Audit of catheter-associated UTI using silver alloy-coated Foley catheters

Coral Seymour

Abstract

Catheter-associated urinary tract infection (CAUTI) is the most common and most costly healthcare-associated infection, and possibly the most preventable (Salgado et al, 2003). The Cochrane Review of silver alloy-coated Foley catheters concluded that they are successful at reducing the rate of this healthcare-associated infection, which can be potentially fatal (Brosnahan et al, 2004). This article discusses the merits of using the silver alloy-coated Foley catheter in reducing the risk of CAUTI in an acute general hospital. A pre- and post-intervention design was used to audit CAUTI rates. During the pre-intervention period of 10 weeks, the Trust's standard catheters were used and CAUTI rates captured. Silver alloy-coated Foley catheters were introduced and their use monitored for a further period of 10 weeks. A total of 117 newly catheterized patients were actively monitored for signs and symptoms of CAUTI. The audit met and exceeded its aim of reducing the CAUTI rate by 20%. The CAUTI risk rate and device rate fell during the evaluation period. The use of the silver alloy-coated Foley catheters proved to be cost-effective given the recognized additional costs of CAUTI and prolonged in-patient stay (Plowman et al, 1999). Given the results of this audit it is recommended that the silver alloy-coated Foley catheter be the catheter of choice for use with acute patient admissions requiring short-term catheterization.

Key words: Urinary catheters ■ Infection control ■ Audit ■ Silver alloy-coated Foley catheters

Catheter-associated urinary tract infection (CAUTI) is a common clinical problem associated with considerable morbidity. The Department of Health's (DH's) evidence-based *Guidelines for Preventing Infections Associated with the Insertion and Maintenance of Short-Term Indwelling Urethral Catheters in Acute Care* (Pratt et al, 2001) draws attention to the significant risk that patients have of developing a urinary tract infection (UTI) when they are catheterized. The prevalence rate of urinary catheterization in hospitalised patients is estimated at 12.6% (Crow et al, 1998). Furthermore, between 20–30% of catheterized patients develop bacteriuria, of whom between 2–6% develop symptoms of UTI (Stamm, 1998). Of those patients with a UTI, 1–4% develop bacteraemia and of these, 13-30 die (Karchmer et al, 2000; Plowman et al, 2001).

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In their study Plowman et al (1999) reported that UTI caused patients to stay in hospital an extra 3.6 days. While a UTI is the least expensive hospital-acquired infection, at £1327 additional cost per patient at 1999 costs (Plowman, 1999), its high incidence renders this category of infection the most expensive single-site infection nationally, with an estimated cost of £123.89 million per year. As UTIs will also occur in the multiple-site infection category, these figures are likely to be an underestimate.

Plowman et al (1999) estimated the gross benefits to the study hospital (a district general hospital) at £48099 if UTI rates were reduced by 10%, with 228 bed days released for alternative use.

In their randomized cross-over trial of the silver alloy hydrogel-coated Foley catheter, involving almost 28000 patients in the US, Karchmer et al (2000) demonstrated a 32% reduction in the risk of infection compared with uncoated catheters. By preventing excess hospital costs from UTIs, significant cost savings were apparent. Using an economic model based on the NHS, Plowman et al (2001) have estimated the benefits of using silver alloy-coated Foley catheters would outweigh the costs when the proportion of infections prevented in the model is lower than demonstrated in the results of the clinical trials cited.

Maki and Tambyah (2001 p342) describe CAUTIs as 'perhaps the largest institutional reservoir of nosocomial antibiotic-resistant pathogens'. The Health Protection Agency (HPA) has reported the finding of community-acquired infections with organisms previously found only in the hospital setting, which emphasizes the need to prevent infection occurring in the first place thus mitigating the public health issue of antimicrobial resistance (HPA, 2003).

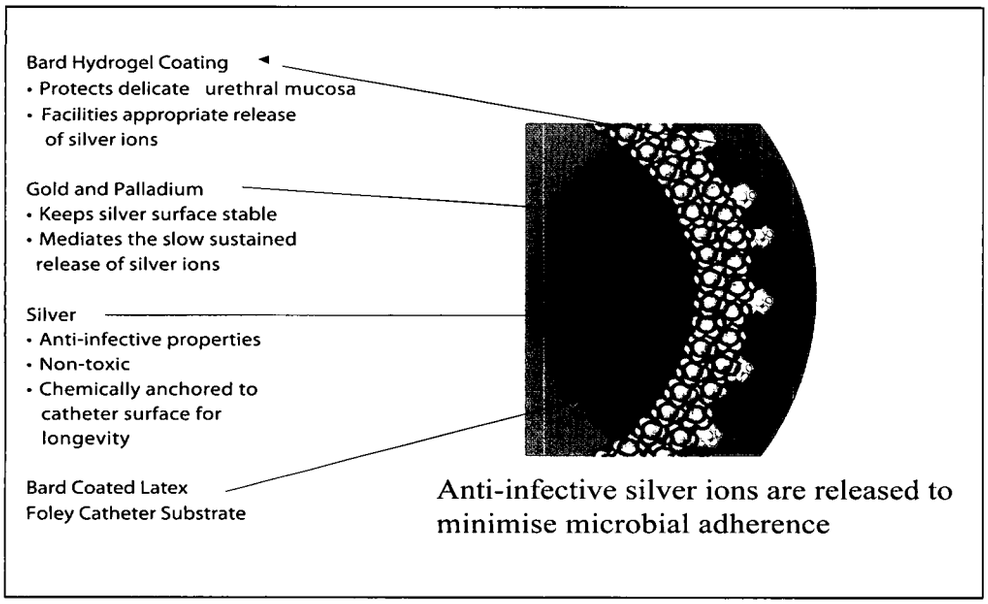
Rationale

Given the evidence above, the need to improve healthcare outcomes by reducing the incidence of CAUTI is apparent and an audit of CAUTI rates was planned. Once appropriate permissions had been gained through the Trust's clinical governance mechanisms, a steering group was formed that comprised representatives from the procurement department, the quality and audit department, the infection prevention and control team, medical and nursing urology specialists, the senior nurse at the district general hospital and the nurse consultant of continence services. The working group included a urology nurse specialist, ward staff, infection control nurses, an infection control clinical consultant and a urology research nurse.

How do silver alloy-coated catheters work?

Silver alloy-coated Foley catheters reduce bacterial adherence, minimizing biofilm formation (Ahearn et al, 2000). Their use has

Figure 1. Precise balance of elements in Bacti-Guard's® Silver Alloy Coating reduces microbial adherence.



been demonstrated to reduce CAUTIs by 32–69% (Bologna et al, 1999; Karchmer et al, 2000; Lai and Fontecchio, 2002; Brosnahan et al, 2004) and to reduce costs associated with this healthcare-associated infection (Plowman et al, 2001). A unique combination of noble metals and hydrogel coats both the inside and outside surfaces of the catheter, allowing a slow release of silver ions into the hydrogel which dissuades bacteria from settling on the catheter surface (*Figure 1*, reproduced with permission from BARD Ltd). No silver particles are released, so toxic effects are not seen in patients using this infection-control catheter, nor has bacterial resistance to silver become apparent, despite its use for thousands of years (Rupp et al, 2004). The silver alloy-coated Foley catheter is now available on the drug tariff, allowing patients cared for in their own home to benefit from this new technology.

Aim of the audit

The aim of this audit was to evaluate the reduction in the rate of nosocomial CAUTI experienced using a pre-test/post-test design. Here, patients using the standard catheter system would be followed and compared to patients using a silver alloy-coated catheter over a 20-week period (10 weeks using standard catheters and 10 weeks using silver alloy hydrogel-coated catheters). The latter was expected to realise a reduction in CAUTI of 20%.

The objectives were to:

- Obtain a baseline measure of the rate of CAUTI over a 10-week period
- Evaluate the rate of CAUTI over a 10-week period following the introduction of a silver alloy-coated catheter into practice across the hospital
- Measure length of stay of catheterized patients in the baseline and evaluation periods
- Record antibiotic usage in catheterized patients
- Identify reasons for catheterization
- Provide an economic analysis of any cost-avoidance potential arising from the use of silver alloy-coated Foley catheter.

Standards

An essential element of the audit process is the standard against which practice is compared (National Institute of Health and Clinical Excellence (NICE), 2002). Benchmarking of nosocomial CAUTI rates is sparse. In their model examining the economics of using silver alloy-coated Foley catheters, Plowman et al (2001) estimated an incidence rate of 7.3%. This provided the standard against which the hospital to be audited would be compared.

Methodology

The audit team adopted the methodology of the Public Health Laboratory Service's (PHLS) Nosocomial Infection National Surveillance Scheme pilot for surveillance of CAUTI (PHLS, 2000). Inclusion and exclusion criteria can be found in *Table 1*.

The urology and infection control clinical nurse specialists and urology research nurse managed the day-to-day data collection activity, assisted by the infection control clinical consultant. Newly catheterized patients' records were examined three times a week for signs and symptoms of CAUTI, including microbiological evidence. Ward nursing staff attached the patient's addressograph label to a patient registration form whenever a patient was catheterized. Where clinical signs and symptoms were recorded, these were documented on the form by the working group, minimizing any effects of the audit process on the nursing staff workload.

The baseline ran from 7 February to 24 April 2005; the evaluation period was from 27 April until 5 July 2005. Based on review of stock and usage levels, all standard catheters were removed from the wards and replaced with silver alloy-coated Foley catheters for the duration of the evaluation period, after which original stock was returned. A wide selection of types and sizes of catheter were found on ward areas and ward managers commented favourably that patient safety was improved by reducing the risk of erroneous

Table 1. Audit inclusion and exclusion criteria

Inclusion criteria	• All areas of the hospital • All adult inpatients who undergo insertion of Foley catheter for more than 48 hours duration until 3 days after catheter removal, discharge from hospital or for a maximum of 28 days after catheterization
Exclusions	• Day-case patients • Outpatients • Use of a three-way catheter • Patients admitted with a Foley catheter unless catheter specimen of urine (CSU) taken on admission is negative • Patients whose catheter is changed during admission unless a catheter is re-inserted within 24 hours. If it is more than 24 hours a new period of catheterization is counted

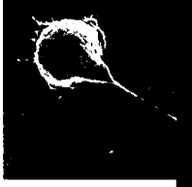


Table 2. Audit results

	Baseline	Evaluation
Patients	54	63
Mean age and range	79 (35–97)	79 (35–94)
Gender	M 17 (31.5%)	M 23 (36.5%)
	F 37 (68.5%)	F 40 (63.5%)
CAUTI	6	2
Risk rate	11.1%	3.2%
Risk rate reduction		71.2%
CAUTI/1000 catheter days	10.3	3.1
Device rate reduction		69.9%
Bacteraemia	1	0
Antibiotic usage	30 (56%)	31 (49%)

catheter selection for both size and type of catheter. No female length catheters were used during the evaluation, removing the risk of catheterizing a male patient with a Foley catheter that is too short, thus causing urethral trauma.

The project lead (urology specialist nurse) and the infection control clinical consultant entered data onto an Excel spreadsheet that calculated descriptive data (see Results section below). Patient-related data were handled confidentially at all times according to the provisions of the *Department of Health Confidentiality: NHS Code of Practice* (DH, 2003a).

Discussion of results

The audit demonstrated a risk rate of CAUTI (11.1%) higher than the standard (7.3%) during the baseline period (*Table 2*). The rate fell to below the standard during the evaluation period (3.2%) when silver alloy-coated Foley catheters were used, demonstrating a reduction in risk rate of 71.2%, exceeding the audit's aim of 20%.

Since the project began (October 2003) the Scottish Centre for Infection and Environmental Health (SCIEH) has piloted the PHLS/NINSS (2000) protocol, demonstrating an incidence of 7.2 CAUTI/1000 catheter days in their surveillance of more than 350 acute and primary care admissions (SCIEH, 2004). Gentry and Cope (2005) also used the same definition of symptomatic bacteriuria and found a rate of 9.5 CAUTI/1000 catheter days in their baseline. Their device rate fell by 48.5% during their evaluation of silver alloy-coated Foley catheters. In the present audit, the device rate fell by 69.9%, from 10.3 to 3.1 CAUTI/1000 catheter days.

It was not possible to demonstrate a reduction in the average length of stay of patients with urinary catheters following the introduction of the new catheters. The patients in the baseline stayed an average of 20 days (2–120 days range, 19 days median) compared with 17 days (1–51 days range, 18 days median) in the evaluation period.

Over half (56%) of catheterized patients in the baseline received antibiotic therapy, 49% in the evaluation. The audit did not seek to investigate prescribing practices, but these figures may be of interest to the infection control team and antibiotic pharmacist. Given the recent concerns regarding the increasing problem of antibiotic resistance (HPA, 2005a) and the spread of resistant pathogens (HPA, 2005b) it may be useful to examine the justification behind such prescribing practices, although it must be noted that the majority of patients in this audit were acutely unwell. Inappropriate prescribing of antibiotics in the elderly has been described by Nicolle (2001), particularly for treating urinary tract infections.

Reasons for catheterization were recorded from the catheterized patients' health records and are summarized in *Table 3*. Many of the patients catheterized on admission were extremely sick, needing accurate measurement of their fluid balance. Good practice guidance dictates that catheterization should be the last resort for the management of continence, after all other methods have been considered (Pratt et al, 2001; Association for Continence Advice, 2003; NICE, 2003). With an average age of 79 years, retention of urine accounted for more than 30% of reasons for requiring patients to be catheterized.

Table 3. Reasons for catheterization

Reason for catheterization	
Fluid balance management	50 (43%)
Incontinence	21 (18%)
Retention of urine	36 (31%)
Other	9 (8%)

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One of the patients suffering a CAUTI in the baseline period went on to develop bacteraemia. In Plowman et al's (1999) seminal work on the cost of healthcare–acquired infection (HCAI) blood stream infection was reported to be the most costly category of HCAI with additional costs, above those of caring for an uninfected patient, of £5397. Where an invasive device was implicated in the development of bacteraemia, urinary catheters come second to central venous catheters as a cause (Coello et al, 2003).

The current audit needs to be viewed against the contemporary context of infection prevention and control. There have been several initiatives focussing on HCAI in recent years. The Chief Medical Officer has highlighted the use of invasive devices and their implication in HCAIs (DH, 2003b), providing guidelines to reduce risks from Foley catheters and other devices. The next year the National Audit Office (NAO) published a progress report (NAO, 2004) following up on their original work examining the problem of HCAIs (Taylor et al, 2001). It noted patchy implementation of earlier recommendations and inconsistent levels of available information to inform Trusts of their progress in infection prevention and control. Audit, such as the work presented here, is one method of discovering what is happening. Infection prevention and control practitioners have been using this systematic method to improve and maintain good practice for many years. In 2004, the Infection Control Nurses' Association (ICNA) in partnership with the DH, published the second edition of its successful audit tools. This edition included tools to audit clinical practice, such as 'short-term urethral catheter management' (ICNA, 2004). The DH has recognized the need for all healthcare staff to be aware of their individual responsibilities for infection prevention and control and has prioritized five interventions considered to be of particular value at reducing HCAI (DH, 2005). Using the care bundle approach by providing the evidence-base, the audit tool, and an action planning facility, it is hoped clinical staff will engage in prioritizing, monitoring and improving their practice. The Royal College of Nursing (RCN) is also supporting these initiatives with its own 'Wipe it Out' Campaign, launched at the Chelsea and Westminster NHS Trust, London (RCN, 2005). Following appraisal of the evidence by the infection control team and liaison with key stakeholders, the silver alloy-coated Foley catheter (Bardex® I.C.) has been introduced as this Trust's catheter of choice as one of its key interventions to reduce HCAI. Using audit the author's Trust has demonstrated a lower rate of CAUTI when the silver alloy-coated Foley catheter was in use. Its clinical efficacy needs to be seen in the context of the above initiatives to improve practice and also in the context of its economic efficacy.

Economic analysis

The health economic repercussions of HCAI are not easy to quantify. Two cost avoidance scenarios using Plowman et al's (1999) findings can be examined in the context of this audit – avoided CAUTI costs and avoided extra bed-day costs:

1) By CAUTI reduction: estimated additional cost of CAUTIs and bacteraemia in baseline = £12 032. Estimated additional costs of CAUTIs in evaluation = £2654. Cost avoidance (minus increased catheter costs* in evaluation) = £9140
2) By reduction in excess bed days: extra bed days used in baseline = 23.6 days. Extra bed days used in evaluation = 7.2 days. Bed days saved = 16.4 days. 16.4 medical bed days saved at £233 (minus increased catheter costs* in evaluation) = £3583

*Calculated from the cost to this Trust of short-term, long-term and Bardex® I.C. catheters used, assuming one catheter per patient (except three patients in the evaluation whose catheters would have been replaced at 28 days).

Plowman et al's (2001) later work examined the costs and benefits of the routine use of silver alloy-coated Foley catheters. This economic model estimates a reduction in risk rate of 5% would cover the cost of Bardex® I.C. for this acute Trust.

Limitations of the audit

The number of catheterized patients examined during this audit precludes statistical analysis and generalization. The results indicate a tendency towards replication of the results of larger studies, although it was not designed as a research project, rather as an audit of a change in clinical practice. A Cochrane Review has reported statistically significant successful clinical outcomes (Brosnahan et al, 2004). This additional information influenced the update of the '*Epic*' national evidence-based guidelines to reduce HCAI that now include the appropriate use of silver alloy-coated Foley catheters (Pellowe et al, 2004). The Rapid Review Panel, recommended by the Chief Medical Officer in his report, *Winning Ways-Working Together to Reduce Healthcare Associated Infection in England*, to fast-track new products and innovations into health care (DH, 2003b) published its first recommendations at the end of 2004. Bardex® I.C. was awarded a Level 1 recommendation – that it should be made available for NHS bodies to use as part of their infection prevention and control strategies (DH, 2004).

The definition of CAUTI used demands both microbiological and symptomatic evidence of infection. Where symptoms were not documented they could not be assumed and it is possible that some infections were missed, especially as the average age of the catheterized patients was 79 years. Classic symptoms of infection are not always present in this group (Strausbaugh and Joseph, 2000).

Conclusions

- The introduction of a new silver alloy-coated Foley catheter was successfully implemented in a busy clinical setting. Here, the audit highlighted the use of different sizes and types of catheter and rationalization of stock by the use of one type of catheter would reduce waste and minimize inappropriate use
- The new catheter exceeded the anticipated 20% reduction of CAUTI. Rates of CAUTI fell during the evaluation period when the silver-alloy coated Foley catheters were in use
- Cost savings were made and Bardex® I.C. proved cost-effective compared with costs of catheters used during baseline.

Recommendations

Given the results of this audit it is recommended that the silver alloy-coated Foley catheter be the catheter of choice for use with acute patient admissions requiring short-term catheterization. The project lead has presented the audit findings to several key groups and to the Clinical Standards and Audit Committee. At the time of writing a decision is awaited. BJN

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Bardex® I.C. Foley catheters were supplied for the duration of the evaluation at the same cost as the Trust's choice of hydrogel-coated latex Foley catheter, Biocath®.

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KEY POINTS

- Urinary tract infections are the commonest healthcare-associated infection (HCAI); 80% of which are related to the use of indwelling Foley catheters (Emmerson et al, 1996).
- Evidence demonstrates that silver alloy-coated Foley catheters are effective at reducing catheter-associated urinary tract infections (CAUTIs) (Brosnahan et al, 2004).
- The routine use of silver alloy-coated Foley catheters is cost-effective (Plowman et al, 2001).
- An audit of CAUTIs in an acute district general hospital demonstrated the above key points. The CAUTI risk rate fell by >70% while silver alloy-coated Foley catheters were in use.

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