

# Decreased Rate of Presentation, but Worsened Racial-Ethnic Disparity in Acute Gastrointestinal Bleeding During Coronavirus 2019 Shutdown: A Retrospective Cohort Study

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**Purpose:** In spring 2020, Coronavirus Disease 2019 (COVID-19) “stay-at-home” orders may have led to later, more acute disease presentations of emergent conditions such as gastrointestinal bleeding (GIB). In this retrospective cohort study, we compared incidence and severity of GIB during the strictest COVID shutdown to pre-COVID periods.

**Patients and methods:** We compared weekly counts of emergency department (ED) visits for GIB between March 27 and May 7, 2020 (COVID period) and pre-COVID periods in 2019 and 2020 in a US statewide network of hospitals. We compared the severity of GIB presentations using incident rate ratios (IRR) of “severe” GIB (requiring  $\geq 4$  units of blood, endoscopic therapy, interventional radiology or surgical procedure), intensive care (ICU) admission and shock. We also looked for effect modification of demographic covariates on associations between year and GIB outcomes.

**Results:** Fewer patients presented to ED for GIB during COVID than during the same dates in 2019 (534 versus 904; IRR 0.59, 95% CI 0.53–0.66). A greater proportion of COVID-period ED visits required inpatient admission (73.6% vs 67.8%,  $p = 0.02$ ) and had severe GIB (19.3% vs 14.9%,  $p = 0.03$ ). Proportion of patients requiring transfusion ( $p < 0.001$ ), with shock ( $p < 0.01$ ), or with critical hemoglobin ( $p = 0.003$ ) or lactate ( $p = 0.02$ ) were worse during COVID. Non-white patients experienced disproportionately worse outcomes during COVID than in 2019, with greater absolute counts of shock (65 vs 62,  $p = 0.01$  for interaction) or ICU admission (40 vs 35,  $p = 0.01$  for interaction).

**Conclusion:** Fewer acute GIB presented during the pandemic period compared to the year prior. The severity of pandemic presentations was greater, driven by disproportionately worse outcomes in minorities.

**Keywords:** SARS-CoV-2 lockdown, collateral damage, health disparities, GI bleed

## Plain Language Summary

A variety of factors led to a decrease in non-COVID health emergencies (such as heart attack and stroke) presenting to emergency departments during the COVID-19 lockdowns of the spring of 2020. These authors report the same phenomenon occurring with a gastrointestinal emergency, gastrointestinal bleeding. The study population was an entire health system consisting of different types of hospitals across the state of North Carolina, and representative of the US population. The authors found that the average bleed was more severe during the COVID period. Most striking however, was that despite this overall decrease in number of bleeds, the absolute number of the most severe bleeds (patients in shock, requiring multiple transfusions, or ICU care) was greater during the COVID period only for racial minorities, and far less than the pre-COVID period in non-Hispanic white patients. Public health messaging and frontline medical providers should encourage seriously ill patients to present to emergency rooms regardless of a pandemic state, with a particular focus on reaching racial and ethnic minorities during such crises.

## Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has been the defining health crisis of the 21st century to-date. Beyond the substantial toll of direct COVID-related morbidity and mortality, the fear of contagion and unprecedented social and economic restrictions dramatically altered the delivery of all healthcare in pandemic times, marked by delays and cancellations of elective ambulatory visits and procedures. During the most intense period of healthcare and economic shutdown, while visits to emergency departments (EDs) for COVID-19 were increasing,<sup>1</sup> ED visits for non-COVID conditions such as myocardial infarction,<sup>2</sup> stroke,<sup>3,4</sup> and others<sup>1,5,6</sup> significantly declined. The health impact of these “indirect” effects of the COVID-19 pandemic is still to be determined, but may eventually rival that of the virus itself.<sup>7</sup> Further, reducing access to health services has widened existing health disparities in racial minority communities,<sup>8</sup> including for gastroenterological conditions.<sup>9</sup>

Delay in routine medical care can lead to increased morbidity and mortality by failing to address new or previously well-controlled conditions until they have manifest complications. This phenomenon occurred during COVID-19 for several emergent medical conditions such as acute coronary syndrome<sup>10</sup> and appendicitis.<sup>11</sup> A similar process would be expected in the quintessential emergent gastrointestinal (GI) complaint, GI bleeding. Indeed, a principal tool for managing and preventing GI bleeding—endoscopy—was severely curtailed during the pandemic.<sup>12</sup> Most studies of inpatient endoscopic procedures during the pandemic showed decreased volume.<sup>13–15</sup> Very few examined whether the severity of bleeding in these presentations was greater,<sup>16,17</sup> or the clinical outcomes worse,<sup>17,18</sup> and these were relatively small samples from urban academic centers. There have been no studies of these phenomena from community hospitals in the US.

We performed a retrospective cohort study examining whether the number of acute GI bleeds presenting to our hospital system decreased during the most stringent period of the US COVID-19 health-care restrictions, compared to pre-COVID times. We also determined if these patients presented with more severe illness, suffered worse outcomes, or if demographic factors such as race or ethnicity affected outcomes. The aim was to assess the “collateral damage” of COVID-19 restrictions on an acute gastroenterological condition.

## Methods

### Participants

We identified patients with any visit to an ED within the electronically linked network of University of North Carolina Health with a diagnosis of GI bleed associated to the visit, during two time periods. GI bleed visits were defined by International Classification of Diseases 10th Edition (ICD-10) codes ([Appendix Table 1](#)). The “COVID” time period included visits from March 27–May 7 in 2020. March 27, 2020 corresponds to the North Carolina governor’s stay-at-home order, and 10 days after the health system’s restriction of elective clinical procedures and ambulatory visits. May 7 corresponds to the re-initiation of some semi-elective procedures. The principal “pre-COVID” time period included visits from March 27–May 7 in 2019, to minimize variation according to seasonality or academic calendar. We also examined events from January 31–March 26 of 2020, to confirm a difference from another pre-COVID period. Time periods were multiples of seven days to allow for comparison of weekly rates, with the 2020 pre-COVID period including a two week overlap from March 12–26 while the pandemic was escalating. The health system that was indexed electronically through the entire study period comprises 8 hospitals, including one university medical center, another 665-bed metropolitan community hospital, and 6 rural community hospitals across the state ranging from 25 to 353 beds each.

### Variables

We obtained an automated abstraction of laboratory results, vital signs, and select ICD-10 diagnoses for the entire ED stay ([Appendix Table 1](#)), as well as inpatient mortality, hospital length of stay (LOS), and intensive care unit (ICU) LOS. We performed manual review of each medical record to confirm a presumed acute GI bleed (overt or symptomatic occult). We manually abstracted the receipt of endoscopic procedures, endoscopic hemostatic therapies, interventional radiology procedures, surgeries for hemostasis, endotracheal intubation, renal replacement therapy, intravenous vasopressor support, and red blood cell transfusion during the same hospital admission.

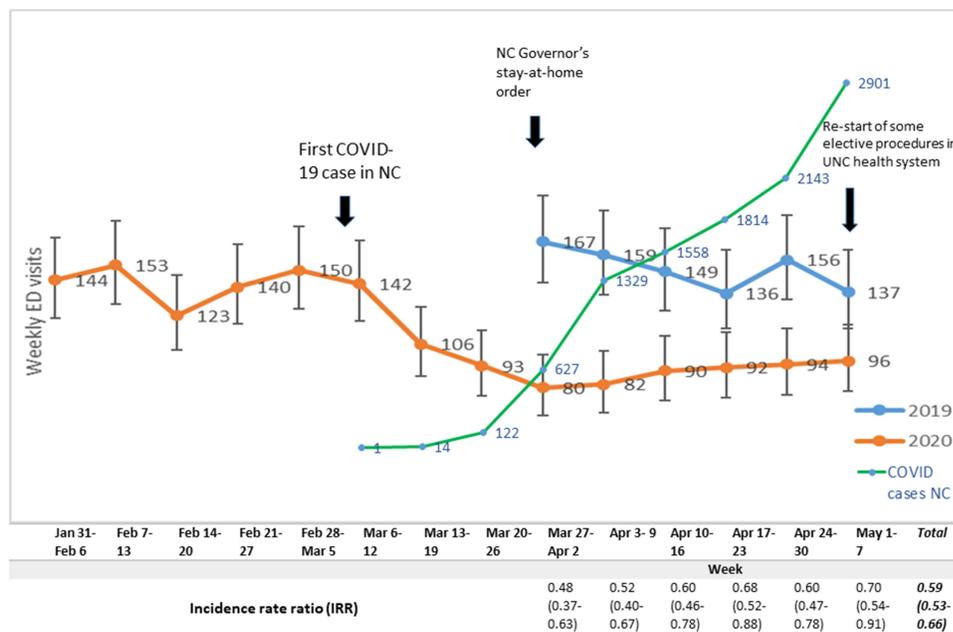
## Comparisons and Statistical Analysis

The primary comparison was weekly counts of total ED visits for GI bleeding between the COVID and pre-COVID periods. We reported incidence rate ratios (IRR) with 95% confidence intervals from Poisson regression, using calendar week as the observation and time period (COVID vs 2019) as the independent variable. We also reported the IRR of “severe bleed”, defined as requiring endoscopic intervention for hemostasis, interventional radiology and/or surgical procedure, or transfusion of  $\geq 4$  units of packed red blood cells during the course of hospitalization, based on principles outlined by the Bleeding Academic Research Consortium.<sup>19</sup> Secondary outcomes included the components of the severe bleed composite outcome, as well as occurrence of shock, defined as ICD-10 diagnosis of shock, systolic blood pressure during ED stay  $< 90$ mmHg, lactate level  $> 4.0$ mg/dL, or any non-intraoperative receipt of intravenous vasopressor. We compared numbers of hospital and ICU admissions, hospital and ICU days, inpatient deaths, endotracheal intubations, and renal replacement therapy. We also examined differences in presenting hemoglobin, lactate, blood pressure, and modified Glasgow-Blatchford Score (mGBS).<sup>20</sup> Lastly, we used multi-variable logistic regression to evaluate factors associated with more severe outcomes during the COVID-19 pandemic. We examined interactions of presentation during COVID with race, ethnicity, age, insurance status, specific hospital, and comorbidity, as indexed by the Charlson Comorbidity Index (CCI).<sup>21</sup> Analyses were performed in STATA, with two-sided alpha of 0.05. We used the STROBE cohort reporting guidelines.<sup>22</sup> The study was approved by the UNC Institutional Review Board (#20-1428).

## Results

Automated search of the health system’s electronic medical record revealed 2686 visits with an ICD-10 code related to GI bleeding in the study periods. Manual chart review revealed 168 were not related to current GI bleeding, leaving 2518 ED visits in the final data set. 1781 required hospitalization. Sample demographics did not differ significantly between study periods, except for CCI, which was on average higher in the COVID period than 2019 ([Appendix Table 2](#)).

For the primary outcome, there were 534 ED visits for GI bleeding in the COVID period, compared to 904 in 2019, for an overall IRR of 0.59 (95% CI 0.53–0.66; [Figure 1](#)). 73.6% of ED visits for GIB required admission during COVID,



**Figure 1** Difference in ED visits for GI bleed during a 6-week period of COVID-19 lockdown and the corresponding period from 2019.

**Notes:** IRR estimated with Poisson regression, and error bars represent Poisson confidence intervals for individual counts.

**Abbreviations:** NC, North Carolina; UNC, University of North Carolina; IRR, incidence rate ratio; CI, confidence interval.

compared to 67.8% in 2019 ( $p = 0.02$ ), though absolute numbers of inpatient admissions were still fewer in 2020 (IRR 0.64, 95% CI 0.56–0.73, [Appendix Figure 1](#)). The overall IRRs for the COVID period vs the 6-week period from January 31–March 12, 2020 were also significantly lower for ED visits (0.79, 95% CI 0.75–0.84, [Figure 1](#)) and inpatient admissions (0.80, 95% CI 0.75–0.85; 71.8% of ED visits, [Appendix Figure 1](#)). The decrease in ED visits for GI bleed were similar to decreases in ED visits for any complaint during the COVID period ([Appendix Figure 2](#), [Appendix Table 2](#)); the percentage of ED visits for GIB remained stable throughout (1.8% in pre-COVID 2019 period, 2.4% in pre-COVID 2020 period, and 2.0% in COVID period,  $p = 0.27$ ).

Upper GI bleeds were the most common source of GIB in the COVID period (39.1%, vs 34.6% in 2019,  $p = 0.09$ , [Table 1](#)), while lower GI bleeds were most common in 2019 (39.9%, vs 37.6% in 2020,  $p = 0.39$ ). We included 25 cases that by discharge were believed to be from non-GI sources (epistaxis, oropharyngeal, hemoptysis), but on presentation were presumed a GI source, and therefore equally affected by pandemic-related alterations in healthcare. 31% of 393 admitted GIB patients in 2020 were tested for COVID-19 (nasal swab PCR), with 6 positives.

**Table 1** Clinical Characteristics of Gastrointestinal Bleeding Patients Presenting to the Emergency Department Between March 27 and May 7 in 2019 and 2020

	2019, N (%)	2020, N (%)	p-value
<b>Total</b>	904	534	
Source of GI bleeding (presumed or confirmed) <sup>a</sup>			
Upper	313 (34.6%)	209 (39.1%)	0.09
Variceal	25 (8.0%)	13 (6.2%)	0.45
Non-variceal	288 (92.0%)	192 (91.9%)	0.95
Lower	361 (39.9%)	201 (37.6%)	0.39
Small bowel	16 (1.8%)	16 (3.0%)	0.13
Peristomal or pancreaticobiliary	2 (0.2%)	2 (0.4%)	0.59
Obscure (but presumed GI)	147 (16.3%)	98 (18.4%)	0.31
Non-GI source	14 (1.5%)	11 (2.1%)	0.47
Mean minimum systolic blood pressure per ED stay <sup>b</sup>	109.7 (108.2–111.2)	107.8 (105.8–109.9)	0.14
Any systolic blood pressure <90 <sup>b</sup>	155 (17.2%)	116 (21.8%)	0.03
Mean maximum lactate (arterial or venous) per ED stay <sup>b</sup>	2.59 (2.30–2.88)	3.45 (2.96–3.95)	0.002
Any lactate ≥4.0 <sup>b</sup>	40 (14.8%)	46 (23.6%)	0.02
Mean maximum hemoglobin per ED stay <sup>b</sup>	10.4 (10.2–10.6)	9.9 (9.6–10.1)	0.002
Any hemoglobin <7.0 <sup>b</sup>	153 (17.6%)	127 (24.3%)	0.003
Mean maximum creatinine per ED stay <sup>b</sup>	1.48 (1.37–1.58)	1.64 (1.48–1.80)	0.08
mGBS	7.79 (N = 359)	8.85 (N = 258)	0.005
mGBS≥6	233 (N = 359)	193 (N = 258)	0.009

**Notes:** <sup>a</sup>The source of bleeding is the source presumed at hospital discharge. This is generally after endoscopic or imaging evaluation when these were performed, but otherwise clinically determined (eg hemodynamically stable hematochezia discharged home from the ED was categorized as lower gastrointestinal bleeding, and any blood in emesis upper, etc.). If the patient was admitted for concern for GI bleed but the bleed was eventually determined to not be GI-related, this was listed as such. Multiple sources could be noted (usually small bowel angioectasias with gastric angioectasias or other gastric source). Obscure/unknown was favored over small bowel unless at least a prior study had shown a small bowel source, and the current admission presumed to be from same. In cirrhotic patients with non-massive hematemesis that did not have endoscopy, neither variceal nor non-variceal were marked. Not all sources were abstracted from ED visits without inpatient admission. <sup>b</sup>Vital sign and laboratory values only collected for the first 24 hours after arrival or until admission from ED to hospital. Continuous variables reported as means with 95% confidence intervals.

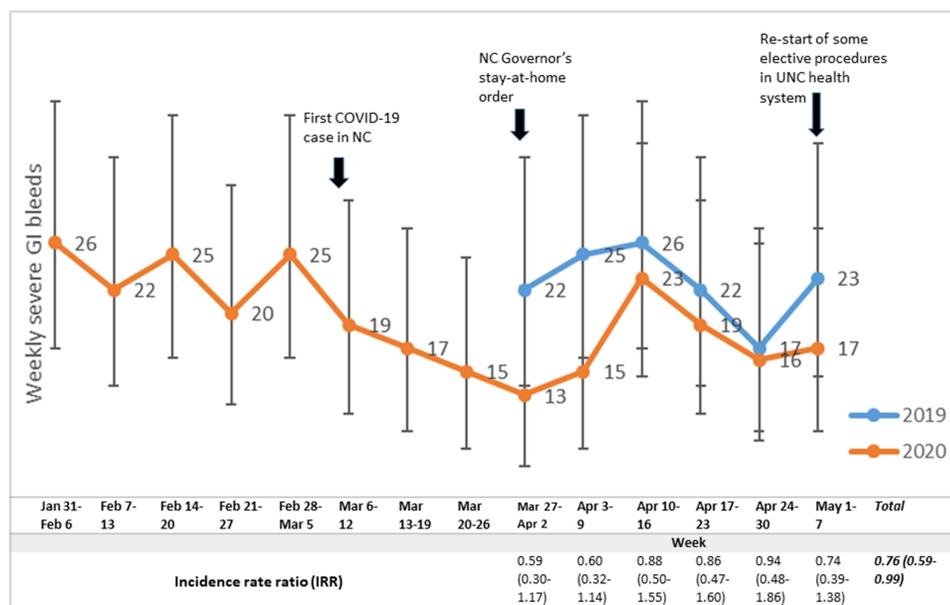
**Abbreviations:** CI, confidence interval; GI, gastrointestinal; ED, emergency department; COVID, coronavirus disease 2019; mGBS, modified Glasgow-Blatchford Score.

## Severity of Presentations

The percentage of visits with severe GI bleeds was significantly higher in COVID (19.3% vs 14.9% in 2019; vs 15.5% in entire non-COVID period including early 2020,  $p = 0.03$  for both comparisons), and the absolute numbers of severe bleeds were similar, with no significantly different IRR for any week (Figure 2). The same was true if the severe GI bleeding definition was expanded to include severe GI bleeding or “shock” (hypotension, lactic acidosis, vasopressor requirement, or cardiac arrest), experienced by 36.1% of COVID visits vs 29.4% 2019 visits ( $p = 0.008$ ), and 48.9% of COVID inpatient admissions vs 42.7% of 2019 admissions ( $p = 0.06$ ). There were overall fewer ICU admissions for GI bleeding (99 vs 137; IRR 0.72, 95% CI 0.56–0.94) in COVID vs 2019 (Appendix Figure 3).

The clinical characteristics of the GI bleeding presentations from the main study periods are described in Table 1, with interventions and outcomes in Appendix Table 3. Of 239 severe GI bleeds across both time periods, the majority (152, 64%) were classified as severe for requiring  $\geq 4$  units of red blood cells, though 98 of the severe bleeds underwent endoscopic therapy (41%). Regarding possible practice shifts away from aerosolizing procedures during COVID, there were fewer procedures per admission compared to the same period in 2019 (0.68 vs 0.77), but this was not statistically significant ( $p = 0.07$ , Appendix Table 3), and in only 5 cases did the medical record suggest that a procedure was foregone due to COVID-related concerns.

The average severity of the presentations was greater during COVID vs the corresponding 6-week period in 2019 across a variety of indices, including ED hemoglobin and lactate, average mGBS score (Table 1), transfusion requirement, and the diagnosis of shock (Appendix Table 3). Raw numbers of health-care resources utilized from the higher frequency variables (eg, number of endoscopic procedures, total units of red cells and patients transfused, hospital LOS) were still much higher in 2019. Interestingly, many of the most severe, but lower frequency clinical outcomes were more similar numerically between the COVID and 2019 periods, as well as occurring in a significantly higher percentage in the COVID group (Appendix Table 3). For instance, inpatient deaths were strikingly similar (32 in 2019 and 28 in COVID,  $p = 0.12$  for proportion), and 53 patients required vasopressor support each year ( $p = 0.01$ ). There were numerically greater numbers of resuscitated cardiac arrests (9 vs 6), endotracheal intubations (39 vs 37), total ventilated days (407 vs 307), and use of renal replacement therapy (11 vs 7) during COVID. Excluding the six COVID-positive patients in the 2020 cohort did not meaningfully affect these differences (Appendix Table 3).



**Figure 2** Difference in severe GI bleeds during a 6-week period of COVID-19 lockdown and the corresponding period from 2019.

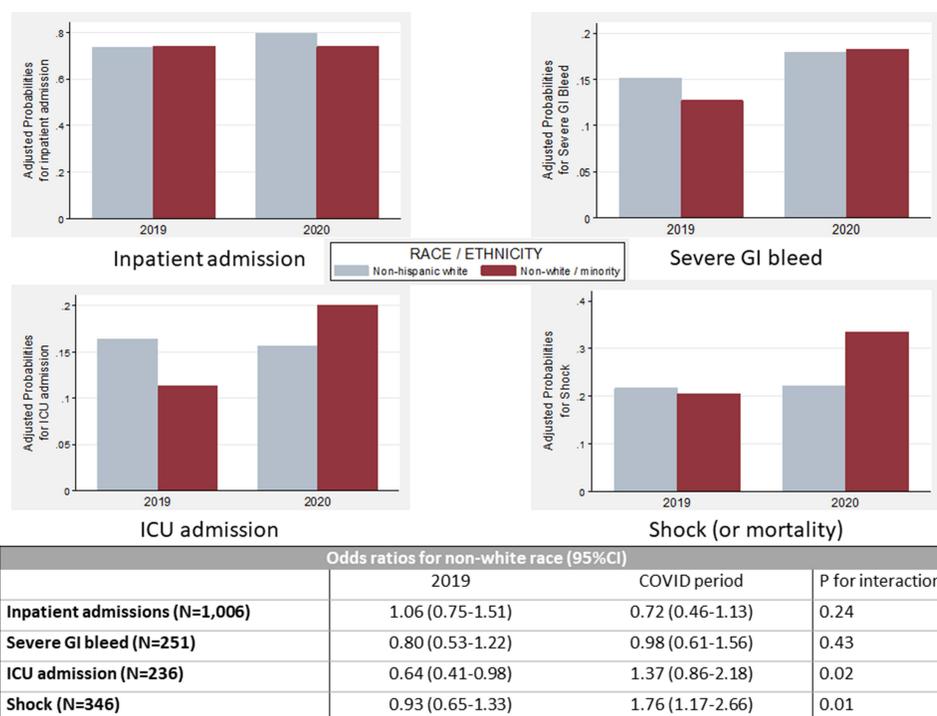
**Notes:** IRR estimated with Poisson regression, and error bars represent Poisson confidence intervals for individual counts. Severe GI bleeds required 1 or more of: 1) endoscopic therapy for hemostasis, 2) interventional radiology procedure for hemostasis, 3) surgical procedure for hemostasis, or 4)  $\geq 4$  units of packed red blood cells transfused during admission.

**Abbreviations:** NC, North Carolina; UNC, University of North Carolina; IRR, incidence rate ratio; CI, confidence interval.

## Relationship of Other Demographic Characteristics to Clinical Outcomes and COVID Period

In multivariable logistic regression, increasing age, male sex, and higher CCI were associated with severe GI bleed, shock, and ICU admission across all time periods (Appendix Table 4). While each adverse clinical outcome occurred in a higher proportion of individuals in the COVID period, this remained statistically significant after multivariable adjustment only for the outcome of shock (Odds ratio [OR] 1.30 95% CI 1.00–1.67,  $p = 0.047$ ).

ED presentations for any complaint (not just GIB) decreased in a similar fashion, but to a slightly lesser degree during the COVID period for minorities than for non-Hispanic whites (Appendix Figure 4). The increased percentage of minority ED visits from 41.2% in 2019 to 44.4% in the COVID period was significant ( $p < 0.01$ , Appendix Table 2). Race or ethnicity were not significantly associated with presentation with GIB or adverse clinical outcomes from GIB overall or within any single time period. However, there was a significant interaction between minority race or ethnicity and presentation during the COVID period for the outcomes of ICU admission and shock from GIB ( $p < 0.05$  for each interaction, Figure 3). This interaction was independent of comorbidity, though mean CCI increased to the proportionately greater degree in COVID-period minority visits (mean CCI in COVID-period vs 2019: 3.59 vs 2.62 for minorities,  $p = 0.003$ ; 3.33 vs 2.98 for non-Hispanic whites,  $p = 0.17$ ). Further, minority patients experienced greater absolute counts of shock and ICU admission during COVID than in 2019 (65 vs 62 instances of shock; 40 vs 35 ICU admissions;  $p = 0.01$  for each, Table 2). Figure 3 demonstrates that minorities with GI bleeding experienced adverse clinical outcomes at slightly lower proportions in 2019, but much higher proportions in the COVID period. The direction was the same for all racial/ethnic minorities, though greater proportions of Latinos in the COVID period required transfusion ( $p = 0.04$  for interaction, Appendix Figure 5, Table 2), while blacks experienced a stronger trend toward shock with elevated lactate (Appendix Figure 6, Table 3). For almost any outcome of clinical severity, the only meaningful decreases in absolute counts during COVID were among non-Hispanic whites, while minorities experienced equivalent or higher numbers of



**Figure 3** Interactions of race/ethnicity with COVID-19 period for clinical outcomes (inpatient admission, severe GI bleed, shock, ICU admission).

**Notes:** COVID period March 27-May 7, 2020.  $p$ -value for interaction derived from multivariable logistic regression adjusted for age, sex, insurance coverage, type of hospital for initial ED visit, and Charlson Comorbidity Index. Shock defined as either 1) any ICD-10 diagnosis of shock, 2) a systolic blood pressure during the emergency department stay  $<90$ mmHg, 3) a lactate level (arterial or venous)  $>4.0$ mg/dL, or 4) any non-intraoperative receipt of intravenous vasopressor. Any cardiac arrest or inpatient mortality was also counted as shock.

**Abbreviations:** CI, confidence interval; COVID, coronavirus disease; GI, gastrointestinal; ICU, intensive care unit.

**Table 2** Interactions of Race and Ethnicity with COVID Period and Counts for Clinical Outcomes

	March 27-May 7, 2019	March 27-May 7, 2020 (COVID period)	P-value for Interaction <sup>a</sup>
<b>Any endoscopy</b>			
Race/ethnicity			0.09 (for non-white race)
Non-Hispanic White	217	133	1.0
Black	97	50	0.06
Hispanic/Latino	15	5	0.19
<b>Severe GI bleeding</b>			
Race/ethnicity			0.45 (for non-white race)
Non-Hispanic White	94	65	1.0
Black	30	26	0.76
Hispanic/Latino	7	7	0.41
<b>Shock</b>			
Race/ethnicity			0.01 (for non-white race)
Non-Hispanic White	135	82	1.0
Black	52	52	0.07
Hispanic/Latino	5	8	0.06
<b>ICU admission</b>			
Race/ethnicity			0.01 (for non-white race)
Non-Hispanic White	102	57	1.0
Black	29	32	0.05
Hispanic/Latino	2	5	0.06
<b>Any transfusion</b>			
Race/ethnicity			0.71 (for non-white race)
Non-Hispanic White	221	162	1.0
Black	83	65	0.56
Hispanic/Latino	8	13	0.04
<b>Transfusion &gt;4 units during hospitalization</b>			
Race/ethnicity			0.13 (for non-white race)
Non-Hispanic White	62	41	1.0
Black	16	18	0.30
Hispanic/Latino	2	6	0.05

(Continued)

**Table 2** (Continued).

	March 27-May 7, 2019	March 27-May 7, 2020 (COVID period)	P-value for Interaction <sup>a</sup>
<b>Endotracheal Intubation</b>			
Race/ethnicity			0.03 (for non-white race)
Non-Hispanic White	28	19	1.0
Black	7	16	0.02
Hispanic/Latino	1	1	0.95
<b>Lactate &gt;4 mg/dL in emergency room</b>			
Race/ethnicity			0.02 (for non-white race)
Non-Hispanic White	28	23	1.0
Black	8	18	0.04
Hispanic/Latino	2	1	0.47
<b>Receipt of vasopressors during hospitalization</b>			
Race/ethnicity			0.46 (for non-white race)
Non-Hispanic White	36	31	1.0
Black	15	19	0.38
Hispanic/Latino	1	1	0.90

**Notes:** <sup>a</sup>P-value for interaction of race with year derived from multivariable logistic regression without adjustment for additional covariates, given the small number of events for each minority. The p-values for the interaction terms on the first line of each outcome are for the binary "Non-Hispanic white vs non-white or Hispanic" race/ethnicity classification, derived from a model also adjusted for age and sex. This model also includes non-black, non-Hispanic minorities, but these were not included as a separate row in the table due to very small numbers.

events (Table 2). There was a signal toward fewer endoscopies as a possible mediator of worse outcomes for minority individuals (in addition to worse clinical parameters on admission), but this was not statistically significant ( $p = 0.09$ , Table 2).

## Discussion

Our study found a significantly lower number of ED visits and hospitalizations related to GI bleeding during the pandemic period (March–May 2020) compared to pre-pandemic times, in a large US health system comprising both referral and rural community hospitals. The severity per presentation was significantly higher during COVID by a variety of measures, with absolute counts of severe clinical outcomes similar between years. The increased severity was driven largely by a racial-ethnic disparity. Minorities failed to experience any of the decreases in absolute counts of shock, ICU admission, transfusions and intubations that non-Hispanic whites did in 2020, despite proportionally lower total presentations.

The reason for the decrease in 2020 ED visits is likely multifactorial. Initial public health messages recommended that minor, non-life-threatening health issues capable of being delayed not present to hospital. Provider recommendations reflected this position, and many may have been willing to address more mild bleeds in the outpatient setting, or even telemedicine. However, overall decreased patient access to ambulatory practices that identify worrisome bleeding, as well as fear of contagion, likely also contributed.

While the pandemic-related reduction in hospital visits has been recognized for a variety of conditions,<sup>2,3,23,24</sup> it has not been studied extensively related to GI bleeding. Studies from Italy,<sup>13,16</sup> Austria,<sup>14</sup> and France<sup>25</sup> reported fewer urgent endoscopies at the height of their pandemic, in either very small samples<sup>16</sup> or from multi-hospital surveys without

granular data on the clinical and laboratory features of the patients.<sup>13,14,25</sup> A study of 203 upper GI bleeds in London teaching hospitals demonstrated an association of fewer inpatient endoscopies with reduced 30-day survival post-endoscopy.<sup>18</sup>

In the US, large health-care databases have demonstrated reductions in admissions for GI bleeding from 24% to 38% of pre-COVID rates, comparable to those of diabetes, sepsis, and acute coronary syndrome.<sup>26,27</sup> Consistent with our findings, a study of 211 patients from a Manhattan academic center found that patients admitted with GI bleeding during the height of the pandemic had more concerning laboratory findings, received more blood transfusions, and had increased hospital length of stay compared to a period earlier in 2020.<sup>17</sup> Investigators from the University of New Mexico also reported fewer endoscopies during the pandemic, though similar numbers of hemodynamically unstable upper GI bleeds.<sup>15</sup> Our study extends these findings in a much broader group of bleeding patients (not restricted to upper GI bleeds, endoscopic procedures, or even inpatient admissions), in a larger sample size that was predominantly non-teaching, rural hospitals. We were able to examine a broader range of covariates and clinical outcomes, including the full breadth of acute GI bleed management with interventional radiology and surgical procedures for hemostasis. Despite fewer GI bleed presentations to hospital during the spring of 2020, a higher proportion experienced more severe illness. While absolute numbers of frequent interventions such as endoscopies and blood transfusions were also less in 2020, the interventions reserved for the most critically ill, such as interventional radiology procedures, vasopressors, mechanical ventilation, dialysis, and cardiac arrest management remained stable or even trended upward during the COVID-19 lockdown.

On the one hand, our findings could be interpreted as vindicating the crisis management of the COVID-19 health-care shutdown. That is, the least ill patients heeded public health warnings and did not present to hospital, while most who truly required acute care did come, as evidenced by the similar numbers of critical care interventions. The true health effects of pandemic restrictions then should be reflected in differences in absolute counts of severe illness between periods, which is why we included these analyses and not only comparisons of proportions, given the smaller denominator of total presentations to healthcare during COVID.

Regarding outcomes, receipt of medical interventions is a problematic index of illness severity, also influenced by a tangle of provider-related concerns such as aerosolization, PPE usage, and ICU bed supply. Such factors should not affect the average lactate or hemoglobin of patients presenting to the ED however. That shock was associated with GI bleeding during COVID even after adjustment for baseline comorbidity suggests that there was some delay in these presentations, and not just that baseline sicker patients were the only ones seeking care. Further, we share the concerns of authors investigating similar phenomena such as MI<sup>2</sup> and stroke<sup>3</sup> that there is no obvious scientific explanation for a true reduction in non-communicable disease during the pandemic. One might expect fewer post-polypectomy bleeds without screening colonoscopies, but this is counterbalanced by increased self-medication with NSAIDs or alcohol.<sup>28</sup> Efforts should be intensified to communicate to the public that it is always worth seeking consultation for acute, severe symptoms.

Perhaps the most significant finding of our study is the type of patient who experienced the worst outcomes from severe GI bleeding in 2020. The disproportionate effect of COVID-19 itself on blacks and Latinos in the US has been well documented;<sup>8</sup> our study shows that this disparity extends to the collateral damage on non-COVID-19 conditions as well. Multiple transfusion, shock, and ICU admission from GIB decreased in whites 30–50% from 2019 to 2020, while these outcomes in Blacks and Latinos *increased*. The causes of this disparity are likely similar to those in other areas of medicine, centered around access to care and material resource deprivation. Notably, the interactions between race and year were significant despite adjustment for type of insurance coverage (a surrogate for socioeconomic status) and comorbidity index, and despite a slightly greater overall percentage of minority ED visits (including non-GIB visits) in 2020 than 2019. Other factors that could have contributed to racial disparities in non-COVID-19 health outcomes in 2020 include access to alternative forms of primary care through telemedicine (from lack of stable internet connection, or language barriers), as well as decreased comfort navigating the healthcare system, or even mistrust of the same. Further research should seek to elucidate these factors in order to improve the racial equity of not only future pandemic responses, but of the healthcare system as a whole.

Our study has limitations. We did not have information on home medication use, such as anticoagulants and NSAIDs. Neither did we have information on patient outcomes after discharge, such as 30- or 90-day mortality, or if COVID-era patients eventually received endoscopy as outpatients. Lastly, the imprecision and often misclassification of ICD-10 billing codes may be transmitted to our analyses incorporating ICD-10 diagnoses (eg, shock, liver disease). We mitigated the impact of such imprecision by incorporating manual chart review for the more difficult-to-code data elements, as well as confirmation of the primary diagnosis of acute GI bleed. This led to exclusion of over 6% of our sample that would have been misclassified based on ICD-10 code alone, a strength relative to other, larger studies of health-care databases.

While the US may have emerged from the height of COVID-19 restrictions on health-care services, variant-driven surges continue to strain resources, and non-COVID-related ED visits remain below pre-COVID levels.<sup>29</sup> Meanwhile, limited access to vaccines allows higher viral transmission and the accompanying restrictions to persist in many countries. For the remainder of the current pandemic, and for future threats, it is critical to balance mitigation of infectious transmission with clear public health messaging and the available health-care resources to not neglect life-threatening non-communicable illness. Our findings of an interaction between the COVID shutdown period and worse GIB outcomes in minorities are a reminder of the potential for health and economic crises to magnify existing health disparities. We must place health equity at the forefront of conversations on future pandemic preparedness.

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## Disclosure

None of the authors have any conflicts of interest (financial, professional, or personal) relevant to this manuscript.

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