# The Economic Impact of Indwelling Urinary Catheterization on Total Joint Arthroplasty Procedures and Implications for Urinary Catheter Alternatives: A Systematic Review, Analysis, and Model

Timothy Kelly, MS, MBA;[1] Jun Li, PhD;[2] Mutsuo Yamazaki, PhD;[3] Hiroshi Kubo, MD, PhD[3]
[1]Becton Dickinson and Company (BD), Franklin Lakes, NJ, USA ; [2]Becton Dickinson Asia, Ltd., Beijing, China; [3]Nippon Becton Dickinson Company, Ltd., Tokyo, Japan

ISPOR 2025
May 13-16, 2025
Code: EE412

## Background

Indwelling urinary catheters (IUCs) are commonly employed with patients undergoing total knee arthroplasty (TKA) and total hip arthroplasty (THA) procedures.[1] IUCs increase the risk of postoperative urinary tract infections (UTIs),[2] which in turn, increase the risk of prosthetic joint infections (PJIs).[3] The use of intermittent straight catheters (ISCs) as alternatives to IUCs has been suggested to be beneficial in selected populations.[4] With recent advances in less invasive alternatives, including external urinary catheters for both female and male patients,[5,6] providers may benefit from estimating the potential reduction in UTIs that may result from avoidance of IUCs, and potentially from avoidance of ISCs, along with estimating the economic consequences of minimizing both UTI and PJI infections.

## Objectives

Estimate the per-patient cost avoidance that may be realized by replacing IUCs with either ISCs, or no transurethral catheter of any type, in total joint arthroscopy patients. Estimate the per-patient cost avoidance achieved by reducing PJIs in TKA and THA patients through elimination of IUCs and ISCs.

## Methods

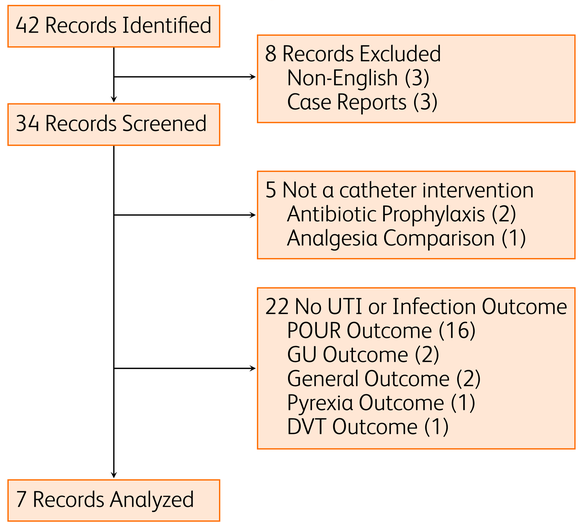
A systematic review of original research and meta-analyses published from 2000-2025 (PubMed) was conducted to assess the impact of transurethral urinary catheters upon the adverse effects associated with TKA and THA procedures. The results were analyzed and applied to a model to estimate the UTI and PJI economic burden avoided when patients are managed without IUCs and ISCs.

## Results

42 records were identified. After exclusions, 34 records were reviewed, and 7 were analyzed (Figure 1 and Table 1). The rate of postoperative UTI in patients managed with IUCs ranged from 1.8% to 6.2% across 6 studies,[1,2,7,8,9,10] from 2% to 7.2% in patients managed with ISCs across 2 studies,[2,10] and from 0% to 3.4% in patients managed without any type of transurethral catheters in 5 studies.[2,7,8,9,10] One study[2] reported on the incidence of PJI: 2.9%, 1.3%, and 1.1% in patients managed with IUCs, with ISCs, and with no transurethral catheters, respectively.

The mean reductions in UTI incidence observed with avoiding IUCs and ISCs (2.5% and 1.9%, respectively) were multiplied by the cost for CAUTI and non-CAUTI hospital onset UTIs[12] (Table 2). That resulted in an estimated per patient UTI cost avoidance of $245 (1,776 CNY; 36,750 JP¥) when IUCs are eliminated and $131 (950 CNY; 19,650 JP¥) when ISCs are eliminated.

## Figure 1: PRISMA Diagram




Search String: Arthroplasty AND Replacement AND (Knee/adverse effects OR Hip/adverse effects) AND urinary catheter

Database: PubMed Search Date: 1/11/2025

PRISMA: Preferred Reporting System for Systematic Reviews and Meta-Analyses

## Results (contd.)

The per-case cost of a 2-stage revision for PJI was found by multiplying the revision rates for PJI occurring in TKA and THA[13] by the cost of revisions for those procedures[14] (Table 2). Those values were multiplied by the estimated PJI incidence reduction that would result from avoiding IUCs and ISCs (62% and 15%, respectively) yielding per-case PJI cost avoidance values ranging from $18 (133 CNY; 2,755 JP¥) when ISCs are avoided for TKA procedures to $211 (1,527 CNY; 31,590 JP¥) when IUCs are avoided for THA procedures.

## Limitations

- Limitations of the model include but are not limited to: heterogeneity of the studies analyzed, applicability of the UTI costs cited to the actual cost of UTIs in the analyzed populations, paucity of studies on the revision rates due to PJI and per-case cost of PJI revisions, and applicability of the estimated PJI incidence reduction to the estimated revision reduction.
- It is unclear whether external urinary catheter alternatives would result in the same UTI rates reported in the various studies when no transurethral catheters (IUCs and ISCs) were used.

## Conclusions

In most studies analyzed, IUCs were associated with higher postoperative UTI rates than were observed with patients managed with ISCs or with no transurethral catheters of any type. Modeling suggests that avoidance of IUCs, and also avoidance of ISCs, may reduce the occurrence, and thus the per-patient costs, associated with UTIs and PJIs.

## Table 1: Publication Analysis

| First Author | Publication Year | N | Type of Procedure | Intervention | UTI Incidence: IUC | UTI Incidence: ISC | UTI Incidence: No Catheter | UTI Incidence: Incidence Reduction (IUC vs. No Cath) | UTI Incidence: Incidence Reduction (ISC vs. No Cath) |
|---|---|---|---|---|---|---|---|---|---|
| Shuai[7] | 2021 | 1,334 | TKA | IUC vs. no catheter | Patients with an IUC had a 2.72 RR of UTI compared to patients with no catheter | | | | |
| Thiengwittayaporn[8] | 2021 | 230 | TKA | IUC vs. no catheter | 1.8% | | 0% | 1.8% | |
| Weintraub[9] | 2023 | 388 | TKA and THA | IUC vs. no catheter | 2.1% | | 0% | 2.1% | |
| Miller[10] | 2013 | 200 | THA | IUC vs. no catheter | 2.8% | | 0% | 2.8% | |
| Bjerregaard[1] | 2019 | 784 | TKA and THA | IUC until first post-op morning | 4.2% | | | | |
| Garbarino (TKA)[2] | 2020 | 9,123 | TKA | IUC vs. ISC vs. both IUC and ISC[i] | 4.8% | 2.0% | 2.0% | 2.8% | 0.0% |
| Garbarino (THA)[11] | 2020 | 3,834 | THA | IUC vs. ISC vs. both IUC and ISC[ii] | 6.2% | 7.2% | 3.4% | 2.8% | 3.8% |
| | | | | | | | Mean reductions in UTI incidence: | 2.5% | 1.9% |

[i]A 5.6% UTI rate was observed in the 'both IUC and ISC' cohort
[ii]A 6.8% UTI rate was observed in the 'both IUC and ISC' cohort
[iii]A 1.3% PJI rate was observed in the 'both IUC and ISC' cohort

| First Author | Publication Year | N | Type of Procedure | Intervention | PJI Incidence: IUC | PJI Incidence: ISC | PJI Incidence: No Catheter | PJI Incidence: Percentage Incidence Reduction (No Cath vs. IUC) | PJI Incidence: Percentage Incidence Reduction (No Cath vs. ISC) |
|---|---|---|---|---|---|---|---|---|---|
| Garbarino (TKA)[2] | 2020 | 9,123 | TKA | IUC vs. ISC vs. both IUC and ISC[iii] | 2.9% | 1.3% | 1.1% | 62% | 15% |

## Table 2: Cost Avoidance Model

| Estimated UTI incidence reduction by avoiding use of: | | Cost of hospital-onset UTI[12] | UTI Cost Avoidance per Patient |
|---|---|---|---|
| ISC | 1.9% | $6,874[iv] | $131 (950 CNY)[vi] (19,650 JP¥)[vi] |
| IUC | 2.5% | $9,807[v] | $245 (1,776 CNY)[vi] (36,750 JP¥)[vi] |

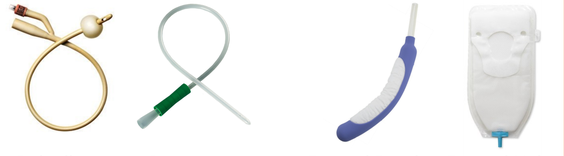
[iv]Cost of a non-catheter-associated UTI (non-CAUTI) hospital-onset UTI [v]Cost of a CAUTI
[vi]Exchange Rates: $1 USD = 7.25 CNY, $1 USD = 150 JP¥

| | | TKA | THA |
|---|---|---|---|
| Mean 90-day revision rate for infection[13] | | 0.10% | 0.30% |
| Cost of a 2-stage revision for PJI[14] | | $122,425 | $113,226 |
| Per case cost of PJI revision | | $122 | $340 |
| Estimated PJI incidence reduction by avoiding use of: | | | |
| ISC | 15% | $18 (133 CNY)[vi] (2,755 JP¥)[vi] | $51 (369 CNY)[vi] (7,643 JP¥)[vi] |
| IUC | 62% | $76 (550 CNY)[vi] (11,386 JP¥)[vi] | $211 (1,527 CNY)[vi] (31,590 JP¥)[vi] |

[vi]Exchange Rates: $1 USD = 7.25 CNY, $1 USD = 150 JP¥

### Urinary Catheter Options

Transurethral Catheters | Alternative External Catheters



Indwelling Urethral Catheter (IUC) | Intermittent Straight Catheter (ISC) | External Female Wicking Catheter | External Male Wicking Catheter

Images courtesy of Becton Dickinson and Company.

## Disclosures and Funding

The authors are all employees of Becton Dickinson and Company, a manufacturer of indwelling, intermittent, and external urinary catheters. Reference reprints and poster printing costs were funded by Becton Dickinson and Company.

## References

[1]Bjerregaard LS, Homilius M, Bagi P, Hansen TB, Kehlet H. Indwelling urinary catheterisation may increase risk of complications in hip and knee arthroplasty. *Dan Med J*. 2019 Apr;66(4):A5538.

[2]Garbarino LJ, Gold PA, Anis HK, Sodhi N, Danoff JR, Boraiah S, Rasquinha VJ, Mont MA. Does Intermittent Catheterization Compared to Indwelling Catheterization Decrease the Risk of Periprosthetic Joint Infection Following Total Knee Arthroplasty? *J Arthroplasty*. 2020 Jun;35(6S):S308-S312.

[3]Pulido L, Ghanem E, Joshi A, Purtill JJ, Parvizi J. Periprosthetic joint infection: the incidence, timing, and predisposing factors. *Clin Orthop Relat Res*. 2008 Jul;466(7):1710-5.

[4]Centers for Disease Control and Prevention. Evidence Review. Guideline for Prevention of Catheter-Associated Urinary Tract Infections (2009). https://www.cdc.gov/infection-control/hcp/cauti/evidence-review.html. Updated: 4/12/24. Accessed: 4/24/25.

[5]Pryor N, Wang J, Young J, et al. Clinical outcomes of female external urine wicking devices as alternatives to indwelling catheters: a systematic review and meta-analysis. *Infect Control Hosp Epidemiol*. 2024 May 6;45(9):1-9.

[6]Wagg A, Redmond DR. A Comparative Randomized Cross-Over Trial to Examine Efficacy of Urine Capture and Comfort of Two Male External Urine Collection Devices in Healthy Male Volunteers. *J Wound Ostomy Continence Nurs*. 2024 Nov-Dec 01;51(6):486-490.

[7]Shuai M, Li Y. Indwelling catheter increases the risk of urinary tract infection in total knee arthroplasty: A meta-analysis of randomized controlled trials. *Medicine (Baltimore)*. 2021 Apr 16;100(15):e25490.

[8]Thiengwittayaporn S, Uthaitas P, Hongku N, Tunyasuwanakul R, Limphunudom P, Leelachiewchankul F. Indwelling urinary catheterization was unnecessary in non-drainage total knee arthroplasty: a randomized controlled trial. *Arch Orthop Trauma Surg*. 2021 Mar;141(3):469-476.

[9]Weintraub MT, Yang J, Nam D, et al. Short-Term Indwelling Foley Catheters Do Not Reduce the Risk of Postoperative Urinary Retention in Uncomplicated Primary THA and TKA: A Randomized Controlled Trial. *J Bone Joint Surg Am*. 2023 Feb 15;105(4):312-9.

[10]Miller AG, McKenzie J, Greenky M, et al. Spinal anesthesia: should everyone receive a urinary catheter?: a randomized, prospective study of patients undergoing total hip arthroplasty. *J Bone Joint Surg Am*. 2013 Aug 21;95(16):1498-503.

[11]Garbarino LJ, Gold PA, Anis H, et al. The Effect of Bladder Catheterization Technique on Postoperative Urinary Tract Infections After Primary Total Hip Arthroplasty. *J Arthroplasty*. 2020 Jun;35(6S):S325-S329.

[12]Kelly T, Ai C, Jung M, Yu K. Catheter-associated urinary tract infections (CAUTIs) and non-CAUTI hospital-onset urinary tract infections: Relative burden, cost, outcomes and related hospital-onset bacteremia and fungemia infections. *Infect Control Hosp Epidemiol*. 2024 Jul;45(7):864-871.

[13]Jin X, Gallego Luxan B, et al. Estimating incidence rates of periprosthetic joint infection after hip and knee arthroplasty for osteoarthritis using linked registry and administrative health data. *Bone Joint J*. 2022 Sep;104-B(9):1060-1066.

[14]Hammat AS, Nelson R, Davis JS, et al. Estimation of two-year hospital costs of hip and knee periprosthetic joint infection treatments using activity-based costing. *Bone Joint J*. 2024 Oct 1;106-B(10):1084-1092.

BD-148885