**Table 1: The clinical course and treatment of C. difficile infections in pediatric oncology and HSCT patients**

| Clinical course and treatment of CDI episodes | Value |
|---|---|
| Abdominal Ultrasound, n (%) | 94 (32%) |
| Presence of colitis, n (%) | 48 (51%) |
| Location at time of CDI, n (%) | |
| Inpatient | 161 (54%) |
| Outpatient | 137 (46%) |
| CDI NHSN classification for incident or recurrent episodes, n (%) | 233 (78%) |
| Incident | 65 (22%) |
| Recurrent | |
| CDI NHSN classification for location of CDI onset, n (%) | |
| Community onset | 97 (32%) |
| Hospital onset | 95 (32%) |
| Community onset - Healthcare facility associated | 106 (36%) |
| Associated symptoms and signs, n (%) | |
| Fever | 86 (29%) |
| Chills | 4 (1%) |
| Diarrhea | 278 (93%) |
| Vomiting | 73 (24%) |
| Abdominal pain | 78 (26%) |
| Dehydration | 15 (5%) |
| Clinical appearance at presentation, n (%) | |
| Well | 222 (75%) |
| Sick | 74 (25%) |
| Median (range) duration of diarrhea in days | 10 (1 – 77) |
| Treatment, n (%) | |
| Metronidazole | 209 (71%) |
| Vancomycin PO | 46 (15%) |
| Fidaxomicin | 22 (7%) |
| Combination | 15 (5%) |
| No treatment | 6 (2%) |
| Co-infection, n (%) | 46 (15%) |
| Adenovirus | 22 (48%) |
| Norovirus | 15 (32%) |
| Rotavirus | 5 (10%) |
| More than one | 4 (10%) |

HSCT, hematopoietic stem cell transplant; NHSN, National Healthcare Safety Network; CDI, *Clostridioides difficile* infection.

**Table 2: The outcomes of C. difficile infections in pediatric oncology and HSCT patients**

| Outcomes of CDI episodes | Value |
|---|---|
| Hospitalization due to CDI, n (%) | 30 (15%) |
| Median (range) length of hospitalization due to CDI in days | 3 (1-49) |
| Complications within 30 days of CDI, n (%) | |
| Hepatitis | 4 (1%) |
| Sepsis | 16 (5%) |
| Dehydration | 8 (3%) |
| Hypotension | 12 (4%) |
| Respiratory distress | 23 (8%) |
| DIC | 1 (0.3%) |
| Renal | 8 (3%) |
| Chemotherapy due during CDI, n (%) | 188 (63%) |
| Chemotherapy modified due to CDI, n (%) | 28 (15%) |
| Chemotherapy delayed due to CDI, n (%) | 13 (7%) |
| ICU admission due to CDI, n (%) | 0 |
| All-cause mortality within 30 days, n (%) | 4 (1.3%) |
| Attributable mortality to CDI within 30 days, n (%) | 0 |

HSCT, hematopoietic stem cell transplant; CDI, *Clostridioides difficile* infection; DIC, Disseminated intravascular coagulation.

**Table 3: Univariate analysis to assess potential risk factors for CDI recurrence**

| Risk factor | Odds Ratio | Odds Ratio 95% Confidence Limits | P-value |
|---|---|---|---|
| Age at diagnosis in years | | | |
| <1yr vs >10yr | 0.64 | [0.07-5.59] | 0.68 |
| (1- 5yr) vs >10yr | 1.74 | [0.86-3.53] | 0.12 |
| (5 -10yr) vs >10yr | 1.00 | [0.39-2.55] | 1.00 |
| Male sex | 1.14 | [0.61-2.15] | 0.67 |
| Race | | | |
| Black vs. other | 1.22 | [0.30-5.02] | 0.77 |
| White vs. other | 1.29 | [0.41-4.05] | 0.65 |
| Primary disease at diagnosis | | | |
| Leukemia / lymphoma vs. ID | 0.22 | [0.03-1.65] | 0.14 |
| (Solid organ / brain tumor) vs. ID | 0.34 | [0.04-2.59] | 0.30 |
| Service at diagnosis | | | |
| HSCT vs. (Solid organ / brain tumor) | 0.70 | [0.32-1.52] | 0.37 |
| Leukemia vs. (Solid organ / brain tumor) | 0.54 | [0.25-1.13] | 0.10 |
| Neutropenia | 1.51 | [0.80-2.85] | 0.19 |
| Inpatient location at time of diagnosis | 0.93 | [0.50-1.74] | 0.82 |
| Chemotherapy prior 4 weeks | 0.81 | [0.35-1.86] | 0.62 |
| Acid suppressants prior 4 weeks | 1.23 | [0.62-2.46] | 0.54 |
| Laxative or stool softener prior 72 hours | 0.87 | [0.33-2.27] | 0.78 |
| Steroids prior 4 weeks | 1.05 | [0.56-1.95] | 0.87 |
| CDI classification per CDC | | | |
| HO vs. CO | 1.61 | [0.73-3.52] | 0.23 |
| COHCFA vs. CO | 1.55 | [0.70-3.45] | 0.27 |
| CDI treatment | | | |
| Combination vs. Metronidazole | 0.65 | [0.13-3.11] | 0.59 |
| Fidaxomicin vs. Metronidazole | 0.46 | [0.10-2.14] | 0.32 |
| Vancomycin vs. Metronidazole | 0.75 | [0.29-1.96] | 0.56 |
| HSCT recipient | 1.39 | [0.70-2.74] | 0.34 |
| Hospitalization due to CDI | 0.77 | [0.25-2.40] | 0.65 |
| Complications due to CDI | 0.64 | [0.26-1.55] | 0.32 |

Yr, years; ID, primary immunodeficiency; CDI, *Clostridioides difficile* infection; HO, Hospital onset; CO, Community onset; COHCFA, Community onset healthcare facility associated.

***Disclosures: Randall Hayden, MD, Abbott Molecular: Advisory Board; Quidel: Advisory Board; Roche Diagnostics: Advisory Board***

## 2384. The Relationship Between Rifaxamin Use and the Prevalence of *Clostridiodes difficile* and Vancomycin-Resistant Enterococcus in Patients with Advanced Liver Disease

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***Background.*** Rifaximin (RFX) is a minimally absorbed antibiotic that achieves high concentrations after administration in the gut lumen. Previously, RFX showed activity against *Clostridiodes difficile* (*C. difficile*) recurrences post treatment with little overall impact on the normal fecal microbiota. Additional studies have found that while exposure to systemic antibiotics was associated with infection with multi drug-resistant organisms, such as VRE, exposure to only RFX was not. RFX has become widely used in hospitalized patients with advanced liver disease (ALD) who have refractory hepatic encephalopathy, but the impact of therapy on the occurrence of *C. difficile* and VRE is not well established.

***Methods.*** ALD patients in the Vizient Clinical Database-Resource Manager (CDB-RM®) were identified based on ICD 10 and MS-DRG codes from January to December 2018. The data were further stratified based on receipt of RFX, documentation of *C. difficile* or VRE, and hospital type (academic medical centers, complex care medical centers or community hospitals). Wilcoxon signed-rank test was used to compare *C. difficile* rates while paired samples t-test was used to compare VRE. Chi-square analysis was used to evaluate differences in RFX use by hospital type.

***Results.*** A total of 527,534 cases from 419 acute care hospitals were included in the ALD cohort. The frequency of *C. difficile* occurrence in patients who received RFX was lower than those who did not receive RFX (3.8% vs 4.3%, respectively, $P = 0.25$), However, VRE frequency was significantly lower in those that received RFX (0.43 cases per 10,000 patient-days) vs. the overall ALD population (2.3 cases per 10,000 patient-days) ($P < 0.05$). Percentage of ALD cases receiving RFX in the academic medical centers, complex care medical centers and community hospitals was 11.94%, 4.87%, and 8.76%, respectively ($P < 0.05$).

***Conclusion.*** Patients with ALD who received RFX had a significantly lower frequency of documented VRE. There was a trend in the reduction in documented *C. difficile*, but this did not reach statistical significance. Utilization of RFX varied significantly by institutional type. These results support further studies on the relationship between receipt of RFX and protective effects against *C. difficile* and VRE in patients with ALD.

***Disclosures.*** **All authors:** No reported disclosures.

## 2385. Evaluating the Antibiotic Risk for *Clostridioides difficile* Infection (CDI): Comparing Piperacillin/Tazobactam to Cefepime and Ceftazidime

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***Background.*** *Clostridioides difficile* infection (CDI) is a common healthcare-associated infection (HAI). Past studies have revealed that anti-pseudomonal cephalosporins such as cefepime (FEP) and ceftazidime (CTZ) are associated with a higher CDI risk than β-lactam/β-lactamase inhibitors (BLBLI) such as piperacillin/tazobactam (PTZ). However, there is limited data evaluating the comparative healthcare-associated CDI (HA-CDI) risk associated with BLBLI and anti-pseudomonal cephalosporin therapy.

***Methods.*** An observational cohort study was performed with patients who received PTZ, FEP, or CTZ at Yale New Haven Hospital and Bridgeport Hospital from February 1, 2013 to June 1, 2018. Patients who received ≥ 3 days of PTZ, FEP, or CTZ therapy were included. Patients under the age of 18, those admitted to oncology, transplant, or pediatric units, and those with < 2 or ≥ 120 days of hospital admission were excluded. Multivariate logistic regression models were constructed to control and to adjust for underlying comorbidities.

***Results.*** A total of 11,909 patient encounters met the study criteria. The median patient-days of therapy for both the PTZ and FEP/CTZ groups was 4 days (Table 1). FEP/CTZ exposure was associated with a higher CDI risk than PTZ exposure ($P = 0.03$) (Figure 1) even with higher *C. difficile* testing frequency in the PTZ group ($P < 0.001$) (Table 1). Using a multivariate logistic regression model controlling for high-risk antibiotic therapy (ciprofloxacin, clindamycin, ertapenem, meropenem, moxifloxacin), acid suppression therapy (famotidine, lansoprazole, pantoprazole), sex, Charlson comorbidity index score, age, and duration of hospital admission, FEP/CTZ exposure was independently associated with a higher CDI risk than PTZ exposure (Table 2) (Table 3).

***Conclusion.*** FEP/CTZ exposure was associated with a higher CDI risk than PTZ exposure. PTZ may be associated with a higher risk for non-CDI antibiotic-associated diarrhea which may lead to an increased frequency of testing for CDI. The findings from this study may justify additional antibiotic stewardship efforts to limit the use of empiric FEP/CTZ therapy.

Table 1: Demographics

| | Aggregate Piperacillin/tazobactam (N = 6185) | Aggregate Cephalosporin (N = 5724) | P-value |
|---|---|---|---|
| **Patient Demographics** | | | |
| Age, median (IQR) | 65 (53-77) | 68 (56-81) | < 0.001 |
| Male, n (%) | 3584 (57.9) | 2954 (51.6) | < 0.001 |
| Charlson Comorbidity Index Score, median (IQR) | 2 (1-4) | 2 (1-4) | NS |
| Days of Hospital Admission, median (IQR) | 10 (6-18) | 9 (6-16) | < 0.001 |
| **Patient Characteristics** | | | |
| Days of Therapy, median (IQR) | 4 (3-5) | 4 (3-5) | < 0.001 |
| High-Risk Antibiotic Therapy, n (%) | 3807 (61.6) | 3427 (59.9) | NS |
| Acid Suppression Therapy, n (%) | 4767 (77.1) | 4746 (82.9) | < 0.001 |
| *C. difficile* Assay | | | |
| % Tested | 805 (13.0) | 322 (5.6) | < 0.001 |

Figure 1: Survival Analysis

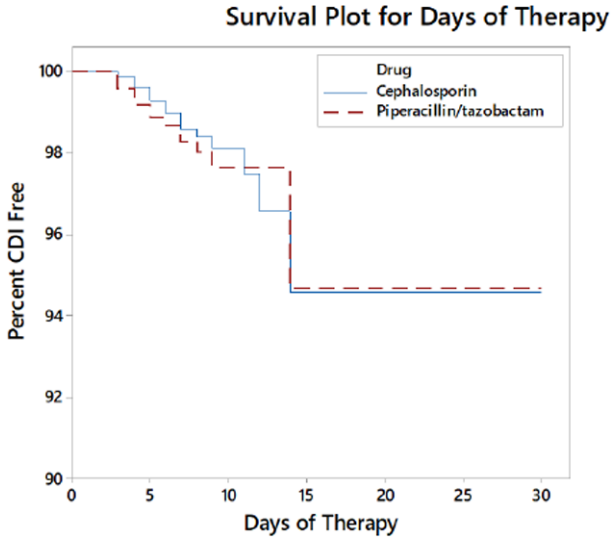


Table 2: PTZ Multivariate Regression Model

| Source | Unadjusted Odds Ratio | 95% CI | P-value | Adjusted Odds Ratio | 95% CI | P-value |
|---|---|---|---|---|---|---|
| High-Risk Antibiotic Therapy | 1.621 | (0.889, 2.956) | 0.104 | - | - | - |
| Acid Suppression Therapy | 0.612 | (0.342, 1.093) | 0.108 | - | - | - |
| Male | 0.925 | (0.535, 1.597) | 0.779 | - | - | - |
| Charlson Comorbidity Index Score | 0.937 | (0.829, 1.060) | 0.290 | - | - | - |
| Age | 1.010 | (0.994, 1.027) | 0.225 | - | - | - |
| Days of Hospital Admission | 1.036 | (1.024, 1.048) | < 0.001 | 1.034 | (1.023, 1.046) | < 0.001 |

Table 3: FEP/CTZ Multivariate Regression Model

| Source | Unadjusted Odds Ratio | 95% CI | P-value | Adjusted Odds Ratio | 95% CI | P-value |
|---|---|---|---|---|---|---|
| High-Risk Antibiotic Therapy | 1.884 | (0.909, 3.905) | 0.076 | - | - | - |
| Acid Suppression Therapy | 0.463 | (0.227, 0.941) | 0.045 | - | - | - |
| Male | 0.782 | (0.409, 1.498) | 0.458 | - | - | - |
| Charlson Comorbidity Index Score | 1.109 | (0.973, 1.263) | 0.133 | - | - | - |
| Age | 1.030 | (1.007, 1.054) | 0.008 | 1.031 | (1.009, 1.054) | 0.004 |
| Days of Hospital Admission | 1.036 | (1.022, 1.051) | < 0.001 | 1.038 | (1.023, 1.052) | < 0.001 |

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**2386. Mortality reduction with implementation of a standardized approach of surveillance, diagnosis and treatment of *Clostridioides difficile* infections.**

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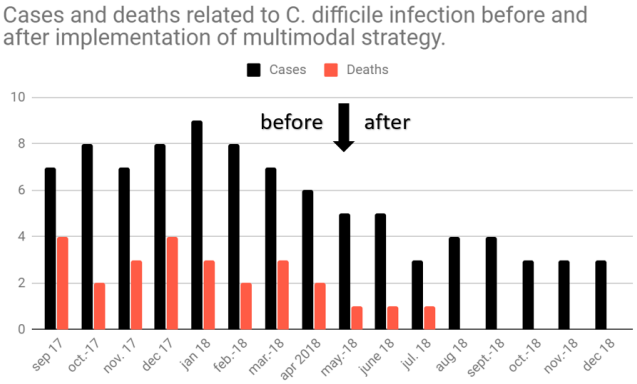
***Background.*** *Clostridioides difficile* (*C. difficile*) infection is the main cause of nosocomial diarrhea in the world. In our hospital, there was no standardized protocol for diagnosis and treatment of this infection. The aim of this study was to measure the impact of implementing a multimodal strategy of active surveillance, diagnosis and treatment in the clinical outcome of patients with *C. difficile* infection.

***Methods.*** Observational, retrospective, and analytical study that compared a multimodal strategy for the treatment of *C. difficile* infection against a traditional strategy, which consisted of treatment with either metronidazole or vancomycin with variable duration of therapy depending on the physician's choice. The multimodal strategy consisted of active surveillance of cases of nosocomial diarrhea, timely diagnosis (<12 hours), and standard treatment with oral vancomycin for a minimum of 10 days (125 mg po qid in mild and moderate illness, and 250 mg qid in severe disease). Patients with a confirmed diagnosis of *C. difficile* infection (PCR- Gene Xpert Cepheid) and inflammatory diarrhea were included. The study was carried out in a third-level hospital, in the period between September 2017 and December 2018.

***Results.*** In 15 month study period, 92 cases of *C. difficile* infection were documented. All cases were caused by strain NAP1 / B1 / 027. Twenty-three patients (25%) had mild disease, 28 (30.4%) moderate illness and 41 (44.56%) complicated illness. Thirty-four patients were evaluated with multimodal strategy and 58 according to the traditional treatment. Only 24 patients (41%) in the traditional treatment group received treatment with oral vancomycin. The clinical outcomes of patients in the multimodal strategy against patients with the tradional strategy were: clinical cure 85.3% vs 37.9% ($P$ = 0.02), recurrence 2.9% vs 17.2% (p = < 0.05) and death 11.8% vs 44.8%(p = < 0.05), respectively.

***Conclusion.*** Unfortunately, in our country, there are no guidelines for the management of *C. difficile* infection, and in many hospitals, metronidazole is the most prescribed treatment. In this study, we documented that implementing a standardized strategy of surveillance, diagnosis and adequate treatment, reduced mortality related to *C. difficile* infection, recurrence, and achieved greater clinical cure.




***Disclosures.*** **All authors:** No reported disclosures.

**2387. Learning the Influence of Individual *Clostridioides difficile* Infections**

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***Background.*** Healthcare-associated *Clostridioides difficile* infection (*C diff* infection, or CDI) imposes a substantial burden on the healthcare system. The impact of an individual *C diff* infection on onward transmission is not well understood. We developed a model of incident infections using self-exciting stochastic processes, known as Hawkes processes. These models can be used to improve our understanding of the factors that affect the likelihood of new infections to result in additional infections.

***Methods.*** All patients admitted to a large urban hospital between January 2013 and June 2014 were included. We used Hawkes processes to model the influence of each new CDI case (index infection) on transmission to other patients resulting in additional CDI. We developed separate Hawkes processes for each unit in the hospital to understand the differential impact of a C diff case across units. Units included both semi- and private-room wards, intensive care units, an emergency department, and specialty units such as oncology.

***Results.*** The magnitude of influence of an index infection on additional infections in the 2 days prior to a C diff test being sent varied across units. Results for an oncology unit, the emergency department, and an all private-room unit are provided (Table 1). An index infection in the emergency department demonstrated the greatest influence, leading to the largest number of additional infections, and increasing in the days leading up to the C diff test being sent. The impact 2 days prior to sample collection was similar across all unit types, and remained constant for oncology unit patients.

***Conclusion.*** We used Hawkes processes to model the impact of an index C diff infection on onward transmission. We identified differential impacts associated with the unit where the index patient was located in the days leading up to diagnosis. These differences, which could relate to unit-specific factors such as cleaning practices, patient turnover rates, use of portable medical equipment, antibiotic use, and other factors that vary across units, suggest that interventions aimed at controlling CDI may need to consider unit-specific approaches.

**Table 1. Increase in expected number of infections per 1000 patient-days.**

| Unit | Day of sample collection | Day prior to sample collection | Two days prior to sample collection |
|---|---|---|---|
| **Emergency** | 1.09 | 0.55 | 2.7e-5 |
| **Oncology** | 1.6e-5 | 1.6e-5 | 1.6e-5 |
| **Private** | 2.0e-5 | 0.60 | 2.0e-5 |

*Notes*: Each entry represents the contribution of the index infection to additional CDI per 1000 patient-days (PD), relative to day of sample collection and by patient unit location.

***Disclosures.*** **All authors:** No reported disclosures.