

Shared Hoppers: A novel risk factor for the transmission of *Clostridium difficile*

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ABSTRACT

Background:

Previous studies have demonstrated that prior hospital room occupant or roommate with a multi-drug resistant organism is a risk factor for acquisition. We observed a cluster of *Clostridium difficile* infections (CDI) in spring 2010, occurring among trauma-surgical intensive care unit (TSICU) patients. Cases shared a rimless, flushable basin (hopper), situated between private and double rooms, with a patient infected with *C. difficile*. We postulated that hoppers contributed to transmission of *C. difficile* spores through contamination of healthcare workers and the shared environment.

Methods:

We conducted a case-control study to identify risk factors for *C. difficile* acquisition in our TSICU between December 15, 2010 to December 14, 2011. Cases were defined as those with new onset diarrhea and positive PCR test for *C. difficile* toxin B at least 36 hours from TSICU admission. Controls also had a TSICU stay of at least 36 hours and negative *C. difficile* PCR for at least 30 days of discharge from the TSICU. Approximately three concurrent controls were randomly selected within one week of admission for each case. Persons with a known history of prior *C. difficile* infection were excluded. Demographics, laboratory data, clinical data, and outcomes were abstracted from the electronic medical record.

Results:

Twenty-six (26) patients with hospital-acquired CDI were identified and 73 controls selected. The mean age of the study group (n=99) was 50.7 ± 20.9 years, 61 male (61.6%), and 78 (78.8%) Caucasian. On bivariate analysis, cases were more likely than controls to have had trauma (OR=3.9 [1.3,11.3]), surgery (OR=16.5 [2.1,128.4]), facial fractures (OR=4.1 [1.1,14.8]), prior room occupant/roommate with *C. difficile* (OR=3.6 [1.2,11.0]), and shared hopper (OR=5.0 [1.6,15.3]). Longer length of stay, cephalosporin use, H2 blocker use, open abdomen, tube feedings, and mechanical ventilation were also associated with CDI. In subsequent multivariate modeling, shared hopper remained significant when length of prior usage was factored in.

Conclusions:

Environmental predictors of *C. difficile* in this study included shared hopper and prior or current room occupant with a *C. difficile*-infected patient. While the potential for transmission of infectious agents by toilet aerosolization of droplets is documented, this study suggests a novel mode of *C. difficile* transmission by shared hoppers. These findings have implications for hospital design. The study is limited by design in that controls are not matched by severity of illness, this may have introduced bias despite adjustment for potential confounders.

Table 1. Select Characteristics of Patients with *C. difficile* Infection and Controls

	Cases (n=26)	Controls (n=73)	Unadjusted OR (95% CI)	p-value
Male	15 (58%)	46 (63%)	0.8 (0.3-2.0)	0.632
Age, Mean (SD)	43.1 (20.2)	53.5 (20.6)	--	0.046
Caucasian Race	22 (85%)	56 (77%)	1.7 (0.5-5.5)	0.401
Trauma patient	21 (81%)	38 (52%)	3.9 (1.3-11.4)	0.010
Admit Severity of Illness- Extreme	16 (62%)	21 (29%)	4.0 (1.6-10.1)	0.004
1 st /2 nd Generation Cephalosporins	23 (89%)	38 (52%)	7.3 (2.0-26.3)	0.001
3 rd /4 th Generation Cephalosporins	11 (42%)	8 (11%)	6.0 (2.0-17.4)	0.001
H2 Blocker	22 (85%)	41 (56%)	4.3 (1.3-13.7)	0.014
Open Abdomen	9 (35%)	2 (3%)	18.8 (3.7-95.1)	0.000
Days of Tube Feeding, Mean (SD)	5.5 (5.4)	1.7(3.9)	--	0.000
Ventilated Patient	24 (92%)	42 (58%)	8.9 (1.9-40.3)	0.001
Facial Fractures	6 (23 %)	5 (7%)	4.1 (1.1,14.8)	0.024
Hospital Length of Stay, Days, Mean (SD)	27.5 (17.9)	12.8 (11.2)	--	0.000
> 1 Trip to Operating Room	15 (58%)	15 (21%)	2.9 (1.1,8.0)	0.040
Current or Prior Room Occupant with CDI	8 (31%)	8 (11%)	3.6 (1.2,11.0)	0.018
Shared Hopper with CDI Patient	9 (35 %)	7 (10%)	5.0 (1.6,15.3)	0.003

Table 2. Interventions to Prevent Transmission of *C. difficile* in TSICU

Infection Prevention Opportunities	Infection Prevention Measures on TSICU
Hand hygiene/ Enteric Precautions	<ul style="list-style-type: none"> Enhanced hand hygiene and Contact Enteric precautions observations Educated staff with unit-specific data Contact Enteric precautions continued for duration of ICU stay
Delayed diagnosis and Isolation	<ul style="list-style-type: none"> Pre-emptive Contact Enteric precautions for patients with diarrhea Educated RN staff to early testing of any patient with diarrhea Introduced new PCR testing for toxin B (4-hr turnaround)
Environment	<ul style="list-style-type: none"> Daily cleaning of CDI patient rooms with hypochlorite solution Terminal clean of all unit discharges with hypochlorite solution and curtain change Hopper shields installed Hypochlorite solution used to clean all hoppers Weekly cleaning audits, including hoppers, with immediate feedback to manager and EVS staff Removal of all receptacles housed in hopper room that travel to bedside for waste disposal (e.g. urinals) Additional EVS staff added for cleaning during off-hours Piloted ultraviolet-C disinfection technology
Antibiotic Stewardship	<ul style="list-style-type: none"> Review of appropriateness of antimicrobials with feedbacks to clinicians
Unit Construction	<ul style="list-style-type: none"> Multidisciplinary meeting and plans for modification of unit to include more hoppers and an additional private room

Figure A. TSICU Cleaning Audits and Rate of *C. difficile* Infection



Figure B. Hopper with Shield

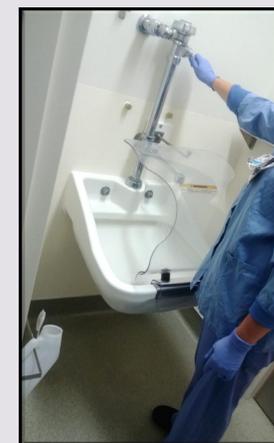


Figure C. Architectural Drawing of TSICU with Proposed Individual Hoppers

