This study has some limitations. First, multiple hospitalizations for Medicare Advantage beneficiaries might be underreported because the Medicare Provider Analysis and Review file captures approximately 92% of the hospitalizations.[6] Second, our results are not generalizable to persons in assisted living communities with fewer than 25 beds.

Despite its limitations, our study provides a first national look, to our knowledge, at potentially burdensome transitions among assisted living residents at the end of life. Future studies are needed to explain the state variation observed in this study and how it relates to factors such as residents' comorbidities, cultural differences in end-of-life preferences, end-of-life care practices in assisted living, local hospice practice and utilization patterns, and state regulations of residential care settings.

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1. Teno JM, Gozalo P, Trivedi AN, et al. Site of death, place of care, and health care transitions among US Medicare beneficiaries, 2000-2015. *JAMA*. 2018;320(3):264-271. doi:10.1001/jama.2018.8981

2. Thomas KS, Belanger E, Zhang W, Carder P. State variability in assisted living residents' end-of-life care trajectories. *J Am Med Dir Assoc*. 2020;21(3):415-419. doi:10.1016/j.jamda.2019.09.013

3. Gozalo P, Teno JM, Mitchell SL, et al. End-of-life transitions among nursing home residents with cognitive issues. *N Engl J Med*. 2011;365(13):1212-1221. doi:10.1056/NEJMsa1100347

4. Thomas KS, Dosa D, Gozalo PL, et al. A methodology to identify a cohort of Medicare beneficiaries residing in large assisted living facilities using administrative data. *Med Care*. 2018;56(2):e10-e15. doi:10.1097/MLR.0000000000000659

5. Makaroun LK, Teno JM, Freedman VA, Kasper JD, Gozalo P, Mor V. Late transitions and bereaved family member perceptions of quality of end-of-life care. *J Am Geriatr Soc*. 2018;66(9):1730-1736. doi:10.1111/jgs.15455

6. Huckfeldt PJ, Escarce JJ, Rabideau B, Karaca-Mandic P, Sood N. Less intense postacute care, better outcomes for enrollees in Medicare Advantage than those in fee-for-service. *Health Aff (Millwood)*. 2017;36(1):91-100. doi:10.1377/hlthaff.2016.1027

Association of Cigarette Sales With Comprehensive Menthol Flavor Ban in Massachusetts

In April 2021, the US Food and Drug Administration announced its intention to ban menthol flavors from cigarettes and cigars.[1] Before this announcement, Massachusetts was the only state to implement a statewide comprehensive flavor ban on tobacco products in June 2020.[2] Evidence of the effectiveness of comprehensive flavor bans on cigarette sales and smoking remains inconclusive in the US; studies have found decreases in menthol and overall tobacco product sales[3] and no changes in the intensity of smoking[4] after San Francisco's flavor ban. In addition, no study, to our knowledge, has quantified a potential switch to nonflavored tobacco after banning flavored tobacco products. We examined changes in menthol and nonflavored cigarette sales in Massachusetts compared with sales in states without a flavor ban.

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Supplemental content

Methods | In this cohort study, we used Nielsen Retail Scanner Data of sales volume (reported in 4-week cycles) of menthol and nonflavored cigarette brands sold by US-based retailers. Our outcomes were state-level sales per 1000 people of packs of menthol, nonflavored, and all (menthol and nonflavored) cigarettes from January 2017 to July 2021 based on state-level annual population data obtained from the US Census Bureau. For the population data not available in 2021, we used the average population growth rate to calculate the population for each state in 2021. We used a controlled before and after design with difference-in-differences (eMethods in the Supplement) to examine temporal changes in cigarette sales in Massachusetts before (January 2017 to May 2020) and after (June 2020 to July 2021) the comprehensive flavor ban. The temporal changes were then compared with changes in

Table 1. Cigarette Sales and Sociodemographic Characteristics for Massachusetts and Comparison States[a]

	Massachusetts	Comparison states[b]	Mean difference (SE)	*P* value
Price per pack in Feb 2021, $				
Menthol cigarettes, mean (SD)	10.16 (0.28)	6.79 (1.31)	3.36 (0.17)	<.001
Nonflavored cigarettes, mean (SD)	9.87 (0.28)	6.58 (1.36)	3.29 (0.18)	<.001
All (menthol and nonmenthol) cigarettes, mean (SD)	9.94 (0.25)	6.65 (1.34)	3.31 (0.18)	<.001
Sociodemographic characteristics				
Sex, % (SD)				
Male	48.26 (0.99)	48.40 (1.05)	−0.15 (0.14)	.29
Female	51.74 (0.99)	51.60 (1.05)	0.15 (0.14)	.29
Marital status, % (SD)				
Married	49.28 (1.04)	52.24 (2.26)	−2.96 (0.30)	<.001
Unmarried	50.72 (1.04)	47.76 (2.30)	2.96 (0.30)	<.001
Age, % (SD)				
<25 y	28.06 (1.12)	29.70 (2.08)	−1.64 (0.27)	<.001
25-44 y	26.68 (1.08)	24.61 (1.66)	2.07 (0.22)	<.001
45-64 y	27.52 (1.29)	26.85 (1.62)	0.68 (0.21)	.002
≥65 y	17.74 (1.65)	18.84 (2.27)	−1.10 (0.30)	<.001
Race and ethnicity, % (SD)				
Asian	7.20 (0.78)	3.83 (2.73)	3.37 (0.36)	<.001
Black	7.23 (0.97)	13.51 (8.97)	−6.29 (1.17)	<.001
White	82.57 (1.65)	79.24 (8.41)	3.33 (1.10)	.002
Other[c]	3.00 (0.81)	3.41 (2.56)	−0.41 (0.33)	0.22
Educational level, % (SD)				
No high school diploma	10.60 (0.92)	13.87 (2.46)	−3.27 (0.32)	<.001
High school diploma	24.09 (1.50)	29.15 (3.76)	−5.06 (0.49)	<.001
Some college	21.08 (0.91)	26.80 (3.07)	−5.72 (0.40)	<.001
College or higher degree	44.23 (2.18)	30.18 (5.56)	14.05 (0.73)	<.001
Household income, % (SD)				
<$10 000	19.03 (1.77)	19.49 (3.43)	−0.46 (0.46)	.31
$10 000-$29 999	10.12 (1.79)	14.31 (3.72)	−4.19 (0.49)	<.001
$30 000-$59 999	15.69 (1.68)	22.71 (3.14)	−7.02 (0.41)	<.001
$60 000-$149 999	32.71 (1.39)	32.54 (3.76)	0.17 (0.49)	0.73
$150 000+	22.46 (2.33)	10.95 (4.61)	11.51 (0.61)	<.001
Unemployment rate, % (SD)	4.97 (3.14)	4.92 (2.39)	0.05 (0.32)	.87
Mean COVID-19 infection cases per 1000 people (SD)	13.84 (29.31)	14.13 (30.75)	−0.29 (4.07)	.94
Observations, No.	59	1593	NA	NA

Abbreviation: NA, not applicable.

[a] The Nielsen Retail Scanner Data used in the study contains universal product code-level sales of cigarette products reported in dollar and unit volumes at 4-week cycles collected at the point-of-sale from convenience stores, including gas stations, and other channels, such as food or grocery, drug, and mass-market stores.

[b] The eMethods in Supplement contains the full list of states included in the comparison states.

[c] Other included the following races and ethnicities as included in the US Census Bureau Basic Monthly Current Population Survey: American Indian, Alaska Native only, Hawaiian/Pacific Islander only, and multiple races.

the 27 states in Nielsen Retail Scanner Data that did not implement state or local flavor bans, and the analyses were controlled for product prices, state-level time-varying factors, seasonality, and state time-invariant factors. State-level time-varying sociodemographic factors were obtained from the US Census Bureau Basic Monthly Current Population Survey. The study did not directly involve human participants and did not require institutional review board approval or informed consent in accordance with the Common Rule. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

All statistical tests were 2-sided, and $P < .05$ was considered to be statistically significant. Analyses were conducted using Stata, version 15.1 (StataCorp).

Results | We analyzed 1652 four-week sales of cigarette data consisting of 59 observations from Massachusetts (44 from before and 15 from after the menthol flavor ban) and 1593 observations from the comparison states (1188 from before and 405 from after the menthol flavor ban). Mean (SD) cigarette prices per pack were higher in Massachusetts than in comparison states ($9.94 [$0.25] vs $6.65 [$1.34]) (**Table 1**). Individuals in Massachusetts compared with those in the comparison states were less likely to be married (49.28% vs 52.24%) and more likely to be aged 25 to 64 years (54.20% vs 51.49%), Asian (7.20% vs 3.83%) or White (82.57% vs 79.24%) persons, have a college degree (44.23% vs 30.18%), and have a household income of $150 000 or more (22.46% vs 10.95%). There were nondivergent trends in state-level sales of menthol and nonflavored cigarette packs per 1000 people in Massachusetts and comparison states during the period before Massachusetts's comprehensive flavor ban. After the comprehensive flavor ban, the unadjusted 4-week sales of packs of cigarettes per 1000 people decreased in Massachusetts for menthol (404.93 to

Table 2. Four-Week Sales of Packs of Menthol, Nonflavored, and All Cigarettes per 1000 People Before and After Massachusetts' Menthol Flavor Ban

Type of cigarette	Per 1000 people (95% CI)						Difference-in-differences estimate (95% CI)		
	Massachusetts			Comparison states[a]					
	Before flavor ban (January 2017-May 2020)	After flavor ban (June 2020-July 2021)	Difference	Before flavor ban (January 2017-May 2020)	After flavor ban (June 2020-July 2021)	Difference	Unadjusted	Adjusted[b]	*P* value
Menthol cigarettes	404.93 (391.00 to 418.85)	32.24 (8.16 to 56.32)	−372.68 (−399.77 to −345.60)	738.33 (709.71 to 766.95)	717.73 (668.84 to 766.61)	−20.60 (−77.28 to 36.08)	−352.08 (−648.84 to −55.32)	−372.27 (−428.90 to −315.64)	<.001
Nonflavored cigarettes	916.37 (872.72 to 960.01)	856.79 (807.24 to 906.33)	−59.58 (−138.82 to 19.66)	1524.85 (1469.01 to 1580.68)	1361.00 (1268.00 to 1454.00)	−163.85 (−273.74 to −53.95)	104.27 (−470.83 to 679.36)	120.25 (72.61 to 167.88)	<.001
All cigarettes	1321.32 (1265.04 to 1377.60)	887.69 (818.16 to 957.22)	−433.63 (−536.85 to −330.40)	2263.36 (2181.19 to 2345.53)	2180.56 (1942.59 to 2218.54)	−182.80 (−344.84 to −20.76)	−250.83 (−1098.24 to 596.58)	−282.65 (−356.07 to −209.23)	<.001
Observations, No.	44	15	NA	1188	405	NA	1652	1652	NA

Abbreviation: NA, not applicable.

[a] See the eMethods in Supplement for the list of states included in the comparison states.

[b] The adjusted cigarette sales were obtained using linear regression models and an indicator for a menthol flavor ban in Massachusetts in June 2020. Models included mean cigarette price, state fixed effects controlling for time-invariant smoking characteristics, state-level time-varying factors (unemployment rate, age, sex, marital status, household income, education, race and ethnicity, and COVID-19 infection cases), and survey date fixed effects to account for time-invariant characteristics that are common in the fiscal year and seasonality in smoking. Standard errors were clustered within states.

32.24), nonflavored (916.37 to 856.79), and all (1321.32 to 887.69) cigarettes (**Table 2**). In comparison states, the unadjusted 4-week sales of packs of cigarettes per 1000 people decreased for menthol (738.33 to 717.73), nonflavored (1524.85 to 1361.00), and all (2263.36 to 2180.56) cigarettes after the Massachusetts comprehensive flavor ban. After the flavor ban, the adjusted 4-week sales of cigarettes in Massachusetts vs the comparison states decreased by 372.27 (95% CI, −428.90 to −315.64; $P < .001$) packs per 1000 people for menthol cigarettes but increased by 120.25 (95% CI, 72.61-167.88; $P < .001$) packs per 1000 people for nonflavored cigarettes. Overall, the adjusted 4-week sales of all cigarettes decreased by 282.65 (95% CI, −356.07 to −209.23; $P < .001$) packs per 1000 people in Massachusetts vs the comparison states.

Discussion | The comprehensive flavor ban in Massachusetts was associated with a statistically significant decrease in state-level menthol and all cigarette sales. Limitations of the study include that cross-border or online cigarette sales in Massachusetts were not accounted for, that states with partial bans were not included, and that Massachusetts enacted other tobacco-related legislation that may have affected the results.[5] Also, the findings should be interpreted cautiously as sales data may not fully capture cigarette consumption.

Nonflavored cigarette sales in Massachusetts vs the comparison states increased after the ban, suggesting the potential substitution of nonflavored cigarettes for menthol cigarettes. The US Food and Drug Administration plans to implement a nationwide menthol ban that can regulate the manufacturing, marketing, and sale of menthol cigarettes; therefore, policies and interventions are needed to address possible menthol cigarette users' switching to nonflavored cigarettes that can undermine the effectiveness of the menthol flavor ban. Future studies are needed to examine changes in noncombustible and other combustible tobacco product sales and in cigarette consumption.

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1. US Food and Drug Administration. FDA commits to evidence-based actions aimed at saving lives and preventing future generations of smokers. Accessed June 1, 2021. https://www.fda.gov/news-events/press-announcements/fda-commits-evidence-based-actions-aimed-saving-lives-and-preventing-future-generations-smokers

2. Delnevo CD, Ganz O, Goodwin RD. Banning menthol cigarettes: a social justice issue long overdue. *Nicotine Tob Res*. 2020;22(10):1673-1675. doi:10.1093/ntr/ntaa152

3. Gammon DG, Rogers T, Gaber J, et al. Implementation of a comprehensive flavoured tobacco product sales restriction and retail tobacco sales. *Tob Control*. 2021;tobaccocontrol-2021-056494. doi:10.1136/tobaccocontrol-2021-056494

4. Guydish JR, Straus ER, Le T, Gubner N, Delucchi KL. Menthol cigarette use in substance use disorder treatment before and after implementation of a county-wide flavoured tobacco ban. *Tob Control*. 2021;30(6):616-622. doi:10.1136/tobaccocontrol-2020-056000

5. Massachusetts Department of Public Health. Public Health Council approves regulations restricting access to vaping and tobacco products. Accessed July 21, 2021. https://www.mass.gov/news/public-health-council-approves-regulations-restricting-access-to-vaping-and-tobacco-products

Invited Commentary

Association of Policy Interventions With Tobacco Use Behaviors

Use of tobacco products remains the leading preventable cause of death and disability for all population groups in the US. Although substantial progress has been made in controlling combustible tobacco use, with a more than 50% decrease of smoking prevalence among men and women, the decrease among adults has slowed during the past decade. Evidence-based multilevel approaches to prevent tobacco use and promote cessation among smokers have included policies such as a complete ban on media advertising (preinternet), robust communication campaigns about the risks of smoking and benefits of quitting, prohibition of indoor smoking, and access to smoking cessation interventions.[1]

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The authority of the US Food and Drug Administration (FDA) to regulate the manufacture, distribution, and marketing of tobacco offers another tool for tobacco control. Unfortunately, the FDA's stated intent to regulate flavored tobacco products, especially a total ban on menthol-flavored tobacco, has not yet been implemented. The findings by Asare and colleagues[2] in this issue of *JAMA Internal Medicine* on the effect of a flavor ban in Massachusetts illustrate the potential association such a ban could have with US tobacco use.

The Massachusetts flavor ban went into effect in June 2020, and state-level sales were evaluated and compared with other states. The 4-week sale of mentholated cigarette brands decreased by 361 packs per 1000 persons in the year following the ban (about a 90% reduction) compared with states that did not have a ban. Although the sale of nonflavored cigarette brands increased by about 171 packs per 1000 persons compared with the other states (presumably some people who could not get flavored cigarettes switched to using unflavored cigarettes) the sum of these trends is positive.[2] A major limitation of flavor bans is that people can still buy flavored cigarettes from surrounding states or from the internet. A federal ban on the sale of flavored tobacco would potentially prevent this.

Menthol-flavored combustible tobacco products are used primarily by African American smokers and have also been favored by youth as a smoking starter product.[3] Tobacco industry marketing targeting African American individuals specifically is responsible for the disproportionate use of mentholated brands compared with other racial and ethnic groups. A menthol ban has long been advocated as a social justice issue to address this intentional marketing, which has led to more addiction, disability, and death among African American individuals.[3] Although mentholated tobacco use has not been found to be associated with higher rates of disease, there is substantial evidence that cessation is more difficult. Concerns that a menthol ban risks affecting mostly African American smokers, thus becoming an equity issue, are unwarranted given the historical context.

Regulation by the FDA could be especially useful in regulating flavored electronic nicotine delivery systems (ENDS). The aggressive marketing of ENDS, including electronic cigarettes, has led to a surge in tobacco use, especially among White youth, for whom it is frequently a first step toward the use of combustible tobacco. A ban on the sale of flavored ENDS products, targeted entirely at youth (eg, cotton candy), is an important intervention that does not remove the option of ENDS use as a possible cessation tool for adults who smoke. An evaluation of the tobacco product flavor ban in San Francisco, California, among youth, using data from the Youth Behavioral Risk Factor Survey, showed that the risk of past 30-day smoking doubled after the flavor ban compared with other California districts.[4] This analysis raises the concern that flavor bans in ENDS products may be associated with an increase in use of combustible tobacco among youth. In fact, 33% of youth who have never smoked remain susceptible to future smoking experimentation.[5]

The socioeconomic class gradient in smoking behavior is marked and often ignored. Cigarette smoking prevalence approaches 40% among persons with 9 to 11 years of education compared with less than 5% among college graduates.[6] This disparity cuts across racial and ethnic populations, but is most accentuated among low-income White individuals. Among adults, Latino and Asian individuals have consistently had lower smoking prevalence, and American Indian and Alaska Native individuals have had the highest prevalence. Youth smoking and ENDS use are higher among White youth compared with African American and Latino youth.[6] The transition from youth to young adulthood is the time during which more than half of adult smokers initiate tobacco use, and this group should be emphasized in evaluating tobacco control policy. Ultimately, the most effective policy change would be for the FDA to require a gradual decrease in the nicotine content of commercial cigarettes over the course of a decade, which could lead to less nicotine dependence and subsequently lower tobacco use overall.[7]

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1. World Health Organization. 2008-2013 action plan for the global strategy for the prevention and control of noncommunicable diseases. Accessed September 22, 2021. https://www.who.int/nmh/publications/ncd_action_plan_en.pdf

2. Asare S, Majmundar A, Westmaas JL, et al. Association of cigarette sales with comprehensive menthol flavor ban in Massachusetts. *JAMA Intern Med*. Published online January 4, 2022. doi:10.1001/jamainternmed.2021.7333

3. Delnevo CD, Ganz O, Goodwin RD. Banning menthol cigarettes: a social justice issue long overdue. *Nicotine Tob Res*. 2020;22(10):1673-1675. doi:10.1093/ntr/ntaa152

4. Friedman AS. A difference-in-differences analysis of youth smoking and a ban on sales of flavored tobacco products in San Francisco, California. *JAMA Pediatr*. 2021;175(8):863-865. doi:10.1001/jamapediatrics.2021.0922

5. Coreas SI, Rodriquez EJ, Rahman SG, et al. Smoking susceptibility and tobacco media engagement among youth never smokers. *Pediatrics*. 2021;147(6):e2020017921. doi:10.1542/peds.2020-017921

6. Cornelius ME, Wang TW, Jamal A, Loretan CG, Neff LJ. Tobacco product use among adults—United States, 2019. *MMWR Morb Mortal Wkly Rep*. 2020;69(46):1736-1742. doi:10.15585/mmwr.mm6946a4

7. Benowitz NL, Henningfield JE. Reducing the nicotine content to make cigarettes less addictive. *Tob Control*. 2013;22(suppl 1):i14-i17. doi:10.1136/tobaccocontrol-2012-050860

Lottery-Based Incentives and COVID-19 Vaccination Rates in the US

On May 12, 2021, Ohio announced a lottery system incentivizing residents to receive COVID-19 vaccinations[1]; several US states subsequently introduced similar programs.[2] Although analysis of vaccination rates from Ohio suggested that lottery-based incentives were not associated with increased vaccination rates,[3] responses to lottery programs across other states are unclear. In this study, we assessed changes in COVID-19 vaccination rates across US states with lottery-based vaccine incentives.

Supplemental content

Methods | We identified lottery states that announced cash prizes for vaccinated individuals from May 24, 2021, to July 19, 2021. States that announced lotteries outside of this period were excluded; other states were non-lottery states. This study was deemed not human participants research by the Boston University Medical Campus institutional review board. Dates were chosen to minimize confounding from vaccine expansion to adolescents (May 10, 2021). Daily rates of first COVID-19 vaccine dose administration per 100 000 persons from May 17, 2021, to July 26, 2021, were obtained from the US Centers for Disease Control and Prevention.[4] Using interrupted time series analyses with segmented regression,[5] we estimated the (1) immediate level change and (2) trend change in (1) daily vaccination rates in lottery states and (2) differences in daily vaccination rates between lottery and non-lottery states after vaccine lottery announcement (primary analysis), with date and state as random intercepts (eMethods in the Supplement). Sensitivity analyses included (1) using state-reported vaccination data when available and (2) a model with state as a fixed effect. A post hoc sensitivity analysis explored states with more than 3 weeks of prelottery data. We also estimated the cumulative difference in vaccines administered during the postlottery period in lottery states compared with what would have been expected from prelottery trends (eMethods and eTables 1 and 2 in the Supplement). Statistical testing was 2-tailed with an α level of .05 using R, version 4.0.2 (R Project for Statistical Computing).

Results | Daily first vaccination rate trends of 15 lottery and 31 non-lottery states are shown in the **Figure**. Among lottery states, the vaccination rate decreased before lottery announcements (-2.8 [95% CI, -4.2 to -1.4] vaccinations/100 000 people/day); following lottery announcements, vaccine administrations did not significantly increase (-0.4 [95% CI, -23.5 to 22.7] vaccinations/100 000 people), and vaccination trends did not significantly change (0.7 [95% CI, -0.9 to 2.4] vaccinations/100 000/day) compared with prelottery trends.

Vaccination rate trends were similar between lottery and non-lottery states before lottery announcements (-0.5 [95% CI, -1.7 to 0.82] vaccinations/100 000 people/day; $P = .69$). After lottery announcements, there was no significant difference in vaccination level change (1.1 [95% CI, -21.7 to 23.8] vaccinations/100 000 people; $P = .92$) and no change in trend in vaccination rate difference (0.4 [95% CI, -1.1 to 2] vaccinations/100 000 people/day; $P = .59$) between lottery and non-lottery states. Sensitivity analyses with (1) state-reported data from 4 lottery states and (2) states as fixed effects showed similar results (**Table**). A sensitivity analysis of states with more than 3 weeks of prelottery data found no significant difference in vaccination levels and a borderline significant increase in trend after lottery announcements ($P = .05$). In the primary analysis (all states), the estimated cumulative difference in vaccines administered during the 28-day postlottery period in lottery states compared with what would have been expected without lottery adoption was 190 vaccines per 100 000 people (-1063 to 1484 vaccines/100 000 persons); in a post hoc sensitivity analysis (states with >3 weeks of prelottery data), the estimated change in vaccinations was 1092 per 100 000 people (-616 to 2800 vaccines/100 000 persons).

Conclusions | This study did not find evidence that vaccine lottery incentive programs in the US were associated with significantly increased rates of COVID-19 vaccinations. These findings expand on similar findings from the first state vaccination lottery.[3] The models may be underpowered to rule out small to moderate increases in vaccination rates.[6] The findings depend on the accuracy of US Centers for Disease Control and Prevention vaccine data; however, sensitivity analyses using data reported by a subsample of states that reported daily vaccination rates resulted in similar findings. Given the lack of a strong association between state lottery-based vaccine incentives and increased vaccination rates, further studies of strategies to increase vaccination rates are needed.