Public health impact of a US menthol cigarette ban on the non-Hispanic black population: a simulation study

Mona Issabakhsh, 1 Rafael Meza, 2 Yameng Li, 1, Zhe Yuan, 1 Luz Maria Sanchez-Romero, 1, David T Levy 1, 1

ABSTRACT

Introduction With the US Food and Drug Administration recently proposing to implement a ban on menthol cigarettes, it is critical to estimate the potential public health effects of such a ban. With high rates of menthol cigarette use and important smoking-related health disparity implications, the impact of the ban on the non-Hispanic black (NHB) population merits strong consideration.

Methods We apply the previously developed Menthol Smoking and Vaping Model to the NHB population. A status quo scenario is developed using NHB-specific population, smoking and vaping initiation, cessation and death rates. Estimates from a recent expert elicitation on behavioural impacts of a menthol cigarette ban on the NHB population are used to develop a menthol ban scenario implemented in 2021. The public health impacts of the menthol ban are estimated as the difference between smoking and vaping attributable deaths (SVADs) and life years lost (LYLs) in the status quo and the menthol ban scenarios from 2021 to 2060.

Results Under the menthol ban scenario, overall smoking is projected to decline by 35.7% in 2026 and by 25.3% in 2060 relative to the status quo scenario. With these reductions, SVADs are estimated to fall by about 18.5% and LYLs by 22.1%, translating to 255 895 premature deaths averted, and 4.0 million life years gained over a 40-year period.

Conclusions A menthol cigarette ban will substantially reduce the smoking-associated health impact on the NHB population, thereby reducing health disparities.

INTRODUCTION

Menthol represents 3.5% of US cigarette sales, 1 and menthol smoking is associated with higher smoking initiation and lower cessation. 2–5 The US Food and Drug Administration (FDA) has proposed a nationwide ban on menthol cigarettes 6 but will be required to assess its potential public health impact. 7 8

The Menthol Smoking and Vaping Model (SAVM) estimated the public health impact of a menthol ban on the total US population. 9 10 The recent FDA menthol ban proposal 6 cited public health impact projections from the original menthol SAVM model 10 in support of banning menthol in cigarettes. On page 93, however, the report noted that failure to separately consider ‘vulnerable populations’, particularly the non-Hispanic black (NHB) population, was a limitation of the analysis. Policy simulation models often lack analyses for specific subpopulations of interest.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ A ban on menthol in cigarettes has been shown to reduce smoking rates and smoking-attributable deaths for the overall population, but less is known about the impact of menthol ban on non-Hispanic blacks. This study evaluates the public health impact of a menthol ban on the non-Hispanic black population.

WHAT THIS STUDY ADDS

⇒ We show that, with a ban on menthol in cigarettes implemented in 2021, non-Hispanic black adult smoking and vaping attributable deaths are estimated to fall by about 18.5% and years of life lost by 22.1% by 2060, translating to 255 895 premature deaths averted, and 4.0 million life years gained over a 40-year period.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE AND/OR POLICY

⇒ Our findings support the implementation of a ban on menthol in cigarettes, resulting simultaneously in considerable health gains and in reductions in health disparities between the non-Hispanic black and the rest of the US population.

Due to their high rates of menthol cigarette use, 11–13 and important smoking-related health disparity implications, 14 15 we apply the previously developed Menthol SAVM 10 to evaluate the impact of a menthol cigarette ban on the NHB population. We apply NHB-specific population and menthol and non-menthol smoking and nicotine vaping product (NVP) data, develop NHB-specific initiation, cessation and switching rates relative to the total population, and calibrate and validate the model to recent trends in NHB smoking prevalence. We then discuss the impacts of a menthol ban on smoking and mortality outcomes for the NHB population and their implications for racial disparities in mortality rates.

METHODS

The SAVM is a publicly available model 16 that simulates the public health impact of cigarette and NVP use. 17 On distinguishing menthol and non-menthol cigarette use, menthol SAVM 10 projects averted deaths and life years lost (LYLs) from 2013 to 2060...
under status quo and menthol ban scenarios. Further model details can be found elsewhere.10

Status quo scenario
The NHB observed and projected population and overall mortality rate by single year, age and sex were obtained from CDC Wonder18 19 and the US Census Bureau.20 21

To initialise the model, menthol and non-menthol NHB smoking prevalence by age and sex are from the 2013/2014 Population Assessment of Tobacco and Health survey.22 Current smoking is defined as having smoked ≥100 cigarettes during one’s lifetime and currently smoking at least some days, with menthol smoking defined as the regular brand flavoured to taste like menthol. Smokers become former smokers after having quit for 2 years, thereby reflecting cessation net of relapse. Regular NVP use is defined in terms of at least 10 days use in the last month.

SAVM37 projects never, current and former smoking prevalence using age-specific sex-specific initiation and cessation rates estimated by applying an age-period–cohort model to the National Health Interview Survey (NHIS).23–26 Using prevalence estimates from the 2014/2015 Tobacco Use Supplement to the Current Population Survey to calibrate to NHBC smoking initiation, we scaled US cigarette initiation rates by 0.91, calculated as the ratio of NHB ages 18–34 years to total US ages 18–34 years smoking prevalence. To calibrate NHBC smoking cessation, we scaled US cessation rates by 0.81, calculated as the ratio of the total US ages 35+ years to NHB ages 35+ years smoking prevalence.

To distinguish menthol and non-menthol smoking initiation, the proportion of menthol smokers among NHB smokers at age 30 years (males 87.8%; females 86.3%), the age at which menthol and non-menthol prevalence rates tended to stabilise, was applied to smoking initiation rates at each age. To distinguish NHB menthol versus non-menthol cessation rates, we applied results of a meta-analysis,27 which reported that NHB menthol smokers had 12% lower odds of cessation than non-menthol smokers. Similar results were reported by Brouwer et al.28

To determine gender-specific and age-specific NHB death rates by smoking status for each year, the ratio of NHB to total US population death rates19 22 was applied to US never, current and former smoker death rates.23 24 29 Mortality rates of menthol and non-menthol smokers are not distinguished, given limited evidence of differences.30 31 To estimate life expectancy for NHB never smokers, the ratio of 2016 NHB life expectancy32 to 2016 US life expectancy33 was applied to the US never smokers life expectancy by age and gender for 2013–2060.23 24 29

Transitions to NVP use start in 2013. Recent studies27 34–37 report lower rates of NVP use among NHB adults than the total adult population. Based on the results from Usidame et al.,37 we scaled US NVP prevalence by 70% for the NHB population. Based on lower transition rates from cigarette use to exclusive NVP use among NHB menthol and non-menthol smokers (0.3% and 0.6%) reported by Brouwer et al.,28 we estimated that NHB menthol smokers switch from smoking to vaping at 50% of the rate of non-menthol smokers.

Menthol ban scenario
We model a federal menthol cigarette ban implemented in 2021. Although the FDA just recently proposed a menthol ban on cigarettes,6 we consider 2021 as the ban implementation date for 2 years, thereby reflecting cessation net of relapse. Regular NVP use is defined in terms of at least 10 days use in the last month.

To estimate life expectancy for NHB and former smoker death rates.23 24 29 Mortality rates of menthol smokers (0.3% and 0.6%) reported by Brouwer et al.,28 we estimated that NHB menthol smokers switch from smoking to vaping at 50% of the rate of non-menthol smokers.

Total US10 and this (NHB) menthol SAVM model. An expert elicitation on the impact of a menthol ban6 found that, of the NHB population who would otherwise initiate into menthol smoking in the absence of a ban, 34.0% would instead become non-menthol smokers, 2.9% illicit menthol smokers, 14.1% NVP users and 49.0% would not use cigarettes or NVPs. These transitions are applied in the model to the initiation rates of otherwise NHB menthol smokers in 2021 and all future years. Among current NHB menthol smokers ages 18–24 years, experts expected 9.4% to switch to illicit menthol combustibles, 43.7% to non-menthol combustibles, 23.4% to NVPs and 23.4% to quit all product use.3 These transitions are applied to those who were current NHB menthol smokers through age 30 years in 2021. Among NHB menthol smokers ages 35–54 years, experts expected 8.7% to switch to illicit menthol combustibles, 50.9% to non-menthol cigarette use, 15.3% to NVPs and 25.1% to quit all product use.3 These transitions are applied to age 30+ years current NHB menthol smokers in 2021. Current non-menthol smokers are unaffected except for those menthol smokers who switch to non-menthol use.

Outcomes
We estimate the public health impact of a menthol ban as the differences in smoking and vaping attributable deaths (SVADs) and LYLs in the status quo and menthol ban scenarios over 2021–2060. Smoking-attributable deaths are estimated as the excess mortality risk for current and former smokers multiplied by their respective populations. Vaping-attributable deaths are estimated assuming 15% of excess smoking risks.3 38 Total LYLs are estimated by the number of SVADs multiplied by the expected years of life remaining of a never smoker.

Validation
We validated the preban NHB smoking prevalence model projections against NHIS estimates from Mattingly et al.40 The model projected that overall smoking prevalence would decline by 21% in relative terms among NHB adult smokers during the first 5 years (2013–2018), which is consistent with the 20% decline in 2010–2015 reported by Mattingly et al.40 Our projected decline of 19% in the menthol smoking rate is also consistent with the menthol smoking decline obtained by Mattingly et al.40 Our projected menthol smoking prevalence trends are also roughly consistent with those of Weinberger et al41 reported for ages 12 years and above using the 2012–2016 National Survey on Drug Use and Health.

RESULTS
Table 1 shows menthol and non-menthol smoking and NVP prevalence, SVADs and LYLs for NHB adults (ages >18 years). Under the status quo, NHB menthol smoking prevalence declines from 12.1% in 2021 to 9.9% in 2026 and 4.4% in 2060, while non-menthol smoking prevalence declines from 2.2% in 2021 to 1.6% in 2026 and 0.6% in 2060. The rapid decline in smoking prevalence reflects the lower levels of smoking initiation and higher levels of smoking cessation in recent years. A recent paper42 also notes dramatic reductions in adolescent menthol and non-menthol smoking rates, especially among the NHB population. Cumulative SVADs from 2021 to 2060 of 1 386 457 translate to 17 887 742 LYLs.

Under the menthol ban, NHB adult menthol smoking prevalence declines from 12.1% in 2021 to 0.7% in 2026 and 0.2% in 2060, while non-menthol smoking prevalence increases from 2.2% in 2021 to 6.7% in 2026 and declines to 3.6% in 2060. Cumulative SVADs of 1 130 563 translate to 13 931 273 LYLs. Comparing the
status quo and menthol ban scenarios, the model projects 255,895 SVADs and 3,956,469 LYLs averted from 2021 to 2060.

**DISCUSSION**

A menthol cigarette ban implemented in 2021 would result in relative reductions in overall menthol and non-menthol NHB cigarette use of 35.7% in 2026 and 25.3% in 2060. While NVP and non-menthol cigarette use would increase, 255,895 premature deaths would be averted (an average of almost 6562 per year) and 4.0 million life years gained (almost 101,448 per year) by 2060.

The ban’s impact on the NHB population compares favourably to projections for the overall US population. We estimated that the ban leads to a relative reduction in NHB adult smoking prevalence of 35.7% compared with 14.7% for the USA in 2026 and 25.3% compared with 15.1% for the USA.

---

**Table 1 NHB adult smoking and NVP prevalence, smoking and vaping attributable deaths, life years lost and public health impact, ages 18 years and above, 2021–2060**

<table>
<thead>
<tr>
<th>Status quo scenario</th>
<th>Category</th>
<th>Category/year</th>
<th>2021</th>
<th>2026</th>
<th>2060</th>
<th>Cumulative impact *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevalence</strong></td>
<td>Menthol smoker</td>
<td>12.1%</td>
<td>9.9%</td>
<td>4.4%</td>
<td>−63.5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>2.2%</td>
<td>1.6%</td>
<td>0.6%</td>
<td>−74.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total smokers</td>
<td>14.4%</td>
<td>11.5%</td>
<td>5.0%</td>
<td>−65.2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>10.5%</td>
<td>10.5%</td>
<td>5.5%</td>
<td>−48.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>3.3%</td>
<td>4.4%</td>
<td>6.3%</td>
<td>88.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP user</td>
<td>0.2%</td>
<td>0.4%</td>
<td>3.6%</td>
<td>2013.1%</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking and vaping attributable deaths</strong></td>
<td>Menthol smoker</td>
<td>30,063</td>
<td>27,622</td>
<td>10,153</td>
<td>779,841</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>8238</td>
<td>6255</td>
<td>1180</td>
<td>138,930</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>8437</td>
<td>9745</td>
<td>9091</td>
<td>413,089</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>696</td>
<td>1015</td>
<td>1479</td>
<td>53,062</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP user</td>
<td>0</td>
<td>0</td>
<td>215</td>
<td>1535</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>47,435</td>
<td>44,637</td>
<td>22,117</td>
<td>1,386,457</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Life years lost</strong></td>
<td>Menthol smoker</td>
<td>474,557</td>
<td>418,730</td>
<td>139,225</td>
<td>11,348,726</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>109,873</td>
<td>82,091</td>
<td>16,468</td>
<td>1,839,936</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>83,179</td>
<td>93,507</td>
<td>84,484</td>
<td>3,850,838</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>11,059</td>
<td>15,546</td>
<td>24,267</td>
<td>820,043</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP user</td>
<td>0</td>
<td>0</td>
<td>3420</td>
<td>28,200</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>678,668</td>
<td>609,874</td>
<td>267,865</td>
<td>17,887,742</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Menthol ban scenario</th>
<th>Category</th>
<th>Category/year</th>
<th>2021</th>
<th>2026</th>
<th>2060</th>
<th>Cumulative impact *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevalence</strong></td>
<td>Menthol smoker</td>
<td>12.1%</td>
<td>0.7%</td>
<td>0.2%</td>
<td>−98.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>2.2%</td>
<td>6.7%</td>
<td>3.6%</td>
<td>58.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total smokers</td>
<td>14.4%</td>
<td>7.4%</td>
<td>3.7%</td>
<td>−74.0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>10.5%</td>
<td>12.8%</td>
<td>5.5%</td>
<td>−47.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>3.3%</td>
<td>6.5%</td>
<td>8.1%</td>
<td>143.4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP user</td>
<td>0.2%</td>
<td>0.5%</td>
<td>4.6%</td>
<td>2590.1%</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking and vaping attributable deaths</strong></td>
<td>Menthol smoker</td>
<td>30,063</td>
<td>2442</td>
<td>560</td>
<td>89,509</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>8238</td>
<td>20,663</td>
<td>5479</td>
<td>496,086</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>8437</td>
<td>10,687</td>
<td>9642</td>
<td>451,850</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>696</td>
<td>2213</td>
<td>2085</td>
<td>91,213</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP user</td>
<td>0</td>
<td>0</td>
<td>268</td>
<td>1904</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>47,435</td>
<td>36,006</td>
<td>18,034</td>
<td>1,130,563</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Life years lost</strong></td>
<td>Menthol smoker</td>
<td>474,557</td>
<td>36,249</td>
<td>7580</td>
<td>1,291,542</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-menthol smoker</td>
<td>109,873</td>
<td>298,181</td>
<td>79,258</td>
<td>7,025,456</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former smoker</td>
<td>83,179</td>
<td>105,110</td>
<td>88,381</td>
<td>4,258,908</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusive NVP user</td>
<td>11,059</td>
<td>32,115</td>
<td>32,234</td>
<td>1,325,126</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Former NVP users</td>
<td>0</td>
<td>0</td>
<td>4290</td>
<td>35,242</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>678,668</td>
<td>471,656</td>
<td>211,743</td>
<td>13,931,273</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Public health impact: difference between the status quo and menthol ban scenario† | Relative reduction in prevalence | Menthol smoker | −92.7% | −96.1% | − |
|                                                                                  | Non-menthol smoker | −308.5% | 518.7% | − |
|                                                                                  | Total smokers | −35.7% | −25.3% | − |
|                                                                                  | Total NVP users | 46.0% | 29.4% | − |
| **Gain** | Averted deaths | −8631 | −4083 | 255,895 |
| | Averted life years lost | −138,218 | 56,122 | 3,956,469 |
| | % averted deaths | −19.3% | 18.5% | 18.5% |
| | % averted life years lost | −22.7% | 21.0% | 22.1% |

* The cumulative impact is measured in terms of the relative change from 2021 to 2060 for prevalence rates (ie, (2060–2021)/2021) and the sum of the smoking and vaping attributable deaths or life years lost over the years 2021–2060.
† Total smokers include menthol and non-menthol smokers.
‡ Exclusive NVP users includes exclusive NVP users who initiated from never smokers and who switched from current smokers (former smoker now using NVPs).
§ The number of smoking and vaping attributable deaths and life years lost is rounded to the nearest integer.
¶ The difference between two scenarios includes the comparisons for prevalence in relative terms and for health gains in absolute terms. Relative reduction in prevalence is measured as the relative difference between the status quo scenario and the menthol ban scenario, (ie, (postban – preban)/preban) in year 2026 and 2060; the gain is measured as the increase in the averted deaths and life years lost from the status quo scenario and the menthol ban scenario, and % reduction in gain is calculated as gain/preban.

NHB, non-Hispanic black; NVP, nicotine vaping product.
in 2060.\textsuperscript{10} The reduction in cumulative NHB averted deaths from 2021 to 2060 is 18.5\% compared with 4.6\% for the USA,\textsuperscript{10} with a 22.1\% relative reduction in NHB cumulative LYLs compared with 7.9\% for the USA.\textsuperscript{10} Projected gains in NHB averted deaths and LYLs are approximately 1/3 of those previously developed for the total population,\textsuperscript{10} despite the NHB population disproportionally making up about 13\% of the overall 2021 US population.\textsuperscript{18} 26 Health disparities are commonly measured in terms of the difference in overall mortality rates between subgroups.\textsuperscript{43} 44 Since the 2021 mortality rate for those ages 40–84 years (when smoking-attributable deaths predominantly occur) is 1.33\% for NHB population compared with 1.13\% for the overall population,\textsuperscript{21} the substantially greater per capita reduction in smoking-attributable deaths for the NHB population relative to that of the rest of the population would lead to a reduction in health disparities (see online supplemental appendix 1). Our results are also consistent with earlier modelling results that find disproportionately greater health impacts on the NHB than the general population from a menthol cigarette ban\textsuperscript{45} and past menthol use.\textsuperscript{46} 47

Our findings are dependent on the model structure, parameters and assumptions. We set the excess risk of vaping to 15\% (SVADs averted=255 895, averted LYLs=3 956 469, by 2060). Since this risk level is controversial, we conducted a sensitivity analysis with risks at 5\% (SVADs averted=268 211, averted LYLs=4 152 320, by 2060) and at 40\% (SVADs averted=226 784, averted LYLs=3 484 083, by 2060). While we calibrated the model to smoking and NVP rates, smoking and NVP rates have been subject to recent instability,\textsuperscript{18} including in the NHB population.\textsuperscript{42} The model also does not distinguish the health impact of exclusive menthol cigarette smokers who switch to cigar use as a result of a menthol ban.

In addition to the proposed ban of menthol cigarettes,\textsuperscript{5} the FDA has also proposed a ban of all flavoured cigarettes,\textsuperscript{19} which may not be implemented at the same time as a ban on menthol in cigarettes. For a ban to be effective, especially as it relates to the NHB population, it will be important that it is applied to both menthol cigarettes and flavoured cigars, since little cigars are a close substitute for cigarettes.\textsuperscript{49}–\textsuperscript{51} A ban on flavoured cigarettes would yield additional health gains, especially for the NHB population. We also note that a ban on flavours in NVPs could lead to more smokers quitting and not becoming NVP users but may instead lead to fewer smokers quitting to the extent that NVPs are used to quit smoking menthol cigarettes rather than transitioning to smoking non-menthol cigarettes. A further limitation of the model is that dual users of NVPs and cigarettes are not distinguished from current cigarette users.\textsuperscript{10} In our expert elicitation,\textsuperscript{5} we did not distinguish dual-use due to definition and measurement issues in determining a stable dual-use state and difficulties in distinguishing the likely transitions from that state.\textsuperscript{52} 53 In terms of the potential impacts of a menthol ban on dual use, a menthol ban may lead to menthol smokers transitioning to dual use of non-menthol cigarettes with NVPs, but current dual menthol and NVP users may be more likely than exclusive menthol smokers to transition to exclusive NVP or no use. Finally, the results are also subject to uncertainties regarding the impacts of a menthol ban. The effects of a menthol ban on smoking and vaping initiation and cessation were based on results of an expert elicitation and thus depend on the participating reviewers’ assessments and the process applied in the elicitation.\textsuperscript{a}

In conclusion, our study strongly supports the implementation of a ban on menthol in cigarettes on public health and especially on health equity grounds for the NHB population.

Acknowledgements We would like to thank the Center for the Assessment of Tobacco Regulations (CAtoR) Data Analysis and Dissemination Core for providing data for this work and to members of CAtoR for providing comments on the initial draft.

Contributors MM wrote the first draft, edited later drafts and helped develop the model; RM helped conceive and fund the topic and edited drafts; YL developed the model, helped write the first draft and edited later drafts; ZY developed the model and edited later drafts; LMS-R helped write the first draft and edited future drafts; DTL directed research, conceived the topic, helped write the first draft and edited later drafts.

Funding Research reported in this publication was supported by the National Cancer Institute of the National Institutes of Health (NIH) and Food and Drug Administration (FDA) Center for Tobacco Products (CTP) under Award Number U54CA229974.

Disclaimer The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH or FDA.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs 
Rafael Meza http://orcid.org/0000-0002-1076-5037
Luz Maria Sanchez-Romero http://orcid.org/0000-0001-7951-3965
David T Levy http://orcid.org/0000-0001-5280-3612

REFERENCES

2 Malone RE. It's the 21st century: isn't it past time to ban menthol cigarette sales? Tob Control 2017;26:359–69.
Public health impact of a US ban on menthol cigarettes and cigars: a simulation study. **Tob Control** 2021; doi:10.1136/tobaccocontrol-2021-056604. [Epub ahead of print: 02 Sep 2021].


Hoffman AC. The health effects of menthol cigarettes as compared to non-menthol cigarettes. **Tob Induc Dis** 2011;9 Suppl 1:57.


Baig SA, Giovenco DP. Behavioral heterogeneity among cigarette and e-cigarette dual-users and associations with future tobacco use: findings from the population assessment of tobacco and health study. *Addict Behav* 2020;104:106263.