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Brief report

Hospital roommates and development of health care–onset *Clostridium difficile* infection

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There is potential for person-to-person transmission in *Clostridium difficile* outbreak settings. A limited number of studies have examined the role of hospital roommates in the development of nosocomial infections. This retrospective cohort study evaluated room cooccupancy and duration of exposure to roommates as predictors of health care–onset *C difficile* infection (CDI). Among roommates of patients with CDI, duration of room cooccupancy was significantly longer in those developing CDI.

Clostridium difficile has emerged as the leading cause of infectious health care–onset diarrhea in adult inpatients.[1] Previous studies have documented the potential for person-to-person transmission, identifying persistent environmental contamination and carrying of the organism on the hands of hospital staff.[2-4] Furthermore, patients shed more *C difficile* in stool and cause greater environmental contamination when they are acutely symptomatic with *C difficile* infection (CDI),[5] and isolation is one of the core recommended practices to control CDI in health care facilities.

A limited number of studies have examined the role of hospital roommates in the development of CDI, and most have not found sharing a room with or being admitted to a room previously occupied by a patient diagnosed with CDI to be a risk factor for CDI.[6-10] Little is known about the impact of sharing a room with a patient with CDI and duration of exposure on the subsequent development of CDI. The purpose of this study was to determine whether room cooccupancy and duration of exposure to patients with CDI are predictors of health care–onset CDI.

METHODS

We conducted a retrospective cohort study from April 2008 to June 2009 to compare hospitalized patients who shared a room with a patient with CDI (exposed roommates) with hospitalized patients who shared a room with a patient without CDI (nonexposed roommates). The study was conducted at a 900-bed tertiary care teaching hospital in Detroit, Michigan. The hospital has single- and double-occupancy rooms. First, patients with CDI were identified using ICD-9 codes, their charts reviewed to confirm diagnosis of CDI with a positive toxin assay (date of CDI onset was defined as the date the toxin assay was ordered), and then their roommates identified to create the exposed group. The nonexposed group consisted of roommates of patients without CDI randomly selected from the same wards. Based on data from prior studies,[9,10] for a significance level of .05 and power of 0.8, estimated outcome of 5% in the nonexposed group, and odds ratio of 3.6 with an exposed/unexposed ratio of 1, a total sample size of 250 was calculated. Patients in single-occupancy rooms and patients with an episode of CDI in the last 30 days were excluded. The primary endpoint was development of CDI from initial roommate exposure until 4 weeks after discharge (positive *C difficile* toxin assay in a patient with new onset diarrhea). Data were collected on past hospitalizations and gastrointestinal surgery, type of service admitted to (teaching vs hospitalist, medical vs surgical), comorbidities, duration of room cooccupancy, antimicrobial exposures, and proton pump inhibitors exposure. Comparisons were done using the χ^2 test or Fisher exact test for categorical variables and Student *t* test or Mann Whitney *U* statistic for continuous variables as appropriate. A 2-sided *P* value of $<.05$ was considered significant. Data analysis and random selection of roommates were performed using SPSS 18 (SPSS Inc, Chicago, IL). The study was approved by the hospital's institutional review board.

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Table 1
Epidemiologic characteristics of exposed and nonexposed roommates

Variable	Exposed roommates (N = 120)	Nonexposed roommates (N = 125)	*P* value
Demographics			
Age, mean (years)	60	60	.90
Female sex	59 (49.2)	64 (51.2)	.70
Admission to teaching service	110 (91.7)	104 (83.2)	.04
Admission to a medical unit	78 (65)	84 (67.2)	.70
Comorbidities			
Diabetes mellitus	36 (30)	40 (32)	.70
Chronic kidney disease	35 (29.2)	27 (21.6)	.10
Myocardial infarction	24 (20)	20 (16)	.40
Hypertension	69 (57.5)	94 (75.2)	<.01
Dementia	10 (8.3)	11 (8.8)	.80
Cerebrovascular disease	15 (12.6)	14 (11.2)	.70
Liver disease	6 (5)	0	.01
Congestive heart failure	28 (23.3)	35 (28)	.40
Inflammatory bowel disease	3 (2.5)	4 (3.2)	.70
Chronic obstructive pulmonary disease	11 (9.2)	23 (18.4)	.03
Any malignancy	23 (19.2)	19 (15.2)	.40
Gastrointestinal surgery within 1 year	20 (16.7)	11 (8.8)	.06
Hospitalization data			
Hospitalized within 1 year	24 (20)	22 (17.6)	.60
Presence of infection during hospitalization	40 (33.3)	38 (30.4)	.60
Length of stay in days (mean)	7.6	7.1	.60
Duration of exposure in days (mean)	3	1.4	<.01
Exposure to antimicrobials and PPIs			
Exposure to antimicrobials during hospitalization	44 (37)	39 (31.2)	.30
Exposure to antimicrobials within 30 days of admission	17 (14.2)	11 (8.8)	.10
Exposure to PPIs	57 (47.5)	51 (40.8)	.20
Developed CDI	9 (7.5)	4 (3.2)	.10

CDI, *Clostridium difficile* infection; *PPI*, proton pump inhibitor.
NOTE. Values are n (%) or as otherwise indicated.

Table 2
Factors associated with development of CDI after bivariate analysis

Variable	Did not develop CDI (N = 232)	Developed CDI (N = 13)	*P* value
Demographics			
Age, mean (years)	61	62	.80
Female sex	111 (47.8)	12 (92.3)	.002
Admission to a teaching service	202 (87.1)	12 (92.3)	.50
Admission to a surgical unit	80 (34.5)	3 (23.1)	.50
Room cooccupancy with a patient with CDI	111 (47.8)	9 (69.2)	.10
Comorbidities			
Diabetes mellitus	71 (30.6)	5 (38.5)	.50
Hypertension	155 (66.8)	8 (61.5)	.70
Chronic obstructive pulmonary disease	32 (13.8)	2 (15.4)	.60
Liver disease	4 (1.7)	2 (15.4)	.03
Chronic kidney disease	60 (25.9)	2 (15.4)	.50
Myocardial infarction	40 (17.2)	4 (30.8)	.20
Dementia	18 (7.8)	3 (23.1)	.08
Cerebrovascular disease	28 (12.1)	1 (7.7)	1
Heart failure	60 (25.9)	3 (23.1)	1
Peptic ulcer disease	12 (5.2)	0 (0)	1
Inflammatory bowel disease	5 (2.2)	2 (15.4)	.04
Any malignancy	42 (18.1)	0 (0)	.10
Immunosuppression	8 (3.4)	2 (15.4)	.09
Tube feeds	6 (2.6)	4 (30.8)	.001
Gastrointestinal surgery within 1 year	29 (12.5)	2 (15.4)	.60
History of CDI within 1 year*	9 (3.9)	1 (7.7)	.50
Exposure to antimicrobials and PPIs			
Exposure to antimicrobials during hospitalization	74 (32)	9 (69.2)	.01
Exposure to antimicrobials within 30 days of admission	25 (10.8)	3 (23.1)	.10
Type of antimicrobial			
Penicillin	14 (6)	0 (0)	1
Fourth-generation penicillin	5 (2.2)	2 (15.4)	.04
Cephalosporin	23 (9.9)	4 (30.8)	.04
Carbapenem	5 (2.2)	0 (0)	1
Fluorquinolone	19 (8.2)	4 (30.8)	.02
Clindamycin	4 (1.7)	0 (0)	1
Vancomycin	25 (10.8)	5 (38.5)	.01
Linezolid	3 (1.3)	1 (7.7)	.10
Other†	23 (9.9)	2 (15.4)	.60
Exposure to PPIs	102 (44)	6 (46.2)	.80
Hospitalization data			
Hospitalized within 1 year	41 (17.7)	5 (38.5)	.07
Length of stay, mean (days)	6.7	19.2	<.001
Exposure time to a roommate, mean (days)	2.1	4.6	<.001
Exposure time to roommate with CDI, mean (days)‡	2.8	5.6	.03
Exposure time to a roommate without CDI, mean (days)‡	1.4	2.2	.20

CDI, *Clostridium difficile* infection; *PPI*, proton pump inhibitor.
NOTE. Values are n (%) or as otherwise indicated.
*All patients with CDI in the previous 30 days were excluded.
†Other antibiotics included sulfas, macrolides, aztreonam, rifaximin, metronidazole, and aminoglycosides.
‡Subgroup analysis.

RESULTS

The study cohort consisted of 120 exposed roommates and 125 nonexposed roommates (Table 1). Exposure to cephalosporins, fluoroquinolones, penicillins, intravenous vancomycin, and other antimicrobials was not different among exposed and nonexposed groups (data not shown). A total of 13 roommates developed CDI, with a higher proportion among the exposed group (n = 9 [7.5%] vs n = 4 [3.2%], $P = .10$). The mean time from exposure to diagnosis of CDI was 9.1 days (range, 1-28). Duration of room cooccupancy was longer in those who shared a room with patients with CDI than with patients without CDI (3.0 vs 1.4 days, $P < .01$).

Results of bivariate analysis are shown in Table 2. Roommates who developed CDI were more likely to be women, have inflammatory bowel disease, have liver disease, have feeding tubes, have been exposed to antimicrobials during their hospitalization, have a longer duration of room cooccupancy with patients with or without CDI, and have a longer length of stay than roommates not developing CDI. Also, roommates that developed CDI were more frequently exposed to intravenous vancomycin, cephalosporins, fluoroquinolones, and fourth-generation penicillins. Subgroup analysis on the exposed group showed a longer duration of room cooccupancy for those who developed CDI (5.6 vs 2.8 days, $P < .001$). Subgroup analysis on the nonexposed group failed to reveal similar findings.

DISCUSSION

In this study, though not statistically significant, a trend toward a higher rate of development of CDI was seen in patients exposed to a patient with CDI. In a previous retrospective cohort study,[9] although roommate exposure was not independently associated with CDI, any physical proximity was found to be associated. Another study in a hospital with up to quadruple-occupancy rooms showed that the total number of roommate exposures per day was associated with CDI, without significant association with the number of days exposed to a unique roommate.[6] CDI pressure has also been found to be an important risk factor for CDI, in that the more patients with CDI in a given patient care area, the greater the risk for other patients to develop CDI.[7]

Duration of exposure to patients with CDI as a risk factor for CDI has not been previously studied. Interestingly, among roommates, duration of room cooccupancy with patients with CDI was significantly longer. This could have been related to a shorter length of stay