

National and State Trends in Sales of Cigarettes and E-Cigarettes, U.S., 2011–2015

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Introduction: In recent years, self-reported cigarette smoking has declined among youth and adults, while electronic cigarette (e-cigarette) use has increased. However, sales trends for these products are less certain. This study assessed national and state patterns of U.S. cigarette and e-cigarette unit sales.

Methods: Trends in cigarette and e-cigarette unit sales were analyzed using retail scanner data from September 25, 2011 through January 9, 2016 for: (1) convenience stores; and (2) all other outlets combined, including supermarkets, mass merchandisers, drug, dollar, and club stores, and military commissaries (online, tobacco-only, and “vape” shops were not available). Data by store type were available for the total contiguous U.S. and 29 states; combined data were available for the remaining states, except Alaska, Hawaii, and DC.

Results: During 2011–2015, cigarette sales exhibited a small, significant decrease; however, positive year-over-year growth occurred in convenience stores throughout most of 2015. E-cigarette unit sales significantly increased during 2011–2015, but year-over-year growth slowed and was occasionally negative. Cigarette unit sales exceeded e-cigarettes by 64:1 during the last 4-week period. During 2014–2015, cigarette sales increases occurred in 15 of 48 assessed states; e-cigarette sales increased in 18 states.

Conclusions: Despite overall declines during 2011–2015, cigarette sales in 2015 grew for the first time in a decade. E-cigarette sales growth was positive, but slowed over the study period in assessed stores. Cigarette sales continued to exceed e-cigarette sales, reinforcing the importance of efforts to reduce the appeal and accessibility of cigarettes and other combusted tobacco products.

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INTRODUCTION

Conventional cigarettes and other combusted tobacco products remain the leading cause of preventable death and disease in the U.S., despite marked declines in smoking among youth and adults.^{1–4} Additionally, certain subpopulations smoke conventional cigarettes at higher rates than the overall adult population, including young adults and low-income individuals.³ Conversely, electronic cigarette (e-cigarette) use is increasing: E-cigarettes are now the most commonly used tobacco product among U.S. youth.²

E-cigarettes present a range of potential public health benefits and harms at the individual and population levels.¹ Adult smokers could benefit if e-cigarettes are used as a complete substitute for all combusted tobacco

products.¹ However, there are potential harms of e-cigarettes for youth,^{2,5–9} including nicotine addiction, adverse consequences of nicotine for brain development,

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and sustained tobacco use; and adults, including delayed quitting among smokers and relapse among former smokers.^{1,10}

Tobacco sales data can enhance understanding of tobacco use patterns.¹¹ Mirroring declines in self-reported conventional cigarette smoking, U.S. cigarette sales decreased 37.1% during 2000–2014.^{11,12} However, cigarette shipments were 3.4% higher in 2015 than 2014, the first annual increase since 2006.¹² Less is known about recent U.S. e-cigarette sales trends, which increased 150% during 2012–2013,¹³ or how the magnitude and patterns of e-cigarette sales compare to cigarettes. To address this uncertainty, this study assessed national and state-specific retail sales of cigarettes and e-cigarettes during 2011–2015.

METHODS

Universal Product Code sales data were obtained from The Nielsen Company for convenience stores (c-stores) and all other outlets combined (AOCs), which were combined given their lower sales relative to c-stores. AOCs included supermarkets, pharmacies, mass merchandisers, dollar stores, club stores, and U.S. military commissaries. Sales were reported in 4-week aggregates from September 25, 2011 through January 9, 2016. Data by store type were available for 29 states and the total U.S., except Alaska, Hawaii, and DC; combined data were available for the remaining states except Alaska, Hawaii, and DC. E-cigarette Universal Product Codes were assigned to four mutually exclusive categories and standardized so that one unit equals either one disposable e-cigarette, rechargeable e-cigarette, cartridge refill, or e-liquid bottle. Cigarette units were standardized so that one unit equals one pack (20 cigarettes).

U.S. Census Bureau estimates were used to aggregate unit sales per 100,000 people by product type and state.¹⁴ The average period-to-period change in the natural logarithm of sales, controlling for autocorrelation, was tested using Joinpoint regression, version 4.2.0.2; statistical significance was defined as $p < 0.05$. To mitigate seasonality effects and contextualize growth over time, year-over-year (YoY) change was measured by calculating the

percentage change in sales from one 4-week period in a given year to sales in the closest 4-week period in the prior year.

RESULTS

During 2011–2015, conventional cigarette sales in c-stores decreased by an average of -0.1% (95% CI = -0.2% , 0.0%) each 4-week period ($p < 0.05$); no significant changes occurred in AOCs (Figure 1). E-cigarette sales increased by an average of 2.6% (95% CI = 1.8% , 3.4%) each period in c-stores ($p < 0.05$), and 4.5% (95% CI = 3.6% , 5.5%) in AOCs ($p < 0.05$). However, during the last period, cigarette sales outweighed e-cigarette sales 64:1 in c-stores and 73:1 in AOCs. C-stores generated 5.7 times more cigarette sales and 6.6 times more e-cigarette sales than AOCs during the last period. During 2014–2015, e-cigarette sales by subtype changed by $+5.3\%$, -42.7% , $+307.7\%$, and $+31.6\%$ for rechargeables, disposables, e-liquid refills, and prefilled cartridges, respectively (Table 1).

The YoY changes in cigarette c-store unit sales were negative from 2013 to late 2014, then turned positive in late 2014 through most of 2015, ranging from 0.1% to 2.0% (Figure 2). In AOCs, YoY changes in cigarette sales were positive during late 2013 and early 2014, ranging from 0.7% to 2.5% , then negative for the remainder of the study period. A notable decrease in AOC cigarette sales in September 2014 resulted in large negative YoY changes during September 2014–August 2015.

The YoY changes in e-cigarette c-store unit sales were mostly positive, but decreased over the study period (Figure 3). In AOCs, the YoY change in e-cigarette sales was positive from early 2013 to April 2014, then remained negative.

During 2014–2015, cigarette sales increased in 15 of 48 (31.3%) assessed states, while 18 (37.5%) experienced increased e-cigarette sales (Table 1). The largest changes

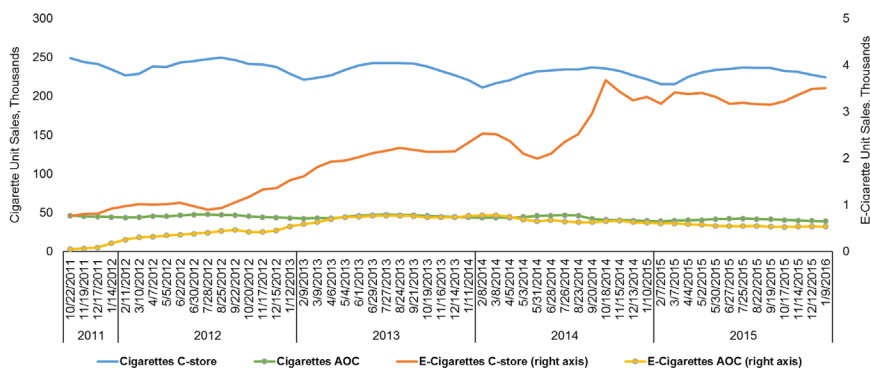


Figure 1. Cigarette and e-cigarette unit sales, U.S. 2011–2015.

Note: Unit sales per 100,000 people.

AOC, all other outlets combined; C-store, convenience stores.

Table 1. Annual Percentage Change in Cigarette and E-Cigarette Unit Sales, C-Stores and AOC, 2014–2015

State	Cigarettes	E-cigarettes				
		Total e-cigarettes	Rechargeable	Disposable	Liquid refill	Prefilled cartridge
Total U.S.	-1.4	14.4	5.3	-42.7	307.7	31.6
Alabama	-0.9	-6.6	3.5	-41.7	602.6	-6.7
Arkansas	1.7	-19.1	25.0	-46.2	98.4	-16.2
Arizona	-2.3	-3.2	-48.4	-36.5	63.3	36.1
California	-3.1	16.1	-6.0	-43.9	187.7	56.5
Colorado	-3.4	-4.7	-26.8	-45.2	130.1	1.2
Connecticut	-15.5	-7.7	27.2	-38.8	924.9	-11.0
Delaware	-6.9	-20.7	-9.3	-56.4	249.8	-14.2
Florida	2.4	9.8	30.4	-33.9	421.1	18.3
Georgia	-8.1	-11.9	0.8	-44.4	308.6	-11.0
Iowa	3.8	-0.5	-37.4	-49.5	91.3	27.1
Idaho	15.1	-19.4	-17.6	-9.6	-49.4	-16.1
Illinois	-1.3	0.2	-25.8	-39.5	384.5	15.5
Indiana	-8.5	4.9	-41.3	-41.5	246.4	24.5
Kansas	-5.3	-18.6	-31.6	-48.8	144.2	-10.2
Kentucky	-1.7	-3.8	-35.8	-44.0	159.9	10.5
Louisiana	-0.4	-7.5	3.7	-49.5	285.7	4.3
Massachusetts	-8.0	16.4	79.3	-32.8	1434.5	20.2
Maryland	-4.9	6.5	22.3	-48.8	114.9	23.8
Maine	-1.0	19.5	83.6	-39.5	538.7	28.2
Michigan	-3.1	27.2	-11.7	-44.6	256.9	54.2
Minnesota	-3.2	-21.5	-12.6	-34.4	138.2	-23.4
Missouri	-1.6	-14.8	-39.6	-43.9	107.8	-3.5
Mississippi	0.9	-18.6	-7.3	-56.5	561.9	-20.0
Montana	9.7	-36.4	45.2	-58.1	-66.1	-34.6
North Carolina	-2.7	-7.9	-0.03	-51.2	411.2	-8.8
North Dakota	-15.0	-29.9	-32.0	-56.6	8.5	-16.8
Nebraska	0.9	-11.3	-44.7	-44.9	59.3	11.3
New Hampshire	1.5	1.3	70.3	-39.4	553.9	3.6
New Jersey	-4.9	6.0	21.1	-35.2	1598.3	1.7
New Mexico	-0.03	-4.4	-13.9	-37.2	176.8	4.5
Nevada	1.2	13.9	-5.3	-43.5	135.5	42.8
New York	-11.0	10.4	24.2	-28.2	850.3	9.9
Ohio	-3.6	15.9	16.2	-49.5	203.5	31.0
Oklahoma	5.6	-0.8	-18.8	-38.3	74.7	13.1
Oregon	-1.3	1.0	-22.3	-52.6	119.2	19.2
Pennsylvania	0.9	15.7	61.3	-49.2	136.9	25.8
Rhode Island	-7.4	-11.6	34.9	-48.8	1155.0	-17.2
South Carolina	-4.8	-12.2	3.0	-57.7	301.8	-11.8
South Dakota	5.8	20.8	-21.6	-41.7	55.0	55.1
Tennessee	0.1	-12.9	10.7	-45.3	261.9	-10.0
Texas	-3.5	-0.8	-3.1	-46.9	146.3	17.8
Utah	1.0	-6.4	-17.0	-41.2	146.6	-5.1
Virginia	-1.0	-2.4	10.2	-52.1	130.8	12.0
Vermont	-2.3	7.4	-60.4	-43.0	695.4	36.8
Washington	-0.9	2.8	-16.7	-43.2	-19.9	27.4
Wisconsin	-0.6	-8.8	-24.8	-42.8	221.6	0.3
West Virginia	2.2	-11.1	1.1	-41.5	101.1	-9.0
Wyoming	-1.4	-13.8	-20.9	-51.5	132.5	-4.4

Note: For cigarettes, 1 unit is equivalent to 1 pack of cigarettes. For e-cigarette products, 1 unit is equivalent to either 1 starter-kit, 1 disposable e-cigarette, 1 e-liquid bottle, or 1 prefilled cartridge.

AOC, all other outlets combined; C-stores, convenience stores.

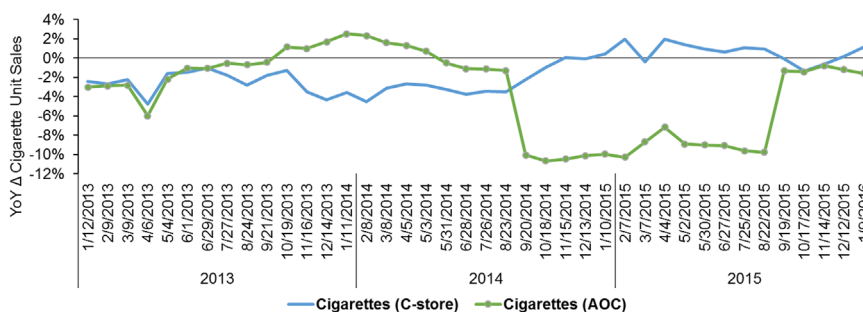


Figure 2. Year-over-year (YoY) change in cigarette unit sales, U.S. 2013–2015.

Note: YoY change is the percentage difference in cigarette unit sales in the indicated period compared to the same period 1 year earlier. AOC, all other outlets combined; C-store, convenience stores.

occurred in Connecticut (−15.5%) and Idaho (+15.1%) for cigarette sales and Montana (−36.4%) and Michigan (+27.2%) for e-cigarette sales.

DISCUSSION

Conventional cigarette sales consistently exceeded e-cigarette sales in major U.S. retail stores during 2011–2015. Positive YoY cigarette sales growth in c-stores occurred throughout most of 2015, the first such increases in a decade.¹² Additionally, the e-cigarette market is highly variable and rapidly changing.¹ E-cigarette sales growth was positive but slowed during 2011–2015 in assessed stores, with exceptions by store and product type.

Recent growth in conventional cigarette sales might be attributed to coincident macroeconomic changes, such as declines in gasoline prices and increases in disposable personal income.^{15–18} Cigarette purchases may have increased especially among low-income and young adults, who are more price sensitive and smoke at higher rates.^{3,19} The notable decrease in YoY cigarette sales in AOCs around September 2014 corresponds to CVS Health’s elimination of tobacco sales in its 7,700 U.S. pharmacies; sales stabilized at this lower level, as seen in the return to modest YoY decreases in September 2015 (−1% to −2%). Implementation of proven tobacco

control interventions, including tobacco product price increases,²⁰ may attenuate the effects of fluctuating macroeconomic conditions on tobacco sales and reduce smoking-related disparities.

Declines in e-cigarette sales growth may reflect purchases shifting to “vape shops” or online, rather than lower overall sales.¹⁵ By one estimate, traditional stores accounted for less than one third of the \$2.5 billion e-cigarette market in 2014.²¹ Declines may also reflect movement from closed- to open-system e-cigarettes, which are often sold in non-traditional outlets.¹⁵ The 303.7% increase in e-liquid sales during 2014–2015 suggests increasing use of open systems. Slowing e-cigarette sales have also been attributed to decreased promotional spending, consumer dissatisfaction, and reversion to combustibles by those who tried e-cigarettes.¹⁵

A majority of adult e-cigarette users report current cigarette smoking.²² Even if smokers use e-cigarettes to reduce conventional cigarette consumption, one to four cigarettes per day doubles the risk of dying from heart disease, and heavy smokers who halve cigarette consumption still risk premature death.^{1,23–25} Accordingly, for adult smokers to benefit from e-cigarettes, they must completely quit combusted tobacco.²⁶ However, e-cigarettes are not a U.S. Food and Drug Administration–approved cessation aid, and there is no conclusive scientific evidence on their efficacy for cessation.^{27–30}

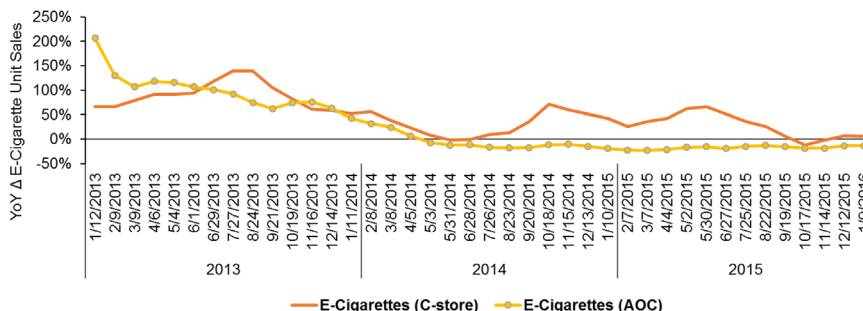


Figure 3. Year-over-year change in e-cigarette unit sales, U.S. 2013–2015.

LIMITATIONS

This study is subject to limitations. First, Nielsen uses proprietary methods to estimate sales; however, findings are consistent with independent reports.^{12,21} Second, Nielsen data exclude sales from “vape shops,” tobacco specialty stores, and online retailers. Third, the data do not capture open-system e-cigarette sales. Nevertheless, this analysis highlights the dynamic nature of cigarette and e-cigarette sales, and underscores the importance of continued tobacco product surveillance.

CONCLUSIONS

Despite conclusive evidence on the harms of conventional cigarettes, the net health impact of e-cigarettes is unknown.¹ E-cigarettes might benefit public health if they speed declines in smoking¹; however, recent increases in conventional cigarette sales reinforce the importance of efforts to reduce the appeal and accessibility of combusted tobacco products. Full implementation of comprehensive tobacco control programs at Centers for Disease Control and Prevention–recommended funding levels, along with Food and Drug Administration regulation of tobacco products, could reduce tobacco use in the U.S.^{1,31}

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KM developed the concept for the paper, interpreted the results, wrote the first draft, and reviewed subsequent drafts of the paper; DG analyzed the data, interpreted the results, contributed to writing, and reviewed drafts. BK, BL, TR, EF, and TW interpreted the results, contributed to writing, and reviewed drafts. All authors approved the final version of the manuscript for submission.

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REFERENCES

- DHHS US. The health consequences of smoking-50 years of progress: a report of the Surgeon General. Atlanta, GA: U.S. DHHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.
- Singh T, Arrazola RA, Corey CG, et al. Tobacco use among middle and high school students - United States, 2011-2015. *MMWR Morb Mortal Wkly Rep.* 2016;65(14):361-367. <http://dx.doi.org/10.15585/mmwr.mm6514a1>.
- Jamal A, Homa DM, O'Connor E, et al. Current cigarette smoking among adults - United States, 2005-2014. *MMWR Morb Mortal Wkly Rep.* 2015;64(44):1233-1240. <http://dx.doi.org/10.15585/mmwr.mm6444a2>.
- National Center for Health Statistics. Early release of selected estimates based on data from the National Health Interview Survey, 2015. www.cdc.gov/nchs/data/nhis/earlyrelease/earlyrelease201605_08.pdf. Published 2016. Accessed July 1, 2016.
- England LJ, Bunnell RE, Pechacek TF, Tong VT, McAfee TA. Nicotine and the developing human: a neglected element in the electronic cigarette debate. *Am J Prev Med.* 2015;49(2):286-293. <http://dx.doi.org/10.1016/j.amepre.2015.01.015>.
- Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. *JAMA.* 2015;314(7):700-707. <http://dx.doi.org/10.1001/jama.2015.8950>.
- Primack BA, Soneji S, Stoolmiller M, Fine MJ, Sargent JD. Progression to traditional cigarette smoking after electronic cigarette use among U.S. adolescents and young adults. *JAMA Pediatr.* 2015;169(11):1018-1023. <http://dx.doi.org/10.1001/jamapediatrics.2015.1742>.
- Wills TA, Knight R, Sargent JD, Gibbons FX, Pagano I, Williams RJ. Longitudinal study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii. *Tob Control.* In press. Online January 26, 2016. <http://dx.doi.org/10.1136/tobaccocontrol-2015-052705>.
- Singh T, Marynak K, Arrazola RA, Cox S, Rolle IV, King BA. Vital Signs: Exposure to Electronic Cigarette Advertising Among Middle School and High School Students - United States, 2014. *MMWR Morb Mortal Wkly Rep.* 2016;64(52):1403-1408. <http://dx.doi.org/10.15585/mmwr.mm6452a3>.
- Benowitz NL, Goniewicz ML. The regulatory challenge of electronic cigarettes. *JAMA.* 2013;310(7):685-686. <http://dx.doi.org/10.1001/jama.2013.109501>.
- Tynan MA, McAfee T, Promoff G, Pechacek T. Consumption of cigarettes and combustible tobacco—United States, 2000-2011. *MMWR Morb Mortal Wkly Rep.* 2012;61(30):565-569.
- U.S. Department of the Treasury. Alcohol and Tobacco Tax and Trade Bureau. Statistical report - tobacco. Reporting period: December 2015. TTB S 5210-12-2015. <https://ttb.gov/statistics/2015/201512tobacco.pdf>. Published 2016. Accessed May 20, 2016.
- Loomis BR, Rogers T, King BA, et al. National and state-specific sales and prices for electronic cigarettes—U.S., 2012-2013. *Am J Prev Med.* 2016;50(1):18-29. <http://dx.doi.org/10.1016/j.amepre.2015.05.003>.
- U.S. Census Bureau. *Current estimates data.* Washington, D.C.: U.S. Census Bureau; 2015. www.census.gov/popest/data/national/totals/2014/index.html. Published 2015. Accessed January 11, 2016.
- Herzog B. CSP Outlook Leadership Conference: Tobacco Industry Trends. November 14, 2015.
- Edelstein P, Kilian L. How sensitive are consumer expenditures to retail energy prices? *J Monetary Econ.* 2009;56(6):766-779. <http://dx.doi.org/10.1016/j.jmoneco.2009.06.001>.
- U.S. Energy Information Administration. U.S. gasoline prices in 2015 were lowest since 2009. www.eia.gov/todayinenergy/detail.cfm?id=24452. Published 2016. Accessed January 28, 2016.
- Mataloni L. GDP and the economy: third estimates for the second quarter of 2015. www.bea.gov/scb/pdf/2015/10%20October/1015_gdp_and_the_economy.pdf. Published 2015. Accessed January 28, 2016.
- Farrelly MC, Bray JW. Response to increases in cigarette prices by race/ethnicity, income, and age groups - United States, 1976-1993. *MMWR Morb Mortal Wkly Rep.* 1998;47(29):605-609. www.cdc.gov/mmwr/preview/mmwrhtml/00054047.htm. Accessed June 10, 2016.
- Guide to Community Preventive Services. Reducing tobacco use and secondhand smoke exposure: interventions to increase the unit price

- for tobacco products. www.thecommunityguide.org/tobacco/increasingleunitprice.html. Published 2012. Accessed June 10, 2016.
21. Herzog B. *Nielsen: Tobacco "All Channel" Data Through December 26, 2015*. Charlotte, NC: Wells Fargo Securities, LLC; 2016. www.akleg.gov/basis/get_documents.asp?session=29&docid=40849. Accessed January 23, 2017.
 22. King BA, Patel R, Nguyen KH, Dube SR. Trends in awareness and use of electronic cigarettes among U.S. adults, 2010-2013. *Nicotine Tob Res*. 2015;17(2):219-227. <http://dx.doi.org/10.1093/ntr/ntu191>.
 23. Bjartveit K, Tverdal A. Health consequences of smoking 1-4 cigarettes per day. *Tob Control*. 2005;14(5):315-320. <http://dx.doi.org/10.1136/tc.2005.011932>.
 24. Tverdal A, Bjartveit K. Health consequences of reduced daily cigarette consumption. *Tob Control*. 2006;15(6):472-480. <http://dx.doi.org/10.1136/tc.2006.016246>.
 25. Godtfredsen NS, Holst C, Prescott E, Vestbo J, Osler M. Smoking reduction, smoking cessation, and mortality: a 16-year follow-up of 19,732 men and women from The Copenhagen Centre for Prospective Population Studies. *Am J Epidemiol*. 2002;156(11):994-1001. <http://dx.doi.org/10.1093/aje/kwf150>.
 26. CDC. CDC Office on Smoking and Health, E-cigarette Information. www.cdc.gov/tobacco/stateandcommunity/pdfs/cdc-osh-information-on-e-cigarettes-november-2015.pdf. Published 2015. Accessed April 28, 2016.
 27. U.S. Preventive Services Task Force. Final update summary: tobacco use in adults and pregnant women: counseling and interventions. www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions. Published 2014. Accessed April 28, 2016.
 28. Hartmann-Boyce J, McRobbie H, Bullen C, Begh R, Stead LF, Hajek P. Electronic cigarettes for smoking cessation. *Cochrane Database Syst Rev*. 2016;9:CD010216. <http://dx.doi.org/10.1002/14651858.cd010216.pub3>.
 29. Bullen C, Howe C, Laugesen M, McRobbie H, Parag V, Williman J. Do electronic cigarettes help smokers quit? Results from a randomised controlled trial [Abstract]. European Respiratory Society Annual Congress, 2013 September 7 - 11, Barcelona, Spain 2013;42:215s-[P1047].
 30. Caponnetto P, Campagna D, Cibella F, et al. Efficiency and Safety of an eElectronic cigarette (ECLAT) as tobacco cigarettes substitute: a prospective 12-month randomized control design study. *PLoS One*. 2013;8(6):e66317. <http://dx.doi.org/10.1371/journal.pone.0066317>.
 31. C.D.C. Best practices for comprehensive tobacco control programs-2014. www.cdc.gov/tobacco/stateandcommunity/best_practices/index.htm?source=govdelivery. Published 2014. Accessed April 28, 2016.