

# Increased rates of suicide ideation and attempts in rural dwellers following the SARS-CoV-2 pandemic

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## Abstract

**Purpose:** Those factors identified to increase the risk of suicide in rural dwellers were exacerbated by the SARS-CoV-2 pandemic, specifically economic factors, substance use, access to health care, and access to lethal weapons. Because the effects of SARS-CoV-2 on suicide ideation and attempts in rural populations have not been fully characterized in published literature, this study compares: (1) the rates of suicide ideation and attempts between the 6 months affected by SARS-CoV-2 to same months of the preceding year (3/18/2020-9/18/20; 3/18/2019-9/18/19), (2) demographics (ie, age, sex, residence, race, and ethnicity), and (3) the locations in which the encounters were billed (inpatient, outpatient, and emergency department).

**Methods:** Deidentified claims data associated with patient encounters billed for *Suicide Ideation* and *Suicide Attempt* were grouped based on time period and analyzed using descriptive statistics, incidence rate ratio (IRR), 2-sample *t*-test, chi-square test of association, or Fisher's exact test.

**Findings:** Suicidal ideation encounters increased in the 6 months post-SARS-CoV-2 when compared to the 6 months of the prior year ( $IRR = 1.19$ ;  $P < .001$ ). Males ( $IRR = 1.27$ ,  $P < .001$ ), those residing rural areas ( $IRR = 1.22$ ,  $P = .01$ ), and Black, non-Hispanic ( $IRR = 1.24$ ,  $P = .024$ ) were found to have increased rates of suicide ideation post-SARS-CoV-2. In adults, White, non-Hispanics ( $IRR = 1.16$ ;  $P < .001$ ) had increased rates of post-SARS-CoV-2. In the pediatric subset, those who were aged 14-17 ( $IRR = 1.50$ ;  $P < .001$ ), resided in rural areas ( $IRR = 1.61$ ,  $P = .009$ ), and identified as Hispanic ( $IRR = 1.89$ ;  $P = .037$ ) or Black, non-Hispanic ( $IRR = 1.61$ ,  $P = .009$ ) had increased rates post-SARS-CoV-2.

**Conclusions:** Our study identified rural dwellers to be at increased risk for suicide ideation.

## KEYWORDS

demographics, emergency department, inpatient, rural, suicide attempt, suicide ideation, urban

## INTRODUCTION

Suicide is consistently a leading cause of death in the United States with rates escalating.<sup>1</sup> In 2020, suicide was the ninth leading cause of death in all US persons and the second leading cause of death in those aged 10-34.<sup>1</sup> In 2020, approximately 12.2 million people had suicidal thoughts and 1.2 million attempted suicide.<sup>1,2</sup> Suicide disproportionately affects those residing in rural areas.<sup>1,3</sup> The annual US suicide rates per 100,000 persons were steadily increasing from 2000 to 2018 (17.7 in 2009 to 22.4 in 2018).<sup>2</sup> In 2019, there was a slight decrease in suicide rates to 22.4 per 100,000.<sup>2</sup> Depression, social isolation, job problems or loss, barriers to health care, and substance misuse have all been shown to contribute to suicidal ideation.<sup>4</sup> In addition to the psychological factors (ie, anxiety, depression, and substance use) also identified in adults, pediatric risk factors for suicidality include family and peer conflict, impulsivity, and neuroticism.<sup>5</sup> Of these factors, access to lethal means, lack of access to mental health services, social isolation, and substance use are specific factors identified to increase suicide risk in rural populations.<sup>3,6</sup> Due to the magnitude of this worsening problem specifically in those disproportionately affected populations, it is essential that factors affecting suicide ideation and suicide attempts be fully characterized, including public health influences.

Kentucky (KY) ranks 17th nationally in suicide rates (17.7 per 100,000 in 2020).<sup>7</sup> KY has a host of unique characteristics that place its residents at increased risk for suicide. Specifically, KY is a predominantly rural state.<sup>8</sup> Similarly, substance use in KY is a long-standing problem reaching epidemic proportions.<sup>9</sup> In 2020, KY had the second highest drug overdose mortality in the United States with a rate of 49.2 per 100,000.<sup>10</sup> KY is also highly affected by poverty.<sup>11</sup> On January 9, 2020, the World Health Organization (WHO) identified a novel strain of a coronavirus, SARS-CoV-2, in Wuhan, China.<sup>12</sup> Less than 2 weeks later, the incident cases were found in the United States and by March 11, 2020, the worldwide effect of SARS-CoV-2 was described as a pandemic.<sup>12-14</sup> Due to the high virulence of this disease, mandates limiting in-person activity came quickly from local, state, and national governments. According to the National Academy for State Health Policy, all but 6 states in the United States had some level of stay-at-home mandates in Spring 2020.<sup>15</sup> People were advised to limit their contacts to just those people in their households. In many places across the United States, including KY, restrictions were not lifted until the early summer of 2020, leaving many socially isolated. Similarly, job loss and substance use increased during the time period affected by SARS-CoV-2.<sup>16,17</sup> In April 2020, over 23 million people in the United States were affected by job loss.<sup>16,17</sup> Therefore, as a result of SARS-CoV-2, many of the risk factors for suicide and suicide ideation were dramatically increased.

Recent studies have been conducted to evaluate the effects of SARS-CoV-2 on suicide.<sup>18-25</sup> A recent meta-analysis suggests that suicide ideation rates increased by nearly 11%, suicide attempts by 4.68%, and self-harm by 9.63%.<sup>26</sup> The majority of published studies included samples of pediatric patients and we could not identify any study evaluating the effects of residing in a rural versus an urban geographic

location on suicide attempts and suicide ideation.<sup>18-25</sup> Because residing in a rural area has been identified as a risk factor for suicide, it is important to understand the potentially compounding effect of SARS-CoV-2 on this population.<sup>27</sup>

With this context, the study purpose was to utilize a health care claims database to evaluate the effects of SARS-CoV-2 on suicide ideation and suicide attempt encounters seen at 1 university health care system and children's hospital serving Central, Eastern, and Southern KY region of the United States. We aimed to compare the rates of suicide ideation and attempts in the first 6 months affected by SARS-CoV-2 to same months of the preceding year (3/18/2020-9/18/20 vs 3/18/2019-9/18/19). We hypothesized that there would be higher rates of encounters for suicide ideation and attempts during the months affected by SARS-CoV-2 versus the unaffected months. We also compared the demographics (ie, age, sex, residence, race, and ethnicity) associated with the encounters for suicide ideation and attempts in the first 6-month period of time affected by the SARS-CoV-2 pandemic and the same 6 months of the prior year. We also compared suicide ideation and attempt rates per the locations in which the encounters were billed (inpatient vs outpatient vs emergency department) per time period: the first 6-month period of time affected by the SARS-CoV-2 pandemic versus the same 6 months of the prior year. We hypothesized that there would be an increased prevalence of inpatient and emergency department suicide ideation encounters during the time period affected by SARS-CoV-2 versus the same months of the preceding year.

## MATERIALS AND METHODS

This project utilized the University of Kentucky's Clinical and Translational Science bioinformatics services as honest brokers to obtain deidentified claims data that included demographic (eg, sex) indicators. All included encounters met the inclusion/exclusion criteria provided in the study design and were extracted following IRB approval of the study protocol. Patient encounters billed with the code for *International Classification of Diseases ICD-10-CM for Suicide Ideation* (R45.851) and *Suicide Attempt* (T14.91XA, T14.91XD, T14.91XS) were extracted and those identified were grouped based on whether the ICD-10 diagnosis codes were submitted in the 6-month time frame initially affected SARS-CoV-2 and related mandates (3/18/2020-9/18/20) versus the same 6 months of the prior year, unaffected by SARS-CoV-2 (3/18/2019-9/18/2019). Extracted data included age, sex, race, ethnicity, Rural Urban Continuum Codes description of county of residence (metro designations are described as urban and nonmetro designations are described as nonurban), and visit type. In an effort to accurately capture the acuity of each patient encounter using the claims dataset, multiple claims for the same deidentified medical record number (MRN) in the same visit were categorized based on the highest acuity patient acuity: inpatient first, then emergency department (ED), and then outpatient. It was recognized that health care utilization would be affected by the SARS-CoV-2 pandemic; specifically, state mandates were in place to cease nonemergent procedures from March 23, 2020

**TABLE 1** Demographic summary of suicidal ideation and attempt claims by study period

	Suicide ideation				Suicide attempt			
	Total sample (N = 2,496)	Pre (n = 1,281)	Post (n = 1,215)	P	Total sample (N = 255)	Pre (n = 155)	Post (n = 99)	P
Age	33.8 (16.9)	34.1 (17.1)	33.5 (16.7)	.39 <sup>a</sup>	30.8 (15.0)	29.9 (14.4)	32.2 (15.8)	.25 <sup>a</sup>
Sex				.14 <sup>b</sup>				.99 <sup>b</sup>
Female	1,250 (50.1%)	660 (51.5%)	590 (48.6%)		139 (54.5%)	85 (54.5%)	54 (54.6%)	
Male	1,246 (49.9%)	621 (48.5%)	625 (51.4%)		116 (45.5%)	71 (45.5%)	45 (45.4%)	
Geographic location				.73 <sup>b</sup>				.96 <sup>b</sup>
Urban	1,881 (76.6%)	972 (76.8%)	909 (76.3%)		161 (65.4%)	98 (65.3%)	63 (65.6%)	
Nonurban	576 (23.4%)	293 (23.2%)	283 (23.7%)		85 (34.6%)	52 (34.7%)	33 (34.4%)	
Race/ethnicity				.54 <sup>b</sup>				.39 <sup>c</sup>
White, non Hispanic (NH)	2,019 (81.6%)	1,029 (81.1%)	990 (82.2%)		214 (83.9%)	133 (85.3%)	81 (81.8%)	
Black, NH	362 (14.6%)	186 (14.7%)	176 (14.6%)		34 (13.3%)	20 (12.8%)	14 (14.1%)	
Hispanic	79 (3.2%)	46 (3.6%)	33 (2.7%)		5 (2.0%)	3 (1.9%)	2 (2.0%)	
Other	13 (0.5%)	8 (0.6%)	5 (0.4%)		2 (0.7%)	0 (0.0%)	2 (2.0%)	

Cells contain mean (SD) or n (%), as appropriate.

Note: Ideation--Although there were 1,566 and 1,573 encounters in the pre- and post-periods, there were 1,281 and 1,215 unique patients in each, respectively. Attempt--Although there were 181 and 116 encounters in the pre- and post-periods, there were 155 and 99 unique patients in each, respectively.

<sup>a</sup>P from 2-sample t-test.

<sup>b</sup>P from chi-square test of association.

<sup>c</sup>P from Fisher's exact test.

to May 13, 2020 when they could resume at 50% capacity.<sup>28</sup> Therefore, differences in health care utilization over the 2 time study periods were considered and total encounters for any diagnosis were extracted for each of the 6-month periods. There were 845,992 patient encounters from 3/18/2019 to 9/18/19 and 714,578 encounters from 3/18/2020 to 9/18/20, a 15.5% decrease. In particular, adult encounters (ages 18 and older) for this time period comparison decreased by 11.9% (from 677,850 to 597,373), while pediatric encounters (ages <18) decreased by 30.3% (from 168,142 to 117,205).

## Data analysis

Demographic characteristics of unique patients in each cohort were summarized using means and standard deviations or frequency distributions, as appropriate. Cohort differences (ie, between the 2019 and 2020 dates) in demographic variables were evaluated using the 2-sample t-test and chi-square test of association or Fisher's exact test, as appropriate. Incidence rate ratios (IRRs) were calculated to estimate the rate of suicidal ideation and attempt during the 2 time points, adjusting for differences in health care utilization frequency. Changes in incidence rates were evaluated overall and by demographic groups in the total sample, as well as for adult and pediatric encounters separately. IRRs and corresponding 95% confidence intervals and P-values were calculated using OpenEpi,<sup>29</sup> and all other data analysis was conducted using SAS, version 9.4 (Cary, NC). An alpha of 0.05 was used to determine statistical significance throughout.

## RESULTS

### Description of results for combined adult and pediatric samples

A total of 2,496 unique patients were included in the analysis of suicide ideation, including 1,281 in the pre-SARS-CoV-2 cohort and 1,215 in the post-SARS-CoV-2 cohort. The average age was 33.8 years (SD = 16.9, range = 5-92; see Table 1). Half were female (50%) and the majority were White, non-Hispanic (82%), and lived in a county designated as urban (77%). There were no differences in the demographic profiles between the 2 study periods. A total of 255 unique patients were included in the analysis for suicide attempt, with 155 and 99 patients in the pre-SARS-CoV-2 cohort and post-SARS-CoV-2 cohort, respectively. The average age was 30.8 years (SD = 15.0). The majority were female (55%), White, non-Hispanic (84%), and lived in a county designated as urban (65%). There were no differences in the demographic distribution by cohort.

In the combined sample, including both adult and pediatric patients, there were 1,566 (1,246 adults, 320 pediatric) and 1,573 (1,266 adults, 307 pediatric) encounters for suicidal ideation in the pre and post cohorts, respectively, which after adjusting for health care utilization, yielded a significant increase in the rate of suicidal ideation encounters in the 6 months post-SARS-CoV-2 (220.1 per 100,000 encounters) when compared to the 6 months of the prior year (185.1 per 100,000 encounters) (IRR = 1.19, 95% CI = 1.11-1.28, P < .001; see Table 2). This same trend is evidenced in demographic subgroups for all demographic variables and acuity (Table 2). The demographic subgroups

**TABLE 2** Comparison of suicide ideation and suicide attempt pre-SARS-CoV-2 versus post-SARS-CoV-2

	Suicide ideation				Suicide attempt			
	PRE IR	POST IR	IRR (95% CI)	P	PRE IR	POST IR	IRR (95% CI)	P
Overall	185.1	220.1	1.19 (1.11-1.28)	<.001	21.4	16.2	0.76 (0.60-0.96)	.020
Sex								
Female	94.1	104.5	1.11 (1.01-1.23)	.039	11.8	9.1	0.77 (0.56-1.05)	.10
Male	91.0	115.6	1.27 (1.15-1.40)	<.001	9.6	7.1	0.75 (0.52-1.06)	.099
Geographic location								
Urban	143.3	167.0	1.17 (1.08-1.26)	<.001	13.8	10.1	0.73 (0.54-0.98)	.033
Nonurban	39.6	48.3	1.22 (1.05-1.42)	.010	6.7	5.7	0.85 (0.57-1.27)	.44
Race/ethnicity								
White, NH	150.5	176.7	1.18 (1.09-1.27)	<.001	18.0	13.2	0.73 (0.56 - 0.95)	.017
Black, NH	26.0	32.2	1.24 (1.03-1.49)	.024	3.0	2.0	0.66 (0.34-1.27)	.22
Hispanic	6.3	7.3	1.16 (0.79-1.71)	.44	0.5	0.8	1.78 (0.49-7.14)	.39
Other	0.9	1.8	1.92 (0.80-4.88)	.15	–	0.3	–	–
Visit type								
Outpatient	19.9	31.5	1.59 (1.30-1.94)	<.001	2.2	2.4	1.06 (0.54-2.05)	.86
Emergency	73.3	84.4	1.15 (1.03-1.29)	.014	2.1	2.9	1.38 (0.73-2.63)	.32
Inpatient	92.0	104.3	1.13 (1.03-1.25)	.014	17.0	10.9	0.64 (0.49-0.84)	.001

Note: The “Other” racial category was excluded from the suicide attempt column due to zero counts for at least 1 cohort. Incidence rates (IR) per 100,000 encounters.

with a greater increase in encounters compared with the overall group included male sex ( $IRR = 1.27, P < .001$ ), nonurban county of residence ( $IRR = 1.22, P = .010$ ), and Black, non-Hispanic race/ethnicity ( $IRR = 1.24, P = .024$ ). Encounter rates were higher for post-SARS-CoV-2 time period, with similar increases in inpatient and emergency room encounters ( $IRR = 1.13, P = .014$  and  $IRR = 1.15, P = .014$ , respectively) and a 59% increase for outpatient encounters ( $IRR = 1.59, P < .001$ ).

For suicide attempts, there were a total of 181 (136 adults, 45 pediatric) and 116 (85 adults, 31 pediatric) encounters in the pre and post cohorts, respectively. Adjusting for differences in health care utilization was a significant reduction in the rate of suicide attempts in the 6 months post-SARS-CoV-2 (16.2 per 100,000 encounters) when compared to the 6 months of the prior year (21.4 per 100,000 encounters) ( $IRR = 0.76, 95\% CI = 0.60-0.96, P = .020$ ; see Table 2). When broken down by demographic characteristics, this reduction was significant for those living in a county designated as urban ( $IRR = 0.73, 95\% CI = 0.54-0.98, P = .017$ ) and those who identified their race/ethnicity as White, non-Hispanic ( $IRR = 0.73, 95\% CI = 0.56-0.95, P = .017$ ). By visit type, there was a 36% reduction in suicide attempt encounters resulting in an inpatient visit in the post-SARS-CoV-2 cohort compared to the pre-SARS-CoV-2 cohort ( $IRR = 0.64, 95\% CI = 0.49-0.84, P < .001$ ).

### Description of results for adult sample

In adults ( $\geq 18$  years of age), there was a 15% increase in the incidence of suicidal ideation encounters in the post-SARS-CoV-2-cohort com-

pared to the pre-SARS-CoV-2 cohort ( $IRR = 1.15, 95\% CI = 1.07-1.25, P < .001$ ; see Table 3). The increase in incidence was significant for both female ( $IRR = 1.46, P < .001$ ) and male ( $IRR = 1.41, P < .001$ ) adult encounters. The increase in suicide ideation among adults from urban locations was significant ( $IRR = 1.14, P = .003$ ), but this was not the case for adults from nonurban locations. White, non-Hispanic encounters increased 16% in the post-cohort compared to pre-cohort ( $IRR = 1.16, P < .001$ ), while the changes in incidence among Black, non-Hispanic or Hispanic adult encounters were not significant. Outpatient suicidal ideation encounters increased by 70% in the post compared to pre-evaluation ( $IRR = 1.70, P < .001$ ) and inpatient increased by 12% ( $IRR = 1.12, P = .048$ ), while emergency adult encounters did not significantly change.

Consistent with the finding among all encounters, there was a significant reduction in adult suicide attempt encounters in the post-SARS-CoV-2 cohort compared to the pre-SARS-CoV-2 cohort ( $IRR = 0.71, 95\% CI = 0.54-0.93, P = .012$ ; see Table 3). This reduction was significant among White, non-Hispanic patients ( $IRR = 0.70, P = .016$ ) and for inpatient encounters ( $IRR = 0.61, P = .002$ ).

### Description of results for pediatric sample

For pediatric encounters, there was a 38% increase in the incidence of suicidal ideation in the post-cohort compared to the pre-cohort ( $IRR = 1.38, 95\% CI = 1.18-1.61, P < .001$ ; see Table 4). However, when looking at specific age groups, the only significant group increase was noted for those aged 14-17, with a 50% increase ( $IRR = 1.50,$

**TABLE 3** Comparison of adult suicidal ideation and attempt pre-SARS-CoV-2 versus post-SARS-CoV-2

	Suicide ideation				Suicide attempt			
	PRE IR	POST IR	IRR (95% CI)	P	PRE IR	POST IR	IRR (95% CI)	P
Overall	183.8	211.9	1.15 (1.07-1.25)	<.001	20.1	14.2	0.71 (0.54-0.93)	.012
Sex								
Female	85.6	125.0	1.46 (1.31-1.63)	<.001	9.6	7.0	0.73 (0.49-1.08)	.12
Male	98.3	138.3	1.41 (1.27-1.56)	<.001	10.5	7.2	0.69 (0.47-1.00)	.051
Geographic location								
Urban	144.3	165.1	1.14 (1.05-1.25)	.003	13.3	9.9	0.74 (0.53-1.03)	.076
Nonurban	37.6	41.8	1.11 (0.93-1.32)	.23	6.0	4.2	0.69 (0.42-1.13)	.15
Race/ethnicity								
White, NH	152.1	176.6	1.16 (1.07-1.7)	<.001	16.8	11.7	0.70 (0.52-0.94)	.016
Black, NH	24.0	27.8	1.16 (0.93-1.43)	.19	2.7	2.0	0.76 (0.35-1.57)	.46
Hispanic	5.0	4.5	0.90 (0.54-1.50)	.69	0.6	0.2	0.28 (0.01-2.26)	.27
Visit type								
Outpatient	11.7	19.8	1.70 (1.28-2.26)	<.001	1.5	1.2	0.79 (0.29-2.11)	.65
Emergency	79.5	88.6	1.11 (0.99-1.26)	.078	1.6	2.7	1.65 (0.76-3.67)	.20
Inpatient	92.6	103.6	1.12 (1.00-1.25)	.048	17.0	10.4	0.61 (0.45-0.83)	.002

Note: The "Other" racial category was excluded from both outcomes due to zero counts for at least 1 cohort. Incidence rates (IR) per 100,000 encounters.

**TABLE 4** Comparison of pediatric suicidal ideation and attempts pre-SARS-CoV-2 versus post-SARS-CoV-2

	Suicide ideation				Suicide attempt			
	PRE IR	POST IR	IRR (95% CI)	P	PRE IR	POST IR	IRR (95% CI)	P
Overall	190.3	261.9	1.38 (1.18-1.61)	<.001	26.8	26.4	0.99 (0.62-1.56)	.97
Age								
5-10	10.1	10.2	1.01 (0.47-2.13)	.97	-	-	-	
11-13	54.1	62.3	1.15 (0.84-1.57)	.37	5.9	7.7	1.29 (0.51-3.25)	.58
14-17	126.1	189.4	1.50 (1.24-1.81)	<.001	20.8	18.8	0.90 (0.52-1.53)	.71
Sex								
Female	128.5	175.8	1.37 (1.13-1.66)	.001	20.8	19.6	0.94 (0.55-1.59)	.83
Male	61.9	86.2	1.39 (1.06-1.83)	.018	5.9	6.8	1.15 (0.43-2.96)	.77
Geographic location								
Urban	139.2	176.6	1.27 (1.05-1.53)	.013	16.1	11.1	0.69 (0.35-1.33)	.28
Nonurban	47.6	81.1	1.70 (1.27-2.30)	<.001	9.5	13.7	1.44 (0.71-2.91)	.31
Race/ethnicity								
White, NH	143.9	177.5	1.23 (1.02-1.48)	.027	22.6	20.5	0.91 (0.64-1.51)	.71
Black, NH	33.9	54.6	1.61 (1.13-2.31)	.009	4.2	1.7	0.41 (0.06-1.84)	.27
Hispanic	11.3	21.3	1.89 (1.04-3.48)	.037	-	4.3	-	-
Visit type								
Outpatient	52.9	91.3	1.73 (1.30-2.29)	<.001	5.4	8.5	1.59 (0.64-4.06)	.32
Emergency	48.2	63.1	1.31 (0.95-1.80)	.094	4.2	4.3	1.03 (0.30-3.31)	.96
Inpatient	89.2	107.5	1.21 (0.95-1.53)	.12	17.2	13.7	0.79 (0.42-1.45)	.46

Note: The "Other" racial category was excluded from both outcomes due to zero counts for at least 1 cohort; "Hispanic" excluded from the suicide attempt column due to zero counts for 1 cohort. Incidence rates (IR) per 100,000 encounters.

$P < .001$ ). For the post-cohort compared to the pre-cohort, there was a significant increase in incidence of suicidal ideation among pediatric patients for both sexes (increases of 37% and 39% for females and males, respectively,  $P < .02$  for both). Encounters from patients living in counties designated as both urban ( $IRR = 1.27$ ,  $P = .013$ ) and nonurban ( $IRR = 1.70$ ,  $P < .001$ ) increased significantly from pre to post. By race/ethnicity, there were increases in pediatric encounters between pre and post among all race/ethnicities, including an increase of 23% among White, non-Hispanic ( $IRR = 1.23$ ,  $P = .027$ ), 61% among Black, non-Hispanic ( $IRR = 1.61$ ,  $P = .009$ ), and 89% among Hispanic encounters ( $IRR = 1.89$ ,  $P = .037$ ). Finally, outpatient encounters increased significantly ( $IRR = 1.73$ ,  $P < .001$ ) over the same time period.

For pediatric suicide attempt encounters, there was no change in the incidence rate in the overall pediatric sample, or within any demographic subgroup, most likely due to limited encounters in that subset.

## DISCUSSION

Our findings provide a unique contribution to the published literature in that we include inpatient, emergency department, and outpatient encounters, and we evaluate the effects of rural versus urban residence on the suicide attempts and ideation. The findings of this study identified significantly increased rates of suicide ideation encounters in the time period affected by SARS-CoV-2 in the total sample. When looking specifically at sex and racial/ethnic groups, residential locations, and encounter location (ie, inpatient, outpatient, and emergency department), consistent patterns of increase in rates were identified. We evaluated the demographic and acuity factors in adult and pediatric populations separately and found similar findings. Although both adult and pediatric groups saw increased rates, some demographic subgroups were at particular risk, with higher increases in rates relative to their population group. Specifically, from the adult encounters, Whites were more highly affected compared with other demographic subsets. Among the pediatric encounters, males, Black and rural patients, Hispanic, and those aged 14-17 years had more elevated rates of ideation compared with the full pediatric group. In the total sample, including adult and pediatric encounters, those who were Black, male, and who resided in rural area were more highly affected. Interestingly, suicide attempts decreased significantly in the time period affected by SARS-CoV-2 in the overall and adult population.

Increased rates of suicide were highly speculated but until recently, there was little evidence to support the postulation. Pirkis and colleagues recently published an article reporting suicide trends in 21 countries. The study included 6 US county regions, territories, or states. Data were collected based on published literature and governmental suicide information internet searches. US rate ratios ranged from 0.79 to 1.27.<sup>30</sup> Of the 6 regions of the United States, 3 reported increased suicide rates and 3 reported decreased suicide rates.<sup>30</sup> Using a different study design, Hill and colleagues evaluated positive suicide ideation and suicide attempt screens at 1 pediatric emergency

department in Texas and compared January through July of 2019 to the same time period in 2020. They identified increased rates of suicide attempts (odds ratio [OR] 1.75-2.34) and ideation (OR 1.6) in the months of March and April of 2020 when compared to the corresponding month of the prior year.<sup>18</sup> Of note, these were not encounters for diagnosis codes for suicide ideation or attempts but were based on screening conducted at the time of an emergency department visit. Our findings support the findings of Hill and colleagues as it related to suicide ideation. The conflicting findings relative to suicide attempts could be accounted for differing populations, specifically an urban sample in Texas versus our sample which included both rural and urban dwellers. Screening versus billed ICD10 codes for encounters might also account for these differences.

Although we identified similar findings to those reported in recent studies, differences in study design and population are potentially relevant.<sup>18,30</sup> Specifically, we evaluated encounters for suicide ideation and attempts as opposed to confirmed suicide (where the confirmation process may delay final determinations) or suicide screening (which relies on self-report).<sup>18,30</sup> An additional study used national data to evaluate the rate of suicide attempts in those aged 12-25 years seen in emergency departments, and found increased rates in the time period affected by SARS-CoV-2. The February to March time frame and the 12-17 age range were highly affected, which supports the findings from our study and is consistent with those in the literature.<sup>19</sup> Ridout and colleagues also identified increased IRR among youth in the time frame affected by SARS-CoV-2 using Kaiser Permanente health care claims data.<sup>20</sup> A couple of studies did not identify increased risk; this finding could be due, in part, to the lack of consideration of the overall reduction in health care utilization due to SARS-CoV-2.<sup>21,31</sup> Holland and colleagues have offered an interesting parallel of the increases in suicide attempts and overdoses using national data, suggesting that the effects of SARS-CoV-2, such as social isolations and lapses of mental health services, impacted at-risk populations.<sup>25</sup> Adolescents, which are at the highest risk for suicide, are highly affected by social isolation due to their developmental need for independence.<sup>1,32</sup> As such, peer relationships are critically important for adolescents as they explore their own identity.<sup>32</sup> The consideration of adolescent developmental stages supports our findings, suggesting that adolescents aged 14-17 were more highly affected by suicide ideations during the time period affected by SARS-CoV-2, which distanced adolescents from their peers due to lack of in-person learning and state mandates. Our unique contribution to the literature is that we include inpatient, outpatient, and emergency department populations in adult and youth populations specifically comparing risk differences between rural and urban county of residence. It is critically important to understand rural health disparities as it relates to suicide ideation in rural populations due to the lack of access to care, specifically mental health services, which is a well-recognized problem for persons residing in rural areas.<sup>33</sup> Similarly, stigma to receiving mental health services in rural communities is an additional barrier to care.<sup>34</sup> It is critically important that interventions to improve suicidality are considered in the context of the barriers maintaining mental health in rural communities.

Our findings identify that one of the high-risk demographic subgroups are Black youths under age 18. Although the time frame was from 1991 to 2017 and unaffected by SARS-CoV-2, a recent study using the Youth Behavioral Risk Survey also identified Black youth to be at increased risk of suicide<sup>35</sup> with different turning points for ideation and attempt than White youth.<sup>36</sup> Sheftall and colleagues found an over 6% increase in deaths by suicide in Black girls from 2003 to 2017 in their recent study.<sup>37</sup> Our findings suggest that suicide rates in this population have escalated further in the time period affected by SARS-CoV-2. In 2017, Haynes and colleagues conducted a study and the results suggested that stressful living environments affected by poverty along with community beliefs which included stigma related to mental health conditions and treatment affected rural Blacks.<sup>34</sup> The findings from this study suggesting an increase in risk of suicide among our Black community call for further research along with targeted community-based efforts to better understand and address this disparity.

Substance misuse and related overdoses have increased in the time period affected by COVID19.<sup>38</sup> Historically, KY has been one of the states most highly affected by opioid misuse and related overdoses, especially in rural counties of KY.<sup>39</sup> Our findings suggest that there is a paralleled increase in suicide ideation that has occurred in the same time period. It could be hypothesized that lack of resources or social isolation are underlying etiologies for these increases but more research is needed to evaluate causality. These findings underscore the need to maintain or enhance services for those suffering mental health issues, including substance misuse, during times of crisis, such as the effects of SARS-CoV-2 especially in highly affected rural communities.

Similarly, our findings reporting increased suicide ideation rates align with the economic effects of SARS-CoV-2, given that job loss is an additional risk factor for increased suicide rates. Brenner and colleagues report that both a decreased GDP per capita and an increased unemployment rate are associated with increased suicide rates.<sup>40</sup> This is especially important as it relates to the COVID-19 pandemic. Prior to the pandemic, the national unemployment rate was steadily under 4%; this number rose to 14.8% at its worst during the onset of COVID-19.<sup>41</sup> The relationship of job loss with mental illness and related suicide ideation during times of crisis need to be further explored in efforts to develop evidenced-based approaches to maintain mental health and wellbeing and prevent suicide ideation and suicide. Similarly, the compounded effects of pandemic-related job loss in rural areas where unemployment was an existing problem on suicide rates need to be further explored.<sup>42</sup>

Of great interest, our findings reported a significant reduction in suicide attempts. Of note, completed rates of suicide also decreased nationally in 2020.<sup>1</sup> It is plausible that efforts to promote mental health awareness and reduce mental health stigma are increasingly effective and individuals sought help prior to a suicidal attempt or suicidal death. It could be hypothesized that there is a relationship between the finding of decreased rates of suicide attempts occurring simultaneously with increased rates of ideation. It may suggest that seeking medical help during times of ideation results in decreased attempts. Additional

studies are needed to substantiate this hypothesis and to understand patient rationale for seeking health care for suicide ideation during both affected and unaffected time periods. It would be of interest to explore whether there were factors that may have contributed to an increased awareness of mental health challenges in the time period affected by SARS-CoV-2.

## Strengths and limitations

The primary strength of this study is the inclusion of both rurality and acuity as potential factors related to differences in rates before and after SARS-CoV-2. In addition, the use of rates rather than raw encounter frequencies is a strength given that patient encounters decreased in the post period (relative to pre). Finally, the use of a fixed 6-month interval in the pre- and post-SARS-CoV-2 timepoints is both a strength and limitation: this strategy was chosen to minimize the potential for differences arising as a result of seasonality in suicide ideation and attempts. However, there may be some cohort effects due to events directly preceding the chosen 6-month time period that were not fully captured. The primary limitation of this study, which relates to the use of an existing dataset of billed encounters, is that health care providers might bill an encounter where suicide ideation was present using alternate codes (ie, depression, accidental overdose, and poisoning), which would have resulted in an undercount of actual cases.

SARS-CoV-2 resulted in increased rates of suicide ideation encounters as a percentage of all encounters. Although nearly all demographic groups were negatively affected, there were specific demographic subgroups more highly affected in comparison to others. Specifically in the pediatric population, males, those 14-17 years of age, those who are Black and Hispanic, and those residing in a rural area had rates above the increased overall pediatric rates. In adults, rates were increased overall but differences in the degree of increase were not as apparent among specific demographic subgroups. It is crucial that we develop a deepened understanding of these increased rates in specific pediatric groups and develop effective interventions that can be sustained, particularly in times of crisis.

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## CONFLICTS OF INTEREST

There are no conflicts of interest to report in regard to this project.

## DISCLOSURES

There are no significant financial disclosures relevant to this project.

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