

Effectiveness of Interventions for Reducing Catheter-Associated Urinary Tract Infections Among Residents in Long-Term Care Facilities: A Systematic Review

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Abstract : Catheter-associated urinary tract infection (CAUTI) is a preventable infection among older adults, particularly in long-term care facilities. Prolonged urinary catheterisation increases infection risk and contributes to antimicrobial use, hospitalisation and transmission of multidrug-resistant organisms. Prevention strategies include catheter-removal protocols, education, infection-prevention bundles, surveillance, audit and feedback, safety huddles and multidisciplinary quality-improvement programmes. **Aim:** This systematic review evaluated the effectiveness of interventions in reducing CAUTI and improving urinary-catheter-related outcomes among residents of long-term care facilities. **Methods:** The review question was structured using the PICO framework. The population comprised long-term care or nursing-home residents; interventions included CAUTI/UTI prevention and catheter-management strategies; comparators were usual care or pre-intervention practice; and outcomes included CAUTI/UTI incidence, catheter utilisation and catheter-related outcomes. Ten publications from 2015–2025 were examined. Five provided direct or partially direct evidence from long-term-care or long-stay geriatric settings, while five publications from acute-care or acute-geriatric settings provided supplementary contextual evidence concerning relevant catheter-management and CAUTI-prevention approaches. Methodological quality was assessed using design-appropriate CASP principles. **Results:** Multicomponent interventions produced the strongest evidence. Mody et al. (2015) reported significantly fewer CAUTIs following a targeted multimodal intervention. Mody et al. (2017) found adjusted CAUTI rates decreased from 6.42 to 3.33 infections per 1,000 catheter-days. Fiveash et al. (2021) reported a 73% reduction with structured safety huddles. Conversely, Krein et al. (2018) found no significant improvement, indicating that baseline performance and organisational context may influence effectiveness. **Conclusion:** Multicomponent interventions combining evidence-based catheter care, staff education, regular assessment of catheter necessity, surveillance, feedback and multidisciplinary engagement appear most promising. However, high-quality controlled research in long-term care is required.

IndexTerms - catheter-associated urinary tract infection; CAUTI; long-term care; nursing home; urinary catheter; infection prevention; catheter management; nurse-led intervention.

1. INTRODUCTION

Urinary tract infection is an important healthcare-associated infection among older adults, and indwelling urinary catheterisation represents a significant modifiable risk factor. Residents of long-term-care facilities may be particularly vulnerable because of advanced age, multimorbidity, functional dependence, prolonged exposure to urinary catheters and repeated antimicrobial treatment (Llor and Kjær, 2026). Evidence from nursing-home populations further indicates that prolonged catheter use increases the risk of infection, including infections involving antimicrobial-resistant organisms (Mody et al., 2017). These factors highlight the importance of effective catheter-management and infection-prevention strategies within long-term-care environments.

CAUTI is clinically important because it may result in discomfort, antimicrobial treatment, sepsis, hospital transfer and increased healthcare utilisation. Mody et al. (2017) emphasised that catheter-associated UTI in nursing-home residents contributes to sepsis, hospital admission and antimicrobial exposure. Prevention is therefore an important component of nursing practice, infection prevention and resident safety.

Many CAUTIs are potentially preventable through appropriate catheter insertion and maintenance, limitation of unnecessary catheterisation, timely catheter removal, hand hygiene, surveillance and staff education. Preventive programmes increasingly combine technical measures with organisational and behavioural strategies rather than relying on a single intervention. For example, the national programme evaluated by Mody et al. (2017) combined catheter removal, aseptic insertion, regular assessment, catheter-care training and incontinence planning with leadership, communication and resident/family engagement.

A related consideration is that reducing catheter use alone may not be sufficient. CAUTI prevention may also depend on correct maintenance, appropriate diagnostic testing, staff adherence, effective communication, timely review of indications and organisational support. In some settings, substantial infection reductions have occurred despite minimal change in catheter utilisation, suggesting that prevention involves more than simply removing devices (Mody et al., 2017).

The evidence base, however, is heterogeneous. Some interventions have been evaluated in nursing homes, whereas others have been studied in acute hospitals or geriatric wards. Designs range from randomised clinical trials to uncontrolled pre-post quality-improvement projects. This variation makes a structured synthesis necessary to determine which approaches appear most useful for long-term-care residents.

2. REVIEW AIM

The aim of this systematic review was:

To evaluate the effectiveness of interventions for reducing catheter-associated urinary tract infections and improving urinary-catheter-related outcomes among residents in long-term care facilities.

2.1 Review Question

How effective are UTI/CAUTI prevention and urinary-catheter management interventions in reducing CAUTI/UTI incidence, catheter utilisation and catheter-related outcomes among residents of long-term care facilities compared with usual care or pre-intervention practice?

PICO component	Description
Population (P)	Residents of long-term care facilities, nursing homes, residential aged-care facilities and comparable long-stay geriatric settings
Intervention (I)	CAUTI/UTI prevention, urinary-catheter management, educational programmes, catheter-removal protocols, bundles, safety huddles, surveillance, audit/feedback, staff training and multidisciplinary interventions
Comparison (C)	Usual care, standard care, control groups/facilities or pre-intervention/baseline practice
Outcome (O)	CAUTI/UTI incidence, catheter utilisation, catheter days/duration, catheter removal, urine-culture use and other catheter-related outcomes

2. PICO Framework

4. METHODOLOGY

4.1 Review Design

A systematic review approach was adopted to synthesise evidence concerning interventions designed to reduce CAUTI and improve urinary-catheter management. The review primarily focused on intervention studies involving residents of long-term-care facilities and nursing homes. Studies conducted in long-term-care and long-stay geriatric settings were considered directly or partially applicable to the review question. Evidence from closely related acute-geriatric and acute-care settings was examined separately as supplementary evidence where the interventions provided relevant insights into CAUTI prevention, catheter management and implementation strategies. This approach maintained a clear distinction between evidence directly applicable to long-term-care residents and evidence that could only provide contextual support.

4.2 Search Strategy

A structured search strategy was developed using the main concepts identified through the PICO framework, including long-term care, urinary catheterisation, catheter-associated urinary tract infection (CAUTI), urinary tract infection (UTI), and preventive interventions. Both controlled vocabulary and free-text terms were considered to maximise the sensitivity of the search. Medical Subject Headings (MeSH) and equivalent database-specific subject headings were used where available, together with relevant keywords, synonyms, spelling variations and abbreviations. Boolean operators were applied to combine the search concepts. The operator OR was used to combine similar terms within each concept, while AND was used to connect the major concepts.

The search strategy was: ("long-term care" OR "long term care" OR "nursing home" OR "residential aged care" OR "residential care" OR "geriatric long-stay") AND ("catheter-associated urinary tract infection" OR CAUTI OR "urinary tract infection*" OR UTI) AND ("urinary catheter*" OR "indwelling urinary catheter*" OR "bladder catheter*" OR catheterisation OR catheterization) AND (intervention* OR education OR protocol* OR bundle* OR "catheter removal" OR "nurse-driven" OR surveillance OR audit OR "safety huddle*").* Search terminology would be modified according to the indexing requirements of individual databases.

4.3 Databases and Sources

The literature-search framework identified PubMed/MEDLINE, CINAHL, Embase, Scopus, Web of Science and Cochrane CENTRAL as relevant electronic databases for identifying studies addressing CAUTI prevention and urinary-catheter management. Google Scholar was considered an additional source for supplementary searching and citation tracking. Reference lists of relevant publications were also considered for identifying potentially eligible primary studies. For the present review, ten publications were assessed in detail and classified according to their relevance to the review question, study design, healthcare setting, intervention and reported outcomes. Studies conducted directly within long-term-care settings were prioritised in the main effectiveness synthesis, while evidence from other healthcare settings was treated as supplementary.

4.4 Keywords and Search Terms

Table 1. Keywords and Search Terms

Concept	Keywords/Search terms
Long-term care	long-term care; nursing home; nursing homes; residential aged care; residential care; aged-care facility; long-stay geriatric; geriatric facility
Infection	catheter-associated urinary tract infection; CAUTI; urinary tract infection; UTI; healthcare-associated infection
Catheter	urinary catheter; indwelling urinary catheter; Foley catheter; urinary bladder catheter; IDC; IUC; UTC; intermittent catheterisation
Intervention	prevention; intervention; bundle; protocol; catheter removal; nurse-driven; nurse-led; education; training; surveillance; safety huddle; checklist; audit; feedback; quality improvement
Comparison	usual care; standard practice; control; baseline; pre-intervention
Outcome	CAUTI incidence; UTI incidence; infection rate; catheter utilisation; catheter days; catheter duration; urine culture; catheter removal

4.5 Inclusion and Exclusion Criteria

Table 2. Inclusion and Exclusion Criteria for Study Selection

Criterion	Inclusion	Exclusion
Population	Older people/residents in nursing homes, long-term-care or comparable long-stay geriatric settings	Paediatric or unrelated populations
Setting	Nursing homes, long-term-care facilities, residential aged care and comparable long-stay geriatric settings for the primary synthesis	Acute-care-only settings excluded from the primary effectiveness synthesis; closely related studies considered separately as supplementary contextual evidence
Intervention	CAUTI/UTI prevention or catheter-management intervention	No relevant intervention
Comparator	Usual care, control group/facility or pre-intervention baseline	No interpretable comparator where effectiveness was being assessed
Outcomes	CAUTI/UTI, catheter use, catheter days, device utilisation or related outcomes	No relevant outcomes
Design	RCTs, controlled studies, quasi-experimental studies, prospective intervention studies, pre-post studies and quality-improvement studies reporting relevant outcomes	Reviews, editorials, opinion papers and protocols without completed outcome data excluded from the primary effectiveness synthesis
Publication	Primary research	Secondary research
Language	English	Insufficient accessible information
Relevance	Direct LTC studies prioritised; closely related studies used contextually	Completely unrelated settings/interventions

4.6 Screening and Selection Process

The screening and selection process was guided by the predefined PICO framework and eligibility criteria. Studies were assessed for their relevance to urinary-catheter management, CAUTI/UTI prevention, intervention effectiveness and long-term-care populations. Particular attention was given to study setting, population, intervention, comparator, outcomes and methodological design.

Five studies provided direct or partially direct evidence relating to long-term-care or long-stay geriatric populations: Mody et al. (2015), Girard et al. (2015), Mody et al. (2017), Krein et al. (2018) and Fiveash et al. (2021). Girard et al. (2015) was classified as partially direct because its population included acute, rehabilitation/subacute and long-stay geriatric settings rather than exclusively long-term-care residents.

Five additional publications—Theobald et al. (2017), Parker et al. (2017), Krocová and Prokešová (2022), Mrziglod et al. (2023) and Kamel et al. (2025)—were not considered direct long-term-care effectiveness evidence because they involved acute-care or acute-geriatric settings or did not directly evaluate intervention effectiveness. These publications were therefore used as supplementary contextual evidence to support interpretation of relevant CAUTI-prevention approaches and implementation strategies.

4.7 Search Outcome and PRISMA Flow

The PRISMA flow diagram summarises the study identification and selection process. A total of 463 records were identified from databases. Before screening, 78 duplicates, 121 records marked ineligible by automation tools, and 39 records for other reasons were removed, leaving 225 records for screening. Of these, 112 were excluded, and 113 reports were sought for retrieval. Seventy-seven reports could not be retrieved, leaving 36 full-text reports assessed for eligibility. Twenty-six reports were excluded: 18 were outside the year range, six had insufficient outcomes, and two had duplicate evidence focus. Finally, 10 studies were included in the systematic review process.

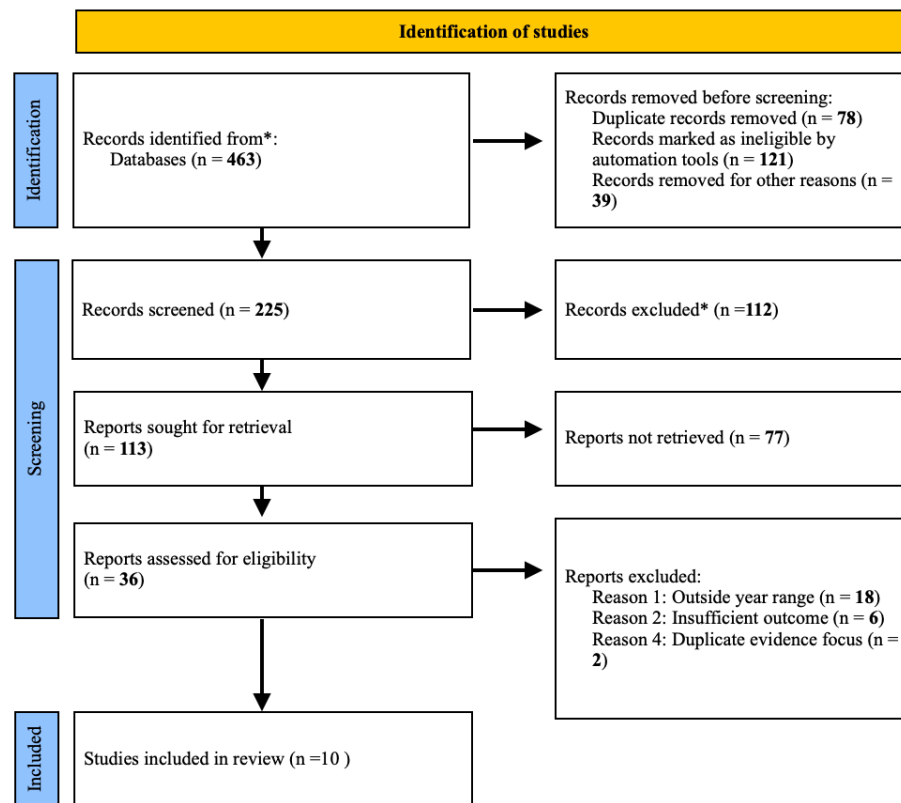


Fig 1. Prisma flow chart of the study selection and inclusion.

4.8 Risk of Bias Assessment and Quality of Evidence

The methodological quality of the evidence was critically appraised using design-appropriate CASP principles where applicable. Assessment considered clarity of the research question, appropriateness of study design, participant or facility selection, measurement of interventions and outcomes, consideration of potential confounding, completeness of follow-up, precision of findings and relevance to the review question. Because the included publications represented heterogeneous methodological designs, quality assessment was interpreted according to the characteristics of each design rather than applying a single numerical score across all studies. Protocol and descriptive evidence were not considered equivalent to completed intervention-effectiveness studies.

Table 3. Risk of Bias and Quality of Evidence Assessment Using CASP Principles

Study	Design	Risk of bias	Overall applicability
Mody et al. (2015)	Randomised clinical trial	Low-moderate	High
Mody et al. (2017)	Prospective national implementation study	Moderate	High
Krein et al. (2018)	Longitudinal implementation cohort	Moderate	High
Fiveash et al. (2021)	Pre-post quality-improvement study	Moderate-high	High/moderate
Girard et al. (2015)	Prospective before-after programme	Moderate-high	Moderate
Theobald et al. (2017)	Pre-post quality-improvement study	Moderate-high	Indirect
Parker et al. (2017)	Study protocol	Effectiveness risk of bias not assessable because outcome results were not reported	Supplementary implementation evidence only
Krocová and Prokešová (2022)	Cross-sectional survey	High risk for drawing causal conclusions regarding intervention effectiveness	Supplementary contextual evidence only
Mrziglod et al. (2023)	Pre-post geriatric intervention	Moderate-high	Indirect/moderate
Kamel et al. (2025)	Pre/post observational intervention	Moderate-high	Indirect

The strongest methodological evidence was provided by Mody et al. (2015), a randomised clinical trial involving nursing-home residents with indwelling devices. The intervention and control groups included 203 and 215 residents respectively before follow-up exclusions.

Mody et al. (2017) provided large-scale real-world evidence, but the authors acknowledged limitations including voluntary participation, inability to isolate individual components of the intervention, potential unmeasured confounding and lack of independent validation of reported CAUTI events.

4.9 Data Extraction

Data were systematically extracted from each publication using a structured approach to facilitate consistent comparison. Extracted information included author and year, country and healthcare setting, study design, population or facility characteristics, intervention components, comparator, follow-up period and reported outcomes. Relevant outcomes included CAUTI or UTI incidence, catheter utilisation, catheter days, catheter removal and other catheter-related measures. Statistical findings and major methodological limitations were also recorded. Each publication was additionally classified according to its applicability to the review question as direct, partially direct or supplementary contextual evidence. This classification was considered when interpreting the overall findings.

4.10 Data Synthesis

Meta-analysis was not undertaken because substantial clinical and methodological heterogeneity existed across the studies in relation to populations, healthcare settings, intervention components, study designs, CAUTI definitions and outcome measures. Therefore, findings were synthesised narratively to identify patterns in intervention effectiveness and implementation. The synthesis considered multimodal infection-prevention programmes, technical and socioadaptive strategies, safety huddles, staff education, catheter-necessity assessment, catheter-removal protocols, surveillance, audit and feedback, and organisational support. Greater interpretive weight was assigned to controlled studies conducted directly in nursing homes or long-term-care facilities. Findings from acute-care and acute-geriatric studies were interpreted separately as supplementary evidence and were not assumed to demonstrate effectiveness among long-term-care residents.

5. Results

Ten publications were examined in the evidence synthesis. Five provided direct or partially direct evidence relevant to long-term-care or long-stay geriatric populations, while five provided supplementary contextual evidence concerning CAUTI-prevention and urinary-catheter-management strategies. Consequently, conclusions regarding effectiveness in long-term-care residents were based primarily on the directly applicable studies, with contextual publications used to support interpretation of intervention mechanisms and implementation considerations.

5.1 Characteristics of the Studies

Table 4. Characteristics and Main Findings of Studies Included in the Evidence Synthesis

Study	Setting/design	Intervention	Main findings
Mody et al. (2015)	Nursing homes; randomised clinical trial	Targeted multimodal infection-prevention programme	CAUTI 5.9 vs 9.2/1,000 catheter-days; adjusted HR 0.69
Girard et al. (2015)	Six geriatric hospitals including long-stay units; before-after	Multimodal education, standardisation and catheter practice improvement	UTI associated with intermittent catheterisation decreased after intervention
Mody et al. (2017)	404 community nursing homes; national implementation	Technical + socioadaptive CAUTI bundle	Adjusted CAUTI 6.42→3.33/1,000 catheter-days; IRR 0.46
Theobald et al. (2017)	Medical inpatient VA ward; pre-post	Reminder, education, structured orders, automatic discontinuation and post-removal protocol	Catheter use ↓35%; interval between CAUTIs 101→>400 days
Parker et al. (2017)	Four acute Australian hospitals; study protocol	“No CAUTI” bundle, nurse-led removal, education, audits	Protocol only; no completed effectiveness outcomes were reported.
Krein et al. (2018)	63 VHA nursing homes	AHRQ collaborative programme	No significant CAUTI or catheter-utilisation reduction
Fiveash et al. (2021)	VA long-term-care facility; QI pre-post	Structured safety huddles and root-cause learning	CAUTI ↓73%; IRR 0.27
Krocová & Prokešová (2022)	Czech acute hospitals; survey	Assessment of preventive-practice implementation	Deficiencies identified in monitoring, documentation and training
Mrziglod et al. (2023)	Acute geriatric wards; pre-post	Champion-led surveillance, education, checklist and catheter review	Utilisation significantly ↓; CAUTI ↓ non-significantly
Kamel et al. (2025)	Acute VA hospital; pre/post observational	HOUDINI nurse-driven catheter-removal protocol + dashboard	CAUTI 0.99→0.27/1,000 catheter-days; DUR 14%→12%

Note: Mody et al. (2015), Girard et al. (2015), Mody et al. (2017), Krein et al. (2018) and Fiveash et al. (2021) provided direct or partially direct long-term-care evidence. Theobald et al. (2017), Parker et al. (2017), Krocová and Prokešová (2022), Mrziglod et al. (2023) and Kamel et al. (2025) were considered supplementary contextual evidence and were not interpreted as direct evidence of effectiveness in long-term-care residents.

5.2 Targeted Infection Prevention in Nursing Homes

Mody et al. (2015) provided strong direct evidence regarding targeted infection prevention among nursing-home residents with indwelling devices. The intervention combined pre-emptive barrier precautions, enhanced infection surveillance, hand-hygiene promotion, interactive staff education and regular feedback. During follow-up, the intervention group experienced 56 clinically defined CAUTI episodes over 9,413

catheter-days, compared with 75 episodes over 8,118 catheter-days in the control group. These represented rates of 5.9 and 9.2 per 1,000 catheter-days, respectively. The adjusted hazard ratio was 0.69 (95% CI 0.49–0.99; $p=0.045$), demonstrating a significant reduction (Mody et al., 2015). When first new CAUTI events were considered, the hazard ratio was 0.54, further supporting the effectiveness of this multimodal approach.

5.3 National Multicomponent CAUTI Prevention

Mody et al. (2017) evaluated a large national CAUTI-prevention programme involving 568 community nursing homes, of which 404 met the analytical criteria. The intervention integrated a technical bundle, including catheter removal, aseptic insertion, regular assessment, catheter-care training and incontinence planning, with a socioadaptive bundle focusing on leadership, communication, and resident and family engagement. Adjusted CAUTI rates decreased from 6.42 to 3.33 per 1,000 catheter-days, producing an IRR of 0.46 (95% CI 0.36–0.58; $p<0.001$) (Mody et al., 2017). Catheter utilisation remained essentially unchanged, suggesting that improved catheter care, surveillance and staff practices contributed importantly to infection reduction. Urine-culture use also decreased, indicating potential improvement in diagnostic stewardship.

5.4 Collaborative Programme in Veterans Health Administration Nursing Homes

Krein et al. (2018) examined 63 Veterans Health Administration nursing homes participating in the AHRQ Safety Program for Long-Term Care. Unlike Mody et al. (2017), no significant improvement was demonstrated. CAUTI rates changed from 2.26 per 1,000 catheter-days at month one to 3.19 at month twelve, with an IRR of 0.99 (95% CI 0.67–1.44). Catheter utilisation remained similar at 11.02% and 11.30%, while urine-culture ordering changed little (Krein et al., 2018). The authors suggested that low baseline CAUTI rates and existing VHA prevention activities may have limited opportunities for further improvement, highlighting the importance of organisational context when implementing prevention programmes.

5.5 Safety Huddles in Long-Term Care

Fiveash et al. (2021) evaluated structured safety huddles in a Veterans Affairs long-term-care facility. Following each CAUTI, staff reviewed the event to identify root causes, behavioural factors and process weaknesses, with lessons shared throughout the facility. CAUTI incidence decreased by 73% compared with baseline, corresponding to an IRR of 0.27 (95% CI 0.11–0.66; $p=0.004$) (Fiveash et al., 2021). Importantly, catheter days increased slightly during the intervention period, indicating that infection reduction could not simply be attributed to decreased catheter exposure. These findings support systematic event review, organisational learning and targeted improvement as useful additions to conventional infection-prevention practices.

5.6 Multimodal Intervention in Geriatric Care

Girard et al. (2015) evaluated UTIs associated with intermittent bladder catheterisation across six geriatric hospitals covering acute, rehabilitation/subacute and long-stay care. Baseline assessment identified inadequate staff knowledge, inconsistent catheterisation indications and techniques, and variations in equipment. A multidisciplinary programme subsequently addressed bladder-volume assessment, catheter-drainage indications, device standardisation, prescribing, traceability and staff education. Following implementation, UTIs associated with intermittent catheterisation decreased to levels more consistent with published evidence (Girard et al., 2015). Although these findings support a coordinated multimodal approach, their direct applicability to long-term care remains limited because the study population included several geriatric care settings rather than exclusively long-term-care residents.

5.7 Supplementary Evidence from Acute-Care and Acute-Geriatric Settings

Theobald et al. (2017) evaluated a five-component quality-improvement intervention incorporating bedside catheter reminders, multidisciplinary education, structured catheter-order sets, automated catheter-discontinuation orders and protocolised post-removal care. Following implementation, urinary-catheter use decreased by 35%, while the average interval between CAUTI events increased from 101 days at baseline to more than 400 days. Although conducted in an acute inpatient setting, these findings demonstrate the potential value of systematic catheter assessment and timely discontinuation of unnecessary catheters.

Parker et al. (2017) described the “No CAUTI” multifaceted intervention across four Australian acute-care hospitals. The intervention included appropriate catheter-insertion criteria, specimen-collection guidance, nurse-led catheter removal, staff education, compliance auditing, standardised insertion packs, monitoring, feedback and ward-based clinical champions. However, the publication was a study protocol and therefore provided no completed effectiveness outcomes. Consequently, it contributes useful information regarding intervention design and implementation but cannot provide direct evidence regarding CAUTI reduction.

Kroková and Prokešová (2022) surveyed 186 nurse managers to examine the implementation of CAUTI-prevention practices within acute-care hospitals. Deficiencies were identified in process and outcome monitoring, documentation of catheterisation and provision of periodic CAUTI-prevention training. Although the study did not directly evaluate intervention effectiveness, its findings highlight organisational and practice-related barriers that could limit consistent implementation of evidence-based urinary-catheter care and infection-prevention measures.

Mrziglod et al. (2023) evaluated a champion-led intervention incorporating surveillance feedback, education, aseptic catheter care, daily catheter-necessity assessment and timely removal. Among 3,564 geriatric patients, catheter utilisation significantly decreased from 19.1 to 15.2 per 100 patient-days (RR 0.80, 95% CI 0.77–0.83; $p<0.001$). CAUTI incidence decreased from 2.07 to 1.40 per 100 patients, although this change was not statistically significant. Limitations included absence of patient-level analysis and sustainability assessment.

Kamel et al. (2025) evaluated the HOUDINI nurse-driven catheter-removal protocol, supported by multidisciplinary leadership, nursing education, electronic documentation and a utilisation dashboard. Nurses could remove catheters when evidence-based indications were absent. CAUTI rates decreased from 0.99 to 0.27 per 1,000 catheter-days, while device utilisation decreased from 14% to 12%. However, the single-centre design, small number of infections and concurrent CAUTI-prevention measures limited attribution of improvements solely to the HOUDINI protocol.

6. Narrative Synthesis of Intervention Effectiveness

Narrative synthesis of the direct long-term-care evidence, supported by relevant contextual findings from acute-care and acute-geriatric settings, identified five recurring themes concerning CAUTI prevention and urinary-catheter management. These themes related to the value of multifaceted interventions, regular assessment of catheter necessity, staff education, organisational context, and the contribution of surveillance, audit and feedback to sustained improvement.

6.1 Multifaceted Strategies Appear More Effective Than Isolated Actions

The strongest pattern across the evidence was the use of multifaceted interventions rather than isolated preventive measures. Mody et al. (2015), Girard et al. (2015), Mody et al. (2017), Theobald et al. (2017) and Mrziglod et al. (2023) combined several strategies, including staff education, appropriate catheter-indication criteria, regular reassessment of catheter necessity, timely removal, safe insertion and maintenance, surveillance, audit and feedback. These interventions were generally supported by multidisciplinary or organisational involvement. Particularly, Mody et al. (2017) demonstrated that combining technical measures with socioadaptive strategies, including leadership, teamwork, communication and resident engagement, can strengthen CAUTI prevention. Overall, the evidence indicates that addressing multiple aspects of catheter management simultaneously is more appropriate than relying on a single preventive action.

6.2 Daily Review and Timely Catheter Removal Are Important

Regular assessment of catheter necessity emerged as another important intervention. Mrziglod et al. (2023) reported a significant reduction in catheter utilisation following implementation of daily catheter-necessity assessments. Similarly, Theobald et al. (2017) achieved a 35% reduction in catheter use through structured catheter orders and automated discontinuation processes. Kamel et al. (2025) also demonstrated reductions in catheter utilisation and CAUTI after introducing a nurse-driven removal protocol. Collectively, these findings emphasise the importance of empowering nurses to identify and remove unnecessary catheters using clear evidence-based protocols.

6.3 Education Alone Is Unlikely to Be Sufficient

Education was included in most interventions, although it was rarely implemented independently. Girard et al. (2015) identified important staff knowledge deficits, while Krocová and Prokešová (2022) highlighted inadequate periodic CAUTI-prevention training. Nevertheless, successful interventions generally combined education with surveillance, catheter review, standardised procedures and feedback. Therefore, education appears most effective when incorporated within a broader prevention programme rather than delivered as a stand-alone intervention.

6.4 Organisational Context Influences Outcomes

Organisational context appeared to influence intervention effectiveness. Mody et al. (2017) demonstrated substantial reductions in CAUTI across community nursing homes, whereas Krein et al. (2018) reported no significant improvement in participating Veterans Health Administration nursing homes. The latter facilities had relatively low baseline CAUTI rates and established prevention practices. These contrasting findings suggest that baseline performance, existing resources and organisational readiness may influence the magnitude of improvement achieved.

6.5 Surveillance, Audit and Feedback Support Sustainability

Continuous surveillance and feedback were recurring components of successful interventions. Mody et al. (2017) incorporated surveillance support, while Fiveash et al. (2021) used safety huddles to transform individual CAUTI events into organisational learning. Mrziglod et al. (2023) combined surveillance with clinical champions and daily checklists, whereas Kamel et al. (2025) employed a dashboard to support monitoring and feedback. Collectively, these findings suggest that routinely collected data should be actively used to identify deficiencies, reinforce good practice and support sustained improvements in catheter management.

7. Discussion

The overall evidence suggests that CAUTI prevention in long-term care is most successful when interventions target several aspects of catheter use simultaneously. The strongest directly applicable studies demonstrated clinically important reductions following comprehensive infection-prevention and quality-improvement approaches.

Mody et al. (2015) is particularly important because randomisation strengthens confidence that the intervention contributed to the observed reduction in CAUTI. The subsequent national study by Mody et al. (2017) provides evidence that similar principles can be scaled across hundreds of nursing homes.

Together, these studies suggest that long-term-care CAUTI prevention should combine evidence-based catheter care with organisational implementation strategies.

The findings also demonstrate that catheter utilisation and CAUTI rates do not always move together. Fiveash et al. (2021) achieved a substantial infection reduction even though catheter days increased, while Mody et al. (2017) achieved a major CAUTI reduction with little change in catheter utilisation. This implies that appropriate catheter maintenance, diagnostic stewardship, staff behaviour and process reliability are important in addition to catheter removal.

A second important finding is the potential value of nurse-led practice. Catheter care is largely embedded within everyday nursing activity. Nurses monitor urinary output, provide catheter hygiene, maintain drainage systems, observe signs of infection and frequently identify whether an indwelling device remains clinically necessary. Evidence from Kamel et al. (2025), although indirect to LTC, suggests that nurse-driven protocols can formalise this responsibility and reduce unnecessary exposure.

However, simply introducing a protocol is unlikely to be sufficient. Successful implementation requires leadership support, multidisciplinary acceptance, staff confidence, documentation processes and continued feedback. Kamel et al. (2025) described barriers including nurses' hesitation and provider distrust, which were addressed through multidisciplinary involvement and organisational support.

The mixed findings of the review also emphasise the importance of context. Krein et al. (2018) found no significant benefit in VHA nursing homes where baseline infection-prevention performance was already relatively strong. Consequently, CAUTI interventions should be preceded by assessment of local problems, existing catheter utilisation, staff knowledge, infection rates and workflow barriers.

Safety huddles are particularly promising in this respect because they allow interventions to be adapted according to local causes of infection rather than applying identical measures across every facility.

8. Implications for Nursing Practice

The findings have several implications for nurses working in long-term-care environments.

First, urinary catheters should only be used when there is a valid clinical indication, and continuing need should be reassessed regularly. Nurses should be empowered through agreed protocols to initiate or recommend catheter removal when an indication no longer exists.

Second, catheter insertion and maintenance must follow evidence-based infection-prevention standards. Aseptic insertion, hand hygiene, appropriate drainage-system management and avoidance of unnecessary disconnection remain fundamental.

Third, long-term-care facilities should provide regular education rather than relying solely on training delivered at induction. Education should include catheter indications, appropriate maintenance, CAUTI recognition, specimen collection, unnecessary urine-culture avoidance and catheter removal.

Fourth, infection surveillance should be linked to feedback and quality improvement. Nursing staff should have access to understandable information regarding CAUTI rates, catheter days and compliance with preventive practices.

Fifth, CAUTI episodes should be reviewed through multidisciplinary safety huddles or root-cause analysis where feasible. The findings of Fiveash et al. (2021) indicate that examining the resident-, staff- and process-level circumstances surrounding infections can facilitate targeted improvement.

Finally, long-term-care facilities should promote a culture in which catheter necessity is questioned rather than assuming that an existing catheter must remain indefinitely.

9. Strengths of the Review

An important strength of this review is its consideration of different intervention approaches, ranging from a randomised nursing-home trial to national implementation programmes and local quality-improvement initiatives. The synthesis clearly distinguishes evidence generated directly within long-term-care settings from supplementary findings obtained in acute-care and acute-geriatric environments, thereby reducing the risk of inappropriate generalisation. Both positive and non-significant findings were considered, allowing a more balanced assessment of intervention effectiveness. In addition, the review examined implementation mechanisms alongside clinical outcomes, including leadership, staff education, surveillance, feedback, safety huddles and nurse involvement. This approach provides useful insight into both the effectiveness of CAUTI-prevention interventions and the organisational conditions that may influence their successful implementation.

10. Limitations of the Review

Several limitations should be acknowledged. First, relatively few studies in the evidence set were conducted exclusively among residents of long-term-care facilities, resulting in a limited body of directly applicable evidence. Second, substantial heterogeneity existed in intervention components, study designs, populations, healthcare settings and outcome measures. Some studies evaluated comprehensive infection-prevention programmes, whereas others examined safety huddles, catheter-removal protocols, surveillance or educational strategies. Differences in CAUTI definitions and reporting methods also prevented meaningful statistical pooling and therefore required narrative synthesis.

Several studies used uncontrolled pre-post designs, which are vulnerable to secular trends, concurrent organisational changes and other potential confounding factors. In addition, Parker et al. (2017) was a study protocol without completed effectiveness outcomes, while Krocová and Prokešová (2022) primarily examined implementation of preventive practices rather than intervention effectiveness. Findings from acute-care and acute-geriatric settings were therefore interpreted only as supplementary evidence and should not be directly generalised to long-term-care residents. Further high-quality controlled research conducted specifically within long-term-care facilities is required.

11. Recommendations for Future Research

Future research should prioritise well-designed, adequately powered controlled studies conducted specifically within nursing homes, long-term care facilities, and residential aged-care settings. More rigorous studies are required to strengthen the evidence regarding interventions that are most effective in preventing CAUTI among older residents. In particular, future research should evaluate nurse-driven catheter-removal protocols and determine whether empowering nurses to regularly assess catheter necessity and initiate timely removal can safely reduce catheter utilisation and infection rates in long-term care.

Further multicentre research should investigate the effectiveness of structured safety-huddle interventions across different nursing homes and examine whether reductions in CAUTI can be sustained beyond one year. Studies should also assess intervention cost-effectiveness and consider resident-centred outcomes, including comfort, satisfaction, quality of life, and complications associated with catheter use. The effects of CAUTI-prevention programmes on antimicrobial prescribing and urine-culture stewardship also require further investigation.

Future studies should explore organisational and implementation factors that may influence intervention success, including staffing levels, staff knowledge, workload, leadership support, multidisciplinary collaboration, and barriers to adherence. Research should additionally identify which individual components of multifaceted interventions provide the greatest clinical benefit. Finally, researchers should adopt consistent and clearly defined CAUTI diagnostic and surveillance criteria to improve comparability between studies and facilitate future meta-analysis.

12. Conclusion

This systematic review indicates that catheter-associated urinary tract infections among residents in long-term-care facilities can be reduced through well-designed, multifaceted interventions. The strongest evidence supports programmes combining appropriate catheter use, aseptic insertion and maintenance, regular review of catheter necessity, education, surveillance, feedback and organisational engagement.

Mody et al. (2015) demonstrated significant CAUTI reduction in a randomised nursing-home trial, while Mody et al. (2017) showed that a combined technical and socioadaptive programme could successfully reduce CAUTI across hundreds of community nursing homes. Fiveash et al. (2021) further demonstrated the potential benefit of safety huddles and local root-cause learning.

Nevertheless, Krein et al. (2018) showed that the same broad approach may not produce additional benefits in facilities with already low baseline rates, highlighting the importance of local context.

Overall, the evidence favours multicomponent, nurse-engaged and data-driven prevention programmes rather than isolated interventions. Long-term-care services should combine rigorous catheter-care standards with daily reassessment, staff education, multidisciplinary collaboration and active surveillance to minimise catheter-associated infection and enhance resident safety.

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