**Supplement**

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**Supplement Methods 1. Protocol Amendments**

The protocol was amended on 8/16/2022 to update progress made and add review team members. Additional reviewers were recruited to reduce workload among reviewers with limited availability. All changes can be viewed on PROSPERO (ID: CRD42022340503).

**Supplement Methods 2. Detailed Search Strategy and Search Report**

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All searches run from inception of the database to 7/12/2022 unless otherwise noted

All searches run without limits unless otherwise noted

Original Ovid Medline search strategy was translated and adapted to other databases using <http://sr-accelerator.com/#/polyglot> and the searcher's discretion.

**Please cite:**

*SR Accelerator Polyglot search translation tool*

Clark JM, Sanders S, Carter M, et al. Improving the translation of search strategies using the Polyglot Search Translator: a randomized controlled trial. *J Med Libr Assoc*. 2020;108(2):195‐207. doi:10.5195/jmla.2020.834

<https://www.ncbi.nlm.nih.gov/pubmed/32256231>

*Endnote deduplication technique*

Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. *J Med Libr Assoc.* 2016;104(3):240‐243. doi:10.3163/1536-5050.104.3.014

<https://www.ncbi.nlm.nih.gov/pubmed/27366130>

**Databases**

* Ovid Medline (Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions 1946 to July 11, 2022)
* Embase.com (including Embase Classic)
* Scopus.com
* Web of Science Core Collection (SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED)
* CINAHL Complete (Ebsco)
* ClinicalTrials.gov

**Total results before deduplication: 2471**

**Total results after modified Bramer method Endnote deduplication: 1271 (1200 duplicate citations removed)**

**SEARCH NOTES:**

In order to be sufficiently broad in the search, we did not include a search concept related to "female". Instead, this concept was applied during screening as inclusion/exclusion criteria.

Condom catheter terms were not included since the focus of the search is on female external catheterization.

The Embase search utilizes the "major" feature for EMTREE terms, due to the more granular nature of Embase's indexing.

**Ovid Medline - 630 results on 07/12/2022**

 (PureWick or "pure wick" or Primafit or "prima fit" or "External catheter\*" or "external female catheter\*" or "external urinary catheter\*" or "External collection" or "external female collection" or FEUC or FEUCs or "wicking device\*").tw. or ((exp "Urinary Catheterization"/ or exp "Urinary Catheters"/) and external\*.tw.) or (((External adj3 catheter\*) or (External adj3 collection)) and urinary).tw.

**Embase - 682 results on 07/12/2022**

purewick:ti,ab OR 'pure wick':ti,ab OR primafit:ti,ab OR 'prima fit':ti,ab OR 'external catheter\*':ti,ab OR 'external female catheter\*':ti,ab OR 'external urinary catheter\*':ti,ab OR 'external collection':ti,ab OR 'external female collection':ti,ab OR feuc:ti,ab OR feucs:ti,ab OR 'wicking device\*':ti,ab OR (('bladder catheterization'/exp/mj OR 'urinary catheter'/exp/mj) AND external\*:ti,ab) OR ((((external NEAR/3 catheter\*):ti,ab) OR ((external NEAR/3 collection):ti,ab)) AND urinary:ti,ab) OR 'external urine collection device'/exp/mj

**Scopus - 708 results on 07/12/2022**

TITLE-ABS(PureWick OR "pure wick" OR Primafit OR "prima fit" OR "External catheter\*" OR "external female catheter\*" OR "external urinary catheter\*" OR "External collection" OR "external female collection" OR FEUC OR FEUCs OR "wicking device\*") OR ((INDEXTERMS("Urinary Catheterization") OR INDEXTERMS("Urinary Catheters")) AND TITLE-ABS(external\*)) OR TITLE-ABS(((External W/3 catheter\*) OR (External W/3 collection)) AND urinary)

**Web of Science Core Collection - 306 results on 07/12/2022**

(TI=(PureWick OR "pure wick" OR Primafit OR "prima fit" OR "External catheter\*" OR "external female catheter\*" OR "external urinary catheter\*" OR "External collection" OR "external female collection" OR FEUC OR FEUCs OR "wicking device\*") OR AB=(PureWick OR "pure wick" OR Primafit OR "prima fit" OR "External catheter\*" OR "external female catheter\*" OR "external urinary catheter\*" OR "External collection" OR "external female collection" OR FEUC OR FEUCs OR "wicking device\*")) OR ((ALL="Urinary Catheterization" OR ALL="Urinary Catheters") AND (TI=external\* OR AB=external\*)) OR (TI=(((External NEAR/3 catheter\*) OR (External NEAR/3 collection)) AND urinary) OR AB=(((External NEAR/3 catheter\*) OR (External NEAR/3 collection)) AND urinary))

**CINAHL - 138 results on 07/12/2022**

((TI PureWick OR AB PureWick) OR (TI "pure wick" OR AB "pure wick") OR (TI Primafit OR AB Primafit) OR (TI "prima fit" OR AB "prima fit") OR (TI "External catheter\*" OR AB "External catheter\*") OR (TI "external female catheter\*" OR AB "external female catheter\*") OR (TI "external urinary catheter\*" OR AB "external urinary catheter\*") OR (TI "External collection" OR AB "External collection") OR (TI "external female collection" OR AB "external female collection") OR (TI FEUC OR AB FEUC) OR (TI FEUCs OR AB FEUCs) OR (TI "wicking device\*" OR AB "wicking device\*")) OR (((MH "Urinary Catheterization+") OR (MH "Urinary Catheters+")) AND (TI external\* OR AB external\*)) OR ((((TI External OR AB External) N3 (TI catheter\* OR AB catheter\*)) OR ((TI External OR AB External) N3 (TI collection OR AB collection))) AND (TI urinary OR AB urinary))

**ClinicalTrials.gov - 7 results on 07/12/2022**

Purewick OR "pure wick" (1 result)

"External catheter" (5 results)

"External catheterization" (0 results)

"External collection" (1 result)

Primafit (0 results)

**2023\_03\_24 search update (total): 78 new citations from search, 32 duplicates removed, 46 new citations reviewed**

* Ovid Medline: 643 total (630 previous) - 13 new, 13 reviewed (0 duplicates)
* Embase: 706 total (682 previous) - 24 new, 18 reviewed (6 duplicates)
* Scopus: 726 total  (708 previous) - 18 new, 6 reviewed (12 duplicates)
* Web of Science Core Collection: 321 total (306 previous) - 15 new, 4 reviewed (11 duplicates)
* CINAHL: 145 (138) - 7 new, 4 reviewed (3 duplicates)
* Clinical Trials: 1 new, 1 reviewed (0 duplicates)

**2023\_07\_10 search update (total after deduplication; please note several citations are older articles, likely backfilled in journals added to Scopus):**

* Ovid Medline: 6 new
* Embase: 10 new
* Scopus: 12 new
* Web of Science Core Collection: 3 new
* CINAHL: 0 new
* Clinical Trials: 0 new

**Supplement Methods 3. Potential CAUTI Definitions Outlined in Protocol *A Priori***

1. Catheter-Associated Urinary Tract Infection (CAUTI)

We anticipate that the most common CAUTI definition reported will be as defined by the National Healthcare Safety Network (NHSN) for public reporting of CAUTI events for comparing hospital performance. The details of the NHSN CAUTI definition have varied over the years, but we anticipate studies regarding this recently developed device will likely use definitions very similar to the current NHSN CAUTI definition (<https://www.cdc.gov/hai/ca_uti/uti.html>), which applies only to symptomatic urinary tract infections that occur after the placement of indwelling urinary catheters (i.e., internal catheters). Indwelling urinary catheters are the most commonly used urinary catheters for which the newer external urinary wicking devices are an option to be used as an alternative when clinically appropriate. In our review of studies of the external urinary wicking devices, we anticipate that many studies will report NHSN CAUTIs in an overall patient population, comparing rates when the external device is available as an alternative as it is impossible, by definition, for an NHSN CAUTI to develop in a patient from the use of an external urinary wicking device as the current NHSN definition only applies to the standard indwelling (internal, inserted into the bladder trans-urethrally) urinary catheter. It is also feasible that some studies will use or apply a different CAUTI definition, such as CAUTI diagnosed clinically and treated with antibiotics (which is distinct from the NHSN CAUTI definition, which is defined only by timing of hospital admission, indwelling catheter placement and removal, symptoms, and specific urine culture results without respect to antibiotic use.

1. Urinary tract infection that is not associated with an indwelling urinary catheter

We anticipate some studies may provide specific definitions such as external catheter-associated UTI, or simply a UTI not associated with an indwelling urinary catheter. As a new device, the infection-related outcomes are still evolving in the literature.

1. Bacteriuria – defined as a positive culture of bacteria in urine (with or without symptoms of UTI)
2. Asymptomatic bacteriuria – positive culture or bacteria in urine without symptoms
3. Bacteriuria treated with antibiotics

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| **Supplement Table 1: Detailed summary of outcomes reported in peer-reviewed published manuscripts included in meta-analyses** | | | | | | | |
|  | **UTI-Related Outcomes** | | | | | | **IUC Utilization Outcomes** |
| **1st Author, Year** | **UTI per 1,000 pd** | **CAUTI per 1,000 dd** | **CAUTI per 1,000 pd** | **FEUWD-UTI per 1,000 dd** | **Urine Culture Orders** | **Bacteriuria (positive cultures)** |  |
| Beeson, 2023 | NR | 1.34→\* 1.55 (Y1)→1.08 (Y2) | NR | NR | NR | NR | % pd with IUC in use: 43.9%→40.6% (Y1)†→38.7% (Y2)† |
| Eckert, 2020 | NR | 1.11→0.00 (Y1)†→0.90 (Y2) | NR | NR | NR | NR | % pd with IUC in use: 31.7%→29.7% (Y1)†→26.0% (Y2)† |
| Jasperse, 2022 | 21.4→15.5 | 2.3→9.3† | 1.54→7.07† | 0→9.8 | 112→  338† | NR | Median number of IUC-days (IQR): 2 (1, 4)→3 (1, 7)† |
| Lem, 2022 | 4.8→5.4† | 4.6→11.2† | NR | 0→4.6 | 77→  152† | NR | Median number of IUC-days (IQR): 2 (1, 3.5)→2 (1, 5) |
| Noval, 2022 | NR | 4.8→2.2 | 0.85→0.33† | NR | NR | 38→28† | 1.6% decrease in utilization per month† |
| Rearigh, 2021 | NR | 1.5→1.6 (overall)  2.12→1.65 (females only) | 0.24→0.20 (overall)  0.15→0.09 (females only) | NR | NR | NR | Catheter utilization in dd per 1,000 dd: 158.56→128.3 (overall)†,  71.49→56.15 (females only)† |
| Zavodnick, 2020 | NR | 3.14→1.42 (females only) † | NR | NR | NR | NR | Average monthly female IUC-days: 610→499 |

\* The change in the outcome measure from the pre-implementation period to post-implementation period is denoted as →.

†Denotes a significant difference (p < 0.05) between the pre- and post-implementation cohorts.

pd, patient-days; dd, device-days (i.e., IUC-days); IUC, indwelling urinary catheter; IQR, interquartile range; Y1/Y2, post-implementation year 1 or 2; NR, not reported

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| **Supplement Table 2. Characteristics of included records not used in meta-analysis** | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | **Study Population** | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Auten (2021) | Pre-post | Neuro-oncology and surgery units | N/A | N/A | NS‡ | SUR decreased 22% in neuro-oncology unit, 12% in Surgery unit; no additional CAUTIs were reported. |
| Beeson (2018) | Pre-post | Adult surgical ICU | Adult female patients requiring UIM | N/A | PrimaFit | CAUTI rate: 2.55→0.70\*, SIR: 1.395→0.381, IUC-days decreased by 9%. |
| Behrend (2018) | Pre-post | 5 ICUs, 2 medical floors, and 2 surgical floors | Incontinent, bedbound female inpatients | Conducted 100 wick surveys in ICUs and 90 wick surveys on floors | PureWick | High nurse and patient satisfaction; no UTIs associated with the device; reduced CAUTIs in females in ICUs and floors; potential net savings of $1 million per year. |
| Cassone (2022) | Validation study | Michigan Medicine Biochemical Laboratory | Refrigerated excess urine specimens | 50 samples | PureWick | Analytes from control and PureWick samples are strongly correlated (between r = 0.9546-0.9974). |
| Chirca (2018) | Pre-post | Large community hospital | N/A | N/A | PureWick‡ | IUC utilization rate: 16.6%→14.5%, CAUTI rate: 1.37→0.8 events per 1,000 dd. |
| Cilluffo (2022) | Scoping Review | Included studies in hospital and home settings | Female patients with UI | N/A (21 included studies) | PureWick and PrimaFit | Recommends FEUWDs for reducing IUC utilization and CAUTIs. |
| Dublynn (2019) | Pre-post | Community hospital | N/A | N/A | NS | 51.7% reduction in CAUTIs, Foley utilization rate: 15.7→10.7, SIR: 1.319→0.965. |
| Ecklund (2020) | Pre-post | A 6-hospital system | N/A | N/A | PrimaFit‡ | 38% decrease in CAUTI counts, 8% decrease in IUC use, SIR: 2.13→1.14. |

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| **Supplement Table 2 (continued). Characteristics of included records not used in meta-analysis** | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | **Study Population** | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Fields (2019) | Pre-post | Neurosciences ICU | N/A | Subarachnoid hemorrhage patients | ISC; female/male external catheter use encouraged (NS‡) | CAUTI rate: 4.5 (± 3.4)→0.42 (± 1.45), IUC DUR: 0.8 (± 0.08)→0.53 (± 0.09). |
| Figueredo (2020) | Pre-post | Montefiore Medical Center | N/A | N/A | PureWick‡ | CAUTI count: 96→36, IUC catheter-days: 35,694→19,936. |
| Fristch (2019) | Pre-post | N/A | N/A | N/A | PureWick‡ | Total reduction in CAUTIs = 59.3%, in catheter-days = 26.5%. |
| Gentile (2020) | Pre-post | ICUs and non-ICU wards | Female patients with UI | N/A | PureWick | Overall IUC DUR: 0.12→0.10†, IUC DUR in ICUs: 0.29→0.27†; female CAUTI rate per 1,000 catheter-days: 0.78→0.31†, female CAUTI rate per 1,000 catheter-days in ICUs: 1.14→0.31†. Significant decreases not observed in wards. |
| Goris (2020) | Pre-post | 2 hospitals (A: 450, B: 472 licensed beds) | N/A | N/A | PureWick | IUC DUR (hospitals combined): 0.15→0.13†; IUC DUR in non-ICUs decreased 18% in A and B†; IUC DUR in ICUs decreased in A but not B; A had a 34% decrease in CAUTI and B had an increase in CAUTI (neither was significant). |
| Gutzmirtl (2019) | Pre-post | Medical ICU | N/A | N/A | NS | Percentage of patients with IUC that were female: 50%→40.3%, CAUTI count: 4→0. |
| Henry (2019) | Pre-post | University of Texas Southwestern Medical Center | N/A | N/A | NS‡ | CAUTI count: 38→25; prevention of 13 CAUTIs saved ~$180,000. |
| Hughes (2020) | Pre-post | N/A | N/A | N/A | PureWick‡ | IUC utilization rate decreased 24%, CAUTI rate decreased by 42%. |

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| **Supplement Table 2 (continued). Characteristics of included records not used in meta-analysis** | | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | **Study Population** | | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Kelly (2018) | Budget Impact Analysis | N/A | N/A | | N/A | NS | Substituting an IUC with a female external catheter = $5.87 gained per day. Using FECs for incontinence management, avoiding toilet-related falls, reducing the nursing time for incontinence care = $36.95 gained per day. Assuming 573 avoidable IUC-days and 1,941 underpad-days in a 10,000 admissions-per-year hospital, $75,030 could be saved annually. |
| Kelly (2022) | Systematic Review | N/A | N/A | | N/A | NS | Average economic benefit per IUC-day avoided ranges from $5.71 to $30.21 (avg. = $23.38). |
| McRae & Kennelly (2023) | Prospective | Carolinas Medical Center | Healthy female patient volunteers | | 71 | PureWick | Regardless of patient BMI, median capture rate was over 95% for provider-placed and self-placed devices. 84.5% of patients found the devices (very) comfortable. Both providers and patients reported ease of use. |
| Khosla (2022) | Cross-sectional survey | Home care | Users (with UI) and caregivers with no professional training | | 119 patients, 205 caregivers | PureWick | Patients: 36% reported improved sleep, 27% improved dryness, 76% concurrent diaper use with PureWick. Caregivers: ratings slightly lower (likely because patients with caregivers tended to be 80+/limited mobility), 17% found fewer UTIs, skin complications. Considered easier to use, but more expensive. Would still recommend to others. |
| Kuzow (2019) | Pre-post | Medical ICU | Patients with IUCs | | N/A | PureWick‡ | IUC utilization rate: 70.5%→64.1%, CAUTI rate: 2.3%→0.9%. |
| Maydick-Youngberg (2020) | Quality Improvement | N/A | N/A | | N/A | NS | Skin complications associated with initial implementation. Provider education, need for protocol emphasized. |
| Mayes (2020) | Pre-post | ICU | ICU patients requiring UIM | | N/A | PureWick‡ | IUC utilization rate: 56%→49%, CAUTI rate per 1,000 device-days: 1.29→0, HAPI events: 4→0. |
| **Supplement Table 2 (continued). Characteristics of included records not used in meta-analysis** | | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | | **Study Population** | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Mena Lora (2020) | Pre-post | ICUs and non-ICUs | | N/A | N/A | PureWick‡ | IUC DUR in ICUs: 0.56→0.35, IUC DUR in non-ICUs: 0.27→0.12, CAUTI rate per 1,000 IUC-days: 1.27→0.16. |
| Minor (2022) | Pre-post | Critical Care Unit | | Patients requiring urine collection | N/A | PureWick and PrimaFit‡ | SIR: 3.22→1.63. |
| Mueller (2019) | Pre-post | Adult inpatient units excluding Maternal and Child Health | | Immobile female patients | N/A | PureWick | IUC SUR: 1.06→0.93†, CAUTI SIR: 0.53→0.62. |
| Nalbandian et al (2022) | Pre-post | ICU at mid-size medical center | | Inappropriately catheterized patients | N/A | NS‡ | SIR: 0.79→0.40†  SUR: 1.18→1.02†  CAUTIs: 9→4 |
| Ohanian (2022) | Pre-post | N/A | | N/A | N/A | PureWick‡ | SIR: 1.86→0.58†, SUR: 0.89→0.71. |
| Pavlovsky (2020) | Pre-post | Orthopedic medical-surgical unit | | Orthopedic surgery patients | N/A | PureWick‡ | Pre-implementation, 117 procedures were performed, 67% of which used a Foley catheter. Post-implementation, 90 procedures, 30% of which used a Foley. |
| Peters (2021) | Pre-post | Burn ICU | | All female patients admitted to the Burn ICU | 46 patients total (31 used a Foley, 11 used an external female catheter) | PureWick | 1 required removal due to skin breakdown. 1 had a Foley reinserted due to oliguria and fluid management. 5 successful users were clinically obese. 3 UTIs developed in Foley patients, 0 in female external catheter patients. |

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| **Supplement Table 2 (continued). Characteristics of included records not used in meta-analysis** | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | **Study Population** | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Reeths (2020) | Pre-post | ICU | All patients requiring UIM | N/A | NS‡ | SUR: 1.067→0.736. |
| Riemenschneider (2020) | Pre-post | Tertiary care facility | All female patients requiring UIM | N/A | PureWick‡ | 20% reduction in IAD, 19% reduction in IUC use in HAPI patients with incontinence. |
| Root (2021) | Pre-post | Emergency Department | Non-critical female patients, ≥18 | N/A | PureWick | IUC count: 738→429 (187 FEUWDs placed post-implementation in addition to a 122 decrease in IUC placement that could not be explained by FEUWDs). |
| Rose (2021) | Validation Study | Nationwide Children’s Hospital | N/A | 20 residual urine samples | PureWick | Urine test strip analysis: nearly identical results between control and PureWick samples. Microscopy: WBC and crystal counts decreased†. Automated analysis: very good agreement between control and PureWick samples. |
| Srisatidnarakul (2021) | Pre-post | A National Cancer Institute-Designated Comprehensive Cancer Center (11 inpatient units) | N/A | N/A | PrimaFit‡ | CAUTI rate: 0.80→0.37, IUC utilization rate: 1.02→0.91. Improvements persisted despite COVID-19 pandemic. |
| Sundhu (2022) | Pre-post | Electro-physiology Lab | Atrial fibrillation ablation patients admitted overnight | 41 | PureWick | Percentage of patients admitted overnight in IUC-only group: 19%, in external catheter-only cohort: 8% |

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| **Supplement Table 2 (continued). Characteristics of included records not used in meta-analysis** | | | | | | |
| **1st Author (Year)** | **Design** | **Setting** | **Study Population** | **No. of Patients** | **Intervention** | **Outcome(s) Reported** |
| Taneja et al (2023) | Systematic Review | N/A | End-of-life patients | N/A | NS | Utilization of FEUWDs among female hospice patients with incontinence has the potential to reduce weekly caregiver hours by 21-61%. |
| Tran et al (2023) | Pre-post | Inpatient units at large academic medical center | Female inpatients | N/A | PrimaFit | Piloted both PrimaFit and Purewick, found comparable results. FEUWD utilization: 36%→46%. IUC utilization: 49%→39-41%. CAUTIs decreased. No skin injury/breakdown; high nurse and patient satisfaction; device stayed in place; estimated per-patient cost savings of $13,786. Staff initially struggled to position device correctly but became proficient with education. Experienced an uptick in IUC use due to COVID-19. |
| Van Decker (2021) | Pre-post | Inner city, safety net medical center | Female ICU patients, ≥18 | N/A | PureWick | CAUTI per 1,000 pd: 2.24→1.62 |
| Warren (2021) | Pre-post | Large academic medical center | Female inpatients | N/A | PureWick | CAUTI per 1,000 dd: 1.950→1.091 (overall), 4.062→1.957 (ICU), 1.342→0.810 (non-ICU). IUC utilization ratio: 0.169→0.156 (overall), 0.464→0.401 (ICU)†, 0.083→0.077 (non-ICU) |
| Whitaker (2023) | Pre-post | Hospital-wide | Female patients | N/A | PureWick‡ | CAUTI SIR: 0.37→0.23→0. IUC SUR significantly decreased and remained steady as external catheter use increased (note: this included both male and female external catheters). |
| Wilkerson (2020) | Pre-post | Large regional medical center | Inpatient units | N/A | NS‡ | CAUTI SIR: 0.85→0.662, SUR: 0.931→0.856. |
| Won (2023) | Pre-post | N/A | Female patients in burn ICU | 77 | PureWick | Foley catheter use: 94%→73%†, FEUWD use: 6%→27%†, CAUTIs: 5→3 |

\* The change in the effect estimate from the pre-implementation period to post-implementation period is denoted as →.

†Denotes a significant difference (p < 0.05) between the pre- and post-implementation cohorts.

‡FEUWD and other interventions implemented together

NS, not specified; UI, urinary incontinence, UIM, urinary incontinence management; ISC, intermittent straight catheterization; DUR, device utilization ratio; HAPI, hospital-acquired pressure injury; SIR, standardized infection ratio; SUR, standardized utilization ratio; IAD, incontinence-associated dermatitis

**Supplement Figure 1. Record Selection Flowchart**

A flowchart of records

Description automatically generated

Adapted from the PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only.

**Supplement Figure 2. Risk of Bias Assessment (ROBINS-I)**

**A table with text and numbers

Description automatically generated with medium confidence**

Risk of bias assessment was only performed on interventional studies that provided adequate methodological information.

A certain amount of confounding is expected to be an inherent feature of studies conducted retrospectively and in clinical settings as part of quality improvement projects. Accordingly, we also used our discretion to gauge the full extent of bias due to confounding.

Studies that reported conflicts of interest related to funding or financial relationships: Beeson et al., 2023; Eckert et al., 2020; Kelly et al., 2018; Kelly & Krome, 2022; Kennelly & McRae, 2023; Khosla et al., 2022. Taneja et al., 2023.

**Supplement Figure 3. Funnel Plots**

A graph of a patient's rate

Description automatically generated

IUC Utilization Rate: Egger’s test p-value = 0.63

Note: 6 studies measured UIC Utilization Rate

CAUTI Rate per 1,000 pd: Egger’s test p-value = 0.07

Note: 7 studies measured CAUTI Rate per 1,000 pd

CAUTI Rate per 1,000 dd: Egger’s test p-value = 0.13

Note: 7 studies measured CAUTI Rate per 1,000 dd

A graph of a patient's rate

Description automatically generated

IUC Utilization Rate – Moderate ROB: Egger’s test p-value = 0.82

Note: Of studies measuring IUC Utilization Rate, 4 had a moderate ROB

CAUTI Rate per 1,000 pd – Moderate ROB: Egger’s test p-value = 0.94

Note: Of studies measuring CAUTI Rate per 1,000 pd, 5 had a moderate ROB

CAUTI Rate per 1,000 dd – Moderate ROB: Egger’s test p-value = 0.85

Note: Of studies measuring CAUTI Rate per 1,000 dd, 5 had a moderate ROB



Note: For all outcomes, there were only 2 studies with serious ROB (Lem and Jasperse). There are too few studies to conduct Egger’s regression test.

In general, tests for funnel plot asymmetry, such as Egger’s test, are likely underpowered to discern chance from real asymmetry when fewer than 10 studies are included in meta-analysis (Sterne et al., 2011). When there is considerable inter-study heterogeneity, as is the case here, a much higher number of studies may be required to achieve adequate test power. Heterogeneity may arise from subgroups of studies each with their own intervention effect. When funnel plots are separated according to risk of bias (ROB) subgroups, there are even fewer studies available to adequately power Egger’s regression tests. The above funnel plots and tests for asymmetry may not reflect the true nature of publication bias because of considerable heterogeneity and the small number of studies that were available for inclusion in meta-analysis.