Economic Impact of Utilizing a Female External Catheter (FEC) to Reduce the Incidence of Catheter-Associated Urinary Tract Infection (CAUTI): Systematic Review, Analysis, and Model

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Background

Urinary tract infections (UTIs) are the most common healthcare-associated infection. Approximately 75% of hospital-acquired UTIs are associated with an indwelling urinary catheter (IUC) and the most important risk factor for developing a CAUTI is prolonged use of the IUC.[1]

Strategies to avoid the use of IUCs include the use of external urinary catheters.[19] Further, specific guidance on when to use external catheters as an alternative to IUCs has been well documented.[2] With several types of FECs being commercially available,[22] institutions may wish to estimate the economic benefit on a per-day basis of proactive efforts to discontinue IUCs and employ FECs as urine management alternatives in appropriate female patients.

Objective

The objective of this systematic literature review (SLR), analysis, and model is to assist organizations in estimating whether FECs offer either/both clinical and economic benefits when they are substituted for IUCs.

Methods

A SLR was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist.[3] Searches were conducted across PubMed (via PubMed.com) and Embase (via embase.com) to identify records published between 2016 and 2021, inclusive. The appropriate records were analyzed to determine the impact of FEC utilization upon CAUTI rates.

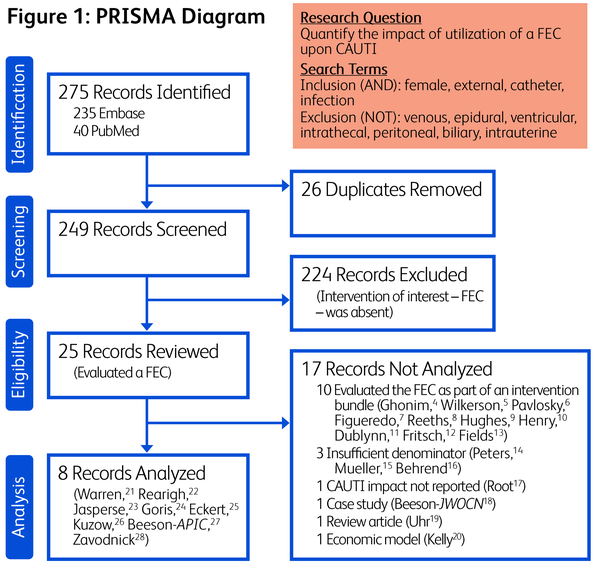
The average CAUTI rate increase or reduction value was then applied to a model that considered the incidence of CAUTI, and the cost of CAUTI, to estimate the per-day economic impact of substituting a FEC in place of an IUC.

Results

The database searches identified 275 records. Upon removal of 26 duplicates, 249 records were available for screening by two reviewers working independently. Following review of titles and abstracts, 25 records were found to cite FECs. 17 records were ineligible for analysis (see criteria cited in **Figure 1**), leaving 8 records that were analyzed.

The average reduction in CAUTI rates observed with implementation of a FEC was 48.1% across all studies, while the average reduction of CAUTI rates of the two studies reporting statistically significant results was 77.4% (see **Table 1**). Those values were analyzed in two scenarios each employing the incidence of CAUTI taken from a 603-hospital analysis,[29] and the cost of CAUTI taken from a six-study analysis prepared for the Agency of Healthcare Research and Quality (AHRQ)[30] and adjusted to 2022 dollars.[31] The cost of CAUTI avoided per day was found to be either $17.27 or $27.79 depending on the value for projected CAUTI rate decrease that was used (see **Model**).

Figure 1: PRISMA Diagram



Research Question
Quantify the impact of utilization of a FEC upon CAUTI

Search Terms
Inclusion (AND): female, external, catheter, infection
Exclusion (NOT): venous, epidural, ventricular, intrathecal, peritoneal, biliary, intrauterine

Table 1: Analyzed Records

Record	Setting	Denominator	Pre	Post	*p* value	Reduction or Increase
Warren[21]	ICU	1,000 catheter-days	4.062	1.957	0.0594	-51.8%
Warren[21]	Non-ICU	1,000 catheter-days	1.342	0.81	0.2776	-39.6%
Rearigh[22]	Hospital-wide	1,000 catheter-days	2.12	1.65	0.38	-22.2%
Jasperse[23]	Hospital-wide	1,000 patient-days	19.1	14.12	0.410	-26.1%
Goris[24]	Hospital-wide, Hospital A	denominator as well as pre- and post-implementation values not reported			not significant	-34.0%
Goris[24]	Hospital-wide, Hospital B	denominator as well as pre- and post-implementation values not reported			not significant	Increase (value not provided)
Eckert[25]	Hospital-wide, Year 1 post	1,000 catheter-days	1.11	0.00	0.005	-100.0%
Eckert[25]	Hospital-wide, Year 2 post	1,000 catheter-days	1.11	0.9	0.726	-18.9%
Kuzow[26]	MICU	1,000 catheter-days	2.3	0.9	not reported	-60.9%
Beeson[27]	SICU	1,000 catheter-days	2.55	0.7	not reported	-72.5%
Zavodnick[28]	All ICUs	1,000 catheter-days	3.14	1.42	0.013	-54.8%
					Average of all records	**-48.1%**
					Average of statistically significant values	**-77.4%**

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Model

2.19	CAUTIs per 1,000 catheter-days[29]
x 48.1%	Reduction in CAUTI
1.05	CAUTIs avoided per 1,000 catheter-days
x $16,398	Cost of CAUTI (2022 dollars)[30,31]
$17,267	Cost avoided per 1,000 catheter-days
$17.27	**Cost avoided per day**

Scenario 1
Average increase/reduction from all analyzed records

2.19	CAUTIs per 1,000 catheter-days[29]
x 77.4%	Reduction in CAUTI
1.69	CAUTIs avoided per 1,000 catheter-days
x $16,398	Cost of CAUTI (2022 dollars)[30,31]
$27,791	Cost avoided per 1,000 catheter-days
$27.79	**Cost avoided per day**

Scenario 2
Average increase/reduction from the two statistically significant records

Limitations

Studies of FEC impact on CAUTI may have been missed due to the use of only two databases and due to the search criteria employed. Additional limitations specific to each study analyzed include, the quality of the analyzed studies, variations in the analyzed denominators, omissions in denominators, omissions in reported results, and failures of studies to calculate or disclose significance.

Limitations of the model include, the incidence value selected (although the model incidence of 2.19 was comparable to that of the studies analyzed: 2.22), the cost of CAUTI value selected, applicability of patients (the model considered only certain adult female patients due to the indications of FECs), and the heterogeneity of the care setting. In addition, the model predicts a linear, cost-avoided-per-day value. This may understate economic benefit because each extra day of catheterization incrementally increases the risk of CAUTI.[32] Lastly, the inflation adjustment employed the CPI/all urban consumer rate and not the medical services rate thus potentially understating the cost of CAUTI.

Conclusions

A SLR suggests that utilization of FECs as substitutes for IUCs, in appropriate patients, may reduce an organization's incidence of CAUTI. Further, modeling suggests that there may be a favorable economic benefit when FECs are substituted for IUCs depending on the organization's baseline incidence of CAUTI, the organization's cost of CAUTI, and the actual CAUTI reduction achieved.

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