A study to compare the microbiological contamination of 3 types of hospital privacy curtains within a district general hospital.

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Background

Providing a microbiological safe patient environment is a challenge for infection prevention teams. The hospital environment may be contaminated with different pathogens as such may act as an important role in the transmission of healthcare associated infections (Boyce, 2007). An area that has received minimal attention over the years is the potential hazard posed by hospital privacy curtains. Hospital fabrics such as curtains that surround the patients' environment could provide a source for transmission of healthcare associated pathogens for several reasons (Klakus, 2008). First, they are commonly touched by both patients and healthcare workers hands (HCWs). Secondly, the recommended intervals for laundering curtains is a minimum every six months unless visibly soiled or after known exposure to 'alert' organisms such as Norovirus, Meticillin resistant *Staphylococcus aureus* (MRSA) and *C.difficile* or following an outbreak (NPSA, 2010). Thirdly, HCWs may inadvertently contaminate their hands from the patient's immediate environment. There are a number of studies that suggest staff are less likely to disinfect their hands after contact with inanimate objects than after direct contact with patients, increasing the likelihood of curtains becoming contaminated (Trillis et al, 2008, Smith et al, 2012). At the time of the study hospital curtains were washed using a commercial external laundry facility which conforms to current standards CFPP 01-04 (DH, 2011) (65ºC for not less than ten minutes or 71ºC for not less than three minutes).

Previously published work examining level of contamination suggest curtains can facilitate the harbour of micro-organisms such as *Staphylococcus aureus*, Glycopeptide Resistant Enterococci, carbapenem-resistant *Acinetobacter baumannii* and MRSA (Trillis et al, 2008, Ohl et al, 2012). A recent study by Ohl (2012), which evaluated the use of a curtain containing a biocide which consisted of a specially formulated metal alloy incorporated into the curtain fibre, delayed the onset of colonisation with micro-organisms compared to traditional hospital polyester curtains.

The aim of this evaluation was to investigate the level of curtain contamination with micro-organisms using 3 types of curtains in a variety of clinical settings and establish the effectiveness of Endurocide® Sporicidal and Antimicrobial Curtain.

Methods

This double blinded study took place within a medium sized district general hospital. The location for the curtain study included Accident and Emergency (A&E) department and two medical wards specialising in respiratory and renal medicine respectively. Within the medical wards three beds from a four bedded bay were identified for the evaluation and within A&E three cubicles next to each other were chosen. New sets of hospital polyester curtains were hung by members of the hospital laundry department on one of the 3 beds within the specified location. A member of the infection prevention & control team (IPC) then hung two other types of curtains within this location. One

being polypropylene disposable curtains which was impregnated with a biocide, known as Endurocide® Sporicidal and Antimicrobial Curtain. The other was an Endurocide® disposable curtain which was identical but without the Sporidical features. The Endurocide® Sporicidal and Antimicrobial Curtain is claimed to work by coating the curtain fabric with a biostatic polymer layer which prevents multiplication of pathogens and is claimed to remain effective for upwards of 12 months.

In order to prevent bias both types of disposable curtains (Endurocide® Sporicidal and Antimicrobial Curtain and Endurocide® disposable) which are produced by the same company looked identical therefore ward staff, laboratory staff and IPC were unable to differentiate between the two disposable curtain types. The clean hospital curtain utilised was a standard hospital curtain which conformed to the clinical areas normal practice. Details of curtain batch numbers were made available once the study data was analysed.

In total there were nine sets of curtains cultured on a twice weekly basis except during Christmas week where sampling occurred once during the week. The cultures were taken between November 2012 to January 2013, in total 204 cultures were taken from the curtains with 36 from A&E, 84 from medical ward (26) and 84 from renal ward (32). The evaluation within A&E lasted over a period of 3 weeks only due to all 3 curtains becoming contaminated with bodily fluids within a few days of each other. These curtains were therefore changed back to standard hospital curtains and data collection ceased. The evaluation within the two medical wards (32 and 26) continued for 8 weeks.

Sampling

The sampling was undertaken by two members of the IPC team only. Prior to sampling staff donned gloves and performed hand hygiene prior to each sampling. Curtains were sampled using an individual agar plate for each curtain. The technique methodology adopted was based on previous research (Klakus, 2008). This approach used the plate to ‘sweep’ the curtains using the leading edge of the agar plate 90 cm above the ground to 190 cm above the ground to disturb loose material and curtain fibres onto the agar surface without contact between the fabric and agar surface. The sampling process then consisted of sampling the leading edge of the curtain using a sterile moist swab 90 cm above the ground to 190 cm above the ground, to a depth of 4 cm, on the front and back sides. This area was chosen on the basis of where patients and staff would be most likely to routinely touch the curtain from observations.

The direct plates (Columbia Blood Agar) received ready-inoculated from the curtain on test were incubated in a 5% carbon dioxide-enriched aerobic environment at 37ºC for a total of 48 hours before examination. The swabs received were plated out by standard methodology onto single plates of Columbia Blood Agar, CLED agar with andrades indicator, Braziers *Clostridium difficile* selective agar and Sabouraud dextrose agar containing

chloramphenicol. Finally, the swab tip was broken into a universal of Brain-Heart Infusion broth to enrich any growth of small numbers of organisms. This broth was sub-cultured after 24 hours incubation onto single plates of Columbia Blood Agar, CLED agar with andrades indicator and Brilliance MRSA 2 agar (all media supplied by Oxoid Ltd, Basingstoke, UK). Media were incubated in the gaseous conditions and for lengths of times as recommended by the manufacturer.

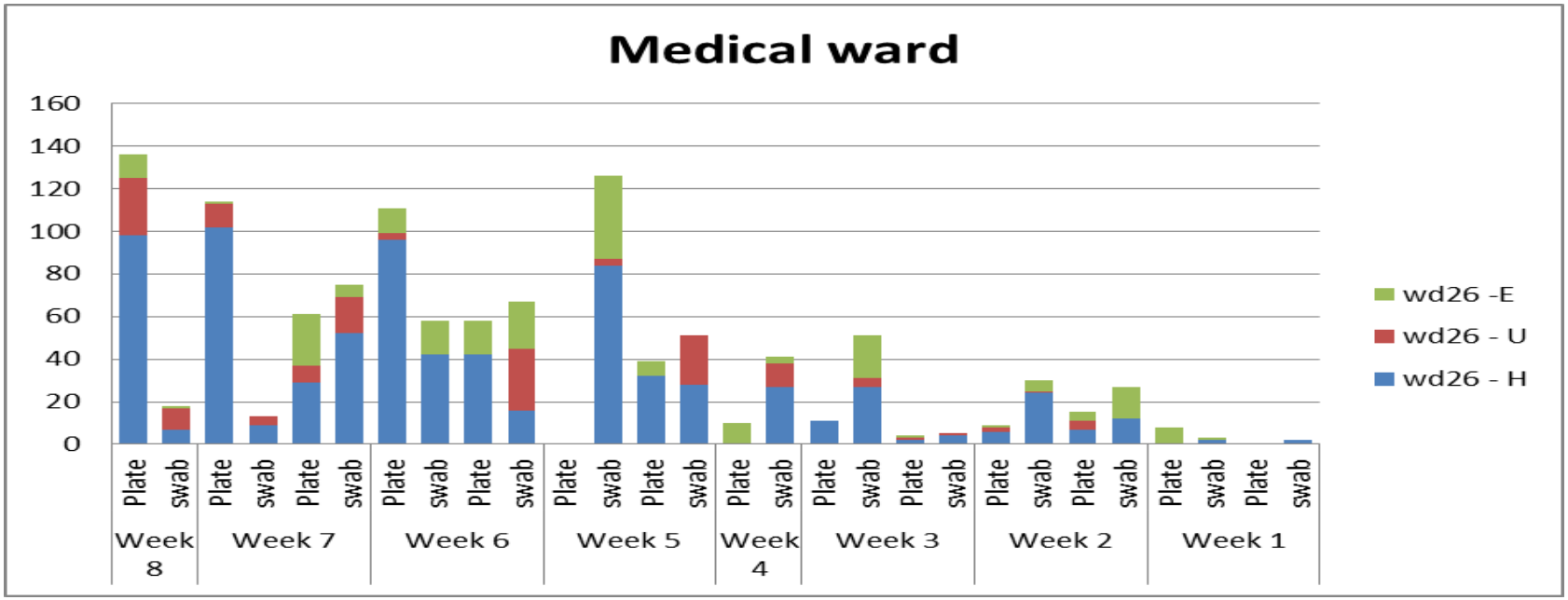
All colonial types were counted and identified by colonial morphology, Gram stain and other standard methods of identification used within this laboratory such as catalase & oxidase enzyme production and Staph Xtra latex for identification of *Staphylococcus aureus* (Pro-Lab Diagnostics, Bromborough, Wirral, UK). Any further identification required was performed by use of the Vitek analyser (BioMerieux, Marcy-l'Etoile, France). All *Staphylococcus aureus* isolated were tested for meticillin resistance by their sensitivity to the antibiotic cefoxitin (method followed as recommended by The British Society for Antimicrobial Chemotherapy).

Target Organisms	**Medium**	**Gaseous conditions**	**Length of incubation (h)**
Most aerobic or facultative- anaerobic organisms	Columbia Blood Agar	Air with 5% carbon dioxide	24
Gram-negative bacilli, *enterococci*, *staphylococci*	CLED agar with andrades	Air	24
Fungi	Sabouraud Dextrose Agar	Air	48
Clostridium difficile	Braziers *C. difficile* selective agar	Anaerobic	120
MRSA	Brilliance MRSA agar	Air	24
Any, for enrichment	Brain Heart infusion Broth	Air	24

Results.

Overall there were 204 samples taken from all curtains within the three separate locations. The commonest micro-organism detected was coagulase negative S*taphylococci* (CoNS) species such as *Staphylococcus epidermidis,* this was found in 78.4% of the positive cultures. The cultures identified 23.5% of bacterial growth was due to Gram negative bacilli. The gram negative group included organisms such as Enterobacter spp, Pseudomonas spp, Acinetobacter spp. The cultures showed 3.9% of samples were *Staphylococcus aureus* of which one was found to be Meticillin resistant *Staphylococcus aureus*. This was detected in a hospital curtain on the medical ward. The mean colony forming unit count (CFU) from samples was16 cfu for Endurocide® Sporicidal and Antimicrobial Curtain and 21 cfu for the Endurocide® curtain. The results for the hospital curtain showed a mean count of 62 cfu.

Chart 1. **Ward 26 showing CFU by sample type over the 8 weeks**.



E= Endurocide sporicidal and antimicrobial curtain
U= Endurocide curtain
H= Hospital curtain

Table 1. **Frequency of contamination on sampled curtains wd 26.**

Growth	N	%
CNS	64	73.5
S.aureus	5	5.7
Gram negative bacilli	20	22.9
Enterococcus spp	8	9.1
Any bacterial growth	72	82.7

X1 *S.aureus* was MRSA

Chart 2. **AE showing CFU by sample type over the 3 weeks.**

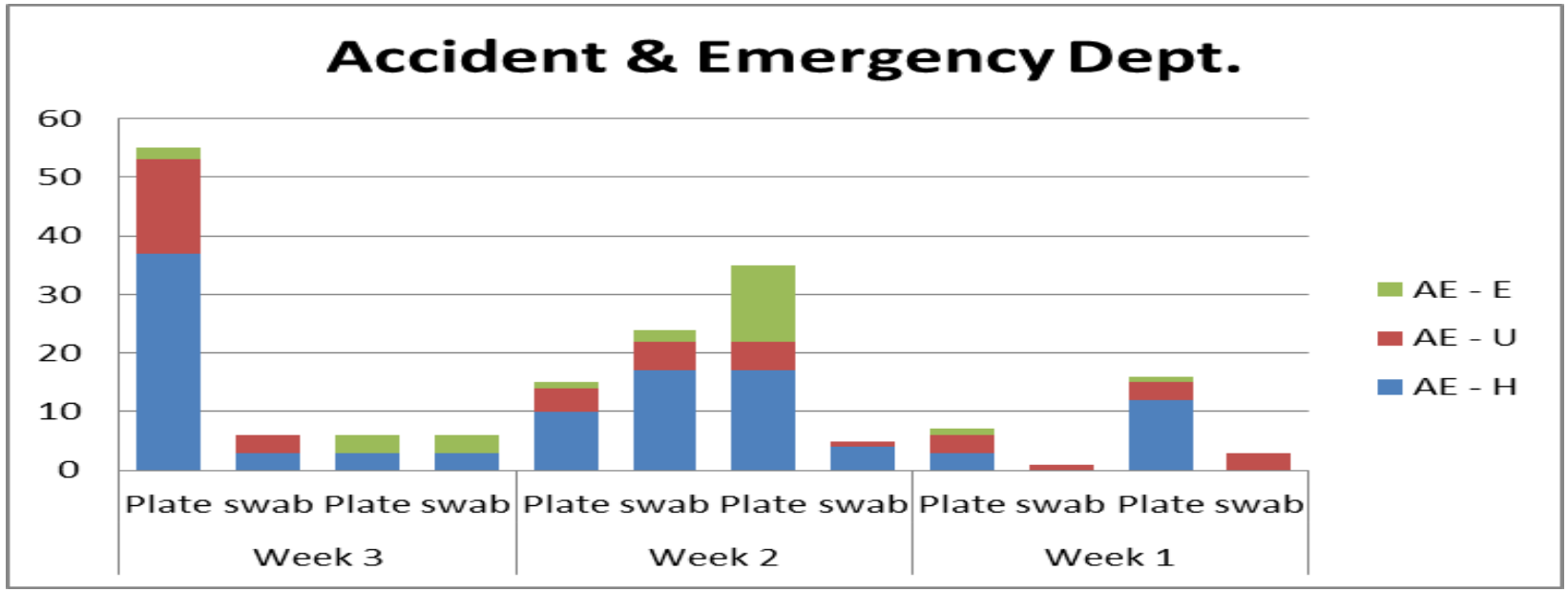


Table 2. **Frequency of contamination on sampled curtains AE.**

Growth	n	%
CNS	29	80.5
S.aureus	1	2.7
Gram negative bacilli	6	16.6
Enterococcus spp	2	5.5
Any bacterial growth	29	80.5

Chart 3. **Renal ward showing CFU by sample type over the 8 weeks.**

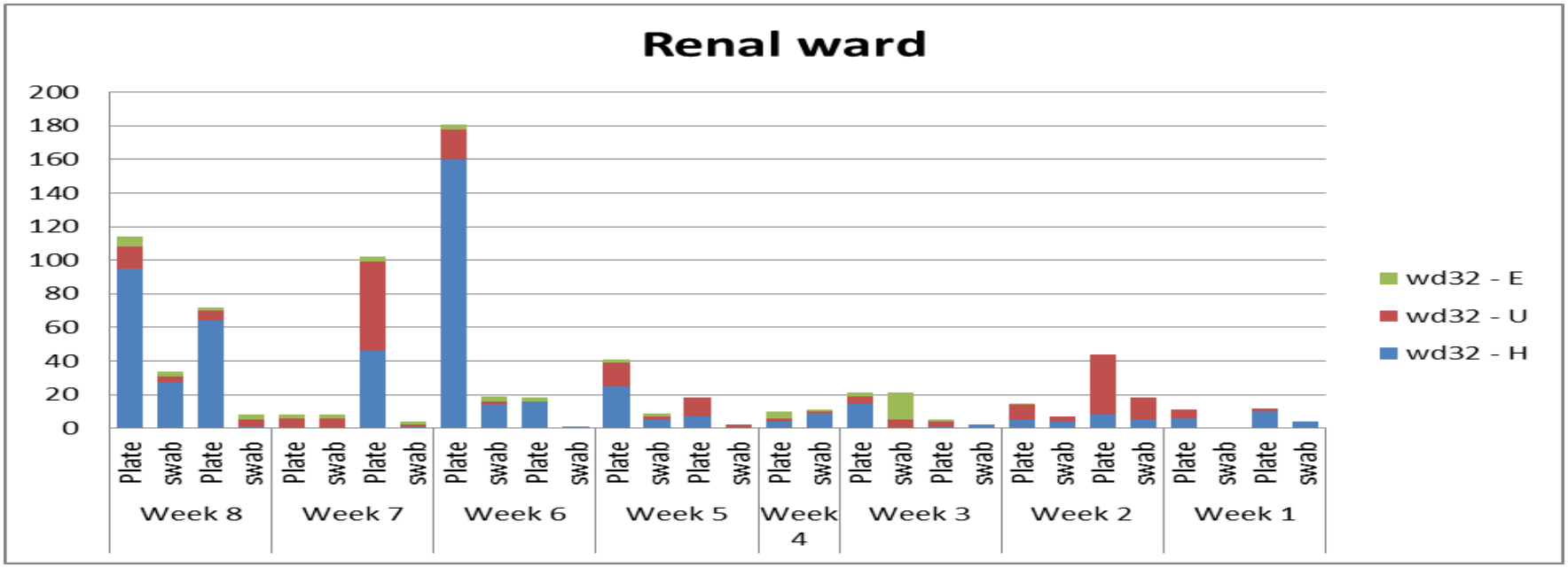


Table 3. **Frequency of contamination on sampled curtains Renal ward**

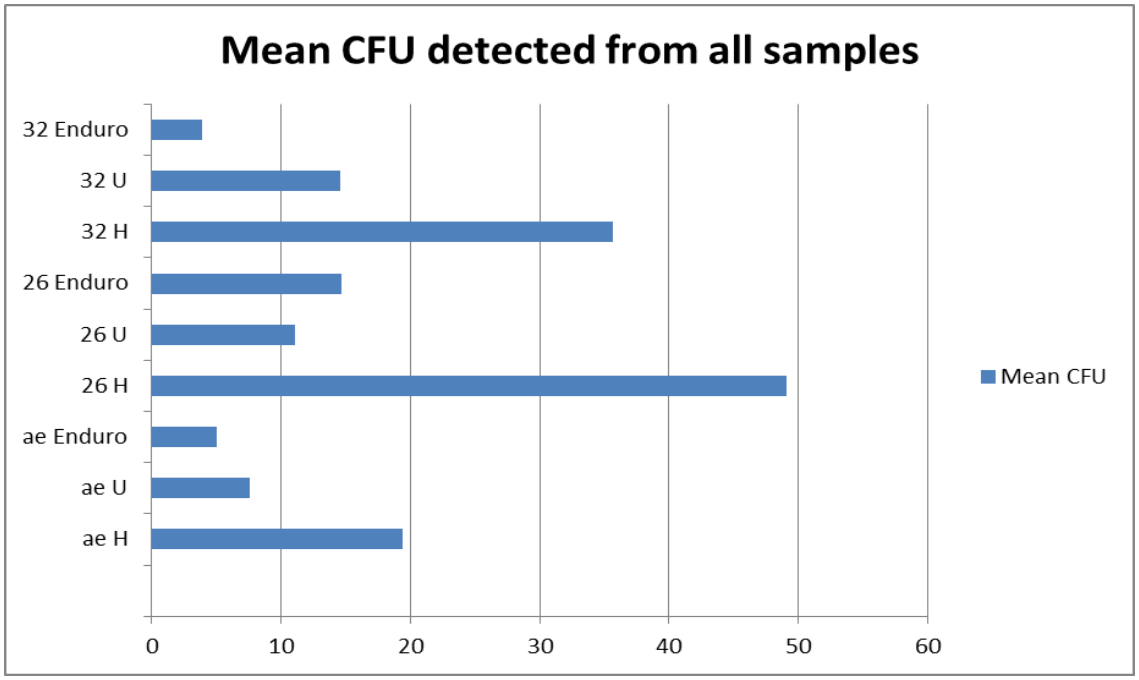
Growth	n	%
CNS	67	79.7
S.aureus	2	2.3
Gram negative bacilli	22	26.1
Enterococcus spp	5	5.9
Any bacterial growth	76	90.4

Table 4 – Mean CFU by curtain type

Colony forming unit counts by curtain type

Measure	ae H	ae U	ae Endurocide	26 H	26 U	26 Endurocide	32 H	32 U	32 Endurocide
Mean	19.40	7.60	5.00	49.07	11.07	14.67	35.67	14.60	3.87
Std. Deviation	15.274	7.162	4.848	47.399	11.430	13.151	49.739	16.128	4.764
Sum	97	38	25	736	166	220	535	219	58

Chart 4 – Mean CFU counts from all samples collected by location.



Findings.

This study has demonstrated that privacy curtains in the hospital setting are frequently and rapidly colonised with a variety of health-care associated pathogens. The sampling within Accident and Emergency department was curtailed due to gross contamination with bodily fluids after a period of 3 weeks. The results showed that the disposable curtains had the lowest CFU counts compared to the hospital curtain but not statistically significant. The results within the medical ward appeared to show the use of disposable curtains was superior to hospital curtains and the Endurocide® curtain had the lowest CFU count ($p = 0.33$). The findings within the renal ward again showed the disposable curtains had the lowest CFU counts compared to the hospital curtain and the Endurocide® Sporicidal and Antimicrobial Curtain had the lowest levels of contamination ($p= 0.38$). The sampling within Accident and Emergency department was curtailed due to gross contamination with bodily fluids after a period of 3 weeks. Overall, the findings suggest that contamination of curtains occurs readily within the clinical setting and may act as a potential source for cross-infection. Hospital curtains are routinely changed on a 6 monthly basis although there is no formal process to ensure this happens. Curtains tend to be changed once they have been exposed to a patient with an active infection such as MRSA or *C.difficile* and will now require off site laundering. The cost of decontamination of hospital curtains is approximately £5 per curtain with the average bed-space requiring two curtains. The capital cost of purchasing new Textile curtains is variable around £50 per bed.

The findings demonstrate the importance of undertaking hand hygiene after patient contact and after undertaking activities within the patient environment such as handling curtains as per the WHO hand hygiene guidelines. The findings of this study also demonstrates that hospital curtains are more likely to become readily colonised with micro-organisms due to the nature of the fabric material, as such could increase risk of dissemination of pathogens during opening and closing of curtains.

This study does have a number of limitations. Firstly, due to the small surface area sampled it is plausible that bacterial growth was grossly underrepresented as it may have missed contaminated areas. Secondly, we did not directly demonstrate transmission of organisms from curtains to patients or identify its source. Thirdly this was a small study undertaken over a limited period of time with limited resources therefore more sophisticated testing using pulsed-field gel electrophoresis (PFGE) was not utilised.

In summary this study found that hospital curtains were frequently contaminated with pathogens and that these organisms could be acquired on hands or dispersed during opening and closing of curtains. Results suggest the use of disposable curtains are superior in having a lower contamination level compared to traditional hospital curtains.

References

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