

COVID-19 Hospitalizations Among U.S. Medicare Beneficiaries With Inflammatory Bowel Disease, April 1 to July 31, 2020

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INTRODUCTION

The COVID-19 pandemic has spread across the world. In the United States, more than 26 million cases with COVID-19 were reported as of February 1, 2021 (https://covid.cdc.gov/covid-data-tracker/#cases_totalcases). People infected with SARS-CoV-2 have a broad range of outcomes, from being asymptomatic or having mild symptoms to having severe illnesses that can result in hospitalization or death.¹ Patients with Crohn's disease (CD) or ulcerative colitis (UC), collectively known as inflammatory bowel disease (IBD), are often under immunosuppressive treatment that makes them more susceptible to opportunistic infections, and this risk is especially high for patients aged 50 years or older.² Patients with IBD are also more likely to have comorbidities than those without IBD,³ and certain chronic medical conditions are known to be risk factors for developing severe COVID-19.⁴ To date, no studies have found that patients with IBD are at a higher risk of SARS-CoV-2 infection compared with the general population.⁵ However, given the complexity of IBD, health providers need to know whether older patients with IBD are more likely to develop severe illness so that they can better manage these patients during the COVID-19 pandemic.

The main objective of this study was to compare COVID-19 hospitalization rates and outcomes between Medicare beneficiaries with and without IBD. We also assessed the association between demographic characteristics and the burden of chronic conditions and COVID-19 hospitalizations among beneficiaries with IBD.

MATERIALS AND METHODS

We used Medicare data (<https://www2.ccwdata.org/documents/10280/19002246/ccw-medicare-data-user-guide.pdf>) obtained from the Centers for Medicare & Medicaid Services to create a study population of approximately 24.5 million Medicare beneficiaries aged ≥ 67 years who were continuously enrolled in part A and part B but not enrolled in a health maintenance organization from January through July 2020. Patients with either CD or UC were identified by *International Classification of Diseases, 10th Revision, Clinical Modification* codes K50 and K51, respectively, when any listed corresponding code appeared at least once in part A claims data or twice with different service dates in part B data with a 3-year look-back. Beneficiaries without the relevant codes listed were considered to have no IBD. We based COVID-19 hospitalization from April 1 to July 31, 2020, on *International Classification of Diseases, 10th Revision, Clinical Modification* code U07.1 as the principal diagnosis. Covariates included age group (ages 67-74, 75-84, and ≥ 85 years), sex, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic others), and Elixhauser comorbidity index category (0-4, 5-7, 8-10, and 11-29) based on 29 chronic conditions (<https://www.hcup-us.ahrq.gov/toolsoftware/comorbidity/comorbidity.jsp>). We searched for data on comorbidities 1 to 12 months before the COVID-19 hospitalization or until July 31, 2020, for beneficiaries with no COVID-19 hospitalization. Hospitalization outcomes included intensive care unit (ICU) admission, in-hospital mortality, and length of stay.

The age-standardized hospitalization rate was calculated using the 2000 U.S. Census data (<https://data.census.gov/cedsci>). Differences in crude and age-adjusted hospitalization rates were compared by IBD status, using a *z*-test. Approximately 0.01% of beneficiaries had multiple admissions with COVID-19 as the primary diagnosis. The first hospitalization was used for all analyses except for the crude and age-standardized hospitalization rates, for which all COVID-19 hospitalizations were included during the study period. Unconditional logistic regressions were used to estimate the odds of hospitalization comparing beneficiaries with CD or UC with those without IBD, adjusting for age, sex, race/ethnicity, and comorbidity index category. For each group, we calculated percentages of ICU admission and in-hospital mortality

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and geometric means of length of stay. We adjusted the *P* values using Bonferroni corrections for multiple group comparisons.

Because beneficiaries with IBD comprised 1% of the total study population, to address the unbalanced sample sizes and potential selection bias, a propensity score analysis with a greedy matching technique was performed separately for CD and UC to create 1:3 case- and control-matched samples, controlling for

age, sex, race, and comorbidity index. The balance of covariates was determined by a standardized difference <0.1. In the unmatched sets, all covariates except for sex were not balanced between CD and non-IBD populations; covariates for non-Hispanic Whites, non-Hispanic Blacks, and comorbidities were not balanced between UC and non-IBD populations. After matching, all covariates were balanced well by IBD status.

TABLE 1. Patient Characteristics Associated With COVID-19 Hospitalizations Among Medicare Beneficiaries by IBD Status, April 1-July 31, 2020

Patient Characteristics	Without IBD (n = 24,254,960)		CD (n = 96,908)		UC (n = 152,498)	
	COVID-19 Hospitalization per 1000 (95% CI)	Adjusted ^a OR (95% CI)	COVID-19 Hospitalization per 1000 (95% CI)	Adjusted OR (95% CI)	COVID-19 Hospitalization per 1000 (95% CI)	Adjusted OR (95% CI)
Overall ^b						
Crude rate	2.84 (2.82-2.86)	—	3.17 (2.84-3.52)	—	4.94 (4.58-5.29)	—
Adjusted rate ^c	2.83 (2.81-2.85)	—	3.27 (2.90-3.63)	—	4.85 (4.50-5.19)	—
Age group (y)						
67–74 (ref)	1.78 (1.76-1.80)	1	2.12 (1.72-2.53)	1	3.27 (2.85-3.69)	1
75–84	2.92 (2.88-2.95)	1.43 (1.40-1.46)***	3.35 (2.74-3.95)	1.35 (1.04-1.77)*	4.83 (4.27-5.40)	1.26 (1.05-1.50)*
≥85	5.30 (5.23-5.37)	2.27 (2.23-2.32)***	5.71 (4.35-7.07)	1.98 (1.45-2.71)***	8.33 (7.18-9.49)	1.85 (1.52-2.25)***
Sex						
Male	2.90 (2.86-2.93)	1.23 (1.21-1.25)***	3.21 (2.65-3.78)	1.25 (0.99-1.58)*	4.79 (4.23-5.30)	1.19 (1.02-1.38)*
Female (ref)	2.59 (2.56-2.62)	1	2.86 (2.43-3.30)	1	4.59 (4.15-5.03)	1
Race/ethnicity						
Non-Hispanic White (ref)	2.02 (2.00-2.04)	1	2.55 (2.21-2.89)	1	3.79 (3.46-4.12)	1
Non-Hispanic Black	8.20 (8.06-8.34)	3.61 (3.54-3.68)***	7.96 (5.25-10.66)	2.45 (1.69-3.55)***	15.62 (12.61-18.63)	3.23 (2.60-4.03)***
Hispanic	7.12 (6.97-7.27)	3.40 (3.32-3.48)***	10.42 (6.18-14.65)	3.46 (2.24-5.34)***	14.17 (10.80-17.54)	2.91 (2.25-3.77)***
Others ^d	2.74 (2.66-2.83)	1.63 (1.58-1.68)***	3.60 (1.72-5.48)	1.76 (1.02-3.03)*	4.84 (3.19-6.49)	1.49 (1.04-2.12)*
Elixhauser comorbidity index category						
0-4 (ref)	1.50 (1.48-1.52)	1	1.14 (0.89-1.39)	1	1.99 (1.72-2.26)	1
5-7	6.63 (6.54-6.72)	3.80 (3.73-3.87)***	4.55 (3.56-5.53)	3.65 (2.66-4.99)***	6.43 (5.48-7.37)	2.90 (2.37-3.55)***
8-10	12.07 (11.84-12.29)	6.56 (6.42-6.71)***	10.31 (8.00-12.61)	8.06 (5.85-11.12)***	13.02 (11.07-14.96)	5.56 (4.52-6.84)***
11-29	18.90 (18.42-19.38)	10.32 (10.03-10.62)***	18.01 (13.34-22.69)	14.03 (9.89-19.90)***	24.32 (20.53-28.12)	10.15 (8.20-12.57)***

COVID-19 as the primary diagnosis.

^aAdjusted by age group, sex, race/ethnicity, and Elixhauser comorbidity index category.

^bAll COVID-19 hospitalizations as the primary diagnosis during the study period.

^cUsing the 2000 U.S. Census population for 3 age groups: 67-74, 75-84, and ≥85 years.

^dOthers includes non-Hispanic Asian or Pacific Islander, American Indian or Alaska Native, and other races/ethnicities.

* 0.01 < *P* ≤ 0.05 *** *P* ≤ 0.001.

CI indicates confidence interval; OR, odds ratio; ref, referent group.

Conditional logistic regressions were constructed to estimate hospitalization, and a generalized estimating equation model with a compound symmetry correlation was used to compare hospitalization outcomes by matched sets. This study is covered by a Centers for Medicare & Medicaid Services Data User Agreement and is not considered human subjects research. Analysis was performed using SAS Enterprise Version 7.1 (SAS Institute, Cary, NC).

RESULTS

From April through July 2020, compared with beneficiaries without IBD, both crude and adjusted COVID-19 hospitalization rates were higher among beneficiaries with UC ($P < 0.001$); the age-adjusted hospitalization rate ($P = 0.02$), not the crude rate ($P = 0.06$), was higher among beneficiaries with CD (Table 1). Regardless of IBD status, the adjusted odds of hospitalization were higher among beneficiaries who were in the older age groups, non-Hispanic Black or Hispanic, and who had more comorbidities.

In the unmatched and matched analysis, after adjustments for age group, sex, race/ethnicity, and comorbidity index categories, there was no significant association between beneficiaries with CD and those without IBD in terms of hospitalization and outcomes. The adjusted odds of hospitalization were 28% higher among beneficiaries with UC than those without IBD in the unmatched analysis and 27% higher

in the matched analysis (Table 2). There was no difference in ICU admission and in-hospital mortality among beneficiaries with UC compared with those without IBD in either analysis. Compared to those without IBD, beneficiaries with UC had a longer hospital stay by 0.7 days ($P = 0.01$) in the unmatched analysis and 0.6 days ($P = 0.02$) in the matched analysis.

We further estimated the odds of COVID-19 hospitalization by each comorbidity adjusting for age, sex, and race/ethnicity. All comorbidities except for AIDS or HIV and cancer were significantly associated with COVID-19 hospitalization, and the odds ratio was highest for depression and psychoses for both CD and UC, ranging from 3.8 to 4.5 (results not shown).

DISCUSSION

The findings suggest that adults with UC aged 67 years or older may have a higher risk of hospitalization after they contract SARS-CoV-2 infection, although COVID-19 incidence in the IBD population is similar to that in the general population.^{5, 6} An Italian study based on 79 patients with IBD with COVID-19 found that a UC diagnosis and older age were significantly associated with severe illness.⁷

During the study period, approximately one-third of beneficiaries hospitalized for COVID-19 had ICU admission and one-fifth died in the hospital. The study showed that in-hospital mortality did not differ by IBD status. A previous

TABLE 2. Comparison of COVID-19 Hospitalizations and Hospitalization Outcomes Among Medicare Beneficiaries by IBD Status, April 1–July 31, 2020

IBD Status	Hospitalizations			Hospitalization Outcomes			
	n	Unadjusted OR (95% CI)	Adjusted OR ^a (95% CI)	n	ICU (%)	In-hospital Mortality (%)	Length of Stay (d)
Unmatched							
No IBD (ref)	24,254,960	1	1	66,080	36.09 (35.72-36.45)	22.41 (22.09-22.73)	6.41 (6.37-6.46)
CD	96,908	1.10 (0.98-1.24)	0.95 (0.84-1.06)	291	35.40 (29.90-40.89)	19.93 (15.34-24.52)	6.75 (6.08-7.50)
UC	152,498	1.71 (1.59-1.85)***	1.28 (1.19-1.38)***	711	36.99 (33.44-40.54)	22.64 (19.57-25.72)	7.08 (6.64-7.54)*
Matched ^b							
Control patients for CD (ref)	290,724	—	1	974	36.24 (33.22-39.26)	22.79 (20.16-25.43)	6.50 (6.16-6.87)
CD	96,908	—	0.90 (0.79-1.02)	291	35.40 (29.90-40.89)	19.93 (15.34-24.52)	6.75 (6.08-7.50)
Control patients for UC (ref)	457,494	—	1	1688	36.61 (34.31-38.91)	23.22 (20.21-25.24)	6.46 (6.20-6.73)
UC	152,498	—	1.27 (1.16-1.38)***	711	36.99 (33.44-40.54)	22.64 (19.57-25.72)	7.08 (6.64-7.54)*

COVID-19 as the primary diagnosis.

^aFor unmatched analysis, unconditional logistic regression is adjusted for age group, sex, race/ethnicity, and Elixhauser comorbidity index category. For matched analysis, odds ratios were based on conditional logistic regression.

^b1:3 matched case and control samples.

* $0.01 < P \leq 0.05$ *** $P \leq 0.001$. *P* values for unmatched samples were corrected by Bonferroni test. *P* values for matched samples was based on generalized estimating equation models with compound symmetry correlation, ICU admission, and in-hospital death as a binary distribution and length of stay with a gamma distribution, accounting for the matched sets.

CI indicates confidence interval; d, days; ICU, intensive care unit; OR, odds ratio; ref, referent group.

study reported that patients with IBD had lower COVID-19 mortality rates than the general population (3.8% vs 10%), possibly because of younger age and few comorbidities in the IBD population studied.⁸ This study population included older adults (ie, Medicare beneficiaries) with considerable comorbidities. Beneficiaries with UC had a hospital stay longer by approximately half a day compared with their matched control patients. Although such a small magnitude may not be clinically meaningful, longer hospital stay may be associated with increased hospital-acquired infection.⁹ Similar to the general population, our study found that beneficiaries in the older age groups and a member of certain racial and ethnic minority groups were also risk factors for COVID-19 hospitalizations among Medicare beneficiaries with IBD. Furthermore, in addition to some underlying conditions known to be risk factors for COVID-19, our study found that mental illnesses prevalent among patients with IBD were strong predictors of COVID-19 hospitalizations, which suggested that assessing and treating psychological disorders among patients with IBD may be important during the COVID-19 pandemic.

This study has at least 3 limitations. First, the study does not include patients with IBD of all age groups, and the findings are only limited to older patients. Furthermore, the study population is Medicare fee-for-service beneficiaries, so the findings cannot be generalized to all older adults in the United States. Second, the claims data lacked clinical information to evaluate IBD severity. The results may be affected by some residual confounding that was not adjusted in the analyses. Third, information about tests for SARS-CoV-2 infection were only available if Medicare payment was submitted. However, beneficiaries may have had tests conducted outside the Medicare system. Because of the incomplete information, the SARS-CoV-2 infection incidence among beneficiaries with IBD could not be determined. Despite these limitations, this is the first population-based study to compare COVID-19 hospitalizations between older adults with and without IBD. Future studies can help further our understanding of this association. For instance, studies can assess the role of immunosuppression

status in the association between IBD status and COVID-19 hospitalizations and outcomes.

CONCLUSIONS

In conclusion, older patients with UC may be at higher risk for hospitalization with COVID-19 during the pandemic although they do not have more adverse hospitalization outcomes compared with patients without IBD. For these patients, clinicians may need to follow IBD management guidelines¹⁰ closely and adjust IBD medications according to the severity of COVID-19 and IBD.

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