

# Is our current cleaning method effective at eradicating Clostridium difficile?

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#### **ABSTRACT**

#### Introduction

C. difficile was first described by Hall & O'Toole in 1935 and was so named due to the difficulty in culturing the bacterium. Antibiotic-associated diarrhoea was later linked to *C. difficile* as was pseudomembranous colitis in 1978.

Incidence and severity of C. difficile infection has changed drastically over this time. Disease is now more severe and a higher number of cases progress to toxic megacolon.

C. difficile inhabits the intestinal tract without causing disease in approximately 3% of healthy adults.

#### Methods

Polywipes™ were used to sample 17 environmental sites in 13 side rooms which were occupied by *C. difficile*-positive patients. Samples were taken both before and after cleaning of the rooms.

Polywipes™ were swabbed over the areas to be tested using both sides of the sponges for maximum recovery of organisms. Culture was performed by pressing the Polywipes™ directly onto Brazier's agar plates.

Plates were read and suspect colonies were confirmed as C. difficile using a C. difficile latex test.

21% of sites were positive for C. difficile before cleaning and 15% of sites were positive after cleaning.

Under bed flooring was the site most frequently positive for C. difficile overall (59%) followed by toilet floors (46%) and bed rails

Toilet floors were most frequently positive for C. difficile both before and after cleaning (45%). Other sites positive both before and after cleaning include under bed floors (43%), locker tops (15%), bed rails and windowsills (both 14%).

#### Discussion

C. difficile is frequently and easily transferred around the patient's environment.

The bacterium is not always eradicated from the environment. Under bed floors are difficult to clean; near-patient equipment may limit access to this area.

Spores of *C. difficile* can be aerosolised by certain actions such as closing curtains and making a bed.

Frequently touched areas may be re-contaminated.

Patients may secrete more than one ribotype of *C. difficile*.

#### The role of Clostridium difficile as a source of serious healthcare acquired infections

In hospitalised patients, the percentage of those colonised with the bacterium rises to 20-40% (Gould & McDonald, 2008; Hookman & Barkin, 2009) and therefore hospital transmission of *C. difficile* is the principal mode of transmission of the bacterium (Gould & McDonald, 2008). Spores of C. difficile are excreted by infected patients (Lawley et al., 2009) and can persist in the environment for months to years (Carter & Barry, 2011).

The risk of disease is increased in certain situations including gastrointestinal surgery, immune-compromising conditions, prolonged length of stay in hospital and treatment with antibiotics and gastric acid inhibitors. The use of antibiotics is believed to be the most important risk factor (Hookman & Barkin, 2009). Disruption of the colonic flora affects the risk of CDI for up to three months (Gould & McDonald, 2008).

It has been reported that up to two-thirds of hospitalised patients may be colonised with C. difficile. Those that are asymptomatic can become sources of transmission of the bacterium (Hookman & Barkin, 2009) through the shedding of highly infectious and resilient spores. C. difficile spores are metabolically dormant and are extremely resistant to common disinfectants. These robust spores create a reservoir of infection so that transmission can occur readily in the hospital environment (Underwood et al., 2009).

It is possible that a patient with CDI excretes between 1 x 10<sup>4</sup> and 1 x 10<sup>7</sup> C. difficile spores per gram of faeces. These spores are easily transferable to a variety of surfaces by the patient and health care workers if hand hygiene with soap and water is not adhered to (Best et al., 2010).

#### References

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## Aims of project

A study evaluating the efficacy of hospital cleaning procedures around patients with Clostridium difficile infection (CDI) is required to determine whether hospital cleaning protocols are effective.

This study explored the transmission of *C. difficile* in the immediate environment of patients with CDI at a hospital in order to determine which sites are most commonly contaminated with the bacterium. In order to do this, a practical environmental sampling protocol was developed for use before and after cleaning. C difficile was subsequently recovered from the sampling wipes (Polywipes™) using a method that was trialled before commencement of environmental sampling.

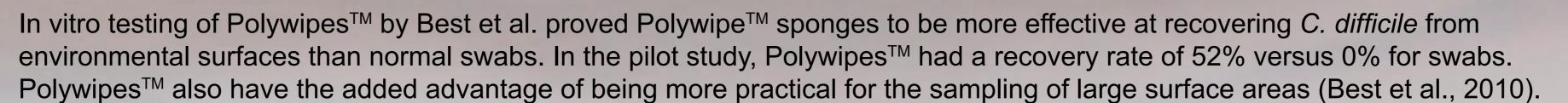
Samples were taken before and after cleaning to establish whether the daily clean of ward side rooms is effective at eradicating C. difficile spores. The positivity and negativity of sites before and after cleaning was analysed to gain insight into cleaning performance and patient behaviours, e.g. effectiveness of Actichlor Plus<sup>™</sup> and hand hygiene of patients.

Ribotyping was performed at Stobhill Hospital on two environmental isolates from each side room and each patient isolate in order to determine a link between the isolates

## Materials

#### Polywipes™

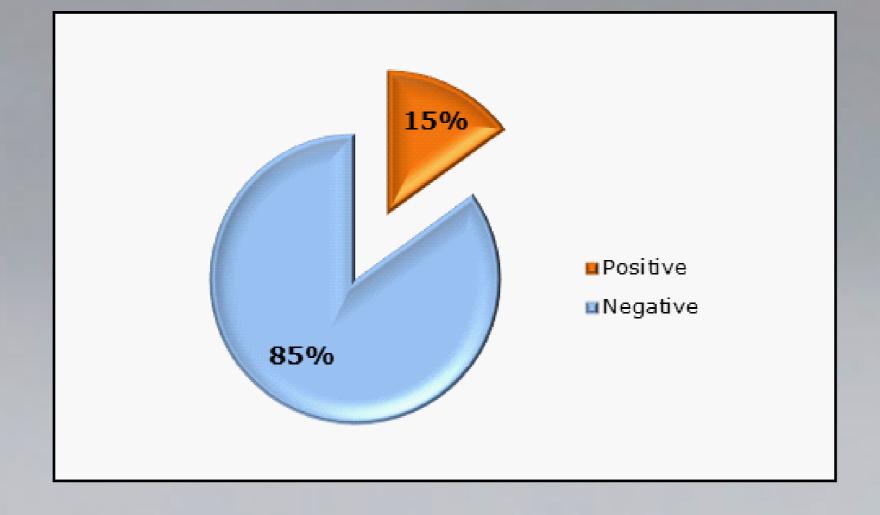
Polywipes™ (Medical Wire) are sterile pre-moistened sponges that are designed for the sampling of large areas e.g. floors, bed rails and over-bed tables. Polywipe™ sponges are 10cm x 5cm and flexible. Maximum recovery of organisms is achieved by the noninhibitory nature of the Polywipe™; any disinfectant present on the sampled surface that is transferred to the Polywipe™ is diluted to levels that are non-lethal to microorganisms. Samples can therefore be stored in a refrigerated environment until commencement of inoculation onto Brazier's medium.

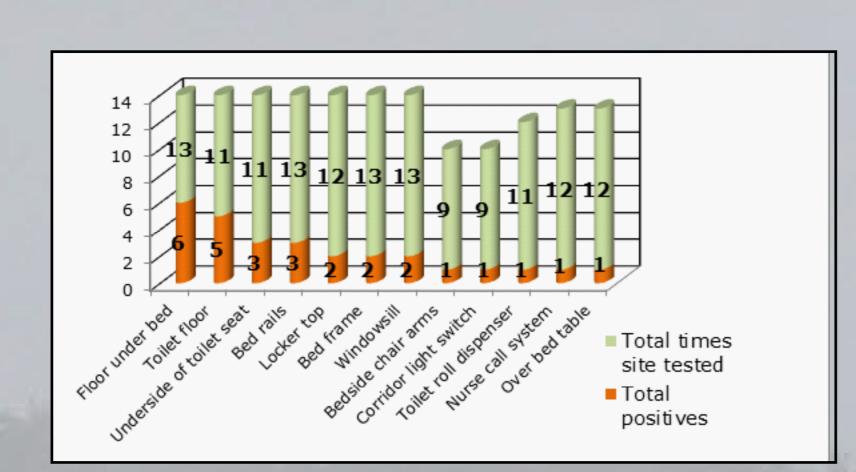


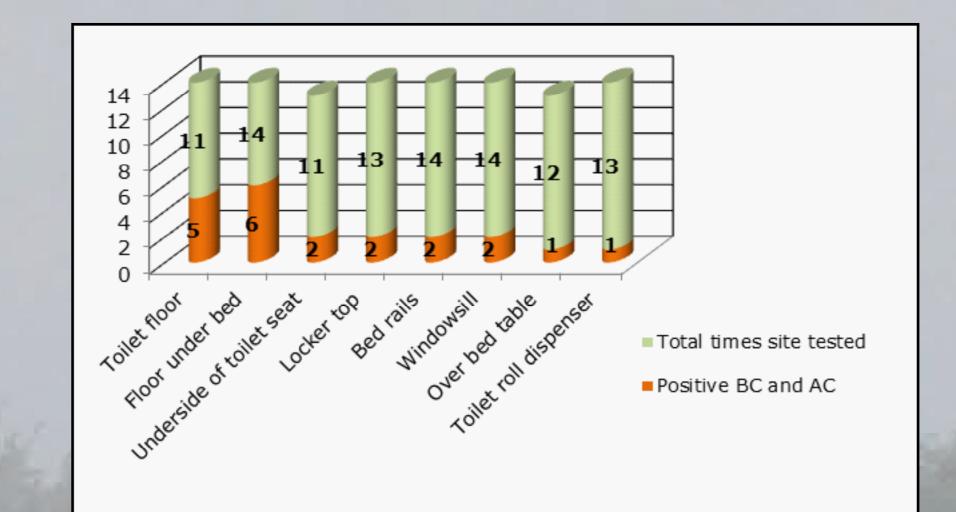
Brazier's Clostridium difficile selective agar: This medium's intended use is for the selected isolation and presumptive identification of C. difficile from clinical specimens. It was utilised in this project for the isolation of C. difficile from environmental specimens.

Fastidious Anaerobe Agar (FAA): FAA is an enriched non-selective medium used for the cultivation of fastidious anaerobes from clinical specimens. Peptone is incorporated in the medium to provide nitrogen and vitamin sources; glucose is the carbon source. Sodium bicarbonate acts as an oxygen scavenger thereby increasing the aerotolerance (acumedia, 2011). FAA was used in this study for the sub-culturing of C. difficile from Brazier's agar in order to yield the maximum number of spores prior to RCM inoculation for ribotyping.

# Results







### Methods

#### Alcohol shock

Alcohol shock (or ethanol treatment, ET) is a selective treatment for the isolation of *C. difficile* (Processing of faeces for *C.* difficile, 2012). A study performed by Marler et al. found alcohol shock to be one of the most effective procedures for the isolation of C. difficile (Marler et al., 1992).

C. difficile forms spores that can survive harsh treatments such as heat shock and alcohol shock. These treatments kill vegetative cells and are therefore used to prevent the growth of contaminating faecal bacteria when attempting to isolate C. difficile. By eliminating competing flora, alcohol shock treatment enhances both the isolation and recognition of C. difficile (Perry et al., 2010).

Alcohol shock was used in the experiments testing the efficacy of Polywipes™. Known *C. difficile*-positive stool samples were used to contaminate a Perspex surface with *C. difficile* in order to test the ability of Polywipes™ to pick up spores from surfaces and release them onto an agar plate. Alcohol shock was performed on the stool samples to kill faecal flora which cannot survive this harsh treatment. Alcohol shock left only C. difficile spores which could then be dispensed onto the Perspex surface for swabbing with the Polywipe™.

#### Inoculation

Polywipes™ were pressed directly onto Brazier's agar plates for the culture of *C. difficile*. Both sides of the Polywipe™ were used when sampling the environmental surfaces and both sides were pressed onto the Brazier's plates. This maximised the yield of any C. difficile recovered from the patient's side room.

#### Sampling sites

Bedside chair arms

• Bed frame

Nurse call system

• Locker top (and underside)

• Television remote control handset • Floor under bed

Over bed table

The following sites were sampled in each ward side room using Polywipes™ before and after cleaning:

Emergency cord/button in toilet

• Toilet floor

• Toilet roll dispenser

 Underside of toilet seat • Inner door handle of toilet • Toilet light switch

Right/left bed rail

• Windowsill

Top of television

Paper towel/soap dispenser in room

## Ribotype Results

There is evidence of poor hand hygiene and transfer of C. difficile from patient's hands when the ribotype of the patient isolate corresponds with that of the environmental isolates. This occurred in the majority of

Patients can shed more than one isolate of *C. difficile*; one may be causing infection and the other may simply be colonising without causing infection. This may be evidenced when the ribotype of the patient isolate does not match that of the environmental isolate. This occurred in two cases. In one case, two different ribotypes were found in the environment, neither of which matched the patient's ribotype. However, if this is not the case, these results may suggest that spores of C. difficile from previous occupants have persisted in the environment and have failed to be removed by cleaning.

## Conclusions

- The sampling method was very effective at recovering C. difficile from different environmental surfaces. The organism was easily recovered from Polywipes™ before and after cleaning.
- These results suggest that either the cleaning technique was not performed correctly or that Actichlor Plus is not entirely effective at eradicating C. difficile spores from the environment. This is supported by the isolation of more than one ribotype of *C. difficile* from a single side room.



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