



Impact of Personal Protective Equipment Usage and hand washing due to COVID-19 on the rate of HA-CDI

Anna Sabu Kurian, BS¹, Kripa Shrestha, MBBS, MPH, MS², Ariel P Santos, MD, MPH, FRCSC, FACS, FCCM², Hector Garcia, Meng¹, Adan Castrodad, MD², Justin Vaughan, MD²

Abstract

Background

Clostridium difficile infection (CDI) is one of the most common healthcare-associated (HA) infections. Advanced age, use of proton pump inhibitors, concomitant antibiotics, steroids, prolonged hospital stay, and gastrointestinal surgeries are associated with increased incidence of disease. CDI is transmissible via the fecal-oral route by ingesting spores and is readily transmitted between patients and caregivers in the hospital. Strict contact precautions and handwashing are implemented in healthcare settings to prevent its transmission. The current pandemic of Coronavirus disease (COVID-19) has led to imposing restrictions on patient admission, visitations, and implementing extra measures on handwashing along with the use of personal protective equipment (PPE). Therefore, the main objective of this study is to identify if additional preventive measures for COVID-19 impact the HA-CDI rate.

Methods:

A retrospective study was conducted on patients diagnosed with HA-CDI during the COVID-19 year (2020) and compared with patients of the pre-COVID-19 year (2019) from March to October. Baseline characteristics, risk factors, and patient hospitalization were compared.

Results:

During the study period, a total of 148 cases were diagnosed with HA-CDI of which 75 cases were in the pre-COVID-19 and 73 cases in the COVID-19 year. The rate of HA-CDI was 5.03 vs. 5.33 per 10,000 hospitalized patients in the pre-COVID-19 year vs. COVID-19 year. A sub-analysis was done with 2020 data to identify if there are any contributing factors to the increased CDI rate. 21 cases were positive for COVID-19, of which 28.5% underwent GI surgery; 19% received steroids (Dexamethasone), 76.1% stayed in ICU with median LOS (16± 20.2) and 52.3% died.

Conclusions:

A slightly higher rate of symptomatic HA-CDI was observed during the COVID-19 year when compared with the pre-COVID-19 year. Implementation of measures to prevent the spread of COVID-19 e.g., use of PPE, handwashing, environmental cleaning, visitor restriction, etc. were expected to help decrease HA-CDI. Higher acuity patients and increased rate of these risk factors amongst patients admitted in the year 2020 might have offset the expected benefit of COVID-19 prevention strategies.

Corresponding Author:

Justin Vaughan MD,
Texas Tech University Health Sciences Center
Department of Surgery, Lubbock TX, USA
Justin.Vaughan@ttuhsc.edu

Background

The Coronavirus pandemic (COVID-19) has drastically changed the healthcare system with the implementation of strict infection prevention measures. To prevent the spread of Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), patients were isolated, and healthcare workers were required to use personal protective equipment (PPE) like gowns, masks, gloves, and face shields. Moreover, hand hygiene was implemented as washing hands with soap and water or using alcohol-based sanitizers. Special attention was made to contact precautions with social distancing, limitation of visitors, and duration of visit time to hospitals. Disinfection and environmental cleaning were routine. Many studies have shown this infection prevention has limited the spread of many organisms especially those causing healthcare-associated infections, including *Clostridium difficile*.¹⁻³

Clostridium difficile infection (CDI) is one of the most common healthcare-associated infections with an increase in morbidity, mortality, and prolonged hospitalization.¹ Healthcare-associated CDI (HA-CDI) is defined as any hospitalized patient with symptoms onset ≥ 72 hours after admission with a history of diarrhea (≥ 3 unformed stools in 24 hours with no other recognized cause) along with positive stool test - polymerase chain reaction (PCR) for toxigenic CD and positive PCR for CD toxin gene(s) or colonoscopic/ histopathologic findings of pseudomembranous colitis.^{4,5} The risk factors for HA-CDI are advanced age, previous hospitalization, antibiotic exposure, presence of comorbidities, and

use of antacids.^{6,7} Several infection control measures are implemented to control the transmission of CD and its spores similar to COVID-19 prevention measures.⁸

Objective

There have been studies with varying results in the rate of CDI during the COVID-19 period. Some studies had shown a decreased rate of CDI and others had no difference. There are only a few studies related to the HA-CDI rate. Therefore, this study aims to identify if these new changes have any effect on the rate of hospital-acquired *Clostridium difficile* infection.

Methods

A retrospective study was performed using the data from two tertiary center hospitals on hospitalized patients who were diagnosed with an initial episode of HA-CDI during the COVID-19 year (2020) and compared with patients of the pre-COVID-19 year (2019) from March 1 to October 31. The HA CDI incidence was collected from the Infection Prevention team registry along with the compliance rate for preventive measures (hand hygiene) for CDI. The inpatient hospital bed days were collected for both hospitals from the daily census of the specified time period. The rates were calculated as the total number of HA CDI cases divided by the total number of hospital-patient-days over the study time period.

Data were collected by reviewing the medical records of patients. Inclusion criteria included all patients aged 18 years and above who tested positive for CDI after hospital admission. The patients who were diagnosed with community-acquired CDI, HA-CDI acquired in another hospital, Community Onset, and Indeterminate cases

were excluded from the study.

The antimicrobial agents that may induce CDI were referred from 2020 UpToDate, Graphic 55479 Version 13.0. The most frequently associated antibiotics are fluoroquinolones, clindamycin, broad-spectrum penicillin, 2nd- 4th generation cephalosporins, and carbapenems. Similarly, macrolides, narrow-spectrum penicillins, 1st generation cephalosporins, trimethoprim-sulfamethoxazole, and sulfonamides are occasionally associated with *C. difficile* infection. The severity of disease was classified as non-severe if white blood cell count <15,000 cells/ μ L and serum creatinine <1.5 mg/dL; severe if white blood cell count \geq 15,000 cells/ μ L and/or serum creatinine \geq 1.5 mg/dL; and fulminant colitis if complicated by hypotension or shock, ileus or megacolon.

A comparison of baseline characteristics, risk factors and patient hospitalization were compared. All variables were analyzed using descriptive statistics (number, percentage, mean, and standard deviation) Categorical variables were compared using the chi-square or the Fisher Exact test where appropriate, and continuous variables were

compared using t-test and Mann-Whitney-Wilcoxon test with significance set at $p < 0.05$. All analysis was performed using RStudio version 4.1.2.

Results

During the study period, a total of 148 cases were diagnosed with HA-CDI of which 75 cases were in the pre-COVID-19 and 73 cases in the COVID-19 year, accounting for a total of 149,092 and 136,982 inpatient bed days respectively. The rate of HA-CDI was 5.03 vs. 5.33 per 10,000 hospitalized patients in the pre-COVID-19 year vs. the COVID-19 year.

No statistically significant differences in baseline demographic characteristics, (age, sex, and BMI); comorbidities (diabetes, hypertension, and cancer), and risk factors like the presence of enteral tube were observed between the two groups. Patients in the pre-COVID year had more comorbidities than in the COVID year (Table 1). Factors associated with CDI like antibiotic use ($p = 0.001$) and proton pump inhibitor use ($p = 0.005$) although significant were prescribed less frequently in patients during the COVID-19 year (Table 2).

Table 1. Demographics, Risk Factor and Hospital course

	Pre COVID 19 year - 2019 (n= 75)	COVID 19 year-2020 (n=73)	p-value
Age (years, Mean \pm SD)	57.98 \pm 17.16	60.56 \pm 16.29	0.43
Male (n, %)	44 (58.66%)	33 (45.20%)	0.14
Body mass index (BMI) (kg/m ²) \pm SD	30.18 \pm 8.6	30.66 \pm 8.3	0.85
Medical comorbidities (n, %)			
Diabetes	38 (50.66%)	28 (38.35%)	0.11
Hypertension	52 (69.33%)	42 (57.53%)	0.09
Chronic Kidney Disease	27 (36%)	15 (20.5%)	0.03
Cancer	13 (17.33%)	10 (13.69%)	0.7
Presence of risk factor	15 (20%)	21 (28.76%)	
Enteral Tube	6 (8%)	4 (5.48%)	0.52
Gastrointestinal surgery	5 (6.6%)	17 (23.28%)	0.01
Both	4 (5.4%)	0	

Table 2. Medication used during hospital stay that are associated with HA-CDI

Type of medication	Pre COVID 19 year-2019 (n=75)	COVID 19 year-2020 (n=73)	p-value
Steroid use	32 (42.6%)	22 (30.1%)	0.15
Antibiotic exposure	67 (89.33%)	51 (69.86%)	0.001
Frequently associated	63 (94%)	35 (68.6%)	
Proton pump inhibitor	48 (64%)	29 (39.7%)	0.005

During the COVID-19 year, there was a significantly high number of patients that had undergone gastrointestinal (GI) surgery (22.6% vs. 6.6%, $p=0.01$). Almost half of the patients in each group stayed in the intensive care unit (ICU) and the mean length of ICU stay was significantly higher in the COVID-19 year (20.4 ± 34.3 days vs 11.6 ± 16.9 days, $p=0.03$).

The mortality rate was higher (20.5% vs. 12%, $p=0.23$) during the COVID-19 period.

Table 3. Hospital Outcome

Characteristics	Pre COVID 19 year - 2019 (n=75)	COVID 19 year-2020 (n=73)	p-value
Length of hospital stay (days, Mean \pm SD)	19.96 \pm 14.66	23.32 \pm 19.44	1
Intensive care unit stay (n, %)	40 (53.3%)	37 (50.6%)	
Intensive care unit stay (days, Mean \pm SD)	11.6 \pm 16.99	20.4 \pm 34.37	0.033
Mortality	9 (12%)	15 (20%)	0.23

A sub-analysis was done with 2020 data to identify if there are any contributing factors to the increased CDI rate. 21 cases were

positive for COVID-19, of which 28.5% underwent GI surgery; 19% received steroids (Dexamethasone), 76.1% stayed in ICU with median LOS (16 ± 20.2) and 52.3% died.

Table 4. Occurrence of Suspected COVID Variables in Patients During the COVID year

COVID variables	
COVID positive cases	21 (28.7%)
No of people stay in ICU	16 (76.1%)
No of people with severe C. difficile	7 (33.3%)
No of people with GI surgery	6 (28.5%)
No of people with cancer	19 (90.4%)
No of people exposed to frequently associated antibiotics	9 (42.8%)
Mortality	11 (52.3%)

Discussion

In this retrospective study, during the COVID-19 pandemic, we found no decline in HA-CDI despite additional strict control measures of hand hygiene and PPE usage for the prevention of COVID-19. The preventive measures of CDI included isolation of patients, using protective clothing as gowns, proper donning, and doffing of PPE to prevent self-contamination and proper hand hygiene. The adherence to this hand hygiene was strictly checked by secret shoppers for compliance and to prevent healthcare workers' hygiene errors that can lead to the spread of COVID-19. Compliance was high in the COVID-19 year compared to the pre-Covid year.

Many studies have shown the rate of CDI was low during the pandemic and concluded that maintaining the standard preventive measures would ultimately reduce the rate of CDI.^{2,9-11} One study adjusted the rate with decreased CDI testing during the COVID period concluding the initial observance of increased rate adjusted for delayed diagnostics.⁹ Our center already had

implemented the best standard method and despite all these measures, our study showed a static rate of HA-CDI same as some of the few studies that had shown no difference in CDI in 2020 versus 2019 concluding the extra precaution did not affect the incidence of HA CDI.¹² One study showed a higher rate of CDI during the COVID year however it accounted for all the CDI and not just HA-CDI.¹³ Another study found a lower incidence of HA-CDI during the COVID-19 year compared to the past three years however when compared to COVID-19 wards versus COVID-free wards the incidence of HA-CDI was higher, suggesting SARS-COV2 can alter the gut microbiota and can be a possible risk factor CDI.¹

We examined the factors responsible for the static rate at our centers during the pandemic. The administration of antibiotics during hospital stays, especially for those frequently associated with *C. difficile*, however, was surprisingly less during the COVID-19 period than the previous year. A study showed no difference in HA-CDI rate despite increased use of broad-spectrum antibiotics during the COVID-19 period.^{2,12} Similarly, results shown in the studies done in a single center, offering the same standard of care were associated with advanced patient age, prolonged hospitalizations, and widespread antibiotic usage which are known risk factors for HA-CDI.¹¹⁻¹³ Our study found the increased length of hospital stay and prolonged ICU stay during the COVID-19 period can contribute to additional risk of getting hospital-acquired infection. Moreover, our study showed a higher rate of GI surgery among patients who had HA-CDI in the COVID-19 period which can be linked to some studies that interpreted intestinal surgery as causing intestinal dysbiosis which might lead to increased risk of CDI.¹⁴

There are limitations to this study as this is retrospective in nature, we were not able to obtain the patient-level risk factor who developed HA-CDI while admitted to the hospital. Identification of COVID-19 itself as a risk for CDI was not able to justify as no data were collected on co-infection of COVID-19 and HA CDI.

Conclusion

Based on our observations, the HA-CDI rate remained static (or a slightly higher rate of symptomatic HA-CDI was observed) during the COVID-19 year when compared with the pre-COVID-19 year in two tertiary centers. Our institutions have already implemented a high level of preventive measures for CDI adherence, and implementation of measures to prevent the spread of COVID-19 which were expected to help decrease HA-CDI, which was not able to provide a significant impact on the rate of HA-CDI at our centers. We did observe longer ICU stays and a higher rate of GI surgery among patients who had HA-CDI in 2020. Higher acuity patients and increased rate of these risk factors amongst patients admitted in the year 2020 might have offset the expected benefit of COVID-19 prevention strategies.

Affiliations:

¹Texas Tech University Health Sciences Center, School of Medicine

²Texas Tech University Health Sciences Center, Department of Surgery

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