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# Indwelling urinary catheter use and associated outcomes among adult patients undergoing surgery

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**Abstract**

**Background:** Indwelling Urinary catheters (IUCs) are the most utilized devices. They are complicated into postoperative catheter-associated urinary tract infections, urethral trauma, pain that culminate into prolonged immobility and hospital stay with associated financial implications. The aim of this review was to give an overview of the use of indwelling catheters among adult patients undergoing surgery.
**Methods:** A systematic review approach was employed. A literature search was done using of search engines that include HINARI, PubMed, Google Scholar and Cochrane, using search words related to the title and aim of the review.
**Results:** Eleven out of 236 articles involving 218,000,790 patients studied met the inclusion criteria. 86% to 87.3% of patients undergoing major operations were exposed to routine catheterization depending on the type of surgical procedure. Only 7.7% to 8% of patients needed postoperative IUCs. Unduly prolonged retention of IUCs was the most reason for inappropriate IUCs use with 18% without a documented removal order. IUCs contributed 80% to 87.8% of postoperative UTIs as the third most common postoperative infections.
**Conclusion:** Use of IUCs is necessary for certain surgeries as per existing guidelines. The lack of IUC removal instructions is one of the factors contributing to CAUTIs.

**Keywords:** indwelling urinary catheter, CAUTI, surgery, perioperative

## Introduction

An IUC is defined as a device that passes through the urethra to drain urine continuously from the bladder to the attached urine bag or another collecting system for a certain period.[1] The IUC has been used as routine preoperative care to visualize the bladder during surgery, prevent the bladder injuries and a postoperative urine retention.[2] However, available evidences support that its use is a risk to patients.[3]

Previous studies confirmed that IUC is associated with various complications. These include pain and difficulties during urination after IUC removal, delayed ambulation, increased hospital stay[2] and catheter-associated urinary tract infection (CAUTIs).[2, 4–10] These complications lead to excessive loss of patients' income, a high morbidity rate and an increased mortality related to UTIs.[4–8, 11–15]

Different interventions are not significantly effective in reducing CAUTIs. These include the use of different types of catheters such as antiseptic, antibiotic, silver coated catheters and others.[16–19] The non-use or appropriate use of urinary catheter has only been found to be effective in reducing the incidences of CAUTIs.[3, 20]

Therefore, the Centre for Disease Prevention and Control (CDC) provided the guidelines to be globally followed to reduce the risks of catheter-associated complications.[21–23] The CDC guidelines stipulated that IUCs be inserted for only appropriate indication, using the appropriate technique and be kept in place as long as needed.[21–23] Among patients undergoing surgery, an IUC is indicated for urologic surgery and other surgery of nearby structures of the genitourinary tract.[14, 21] It is also indicated for patients with predictable prolonged surgery or at risk for being administered diuretics or much fluids during surgical operation.[14, 21] This catheter is removed before a patient leave post-anaesthesia care unit (PACU).[14, 21] Postoperatively, an IUC is used to manage an acute urine retention and gross hematuria with blood clots in urine.[24] Any IUC placement for any reason different from the ones mentioned above is inappropriate and should be removed.[25] Most perioperative IUCs are preferably removed within 24 hours, and later when still indicated.[21] At the service level, CDC recommends the use of

policies specific to surgical procedures to guide catheter selection, placement and care, while continuously monitoring for CAUTIs.[13, 21]

Although IUCs are commonly used among patients undergoing surgery, their inappropriate use may be detrimental to patients due to the risk of CAUTIs and other complications. Non-placement of IUCs and the immediate removal of IUCs in situ are the best ways of preventing catheter-associated complications. [26] The appropriate use of IUC among patients undergoing surgery remains unknown. Therefore, this systematic review will help to determine the incidence of IUC placement, the appropriateness of IUC use and associated outcomes among patients undergoing surgery.

## Methodology

A team of 4 authors carried out this systematic review. The review considered the worldwide literature available on the IUC use among patients undergoing surgery, published between 2007 and 2017(figure1). The databases used for the review included HINARI, PubMed, Google Scholar and Cochrane. These databases allowed access to worldwide journals and published literature using search words related to the review title and objectives. The combination of search words included "Indwelling urinary catheter"; "Catheter-associated urinary tract infections"; "IUC use"; "appropriate IUC use"; and "inappropriate IUC use". They were combined with either "surgery" or postoperative or perioperative" key words.

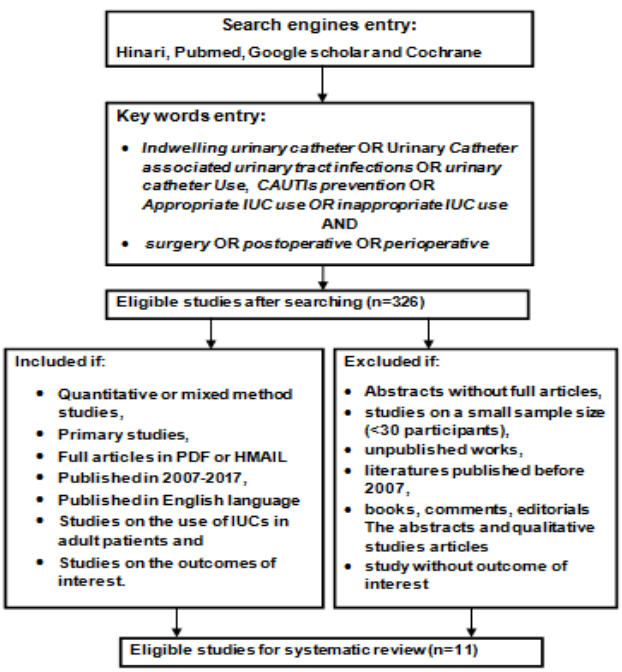


**Figure 1. Literature search process**

Inclusion criteria comprised full articles published in the English language of quantitative or mixed method studies, primary studies, studies on the use of IUCs in adult patients and their outcomes. The abstracts without full articles, studies on a small sample size (<30 participants), unpublished works, literature published before 2007, books, comments, editorials were excluded. The abstracts and qualitative studies articles were excluded due to the absence of statistics relevant to inform the review (Figure1). All the articles that met the inclusion criteria were selected for the review (Table 1, 2, 3).

## Results

The combination of keywords provided 236 articles that assessed the use of IUCs and/or associated outcomes among patients undergoing surgery worldwide. Excluded were 225 articles not meeting the inclusion criteria; therefore, only 11 articles were selected for the review (figure 1, tables 1, 2, 3).

The selected articles were primary quantitative studies. Among them, 4 (36.4%) were randomized controlled trials (Table 1), 5 (45.4%) retrospective studies (Table 2) while 2 (12.2%) were prospective studies (Table 3). The most of studies 6 (54.5%) were conducted in the United States of America, one in India, one in Sweden, one in Tarnow, Poland, one in Brazil, and one in the Netherlands (tables 1,2,3). Three articles assessed the incidence of IUC use,[27–29] four articles talked about the appropriateness of IUCs in terms of timing, duration and need of IUCs based on individual bladder capacity[29–31] while seven studies assessed outcomes of IUCs use.[15, 27–29, 32–34]

**Table 1. Summary of the 4 Randomized Controlled Studies reviewed**

| Authors | Study title | Country | Study type | Study design | Study population | Sample size |
|---|---|---|---|---|---|---|
| **Allen SM, Blackmon SH, Nichols FC, Cassivi SD, Harmsen WS, Lechtenberg B, Pierson K, et al.,2016** | Optimal Timing of Urinary Catheter Removal After Thoracic Operations: A Randomized Controlled Study | Minnesota, USA | Quantitative | A Randomized Controlled Study | patients undergoing a general thoracic surgical procedure | 374 patients |
| **Nyman MH, Gustafsson M, Langius-Eklöf A, Johansson JE, Norlin R, Hagberg L,2013** | Intermittent versus indwelling urinary catheterisation in hip surgery patients: A randomised controlled trial with cost-effectiveness analysis | Sweden | Quantitative | A randomised controlled trial with cost-effectiveness analysis | hip surgery patients (patients with fractures or with osteoarthritis) | 170 patients |
| **Brouwer TA, et al.,2015** | Postoperative Bladder Catheterization Based on Individual Bladder Capacity. A Randomized Trial | Netherlands | Quantitative | A Randomized Trial | Surgical patients, operated under general or spinal anaesthesia without an indwelling urinary catheter. | 1,840 |
| **Joshi B., Aggarwal N., Chopra S., Taneja N.,2014** | A prospective randomized controlled comparison of immediate versus late removal of urinary catheter after abdominal hysterectomy | Chandigarh, India | Quantitative | A prospective randomized trial | women undergoing abdominal hysterectomy with or without salpingoophrectomy | 70 patients |

**Table 2. Summary of the 5 Retrospective studies reviewed.**

| Author | Study title | Country | Study type | Study design | Study population | Sample size |
|---|---|---|---|---|---|---|
| **Wałaszek M.,2015** | The analysis of the occurrence of nosocomial infections in the neurosurgical ward in the district hospital from 2003 to 2012 | Tarnów | Quantitative | Retrospective study | patients hospitalized from 2003 to 2012 | 13,351 patients |
| **Conterno LO et al.,2014** | Impact of hospital infections on patients outcomes undergoing cardiac surgery at Santa Casa de Misericórdia de Marília | Brazil | Quantitative | Retrospective cohort study | consecutive patients from 2006 to 2012 at the Santa Casa de Misericórdia de Marília | 2060 |
| **Wald HL, Ma A, W. Bratzler D, Kramer AM,2008** | Indwelling Urinary Catheter Use in the Postoperative Period. Analysis of the National Surgical Infection Prevention Project Data | USA | Quantitative | Retrospective cohort study | patients undergoing major operations | 35 904 |
| **Alvalez et al.,2016** | Risk Factors for Postoperative Urinary Tract Infections in<br>Patients Undergoing Total Joint Arthroplasty | Chicago<br>USA | quantitative | retrospective study | Patients Undergoing Total Joint Arthroplasty | 115630 patients |
| **Gillen JR, Isbell MI, Michaels DA, Lau CL, Sawyer RG.,2015** | Risk Factors for Urinary Tract Infections<br>In Cardiac Surgical Patients | Virginia, USA | Quantitative | A restrospective study | All patients undergoing cardiac surgery at a single institution from 2006 through 2012 | 4,883<br>patients |

**Table 3. Summary of the Prospective studies reviewed**

| Authors | Study title | Country | Study type | Study design | Study population | Sample size |
|---|---|---|---|---|---|---|
| **Lawrie MC, Ong AC, Hernandez HV, Rosas S, Post ZD, Orozco FR.,2017** | Incidence and Risk Factors for Postoperative Urinary Retention in Total<br><br>Hip Arthroplasty Performed Under Spinal Anesthesia | Florida, USA | Quantitative | Prospective study | Patients who underwent total<br><br>Hip Arthroplasty Performed Under Spinal Anesthesia | 180 patients |
| **Tiwari MM, et al,2011** | Inappropriate use of urinary catheters | Nebraska, USA | Quantitative | Prospective study | All patients admitted to adult medical-surgical unit between October and December 2007 | 436 |

The review found that IUCs are mostly used for patients undergoing major operations. The incidence range of IUCs placement was between 86% and 87.3% among patients undergoing surgery.[8, 28]
The incidence was variable depending on the type of surgery. It was 26.9% in genitor-urinary surgeries,[35] 38% in the orthopaedic surgeries, 28% in cardiac surgeries, 22% for GI surgeries, 21.7% in gynaecology, 20.4% in general surgery and 12% in vascular surgery.[8] The incidence of IUC use is as high as 42–50% among patients in resource-limited settings.[36]

However, the incidence of postoperative IUCs reduces drastically if the individual bladder capacity is measured and taken into consideration before inserting a urinary catheter (8.6% versus 11.8%).[27] The studies also identified that only 7.5% to 8.6% of operated patients that needed IUCs after surgery.[27, 30, 32]" Therefore, the inappropriate use of IUCs among patients undergoing surgery was found to be an unduly prolonged retention of IUCs.[35] The mean days were variant from 2.5 days among patients who underwent orthopaedic surgery to 5.1 days among patients who underwent GI surgery.[8] The IUC retention lasted up to 21 days in fistula repairs[37] and 18% did not have documented catheter removal order.[8]

The complications associated with IUCs use among adult patients undergoing surgery were CAUTIs, urethral trauma and voiding pain,[38] the increased period for hospitalization and excessive loss of patients' income, high morbidity rate and increased number of deaths related to UTIs.[4–8, 11–15] Postoperative UTIs are the 3rd postoperative infections counting for 25.9% of bacteremia,[39] febrile morbidity (10%) [39] and 0.58%,[40] 1.1%,[33, 34] 2.8%,[28] 11%[41] symptomatic UTIs. An IUC contribute 80%[42] to 87.8% of postoperative UTIs,[41] and postoperative mortality of 0.54%[29] to 10.9%.[34] Non-use and immediate or early removal of IUC catheter are the only successful strategies for preventing postoperative CAUTIs and other related complications.[2, 27, 29, 39, 41, 43]

**Discussion**

This systematic review determined the incidence of IUC placement, the appropriateness of IUC use and their associated outcomes among patients undergoing surgery.

Regarding the incidence of IUCs use, the review findings showed that IUCs were mostly used among patients undergoing surgery in tandem with results from other studies.[28, 29, 31, 35] However, the articles reviewed showed the high predominance of the use of IUCs in major surgery.[8, 35] This is explained by the fact that the major surgery last longer and the associated critical status of the patient needs a close monitoring of fluids intake and output which is also an indication for IUC placement.[14, 44]

Studies have recommended that appropriate IUCs use and proper insertion technique are strategies to prevent catheter-associated urinary tract infections. These studies recommended use IUCs among patients undergoing urologic surgery and other surgery of nearby structures of the genitourinary tract.[44] Patients with predictable prolonged surgery or at risk for being administered diuretics or much fluids during surgical operation and postoperative urine retention were also found eligible for IUCs use. However, these IUCs were to be removed before the patients leave post-anaesthesia care unit (PACU).[14, 21]

In some exceptions, an IUC is used postoperatively, to manage an acute urine retention and gross haematuria

with blood clots until it is no longer needed,[24] and few patients will need a prolonged IUC for the indication. [27] There was a drastic reduction postoperatively where bladder capacity is measured and taken into consideration before inserting a urinary catheter.[27] This implies that the use of IUCs was found to be mainly in the preoperative and the intra-operative periods. This captured IUCs' removal postoperatively as a strategy for IUCs risks prevention.

Any catheter used without appropriate indication, without adhering to placement principles and unnecessary delays of catheter removal are considered inappropriate and have to be removed.[14, 21, 23] Other studies have found that most of the catheterization (21% to 63%) are done without proper indications or extending their unnecessary use.[8, 14, 25, 45, 46] The odds ratio of inappropriate use of IUC was as high as 23.38 in general surgery, 5.0 in orthopaedic surgery and 1.05 for unnecessary prolonged use.[35]

In this review, the inappropriate use of IUCs among patients undergoing surgery was found to be an unduly prolonged retention of IUCs.[35] The average was from 2.5 days in orthopaedic operations to 5.1 days for gastro-intestinal surgery[8]. The IUC retention prolonged up to 21 days in fistula repairs,[37] and 18% did not have documented catheter removal order.[8] The orthopaedic types of surgery are mostly followed by an immobilization to allow bones healing and patients operated for gastro-intestinal disorders are likely to be critical and require continuous monitoring of fluids intake and output.[14] Therefore, we can't ignore that unnecessary prolonged IUCs after surgery. The treating team may keep unnecessary IUCs in place because of forgetting, non-availability of toileting supportive supplies or because of ignorance.[14, 47, 48]

Regarding the outcomes associated with IUCs use among patients undergoing surgery, the findings highlighted the association between IUCs use and CAUTIs, urethral trauma, voiding pain and discomfort,[14, 38, 49] decreased activities of daily life, increased period for hospitalization, excessive loss of patients' incomes, high morbidity rate and increased number of deaths related to UTIs.[4–8, 11–15, 25] Postoperative UTIs are the 3rd postoperative infections counting 25.9% of bacteraemia,[39] 10% of febrile morbidity,[39] and 0.58% to 11% of symptomatic UTIs.[28, 33, 34, 40, 41] An IUC contributes 80%, [42] to 87.8% of postoperative UTIs[41] and postoperative mortality of 0.54%[29] to 10.9%.[34] The most common identified bacteria were Candida albicans (26.6%), Enterobacter cloacae, and Escherichia coli (73.4%).[28] The main risk factor for postoperative CAUTIs is the duration of the catheter. The risk increases as the catheter last longer (positive urine cultures and febrile morbidity were augmented in delayed removal group to 25.9% and 10% respectively versus 8% and 0% in immediate removal).[8, 39]

In spite of associated complications, perioperative IUCs have benefits to patients such as reducing the incidence of urine retention and need for re-catheterization due to continuous flow of urine.[2, 27, 30, 38, 43] The incidence of urine retention significantly reduced in the catheter group compared to non-catheter group during caesarean delivery.[2] The early removal of IUC was significantly associated with the re-catheterization (12.4% vs. 3.2%, P=0.0065) and required more in and out catheters (59.5%) compared with those whose IUC was removed 6 hours after epidural anaesthesia was discontinued (31%, P< 0.0001)[30]. The intermittent group experienced more catheterization ($p < 0.001$) and bladder scans ($p < 0.001$), non-catheterization (14%) and early return to function compared to normal bladder functions compared to the IUC group.[41] Less pain was reported in immediate IUCs removal group. [39] Some anaesthesia techniques such as epidural and spinal anaesthesia and opioid analgesics that are mostly used in surgery contribute to urine bladder dysfunction and require attention before an IUC removal.[50]

**Limitations of the review**

During this review, the researchers have found that few studies were conducted on the perioperative use of an IUC. Only one study found done on the incidence of IUC use among perioperative patients.[8]The randomized control studies assessed the effectiveness of IUC in the management of postoperative urine retention,[27, 43] CAUTIs among patients undergoing cardiac surgery,[28] the IUCs use as perioperative care among patients undergoing caesarean delivery,[38] and other types of surgery. Other studies done on the appropriate and inappropriate use of IUCs provided some information on perioperative IUC use.[31, 35]

In spite of the common use of IUCs among patients undergoing surgery in developing and developed countries, they are less studied in Africa and other developing countries. A little is still known about their use among patients undergoing surgery. In African countries with limited resources, surgery is being performed regularly, IUCs are used but we found no study published on the perioperative use of IUCs among patients undergoing surgery. Few articles on the use of the IUC during surgery and heterogeneity in surgical procedures limited the ability to make a conclusion on the appropriate use of catheter during surgery.

**Conclusion and Recommendations**

During this review, the findings showed that IUCs are a commonly used device among perioperative patients. Their use is associated with complications

such as CAUTIs, patient discomfort, immobility, delay hospitalization and deaths but also prevent complications such as urine retention. The non-placement of the urinary catheter and the early removal of unnecessary catheters are costless, low risk and constitute effective interventions to prevent CAUTIs. Therefore, the findings highlighted that an IUC is essential during surgery and its necessity and duration vary with the surgical procedure and the anaesthesia technique used. Non-use and immediate removal are recommended during hysterectomy and caesarean section while delayed removal is recommended when epidural anaesthesia was used during surgery and in the postoperative period to manage pain. The institutional policy based on types of surgery should limit the unnecessary use and delays of IUC removal, hence preventing catheter-associated complications.

Few articles on the use of the IUC during surgery and heterogeneity in procedures limit the ability to make a conclusion on the appropriate use of catheter during surgery. More evidence is needed on the use of IUC during surgery. More research is encouraged on needs of IUC, appropriateness of IUC use among patients undergoing surgery to inform the formulation of appropriate policies for catheter use during surgery.

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