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Stephanie L. Mayne, PhD, MHS, Chloe Hannan, MS, Molly Davis, PhD, Jami F. Young, PhD, Mary Kate Kelly, MPH, Maura Powell, MPH, George Dalembert, MD, MSHP, Katie E. McPeak, MD, Brian P. Jenssen, MD, MSHP, Alexander G. Fiks, MD, MSCE

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# COVID-19 and Adolescent Depression and Suicide Risk Screening Outcomes

Stephanie L. Mayne, PhD, MHS,<sup>a,b,c</sup> Chloe Hannan, MS,<sup>a,c</sup> Molly Davis, PhD,<sup>d,e</sup> Jami F. Young, PhD,<sup>c,d,f</sup> Mary Kate Kelly, MPH,<sup>a,c</sup> Maura Powell, MPH,<sup>a</sup> George Dalembert, MD, MSHP,<sup>a,b,c</sup> Katie E. McPeak, MD,<sup>a,b,c</sup> Brian P. Jenssen, MD, MSHP,<sup>a,b,c</sup> Alexander G. Fiks, MD, MSCE<sup>a,b,c</sup>

## Affiliations:

<sup>a</sup>The Possibilities Project Children's Hospital of Philadelphia (CHOP); <sup>b</sup>Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania; <sup>c</sup>Center for Pediatric Clinical Effectiveness and PolicyLab, CHOP; <sup>d</sup>Department of Psychiatry, Perelman School of Medicine, University of Pennsylvania; <sup>e</sup>Penn Implementation Science Center at the Leonard Davis Institute of Health Economics (PISCE@LDI), University of Pennsylvania, Philadelphia, PA; <sup>f</sup>Department of Child and Adolescent Psychiatry and Behavioral Sciences, CHOP

**Address correspondence to:** Stephanie Mayne, PhD, MHS, 2716 South Street, 10-471, Philadelphia PA 19146, [maynes@chop.edu](mailto:maynes@chop.edu), 267-426-0192

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**Abbreviations:** Children's Hospital of Philadelphia (CHOP), Patient Health Questionnaire-Modified for Teens (PHQ-9-M), American Academy of Pediatrics (AAP), Guidelines for Adolescent Depression in Primary Care (GLAD-PC)

**Article Summary:** Data from a large pediatric primary care network demonstrates increases in positive depression and suicide risk screens during the COVID-19 pandemic.

**What's Known on This Subject:** Adolescent mental health concerns have increased during the COVID-19 pandemic. Adolescents are routinely screened for depression and suicidality in pediatric primary care, but past studies have not examined changes in these outcomes during the pandemic in the primary care setting.

**What This Study Adds:** Using electronic health record data from a large pediatric primary care network, this study identified increases in the proportion of adolescents screening positive for depressive symptoms and suicide risk in pediatric primary care during the pandemic, especially among female adolescents.

**Contributors' Statement:**

Dr. Mayne conceptualized and designed the study, supervised data analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

Ms. Hannan and Ms. Kelly collected the data, carried out the analyses, and reviewed and revised the manuscript.

Dr. Davis, Dr. Young, Ms. Powell, Dr. Dalember, Dr. McPeak, Dr. Jensen, and Dr. Fiks conceptualized and designed the study, and critically reviewed and revised the manuscript for important intellectual content.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

## Abstract:

**Background:** Mental health concerns increased during the COVID-19 pandemic, but prior studies have not examined depression screening in the pediatric primary care setting. We aimed to describe changes in screening, depressive symptoms, and suicide risk among adolescents during the COVID-19 pandemic.

**Methods:** In a repeat cross-sectional analysis of electronic health record data from a large pediatric primary care network, we compared the percent of primary care visits where adolescents aged 12-21 were screened for depression, screened positive for depressive symptoms, or screened positive for suicide risk between June-December 2019 (pre-pandemic) and June-December 2020 (pandemic). Changes were examined overall, by month, and by gender, race/ethnicity, insurance type, and income. Poisson regression with robust variance estimates was used to calculate prevalence ratios for the pre-pandemic to pandemic changes, overall and by subgroup.

**Results:** Depression screening at primary care visits declined from 77.6% to 75.8% during the pandemic period (prevalence ratio (PR): 0.98, 95% CI: 0.90, 1.06). The percent of adolescents screening positive for depressive symptoms increased from 5.0% to 6.2% (PR: 1.24, 95% CI: 1.15, 1.34)), with greater increases among female, non-Hispanic Black, and non-Hispanic White adolescents. Positive suicide risk screens increased from 6.1% to 7.1% (PR: 1.16, 95% CI: 1.08, 1.26), with a 34% relative increase in the odds of reporting recent suicidal thoughts among female adolescents (PR: 1.34, 95% CI: 1.18, 1.52).

**Conclusions:** Results suggest that depression and suicide concerns have increased during the pandemic, especially among female adolescents. Results underscore the importance of consistent screening for depression and suicidality.

## Introduction

Rates of mental health concerns among adolescents, including depression and suicidal ideation, have risen substantially in recent years.<sup>1,2</sup> The COVID-19 pandemic has placed numerous stresses on adolescents due to school closures, disruptions of routines, social isolation, and concerns about family illness and economic impacts.<sup>3</sup> Consequences of these stressors among

children from racially/ethnically minoritized and low-income communities may be especially acute.<sup>4,5</sup> Several studies have reported high prevalence of mental health concerns among children and adolescents during the pandemic.<sup>6-9</sup> However, few studies to date have examined changes in depression and suicidality, as well as changes in screening for these concerns, among adolescents from before to during the pandemic.

One recent U.S. study reported higher rates of suicidal ideation and suicide attempts among youth aged 11-21 years in a pediatric emergency department during the first six months of the COVID-19 pandemic compared to the same period a year earlier.<sup>10</sup> However, no studies have yet reported on depression and suicide risk screening outcomes in pediatric primary care, an important setting for routine mental health screening among adolescents. Primary care providers develop longitudinal, trusting relationships with families and may facilitate linking adolescents to needed treatments.<sup>11,12</sup> The American Academy of Pediatrics (AAP) and the U.S. Preventive Services Task Force recommend universal screening for depression among adolescents,<sup>13,14</sup> and many pediatric primary care practices have implemented depression screening programs. Screening for depression often involves administering questions about suicide risk. Although mental health screening occurs in other settings, including schools, the transition to virtual education during the pandemic has magnified the importance of the medical setting for adolescent mental health screening.

In order to understand how the COVID-19 pandemic has impacted mental health among adolescents in pediatric primary care, we examined changes in the frequency of screening for

depression and suicide risk, as well as the percent of positive screens, in a large pediatric primary care network from before to during the pandemic. We also examined whether changes in these outcomes varied by sex, race/ethnicity, insurance type, and neighborhood socioeconomic status in order to understand patterns in the context of existing disparities.<sup>2, 15, 16</sup>

## **Methods**

### *Study Population*

Our study took place in the Children's Hospital of Philadelphia (CHOP) primary care network, a large pediatric primary care network made up of 29 urban, suburban, and semi-rural practices in the greater Philadelphia region.<sup>17</sup> The Care Network provides care for nearly 300,000 patients. Using a repeated cross-sectional design, we extracted electronic health record data from all preventive visits by adolescents aged 12-21 (up to the 22<sup>nd</sup> birthday) who attended a primary care visit in the CHOP primary care network between June 1, 2019 and December 31, 2020. The CHOP Institutional Review Board determined this study to be exempt from review.

### *Outcomes*

In order to examine changes in screening, depression, and suicide risk from before the COVID-19 pandemic to during the pandemic, we defined two periods: June to December 2019 (pre-pandemic) and June to December 2020 (pandemic). These months were chosen as comparison periods because primary care visit volume had begun to normalize in June 2020 after a steep decline in March-May 2020. We assessed three primary outcomes in each period (overall, and by

month): 1) the percent of adolescents screened for depression and suicide risk among those attending a primary care preventive visit, 2) the percent of adolescents screened with a positive result for depression symptoms, and 3) the percent of adolescents screened with a positive result for suicide risk. Depression and suicide risk during the two weeks prior to screening were assessed routinely through a fully automated electronic screening system using the Patient Health Questionnaire-Modified for Teens (PHQ-9-M), which includes nine core items and two supplemental items assessing suicide risk.<sup>11, 18</sup> CHOP implemented the PHQ-9-M for routine depression and suicide risk screening after review of available tools by a committee of screening experts. The PHQ-9-M was chosen because it is brief, non-proprietary, has been validated and used previously in large health systems,<sup>19, 20</sup> and is recommended in clinical guidelines including the Guidelines for Adolescent Depression in Primary Care (GLAD-PC)<sup>13</sup> and the AAP's Bright Futures recommendations.<sup>21</sup> At CHOP, the PHQ-9-M is currently available in English and Spanish. PHQ-9-M scores of 11-27 indicate a positive result for moderate-to-severe symptoms of depression, while scores of 5-10 indicate borderline (i.e., subthreshold) depressive symptoms. Suicide risk was assessed using three questions; an affirmative response to any of the three flagged the adolescent for suicide risk. The questions included the item on the PHQ-9-M assessing thoughts of death and/or self-harm ("Thoughts that you would be better off dead, or of hurting yourself in some way?"; on a scale ranging from 0-3, where a score of 1 or greater was considered endorsement of risk) and two supplemental yes/no questions ("Has there been a time in the past month when you have had serious thoughts about ending your life?"; "Have you ever, in your whole life, tried to kill yourself or made a suicide attempt?") Because the item on thoughts of death or self-harm may identify adolescents with a wide range of suicidal ideation severity,<sup>18</sup> we also examined the two supplemental questions separately.

### *Demographic Variables*

We examined changes in depression and suicide risk screening outcomes during the pandemic based on four demographic variables: sex, race/ethnicity (non-Hispanic Black, non-Hispanic White, Hispanic, Asian, other race), payor (public, commercial, self-pay/other), and neighborhood socioeconomic status (quartiles of census tract-level median household income). Sex, race/ethnicity, and payor were extracted from the electronic health record. Patient addresses were geocoded by the health system and linked to residential census tracts. Neighborhood socioeconomic status was assessed as census tract-level median household income using data from the American Communities Survey 2014-2018 5-year estimates, and was divided into quartiles for analysis.<sup>22</sup>

### *Statistical Analysis*

Changes in screening, positive depression screens, and positive suicide risk screens between the pre-pandemic and pandemic periods were calculated overall, by month, and across subgroups based on sex, race/ethnicity, insurance, and neighborhood income. We used logistic regression, followed by marginal standardization, to calculate 95% confidence intervals around the absolute changes in each outcome. We used Poisson regression with robust variance estimates<sup>23</sup> to calculate prevalence ratios to show changes in depression and suicide risk screening outcomes on a relative scale. We estimated robust standard errors accounting for the clustering of adolescents within primary care practices. To examine differences in the amount of change between demographic subgroups, we used multivariable Poisson models including the demographic variables described above, a binary indicator for time period (June-Dec 2020 versus June-Dec



2019) and interaction terms between time period and demographic variables. Statistical analyses were conducted using Stata version 16.1 and R version 3.6.1.

## Results

Our study sample included 91,188 well visits by 68,669 adolescents, including 43,504 in the pre-pandemic period and 47,684 in the pandemic period. The total number of visits was higher during the pandemic period due to a local initiative to bring adolescents in for well visits where vaccines were needed in advance of the start of the school year, and due to rescheduling of adolescents whose visits were cancelled during the early months of the pandemic. Adolescents' average age was 15.2 (standard deviation (SD): 2.1) in the pre-pandemic and 15.3 (SD: 2.1) in the post-pandemic period. The proportion of visits by non-Hispanic Black adolescents declined slightly during the pandemic period, as did the proportion of visits among commercially insured adolescents and those in the lowest quartile of neighborhood household income (Table 1).

### *Changes in Mental Health Screening Prevalence*

The total number of adolescents screened for depression increased slightly, from 33,754 in the pre-pandemic period to 36,161 in the post-pandemic period, reflecting the overall increase in visits during this period. However, the percentage of well visits at which a screen was completed declined slightly, from 77.6% to 75.8% (prevalence ratio (PR): 0.98, 95% CI: 0.90, 1.06). The difference between 2019 and 2020 was most pronounced in June (PR: 0.86, 95% CI: 0.75, 0.99; Figure 1A) and diminished over time. Screening rates declined among all demographic groups except non-Hispanic Black adolescents and those with non-commercial insurance (Table 2).

However, adjusted prevalence ratios indicated there were minimal differences after accounting for demographic characteristics and clustering by practice (Table 2).

### *Changes in Positive Screens for Depressive Symptoms*

Overall, the percent of adolescents screening positive for moderate-to-severe depressive symptoms (scores of 11-27) increased from 5.0% in the pre-pandemic period to 6.2% in the post-pandemic period. This reflects a 24% increase in the prevalence of moderate-to-severe depressive symptoms (PR: 1.24, 95% CI: 1.15, 1.34). When broken down by month, there was an increase in prevalence in the pandemic period in August, October, November, and December (Figure 1B). The amount of change differed by sex (p-interaction: <0.001, Table 3), with an increase among female, but not male, adolescents [PR: 1.32 (1.24, 1.42) versus 1.02 (0.89, 1.67)]. By race/ethnicity, changes were largest among non-Hispanic White (PR: 1.29, 95% CI: 1.18, 1.42), non-Hispanic Black (PR: 1.24, 95% CI: 1.11, 1.39), and other race adolescents (PR: 1.24, 95% CI: 1.00, 1.54 p-interaction: 0.02). Positive depression screens increased similarly among commercially and publicly insured adolescents and among adolescents of all neighborhood incomes (Table 3). The percent of adolescents screening positive for borderline depressive symptoms increased from 15.6% to 16.7% (PR: 1.07, 95% CI: 1.02, 1.13). By month, there was an increase in prevalence during the pandemic period in July and December (Figure 1C). Patterns differed by insurance type, with the largest increase among self-pay/other insurance (PR: 1.41, 95% CI: 1.06, 1.87; Table 3).

### *Changes in Positive Screens for Suicide Risk*

The percent of adolescents screening positive on any of the three suicide risk items increased from 6.1% to 7.1%, reflecting an 16% relative increase in prevalence (PR: 1.16, 95% CI: 1.08, 1.26). The pandemic period had an increase in positive suicide risk screens during October, November, and December (Figure 1D). The increase in suicide risk was greater among female compared to male adolescents [PR: 1.18 (1.11, 1.26) vs. 1.09 (0.99, 1.19), p-interaction 0.07], but did not differ significantly according to other sociodemographic characteristics (Table 4). For the two supplemental suicide questions, we similarly found small absolute increases from the pre-pandemic to pandemic periods, but larger relative changes. The percent endorsing recent suicidal thoughts increased from 1.8% to 2.2% overall (PR: 1.22, 95% CI: 1.10, 1.37), with an increase relative to the pre-pandemic period during October and November (Figure 1E). There was a greater increase among female compared to male adolescents [PR: 1.34 (1.18, 1.52) vs 1.00 (0.86, 1.17), p-interaction: <0.001]. The relative increase in recent suicidal thoughts was higher among non-Hispanic White adolescents (PR: 1.45, 95% CI: 1.27, 1.65) compared to other race/ethnicity groups (Table 4, p-interaction: 0.16). Increases were similar between commercially and publicly insured adolescents, while the prevalence of recent suicidal thoughts decreased among adolescents with self-pay/other insurance. The percent reporting a lifetime suicide attempt increased from 3.1% to 3.5% (PR: 1.13, 95% CI: 1.01, 1.25). and did not differ substantially by month or by demographic characteristics (Figure 1F, Table 4).

## Discussion

In this analysis of depression and suicide risk screening among adolescents in pediatric primary care, we found that the percent of adolescents screened initially declined, but quickly returned to pre-pandemic levels. The percent of positive depression screens increased in the pandemic period, particularly among female, non-Hispanic Black, and non-Hispanic White adolescents. Suicide risk positive screens also increased, especially among female adolescents. By month, increases in positive screens relative to the pre-pandemic period tended to be largest later in the year (October-December). While the absolute magnitude of the changes was modest, reflecting the low prevalence of positive screens overall, the relative increase in the percent of adolescents screening positive for moderate-to-severe depressive symptoms or recent suicidal thoughts was substantial.

The initial decrease in screening prevalence during the pandemic was likely due to infection prevention efforts at practice sites that resulted in reduced tablet utilization for screening and efforts to room patients as quickly as possible. These workflow changes varied by network site, as demonstrated by the attenuation of sociodemographic differences after accounting for clustering by practice. These patterns suggest that urban practices caring for predominantly lower income, publicly-insured, and non-Hispanic Black adolescents may have experienced less of a decline in screening during the early months of the pandemic. However, for depression and suicide risk outcomes, accounting for practice-level differences did not eliminate differences among demographic subgroups, indicating that results were more consistent across practices.

The changes in suicide risk we observed in primary care were smaller than those reported in a recent analysis of emergency department (ED)-based suicide risk screens.<sup>10</sup> This may reflect the fact that the PHQ-9 is routinely administered at preventive visits where adolescents are not specifically seeking care for depression or suicide risk. Adolescents with the most severe suicide risk concerns may have sought care at the ED, and the primary care population may reflect an adolescent sample with fewer social and medical needs. However, a recent study of largely low income adolescents in an urban primary care network in Ohio also reported higher suicide risk prevalence compared to our network, although that study did not find increases in depression or suicide risk during the pandemic.<sup>24</sup> Our larger study population in the Philadelphia area included adolescents from urban, suburban, and semi-rural areas as well as a wide range of socioeconomic backgrounds, which may contribute to the differences in our findings. However, in the primary care context, even a small increase in adolescents screening positive for suicide risk may have a substantial impact on practice, given the amount of work required to safely engage at-risk adolescents in appropriate services. The mental health system is already over-burdened, and many children's hospitals have been overwhelmed by mental health complaints during the pandemic.<sup>3, 25</sup> Our findings suggest that female adolescents in particular may be at heightened risk of suicidal ideation during the pandemic, which may have exacerbated national pre-pandemic trends.<sup>2, 26, 27</sup>

As with suicide risk, the most consistent increase in depressive symptoms in our analysis was among female adolescents. This also aligns with national pre-pandemic data,<sup>2</sup> and suggests that the pandemic may have exacerbated existing patterns, at least in the Philadelphia region. Social isolation and loneliness are associated with increased risk of depression in children and

adolescents,<sup>28</sup> and school closures and other COVID-19 mitigation measures have restricted social interactions among adolescents. Adverse effects of social media (e.g. bullying) have been implicated as potential contributors to the greater burden of depression among girls,<sup>2</sup> and these effects may have been magnified during the pandemic as in-person social interactions have declined or shifted online. The increases in depressive symptoms among non-Hispanic Black and non-Hispanic White adolescents during the pandemic are also concerning. National prevalence estimates suggest depression rates are higher among non-Hispanic White and Hispanic adolescents compared to Black and Asian adolescents.<sup>29</sup> However, Black and Hispanic adolescents may be less likely to receive a depression diagnosis and treatment when needed.<sup>15</sup> Black communities have experienced disproportionate health and economic impacts of COVID-19 as a result of structural racism,<sup>30,31</sup> which may explain the increase in depressive symptoms in Black adolescents and suggest growing unmet mental health needs. In addition, persistent school closures and stricter social distancing policies in urban areas may have disproportionately increased isolation among non-Hispanic Black adolescents. Although COVID-19 has also heavily impacted Hispanic communities,<sup>32</sup> and anti-Asian violence and rhetoric has risen during the pandemic,<sup>33</sup> we did not identify increases in moderate to severe depressive symptoms among Hispanic and Asian adolescents. This is in contrast to national survey data indicating heightened rates of suicidal ideation and attempts among Hispanic youth.<sup>34</sup> However, as there were relatively few Hispanic and Asian adolescents in our study population, and these groups are not monolithic and represent many nationalities, these findings should be interpreted with caution. Since we lack details regarding potential protective factors (e.g. parenting practices, peer supports), the reason for these patterns remains unclear and warrants further investigation. Rates of borderline depressive symptoms, however, increased by a similar amount among Hispanic and

Asian compared to non-Hispanic White adolescents. Closer attention to adolescents with borderline depressive symptoms is needed, as these adolescents may be at risk for more severe depression and suicide in the future.

In addition to the primary care setting, screening for mental health concerns routinely occurs in schools. With the transition to virtual school during the pandemic, primary care may be the only screening opportunity available to many adolescents. The rise in mental health concerns suggests that additional resources may be needed to support clinicians in conducting depression and suicide screening. As one strategy, telehealth has been rapidly adopted during the pandemic to support access to the medical home in the context of physical distancing policies<sup>35</sup> and could be used to expand screening and support follow-up of adolescents with mental health concerns, as highlighted in the recent AAP “Interim Guidance on Supporting the Emotional and Behavioral Health Needs of Children, Adolescents, and Families During the COVID-19 Pandemic.”<sup>3</sup> Effective telehealth interventions, however, must take into account the digital divide and the often disparate rates of uptake of these services.<sup>36-38</sup> In addition, the integration of social workers and co-located mental health providers into pediatric primary care can facilitate more successful mental health treatment and follow-up.<sup>39</sup> In our network, half of the practices had integrated behavioral health and only six had embedded social workers during the study period. However, many primary care practices nationwide do not have co-located or integrated behavioral health,<sup>40</sup> indicating an opportunity to better support screening and follow-up of adolescents with mental health concerns. Finally, patient-facing strategies, such as educating families to ask their pediatricians about depression screening and resources, could be implemented alongside

clinician and systems-focused changes. Advocacy on the part of health systems is needed for ongoing billing reform to support these changes.

A strength of this study is the large and diverse population of adolescents seen in pediatric primary care spanning urban, suburban, and semi-rural geographic areas. This study was also subject to several limitations. First, the use of routinely collected electronic health record data is inherently limited to adolescents who attend primary care visits. Rates of primary care visit attendance tend to be lower among adolescents than younger children,<sup>41</sup> and patterns may not reflect depressive symptoms or suicide risk among adolescents who do not receive primary care. Adolescents with the most severe symptoms might have bypassed primary care and sought care at the ED for acute concerns. It is also possible that disparities in rates of routine preventive visit attendance may have masked larger differences in depression and suicide risk outcomes by race/ethnicity, as non-Hispanic Black adolescents have lower attendance at preventive visits compared to non-Hispanic White adolescents in several practices in our network with high levels of concentrated poverty. In addition, the COVID-19 pandemic impacted primary care visit volumes. We attempted to account for this by comparing the June-December period after visit patterns had stabilized, but this issue may have introduced bias if adolescents with mental health concerns were differentially more (or less) likely to attend visits during the pandemic. It is also possible, given the lower screening rates during the pandemic, that clinicians were selectively screening adolescent patients they perceive to be higher risk. Despite this possibility, screening activities in the network during the pandemic were driven largely by practices' ability to safely sanitize tablets used for screening. Also, results may not generalize to other geographic regions. Due to limitations in the electronic health record data, we were unable to examine patterns



among lesbian, gay, bisexual, transgender, and queer/questioning (LGBTQ) adolescents or according to language preference. Also, given the nature of the PHQ-9-M, interpretations are restricted to depressive symptoms, rather than diagnostic rates of depression. Additional research examining changes in diagnostic rates during the COVID-19 pandemic would be beneficial. Also, we did not have access to details on follow-up and interventions that were put in place for teens who screened positive for depression or suicide risk, although this has been examined in other studies.<sup>11, 18, 24</sup> Studies examining patterns of follow-up care provided after positive screens during COVID-19 will be an important next step, given high variability in follow-up after primary care depression and suicide risk screening in general.<sup>11, 18</sup> Finally, future work should examine longitudinal, individual-level changes in depressive symptoms and suicide risk in addition to population-level patterns.

*Conclusion:* Positive screens for depressive symptoms and suicide risk increased by a small but significant amount during the COVID-19 pandemic. Increases were most pronounced among female adolescents for both depression and suicide risk screening, with some indication of increases among non-Hispanic White and non-Hispanic Black adolescents. Given these patterns, pediatricians are encouraged to consistently screen adolescents for depression and link identified adolescents to treatment. Additionally, advocacy and effort on the part of primary care practices is needed to ensure adolescents are screened and linked to treatment, and that existing gaps between the identification of depression symptoms/suicide risk and initiating (and sustaining) treatment are filled, including known barriers to receiving treatment faced by non-Hispanic Black adolescents.

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**Table 1: Population Characteristics at Adolescent Preventive Visits**

Characteristic	Pre-Pandemic (2019) N (%)	Pandemic (2020) N (%)
Total Visits	43,504	47,684
Age – Mean (SD)	15.2 (2.1)	15.3 (2.1)
Sex		
Female	21,436 (49.3)	23,715 (49.7)
Male	22,068 (50.7)	23,968 (50.3)
Race/Ethnicity		
Non-Hispanic Black	10,190 (23.4)	10,294 (21.6)
Non-Hispanic White	24,578 (56.5)	26,976 (56.6)
Hispanic or Latino	2,700 (6.2)	3,360 (7.0)
Asian	1,883 (4.3)	2,123 (4.5)
Other Race	4,152 (9.5)	4,931(10.3)
Insurance Type		
Commercial	32,566 (74.9)	35,261 (73.9)
Medical Assistance	10,334 (23.8)	11,834 (24.8)
Self-Pay/Other	603 (1.4)	588 (1.2)
Neighborhood Median Income (quartiles)		
\$11,497 - \$59,870	11,260 (25.9)	11,553 (24.2)
\$59,871 - \$86,620	10,707 (24.6)	12,092 (25.4)
\$86,621 - \$111,591	10,870 (25.0)	12,076 (25.3)
\$111,591 - \$236,518	10,653 (24.5)	11,948 (25.0)

**Table 2: Changes in Depression Screening from Pre-Pandemic to Pandemic Periods<sup>1,2</sup>**

	Pre-Pandemic (2019) %	Pandemic (2020) %	Percentage point Change (95% CI)	Adjusted Prevalence Ratio (95% CI)	p-interaction
By Sex:					0.14
Females	78.0	76.7	-1.3 (-2.1, -0.6)	0.98 (0.91, 1.07)	
Males	77.2	75.0	-2.2 (-3.0, -1.4)	0.97 (0.89, 1.06)	
By Race/Ethnicity					0.55
Non-Hispanic Black	73.3	73.7	0.4 (-0.8, 1.6)	1.01 (0.83, 1.22)	
Non-Hispanic White	79.7	77.3	-2.4 (-3.2, -1.7)	0.97 (0.91, 1.03)	
Hispanic or Latino	76.8	73.9	-2.9 (-5.1, -0.7)	0.96 (0.86, 1.07)	
Asian	74.9	71.7	-3.2 (-6.0, -0.5)	0.95 (0.84, 1.08)	
Other Race	77.2	75.6	-1.6 (-3.4, 0.1)	0.98 (0.90, 1.06)	
By Insurance:					0.17
Commercial	77.8	75.4	-2.5 (-3.1, -1.8)	0.97 (0.90, 1.04)	
Medical Assistance	77.9	77.9	0.1 (-1.0, 1.2)	1.00 (0.86, 1.16)	
Self-Pay/Other	59.0	60.5	1.5 (-4.1, 7.1)	1.03 (0.89, 1.20)	
By Neighborhood Income:					0.29
\$11,497 - \$59,870	72.9	72.6	-0.3 (-1.5, 0.8)	1.00 (0.81, 1.23)	
\$59,871 - \$86,620	77.3	74.8	-2.5 (-3.6, -1.4)	0.97 (0.90, 1.04)	
\$86,621 - \$111,591	77.2	73.7	-3.6 (-4.7, -2.5)	0.95 (0.88, 1.03)	
\$111,591 - \$236,518	83.2	82.2	-1.0 (-1.9, 0.0)	0.99 (0.90, 1.09)	

<sup>1</sup>Percentages in 2019 and 2020 reflect crude percent of visits where adolescents were screened. Percentage point changes reflect the absolute change in screening from the pre-pandemic (2019) to pandemic (2020) period, with 95% confidence intervals calculated using logistic regression and marginal standardization. Negative numbers indicate a decline during the pandemic period, while positive numbers indicate an increase.

<sup>2</sup>Adjusted prevalence ratios and interaction p-values were estimated using multivariable Poisson models with robust variance estimates that accounted for clustering by primary care practice. Prevalence ratios reflect the relative change in screening prevalence in the pandemic period compared to the pre-pandemic period.

**Table 3: Changes in Depression Screening Outcomes from Pre-Pandemic to Pandemic Periods<sup>1,2</sup>**

	Pre-Pandemic (2019) %	Pandemic (2020) %	Percentage point Change (95% CI)	Adjusted Prevalence Ratio (95% CI)	p-interaction
<b>Screened Positive for Moderate to Severe Depressive Symptoms (PHQ-9-M score 11-27)</b>					
By Sex:					<0.001
Females	6.7	9.0	2.3 (1.7, 2.8)	1.32 (1.24, 1.42)	
Males	3.3	3.4	0.1 (-0.3, 0.5)	1.02 (0.89, 1.67)	
By Race/Ethnicity:					0.02
Non-Hispanic Black	7.0	8.8	1.8 (0.9, 2.7)	1.24 (1.11, 1.39)	
Non-Hispanic White	4.0	5.2	1.3 (0.8, 1.7)	1.29 (1.18, 1.42)	
Hispanic or Latino	7.9	7.9	0.1 (-1.5, 1.6)	0.99 (0.81, 1.21)	
Asian	4.7	4.1	-0.5 (-2.0, 1.0)	0.92 (0.67, 1.27)	
Other Race	5.0	6.2	1.2 (0.1, 2.3)	1.24 (1.00, 1.54)	
By Insurance:					0.52
Commercial	4.1	5.2	1.1 (0.8, 1.5)	1.27 (1.16, 1.39)	
Medical Assistance	7.9	9.1	1.2 (0.3, 2.0)	1.15 (1.04, 1.26)	
Self-Pay/Other	6.2	9.6	3.4 (-0.6, 7.3)	1.69 (0.99, 2.88)	
By Neighborhood Income:					0.20
\$11,497 - \$59,870	7.5	8.6	1.2 (0.3, 2.0)	1.14 (1.04, 1.25)	
\$59,871 - \$86,620	5.4	6.8	1.4 (0.7, 2.1)	1.23 (1.09, 1.40)	
\$86,621 - \$111,591	4.2	5.3	1.2 (0.5, 1.8)	1.26 (1.10, 1.43)	
\$111,591 - \$236,518	3.2	4.4	1.2 (0.7, 1.8)	1.36 (1.15, 1.61)	
<b>Screened Positive for Borderline Depressive Symptoms (PHQ-9-M score 5-10)</b>					
By Sex:					0.42
Females	17.8	19.4	1.5 (0.7, 2.3)	1.08 (1.03, 1.13)	
Males	13.4	14.1	0.7 (0.0, 1.4)	1.05 (1.00, 1.10)	
By Race/Ethnicity:					0.13
Non-Hispanic Black	21.2	22.0	0.7 (-0.6, 2.0)	1.03 (0.97, 1.09)	

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Non-Hispanic White	13.2	14.7	1.5 (0.8, 2.1)	1.10 (1.06, 1.16)	
Hispanic or Latino	20.0	22.0	2.0 (-0.4, 4.4)	1.08 (0.97, 1.22)	
Asian	13.3	14.7	1.5 (-1.0, 4.0)	1.12 (0.97, 1.29)	
Other	15.3	15.0	-0.3 (-2.0, 1.4)	0.98 (0.89, 1.08)	
By Insurance:					<0.001
Commercial	13.6	14.8	1.1 (0.5, 1.7)	1.09 (1.05, 1.13)	
Medical Assistance	21.8	22.3	0.5 (-0.8, 1.7)	1.02 (0.96, 1.09)	
Self-Pay/Other	14.9	21.1	6.2 (0.5, 11.8)	1.41 (1.06, 1.87)	
By Neighborhood Income:					0.37
\$11,497 - \$59,870	20.3	21.9	1.5 (0.3, 2.8)	1.07 (1.02, 1.12)	
\$59,871 - \$86,620	16.5	17.5	1.1 (-0.1, 2.2)	1.05 (0.99, 1.11)	
\$86,621 - \$111,591	14.0	15.1	1.1 (0.0, 2.1)	1.07 (1.00, 1.15)	
\$111,591 - \$236,518	11.9	13.1	1.2 (0.3, 2.2)	1.09 (1.01, 1.17)	

<sup>1</sup>Percentages in 2019 and 2020 reflect crude percent among those screened who screened positive for depression. Percentage point changes reflect the absolute change in depressive symptoms from the pre-pandemic (2019) to pandemic (2020) period, with 95% confidence intervals calculated using logistic regression and marginal standardization. Negative numbers indicate a decline during the pandemic period, while positive numbers indicate an increase.

<sup>2</sup>Adjusted prevalence ratios and interaction p-values were estimated using multivariable Poisson models with robust variance estimates that accounted for clustering by primary care practice. Prevalence ratios reflect the relative change in prevalence of screening positive for depression symptoms in the pandemic period compared to the pre-pandemic period.



Table 4: Changes in Suicide Risk Screening Outcomes from Pre-Pandemic to Pandemic Periods<sup>1</sup>

	Pre-Pandemic (2019) %	Pandemic (2020) %	Percentage point Change (95% CI)	Adjusted Prevalence Ratio (95% CI)	p-interaction
<b>Positive Screen for Suicide Risk</b>					
By Sex:					0.07
Females	8.2	9.7	1.5 (0.9, 2.1)	1.18 (1.11, 1.26)	
Males	4.1	4.5	0.4 (0.0, 0.8)	1.09 (0.99, 1.19)	
By Race/Ethnicity:					0.49
Non-Hispanic Black	10.4	11.5	1.1 (0.1, 2.1)	1.09 (0.99, 1.20)	
Non-Hispanic White	4.5	5.6	1.1 (0.7, 1.5)	1.22 (1.14, 1.32)	
Hispanic or Latino	7.5	8.4	0.9 (-0.7, 2.5)	1.09 (0.93, 1.29)	
Asian	5.5	5.7	0.2 (-1.5, 1.8)	1.03 (0.74, 1.45)	
Other Race	6.0	6.9	1.0 (-0.2, 2.1)	1.16 (0.99, 1.36)	
By Insurance:					0.64
Commercial	4.8	5.7	0.9 (0.5, 1.3)	1.20 (1.11, 1.29)	
Medical Assistance	10.2	11.2	0.9 (0.0, 1.8)	1.09 (1.02, 1.17)	
Self-Pay/Other	7.9	7.9	0.0 (-0.4, 0.4)	1.08 (0.73, 1.61)	
By Neighborhood Income:					0.90
\$11,497 - \$59,870	9.7	11.1	1.4 (0.5, 2.4)	1.13 (1.03, 1.23)	
\$59,871 - \$86,620	6.2	7.3	1.1 (0.4, 1.9)	1.15 (1.03, 1.29)	
\$86,621 - \$111,591	4.8	5.6	0.8 (0.2, 1.5)	1.15 (1.04, 1.29)	
\$111,591 - \$236,518	4.1	4.9	0.9 (0.3, 1.5)	1.20 (1.02, 1.40)	
<b>Past month suicidal thoughts</b>					
By Sex:					<0.001
Females	2.4	3.2	0.8 (0.4, 1.1)	1.34 (1.18, 1.52)	
Males	1.2	1.2	0.0 (-0.2, 0.2)	1.00 (0.86, 1.17)	
By Race/Ethnicity:					0.16
Non-Hispanic Black	3.6	4.0	0.5 (-0.2, 1.1)	1.12 (0.96, 1.30)	

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Non-Hispanic White	1.1	1.6	0.5 (0.3, 0.7)	1.45 (1.27, 1.65)	
Hispanic or Latino	2.2	2.2	0.0 (-0.8, 0.9)	1.02 (0.70, 1.47)	
Asian	1.8	1.7	-0.1 (-1.1, 0.8)	0.95 (0.63, 1.43)	
Other	1.8	2.2	0.4 (-0.3, 1.0)	1.23 (0.95, 1.59)	
By Insurance:					0.05
Commercial	1.3	1.6	0.3 (0.1, 0.5)	1.22 (1.05, 1.42)	
Medical Assistance	3.2	3.9	0.7 (0.2, 1.3)	1.26 (1.12, 1.42)	
Self-Pay/Other	2.0	0.8	-1.1 (-2.9, 0.6)	0.50 (0.14, 1.84)	
By Neighborhood Income:					0.44
\$11,497 - \$59,870	3.3	3.7	0.3 (-0.2, 0.9)	1.09 (0.96, 1.25)	
\$59,871 - \$86,620	1.8	2.3	0.5 (0.1, 0.9)	1.29 (1.08, 1.54)	
\$86,621 - \$111,591	1.1	1.6	0.5 (0.2, 0.9)	1.49 (1.21, 1.84)	
\$111,591 - \$236,518	1.1	1.4	0.3 (0.0, 0.6)	1.27 (1.03, 1.58)	
<b>Lifetime suicide attempt</b>					
By Sex:					0.64
Females	4.3	4.8	0.5 (0.0, 0.9)	1.09 (1.00, 1.18)	
Males	2.0	2.3	0.3 (0.0, 0.6)	1.13 (1.00, 1.28)	
By Race/Ethnicity:					0.49
Non-Hispanic Black	5.9	6.5	0.6 (-0.2, 1.4)	1.07 (0.95, 1.21)	
Non-Hispanic White	2.1	2.6	0.4 (0.1, 0.7)	1.17 (1.05, 1.31)	
Hispanic or Latino	4.4	4.4	0.0 (-1.2, 1.2)	0.96 (0.77, 1.19)	
Asian	1.9	2.0	0.1 (-0.9, 1.1)	1.02 (0.65, 1.62)	
Other	2.7	3.0	0.4 (-0.4, 1.2)	1.12 (0.92, 1.36)	
By Insurance:					0.05
Commercial	2.3	2.6	0.3 (0.1, 0.6)	1.15 (1.06, 1.26)	
Medical Assistance	5.7	6.2	0.5 (-0.2, 1.2)	1.06 (0.95, 1.20)	
Self-Pay/Other	4.8	2.2	-2.5 (-5.2, 0.2)	0.54 (0.28, 1.07)	
By Neighborhood Income:					0.40
\$11,497 - \$59,870	5.5	6.2	0.8 (0.0, 1.5)	1.10 (0.98, 1.25)	

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\$59,871 - \$86,620	3.1	3.6	0.6 (0.0, 1.1)	1.15 (1.01, 1.32)	
\$86,621 - \$111,591	2.1	2.5	0.3 (-0.1, 0.8)	1.13 (0.88, 1.44)	
\$111,591 - \$236,518	2.0	2.1	0.1 (-0.3, 0.5)	1.01 (0.86, 1.18)	

<sup>1</sup>Percentages in 2019 and 2020 reflect crude percent among those screened who screened positive for suicide risk. Percentage point changes reflect the absolute change in suicide risk from the pre-pandemic (2019) to pandemic (2020) period, with 95% confidence intervals calculated using logistic regression and marginal standardization. Negative numbers indicate a decline during the pandemic period, while positive numbers indicate an increase.

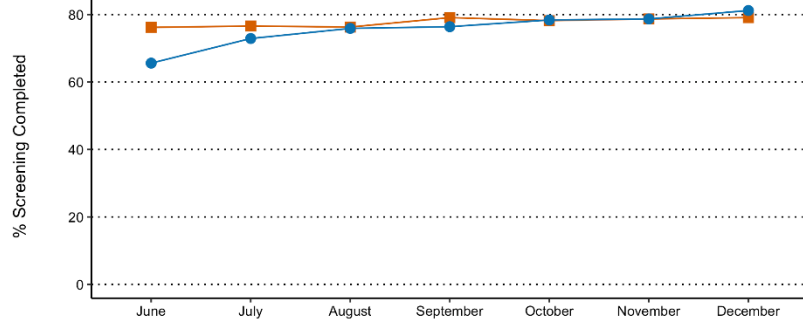
<sup>2</sup>Adjusted prevalence ratios and interaction p-values were estimated using multivariable Poisson models with robust variance estimates that accounted for clustering by primary care practice. Prevalence ratios reflect the relative change in prevalence of screening positive for suicide risk in the pandemic period compared to the pre-pandemic period.

**Figure 1. Depression and Suicide Risk Screening Outcomes by Month, Comparing Pre-Pandemic (2019) to Pandemic (2020)**

**Periods.** Percentages reflect crude percent of visits where adolescents were screened, or the crude percent among those screened who screened positive for depression or suicide risk. Prevalence ratios reflect the relative change in prevalence of each screening outcome for a given month in the pandemic period compared to the pre-pandemic period. Prevalence ratios were calculated using Poisson regression with robust variance estimates that accounted for clustering of participants within primary care practices.

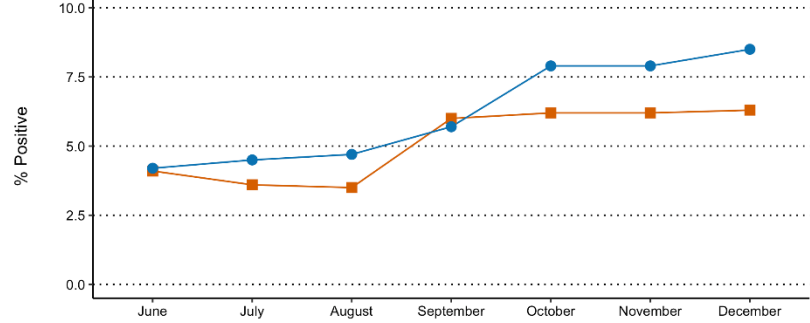
# Prepublication Release

**a. Screening Completed**



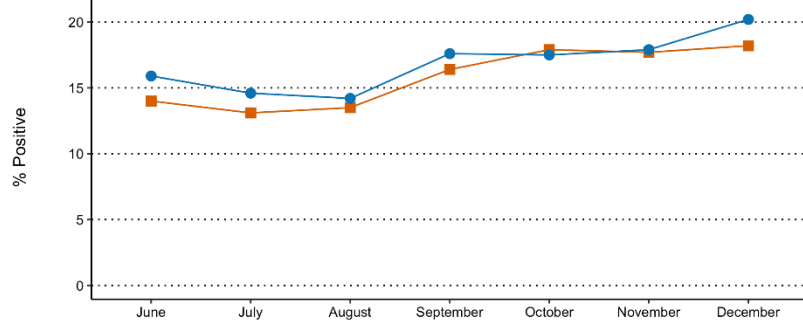
PR (95% CI) 0.86 (0.75, 0.99) 0.95 (0.86, 1.06) 1.00 (0.91, 1.09) 0.97 (0.88, 1.06) 1.00 (0.91, 1.10) 1.00 (0.89, 1.12) 1.03 (0.97, 1.09)

**b. Moderate/Severe Depression**



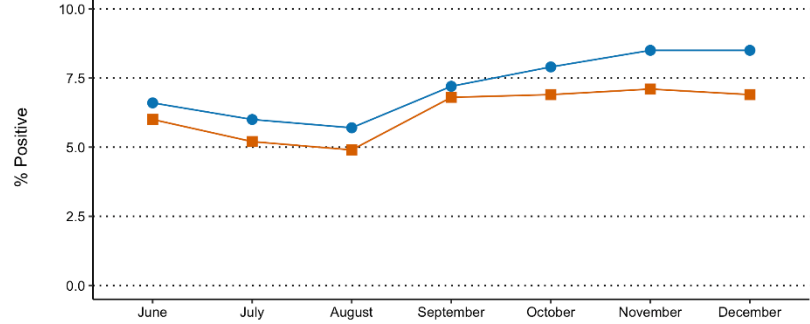
PR (95% CI) 1.04 (0.82, 1.31) 1.24 (0.97, 1.57) 1.33 (1.09, 1.62) 0.94 (0.79, 1.13) 1.28 (1.09, 1.49) 1.26 (1.09, 1.46) 1.34 (1.18, 1.52)

**c. Borderline Depression**



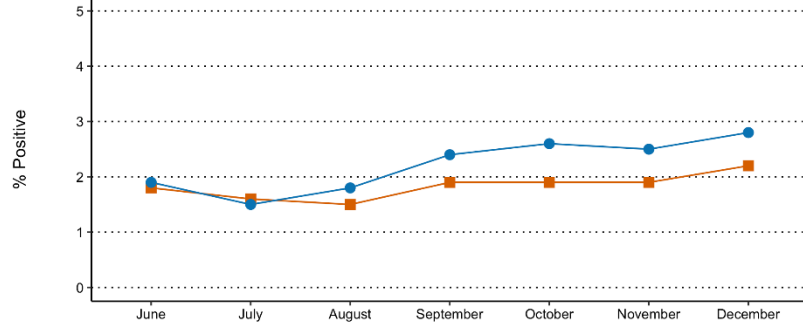
PR (95% CI) 1.14 (0.99, 1.31) 1.12 (1.00, 1.25) 1.05 (0.97, 1.14) 1.07 (0.96, 1.19) 0.98 (0.90, 1.06) 1.01 (0.93, 1.10) 1.11 (1.02, 1.22)

**d. Suicide Risk**



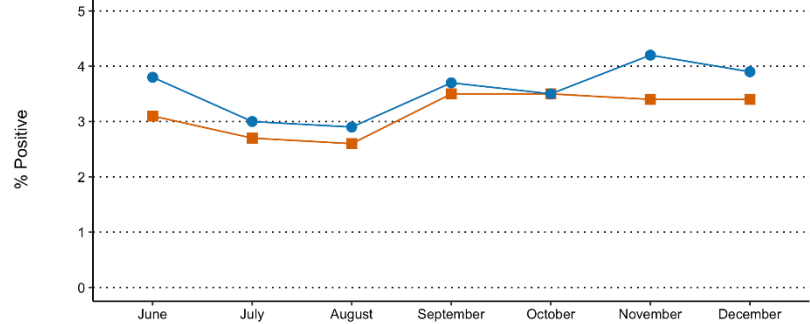
PR (95% CI) 1.11 (0.90, 1.37) 1.14 (0.97, 1.34) 1.16 (0.99, 1.35) 1.06 (0.91, 1.24) 1.14 (1.03, 1.28) 1.19 (1.00, 1.42) 1.24 (1.07, 1.44)

**e. Past-Month Suicidal Ideation**



PR (95% CI) 1.07 (0.72, 1.58) 0.93 (0.68, 1.27) 1.22 (0.91, 1.63) 1.24 (0.97, 1.58) 1.37 (1.08, 1.73) 1.32 (1.07, 1.63) 1.26 (0.99, 1.60)

**f. Lifetime Suicide Attempt**



PR (95% CI) 1.22 (0.95, 1.55) 1.13 (0.90, 1.42) 1.12 (0.91, 1.38) 1.05 (0.80, 1.39) 1.02 (0.87, 1.20) 1.21 (0.91, 1.61) 1.13 (0.92, 1.39)

■ 2019 ● 2020

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