechanical ventilation was  $5.43 \pm 2.67$  days in the intervention group and  $5.17 \pm 2.64$  days in the control group (P = .699).

**Table (3):** presents that vital signs were comparable at baseline. From day 3 onward, the intervention group showed significant improvements in temperature, pulse, respiration, blood pressure, and Glasgow Coma Scale compared to controls, indicating faster clinical stabilization.

**Table (4):** shows the comparison of urinary tract infection symptoms between the intervention and control groups before and after the intervention. At baseline, no statistically significant differences were observed between the two groups for any of the assessed urinary symptoms (P > .05), indicating baseline comparability. After the intervention, significantly lower proportions of patients in the intervention group reported suprapubic tenderness, hematuria, and polyuria compared with the control group (10.0% vs. 53.3%, P < .001; 6.7% vs. 53.3%, P < .001; and 6.7% vs. 50.0%, P < .001, respectively). No statistically significant between-group differences were observed in dysuria, urgency, frequency, or loin pain after the intervention (P > .05).

**Table (5):** presents the comparison of clinical and laboratory manifestations suggestive of urinary tract infection between the intervention and control groups before and after the intervention. At baseline, no statistically significant differences were observed between the two groups in any of the assessed manifestations (P > .05). After the intervention, significantly lower proportions of patients in the intervention group had abnormal body temperature, heart rate >90 beats/min, respiratory rate >20 breaths/min, blood glucose >7 mmol/L among non-diabetic patients, and new-onset confusion or agitation compared with the control group (P = .011, P = .038, P = .010, P = .038, and P = .028, respectively).

Furthermore, bacteriuria  $\geq 100,000$  CFU/mL was significantly less frequent in the intervention group than in the control group after the intervention (23.3% vs. 50.0%,  $P = .032$ ).

**Table (6):** presents the distribution of bacterial species isolated from urine cultures in the intervention and control groups before and after the intervention. At baseline, no statistically significant differences were observed between the two groups for *Escherichia coli*, *Klebsiella*, *Proteus*, or *Staphylococci* ( $P > .05$ ). However, *Enterobacter* was significantly more frequently isolated in the control group than in the intervention group at baseline (23.3% vs. 0.0%,  $P = .005$ ), indicating a baseline imbalance between the groups for this organism. After the intervention, *Escherichia coli* and *Staphylococci* were significantly less frequently isolated in the intervention group than in the control group (10.0% vs. 33.3%,  $P = .028$ ; and 0.0% vs. 20.0%,  $P = .010$ , respectively). No statistically significant between-group differences were observed for *Klebsiella* or *Proteus* after the intervention ( $P > .05$ ).

**Table (7):** presents the clinical outcomes of patients in the intervention and control groups. The proportion of patients who developed sepsis was significantly lower in the intervention group than in the control group (3.3% vs. 36.7%,  $P = .001$ ). Similarly, the proportion of patients classified as having an increased ICU length of stay was significantly lower in the intervention group than in the control group (13.3% vs. 53.3%,  $P = .001$ ). Recurrent urinary tract infection was also significantly less frequent in the intervention group than in the control group (26.7% vs. 63.3%,  $P = .004$ ). Although mortality was lower in the intervention group than in the control group (3.3% vs. 16.7%), the difference was not statistically significant ( $P = .085$ ).

**Figure (1)** illustrates the distribution of patients according to their clinical progress during the 7-day follow-up period. In the intervention group, 93.3% of patients showed clinical improvement and 6.7% deteriorated, with no deaths recorded during the follow-up period. In the control group, 46.7% of patients improved, 40.0% deteriorated, and 13.3% died.

**Table (1): Percentage Distribution of the Studied Sample according to their Demographic Data (N=60)**

| Demographic Data                     | Intervention<br>(n=30)          |      | Control<br>(n=30)                |      | X2           | P. Value     |
|--------------------------------------|---------------------------------|------|----------------------------------|------|--------------|--------------|
|                                      | No                              | %    | No                               | %    |              |              |
| <b>Age group</b>                     |                                 |      |                                  |      |              |              |
| 18-30 years                          | 3                               | 10.0 | 0                                | 0.0  | 4.06         | 0.255        |
| 30-40 years                          | 6                               | 20.0 | 4                                | 13.3 |              |              |
| 40-50 years                          | 11                              | 36.7 | 15                               | 50.0 |              |              |
| 50-60 years                          | 10                              | 33.3 | 11                               | 36.7 |              |              |
| <b>Mean<math>\pm</math>SD(range)</b> | <b>45.5<math>\pm</math>9.94</b> |      | <b>48.33<math>\pm</math>7.28</b> |      | <b>-1.26</b> | <b>0.213</b> |
| <b>Sex</b>                           |                                 |      |                                  |      |              |              |
| Male                                 | 17                              | 56.7 | 16                               | 53.3 | 0.07         | 0.795        |
| Female                               | 13                              | 43.3 | 14                               | 46.7 |              |              |

*Chi square test for qualitative data between the two groups*

*- Independent T-test quantitative data between the two groups*

*\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01*

Table (2): Percentage Distribution of the Studied Sample according Clinical Data (No =60)

| Clinical Data                                        | Intervention<br>(n=30) |      | Control<br>(n=30) |      | X2    | P.Value |
|------------------------------------------------------|------------------------|------|-------------------|------|-------|---------|
|                                                      | No                     | %    | No                | %    |       |         |
| <b>Medical Diagnosis</b>                             |                        |      |                   |      |       |         |
| Respiratory                                          | 16                     | 53.3 | 11                | 36.7 | 1.80  | 0.406   |
| Medical                                              | 8                      | 26.7 | 12                | 40.0 |       |         |
| Cardiovascular                                       | 6                      | 20.0 | 7                 | 23.3 |       |         |
| <b>Type of ICU</b>                                   |                        |      |                   |      |       |         |
| General                                              | 8                      | 26.7 | 7                 | 23.3 | 7.64  | 0.106   |
| Trauma                                               | 1                      | 3.3  | 1                 | 3.3  |       |         |
| Critical care                                        | 16                     | 53.3 | 16                | 53.3 |       |         |
| <b>Past medical history</b>                          |                        |      |                   |      |       |         |
| Non                                                  | 11                     | 36.7 | 9                 | 30.0 | 19.13 | 0.14    |
| HTN                                                  | 5                      | 16.7 | 8                 | 26.7 |       |         |
| DM                                                   | 2                      | 6.7  | 4                 | 13.3 |       |         |
| COPD                                                 | 4                      | 13.3 | 0                 | 0.0  |       |         |
| Angina                                               | 0                      | 0.0  | 2                 | 6.7  |       |         |
| MI                                                   | 1                      | 3.3  | 6                 | 20.0 |       |         |
| Other                                                | 0                      | 0.0  | 1                 | 3.3  |       |         |
| HTN&COPD                                             | 2                      | 6.7  | 0                 | 0.0  |       |         |
| DM&CHF                                               | 5                      | 16.7 | 0                 | 0.0  |       |         |
| <b>Number of days on Mechanical ventilator</b>       |                        |      |                   |      |       |         |
| None                                                 | 4                      | 13.3 | 4                 | 13.3 | 0.08  | 0.959   |
| <5                                                   | 9                      | 30.0 | 10                | 33.3 |       |         |
| From 6-10 days                                       | 17                     | 56.7 | 16                | 53.3 |       |         |
| <b>Total Number of days on Mechanical ventilator</b> | 5.43±2.67              |      | 5.17±2.64         |      | 0.39  | 0.699   |

HTN:hypertension MI: myocardial infarction CHF:congestive heart failure

DM:diabetes mellitus COPD:chronic obstructive pulmonary disease

Chi square test for qualitative data between the two groups

- Independent T-test quantitative data between the two groups

\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01

Table (3): Comparison between Intervention and Control Groups Regarding Vital Signs (N=60)

| Vital signs               | Intervention<br>(n=30) | Control<br>(n=30)  | T     | P. Value |
|---------------------------|------------------------|--------------------|-------|----------|
|                           | Mean $\pm$ SD          | Mean $\pm$ SD      |       |          |
| <b>Temperature</b>        |                        |                    |       |          |
| 1 <sup>st</sup> day       | 38.19 $\pm$ 0.89       | 38.09 $\pm$ 0.9    | 0.43  | 0.666    |
| 3 <sup>rd</sup> day       | 37.41 $\pm$ 1.73       | 37.17 $\pm$ 2.33   | 0.45  | 0.656    |
| 5 <sup>th</sup> day       | 37 $\pm$ 0.34          | 37.21 $\pm$ 0.43   | -2.04 | 0.046*   |
| 7 <sup>th</sup> day       | 36.79 $\pm$ 0.2        | 36.93 $\pm$ 0.29   | -2.19 | 0.033*   |
| <b>Pulse</b>              |                        |                    |       |          |
| 1 <sup>st</sup> day       | 100.97 $\pm$ 11.6      | 99.63 $\pm$ 10.87  | 0.46  | 0.648    |
| 3 <sup>rd</sup> day       | 94.3 $\pm$ 9.83        | 94.77 $\pm$ 10.45  | -0.18 | 0.859    |
| 5 <sup>th</sup> day       | 89.3 $\pm$ 5.42        | 93.17 $\pm$ 7.43   | -2.30 | 0.025*   |
| 7 <sup>th</sup> day       | 85.97 $\pm$ 6.57       | 90.13 $\pm$ 9.16   | -2.02 | 0.048*   |
| <b>Respiration</b>        |                        |                    |       |          |
| 1 <sup>st</sup> day       | 23.9 $\pm$ 2.84        | 23.5 $\pm$ 3.03    | 0.53  | 0.600    |
| 3 <sup>rd</sup> day       | 21.73 $\pm$ 2.46       | 25.25 $\pm$ 6.57   | -2.74 | 0.008**  |
| 5 <sup>th</sup> day       | 19.57 $\pm$ 1.45       | 19.37 $\pm$ 1.59   | 0.51  | 0.613    |
| 7 <sup>th</sup> day       | 17.43 $\pm$ 1.7        | 17.43 $\pm$ 1.7    | 0.00  | 1.000    |
| <b>SBP</b>                |                        |                    |       |          |
| 1 <sup>st</sup> day       | 118 $\pm$ 13.68        | 118.93 $\pm$ 12.55 | -0.28 | 0.784    |
| 3 <sup>rd</sup> day       | 112.33 $\pm$ 5.98      | 111 $\pm$ 11.48    | 0.56  | 0.575    |
| 5 <sup>th</sup> day       | 116 $\pm$ 5.78         | 116.67 $\pm$ 9.77  | -0.32 | 0.749    |
| 7 <sup>th</sup> day       | 118.17 $\pm$ 6.76      | 110.33 $\pm$ 14.68 | 2.66  | 0.010*   |
| <b>DBP</b>                |                        |                    |       |          |
| 1 <sup>st</sup> day       | 72.67 $\pm$ 5.04       | 71.17 $\pm$ 5.36   | 1.12  | 0.269    |
| 3 <sup>rd</sup> day       | 72.67 $\pm$ 3.41       | 70.5 $\pm$ 8.74    | 1.26  | 0.211    |
| 5 <sup>th</sup> day       | 76.5 $\pm$ 3.51        | 76.33 $\pm$ 7.3    | 0.11  | 0.911    |
| 7 <sup>th</sup> day       | 77.67 $\pm$ 7.74       | 70.53 $\pm$ 14.53  | 2.37  | 0.021*   |
| <b>Glasgow coma scale</b> |                        |                    |       |          |
| 1 <sup>st</sup> day       | 12.4 $\pm$ 2.18        | 12.07 $\pm$ 2.3    | 0.58  | 0.567    |
| 3 <sup>rd</sup> day       | 13.2 $\pm$ 1.61        | 12.07 $\pm$ 2.3    | 2.21  | 0.031*   |
| 5 <sup>th</sup> day       | 14.37 $\pm$ 1.65       | 12.07 $\pm$ 2.3    | 4.45  | 0.000**  |

SBP:systolic blood pressure

DBP:Dystolic blood pressure

- Independent T-test quantitative data between the two groups

\*Significant level at P value &lt; 0.05, \*\*Significant level at P value &lt; 0.01

**Table (4): Comparison between the Intervention and Control Groups Regarding Urinary Tract Infection Symptoms Before and After the Intervention (N=60)**

| Symptom Timing               | Intervention<br>(n=30) |      | Control<br>(n=30) |      | X2    | P. Value |
|------------------------------|------------------------|------|-------------------|------|-------|----------|
|                              | No                     | %    | No                | %    |       |          |
| <b>Dysuria</b>               |                        |      |                   |      |       |          |
| Before                       | 20                     | 66.7 | 12                | 40.0 | 1.95  | 0.162    |
| After                        | 5                      | 16.7 | 6                 | 20.0 | 0.11  | 0.739    |
| <b>Urgency</b>               |                        |      |                   |      |       |          |
| Before                       | 11                     | 36.7 | 9                 | 30.0 | 0.30  | 0.584    |
| After                        | 3                      | 10.0 | 6                 | 20.0 | 1.18  | 0.278    |
| <b>Frequency</b>             |                        |      |                   |      |       |          |
| Before                       | 16                     | 53.3 | 13                | 43.3 | 0.60  | 0.438    |
| After                        | 4                      | 13.3 | 10                | 33.3 | 3.35  | 0.067    |
| <b>Suprapubic Tenderness</b> |                        |      |                   |      |       |          |
| Before                       | 11                     | 36.7 | 18                | 60.0 | 3.27  | 0.071    |
| After                        | 3                      | 10.0 | 16                | 53.3 | 13.02 | <0.001** |
| <b>Hematuria</b>             |                        |      |                   |      |       |          |
| Before                       | 10                     | 33.3 | 16                | 53.3 | 2.44  | 0.118    |
| After                        | 2                      | 6.7  | 16                | 53.3 | 15.56 | <0.001** |
| <b>Polyuria</b>              |                        |      |                   |      |       |          |
| Before                       | 9                      | 30.0 | 16                | 53.3 | 3.36  | 0.067    |
| After                        | 2                      | 6.7  | 15                | 50.0 | 13.87 | <0.001** |
| <b>Loin Pain</b>             |                        |      |                   |      |       |          |
| Before                       | 8                      | 26.7 | 6                 | 20.0 | 0.37  | 0.542    |
| After                        | 1                      | 3.3  | 1                 | 3.3  | 0.00  | 1.000    |

*Chi square test for qualitative data between the two groups*

*\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01*

Table (5): Comparison between the Intervention and Control Groups Regarding Clinical and Laboratory Manifestations of Urinary Tract Infection Before and After the Intervention (N=60)

| Items                                                         | Before       |      |         |      |      |          | After        |       |         |      |      |          |
|---------------------------------------------------------------|--------------|------|---------|------|------|----------|--------------|-------|---------|------|------|----------|
|                                                               | Intervention |      | Control |      | X2   | P. Value | Intervention |       | Control |      | X2   | P. Value |
|                                                               | No           | %    | No      | %    |      |          | No           | %     | No      | %    |      |          |
| <b>Temp above 38 c or below 36 c</b>                          |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 27           | 90.0 | 22      | 73.3 | 2.78 | 0.095    | 29           | 96.7  | 22      | 73.3 | 6.41 | 0.011*   |
| Yes                                                           | 3            | 10.0 | 8       | 26.7 |      |          | 1            | 3.3   | 8       | 26.7 |      |          |
| <b>H.R&gt;90b/m</b>                                           |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 28           | 93.3 | 25      | 83.3 | 1.46 | 0.228    | 30           | 100.0 | 26      | 86.7 | 4.29 | 0.038*   |
| Yes                                                           | 2            | 6.7  | 5       | 16.7 |      |          | 0            | 0.0   | 4       | 13.3 |      |          |
| <b>Res.rate &gt;20br/m</b>                                    |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 27           | 90.0 | 22      | 73.3 | 2.78 | 0.095    | 30           | 100.0 | 24      | 80.0 | 6.67 | 0.010*   |
| Yes                                                           | 3            | 10.0 | 8       | 26.7 |      |          | 0            | 0.0   | 6       | 20.0 |      |          |
| <b>Blood glucose &gt; 7mmol in the absence of diabetes</b>    |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 26           | 86.7 | 24      | 80.0 | 0.48 | 0.488    | 30           | 100.0 | 26      | 86.7 | 4.29 | 0.038*   |
| Yes                                                           | 4            | 13.3 | 6       | 20.0 |      |          | 0            | 0.0   | 4       | 13.3 |      |          |
| <b>New onset or worsening confusion or agitation</b>          |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 18           | 60.0 | 16      | 53.3 | 0.27 | 0.602    | 24           | 80.0  | 16      | 53.3 | 4.80 | 0.028*   |
| Yes                                                           | 12           | 40.0 | 14      | 46.7 |      |          | 6            | 20.0  | 14      | 46.7 |      |          |
| <b>bacteriuria is greater than or equal to 100,000 CFU/ml</b> |              |      |         |      |      |          |              |       |         |      |      |          |
| No                                                            | 20           | 66.7 | 14      | 46.7 | 2.44 | 0.118    | 23           | 76.7  | 15      | 50.0 | 4.59 | 0.032*   |
| Yes                                                           | 10           | 33.3 | 16      | 53.3 |      |          | 7            | 23.3  | 15      | 50.0 |      |          |

*Chi square test for qualitative data between the two groups*

*\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01*

Table (6): Comparison between the Intervention and Control Groups Regarding Urine Culture Results Before and After the Intervention (N=60)

| Bacteria Species Timing | Intervention (n=30) |      | Control (n=30) |      | X2   | P. Value |
|-------------------------|---------------------|------|----------------|------|------|----------|
|                         | No                  | %    | No             | %    |      |          |
| <b>Escherichia coli</b> |                     |      |                |      |      |          |
| Before                  | 10                  | 33.3 | 12             | 40.0 | 0.29 | 0.592    |
| After                   | 3                   | 10.0 | 10             | 33.3 | 4.81 | 0.028*   |
| <b>Klebsiella</b>       |                     |      |                |      |      |          |
| Before                  | 7                   | 23.3 | 4              | 13.3 | 1.00 | 0.317    |
| After                   | 2                   | 6.7  | 3              | 10.0 | 0.22 | 0.640    |
| <b>Proteus</b>          |                     |      |                |      |      |          |
| Before                  | 3                   | 10.0 | 6              | 20.0 | 1.18 | 0.278    |
| After                   | 0                   | 0.0  | 3              | 10.0 | 3.16 | 0.076    |
| <b>Enterobacter</b>     |                     |      |                |      |      |          |
| Before                  | 0                   | 0.0  | 7              | 23.3 | 7.93 | 0.005**  |
| After                   | 0                   | 0.0  | 7              | 23.3 | 7.93 | 0.005**  |
| <b>Staphylococci</b>    |                     |      |                |      |      |          |
| Before                  | 8                   | 26.7 | 7              | 23.3 | 0.09 | 0.766    |
| After                   | 0                   | 0.0  | 6              | 20.0 | 6.67 | 0.010*   |

*Chi square test for qualitative data between the two groups*

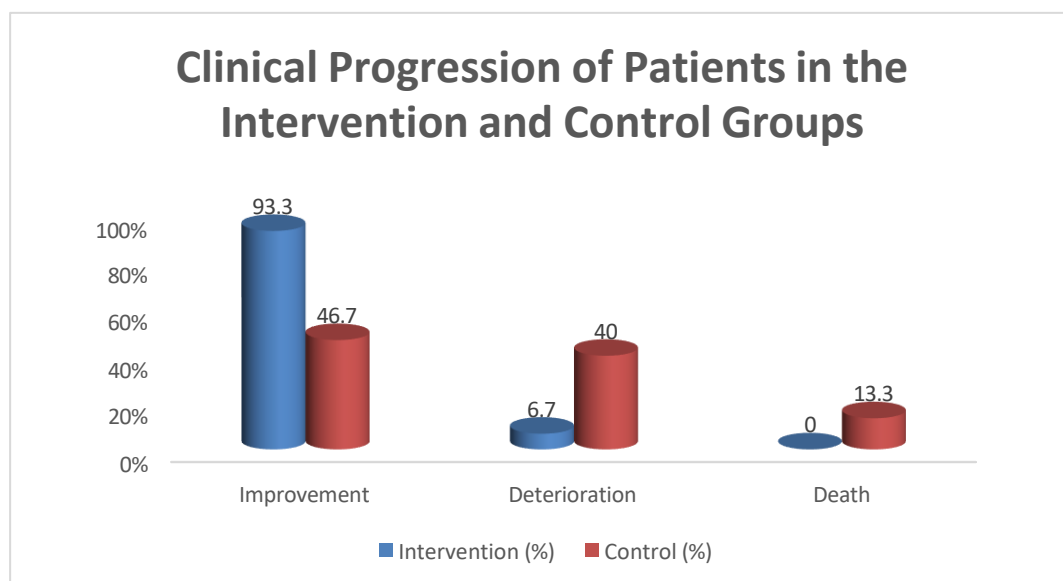
*\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01*

Table (7): Comparison between the Intervention and Control Groups Regarding Clinical Outcomes (N=60)

| Clinical Outcome                        | Intervention (n=30) |      | Control (n=30) |      | X2    | P. Value |
|-----------------------------------------|---------------------|------|----------------|------|-------|----------|
|                                         | No                  | %    | No             | %    |       |          |
| <b>Sepsis</b>                           |                     |      |                |      |       |          |
| No                                      | 29                  | 96.7 | 19             | 63.3 | 10.42 | 0.001**  |
| Yes                                     | 1                   | 3.3  | 11             | 36.7 |       |          |
| <b>Increased length of stay</b>         |                     |      |                |      |       |          |
| No                                      | 26                  | 86.7 | 14             | 46.7 | 10.80 | 0.001**  |
| Yes                                     | 4                   | 13.3 | 16             | 53.3 |       |          |
| Less than 10 days                       | 12                  | 40.0 | 12             | 40.0 |       |          |
| From 10-15 days                         | 18                  | 60.0 | 17             | 56.7 |       |          |
| More than 15 days                       | 0                   | 0.0  | 1              | 3.3  |       |          |
| <b>Frequent urinary tract infection</b> |                     |      |                |      |       |          |
| No                                      | 22                  | 73.3 | 11             | 36.7 | 8.15  | 0.004**  |
| Yes                                     | 8                   | 26.7 | 19             | 63.3 |       |          |
| <b>Mortality</b>                        |                     |      |                |      |       |          |
| No                                      | 29                  | 96.7 | 25             | 83.3 | 2.96  | 0.085    |
| Yes                                     | 1                   | 3.3  | 5              | 16.7 |       |          |

*Chi square test for qualitative data between the two groups*

*\*Significant level at P value < 0.05, \*\*Significant level at P value < 0.01*



**Figure (1)** Distribution of Patients According to Their Level of Clinical Progress in the Intervention and Control Groups

## Discussion

Urinary tract infections (UTIs) remain among the most common healthcare-associated infections and represent an important concern in critical care settings, particularly among patients requiring indwelling urinary catheters. Critically ill patients are at increased risk of catheter-associated urinary tract infection (CAUTI) because of prolonged catheterization, impaired host defenses, multiple comorbidities, and frequent exposure to invasive procedures and antimicrobial therapy. Catheter-associated infections may contribute to prolonged ICU stays, systemic complications, and increased healthcare utilization (Reddy et al., 2026). Therefore, strategies aimed at improving urinary catheter management and reducing catheter-related infection are important components of quality and safety in critical care practice. The present study was conducted to evaluate the effect of exchanging the urinary catheter before urine specimen collection on clinical and infection-related outcomes among critically ill patients.

## Demographic and Clinical Characteristics

The results of the present study showed that the intervention and control groups were comparable regarding demographic and baseline clinical characteristics, including age, sex, diagnosis, comorbidities, and duration of

mechanical ventilation, with no statistically significant differences between the two groups. This matches what other studies have found when they looked at how to manage catheters and prevent infections from them (Advani & Fakhri 2019; Mesbah et al., 2026). When the two groups are alike at the start it means that other things are not mixing up the results. This strengthens the internal validity of the study. This suggests that any differences observed after the intervention were likely due to the intervention itself rather than to baseline patient characteristics.

## Vital Signs and Glasgow Coma scale

At baseline, no significant differences were observed between the intervention and control groups regarding vital signs or Glasgow Coma Scale (GCS) scores. Following implementation of the intervention, patients in the intervention group demonstrated progressive improvement in body temperature, heart rate, respiratory rate, blood pressure, and GCS scores, with significant differences becoming evident from the third day of follow-up. These results suggest faster clinical stabilization among patients who underwent catheter replacement before urine specimen collection. Similar findings have been reported in previous studies emphasizing the role of evidence-based CAUTI prevention strategies in improving recovery indicators and reducing infection-

related complications (**Rosenthal et al., 2025; Reddy et al., 2026**). Like, **Suleyman et al. (2026)** found that structured catheter-management interventions were associated with a reduction in systemic inflammatory responses and enhanced clinical recovery. The researchers believe that the observed improvements may be related to better infection control practices and a lower infection burden, which collectively contributed to improved physiological stability among critically ill patients.

Although the beneficial effects observed in the intervention group are consistent with previous evidence, some studies have suggested that improvements in patient outcomes cannot always be attributed solely to catheter-related interventions. Variations in concurrent clinical management, patient condition, and supportive therapies may also influence recovery and clinical outcomes (**Westgeest et al., 2024; Patel et al., 2023**). In the current study, the favorable changes observed in physiological parameters may be explained by reduced microbial colonization, improved adherence to infection prevention measures, and more effective catheter-care practices. Collectively, these factors may have contributed to limiting systemic inflammatory responses and promoting earlier clinical stabilization among critically ill patients.

The researchers believe that the observed physiological improvements in the intervention group resulted from reduced microbial colonization, improved infection prevention practices, and enhanced nursing interventions. These factors have likely contributed to reducing the systemic inflammatory response and accelerating clinical stabilization. The significant improvements in GCS scores in the intervention group are particularly noteworthy, as they suggest that effective infection management may have positive effects on neurological status, possibly through reduction of sepsis-related encephalopathy or improved overall physiological stability.

#### **Clinical and Laboratory Manifestations of Urinary Tract Infection**

Regarding urinary tract infection symptoms, the current study hypothesizes that critically ill patients who undergo urinary

catheter replacement before urine specimen collection will demonstrate lower frequencies of urinary tract infection manifestations than the control group. The findings of the study support the hypothesis and demonstrated clear improvement in both local and systemic manifestations among patients who received the intervention. Infection-related signs were considerably less frequent in the intervention group than in the control group, indicating the beneficial effect of the intervention on limiting infection progression and enhancing patients' clinical status. Marked reductions were particularly observed in hematuria, suprapubic tenderness, and polyuria, all of which showed highly statistically significant differences. Similar results have been documented in previous studies evaluating CAUTI prevention interventions. **Suleyman et al. (2026)** reported that structured CAUTI prevention programs and appropriate urine culture management were associated with better patient outcomes and lower infection rates. Also, **Ahmed et al. (2026)** found that implementation of a nurse-led urinary catheter management protocol reduced catheter-related complications and improved patients' clinical condition. **Alfare et al. (2026)** also highlighted the importance of continuous monitoring, regular reassessment of catheter necessity, and performance feedback in reducing infection-related complications and promoting patient safety.

Although positive outcomes were observed after implementation of the intervention, the effect of CAUTI prevention strategies may differ from one healthcare setting to another. Variability in patient conditions, staff compliance with infection-control measures, resource availability, and differences in clinical practice may influence the effectiveness of such interventions. **Rosenthal et al. (2025) and Advani and Fakihi (2019)** noted that inconsistent application of preventive practices can affect both infection occurrence and patient recovery. In the present study, patients who underwent the intervention experienced fewer urinary symptoms and demonstrated better overall clinical improvement. This may be due to reduced opportunities for bacterial growth within the urinary tract, better catheter management, and adherence to aseptic care principles. The observed decline in suprapubic

tenderness, hematuria, and polyuria may reflect reduced local inflammation and lower bacterial burden, which could have facilitated the recovery process and contributed to the improvement in patients' condition.

**Concerning urine culture results**, the findings of this study highlight the potential value of catheter exchanging before urine specimen collection in reducing bacterial contamination and improving the accuracy of microbiological diagnosis. The intervention group demonstrated significant reductions in the isolation of major urinary pathogens, particularly *Escherichia coli* and *Staphylococci*. These findings are consistent with **Patel et al. (2023)**, who reported that minimizing unnecessary catheter use and ensuring timely catheter removal are effective strategies for reducing CAUTI risk and microbial colonization. **Rosenthal et al. (2025)** reported that CAUTI prevention practices significantly reduced hospital-acquired urinary infections and improved patient safety. Furthermore, **Mody et al. (2017)** found that implementing multifaceted catheter management strategies was associated with fewer catheter-related infections and improved quality of care.

However, several recent studies suggest that success in reducing catheter-related infections depends not only on the implementation of a preventive package but also on the consistency and quality of its implementation. Differences in microbiological results noted between studies may be due to variability in adherence to catheter maintenance practices, underscoring the importance of ongoing surveillance and quality improvement initiatives (**Rosenthal et al., 2025; Mody et al., 2017**).

The significant reduction in bacterial pathogens in the intervention group may be explained by improved catheter maintenance, enhanced adherence to infection prevention practices, and reduced opportunities for bacterial migration and biofilm formation. The complete elimination of *Staphylococci* in the intervention group is particularly noteworthy, as this organism is a common cause of catheter-related infections. The findings suggest that replacing the catheter before specimen collection not only improves diagnostic

accuracy but also contributes to effective eradication of urinary pathogens.

**Regarding clinical outcomes**, the findings suggest that patients who received the intervention experienced significantly better clinical outcomes than patients in the control group. These findings are consistent with **Mody et al. (2023)**, who highlighted the role of evidence-based catheter care interventions in reducing infection-related complications in hospitalized patients. Similarly, **Saint et al. (2023)** reported that reduced catheter-related complications contributed to shorter hospital stays and decreased healthcare utilization.

The findings are further supported by **Rosenthal et al. (2025)**, who showed that adherence to CAUTI prevention strategies reduced healthcare-associated urinary tract infections. Similarly, **Fakih et al. (2023)** reported that catheter stewardship and ongoing monitoring programs were associated with lower rates of recurrent urinary tract infections and improved infection prevention outcomes. Similar findings were reported by **Patel et al. (2023)** and **Rosenthal et al. (2025)**, who noted that although CAUTI prevention strategies effectively reduce infection-related complications, a direct influence on mortality remains a challenge because mortality in critically ill patients is influenced by a variety of clinical factors, comorbidities, and organ dysfunction, not only catheter-related infections.

In contrast to the findings of this study, several recent studies suggest that the magnitude of benefit derived from CAUTI prevention interventions may vary according to patient characteristics and baseline risk factors. As a result, differences in implementation practices across healthcare settings may contribute to variability in reported clinical outcomes (**Mody et al., 2017**).

The favorable clinical outcomes observed in the intervention group may be explained by consistent adherence to CAUTI prevention measures, including timely catheter exchanging before specimen collection. Such adherence likely reduced the risk of infection, limited infection-related complications, and supported physiological recovery and overall

clinical stability. The clinically meaningful reduction in mortality, although not statistically significant, suggests a potential survival benefit that should be investigated in larger studies with adequate statistical power.

**In relation to the occurrence of complications**, the current study showed that patients who received the intervention experienced fewer complications than those who received routine care. The intervention group demonstrated significantly lower rates of sepsis, prolonged hospitalization, recurrent urinary tract infections, and death, indicating that implementation of the intervention was associated with improved clinical outcomes and decreased infection-related complications. The reduction in sepsis in the intervention group may reflect the effectiveness of infection prevention measures in limiting bacterial colonization, reducing the progression of local infections to systemic complications. These findings are in line with the Agency for Healthcare Research and Quality (AHRQ, 2022), which emphasizes that evidence-based intervention can effectively reduce serious infection-related events and improve patient safety.

The findings are further supported by Reddy et al. (2026), who showed that prolonged catheterization is associated with increased infectious complications and patient morbidity, underscoring the importance of effective catheter management strategies in improving clinical outcomes. Similar findings were reported by Flores et al. (2019), who emphasized that strict catheter management practices are essential to reduce recurrent urinary tract infections. Mody et al. (2017) also highlighted the importance of evidence-based catheter care in preventing recurrent CAUTI events.

The favorable outcomes observed in the intervention group may be attributed to the effectiveness of appropriate catheter placement, maintenance, and timely catheter exchanging practices. The significant reduction in sepsis and recurrent UTIs suggests that replacing the catheter before specimen collection not only improves diagnostic accuracy but also serves as a therapeutic intervention by removing a potential source of ongoing infection.

### Limitation of the study

The findings of the present study should be interpreted in light of certain limitations. Participants were recruited from a single hospital, which may limit the generalizability of the findings. In addition, the use of a non-probability sample may have introduced selection bias. To minimize the effect of these limitations, clearly defined inclusion and exclusion criteria were applied, standardized data collection procedures were followed, and all participants were assessed using the same validated study tools under similar clinical conditions. Despite these limitations, the study provides valuable evidence regarding the effect of urinary catheter replacement before urine specimen collection on clinical outcomes among critically ill patients.

### Conclusion

Early urinary catheter replacement before urine specimen collection, combined with adherence to aseptic catheter care practices, was associated with significantly improved patient outcomes and reduced catheter-related complications among critically ill patients. This intervention demonstrated: significant reduction in major urinary pathogens, particularly *E. coli* and *Staphylococci*, reduced incidence of sepsis, recurrent urinary tract infections, and prolonged ICU stay, faster clinical stabilization, improved vital signs and neurological status, and favorable clinical progress.

These results highlight the importance of standardized catheter management protocols as an integral component of infection prevention strategies and support their implementation in intensive care settings to promote safer and better-quality patient care. The study provides strong evidence that exchanging the urinary catheter before urine specimen collection is an effective, simple, and low-cost intervention that should be incorporated into routine nursing care protocols for critically ill patients requiring urine culture.

### Recommendations:

#### For Clinical Practice

1. Develop and implement a standardized urinary catheter replacement protocol before urine specimen collection for critically ill patients with indwelling urinary catheters when continued catheterization is clinically indicated.

2. Ensure strict adherence to aseptic catheter insertion and maintenance techniques during catheter replacement and routine catheter maintenance to minimize microbial contamination and reduce catheter-related urinary tract infections.

3. Implement regular audits and feedback mechanisms to monitor compliance with catheter replacement protocols and identify areas for improvement.

4. Provide ongoing education and training for nursing staff on the importance of catheter replacement before urine specimen collection and proper aseptic techniques.

#### **For the Health Services Administration**

1. Develop institutional policies and clinical guidelines that support evidence-based urinary catheter management practices, including catheter replacement before urine culture collection when clinically appropriate.

2. Allocate necessary resources for implementation of catheter replacement protocols, including sterile catheterization supplies and staff training.

3. Establish surveillance systems to monitor CAUTI rates and evaluate the effectiveness of catheter management interventions.

4. Promote multidisciplinary collaboration among physicians, nurses, and infection control practitioners to support implementation of catheter management protocols.

#### **For Future Research**

1. Conduct multicenter studies with larger sample sizes to further evaluate the effectiveness of catheter replacement before urine specimen collection in different patient populations and healthcare settings.

2. Examine the cost-effectiveness of routine catheter replacement before urine culture collection compared with conventional catheter management approaches, including assessment of direct costs (supplies, staff time)

and indirect cost savings (reduced infections, shorter hospital stays).

3. Investigate the long-term outcomes of catheter replacement interventions, including rates of antimicrobial resistance and patient quality of life.

4. Conduct implementation science research to identify barriers and facilitators to adopt catheter replacement protocols and develop strategies to promote sustained practice change.

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