Major article

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

Dinah Gould PhD, RN[a] *, Sarah Gaze[a] BSc, Nicholas Drey PhD[b], Tracey Cooper MSc RN[c]

[a]Cardiff University, Wales, UK

[b] City University London, England, UK

[c] Betsi Cadwaladr University Health Board, North Wales, UK

*Address for correspondence to Dinah Gould, School of Healthcare Sciences, Cardiff University, Eastgate House, Newport Road, Cardiff, CF24 OAB; UK

Tel: = +44(0)2920 917804

Email: gouldd@cardiff.ac.uk

Key words: catheter-associated urinary tract infection; clinical guidelines; infection prevention and control; nursing homes; long-term care; systematic review

Title page without author identifiers

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

Key words: catheter-associated urinary tract infection; clinical guidelines; infection prevention and control; nursing homes; long-term care; systematic review

Summary

Background: Catheter-associated urinary tract infection is the most common healthcare-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.

Conclusion: Prevention of catheter-associated urinary tract infections in nursing homes has received little clinical or research attention. Studies concerned with whole guideline implementation emerged as methodologically poor using recognised criteria for critically appraising epidemiological 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.

152 words in summary

Key words: catheter-associated urinary tract infection; clinical guidelines; infection prevention and control; nursing homes; long term care

Introduction

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, 3, 4, 5]. Although CAUTI is the most common healthcare-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 recognised 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 (e.g. 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, 3, 4, 13, 14, 15]. The guidelines are not based on the highest levels of evidence (i.e. they do not come from randomised 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 20, 21, 22, 23, 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 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

Papers were identified from the following databases: MEDLINE, CINAHL, EMBASE, PUBMED, BNI and the Cochrane database using the search terms shown on Table 1. Additional search strategies included: searching the internet with a general browser; screening the reference lists of papers already retrieved; and hand searching key journals (American Journal of Infection Control; Journal of Hospital Infection; Infection Control and Hospital Epidemiology and Journal of Infection Prevention). To meet the original inclusion criteria, papers had to report use of a guideline to prevent CAUTI and/or improve quality of urinary catheter care in nursing homes and/or long-term care facilities by implementing a clinical guideline. Studies had to be reported from nursing homes/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 initial screening very few papers reported implementation of all the individual elements of any guideline to prevent CAUTI specifically in nursing homes/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 (e.g. 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 papers were downloaded, read by at least two members of the research team and the 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 ORION checklist [28] which consists of 22 statements that assess transparency of reporting, study design and appropriateness of analysis in epidemiological studies concerned with healthcare-associated infection.

Results

The searches identified 902 potentially eligible papers after duplicates were removed (see Table 2). 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 to replacement only in cases of blockage or encrustation. Routine catheter replacement is not in line with current clinical guidelines [2, 3, 4, 13, 14, 15]. Additional reasons for exclusion were that the study was conducted in an acute setting [31], in community hospitals with no information on patient acuity [32] and because data from acute and long-term care were not separately presented [33]Eight studies were eligible for review (see Table 3).

Three studies evaluated the introduction of complete CAUTI guidelines in nursing homes [34, 35, 36]. Findings were mixed. Gokula and Gaspar [34] established no difference in CAUTI rate or standards of care for residents in 14 nursing homes three months after the guideline had been introduced compared to 17 nursing homes acting as controls. In contrast Galeon [35] reported a 16% reduction in CAUTI 24 months after the introduction of a clinical guideline, Abraham [36] reported decline in CAUTI from 10.1% to 0% over 12 months. The two studies [35, 36] reporting positive findings adopted uncontrolled before and after (pre-post test) designs in which each participating centre operated as its own control.

Five studies evaluated individual elements of a clinical guideline. Rummukainen [37] 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 four years after the introduction of an initiative designed to reduce unnecessary antimicrobial treatment. A cluster RCT in 12 long-term care facilities [38] 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. Hazard ratio for CAUTI was significantly reduced in the intervention group compared to the control. CAUTI declined over three years (95% CI, 0.30-0.97). Another study [39] evaluated the impact of discontinuing routine screening and antimicrobial prescription for asymptomatic bacteriuria for catheterized patients in one nursing home compared to a control where there was no change in clinical policy. The result is unclear. No information was provided concerning selection of the nursing homes or possible confounding variables such as resident dependency. Two further studies [40, 41] reported impact of discontinuing routine screening and antimicrobial prescription for asymptomatic bacteriuria but did not separate data for catheterized and non-catheterized residents. One [41] was a cluster randomised controlled trial in 24 nursing homes with 4,217 residents. Control and test homes were matched in terms of key

variables (e.g. number of beds, residents' dependency levels). The other [40] was an uncontrolled before and after study in a single centre. There were significant reductions in inappropriate submission of specimens and treatment of bacteriuria (p<0.001) 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 clinical guidelines overlook the needs of this group altogether [14] and in guidelines where they are included [2, 3, 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 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 [40] was a short report with limited detail thus reducing the amount of information available for critical appraisal. However, it was possible to establish that in three short reports [35, 36, 37] the results were based on evidence from uncontrolled before and after studies which are methodologically weak [42] and the remaining study [34] suffered from poor control [42]. These methodological weaknesses combined with samples drawn from only one nursing home in two of the studies [35, 36] mean that findings lack internal and external validity and fall short of accepted criteria [29] to assess adequacy of epidemiological studies concerned with preventing healthcare-associated infections. Two studies evaluating the impact of introducing individual elements of a clinical guideline [38, 41] were robust cluster randomized controlled trials which meet ORION criteria [29] and contain findings that are 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 rigour. Studies evaluating 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 to hospitals [28, 43]. Nursing homes in the UK are staffed mainly by unqualified healthcare 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 co-morbid conditions for which there is no cure [44]. Numbers admitted to nursing homes are increasing in line with societal and demographic trends [45, 46]. Ten per cent 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 heal sacral lesions for patients who are incontinent if all other wound care approaches have failed. As 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 particular challenges they pose.

Study limitations

Although extensive and thorough electronic searches were undertaken one 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 given. 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.

Table 1. Search terms

1	(urinary adj2 infection$).ti,ab. (29059)
2	(healthcare adj2 infection$).ti,ab. (3006)
3	(nosocomial adj2 infection$).ti,ab. (12369)
4	(catheter adj3 infection$).ti,ab. (5378)
5	exp Catheterization, Central Venous/ (6010)
6	catheter.mp. or exp Catheters/ (158589)
7	urinary tract infection$.mp. or exp Urinary Tract Infections/ (55277)
8	(nursing adj2 home$).ti,ab. (21040)
9	(care adj2 home$).ti,ab. (17599)
10	(residential adj2 home$).ti,ab. (1134)
11	(care adj2 facilities).ti,ab. (10397)
12	exp Homes for the Aged/ or exp Long-Term Care/ or exp Residential Facilities/ (968693)
13	(residential adj2 facilities).ti,ab. (817)
14	exp Nursing Homes/ (26055)
15	8 or 9 or 10 or 11 or 12 or 13 or 14 (1011533)
16	1 or 2 or 3 or 4 or 7 (73930)
17	5 or 6 (160680)
18	15 and 16 and 17 (1582)
19	limit 18 to english language (1478)
20	intervention$.ti,ab. (705052)
21	program$.ti,ab. (577645)

22 20 or 21 (1189750)

23 19 and 22 (280)

Table 3 Data extraction (PRISMA format)

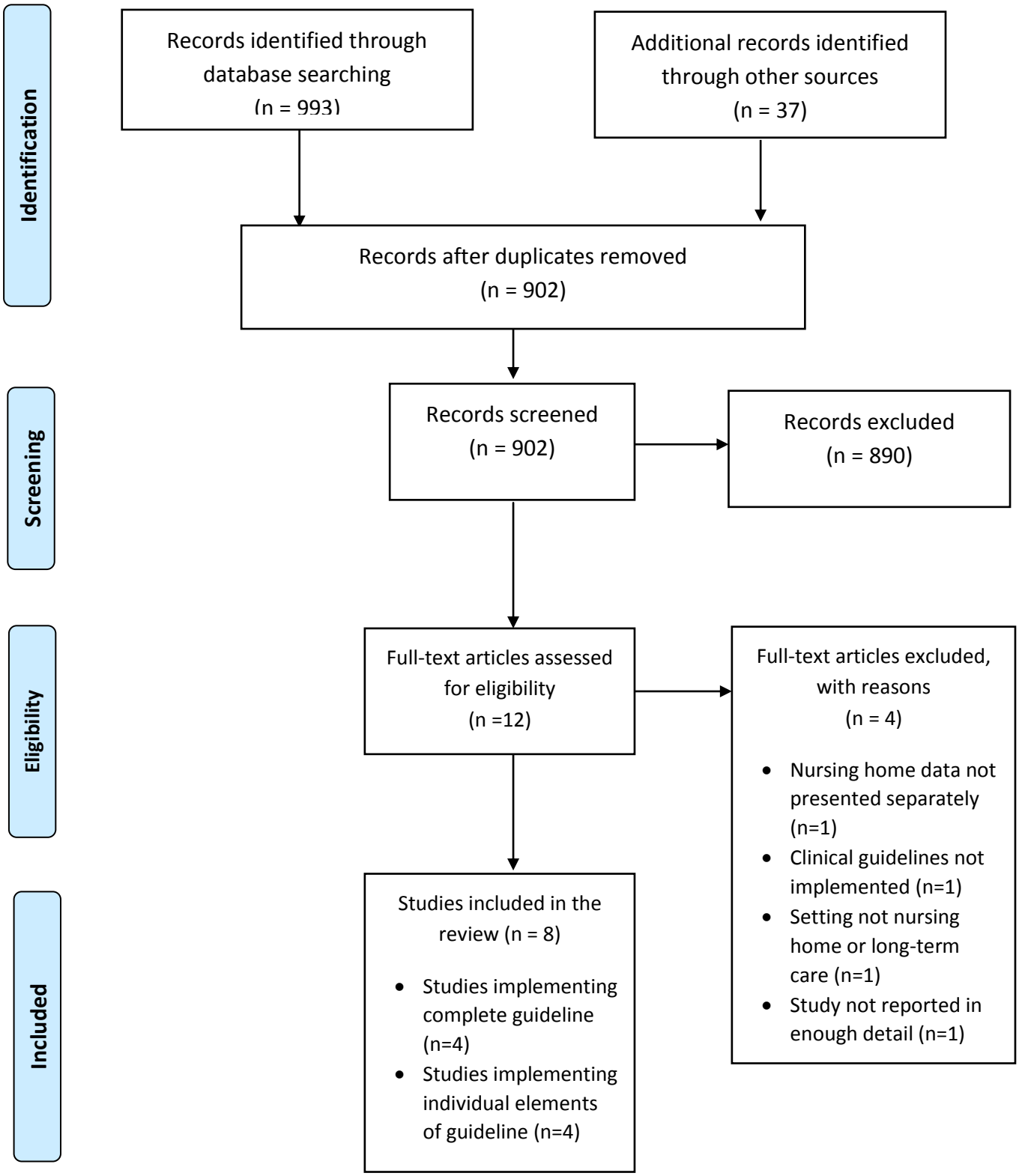
Study	Design	Aims	Sample	Duration	Result
Mody et al 2015 [38] Full Report	CRCT	To test whether a multimodal targeted infection program reduces the prevalence of (MDRO) multidrug resistant organisms and incident device-related infections (urinary catheters and feeding tubes). Evaluates use of a partial CAUTI guideline.	12 community-based nursing homes (mean 137 beds each) in the USA.	3 years	Hazar all (in were: 0.54 (0.69 (respe interv contro
Loeb et al 2015 [41] 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, USA.	12 months	Fewer antim urinar 1000 presc nursin usual cours differ to −0. suspe infect all cou in the home presc home differ 2.4%)
Gokula and Gaspar 2014[34] Abstract Only	NRCT	To increase appropriate use of indwelling urinary catheters in long-term care thus 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 months	There differ CAUTI betwe compa
Trautner et al 2016 [39] Abstract only	NCRT	To avoid inappropriate treatment antibiotic prescription for asymptomatic bacteriuria (ASB). Evaluates the use of a partial CAUTI guideline.	Setting not clear one intervention and one control site: two Veterans Administration Geriatric facilities in Texas, USA.	12 months	Urine marke screer by 42 bed-d interv cultur

					interv a 0% c site(p outco manag decre time (indivi treate antibi CAUTI inapp antibi
Rummukainen al 2012 [37] 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 (64) providing long-term health care for older people in Central Finland (population 267,000)	4 years	The p receiv from 1 2008. the pr receiv for UT 6% (P<
Zabarsky et al 2008[40] Full Report	UCBA	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 healthcare facility, Cleveland, Ohio, USA.	33 months	Six mo interv submi decre 1000 p The ov for AS 0.6 pe (P<0.0 persis
Galeon and Romero 2014 [35] Abstract Only	UCBA	To reduce CAUTI rates. Evaluates the use of a complete CAUTI guideline.	A single multi-level teaching facility with 257 acute care beds which includes a specialized acute Spinal Cord Unit and 99 Long Term Care (LTC) beds. San Francisco, California, USA.	24 months	16% r
Abraham and DeBakey 2014 [36] Abstract Only	UCBA	To reduce the incidence of Catheter-Associated Urinary Tract Infections in patients in along-term care unit. Evaluates the use of a complete CAUTI guideline.	A single centres with several long-term care units, Houston, Texas, USA.	12 months	A redu per 1, to 0.0

*The main results in respect of CAUTI and components of CAUTI guidelines, including: inappropriate antimicrobial prescribing

** Controlled studies were assessed using the EPOC controlled studies risk of bias tool, Uncontrolled studies were assessed using the NIH, Quality Assessment Tool for Before and After Studies

Figure 1. Flow diagram and selection of the studies



References

1. Aaronson DS, Wu AK, Blaschko SD, McAninch JW, Garcia M. National incidence and impact of noninfectious urethral catheter related complications on the surgical care improvement project. J Urol 2011; 185: 1756-60.

2. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA (HICPAC) HICPAC Guideline for prevention of catheter-associated urinary tract infections: 2009. International clinical practice guidelines http://www.cdc.gov/hicpac/cauti/001_cauti.html accessed 5.11.2015

3. APIC Implementation guide to preventing catheter-associated urinary tract infections. http://apic.org/Resource_/EliminationGuideForm/0ff6ae59-0a3a-4640-97b5-eee38b8bed5b/File/CAUTI_06.pdf accessed 5.11.2015

4. Smith PW, Bennett G, Bradely S, Drinka P, Lautenbach E, Marx J, Mody L, Nicholle C, Stevenson L. SHEA/APIC guideline: Infection prevention and control in long-term care facilities. Infect Control Hosp Epidemiol 2008;89: 785-814.

5. Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton TM, et al. Infectious Diseases Society of America Guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. Clin Infect Dis. 2005;40: 643–54.

6. Saint S, Olmsted RN, Fakih MG, Kowalski, CP Watson, SR, Sales AE et al. Translating health care-associated urinary tract prevention research into practice via the bladder bundle. Jt Comm J Qual Patient Safety 2009; 35: 449-55.

7. Trautner BW. Management of catheter-associated urinary tract infections. Curr Op Infect Dis 2010; 23: 76-82.

8. Oman KS, Makic MBF, Fink R, Schraeder N, hulett T, Keech T, Wald H. Nurse-directed interventions to reduce catheter-associated urinary tract infections. Am J Infect Control 2012; 40: 548-53.

9. Toughill E. Indwelling urinary catheters: common mechanical problems. Am J Nurs 2005; 105: 35-7.

10. Garibaldi RA, Burke JP, Dickman MI, smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterization. New Eng J Med 1974; 291: 215-19.

11. Huang WC, Wann SR, Lin SL, kunin CM, Kung MH, Lin CH et al. Catheter-associated urinary tract infections in intensive care units can be reduced by

prompting physicians to remove unnecessary catheters. Infect Control Hosp Epidemiol 2004; 25: 974-8.

12. Zimakoff, J, Pontoppidan, S, Larsen, SO et al 1995. The management of urinary catheters: compliance of practice in Danish hospitals, nursing homes and home care to national guidelines. Scand J Urol Nephrol 1995; 29: 299-305.

13. National Institute of Health and Clinical Excellence. Infection prevention and control of healthcare associated infections in primary and community care. https://www.nice.org.uk/guidance/cg139 2012. accessed 5.11.2015

14. Loveday HP, Wilson JA, Pratt RJ, Golsorkhia A, Tingle A, Bak J, Browne J, Prieto J, Wilcox M. epic3: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect 2014; 86: supplement 1 S1-S70. accessed 5.11.2015

15. Royal College of Nursing: Catheter guidance for nurses; 2012: https://www.rcn.org.uk/__data/assets/pdf_file/0018/157410/003237.pdf accessed 5.11.2015

16. Tsuchida T, Makimoto K, Ohsako S, Fujino MK, Miyazaki T, Sugimoto T. Realtionship between catheter care and catheter-associated urinary tract infection at Japanese general hospitals: a prospective observational study. Internat J Nurs Stud 2008; 45:352-361.

17. Fink R, Gilmartin H, Richard A, Capezuti E, Boltz M, Wald H. Indwelling urinary catheter management and catheter-associated urinary tract infection prevention practices in Nurses Improving Care for Healthsystem Elders hospitals. Am J Infect Control 2012; 40 :715-20.

18. McNulty J, Bowen J, Foy C, Gunn K. Urinary catheterization in care homes for older people. J Hosp Infect 2006; 62: 29-36.

19. Ching TY, Seto S. Evaluating the efficacy of the infection control liaison nurse in the hospital. J Adv Nurs 1990;15: 1128-31.

20. Fakih MG, George C, Edson BS, Goeschel CA, Saint S. Implementing a national program to reduce catheter-associated urinary tract infection: a quality improvement collaboration of state hospital associations, academic medical centres, professional societies and government agencies. Infect Control Hosp Epidemiol 2013; 34:1048-54.

21. Goetz AM, Kedzuf S, Wagener M, Muder RR. Feedback to nursing staff as an intervention to reduce catheter-associated urinary tract infections. Am J Infect Control 1999; 27:402-5.

22. Tillekeratne LG, Linkin DR, Obino M, Omar A, Wanjiku M, Holtzman D, Cohn J. A multifaceted intervention to reduce rates of catheter-associated urinary tract infections in a resource-limited setting. Am J Infect Control 2014; 42: 12-16.

23. Marigliano A, Barbadoro P, Pennacchietti L, D'Errico M, Prospero E and CAUTI Working Collaborative Group. Active training and surveillance: 2 good friends to reduce urinary catheterization rate. Am J Infect Control 2012; 40: 692-5.

24. Marra AR, Camargo TZS, Goncalves P, Sogayar AMC et al. Preventing catheter-associated urinary tract infection in the zero-tolerance era. Am J Infect Control 2011; 39: 817-22.

25. Williams, D 2012. Prevalence survey of healthcare-associated infections in long term care facilities (HALT Study). Public Health Wales https://www2.nphs.wales.nhs.uk/WHAIPDocs.nsf/Public/29B97D254270976280257A0D00426B0E/$file/Halt%20Report%20Wales.pdf?OpenElement. www.carehome.co.uk accessed 5.11.2015

26. Nicholle LE. Urinary tract infections in long-term care facilities. Infect Control Hosp Epidemiol 2001; 22 167-75.

27. Barr B, Wilcox MH, Brady A, Parnell P, Darby B, Tompkins D. Prevalence of methicillin-resistant *Staphylococcus aureus* colonization among older residents of care homes in the United Kingdom. *Infect Control Hosp Epidemiol* 2007; 28: 853-59.

28. Gopal Rao G., Jeanes A., Russell H., Wilson,D., Atere-Roberts E., O'Sullivan D., Donaldson. N. Effectiveness of short-term, enhanced, infection control support in improving compliance with infection control guidelines and practice in nursing homes: a cluster randomised trial. Infect Control Hosp Epidemio l; 2009: 137 1465-1471.

29. ORION statement checklist http://www.idrn.org/documents/events/workshops/Checklist.doc accessed 15.1.2016

30. Priefer BA, Duthie EH, Gambert SR. Frequency of urinary catheter change and clinical urinary tract infection. Study in a hospital-based skilled nursing home. Urology 1982;20 141-142.

31. Andreeson L, Wilde MH, Herendeen P. Preventing catheter-associated urinary tract infections in acute care. The bundle approach. J Nurs Qual 2012; 27 209-17.

32. Wierman HR, Hallen S, Marino R, Morrione T. Development and implementation of an uncomplicated urinary tract infection protocol for interprofessional teams in the nursing home. Am J Infect Control 2014; S138.

33. Fakih M, George C, Edson BS, Goeschel CA, Saint S. Implementing a national program to reduce catheter-associated urinary tract infection: a quality improvement collaboration of state hospital associations, academic medical centres, professional societies and government agencies. Infect Control Hosp Epidemiol 2013; 34: 1048-54.

34. Gokula M, Gaspar P. Implementation of an EBP protocol to reduce use of indwelling urinary catheters in the long-term care environment. Am J Infect Control 2014; S232.

35. Galeon C, Romero I. Implementing a performance improvement project in a multi-level teaching facility on reducing catheter associated ur8inary tract infections (CAUTI). Am J Infect Control 2014; S130.

36. Abraham F, DeBakey E. A CAUTI bundle with a twist. Am J Infect Control 2014; S125.

37. Rummukainen ML, Jakobsson A, Matsinen M, Javenpaa S, Nissinen A, Karpi P, Lyytikainen O. Reduction in inappropriate prevention of urinary tract infections in nursing homes. Am J Infect Control 2012; 40: 711-14.

38. Mody L, Krein S, Saint S, Montoya A, Lansing B, McNamara S, Symons K, Fisch J, Koo E, Rye RA, Galecki A, Kabeto M, Fitzgerald JT, Olmstead RN, Kaufman C, Bradely S. Targeted infection prevention intervention in nursing home residents with indwelling devices. A randomized clinical trial. J Am Med Soc 2015; VOLUME: 714-24.

39. Trautner BW, Petersen NJ, Gendrett A, Hysong S, Patterson JE, Naik AD, An audit/feedback intervention reduces inappropaiate screening and treatment in patients with urinary catheters. Am J Infect Control 2012; 40: *e*79.

40. Zabarsky TF, Sethi AR, Donskey CJ. Sustained reduction in inappropriate treatment of asymptomatic bacteriuria in a nursing home through an educational intervention. Am J Infect Control 2008; 36:476-80.

41. Loeb M, Brazil K, Lohfield L, McGeer A, Simor A, Stevenson K, Zoutman D, Smith S, Liu, X, Walter SD. Effect of a multifaceted intervention on number of antimicrobial prescriptions for suspected urinary tract infections in residents in nursing homes: cluster randomized controlled trial. BMJ 2005; 331:669-705.

42. Grimshaw J, Campbell M, Eccles M Steen, N. Experimental anad quasi-experimental designs for evaluating guideline implementation strategies. Fam Pract; 2000: 17 S11-S18.

43. Spilsbury K, Hanratty B, McCaughan D. Supporting nurses in care homes. University of York Project Report: 2015.

44. Bowman C, Whistler J, Ellerby M. A national census of care home residents. Age Aging 2004; 33:561-66.

45. Laing and Buisson. Care of elderly people in UK Market Survey 2010/11. London: Laing and Buisson.

46. Administration on Aging. Statistics on the aging population. http://www.aoa.gov/prof/Statistics/statistics.asp. accessed 5.11.2015

Acknowledgements

This review was funded by Pathway to Portfolio Research Grant from Betsi Cadwaladr University Health Board, Wales, UK.

We would like to thank Deborah Edwards in the School of Healthcare Sciences, Cardiff University, Wales for advice with literature searching.

Conflict of interest

No conflicts of interest are declared

Highlights – to be put in a separate file labelled 'highlights'

1. Little research has been undertaken to prevent CAUTI in long-term catheterization

2. Evidence of the effectiveness of implementing clinical guidelines is mixed

3. Feasibility work could explore interventions that hold promise of effectiveness