

# Assessing the Consistency of Reporting for E-Cigarette Brand, Device Type, and Flavor in the National Youth Tobacco Survey: Implications for Regulatory Decision-Making \*

by

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## SUMMARY

The National Youth Tobacco Survey (NYTS) collects self-reported data from U.S. middle and high school students on past-30-day e-cigarette use, including device type used most often, all flavors used, and all brands used. These data are central to regulatory decision-making by the U.S. Food and Drug Administration (FDA) when assessing the population-level risks of e-cigarettes, which underscores the importance of verifying that estimates from the survey are accurate. The current analyses assessed the 2023 and 2022 NYTS estimates of youth e-cigarette use to examine whether the reported brand used is consistent with the reported device type and flavors used among past-30-day only brand and usual brand users of Vuse, JUUL, Elf Bar (2023), and Puff Bar (2022) e-cigarettes. In 2023, 333 respondents (1.5% of all youth) reported any past-30-day use of Vuse e-cigarettes, with 134 (0.6% of all youth) reporting Vuse as their only or usual brand. Among these 134 only or usual brand users, 84 (0.3% of all youth) provided responses for device type and flavors used that were consistent with use of Vuse. Past-30-day use of JUUL e-cigarettes was reported by 237 respondents (1.2% of all youth), with 42 (0.3% of all youth) reporting JUUL as their only or usual brand. Among these 42 only or usual brand users, 3 (< 0.1% of all youth) provided responses for

device type and flavors used that were consistent with use of JUUL. For Elf Bar e-cigarettes, 839 respondents (4.2% of all youth) reported past-30-day use, with 478 (2.3% of all youth) reporting Elf Bar as their only or usual brand. Among these 478 only or usual brand users, 392 (2.0% of all youth) provided responses for device type that were consistent with use of Elf Bar (flavors could not be validly assessed). Analyses of the 2022 NYTS data showed similarly low levels of consistency in reporting for Vuse, JUUL, and Puff Bar e-cigarettes. Thus, substantial proportions of youth in both survey years provided responses for device type used most often and flavors used during the past 30 days that were not consistent with the reported brand used. These findings raise significant concerns regarding the accuracy of the brand-specific prevalence estimates derived from the NYTS data, especially given the weight that the FDA places on these data during its regulatory decision-making. [Contrib. Tob. Nicotine Res. 34 (2025) 94–104]

## KEYWORDS

Past-30-day e-cigarette use; e-cigarette brand; National Youth Tobacco Survey

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## ZUSAMMENFASSUNG

Der National Youth Tobacco Survey (NYTS) erhebt Selbstauskünfte von US-Schülern der Mittel- und Oberstufe über den Konsum von E-Zigaretten für den Zeitraum der vergangenen 30 Tage, einschließlich des am häufigsten verwendeten Gerätetyps, aller verwendeten Geschmacksrichtungen und aller konsumierten Marken. Diese Daten sind von zentraler Bedeutung für die regulatorische Entscheidungsfindung der US-amerikanischen Food and Drug Administration (FDA) bei der Bewertung der Risiken von E-Zigaretten auf Bevölkerungsebene. Dies unterstreicht, wie wichtig es ist, zu überprüfen, ob die Schätzungen aus der Umfrage korrekt sind. In den aktuellen Analysen wurden die NYTS-Schätzungen für den E-Zigarettenkonsum von Jugendlichen aus den Jahren 2023 und 2022 ausgewertet, um zu untersuchen, ob die angegebene Marke mit dem angegebenen Gerätetyp und den Geschmacksrichtungen übereinstimmt, die von den Nutzern von E-Zigaretten der Marken Vuse, JUUL, Elf Bar (2023) und Puff Bar (2022) in den letzten 30 Tagen verwendet wurden. Im Jahr 2023 gaben 333 Befragte (1,5% aller Jugendlichen) an, in den vergangenen 30 Tagen E-Zigaretten der Marke Vuse verwendet zu haben, wobei 134 (0,6% aller Jugendlichen) Vuse als einzige oder übliche Marke angaben. Von diesen 134 Nutzern der einzigen oder üblichen Marke gaben 84 (0,3% aller Jugendlichen) Antworten zum Gerätetyp und den verwendeten Geschmacksrichtungen, die mit der Nutzung von Vuse übereinstimmten. Der Gebrauch von JUUL-E-Zigaretten in den letzten 30 Tagen wurde von 237 Befragten (1,2% aller Jugendlichen) angegeben, wobei 42 (0,3% aller Jugendlichen) JUUL als einzige oder übliche Marke angaben. Von diesen 42 Nutzern der einzigen oder üblichen Marke machten 3 (<0,1% aller Jugendlichen) Angaben zum Gerätetyp und den verwendeten Geschmacksrichtungen, die mit der Nutzung von JUUL übereinstimmten. Für Elf Bar E-Zigaretten meldeten 839 Befragte (4,2% aller Jugendlichen) den Konsum in den letzten 30 Tagen, wobei 478 (2,3% aller Jugendlichen) Elf Bar als ihre einzige oder übliche Marke angaben. Von diesen 478 Nutzern der einzigen oder üblichen Marke gaben 392 (2,0% aller Jugendlichen) Antworten zum Gerätetyp an, die mit dem Konsum von Elf Bar übereinstimmten (die Geschmacksrichtungen konnten nicht valide bewertet werden). Analysen der NYTS-Daten aus dem Jahr 2022 ergaben ähnlich geringe Übereinstimmungen bei den Angaben zu Vuse-, JUUL- und Puff Bar-E-Zigaretten. So gab ein erheblicher Anteil der Jugendlichen in beiden Erhebungsjahren Antworten für den am häufigsten verwendeten Gerätetyp und die in den letzten 30 Tagen verwendeten Geschmacksrichtungen, die nicht mit der angegebenen Marke übereinstimmten. Diese Ergebnisse geben Anlass zu erheblichen Bedenken hinsichtlich der Genauigkeit der aus den NYTS-Daten abgeleiteten markenspezifischen Prävalenzschätzungen, insbesondere angesichts des Gewichts, das die FDA diesen Daten bei ihren regulatorischen Entscheidungen beimisst. [Contrib. Tob. Nicotine Res. 34 (2025) 94–104]

## RESUME

L'enquête nationale sur le tabagisme chez les jeunes (National Youth Tobacco Survey, NYTS) recueille des données autodéclarées par des collégiens et des lycéens américains sur l'utilisation de l'e-cigarette au cours des 30 derniers jours, y compris le type d'appareil utilisé le plus souvent, tous les arômes utilisés et toutes les marques choisis. Ces données sont essentielles à la prise de décision réglementaire par la Food and Drug Administration (FDA) des États-Unis lors de l'évaluation des risques des e-cigarettes au niveau de la population, ce qui souligne l'importance de vérifier que les estimations de l'enquête sont exactes. Les analyses actuelles ont évalué les estimations de 2023 et 2022 de l'enquête NYTS sur l'utilisation de l'e-cigarette par les jeunes afin d'examiner si la marque déclarée utilisée est cohérente avec le type de dispositif déclaré et les arômes utilisés parmi les utilisateurs de marque unique et de marque habituelle au cours des 30 derniers jours des e-cigarettes Vuse, JUUL, Elf Bar (2023), et Puff Bar (2022). En 2023, 333 répondants (1,5% de tous les jeunes) ont déclaré avoir utilisé des e-cigarettes Vuse au cours des 30 derniers jours, et 134 (0,6% de tous les jeunes) ont déclaré que Vuse était leur marque unique ou habituelle. Parmi ces 134 utilisateurs de la seule marque ou de la marque habituelle, 84 (0,3% de tous les jeunes) ont fourni des réponses sur le type de dispositif et les arômes utilisés qui correspondaient à l'utilisation de Vuse. L'utilisation des e-cigarettes JUUL au cours des 30 derniers jours a été déclarée par 237 répondants (1,2% de tous les jeunes), dont 42 (0,3% de tous les jeunes) ont déclaré que JUUL était leur seule marque ou leur marque habituelle. Parmi ces 42 utilisateurs de la seule marque ou de la marque habituelle, 3 (<0,1% de tous les jeunes) ont fourni des réponses sur le type d'appareil et les arômes utilisés qui correspondaient à l'utilisation de JUUL. En ce qui concerne les e-cigarettes Elf Bar, 839 répondants (4,2% de tous les jeunes) ont déclaré les avoir utilisées au cours des 30 derniers jours, et 478 (2,3% de tous les jeunes) ont déclaré qu'Elf Bar était leur seule marque ou leur marque habituelle. Parmi ces 478 utilisateurs de la seule marque ou de la marque habituelle, 392 (2,0% de l'ensemble des jeunes) ont fourni des réponses concernant le type de dispositif qui correspondaient à l'utilisation d'Elf Bar (les arômes n'ont pas pu être évalués de manière valide). Les analyses des données de l'ETJS de 2022 ont révélé des niveaux de cohérence tout aussi faibles pour les e-cigarettes Vuse, JUUL et Puff Bar. Ainsi, des proportions substantielles de jeunes dans les deux années d'enquête ont fourni des réponses pour le type de dispositif utilisé le plus souvent et les arômes utilisés au cours des 30 derniers jours qui ne correspondaient pas à la marque déclarée utilisée. Ces résultats soulèvent d'importantes préoccupations quant à l'exactitude des estimations de prévalence par marque dérivées des données de l'enquête NYTS, en particulier compte tenu de l'importance que la FDA accorde à ces données dans le cadre de ses décisions réglementaires. [Contrib. Tob. Nicotine Res. 34 (2025) 94–104]

## INTRODUCTION

In November 2023, the U.S. Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) reported annual estimates of youth tobacco use (1). The data source for these estimates was the 2023 National Youth Tobacco Survey (NYTS), which is a cross-sectional, school-based, self-administered online survey of U.S. students in middle school (grades 6–8) and high school (grades 9–12) (2). Estimates from the 2023 NYTS suggested that 10.0% (2.80 million) of middle and high school students reported current use of one or more tobacco products, with current use defined as any past-30-day use, even one time. The most common product use categories reported by youth were e-cigarettes (7.7%; 2.13 million), followed by cigarettes (1.6%; 0.43 million), cigars (1.6%; 0.42 million), nicotine pouches (1.5%; 0.40 million), smokeless tobacco (1.2%; 0.33 million), hookahs (1.1%; 0.29 million), heated tobacco products (1.0%; 0.26 million)<sup>1</sup>, and pipe tobacco (0.5%; 0.13 million).

The FDA and CDC further reported that 4.6% of middle school students (0.55 million) and 10.0% of high school students (1.56 million) reported any past-30-day e-cigarette use. The device types reported to be used most often by past-30-day e-cigarette users were disposable devices (60.7%; 1.24 million), followed by e-cigarettes that use prefilled or refillable pods or cartridges (16.1%; 0.33 million) and tanks or mod systems (5.9%; 0.12 million). The most commonly reported usual brands of e-cigarettes used by past-30-day e-cigarette users were Elf Bar (31.1%; 0.63 million), Vuse (8.7%; 0.17 million), Esco Bars (6.0%; 0.12 million), and JUUL (3.4%; 0.07 million). Importantly, 13.2% (0.27 million) of middle and high school students reported “Some other brand(s) not listed here” and 19.8% (0.40 million) reported “Not sure/I don’t know the brand”. E-cigarettes with flavors other than ‘tobacco’ or ‘unflavored’ were used by 89.4% of past-30-day e-cigarette users (1.90 million), and the most commonly reported flavors used were ‘fruit’ (63.4%; 1.28 million), ‘candy, desserts, or other sweets’ (35.0%; 0.70 million), ‘mint’ (27.8%; 0.56 million), and ‘menthol’ (20.1%; 0.40 million) (1).

The Family Smoking Prevention and Tobacco Control Act (TCA) gave authority to regulate tobacco products to the FDA. In February 2020, the FDA exercised its enforcement discretion against flavored, cartridge-based e-cigarette products (other than ‘tobacco’ and ‘menthol’) (3). This action created a loophole whereby products with flavors characterized as ‘fruit’, ‘candy, desserts, or other sweets’, and ‘mint’ in cartridge-based e-cigarettes were to be removed from the market, but these flavors remained available in disposable e-cigarettes and refillable tank systems.

1

The FDA and CDC reported that approximately 260,000 middle school and high school students used heated tobacco products in 2023, but there was minimal to no availability of these products on the U.S. market in 2023. The only heated tobacco product with marketing authorization in the U.S. (i.e., IQOS) was only available in a small number of Southeastern states for a short period of time, which ended when the U.S. International Trade Commission imposed a ban on imports of IQOS into the U.S. in September 2021, and sales of IQOS were suspended in November 2021.

The regulatory authority given to the FDA over tobacco products requires that manufacturers who wish to market a new tobacco product must apply for and obtain marketing authorization. Furthermore, the FDA requires that manufacturers applying for marketing authorization of new tobacco products, such as e-cigarettes, provide product-specific data on the use of those products, including data specific to each flavor. Manufacturers must also provide evidence of an increased benefit (e.g., reduced cigarette consumption among adult smokers) for flavored e-cigarettes that exceeds the benefit shown for tobacco-flavored e-cigarettes, and these benefits must more than offset any potential harms that may be associated with the potential for youth use of the product.

The FDA’s assessment of the potential risks associated with e-cigarette use among youth has been based on data from the NYTS, and the FDA specifically cites the NYTS data when it has publicly announced its decisions denying marketing authorization of e-cigarette products (4–6); the FDA has also cited these data as supportive of low levels of youth use when authorizing a menthol-flavored e-cigarette (7). Thus, from a regulatory perspective, estimates from the NYTS on e-cigarette use among youth are the measure of population risk that products must offset in order to receive marketing authorization. Therefore, accurate estimates of youth use of e-cigarettes by brand should be used to guide regulatory decision-making.

This study sought to build upon findings from a previous study (8) that found inconsistencies in reported e-cigarette brands and device types among youth using a combined analysis of the 2021 and 2022 NYTS. That study found that one-third of youth who reported using a pod-based e-cigarette brand and approximately 20.0% of youth who reported using a disposable e-cigarette brand reported device types that were not consistent with their reported brand used. Reporting inconsistencies regarding current e-cigarette use do not appear to be limited to youth, as similar analyses of data from the adult survey of the Population Assessment of Tobacco and Health (PATH) study also showed discrepancies between reported brand used and device type used (9). Given the significant regulatory implications of youth e-cigarette use, the current analyses extend the findings from a previous study (8) by examining the consistency of responses between reported brand used and device type used, in addition to reported flavors used, based on data from both the 2023 and 2022 NYTS. Specifically, the analyses examined past-30-day e-cigarette users’ reported only brand or usual brand used and their reported device type used most often and all flavors used during the past 30 days. The brands examined in the current analyses include Vuse, JUUL, Elf Bar (2023), and Puff Bar (2022), which represent two pod-based devices (Vuse and JUUL) and two disposable devices (Elf Bar and Puff Bar) that are reported by sufficient proportions of youth relative to the other response options available in the NYTS.

## MATERIALS AND METHODS

Data from the nationally representative NYTS were collected in March through June of 2023 (2) and in January through May of 2022 (10). The 2023 NYTS was completed

by 22,069 students from 179 participating schools (1), and the 2022 NYTS was completed by 28,291 students from 341 participating schools (11).

Questions on e-cigarette use, including those used to identify only or usual brand used, device type used most often, and flavors used during the past 30 days, differed slightly between the two years of the NYTS. Relevant to the current analyses, the e-cigarette brands and flavors that were presented to the respondents varied slightly (e.g., Elf Bar was only shown in the 2023 NYTS and Puff Bar was only shown in the 2022 NYTS).

For the current analyses, data from the 2023 and 2022 NYTS were analyzed separately using survey year specific weighting (2, 10), and all analyses were completed using SAS software version 9.4 (12).

For each year of the NYTS, the sample for the analyses included respondents who were past-30-day only brand or usual brand users of Vuse, JUUL, Elf Bar (2023), or Puff Bar (2022) e-cigarettes. These respondents reported ever using an e-cigarette, using an e-cigarette at least one day in the past 30 days, and selected one of these four brands as the only brand used or usual brand used.

The brand of e-cigarette used was based on the question “During the past 30 days, what e-cigarette brands did you use? (**Select one or more**).” Response options included “Vuse”, “JUUL”, “Elf Bar” (2023 NYTS only), and “Puff Bar” (2022 NYTS only), in addition to other brands.<sup>2</sup> If only one brand was selected, that brand was considered a respondent’s only brand used. Those who selected more than one brand were then asked “During the past 30 days, what brand of e-cigarettes did you **usually** use? (**Choose only one answer**)”. If Vuse, JUUL, Elf Bar, or Puff Bar was selected as the only brand used in the first question or the brand usually used in the subsequent question, that brand was considered the respondent’s usual brand.<sup>3</sup> This designation of usual brand is the same as that reported by CHEN-SANKEY *et al.* (13) and GENTZKE *et al.* (14). Write-in responses were allowed and were included in these analyses if respondents wrote in responses that indicated use of Vuse, JUUL, Elf Bar, or Puff Bar.<sup>4</sup>

2

Other response options listed in the 2023 NYTS were blu, Breeze, Esco Bars, Fume, HQD, Kangvape (including Onee Stick), Logic, Mr. Fog, NJOY, SMOK (including NOVO), Suorin (including Air Bar), Some other brand(s) not listed here (specify), and Not sure / I don’t know the brand. Other response options listed in the 2022 NYTS were I did not use a usual brand, blu, Eonsmoke, Leap, Logic Mojo, NJOY, Posh, SMOK (including NOVO), STIG, Suorin, Some other brand(s) not listed here (specify), and Not sure / I don’t know the brand.

3

For a small number of respondents in the 2022 NYTS, the e-cigarette brands selected as being used during the past 30 days did not include the brand they indicated as their usual brand in the subsequent question. These respondents were included in the analyses as usual brand users of the brand they indicated was their usual brand (i.e., 4 respondents for Vuse, 1 respondent for JUUL, and 9 respondents for Puff Bar).

4

Based on write-in responses to the 2022 NYTS, 4 respondents self-identified as past-30-day users of Vuse, none self-identified as past-30-day users of JUUL, and 2 self-identified as past-30-day users of Puff Bar. Based on write-in responses to the 2023 NYTS, no additional users of Vuse, JUUL, or Elf Bar were identified.

### Only brand users

Initial analyses were conducted to assess the consistency of reporting among respondents who reported only using one brand of e-cigarette during the past 30 days and their responses regarding device type used most often and flavor(s) used during the past 30 days. E-cigarette device type was assessed with the question “Which of the following best describes the type of e-cigarette you have used in the past 30 days? **If you have used more than one type, please think about the one you use most often.**” Response options included “A disposable e-cigarette (for example, Elf Bar, or Kangvape)”, “An e-cigarette that uses pre-filled or refillable pods or cartridges (for example, JUUL, Vuse, or Suorin)”, “An e-cigarette with a tank that you refill with liquids (including mod systems that can be customized by the user)”, and “I don’t know the type”.

Vuse and JUUL are e-cigarettes that use pre-filled pods or cartridges; thus, respondents who reported that their only brand used during the past 30 days was Vuse or JUUL and reported that the device type they used most often was an e-cigarette that uses pre-filled or refillable pods or cartridges were assessed as providing a consistent response with regard to their current e-cigarette use. Similarly, respondents who reported Elf Bar or Puff Bar, which are disposable e-cigarettes, as their only brand of e-cigarette used during the past 30 days were assessed as providing a consistent response if they reported using a disposable e-cigarette as the device type used most often.

Respondents in the 2023 NYTS who reported using only one brand of e-cigarette during the past 30 days were also asked to identify all of the e-cigarette flavors used during that period. E-cigarette flavor use was assessed with the question “In the past 30 days when you used e-cigarettes, what flavors did you use? (**Select one or more**).” Response options were “tobacco-flavor”, “menthol”, “mint”, “spice (such as cinnamon, vanilla, or clove)”, “fruit”, “chocolate”, “alcoholic drinks (such as wine, margarita, or other cocktails)”, “non-alcoholic drink (such as coffee, soda, lemonade, or other beverage)”, “candy, desserts, or other sweets”, “unflavored”, and “some other flavor not listed here”. Respondents who were using some other flavor not listed could provide write-in responses, but none of these respondents indicated use of menthol or tobacco flavored products.

For the 2022 NYTS, e-cigarette flavor use was assessed generally with the question “Were any of the e-cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove or spice, alcoholic drinks, candy, fruit, chocolate, or any other flavor?” Response options were “yes”, “no”, and “don’t know”. Those who responded “no” to the question were considered to be unflavored e-cigarette users, which, for these analyses, was considered ‘tobacco-flavor’ as there was no such option in the list of flavors for the 2022 NYTS. Those who responded “yes” to the question were then asked “What flavors were the e-cigarettes that you have used in the **past 30 days**? (**Select one or more**).” Response options were “menthol”, “mint”, “clove or spice”, “fruit”, “chocolate”, “alcoholic drinks (such as wine, margarita, or other cocktails)”, “candy, desserts, or other sweets”, and “some other flavor not listed here”. Respondents who indicated they used some other

flavor not listed could provide write-in responses. Two respondents indicated they used “tobacco” flavored products, but both reported using multiple brands and both reported using menthol flavored products.

The only flavors available for Vuse and JUUL during the survey years of 2023 and 2022 were ‘tobacco-flavor’ and ‘menthol’. Respondents in the 2023 NYTS who reported only using Vuse or JUUL and reported using only ‘tobacco-flavor’, only ‘menthol’, or only ‘tobacco-flavor’ and ‘menthol’ during the past 30 days were assessed as providing responses that were consistent with the use of those products. Respondents to the 2022 NYTS who reported only using Vuse or JUUL and reported using only ‘tobacco-flavor’ (i.e., answered “no” to the flavor question) or only ‘menthol’ during the past 30 days were assessed as providing responses that were consistent with the use of those products.

This flavor assessment was not conducted for respondents who reported Elf Bar or Puff Bar as their only brand of e-cigarette used during the past 30 days, based on the considerable number of flavors available for these brands and the lack of certainty regarding which flavors were available during the survey periods. Thus, for Elf Bar and Puff Bar, only e-cigarette device type was considered when assessing the consistency of reporting for brand of e-cigarette used.

#### *Usual brand users*

For those respondents who reported use of more than one e-cigarette brand in the past 30 days, analyses assessed consistency between respondents’ reported brand of e-cigarette usually used (i.e., usual brand) and responses regarding device type used most often and flavors used during the past 30 days. Respondents who reported either Vuse or JUUL as their usual brand were assessed as providing consistent responses if they reported that the device type used most often was an e-cigarette that uses pre-filled or refillable pods or cartridges. Similarly, respondents who reported their usual brand of e-cigarette used was Elf Bar or Puff Bar were assessed as providing consistent responses if they reported the device type used most often was a disposable e-cigarette.

Respondents who reported a usual brand of e-cigarette used during the past 30 days were asked to identify all e-cigarette flavors used during that period. Since the question used to assess flavor use in the NYTS does not ask about flavors used for a specific brand, it is not possible to assign a usual flavor to a respondent’s usual brand as can be done when only one brand is reported. Thus, respondents in the 2023 NYTS who reported either Vuse or JUUL as their usual brand used during the past 30 days were assessed as providing responses that were consistent with the use of those products if they reported using either ‘tobacco-flavor’ (with or without other flavors) or ‘menthol’ (with or without other flavors). Respondents in the 2022 NYTS who reported that their e-cigarettes were ‘tobacco-flavor’ (i.e., answered “no” to the flavor question) or ‘menthol’ (with or without other flavors) during the past 30 days were assessed as providing responses that were consistent with the use of those products.

The flavor assessment was not conducted for respondents

who reported Elf Bar or Puff Bar as their usual brand of e-cigarette used during the past 30 days, based on the considerable number of flavors available for these brands and the lack of certainty regarding which flavors were available during the survey periods.

## RESULTS

Findings from analyses of the 2023 NYTS data examining the consistency between past-30-day e-cigarette users’ reported only brand or usual brand used - specifically, Vuse, JUUL, or Elf Bar - and the device type used most often and flavors used during the past 30 days are presented in Table 1. Among all middle and high school students (N = 21,718, excluding 351 with missing data), 333 respondents (1.5% of all youth [all proportions weighted]) reported any past-30-day use of Vuse e-cigarettes, 237 respondents (1.2% of all youth) reported any past-30-day use of JUUL e-cigarettes, and 839 respondents (4.2% of all youth) reported any past-30-day use of Elf Bar e-cigarettes. Focusing on middle and high school students’ only brand or usual brand used in the past-30-days (Table 1), 134 respondents (0.6% of all youth) reported using Vuse as their only or usual brand, 42 respondents (0.3% of all youth) reported using JUUL as their only or usual brand, and 478 respondents (2.3% of all youth) reported using Elf Bar as their only or usual brand.

Assessing the consistency of responses between brand and device type among past-30-day Vuse e-cigarette users (only brand or usual brand users, n = 134) shows that 96 respondents (58.4% of Vuse brand users; 0.4% of all youth) reported a device type consistent with that brand (i.e., an e-cigarette that uses pre-filled or refillable pods or cartridges) (Table 1). Among those reporting past-30-day use of JUUL e-cigarettes (only brand or usual brand users, n = 42), 21 respondents (57.1% of JUUL users; 0.1% of all youth) reported a device type consistent with that brand (i.e., an e-cigarette that uses pre-filled or refillable pods or cartridges). Among those reporting past-30-day use of Elf Bar (only brand or usual brand users, n = 478), 392 respondents (85.4% of Elf Bar users; 2.0% of all youth) reported a device type consistent with that brand (i.e., a disposable e-cigarette).

Consistency of responses between past-30-day e-cigarette users’ reported only brand or usual brand used and all flavors used during that period was assessed among respondents who provided consistent responses for their device type. Table 1 shows that 84 respondents who reported past-30-day use of Vuse e-cigarettes (as their only brand or usual brand) and provided a consistent response for the device type they used most often also reported flavor(s) used in the past 30 days that were consistent with the use of Vuse e-cigarettes (i.e., ‘tobacco-flavor’ and/or ‘menthol’). Thus, 45.6% of only brand and usual brand past-30-day Vuse e-cigarette users provided consistent responses for both device type and flavors used, representing 0.3% of all youth.

For respondents who reported past-30-day use of JUUL e-cigarettes (as their only brand or usual brand) and a consistent response for device type, 3 respondents (1.4% of only one brand and usual brand JUUL users; 0.1% of all

**Table 1. Consistency of reporting among past-30-day users of Vuse, JUUL, or Elf Bar e-cigarettes: 2023 NYTS.**

| Product                             | Unweighted number of respondents (weighted) | Unweighted number reporting product use (weighted) | Weighted proportions    |                               |
|-------------------------------------|---------------------------------------------|----------------------------------------------------|-------------------------|-------------------------------|
|                                     |                                             |                                                    | Among all youth         | Among only/ Usual brand users |
| <i>Vuse</i>                         |                                             |                                                    | N = 21,718 <sup>a</sup> | n = 134                       |
| Any past-30-day use                 | 21,718 <sup>a</sup><br>(27,730,794)         | 333<br>(426,682)                                   | 1.5%                    | —                             |
| Only/usual brand <sup>b</sup>       | 21,713<br>(27,724,972)                      | 134<br>(178,544)                                   | 0.6%                    | —                             |
| Consistent device type <sup>c</sup> | 21,713<br>(27,724,972)                      | 96<br>(104,235)                                    | 0.4%                    | 58.4%                         |
| Consistent flavor <sup>d</sup>      | 21,713<br>(27,724,972)                      | 84<br>(81,400)                                     | 0.3%                    | 45.6%                         |
| <i>JUUL</i>                         |                                             |                                                    | N = 21,718 <sup>a</sup> | n = 42                        |
| Any past-30-day use                 | 21,718 <sup>a</sup><br>(27,730,794)         | 237<br>(339,495)                                   | 1.2%                    | —                             |
| Only/usual brand <sup>b</sup>       | 21,713<br>(27,724,972)                      | 42<br>(70,127)                                     | 0.3%                    | —                             |
| Consistent device type <sup>c</sup> | 21,713<br>(27,724,972)                      | 21<br>(40,020)                                     | 0.1%                    | 57.1%                         |
| Consistent flavor <sup>d</sup>      | 21,713<br>(27,724,972)                      | 3<br>(1,007)                                       | < 0.1%                  | 1.4%                          |
| <i>Elf Bar</i>                      |                                             |                                                    | N = 21,718 <sup>a</sup> | n = 478                       |
| Any past-30-day use                 | 21,718 <sup>a</sup><br>(27,730,794)         | 839<br>(1,166,757)                                 | 4.2%                    | —                             |
| Only/usual brand <sup>b</sup>       | 21,713<br>(27,724,972)                      | 478<br>(637,285)                                   | 2.3%                    | —                             |
| Consistent device type <sup>c</sup> | 21,713<br>(27,724,972)                      | 392<br>(544,539)                                   | 2.0%                    | 85.4%                         |
| Consistent flavor                   | N/A <sup>e</sup>                            | N/A <sup>e</sup>                                   | N/A <sup>e</sup>        | N/A <sup>e</sup>              |

Proportions are weighted estimates based on the total number of respondents providing valid data. Data for the 2022 NYTS are shown in [Table S1 in the Supplemental Material](#).

<sup>a</sup> Respondents with missing data on e-cigarette use (n = 351) were excluded from the analyses.

<sup>b</sup> Respondents with missing data on only or usual brand (n = 5) were excluded from the analyses.

<sup>c</sup> Consistent device type for Vuse and JUUL is an e-cigarette that uses pre-filled or refillable pods or cartridges; consistent device type for Elf Bar is a disposable e-cigarette.

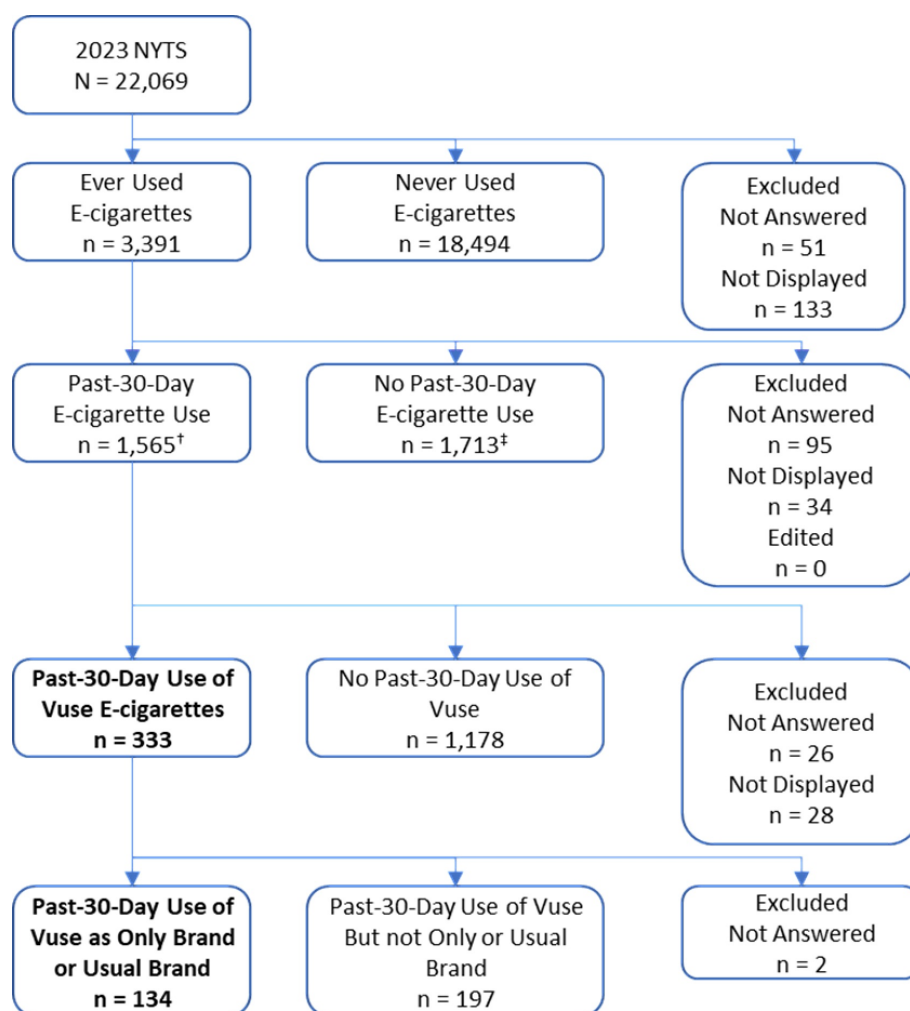
<sup>d</sup> Consistent flavors for Vuse and JUUL e-cigarettes are ‘tobacco-flavor’ and/or ‘menthol’.

<sup>e</sup> Due to uncertainty regarding the flavors available for Elf Bar e-cigarettes, reporting consistency was not assessed for flavors.

youth) also reported flavor(s) used in the past 30 days that were consistent with the use of JUUL e-cigarettes (i.e., ‘tobacco-flavor’ and/or ‘menthol’) (Table 1). Flavor analyses were not conducted for past-30-day users of Elf Bar e-cigarettes due to the considerable number of flavors available for this brand and the lack of certainty regarding which flavors were available during the survey periods.

The analytic approach used to assess consistency of responses among past-30-day Vuse e-cigarette users (only brand or usual brand users) regarding device type used most often and flavors used during the past 30 days, as well as an accounting of all respondents is shown in Figures 1a and 1b. The same approach was used for past-30-day JUUL e-cigarette users (only brand or usual brand users), and a modified approach was used for past-30-day Elf Bar e-cigarette users. See [Supplemental Material](#) for JUUL [Figures S1a and S1b] and Elf Bar [Figures S2a and S2b] e-cigarette users. All middle and high school students who participated in the 2023 NYTS (N = 22,069) were accounted for in these analyses.

In the 2022 NYTS, 627 respondents reported any past-30-day use of Vuse e-cigarettes (2.2% of all youth), with 342 respondents (1.1% of all youth) reporting Vuse e-cigarettes as their only or usual brand. For these 342 only or usual brand users, 177 respondents (0.5% of all youth) provided responses for device type used most often and flavors used during the past 30 days that were consistent with the use of Vuse e-cigarettes. A total of 542 respondents (2.0% of all youth) reported any past-30-day use of JUUL e-cigarettes, with 130 respondents (0.5% of all youth) reporting JUUL e-cigarettes as their only or usual brand. For these 130 only or usual brand users, 23 respondents (0.2% of all youth) provided responses for device type used most often and flavors used during the past 30 days that were consistent with the use of JUUL e-cigarettes. Lastly, 874 respondents (2.8% of all youth) reported any past-30-day use of Puff Bar e-cigarettes, with 444 respondents (1.3% of all youth) reporting Puff Bar e-cigarettes as their only or usual brand. For the 444 only or usual brand users, 354 respondents



† Four of the 51 respondents did not answer the question on 'ever use' but did report on using an e-cigarette in the past 30 days. Those respondents are included for "Past 30-Day E-cigarette Use".

‡ 12 of the 51 respondents did not answer the question on 'ever use' but reported no e-cigarette use in the past 30 days. Those respondents are included for "No Past 30-Day E-cigarette Use".

Data "missingness" was categorized in the NYTS methodology report into one of four types: as a legitimate skip based on programmed logic, as item-level refusal if a question was presented to a respondent on screen but not answered, as not answered because the respondent was never shown a question on screen (e.g., partial complete), or as recoded to missing due to edit checks (Edited).

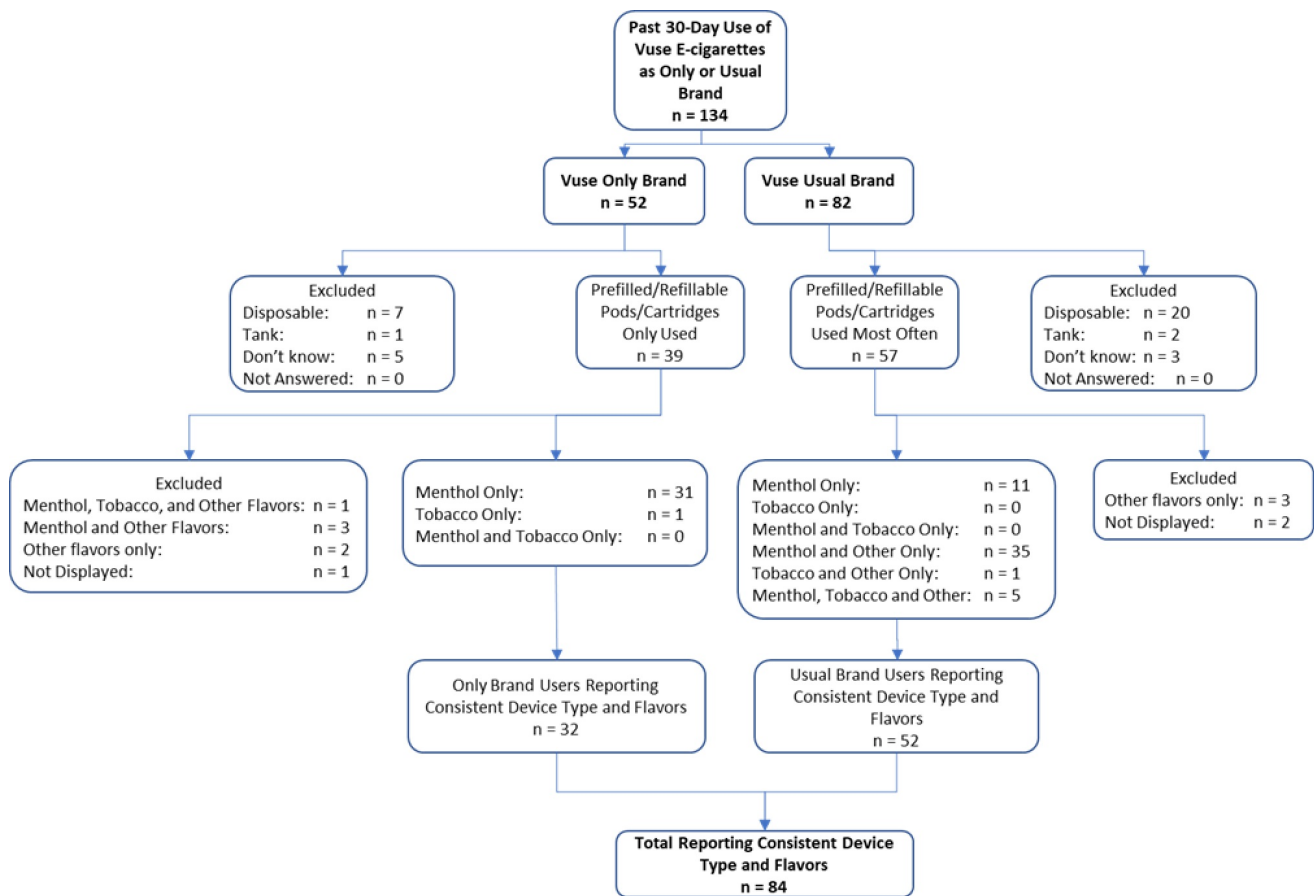
**Figure 1a. Analytic approach for assessing consistency of reporting for past-30-day Vuse e-cigarette users: 2023 NYTS.**

(1.1% of all youth) provided responses for device type used most often that were consistent with the use of Puff Bar e-cigarettes (flavors could not be validly assessed). See [Supplemental Material \(Table S1, Figures S3a, S3b, S4a, S4b, S5a, and S5b\)](#) for results based on the 2022 NYTS data.

## DISCUSSION

Evidence from the 2023 NYTS clearly shows that merely presenting youth self-reported data on past-30-day e-cigarette use by only brand and usual brand without further examining whether those data are consistent with other reported data, such as device type used most often and flavors used during the past 30 days, substantially overestimates youth e-cigarette brand prevalence. Data from the 2023 NYTS suggest that 1.5% of all youth

(426,682 youth) reported any past-30-day use of Vuse e-cigarettes and that 0.6% of all youth (178,544 youth) reported using Vuse e-cigarettes as their only brand or usual brand; these weighted estimates are consistent with the weighted (and rounded) estimates of 420,000 and 170,000 youth, respectively, reported by the FDA and CDC (1). Applying a straightforward data quality assessment - in this case, assessing the consistency of responses for device type used most often and flavors used during the past 30 days with the reported only brand or usual brand - reduces the estimate of Vuse e-cigarette users to 0.3% of all youth (81,400 youth). For analyses that assessed consistency based only on flavors used during the past 30 days, the estimate of Vuse e-cigarette users is reduced to 0.5% of all youth (142,669 youth). These estimates are far lower than those reported by the FDA and CDC. It is also noteworthy that 41.6% of only brand or usual brand users of Vuse e-cigarettes did not provide responses for the device type



**Figure 1b. Analytic approach for assessing consistency of reporting for past-30-day Vuse e-cigarette users: 2023 NYTS.**

they used most often that were consistent with the use of a Vuse e-cigarette, despite Vuse being listed as an example of a pre-filled or refillable pod or cartridge e-cigarette in the 2023 NYTS questionnaire.

The reporting of JUUL e-cigarette use among youth showed an even larger discrepancy, with 1.2% of all youth (339,495 youth; similar to the 330,000 reported by the FDA and CDC (1)) reporting any past-30-day use of JUUL e-cigarettes and 0.3% of all youth (70,127 youth) reporting JUUL e-cigarettes as their only brand or usual brand. Again, applying a straightforward data quality assessment shows that only < 0.1% of all youth (1,007 youth) who reported JUUL e-cigarettes as their only brand or usual brand provided responses for device type used most often and flavors used during the past 30 days that were consistent with the use of JUUL e-cigarettes. Nearly 43.0% of only brand or usual brand users of JUUL e-cigarettes did not provide consistent responses for the device type they used most often, despite JUUL being listed as an example of a pre-filled or refillable pod or cartridge e-cigarette in the NYTS questionnaire. Similarly, 14.6% of only brand or usual brand Elf Bar e-cigarette users did not provide consistent responses for device type used most often, despite Elf Bar being listed as an example of a disposable e-cigarette in the NYTS questionnaire.

Parallel analyses of data from the 2022 NYTS show that the low levels of consistency in reporting by youth was not

limited to the 2023 NYTS. Findings from analyses of the 2022 NYTS data show that over half (55.7%) of those who reported Vuse e-cigarettes as their only brand or usual brand and more than two-thirds (67.2%) of those reporting JUUL e-cigarettes as their only brand or usual brand provided responses for device type used most often and flavors used during the past 30 days that were not consistent with the use of those respective brands. Thus, the evidence suggests that inconsistent reporting of tobacco use behaviors by youth - at a minimum, those youth participating in the NYTS - is common.

These results expand upon those from a recent study that reported inconsistencies between self-reported brand and device type among youth e-cigarette users in the 2022 and 2021 NYTS (8). A similar analysis among adults using data from the PATH study that examined the consistency between self-reported e-cigarette device type and actual device type also found inconsistencies (9), suggesting that inconsistent reporting of e-cigarette brand and device type used is not unique to youth or to the NYTS.

A potential limitation of the current analyses is that they cannot assess consistency of responses among youth who reported any past-30-day use of Vuse, JUUL, Elf Bar, or Puff Bar e-cigarettes but did not report one of those brands as their only brand or usual brand. In addition, the relative standard error for some of the estimates provided in the current analyses exceeded 30%, which is the threshold used

to evaluate their reliability. Nonetheless, the purpose of the analyses was to evaluate the consistency of reporting current e-cigarette use among youth, and this limitation further highlights the need for careful consideration of these data.

Beyond the practical limitations of assessing consistency of responses for these any past-30-day users (due to limitations associated with the questions asked in the NYTS), a more consequential consideration is technical accuracy in data reporting. Respondents in the NYTS who reported any past-30-day use of e-cigarettes were asked to report all brands of e-cigarettes used during that period. For those who reported using only one brand, that brand was considered to be the respondents' usual (only) brand. Those who selected more than one brand were additionally asked to report the one brand that they used most often during the past 30 days. This means that every respondent who reported using e-cigarettes in the past 30 days was required to report a usual brand of e-cigarette (only brand or usual brand used), which allows each respondent to be counted once in the population-based estimates.

Given that an important outcome measure from these analyses was weighted estimates (proportions) for all youth, analyses that include respondents who report any past-30-day use of a product but do not report only or usual use of that product artificially increases the total number of youth reporting past-30-day use of e-cigarettes. For example, estimates provided by the FDA and CDC (1) suggested that an estimated 2.13 million youth reported using e-cigarettes during the past 30 days in 2023, but the estimated number of users based on use by brand was more than twice that number, or 4.87 million youth, due to a considerable number of youth who reported using more than one e-cigarette brand. Thus, for technical accuracy, each respondent should only be counted once when reporting estimates of e-cigarette brand prevalence (including by the FDA) and when using such estimates during regulatory decision-making.

Over-estimating the number of youth who report using a particular e-cigarette brand has significant regulatory implications, including for the FDA's pre-market review of e-cigarette applications. The TCA requires that the FDA assess new tobacco products, including e-cigarettes, based on risks and benefits to the population as a whole. Currently, the FDA requires that product-specific data be included in an application requesting marketing authorization for an e-cigarette, including data for each flavor of an e-cigarette, to demonstrate a benefit (i.e., reduced cigarette consumption among adult smokers) that more than offsets any potential harms that may occur with youth e-cigarette use. The FDA also requires evidence of an increased population benefit for non-tobacco flavored e-cigarettes above the benefit shown for tobacco-flavored e-cigarettes.

To date, the FDA's assessment of the risks likely to be associated with youth use of e-cigarettes has been based on brand-specific and, in some instances, category-specific estimates of flavored e-cigarette use from the NYTS. From a regulatory perspective, these estimates are used by the FDA as the threshold of risk that must be more than offset by a product(s) in order to receive marketing authorization. Thus, this regulatory threshold must be based on complete

and accurate analyses of data on youth e-cigarette brand use, which have not been conducted in recent published reports (1, 11, 15).

The FDA is required by the TCA to assess the risks and benefits of e-cigarette use at the population level and, for that reason, has requested that those seeking marketing authorization provide population-level data to assist with its review. It is noteworthy that for FDA's most recent denials of marketing authorization for e-cigarettes, the agency has specifically mentioned the NYTS data in its press releases (4–6), citing to rates of any past 30-day use of the products among youth e-cigarette users (not the population rates among all youth). It is unclear why the FDA does not conduct analyses similar to those presented here, to adjust its estimates based on consistency of reporting.

Even without adjusting prevalence estimates for consistency in reporting, self-reported past-30-day use by youth is low for Vuse (1.5% of all youth, or 0.43 million) and JUUL (1.2% of all youth, or 0.34 million) e-cigarettes. The analyses presented herein clearly show that, after adjusting these prevalence estimates based on respondents who provided responses for device type used most often and flavors used during the past 30 days that were consistent with the use of those e-cigarettes, the population-level use estimates are even lower for Vuse (0.3% of all youth, or 0.08 million) and JUUL (< 0.1% of all youth, or 0.001 million) e-cigarettes.

These estimates of e-cigarette brand prevalence at the population level, as a proportion of all youth, raises an important question regarding the level of youth e-cigarette use that would be sufficiently low during the FDA's risk assessment to permit the marketing authorization of an e-cigarette product. Perhaps the answer to that question is self-evident, as the FDA has denied marketing authorization for the vast majority of e-cigarette product applications it has reviewed, granting marketing authorization for just 34 e-cigarette products and devices (16) and only one non-tobacco flavored product.

Given the clear weight that the FDA places on brand-specific prevalence estimates in its assessment of whether to grant marketing authorization for an e-cigarette product, and the high level of inconsistent reporting of youth e-cigarette use in the NYTS data, the structure of the NYTS should be modified so that each identified brand is assessed separately for device type and flavors associated with that specific brand. Additionally, as suggested by other researchers (8, 9), the inclusion of images of e-cigarette products in the NYTS would serve to improve reporting accuracy. In the absence of changes to the NYTS questionnaire, the FDA's sole reliance on data from that survey for prevalence estimates of youth e-cigarette use during its regulatory decision-making cannot be justified.

## CONCLUSIONS

These analyses of the 2022 and 2023 NYTS data demonstrate that a sizable proportion of youth who reported an e-cigarette brand as their only or usual brand used provided information on the device type or flavors used that were not consistent with the use of that brand of e-cigarette. Estimating the population prevalence of use based on only

those youth reporting consistent data demonstrates that very small proportions provided responses that suggest they used the brand reported: Vuse (2023: 0.3%; 2022: 0.5%), JUUL (2023: < 0.1%; 2022: 0.2%), Elf Bar (2023: 2.0%), and PuffBar (2022: 1.1%). The implications for this lack of consistency reach into the regulatory decision-making process in the U.S., as the FDA employs these data as part of its assessment of the population-level risk of e-cigarettes. A more rigorous assessment of these survey data is warranted for regulatory decisions.

## SUPPLEMENTARY INFORMATION

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## AUTHOR CONTRIBUTIONS

JMR conducted all the analyses and drafted the methods section. KKG wrote the initial draft of the manuscript. All authors contributed equally to the final version.

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## CONFLICTS OF INTEREST

The authors provide regulatory consulting services to Reynolds American Inc. The findings reported are the work of the authors only, and Reynolds American had no input to the decision to conduct the analyses, the interpretation of the data, nor the decision to report the findings.

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