

## Demographic Characteristics Associated With Adolescent Receipt of Provider E-Cigarette Screening and Advice and the Impact on Harm Perception



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**Introduction:** The growing prevalence of E-cigarette use among adolescents is alarming because it increases the probability of persistent tobacco use and addiction to nicotine. Healthcare providers are in a unique position to influence their patients' use of E-cigarettes. The purpose of the study is to determine the frequency at which providers screen adolescents for E-cigarette use and advise against use during healthcare visits. The study also examines associations between provider intervention and adolescent harm perception.

**Methods:** Using data from the 2021 National Youth Tobacco Survey, the authors examined provider E-cigarette screening and advice to not use from 16,910 participants who self-reported receiving medical care within the preceding year. Multivariable logistic regression models were used to assess whether the odds of provider intervention varied by age, sex, and race/ethnicity and whether receiving provider intervention was associated with a likelihood for harm perception.

**Results:** Provider intervention was more likely among those aged 13–18 years, who are male, and who are White and/or non-Hispanic ( $p < 0.001$ ). The authors found no association between provider intervention and increased harm perception of E-cigarettes; however, provider intervention was associated with the belief that E-cigarettes are equally or more addictive than cigarettes ( $p < 0.0001$ ).

**Conclusions:** Study findings emphasize the significance of addressing disparities in E-cigarette use and healthcare provider intervention among minority adolescents, underscoring the need for healthcare providers to be thorough in screening for E-cigarette use and providing appropriate cessation support.

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### INTRODUCTION

The prevalence of E-cigarette use is greater than the use of any other tobacco products among the adolescent population.<sup>1</sup> Currently, 14.1% of high-school students and 3.3% of middle-school students report using E-cigarettes, and the rate of E-cigarette use has tripled since 2011 among adolescents aged 14–17 years, with a 59 % increase in reported daily and frequency of use since 2017.<sup>2–4</sup> Reduced harm perception, perceived benefits, and reports of safety compared with tobacco cigarettes likely drive increasing utilization rates.<sup>5</sup>

Escalation in the use of E-cigarettes and other electronic nicotine delivery devices among adolescents raises concerns about the related negative physical and mental health outcomes.

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2773-0654/\$36.00

<https://doi.org/10.1016/j.focus.2024.100309>

E-cigarettes contain nicotine, carcinogens, and other toxins that can cause detrimental health effects.<sup>6,7</sup> The nicotine present in E-cigarettes is highly addictive, and the adolescent brain has an increased sensitivity to nicotine because it alters the developing brain's structure and function, leading to long-term health effects.<sup>6,8,9</sup> Exposure to nicotine has been shown to excite receptors in the brain, resulting in inhibition of attention.<sup>10</sup> Consequently, research indicates that suicidal ideation and depression risk are greater in E-cigarette users than in nonusers.<sup>10</sup>

Despite all the health effects attributed to E-cigarette use, adolescents perceive E-cigarettes to be less harmful than conventional tobacco products.<sup>2,11,12</sup> Previous research indicates that harm perception is the most influential factor in predicting whether adolescents will use E-cigarettes.<sup>13</sup> Adolescents who perceive E-cigarettes as harmless or less harmful than conventional cigarettes are more likely to use these products.<sup>14</sup> Marketing ploys and misinformation convince adolescents of the safety of E-cigarette use and fail to share the deleterious effects and constituents of their products.<sup>15,16</sup>

Awareness of the factors that lead to E-cigarette use in adolescents, such as harm perceptions, can lead to effective preventative measures. Research shows that physicians are well positioned to intervene, prevent, or reduce adolescent E-cigarette use and influence existing perceptions.<sup>17</sup> Adolescents who meet with a healthcare provider annually allow for the unique opportunity to develop relationships over many years.<sup>18</sup> This provides an opportunity for screening and counseling adolescents for risky behaviors, such as E-cigarette use, and ultimately influencing harm perception.<sup>19</sup> Preventative services, such as screening for tobacco use, are effective in modifying behavioral changes in as little as 3 months.<sup>20</sup> Although best practice guidelines recommend that healthcare providers screen their patients for tobacco and E-cigarette use at every visit and offer advice on cessation, it is not well documented how often this occurs among adolescents.<sup>21</sup> An analysis of the 2013 National Survey on Drug Use and Health revealed that 49% of individuals aged 12–17 years are screened annually for tobacco products but only 13% for E-cigarettes.<sup>22</sup> Another study, conducted across multiple U.S. pediatric clinics, revealed that <1% of adolescents are screened for E-cigarette use.<sup>23</sup>

Demographics are impactful when it comes to the possibility of engaging in tobacco treatment and cessation.<sup>24</sup> Among adults, physician recommendations to quit tobacco have increased over the years; however, sex, race, age, and insurance status are correlated to disparities in advice given to quit.<sup>25,26</sup> Uninsured and minority populations are less likely to receive cessation advice

than White cohorts with higher SES.<sup>26</sup> Across adolescent populations, research involving racial disparities and E-cigarette screening is limited.

The objectives of this study are twofold: (1) to examine the frequency of provider E-cigarette intervention (screen and advised of harms) at a healthcare visit and explore the influence of respondent demographic characteristics on the probability of the provider delivering the E-cigarette intervention and (2) to evaluate the association between provider E-cigarette intervention and the participant's harm perception of E-cigarette exposure. Identifying provider E-cigarette screening and guidance in the adolescent population is crucial because provider intervention may positively influence adolescent harm perception of E-cigarettes and, thus, impact initiation and/or cessation.

## METHODS

### Study Sample

This study was a cross-sectional analysis of public-use data from the 2021 National Youth Tobacco Survey (NYTS) downloaded from the Centers for Disease Control and Prevention (CDC) in 2022. General details of CDC IRB approval and informed consent procedures as well as the sample procedures for NYTS are available on the CDC website.<sup>27</sup> IRB approval was not required by Florida State University for this secondary analysis of a publicly available and nonidentifiable data set.

The NYTS is a stratified, 3-stage cluster sample providing comprehensive and nationally represented samples of youth in the U.S. and their tobacco-related benefits, exposure, and use. Youth participants comprised of private and public middle- and high-school students in Grades 6–12. Participation in the NYTS is anonymous and voluntary.

A sample of  $n=20,413$  middle- and high-school students completed the NYTS survey included in this study. The authors limited the analysis to a subpopulation of participants ( $n=17,195$ ) who indicated that they had a healthcare visit in the last 12 months. In addition, participants who had missing data variables regarding harm perception, demographics, and/or E-cigarette screening were excluded from the sample ( $n=285$ ; 2% of the total sample). This resulted in a final sample of  $N=16,910$ .

### Measures

The intervention was provider E-cigarette screening and advising of harms. These were assessed through 2 different survey questions: (1) *During any of these visits to a doctor, dentist, nurse, or other health professional, were you asked if you used e-cigarettes?* and (2) *During any of these visits, were you advised to not use e-cigarettes?* A

response of yes to either of these questions was coded as 1, and a response of no was coded as 0.

For the purposes of this study, the authors used the following survey items to measure participant harm perception: *How much do you think people harm themselves when they use e-cigarettes some days but not every day?*, *Do you believe that e-cigarettes are (LESS ADDICTIVE, EQUALLY ADDICTIVE, or MORE ADDICTIVE) than cigarettes?*, and *Do you think that breathing the vapor from other people's e-cigarettes causes harm?* Each survey item was modeled as a separate binary outcome by collapsing categorical responses into values of 1, indicating a higher level of harm perception, and 0, indicating lower harm perception.

In addition, several demographic characteristics were included as explanatory variables. Demographic measures included age, sex (male/female), race (White, Black, Asian, American Indian or Alaska Native, Native Hawaiian or other Pacific Islander, or multirace), and ethnicity (Cuban, Mexican, Puerto Rican, other Hispanic, or non-Hispanic).

To better describe the sample, the authors report on 2 measures of E-cigarette use. First, lifetime (ever) use was defined as a binary yes/no variable on the basis of the participant's response to the survey question, *Have you ever used an e-cigarette, even once or twice?* Current use was defined as a binary Yes/No variable on the basis of responses to the survey question, *When was the last time you used an e-cigarette, even one or two times?* Responses to this question indicating E-cigarette use within the last 30 days were coded as yes, with all other responses coded as no.

### Statistical Analysis

Analysis for this study was conducted using SAS statistical software (9.4). For descriptive analysis, the authors ran tests for differences and associations against each outcome using an appropriate statistical method on the basis of variable distribution (chi-square tests for binary/categorical variables). For the main analytic approach, the authors used multiple logistic regression with SAS's survey procedures (PROC SURVEYLOGISTIC) required for statistical analysis of data collected with a multistaged probability sampling. The authors conducted 4 separate multiple logistic regression analyses that modeled (1) the probability of receiving the provider E-cigarette intervention (screening and/or advised of harms) in relation to the demographic characteristics of the respondent, (2) the probability of having a higher perception of harm from E-cigarette use in relation to whether or not the patient received E-cigarette screening and/or advice, (3) the probability of perceiving E-cigarettes as equally or more addictive than regular cigarettes

in relation to whether or not the patient received E-cigarette screening and/or advice, and (4) the probability of perceiving vapor from other people's E-cigarette as harmful in relation to whether or not the patient received E-cigarette screening and/or advice. A  $p=0.05$  was used as the threshold to test for statistical significance in all analyses.

## RESULTS

Weighted percentages for demographic characteristics of the analytic sample (N=16,910) are presented in [Table 1](#). A majority of the sample (72.3%) was aged between 13 and 18 years. Approximately 51% of the participants were male, with 69.1% reporting as White and 74.6% indicating to be of non-Hispanic origin. Of the analytic sample, 41.7% received the provider E-cigarette screening and/or advice intervention.

The results for the prevalence of E-cigarette use across the samples' demographic characteristics are presented in [Table 2](#). The prevalence of lifetime E-cigarette use was higher among older participants, with 36.4% among participants aged  $\geq 18$  years, 21% among participants aged  $\geq 13$  and  $< 18$  years, and 4.4% among participants aged  $\geq 9$  and  $< 13$  years. Lifetime prevalence of E-cigarette use was similar across sex, with 17.9% of males and 19.5% of females indicating lifetime use of E-cigarettes. The percentage of lifetime E-cigarette users varied by race category, with American Indian and Alaska Native participants and Whites having the highest prevalence at 21.3% and 21.2%, respectively. Overall, prevalence of current E-cigarette use was lower than lifetime prevalence across all demographic characteristics; however, the variation across categories was similar to lifetime use percentages.

The odds of receiving the intervention increased with age ([Table 3](#)). Specifically, participants aged  $\geq 18$  years had 2.34 times greater odds of receiving the intervention than participants aged  $\geq 9$  and  $< 13$  years (OR=2.34; 95% CI=1.91, 2.88;  $p<0.0001$ ). In addition, the odds of receiving the intervention were more than double for participants in the age range between 13 and 18 years (OR=2.01; 95% CI=1.78, 2.30;  $p<0.0001$ ) than for those aged between 9 and 13 years. Males had 12% greater odds of receiving the intervention than females (OR=1.12; 95% CI=1.03, 1.21;  $p=0.0069$ ). Asian (OR=0.70; 95% CI=0.55, 0.90;  $p=0.0052$ ) and Black or African American (OR=0.72; 95% CI=0.62, 0.84;  $p<0.0001$ ) participants had lower odds of receiving the intervention than White participants. Finally, non-Hispanic participants had 40% greater odds of receiving the intervention than Hispanic participants (OR=1.40; 95% CI=1.17, 1.27;  $p=0.0004$ ).

**Table 1.** Demographic Characteristics Among Participants With a Healthcare Appointment in the Last 12 Months From the National Youth Tobacco Survey, 2021 (N=16,910)<sup>a</sup>

Characteristic	Total %	Received intervention <sup>b</sup> %	No intervention <sup>b</sup> %	p-value <sup>c</sup>
Overall (N=16,910)	—	41.7	58.3	NA
Age category, year				
≥9 and <13	20.4	14.0	25.0	<0.0001
≥13 and <18	72.3	77.6	68.8	<0.0001
≥18	7.3	8.5	6.4	0.0070
Sex				
Male	51.0	52.9	49.6	0.0020
Female	49.0	47.1	50.4	0.0020
Race				
AI/NA	6.4	6.1	6.6	0.4140
Asian	7.9	6.7	8.7	0.0296
Black or AA	16.5	14.3	18.0	0.0002
NH/PI	2.6	2.5	2.7	0.6539
White	69.1	73.7	65.7	<0.0001
Ethnicity				
Non-Hispanic	74.6	78.1	72.1	0.0004
Hispanic <sup>d</sup>	25.4	21.9	27.9	0.0004

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Results are weighted percentage estimates using National Youth Tobacco Survey sampling design parameters.

<sup>b</sup>Intervention: defined as being screened for use of and/or advised of E-cigarette harms.

<sup>c</sup>Rao-Scott chi-square test.

<sup>d</sup>Includes Mexican, Puerto Rican, Cuban, and other Hispanic.

AA, African American; AI/NA, American Indian or Alaskan Native; NA, not applicable; NH/PI, Native Hawaiian or other Pacific Islander.

**Table 2.** Prevalence of E-Cigarette Use Across Demographic Characteristics Among Participants With a Healthcare Appointment in the Last 12 Months From the National Youth Tobacco Survey, 2021 (N=16,910)<sup>a</sup>

Characteristic	E-cigarette use (lifetime) <sup>b</sup> %	E-cigarette use (current) <sup>b</sup> %
Age category, year		
≥9 and <13	4.4%	1.2%
≥13 and <18	21.0%	7.2%
≥18	36.4%	15.2%
Sex		
Male	17.9%	5.8%
Female	19.5%	7.4%
Race		
AI/NA	21.3%	7.6%
Asian	11.9%	3.2%
Black or AA	14.4%	4.5%
NH/PI	15.7%	3.1%
White	21.2%	8.0%
Ethnicity		
Non-Hispanic	15.7%	4.3%
Hispanic <sup>c</sup>	19.7%	7.4%

<sup>a</sup>Results are weighted percentage estimates using National Youth Tobacco Survey sampling design parameters. The percentage figure represents the percentage of E-cigarette users within the demographic characteristic category.

<sup>b</sup>Lifetime use defined as a yes response to the survey question, *Have you ever used an e-cigarette, even once or twice?* Current use (within last 30 days) was defined as yes for response to the survey question, *When was the last time you used an e-cigarette, even one or two times?*, that indicated E-cigarette use within the last 30 days.

<sup>c</sup>Includes Mexican, Puerto Rican, Cuban, and other Hispanic.

AA, African American; AI/NA, American Indian or Alaskan Native; NH/PI, Native Hawaiian or other Pacific Islander.

**Table 3.** Multiple Logistic Regression Model of Demographic Factors Associated With the Odds of Receiving E-Cigarette Intervention<sup>a</sup> From NYTS, 2021 (N=16,275)

Variable	OR (95% CI)	p-value
Age category, year		
≥9 and <13 (ref group)	1.00	NA
≥13 and <18	2.01 (1.78, 2.30)	<0.0001
≥18	2.34 (1.91, 2.88)	<0.0001
Sex (male versus female)	1.12 (1.03, 1.21)	<b>0.0069</b>
Race		
White (ref group)	1.00	NA
AI/NA	1.01 (0.84, 1.22)	0.924
Asian	0.70 (0.55, 0.90)	0.0052
Black or AA	0.72 (0.62, 0.84)	<0.0001
NH/PI	1.10 (0.83, 1.44)	0.5044
Ethnicity (non-Hispanic versus Hispanic <sup>b</sup> )	1.40 (1.17, 1.27)	<b>0.0004</b>

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Intervention: defined as being screened for use of and/or advised of E-cigarette harms.

<sup>b</sup>Includes Mexican, Puerto Rican, Cuban, and other Hispanic.

AI/NA, Native American or Alaskan Native; AA, African American; NYTS, National Youth Tobacco Survey; NA, not applicable; NH/PI, Native Hawaiian or other Pacific Islander.

The results for participant harm perception outcomes are presented in Table 4. After controlling for age, sex, race, and ethnicity, receipt of the intervention was not statistically associated with increased harm perception for E-cigarettes or related second-hand vapor. Conversely, receipt of the intervention was associated with a 42% increase in the odds of a participant reporting a belief that E-cigarettes are equally or more addictive than the cigarettes (OR=1.42; 95% CI=1.30, 1.54;  $p < 0.0001$ ).

## DISCUSSION

This study is the first to incorporate a national scope to investigate provider intervention for adolescent E-cigarette users, and the findings suggest disparities in provider intervention rates among minority adolescents. Overall, the authors found that less than half (41.7%) of participants who had a healthcare visit in the past year received provider E-cigarette screening and/or advice to quit, and provider intervention was more frequent among those aged 13–18 years, who are male, White and/or, non-Hispanic. This finding highlights the need for healthcare providers to screen all adolescent patients for E-cigarette use, not just young, White males. Moreover, this study adds to the growing body of evidence suggesting that there are significant disparities in E-cigarette use among minority adolescents. For example, a recent study found that Black and Hispanic adolescents are more likely to use E-cigarettes than their White counterparts.<sup>28</sup> The current study builds on this evidence, revealing that the same minority adolescent E-

cigarette users receive provider intervention less frequently than their nonminority peers while having similar or higher health risks.<sup>29</sup>

Although provider intervention was not associated with increased E-cigarette harm perceptions, the authors observed an increase in the odds of reporting the belief that E-cigarettes are equally or more addictive than cigarettes. The lack of significance in harm perception is surprising because previous research indicates that provider messaging and intervention increase E-cigarette harm perceptions.<sup>30</sup> Contrastingly, the finding that provider intervention was correlated with the belief that E-cigarettes are equally or more addictive than cigarettes aligns with previous research.<sup>31</sup> These somewhat conflicting findings underscore the complexity of E-cigarette perceptions. Harm perception associated with E-cigarettes is multifaceted and influenced by media portrayal, peer influence, and personal experience. In contrast, the belief in E-cigarette addictiveness is more straightforward because nicotine is inherently addictive, and adolescents may recognize this fact regardless of their overall harm perception. Another possible explanation for this discrepancy is the concept of cognitive dissonance. Adolescents may acknowledge the addictive nature of E-cigarettes but minimize harm to justify their use, despite provider intervention.

The results of this study have significant implications for both healthcare providers and researchers. Healthcare providers have not consistently screened adults for E-cigarette use, which may result in missed opportunities for intervention and support.<sup>32</sup> This study extends this finding by revealing that minority adolescents are

**Table 4.** Multiple Logistic Regression Model—Provider Intervention<sup>a</sup> and the Odds of Participants Perceiving E-Cigarettes as Harmful From the NYTS, 2021

Variable	E-cigarette harm perception <sup>b</sup>		E-cigarette harm addictive <sup>c</sup>		E-cigarette harm second-hand vapor <sup>d</sup>	
	n OR (95% CI)	16,456 p-value	n OR (95% CI)	16,447 p-value	n OR (95% CI)	16,275 p-value
Intervention (ref=no)	1.08 (0.95, 1.23)	0.237	1.42 (1.30, 1.54)	<0.0001	0.98 (0.90, 1.07)	0.714
Age category, year						
≥9 and <13 (ref group)	1.00	—	1.00	—	1.00	—
≥13 and <18	0.73 (0.64, 0.85)	<0.0001	1.54 (1.37, 1.74)	<0.0001	0.65 (0.56, 0.75)	<0.0001
≥18	0.65 (0.50, 0.85)	0.002	1.36 (1.08, 1.72)	0.0101	0.69 (0.54, 0.88)	0.0029
Sex (male versus female)	0.75 (0.67, 0.84)	<0.0001	0.89 (0.81, 0.99)	0.0257	0.90 (0.83, 0.96)	0.0225
Race						
White (ref group)	1	—	1	—	1	—
AI/NA	0.79 (0.64, 0.98)	0.0286	0.89 (0.75, 1.05)	0.149	1.06 (0.87, 1.29)	0.5558
Asian	1.41 (1.10, 1.81)	0.0071	0.81 (0.65, 1.02)	0.0761	1.44 (1.16, 1.79)	0.0015
Black or AA	0.88 (0.76, 1.03)	0.1025	0.71 (0.62, 0.83)	<0.0001	1.42 (1.26, 1.59)	<0.0001
NH/PI	1.02 (0.64, 1.62)	0.9281	0.86 (0.65, 1.14)	0.279	0.98 (0.73, 1.32)	0.8957
Ethnicity (non-Hispanic versus Hispanic <sup>e</sup> )	0.99 (0.84, 1.16)	0.882	1.19 (1.05, 1.34)	0.0054	0.80 (0.70, 0.91)	0.001

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

Sample will vary for each model due to missing data.

<sup>a</sup>Intervention: defined as being screened for use of and/or advised of E-cigarette harms.

<sup>b</sup>How much do you think people harm themselves when they use e-cigarettes some days but not every day? (some harm and a lot of harm=1, none or a little=0).

<sup>c</sup>Do you believe that e-cigarettes are (LESS ADDICTIVE, EQUALLY ADDICTIVE, or MORE ADDICTIVE) than cigarettes? (equally or more addictive=1, less=0).

<sup>d</sup>Do you think that breathing the vapor from other people's e-cigarettes causes harm? (some harm and a lot of harm=1, none or a little=0).

<sup>e</sup>Includes Mexican, Puerto Rican, Cuban, and other Hispanic.

AA, African American; AI/NA, Native American or Alaskan Native; NH/PI, Native Hawaiian or other Pacific Islander; NYTS, National Youth Tobacco Survey.

also receiving fewer interventions from providers, which may contribute to the disparity in E-cigarette use. Although further research is needed to explore the underlying reasons for disparities in provider intervention rates, using electronic medical records to prompt healthcare providers during patient visits facilitates consistent and comprehensive assessment of E-cigarette use. In addition, inclusion of tobacco cessation education in medical school curricula and postgraduate training can increase provider awareness and confidence in offering routine screening and appropriate interventions to improve patient outcomes. Finally, study results suggest that providers may have a limited impact on adolescent harm perception but can be influential in shaping beliefs about addiction. Future research could explore these discrepancies utilizing qualitative interviews or mixed methods approaches to provide deeper insight into cognitive processes. Furthermore, studies can investigate effective provider interventions to decrease E-cigarette use and impact related beliefs, whereas educational interventions targeting harm perception and addiction awareness could enhance public health efforts.

### Limitations

It is important to note that this study has limitations. The data set used in this study, the NYTS, is observational and cross-sectional, which makes any causal inference about the relationship between provider screening, demographic biases, and harm perception inappropriate. The distribution of the NYTS questionnaire is limited to middle- and high-school students attending public and private schools in the U.S., thus excluding adolescents who are homeschooled, not enrolled in school, dropped out, or attending other types of facilities.

Furthermore, the analytic sample in this study was limited to adolescents who had a healthcare visit in the last 12 months and had no missing data variables regarding harm perception, demographics, and/or E-cigarette screening. It is possible that differences in findings between this study and previous research may be due to differences in populations studied, interventions used, or other methodologic factors. For instance, previous studies included both adults and adolescents; however, this study focused solely on adolescents.<sup>33</sup>

Finally, this study did not specify what types of interventions were provided by healthcare providers, whereas previous research has often focused on specific interventions such as brief counseling or nicotine replacement therapy. Future research should focus on examining which types of interventions are most impactful to adolescents. Nevertheless, this study's findings support and add to the existing research on adolescent E-cigarette use, harm perception, and screening.

## CONCLUSIONS

This study highlights the continued presence of demographic disparities in healthcare provider screening practices and intervention, specifically among minority adolescents. Uniquely, specific provider influence on harm perception of E-cigarettes had not previously been analyzed. The mixed findings indicate that further research is necessary to explore the direct relationship between harm perception and adolescent E-cigarette use to better understand and communicate the dangers associated with E-cigarette use. Ultimately, providers are in a unique position to influence adolescent use of E-cigarettes. By routinely providing interventions to their adolescent patients, they have the opportunity to positively impact the health of younger generations.

## ACKNOWLEDGMENTS

Funding: none.

Declaration of interest: none.

## CREDIT AUTHOR STATEMENT

John S. Acosta-Peñaloza: Conceptualization, Investigation, Visualization, Writing – original draft. Karen W. Geletko: Conceptualization, Supervision, Writing – review & editing. Jon Mills: Formal analysis, Methodology, Writing – review & editing.

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