Evaluation of *Clostridioides Difficile* Environmental Contamination Surrounding *C. Difficile* Patients and Non-*C. Difficile* Patients in Outpatient Infusion Centers

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ABSTRACT

Background. Clostridioides difficile infection (CDI) is the most common cause of healthcare-associated infection. CDI and non-CDI patients (pts) are often treated at the same time in outpatient infusion centers (OICs). This proximity may allow horizontal transfer of spores. However, C. difficile (C. diff) spores are ubiquitous in nature and baseline contamination rates at OICs are unknown. The purpose of this pilot study was to determine toxigenic C. diff contamination in the OIC surrounding CDI pts receiving bezlotoxumab compared to non-CDI pts receiving another infusion in the same OIC before and after cleaning.
Methods. OIC contamination rates were assessed at baseline, after infusion and after cleaning the environment of CDI pts receiving bezlotoxumab compared to non-CDI pts receiving other infusions. For each pt receiving an infusion, 11 areas were sampled at each time period; the infusion chair (n=4), medical and non-medical equipment (n=3), and the floor surrounding the infusion chair (n=4). Five high traffic control areas per sampling day were included. Swabs were cultured anaerobically, and PCR was used to identify toxin genes. Proportion of toxigenic C. diff positive samples were compared between CDI and non-CDI pts for each time point. Cleaning was performed using a standard protocol of bleach (CDI pt) or non-bleach (non-CDI pt) products.
Results. Samples (n=709) were obtained from 10 pts in each group (329 CDI, 330 non-CDI, 50 high-traffic) from 7 OICs over 4 months. Overall, 55 patient area cultures (8%) were positive for C. diff. Positive sampling areas were highest for floors (13%) followed by infusion chairs (7%) and equipment (4%). Baseline contamination in high traffic areas was 6%. Contamination rates (Table 2) for CDI pts were 7% at baseline, higher after infusion (15%) and lower after cleaning (5%). For non-CDI pts, rates were similar at baseline (8%), after infusion (6%) and after cleaning (9%).
Conclusion. Compared to non-CDI pts, CDI pts had similar baseline but lower after cleaning contamination rates. These preliminary results suggest that with a proper cleaning protocol in place, the presence of CDI patients in an OIC does not increase the likelihood of C. diff transmission for other at-risk populations.

OBJECTIVE

- Primary: To determine toxigenic *C. difficile* spore contamination in the environment of U.S. outpatient infusion centers (OICs), specifically in areas surrounding the infusions of CDI patients compared to non-CDI patients.
- Secondary: To assess the effectiveness of the center's standard cleaning protocol on the environmental *C. difficile* spore count.

METHODS

- Study design: observational multicenter study
- Study Environment: *C. difficile* spore contamination rates in the environment around patients receiving infusions at OICs were assessed for two groups:
  - ***Group 1*:** CDI patients with positive *C. difficile* test, on oral SoC therapy for CDI, who received bezlotoxumab for 60 min.
  - ***Group 2*:** non-CDI patients receiving another infusion for at least 30 min in an infusion chair not used by a patient in Group 1 and a different time.

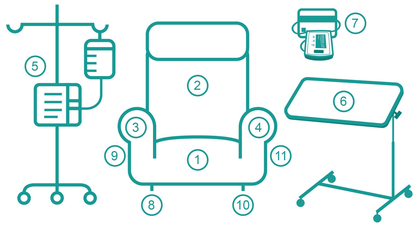
Sampling: For each patient receiving an infusion, 11 areas were sampled at each time period (Fig. 1); the infusion chair (n=4), medical and non-medical equipment surrounding the infusion chair (n=3), and the floor surrounding the infusion chair (n=4). Sampling per infusion group (i.e. one CDI patient infusion and one non-CDI patient infusion) occurred at separate times on the same day per site. Five control samples from non-patient care, high-traffic areas were also included from each OIC per collection day.

Samples were collected using moist swabs at baseline, after infusion and after cleaning the environment for each group, with an identical sampling protocol used for each. A total of 71 samples were collected per infusion set during the sampling periods (Fig. 2).

METHODS, cont.

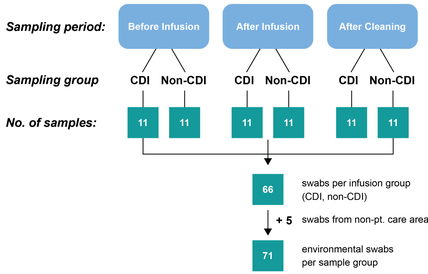
- Cleaning: Cleaning was performed according to OIC standard protocol. Areas surrounding CDI patients were cleaned with a hypochlorite-based sporicidal solution (bleach solution) and areas around non-CDI patients with quaternary ammonium and isopropyl alcohol-based (non-bleach) disinfectants. Floors were cleaned at the end of the day for all groups.
- Diagnostic method: Collected samples were cultured anaerobically at 37°C up to 5 days and quantitative analysis performed to identify toxigenic *C. difficile* using multiplex PCR and fluorescent ribotyping [2].
- Variables: Additional data collected per patient included demographics (age, gender), length of infusion, presence of diarrhea on day of infusion, oral standard of care (SoC) antibiotic for CDI patients, and geographic location.
- Analysis: Proportion of samples positive for toxigenic *C. difficile* were assessed for each group, sampling location and time period. Data were analyzed using SAS, version 9.3 (SAS Institute, Cary, NC).

Figure 1. Environmental Sampling Locations



- Patient care areas: 1. chair seat, 2. chair back, 3. right chair armrest, 4. left chair armrest, 5. infusion pole and pump, 6. rolling tray, 7. blood pressure cuff or vital sign machine, 8. floor on right side in front of infusion chair, 9. floor on right side of infusion chair, 10. floor on left side in front of infusion chair, 11. floor on left side of infusion chair
- Non-patient care areas: 1. door outside physician practice, 2. door handle outside physician practice, 3. surface of reception area, 4. hallway leading to OIC, 5. door handle of OIC entrance.

Figure 2. Sampling Flowchart



RESULTS

- Overall Study Environment and Sample Size:

Samples (n=709) were obtained from 10 patients in each group (329 CDI, 330 non-CDI, 50 non-patient care) from 7 OICS over 4 months.

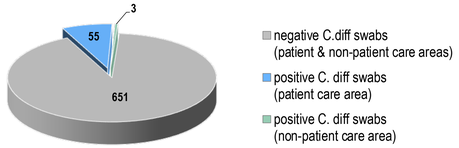
Table 1. Characteristics of CDI and Non-CDI Patients Receiving Infusions

Variable	CDI patients[1] (n=10)	Non-CDI patients[2] (n=10)
Age, mean±SD	65±10	60±14
Gender, male (n, %)	6 (60)	5 (50)
Length of infusion time, min±SD	62±0.5	38±13
Presence of diarrhea at time of infusion (n, %)	7 (70)	0 (0)

[1]: 60-min bezlotoxumab infusion.
[2]: infusion other than bezlotoxumab for ≥30 min.

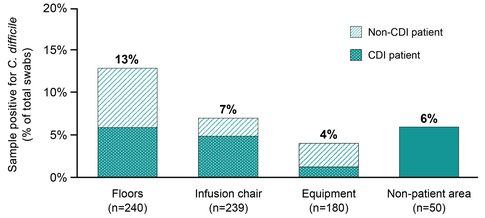
- SoC therapy in CDI patients included vancomycin (n=6), fidaxomicin (n=2), vancomycin/fidaxomicin (n=1) and metronidazole (n=1).
- Geographic locations of 7 OICs included 6 in the South and 1 in the Midwest.

Figure 3. Environmental Contamination Rate of Toxigenic *C. Difficile*



- 58 of 709 (8.2%) collected samples were positive for toxigenic *C. difficile* including 55 samples in patient care areas (8%) and 3 samples in non-patient care areas (0.4%).

Figure 4. Overall Location of *C. Difficile* Contamination



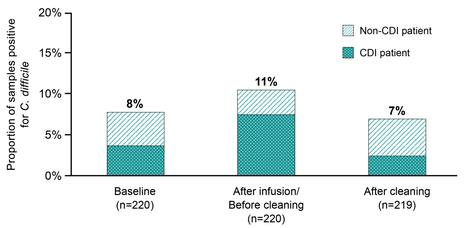
- Overall, positive sampling areas were highest for floors (13%) followed by infusion chairs (7%) and lowest for equipment (4%).
- Baseline contamination for non-patient care areas was 6%.

Table 2. *C. Difficile* Contamination Rate in the Environment of CDI and Non-CDI Patients Before Infusion, After Infusion, and After Cleaning

Environmental Sample Locations	No. of toxigenic C. difficile-positive samples/ Total no. of samples (%)					
	Before infusion		After infusion		After cleaning	
	Non-CDI	CDI	Non-CDI	CDI	Non-CDI	CDI
Infusion chair area (n=4)	3/40 (8%)	2/40 (5%)	1/40 (3%)	7/40 (18%)	0/40 (0%)	3/39 (8%)
Medical & non-medical equipment (n=3)	1/30 (3%)	1/30 (3%)	2/30 (7%)	1/30 (3%)	2/30 (7%)	1/30 (3%)
Floors surrounding infusion chair (n=4)	5/40 (13%)	5/40 (13%)	4/40 (10%)	8/40 (20%)	8/40 (20%)	1/40 (2%)
Total	**9/110 8%**	**8/110 7%**	**7/110 6%**	**16/110 15%**	**10/110 9%**	**5/109 5%**

- Contamination rates for CDI patients were 7% at baseline, higher after infusion (15%) and lower after cleaning (5%).
  - Floor contamination increased from 13% at baseline to 20% after infusion, for infusion chairs from 5% to 18% and remained the same at 3% for equipment.
  - Contamination decreased on floors after cleaning from 20% to 2%, infusion chairs from 18% to 8% and remained the same for equipment.
- For non-CDI patients, contamination rates were similar at baseline (8%), after infusion (6%) and after cleaning with a non-sporicidal agent (9%).
  - Floor contamination decreased from baseline of 13% to 10% after infusion, infusion chairs from 8% to 3% and equipment increased from 3% to 7%.
  - Contamination increased after cleaning on floors from 10% to 20%, infusion chairs decreased from 3% to 0% and remained the same for equipment.

Figure 5. Effectiveness of Cleaning Procedure on Overall *C. Difficile* Contamination



- The rate of positive samples decreased from 15% to 5% in areas surrounding CDI patients after cleaning with hypochlorite-based sporicidal solution.
- Non-CDI areas did not decrease after cleaning. Cleaning was performed with a quaternary ammonium/alcohol-based solution in these instances and not with a hypochlorite-based disinfectant, floors were cleaned at the end of the day.

DISCUSSION

- This pilot study evaluated the environmental *C. difficile* spore contamination in outpatient infusion centers (OICs) by comparing areas occupied by CDI patients receiving bezlotoxumab to areas of non-CDI patients receiving other infusions on the same day. Effectiveness of the OIC standard cleaning protocol on reduction of *C. difficile* spores was also evaluated for both groups.
- Contamination rates of *C. difficile* spores at baseline were similar for CDI and non-CDI patients (7% vs. 8%), increased after infusion with CDI patients (15%) and showed no meaningful change for non-CDI patients (6%).
- *C. difficile* spore contamination rates from after infusion to after cleaning with a sporicidal agent decreased for CDI patients from 15% to 5%. Rates increased for non-CDI patients (6% to 9%), largely because of floor contamination. Non-sporicidal agents were used for non-CDI patients and floors were cleaned once per day after all infusions.
- Overall, toxigenic *C. difficile* was detected in 8% of OIC samples. This rate is considerably lower than reported in other outpatient settings; e.g., 38% in long-term care facilities [1], 11% in emergency departments [3], and 19% in free-standing outpatient clinics [3].
- Limitations of the study are the small sample size. Also, no floor sampling was performed at the end of the day. This study is ongoing.

CONCLUSIONS

- **Baseline contamination rates of *C. difficile* spores in OICs were similar prior to infusions of CDI and non-CDI patients, with an increase seen after infusions of CDI patients.**
- **Use of sporicidal cleaning agents after infusions in CDI patients demonstrated a decrease of *C. difficile* spore contamination to a rate comparable to the rate before infusion.**
- **The *C. difficile* contamination rate in OICs was low compared to other outpatient care settings.**
- **Findings should be interpreted with consideration of the small sample size, but they suggest that with a proper cleaning protocol in place, the presence of CDI patients in an OIC does not increase the likelihood of *C. difficile* transmission to other at-risk populations.**

Disclosures

This study was sponsored by Merck & Co., Inc., Rahway, NJ, USA.

References

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