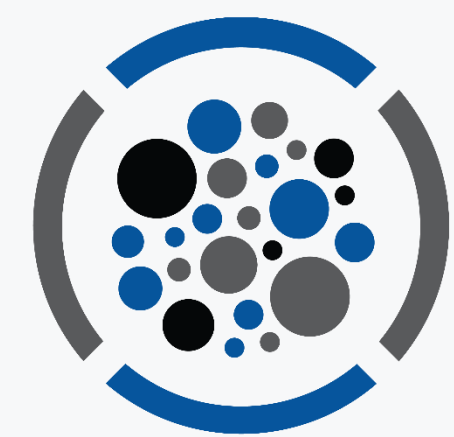


Clostridioides difficile environmental contamination in hospitalized patients with diarrhea: a pilot study



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Abstract

Background: The relative contribution of *Clostridioides difficile* colonization or infection in contamination of the hospital environment is poorly understood.

Methods: We performed a prospective cohort study of patients with diarrhea who were tested for *C. difficile* infection via PCR and enzyme immunoassay (EIA) to compare *C. difficile* environmental contamination by test result. Patients were stratified into one of three cohorts: PCR⁻, PCR⁺/EIA⁺ or PCR⁺/EIA⁻. Environmental microbiological samples were taken within 24 hours of *C. difficile* cultures and again for two successive days for a total of three days. Patients were excluded if they had *C. difficile* infection in the past 6-weeks. Microbiological samples of surfaces were obtained with pre-moistened cellulose sponges from three locations (bathroom, adjacent to bed, and care areas) and processed using the stomacher technique. Ribotyping was completed on a subset of stool and environmental samples to measure concordance of isolates. CFU and recovery rates between arms were compared with a global ANOVA followed by pairwise comparisons using a Bonferroni adjustment.

Results: We enrolled 41 patients between November 2019 and March 2020. 7 patients were PCR⁺/EIA⁺, 8 were PCR⁺/EIA⁻ and 26 were PCR⁻ (Table 1). A total of 347 individual and 116 room samples were obtained. PCR⁺/EIA⁺ patient rooms had a higher average room burden (435.6 CFU (95%CI: 178.0-694.0)) compared to PCR⁺/EIA⁻ (83.5 (-9.1-175.0), p< 0.01) and PCR⁻ rooms (17.1 (1.2-33.0), p< 0.01); PCR⁺/EIA⁻ and PCR⁻ rooms were similar (p=0.83). PCR⁺/EIA⁺ patient rooms had a higher recovery rate (61%) compared to PCR⁺/EIA⁻ (36%, p=0.64), although not statistically significant, and PCR⁻ rooms (16%, p< 0.01); PCR⁺/EIA⁻ had a similar recovery rate to PCR⁻ rooms (p=0.14) (Table 2). Of the rooms with both patient and environmental isolates, 79% of patient isolates had a concordant isolate recovered in the environment.

Conclusion: The amount of environmental contamination of PCR⁺/EIA⁺ patients was higher than both PCR⁺/EIA⁻ and PCR⁻ patients, however, the recovery rate of PCR⁺/EIA⁺ patients was similar to PCR⁺/EIA⁻ patients. Subsequent larger trials are needed to expand on this pilot data to determine the difference, if any, between environmental contamination levels of these patient populations.

Background

- Healthcare environments are frequently contaminated with clinically important pathogens, such as *C. difficile*, that can cause healthcare associated infections.
- The relative contribution of patient *C. difficile* colonization or infection to contamination of the hospital environment is not known.

Methods

- From November 2019 to March 2020, 41 patients with diarrhea and a *C. difficile* diagnostic test were enrolled at Duke University Hospital (Table 1).
- Patients were stratified into 3 cohorts based on combination of PCR and EIA results (PCR⁻, PCR⁺/EIA⁺ or PCR⁺/EIA⁻)
- Environmental microbiological samples were...
 - ...taken within 24 hours of *C. difficile* cultures and repeated for two successive days → 3 days total
 - ...obtained from the bathroom, patient bed and care areas
 - ...processed using the stomacher technique.
- Eluent was plated on *C. difficile* selective agar (CDSA) and incubated anaerobically at 37°C for 48 hours.
- Ribotyping was completed on a subset of stool and environmental samples to measure concordance (Fig 1).

Table 1: Patient characteristics

	Total (%) N = 41	PCR ⁺ /EIA ⁺ N = 7 n (%)	PCR ⁺ /EIA ⁻ N = 8 n (%)	PCR ⁻ N = 26 n (%)
Median Age, years (IQR)	63 (56-70)	64 (54-70)	64 (55-70)	63 (55-70)
Female Sex	16 (39)	3 (29)	3 (38)	10 (38)
On Contact Precautions	23 (56)	7 (100)	7 (88)	9 (35)
Bedridden	13 (32)	1 (14)	4 (50)	8 (31)
Average Bowel Movements Within 24 hours of Enrollment (STDEV)	5 (5)	5 (4)	5 (5)	5 (5)
Prior Room Occupant <i>C. difficile</i> +	2 (5)	1 (14)	0 (0)	1 (4)
Hospitalized in Last 12 Months	25 (61)	4 (57)	2 (25)	19 (73)
Antibiotic Therapy in Prior 6 Months	17 (41)	5 (71)	1 (13)	18 (69)
Antibiotic Therapy in Last 24 Hours	30 (73)	5 (71)	6 (75)	19 (73)
Average Hours From PCR Culture to Sampling (STDEV)	18 (3)	18 (4)	17 (3)	18 (4)
Average Number of Days Patient Was in the Room Before Sampling (STDEV)	8 (14)	5 (5)	6 (4)	10 (17)

Results

- Room bioburden:** PCR⁺/EIA⁺ patient rooms had a higher average room burden (435.6 CFU (95%CI: 178.0-694.0)) compared to PCR⁺/EIA⁻ (83.5 (-9.1-175.0), p< 0.01) and PCR⁻ rooms (17.1 (1.2-33.0), p< 0.01). PCR⁺/EIA⁻ and PCR⁻ average room burdens were similar (p=0.83)
- Recovery rate:** PCR⁺/EIA⁺ patient rooms had a higher recovery rate (61%) compared to PCR⁺/EIA⁻ (36%, p=0.64), although not statistically significant, and PCR⁻ rooms (16%, p< 0.01). PCR⁺/EIA⁻ had a similar recovery rate to PCR⁻ rooms (p=0.14)
- Concordance:** Of the rooms with both patient and environmental isolates, 79% of patient isolates had a concordant isolate recovered in the environment.

Figure 1: Example ribotyping image

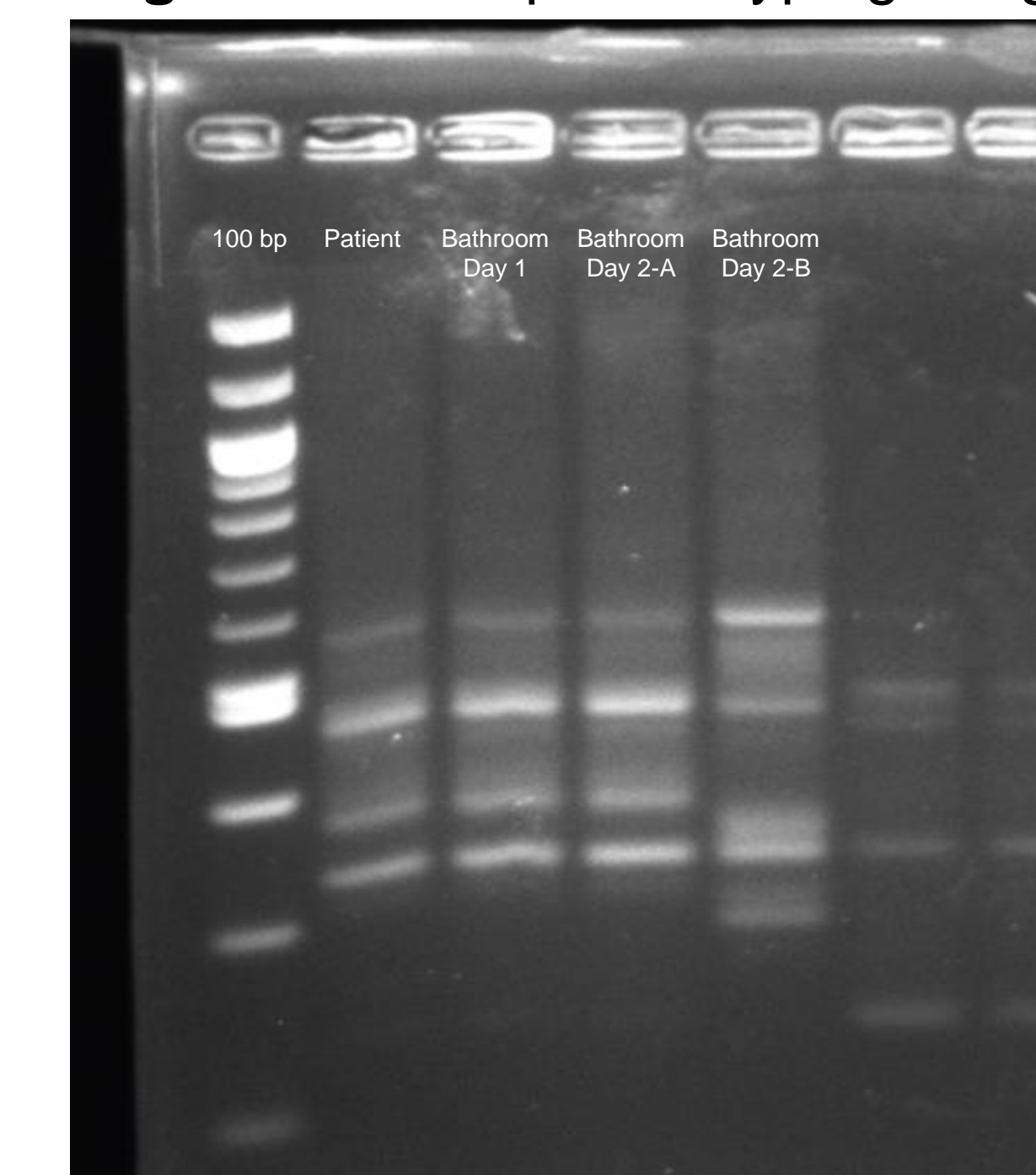


Table 2: CFU and Recovery Rate* of *C. difficile* among enrolled patients

	Total N = 116	PCR ⁺ /EIA ⁺ N = 18	PCR ⁺ /EIA ⁻ N = 22	PCR ⁻ N = 76	p EIA ⁺ vs EIA ⁻ , EIA ⁺ vs PCR ⁻ , EIA ⁻ vs PCR ⁻
Room					
Average CFU	147.3	435.6	83.5	17.1	<0.01, <0.01, 0.83
Recovery Rate	27%	61%	36%	16%	0.64, <0.01, 0.14
Patient Area					
Average CFU	8.6	48.4	1.1	1.3	0.27, 0.27, 0.90
Recovery Rate	7%	22%	5%	4%	0.09, <0.01, 0.90
Bathroom Area					
Average CFU	139.4	385.6	82.4	15.7	0.04, 0.01, 0.19
Recovery Rate	23%	56%	32%	12%	0.13, <0.01, 0.44
Care Area					
Average CFU	0.4	1.5	0	0.3	0.33, 0.46, 0.33
Recovery Rate	2%	6%	0%	1%	0.26, 0.26, 0.59

*Recovery rate – Percentage of samples with isolated *C. difficile*

Conclusions

- The amount of environmental contamination of PCR⁺/EIA⁺ patients was higher than both PCR⁺/EIA⁻ and PCR⁻ patients, however, the recovery rate of PCR⁺/EIA⁺ patients was similar to PCR⁺/EIA⁻ patients.
- Subsequent larger trials are needed to expand on this pilot data to determine the difference, if any, between environmental contamination levels of these patient populations.

