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Major Article

Implementing clinical guidelines to prevent catheter-associated urinary tract infections and improve catheter care in nursing homes: Systematic review

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Key Words:
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Background: Catheter-associated urinary tract infection is the most common health care–associated infection, is considered avoidable, and has cost implications for health services. Prevalence is high in nursing homes, but little research has been undertaken to establish whether implementing clinical guidelines can reduce infection rates in long-term care or improve quality of urinary catheter care.
Methods: Systematic search and critical appraisal of the literature.
Results: Three studies evaluated the impact of implementing a complete clinical guideline. Five additional studies evaluated the impact of implementing individual elements of a clinical guideline.
Conclusions: Prevention of catheter-associated urinary tract infection in nursing homes has received little clinical or research attention. Studies concerned with whole guideline implementation emerged as methodologically poor using recognized criteria for critically appraising epidemiologic studies concerned with infection prevention. Research evaluating the impact of single elements of clinical guidelines is more robust, and their findings could be implemented to prevent urinary infections in nursing homes.

The major risk factor for catheter-associated urinary tract infection (CAUTI) is urethral catheterization.[1] Risk increases with the length of time that the catheter remains in place.[1] Catheterized patients inevitably develop asymptomatic bacteriuria within 24-48 hours of catheterization, but it resolves spontaneously when the catheter is removed. Routine specimen taking and culture, antimicrobial treatment, and prophylaxis are not recommended.[2-5] Although CAUTI is the most common health care–associated infection, is considered avoidable, and has cost implications for health services,[6,7] it has received less attention than other infections associated with indwelling medical devices,[8] probably because it has less impact on length of hospital stay and mortality.[3] However, concerns about CAUTI are increasing as catheterized patients have become recognized as a major reservoir of antimicrobial-resistant organisms and a possible source of infection to other patients.[3] Risks to the individual who is catheterized are considerable: pyelonephritis, secondary bacteremia, sepsis, encrustation, obstruction of urinary flow, and urethral stricture.[9] Nevertheless, catheterization is frequently undertaken for inappropriate reasons (eg, urinary incontinence), and catheters are left in place unnecessarily, increasing risk,[10,11] which is exacerbated by poor management: breaking the closed system of drainage, failing to cleanse hands before and after handling catheters, and not positioning drainage bags below the level of the bladder.[12]

Clinical guidelines have been developed to prevent and control CAUTI and enhance urinary catheter care.[2-4,13-15] The guidelines are not based on the highest levels of evidence (ie, they do not come from randomized controlled trials but are based mainly on expert consensus opinion). However, there is good agreement of what constitutes best practice. Poor adherence is frequently reported, especially for older patients[16,17] and in nursing homes.[12,18] Numerous intervention studies have been undertaken to evaluate the effectiveness of campaigns to promote adherence to clinical guidelines for urinary catheter care in acute care settings,[8,19-24] but little work has been attempted in long-term care despite high reported rates of CAUTI.[25,26] Nursing home residents are frequently admitted to acute care settings and back again and can operate as a source

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of infection, placing other patients and residents at risk.[27] We undertook a systematic search and critical appraisal of the literature to assess the effectiveness of implementing urinary catheter care guidelines specifically in nursing homes. The review was undertaken to help develop an intervention to improve catheter management and reduce CAUTI specifically in the nursing home environment where implementation of infection prevention guidelines is reported to be more challenging than in hospitals.[28]

METHODS

Articles were identified from the following databases: MEDLINE, CINAHL, Embase, PubMed, British Nursing Index, and the Cochrane database using the search terms shown in Table 1. Additional search strategies included searching the Internet with a general browser, screening the reference lists of articles already retrieved, and hand searching key journals (*American Journal of Infection Control*, *Journal of Hospital Infection*, *Infection Control & Hospital Epidemiology*, and *Journal of Infection Prevention*). To meet the original inclusion criteria, articles had to report use of a guideline to prevent CAUTI or improve quality of urinary catheter care in nursing homes or long-term care facilities by implementing a clinical guideline. Studies had to be reported from nursing homes or long-term care facilities because of the challenges reported implementing infection prevention practices in this setting.[29] Information derived from hospital studies was not considered transferable. After the initial screening, very few articles reported implementation of all of the individual elements of any guideline to prevent CAUTI, specifically in nursing homes or long-term care facilities. The inclusion criteria were therefore broadened to include publications where individual elements or a few elements of a guideline were implemented (eg, ceasing to screen for bacteriuria, use of stringent contact precautions). Studies were eligible if they considered nursing homes as part of a larger sample, providing the data had been presented separately. There were no language restrictions. Eligible articles were downloaded, read by at least 2 members of the research team, and data were extracted onto a template developed especially for the review. In cases of disagreement, the advice of a third reviewer was sought. Quality of the studies was assessed using the Outbreak Reports and Intervention Studies Of Nosocomial infection (ORION) checklist,[28] which consists of 22 statements that assess transparency of reporting, study design, and appropriateness of analysis in epidemiologic studies concerned with health care–associated infection.

Table 1
Search terms

Search no.	Search terms (no. of results)
1	(urinary adj2 infection$).ti,ab. (29,059)
2	(healthcare adj2 infection$).ti,ab. (3,006)
3	(nosocomial adj2 infection$).ti,ab. (12,369)
4	(catheter adj3 infection$).ti,ab. (5,378)
5	exp Catheterization, Central Venous/ (6,010)
6	catheter.mp. or exp Catheters/ (158,589)
7	urinary tract infection$.mp. or exp Urinary Tract Infections/ (55,277)
8	(nursing adj2 home$).ti,ab. (21,040)
9	(care adj2 home$).ti,ab. (17,599)
10	(residential adj2 home$).ti,ab. (1,134)
11	(care adj2 facilities).ti,ab. (10,397)
12	exp Homes for the Aged/ or exp Long-Term Care/ or exp Residential Facilities/ (968,693)
13	(residential adj2 facilities).ti,ab. (817)
14	exp Nursing Homes/ (26,055)
15	8 or 9 or 10 or 11 or 12 or 13 or 14 (1,011,533)
16	1 or 2 or 3 or 4 or 7 (73,930)
17	5 or 6 (160,680)
18	15 and 16 and 17 (1,582)
19	limit 18 to english language (1,478)
20	intervention$.ti,ab. (705,052)
21	program$.ti,ab. (577,645)
22	20 or 21 (1,189,750)
23	19 and 22 (280)

RESULTS

The searches identified 902 potentially eligible articles after duplicates were removed (Fig 1). Of these, 12 were short-listed with the ORION checklist[29] and read in detail. Four studies were excluded. One excluded study dating from 1982[30] was ineligible because it compared routine catheter replacement with replacement only in cases of blockage or encrustation. Routine catheter replacement is not in line with current clinical guidelines.[2-4,13-15] Additional reasons for exclusion were as follows: the study was conducted in an acute setting,[31] the study was conducted in community hospitals with no information on patient acuity,[32] and data from acute and long-term care were not separately presented.[33] Eight studies were eligible for review (Table 2).

Three studies evaluated the introduction of complete CAUTI guidelines in nursing homes.[36,40,41] Findings were mixed. Gokula and Gaspar[36] established no difference in CAUTI rates or standards of care for residents in 14 nursing homes 3 months after the guideline had been introduced compared with 17 nursing homes acting as controls. In contrast, Galeon and Romero[40] reported a 16% reduction in CAUTIs 24 months after the introduction of a clinical guideline, and Abraham and DeBakey[41] reported a decline in CAUTI from 10.1% to 0% over 12 months. The 2 studies[40,41] reporting positive findings adopted uncontrolled before and after (pre-post test) designs in which each participating center operated as its own control.

Five studies evaluated individual elements of a clinical guideline. Rummukainen et al[38] reported an uncontrolled before and after study resulting in reduction from 19.9% to 15.5% antimicrobial prescriptions for patients with asymptomatic bacteriuria in nursing homes throughout one administrative area of Finland 4 years after the introduction of an initiative designed to reduce unnecessary antimicrobial treatment. A cluster randomized controlled trial in 12 long-term care facilities[34] reported a complex intervention intended to reduce overall rate of infection from indwelling devices through the introduction of stringent hygiene, barrier precautions, surveillance, and staff education. The hazard ratio for CAUTI was significantly reduced in the intervention group compared with the control group. CAUTIs declined over 3 years (95% confidence interval, 0.30-0.97). Another study[37] evaluated the impact of discontinuing routine screening and antimicrobial prescriptions for asymptomatic bacteriuria for catheterized patients in one nursing home compared with a control where there was no change in clinical policy. The results are unclear. No information was provided concerning selection of the nursing homes or possible confounding variables, such as resident dependency. Two further studies[35,39] reported impact of discontinuing routine screening and antimicrobial prescription for asymptomatic bacteriuria but did not separate data for catheterized and noncatheterized residents. One study[35] was a cluster randomized controlled trial in 24 nursing homes with 4,217 residents. Control and test homes were matched in terms of key variables (eg, number of beds, residents' dependency levels). The other study[39] was an uncontrolled before and after study in a single center. There were significant reductions in inappropriate submission of specimens and treatment of bacteriuria ($P < .001$), which were sustained over 30 months. These studies do not report treatment effect.

DISCUSSION

The care of patients with long-term urethral catheters and CAUTI prevention has received little clinical or research attention. Some

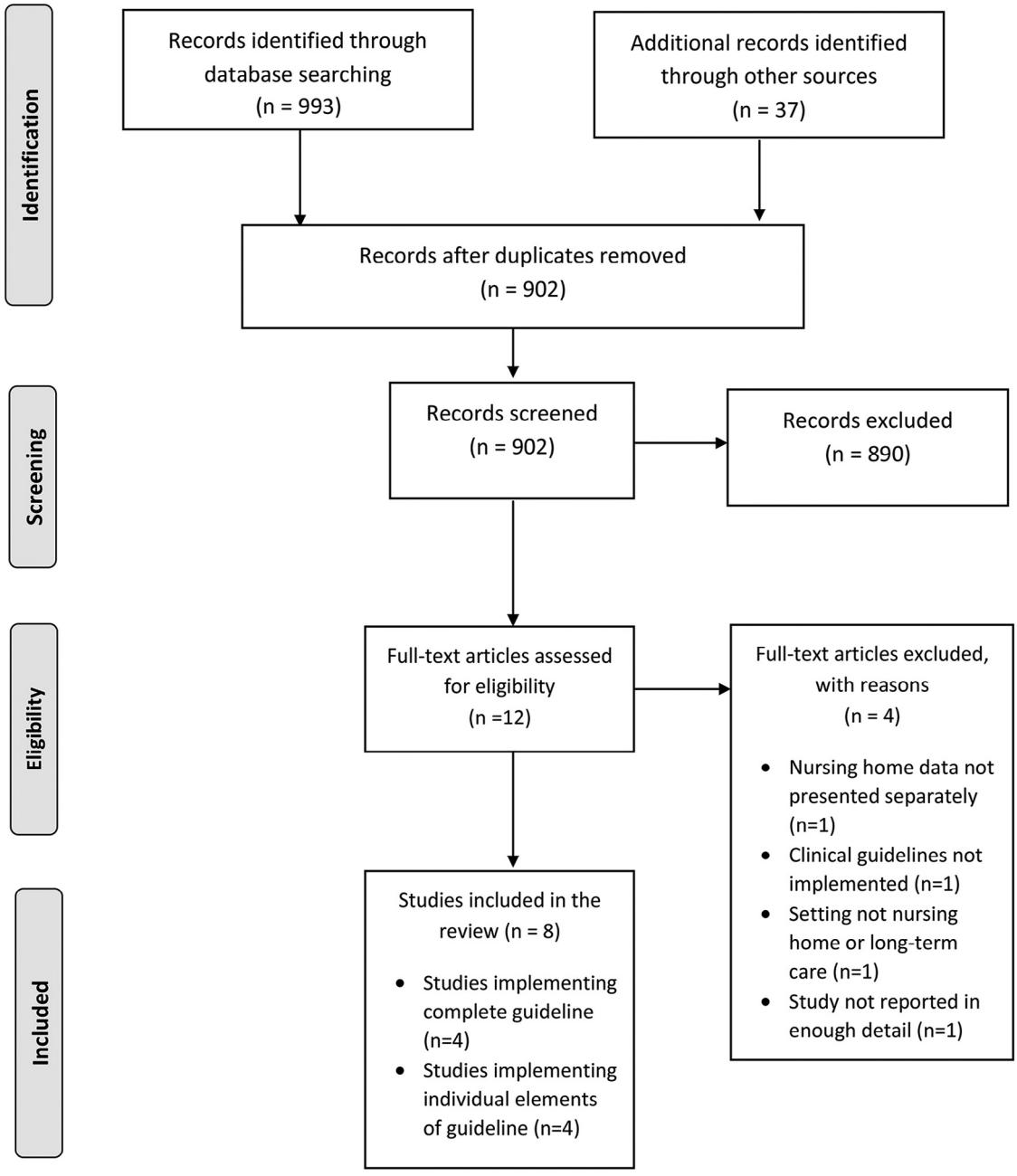

Fig 1. Flow diagram and selection of the studies.

clinical guidelines overlook the needs of this group altogether,[14] and in guidelines where they are included,[2-4] the care of catheterized patients receives less attention than patients in acute care settings. Three studies explored whether implementing a complete clinical guideline (all of the individual elements) can prevent CAUTI or improve overall quality of long-term urinary catheter care in nursing homes. All implemented complex, multifaceted interventions which were developed by undertaking in-house systematic reviews rather than based on published clinical guidelines. All but one of the publications[39] was a short report with limited detail, therefore reducing the amount of information available for critical appraisal. However, it was possible to establish that in 3 short reports,[38,40,41] the results were based on evidence from uncontrolled before and after studies which are methodologically weak,[42] and the remaining study[36] suffered from poor control.[42] These methodologic weaknesses combined with samples drawn from only 1 nursing home in 2 of the studies[40,41] mean that findings lack internal and external validity and fall short of accepted criteria[29] to assess adequacy of epidemiologic studies concerned with preventing health care–associated infections. Two studies evaluating the impact of introducing individual elements of a clinical guideline[34,35] were robust cluster randomized controlled trials which met ORION criteria[29] and contain findings relevant to catheter care in nursing homes.

Our review has established increasing interest in the prevention of CAUTI in nursing homes and identified an important gap in the literature: there is insufficient evidence to demonstrate the effectiveness of implementing a complete clinical guideline to prevent CAUTI in this setting because research is reported in little detail and has not been undertaken with sufficient rigor. Studies evaluating

Table 2
Data extraction (Preferred Reporting Items for Systematic Reviews and Meta-Analyses format)

Study/format	Design	Aims	Sample	Duration	Results*	Quality†
Mody et al, 2015[34]/full report	CRCT	To test whether a multimodal targeted infection program reduces the prevalence of MDROs and incident device-related infections (urinary catheters and feeding tubes). Evaluates use of a partial CAUTI guideline.	12 community-based nursing homes (mean, 137 beds each) in the United States.	3 y	Hazard ratios for the first and all (including recurrent) CAUTI) were 0.54 (95% CI, 0.30-0.97) and 0.69 (95% CI, 0.49-0.99), respectively, in the intervention group and the control group.	Low risk of bias
Loeb et al, 2005[35]/full report	CRCT	To assess whether a multifaceted intervention can reduce the number of prescriptions for antimicrobials for suspected urinary tract infections in residents of nursing homes. Evaluates the use of a partial CAUTI guideline.	24 nursing homes in Ontario, Canada, and Idaho.	12 mo	Fewer courses of antimicrobials for suspected urinary tract infections per 1,000 resident days were prescribed in the intervention nursing homes than in the usual care homes (1.17 vs 1.59 courses, respectively; weighted mean difference, –0.49, (95% CI, –0.93 to –0.06).Antimicrobials for suspected urinary tract infection represented 28.4% of all courses of drugs prescribed in the intervention nursing homes compared with 38.6% prescribed in the usual care homes (weighted mean difference, –9.6%, 95% CI, –16.9% to –2.4%).	Low risk of bias
Gokula and Gaspar, 2014[36]/ abstract only	NRCT	To increase appropriate use of indwelling urinary catheters in long-term care, therefore reducing related infections and other complications. Evaluates the use of a complete CAUTI guideline.	14 long-term care settings with 17 comparison sites. No further details.	3 mo	There were no statistical differences in occurrence of CAUTIs and recurrent UTIs between the intervention and comparison sites.	High risk of bias
Trautner et al, 2012[37]/ abstract only	NCRT	To avoid inappropriate treatment antibiotic prescription for ASB. Evaluates the use of a partial CAUTI guideline.	Setting not clear; 1 intervention and 1 control site: 2 Veterans Administration Geriatric facilities in Texas.	12 mo	Urine culture ordering, a marker for unnecessary screening for ASB, decreased by 42% from 49.87 cultures/bed days prior to the intervention to 23.98 cultures/bed days after the intervention, in comparison with a 0% decrease in the control site ($P = .04$). The combined outcome of inappropriate management of ASB and CAUTI decreased significantly over time ($P < .0001$), as have the individual outcomes of ASB treated inappropriately with antibiotics ($P < .0001$) and CAUTI managed inappropriately by withholding antibiotics ($P < .0001$).	High risk of bias/ unclear
Rummukainen et al, 2012[38]/ full report	UCBA	To reduce the inappropriate use of antimicrobials in long-term care facilities. Evaluates the use of a partial CAUTI guideline.	All units (N = 64) providing long-term health care for older people in Central Finland (population 267,000)	4 y	The proportion of patients receiving antimicrobials down from 19.9% in 2005 to 15.4% in 2008. Between 2005 and 2008, the proportion of patients receiving antibiotic prophylaxis for UTI decreased from 13% to 6% ($P < .001$).	Good/fair quality. High risk of bias as uncontrolled.
Zabarsky et al, 2008[39]/full report	UCBA	To determine effect of discontinuing routine screening and antimicrobial prescription for bacteriuria. Evaluates the use of a partial CAUTI guideline.	A single 190-bed long-term health care facility, Cleveland, OH.	33 mo	6 months after the intervention, inappropriate submission of urine cultures decreased from 2.6 to 0.9 per 1,000 patient days ($P < .0001$). The overall rate of treatment for ASB reduced from 1.7 to 0.6 per 1,000 patient days ($P < .001$). These reductions persisted for 30 mo.	Fair quality. High risk of bias as uncontrolled.
Galeon and Romero 2014[40]/ abstract only	UCBA	To reduce CAUTI rates. Evaluates the use of a complete CAUTI guideline.	A single multilevel teaching facility with 257 acute care beds, which includes a specialized acute spinal cord unit and 99 long-term care beds in San Francisco, CA.	24 mo	16% reduction in CAUTI.	Poor quality. High risk of bias as uncontrolled.
Abraham and DeBakey 2014[41]/ abstract only	UCBA	To reduce the incidence of CAUTIs in patients in a long-term care unit. Evaluates the use of a complete CAUTI guideline.	A single center with several long-term care units, Houston, TX.	12 mo	A reduction in CAUTIs from 10.1 per 1,000 Foley catheter days to 0.0, sustained for 2 mo.	Poor quality. High risk of bias as uncontrolled.

ASB, asymptomatic bacteriuria; *CAUTI*, catheter-associated urinary tract infection; *CI*, confidence interval; *CRCT*, controlled clinical trial; *MDRO*, multidrug-resistant organism; *NRCT*, non-controlled clinical trial; *UCBA*, uncontrolled before and after study; *UTI*, urinary tract infection.

*The main results regarding CAUTIs and components of CAUTI guidelines, including inappropriate antimicrobial prescribing.

†Controlled studies were assessed using the Effective Practice and Organization of Care controlled studies risk of bias tool, and uncontrolled studies were assessed using the National Institutes of Health's quality assessment tool for before and after studies.

individual aspects of a clinical guideline were better controlled, and their findings could be implemented to improve care. High-quality research to prevent CAUTI is important. There are particular challenges to introducing guidelines for best practice and the education that health workers need to implement them compared with hospitals.[28,43] Nursing homes in the United Kingdom are staffed mainly by unqualified health care assistants, with little supervision by qualified nurses. Staff turnover is high (making educational interventions, which usually form part of infection prevention interventions, difficult to implement), and access to medical care can be difficult.[43] However, need for research to improve practice is considerable. Nursing home residents are becoming older, frailer, and more likely to suffer comorbid conditions for which there are no cures.[44] Numbers admitted to nursing homes are increasing in line with societal and demographic trends.[45,46] Ten percent of the population die in nursing homes.[43] Guidelines for CAUTI prevention do not recommend catheterization for patients with urinary incontinence, but there is a consensus[2,15] that catheterization is permissible to improve comfort during end of life care and to heal sacral lesions for patients who are incontinent if all other wound care approaches have failed. Because length of the end of life period can be difficult to predict, and sacral sore healing can take weeks or months, there is ample time for the development of reservoirs of antimicrobially resistant organisms and for residents to suffer unnecessary discomfort. Guidelines for the care of patients catheterized long term outside hospital are available.[13] Feasibility work could be undertaken to establish their suitability for use in nursing homes. Such work should include discussion with staff and observation of usual practice to establish the type of interventions that could be implemented effectively in these settings given the particular challenges they pose.

Study limitations

Although extensive and thorough electronic searches were undertaken, 1 of the 12 studies identified for detailed review was obtained by hand-searching. It is possible that other relevant studies were not identified. Recently conducted studies were reported too briefly for adequate critique.

CONCLUSIONS

There is a need to ensure that evidence-based clinical guidelines to prevent CAUTI in residents catheterized long term are implemented in nursing homes. Before this work can be undertaken, feasibility studies are required to establish what can be achieved in these settings. Robust studies then need to be designed to evaluate the impact of these guidelines on clinical outcomes. Publications reporting implementation of guidelines need to describe interventions clearly and completely to facilitate critical appraisal and replication.

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