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Concise Communication

Factors associated with repeat *Clostridioides difficile* testing in VA medical centers

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Abstract

Clostridioides difficile infection (CDI) guidelines advise against repeat testing within 7 days. This retrospective study identified factors associated with 7-day repeat testing. Attending physicians (aOR = 0.67) and advanced practice practitioners (aOR = 0.61) ordered fewer repeat tests compared to residents. Further research is necessary to address inappropriate repeat testing.

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Background

Clostridioides difficile infection (CDI) affects 500,000 people and contributes to 30,000 deaths annually.[1] Risk factors include prolonged use of antibiotics or gastric acid reducers, advanced age, frequent healthcare encounters, and chronic gastrointestinal (GI) disease.[2,3] These factors also increase the risk for asymptomatic colonization, for which clinical guidelines recommend against treatment.[4] The Department of Veterans Affairs (VA) has issued guidelines to improve CDI diagnostic stewardship. These guidelines discourage repeat testing within 7 days of a previous test for the same episode of diarrheal illness and specifically discourage repeat testing as a "test of cure" after treatment.[5] The goal of this retrospective cohort study was to examine the rates of 7-day repeat testing within the VA healthcare system.

Methods

Study design and patient population

This was a retrospective cohort of patients who had at least one CDI test ordered between January 1, 2019, and December 31, 2022. Only tests performed in inpatient and long-term care settings were included. Data was collected from eight VA Medical Centers (VAMC) in Illinois, Wisconsin, and Michigan.

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Data collection

The VA corporate data warehouse (CDW) is a national repository of clinical and administrative data, which was used to obtain the following patient information: birth date, CDI test date, race, ethnicity, sex, admission date, discharge date, facility complexity, and facility urban/rural status. Comorbidities in the previous 365 days before the CDI test were identified by using ICD-10 codes to calculate the Charlson Comorbidity Score. The degree and title/classification of the ordering provider were collected. Based on their degree and title/classification, providers were categorized as resident physicians, attending physicians, or advanced practice practitioners (APPs).

7-day repeat definition

A two-step testing algorithm was used to diagnose CDI at all included facilities, which involved various combinations of the following tests: nucleic acid amplification tests for Toxin A and B genes, Toxin Enzyme Immunoassays, and Glutamate dehydrogenase tests. An infectious disease clinician defined test results as either positive, negative, or cancelled. If both tests were positive, the test was considered positive. If both tests were negative, the test was considered negative. If one test resulted positive and one was negative, then the test was considered negative. If one or both tests were cancelled, then the test was defined as cancelled. A seven-day repeat test was a CDI test ordered for the same patient within seven days of a previous test, regardless of the result of either test.

Statistical analysis

Unadjusted analyses were conducted using chi-squared and t-tests, or their non-parametric equivalents, to determine factors

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Table 1. Factors associated with 7-day repeat testing ($n = 6584$ tests)

	7 Day repeat test ($n = 294$, 4.5%)		No 7 day repeat test ($n = 6289$, 95.5%)		p-value	Adjusted odds ratio (95% confidence interval)	p-value
Patient demographics							
Race					0.054		
White	168	57.1%	3862	61.4%			
Black	180	36.7%	1900	30.2%			
Hispanic	12	4.1%	22	0.3%			
Missing	6	2.0%	255	4.1%			
Age					0.217		
18–49	11	3.7%	331	5.2%			
50–64	55	18.7%	1374	21.8%			
65–80	184	62.6%	3569	56.7%			
81+	44	15.0%	1016	16.2%			
Sex					0.289		
Male	285	96.9%	6017	95.7%			
Female	9	3.1%	273	4.3%			
Charlson score					0.163		
0	86	29.3%	2036	32.4%			
1–4	90	30.6%	2069	32.9%			
5+	118	40.1%	2185	34.7%			
LTC Test (vs no LTC)	42	14.3%	688	10.9%	0.074	1.83 (1.52, 2.21)	< 0.0001
ICU Test (vs no ICU)	100	34.0%	1420	22.6%	< 0.0001	1.83 (1.44, 2.33)	< 0.0001
CDI test results					< 0.0001		
Positive	9	3.1%	617	9.8%		**Reference**	
Negative	242	82.3%	5176	82.3%		3.62 (1.86, 7.04)	0.0004
Cancelled	43	14.6%	497	7.9%		8.52 (3.32, 21.82)	< 0.0001
Provider/Facility Demographics							
Provider type					0.015		
Resident	218	74.1%	4155	66.1%		**Reference**	
Attending	55	13.6%	1596	25.4%		0.67 (0.52, 0.86)	0.002
APP	21	6.8%	538	8.6%		0.61 (0.34, 1.09)	0.097
Rurality					0.092		
Urban facility	244	83.3%	4974	79.1%			
Rural facility	49	16.7%	1306	20.8%			
Year of culture					0.081		
2019	110	37.4%	1983	31.5%		**Reference**	
2020	76	25.9%	1538	24.5%		0.79 (0.56, 1.14)	0.217
2021	64	21.8%	1663	26.4%		0.63 (0.45, 0.88)	0.006
2022	44	15.0%	1106	17.6%		0.65 (0.40, 1.05)	0.081

associated with repeat testing. Binomial logistic regression models included variables that were significant at the $p < 0.05$ level. To account for procedural differences across facilities, as well as differences in provider demographics, as smaller VAs often do not have residency programs, models were clustered at the facility level. Only variables that remained significant in the adjusted model were retained in the final parsimonious model. All statistical analyses were completed using SAS 9.4.

Results

There were 6584 tests for 4640 unique patients identified for the study period. The overall cohort was primarily White (61.2%), male (95.7%), older (mean = 70.2 years, SD = 11.8), and treated at an urban VAMC (88.9%). The volume of CDI tests ordered at each medical center across the four-year study period varied considerably from 77 to 2116. The frequency of 7-day repeats ranged

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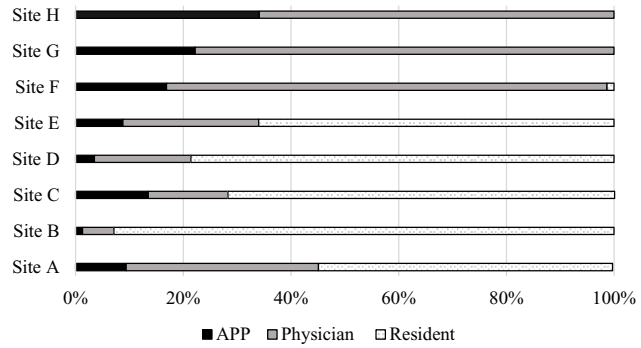

Figure 1. CDI Tests ordered by facility: the number of tests ordered by each provider type by facility over the four-year study period.

from 0% to 5% (p-value = 0.0003). There was also a wide variation in the percentage of tests ordered by each provider classification by VAMC. The percentage of tests ordered by residents ranged from 0% to 93%, by attendings from 6% to 82%, and for APPs from 1% to 34% (Figure 1).

There were 294 (4.5%) tests defined as 7-day repeats (Table 1). There was no association between repeat testing and patient race/ethnicity, age, sex, Charlson score, or urban/rural geography. Repeat tests had 83% higher odds of being ordered for a patient in long-term care compared to those ordered in acute care (OR = 1.83 (95% CI 1.52,2.22)) (Table 1). Tests that were 7-day repeats were three times more likely to be negative (OR = 3.62 (1.86, 7.04)) and eight times more likely to be cancelled (OR = 8.52 (3.32, 21.8)). Compared to residents, attending physicians (OR = 0.67 (0.52, 0.86)) and APPs (OR = 0.61 (0.34, 1.09)) were less likely to order repeat testing. There was a 2.1% conversion rate from negative to positive between initial and repeat tests and a 6.3% rate from cancelled to positive repeat (Supplemental Table 1).

Discussion

In this evaluation of over 4600 patients who had at least one CDI test ordered, we found the overall frequency of 7-day repeat testing was low (4.5%) compared to other studies that have reported repeat testing rates ranging from 11% to 31%.[6,7] This finding suggests strong adherence to VA diagnostic stewardship guidance. Care settings (long-term and intensive) and provider type (resident vs. attending/APP) were found to be significantly associated with repeat testing. Finally, repeat tests were three times more likely to be negative and eight times more likely to be cancelled, strengthening the argument that repeat tests are low-value and should continue being de-implemented in the healthcare setting.

Previous studies have found similar associations between care setting and repeat CDI testing. One evaluation of over 75,000 CDI orders found a 30% increased likelihood of inappropriate testing (for several reasons, including repeat testing) in the intensive care setting compared to general medicine wards.[8] Providers in long-term and intensive care settings may be more concerned about CDI risks and complications in their patients. They may have greater misperceptions about the benefit of repeat CDI testing. Targeted education tailored to the needs of these care settings could be beneficial in decreasing inappropriate testing. Furthermore, the finding that residents were more likely to order repeat CDI tests compared to attendings or APPs suggests the need for educational interventions for trainees.

This study has several strengths. The large sample size allowed for a robust evaluation of the research question. Clustering helped account for the variation between facilities. Additionally, VA's extensive data sources enabled the analysis of patient, provider, and facility factors associated with repeat testing.

However, the study has some limitations. First, the retrospective nature of the data could have allowed for some misclassification of factors. Although the missing data was minimal, there may have been bias due to data exclusion from the cohort. Additionally, repeat testing could be clinically appropriate in certain situations; this could not be assessed in this study, as such determinations would require a chart review, which was outside the scope of this project. The reason for admission could be associated with CDI testing, but it was not collected. However, the overall health of patients was assessed via the Charlson comorbidity index and was associated with repeat testing. Any ongoing CDI or diagnostic stewardship efforts occurring at individual facilities were not captured. Finally, the VA population is predominantly older and male; therefore, the results of this study may not be generalizable.

Conclusion

This study found that 7-day repeat testing for CDI was a rare occurrence in the VA (4.5%). Care setting and provider type were associated with an increased likelihood of repeat testing. Future work should continue to identify factors that contribute to repeat testing and design prevention interventions for inappropriate testing.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2025.10267.

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Competing of interests. The authors declare that they have no conflicts of interest.

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