

Curtains as a source of *Clostridium difficile*: the importance of sampling methods

Introduction and Purpose

C. difficile is highly transmissible between hospitalised patients and control measures to limit cross infection are part of routine practice⁽¹⁾. It has become increasingly important to determine how transmission is occurring and to establish effective interventions to minimise these risks⁽²⁾. Control methods to limit *C. difficile* transmission in healthcare environments include barrier methods, isolation of infected patients and compliance with hand hygiene measures to minimise the dissemination of spores⁽³⁾.

Hospital curtains could be a source for transmission of *C. difficile* as they are commonly touched by patients, healthcare staff and visitors to the ward. Curtains are cleaned and changed infrequently, and healthcare staff are less likely to wash their hands after contact with inanimate objects than contact with patients. Additionally, recent work has demonstrated the potential for airborne dissemination of *C. difficile* spores, especially from patients with recent onset diarrhoea, which may contribute to widespread environmental contamination⁽⁴⁾. Curtains when drawn might also release particles and microorganisms that could potentially increase the risk of airborne transmission.

We aimed to determine the extent of *C. difficile* contamination on ward curtains in the vicinity of patients with symptomatic CDI and from this demonstrate that curtains may be a source of transmission of *C. difficile* using an intensive sampling method for bacterial recovery.

Materials and Methods

Organisation of curtain sampling and setting

- All curtains sampled were located in single rooms in elderly care wards in Leeds Teaching Hospitals. Curtains at windows in the rooms of 4 symptomatic CDI patients and 4 control hospitalised patients were intensively sampled.
- Patients with CDI had been laboratory confirmed (cytotoxin testing) and had diarrhoea at the time of sampling (Table 1).
- All curtains tested were approximately 120cm x 140cm (total surface area 16800 cm²), made from 40% cotton and 60% polyester and were hung on an overhead track at the windows in single bedded side rooms.
- Sponge wipes (Polywipes™ Medical Wire & Equipment, UK) (Figure 1) were used to remove particulate matter from the entire surfaces of curtains hanging at the windows in patient side rooms.
- To ensure complete coverage of each curtain, the total surface area was split into 9 segments (Figure 2) on the front and 9 on the back, with each segment (approximately 1600 cm²) sampled separately. This yielded 18 samples per curtain, and a total of 144 samples (72 from CDI case and 72 from control curtain segments).

Sampling and processing

- Following sampling, Polywipe™ sponges were placed directly into Robertson's cooked meat broth (E&O Laboratories, UK) and incubated anaerobically, at 37°C for 48 hours.
- A 20µl sample was removed and subcultured onto a *C. difficile* selective agar plate containing Brazier's cycloserine-cefoxitin-egg yolk agar (Bioconnections, UK) supplemented with 5 mg/mL lysozyme (CCEYL) plate and incubated anaerobically for 48 hours at 37°C. Plates were examined for presence of *C. difficile*.

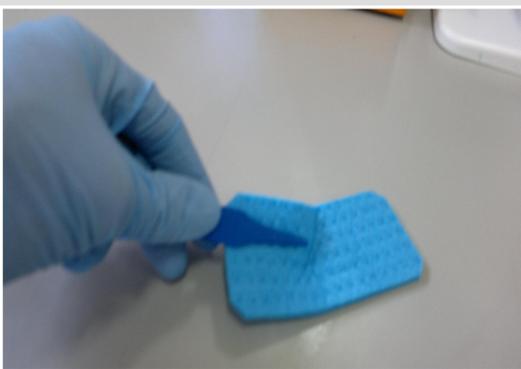


Figure 1. Polywipe sponge



Figure 2. Example of curtain sampling plan (front & back)

Results

- C. difficile* were isolated from every curtain sampled in rooms housing known CDI cases.
- No *C. difficile* was recovered from the curtains in the rooms housing patients without CDI.
- Figure 3 shows the percentage of each curtain that was positive based on the 18 segments per curtain sampled (9 on the front and 9 on the back). For three of the four curtains sampled only the front or the back was positive; for the remaining curtain *C. difficile* was recovered from both surfaces.
- The proportion of each total curtain surface area contaminated with *C. difficile* averaged 19% (range 11-55%).
- Therefore random sampling of a single curtain surface area of 1600 cm² had an approximate 80% chance of missing true *C. difficile* contamination. This risk likely increases further if the surface area sampled is less than the large segments examined in the present study (i.e. 1600cm²).
- When comparing the *C. difficile* positive areas of each curtain we found no clear similarities. The areas of the curtain assumed to be handled most frequently, such as the inside edge at hand height, and therefore the most contaminated were not always positive. However, curtain number 3 which had the highest percentage area positive for *C. difficile* (44.4% on the front and 55.5% on the back) was a single unfixed curtain across the whole window, which may have been handled more and moved on the track more often than typical fixed curtains.

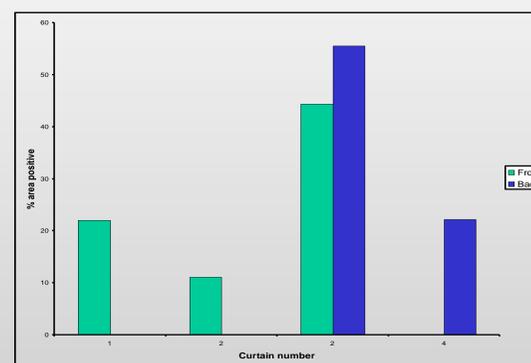


Figure 3. Percentage area of curtains positive for *C. difficile*

Curtain test no.	Curtain position/details	Front/back	% curtain area positive <i>C. difficile</i>	Clinical details of patient in side room
1	LHS	Front	22	Day 3 of CDI, loose stools (6+ times per day).
		Back	0	
2	RHS	Front	11.1	Day 6 CDI, loose stools (6+ times per day).
		Back	0	
3	Center (1 curtain)	Front	44.4	Day 7 of CDI, loose stools type 6 (3-4 times per day).
		Back	55.5	
4	Middle (of 3 curtains)	Front	0	Day 6 of CDI, loose stools (2-3 times per day).
		Back	22.2	

Table 1. Details of curtains in side rooms and clinical details of patients

Discussion

This study has demonstrated that hospital curtains in the vicinity of patients with symptomatic CDI are frequently contaminated with *C. difficile*. Strict adherence to environmental cleaning and disinfection policies including surfaces and equipment have been shown to be important in reducing spore contamination and CDI infection rates⁽⁵⁾. Despite implementation of control measures, hospitals still experience CDI case clusters, prompting a search for ways to reduce and limit environmental contamination. Our data suggest that hospital curtains may have the potential to contribute to contamination of hands and/or environmental dissemination of *C. difficile* spores. As hands are considered to be a major source of transmission of *C. difficile*, hand hygiene immediately after touching curtains should therefore be considered.

The intensive sampling method used in this study has shown that only by sampling the entire curtain surface can an accurate representation of *C. difficile* contamination be ascertained. We found that the proportion of each curtain total surface area associated with CDI cases that was *C. difficile* contaminated averaged 19%. Previous studies which aimed to recover healthcare associated pathogens on hospital curtains have sampled a small area of the curtain, and therefore have likely underestimated the true extent of contamination⁽⁶⁾.

It has been demonstrated that *C. difficile* can be present in the air in the vicinity of symptomatic CDI patients⁽⁴⁾; therefore, curtain contamination may occur via the airborne route, or by contact through contaminated hands. The action of drawing/undrawing curtains may further disperse *C. difficile* spores into the immediate environment. Further studies are required to demonstrate transmission between curtains and surfaces within the environment of CDI patients.

Conclusions

- Our results emphasize the importance of sampling the entire curtain surface to detect *C. difficile*.
- Random sampling of a single curtain surface area, even using a relatively large sampling area (1600cm²) had an approximate 80% chance of missing true *C. difficile* contamination.
- Curtains in the vicinity of CDI cases appear to be very frequently contaminated by *C. difficile*, likely reflecting the aerosolisation of spores and hand transmission.
- Curtains may act as a reservoir for transmission of *C. difficile*. Hand hygiene should be encouraged immediately after touching curtains in the vicinity of CDI cases.

References

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Acknowledgements

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