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Consumption of Combustible and Smokeless Tobacco — United States, 2000–2015

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Combustible and smokeless tobacco use causes adverse health outcomes, including cardiovascular disease and multiple types of cancer (*1*,*2*). Standard approaches for measuring tobacco use include self-reported surveys of use and consumption estimates based on tobacco excise tax data (*3*,*4*). To provide the most recently available tobacco consumption estimates in the United States, CDC used federal excise tax data to estimate total and per capita consumption during 2000–2015 for combustible tobacco (cigarettes, roll-your-own tobacco, pipe tobacco, small cigars, and large cigars) and smokeless tobacco (chewing tobacco and dry snuff). During this period, total combustible tobacco consumption decreased 33.5%, or 43.7% per capita. Although total cigarette consumption decreased 38.7%, cigarettes remained the most commonly used combustible tobacco product. Total noncigarette combustible tobacco (i.e., cigars, roll-your-own, and pipe tobacco) consumption increased 117.1%, or 83.8% per capita during 2000–2015. Total consumption of smokeless tobacco increased 23.1%, or 4.2% per capita. Notably, total cigarette consumption was 267.0 billion cigarettes in 2015 compared with 262.7 billion in 2014. These findings indicate that although cigarette smoking declined overall during 2000–2015, and each year from 2000 to 2014, the number of cigarettes consumed in 2015 was higher than in 2014, and the first time annual cigarette consumption was higher than the previous year since 1973. Moreover, the consumption of other combustible and smokeless tobacco products remains substantial. Implementation of proven tobacco prevention interventions (*5*) is warranted to further reduce tobacco use in the United States.

Publicly available federal excise tax data from the U.S. Department of Treasury's Alcohol and Tobacco Tax and Trade Bureau were analyzed for 2000–2015; these data included information on products taxed domestically and imported into the United States (*6*). Using monthly tax data, per unit (e.g., per cigarette or per cigar) consumption for each combustible product was assessed. To enable comparisons between cigarettes, cigars (small and large), and loose tobacco (roll-your-own and pipe tobacco), data were converted from pounds of tobacco to a per cigarette equivalent using established methods (*4*).* Smokeless tobacco (i.e., chew and dry snuff) data were reported in pounds. Adult per capita tobacco consumption was estimated by dividing total consumption by the number of U.S. persons aged ≥18 years using Census Bureau data.†

* 0.0325 oz (0.9 g) = one cigarette. The conversion of 0.0325 oz (0.9 g) = one cigarette was cited in the 1998 Tobacco Master Settlement Agreement (http://ag.ca.gov/tobacco/pdf/1msa.pdf).

† https://www.census.gov/popest/data/national/asrh/2015/index.html.

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Relative percent change was calculated across years. Joinpoint regression was performed to determine statistically significant trends during 2000–2015.

During 2000–2015, total consumption of all combustible tobacco products decreased 33.5% from 450.7 to 299.9 billion cigarette equivalents (p<0.05), a per capita decrease of 43.7% from 2,148 to 1,211 cigarette equivalents (p<0.05) (Table). The proportion of total combustible tobacco consumption composed of loose tobacco and cigars increased from 3.4% to 11.0% (p<0.05).

During 2000–2015, total cigarette consumption decreased 38.7% from 435.6 billion to 267.0 billion cigarettes (p<0.05) (Table), a per capita decrease of 48.1% from 2,076 to 1,078 cigarettes (p<0.05) (Figure 1). Total cigarette consumption was 267.0 billion cigarettes in 2015 compared with 262.7 billion in 2014, or seven more cigarettes per capita. In 2015, cigarettes accounted for 89% of total combustible tobacco consumption.

During 2000–2015, total roll-your-own tobacco consumption decreased 70.0% (p<0.05), whereas total pipe tobacco consumption increased 556.4% (p<0.05) (Table). The largest changes occurred during 2008–2011, when roll-your-own consumption decreased from 10.7 billion to 2.6 billion cigarette equivalents (75.7% decrease, p<0.05), while pipe tobacco consumption increased from 2.6 billion to 17.5 billion cigarette equivalents (573.1% increase; p<0.05).

During 2000–2015, total small cigar[§] consumption decreased 75.6% (p<0.05), or 79.3% per capita (p<0.05). However, large cigar consumption increased 179.6% (p<0.05), or 136.8% per capita (p<0.05) (Table) (Figure 2). Large and small cigar consumption diverged in 2008; large cigar consumption increased during 2008–2011 (p<0.05), whereas small cigar consumption decreased during 2008–2015 (p<0.05).

During 2000–2015, total smokeless tobacco consumption increased 23.1% (p<0.05), or 4.2% per capita (Table) (Figure 1). However, chewing tobacco and snuff consumption patterns diverged; total chewing tobacco consumption decreased 55.8% from 45.6 to 20.2 billion pounds (from 20.7 to 9.2 billion kilograms) (p<0.05), whereas total snuff consumption increased 77.5% from 66.2 to 117.4 billion pounds (from 30.0 to 53.3 billion kilograms) (p<0.05).

Discussion

During 2000–2015, combustible tobacco consumption declined overall, and total and per capita cigarette consumption declined each year during 2000–2014. However, during 2015, the number of cigarettes consumed was higher than during 2014, the first time annual cigarette consumption was higher than the previous year since 1973. Because cigarettes remained

[§] In 26 USC 5701, small cigars are defined as cigars that weigh ≥3 pounds (1.36 kg) per 1,000 cigars, and large cigars are defined as cigars that weigh >3 pounds per 1,000.

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TABLE. Total and per capita* consumption of cigarettes, all combustible tobacco, noncigarette combustible tobacco, and smokeless tobacco products — United States, 2000–2015

Year	Cigarettes				All combustible tobacco (cigarettes, cigars, and loose tobacco [cigarette equivalents])				Noncigarette combustible tobacco (cigars and loose tobacco [cigarette equivalents])			
	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change
2000	**435,570**	—	2,076	—	**450,725**	—	2,148	—	**15,155**	—	72	—
2001	**426,720**	-2.0	2,010	-3.2	**440,693**	-2.2	2,075	-3.4	**13,973**	-7.8	66	-8.9
2002	**415,724**	-2.6	1,936	-3.7	**430,763**	-2.3	2,006	-3.4	**15,040**	7.6	70	6.4
2003	**400,327**	-3.7	1,844	-4.7	**415,930**	-3.4	1,916	-4.5	**15,603**	3.8	72	2.6
2004	**397,655**	-0.7	1,811	-1.8	**414,421**	-0.4	1,888	-1.5	**16,766**	7.5	76	6.2
2005	**381,098**	-4.2	1,717	-5.2	**401,187**	-3.2	1,807	-4.3	**20,089**	19.8	90	18.5
2006	**380,594**	-0.1	1,695	-1.3	**401,241**	0.01	1,787	-1.1	**20,648**	2.8	92	1.6
2007	**361,590**	-5.0	1,591	-6.1	**384,087**	-4.3	1,690	-5.4	**22,497**	9.0	99	7.7
2008	**346,419**	-4.2	1,507	-5.3	**371,264**	-3.3	1,615	-4.5	**24,845**	10.4	108	9.1
2009	**317,736**	-8.3	1,367	-9.3	**342,124**	-7.9	1,472	-8.9	**24,388**	-1.8	105	-2.9
2010	**300,451**	-5.4	1,278	-6.5	**329,239**	-3.8	1,400	-4.9	**28,788**	18.0	122	16.7
2011	**292,769**	-2.6	1,232	-3.6	**326,577**	-0.8	1,374	-1.9	**33,808**	17.4	142	16.2
2012	**287,187**	-1.9	1,196	-2.9	**322,396**	-1.3	1,342	-2.3	**35,209**	4.1	147	3.0
2013	**273,785**	-4.7	1,129	-5.6	**309,641**	-4	1,277	-4.9	**35,856**	1.8	148	0.8
2014	**262,681**	-4.1	1,071	-5.1	**298,196**	-3.7	1,216	-4.8	**35,515**	-1.0	145	-2.1
2015	**267,043**	1.7	1,078	0.6	**299,938**	0.6	1,211	-0.4	**32,894**	-7.4	133	-8.3
% change, 2000–2015	—	**-38.7†**	—	**-48.1†**	—	**-33.5†**	—	**-43.7†**	—	**117.1†**	—	**83.8†**

Year	Total cigars (small cigars and large cigars [cigarette equivalents])				Small cigars (cigarette equivalents)				Large cigars (cigarette equivalents)			
	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change
2000	**6,161**	—	29	—	**2,279**	—	11	—	**3,882**	—	19	—
2001	**6,344**	3.0	30	1.7	**2,239**	-1.8	11	-2.9	**4,105**	5.7	19	4.5
2002	**6,546**	3.2	31	3.8	**2,343**	4.6	11	3.5	**4,203**	2.4	20	1.3
2003	**7,007**	7.0	32	4.1	**2,474**	5.6	11	4.50	**4,533**	7.9	21	6.7
2004	**7,852**	12.1	36	10.8	**2,917**	17.9	13	16.6	**4,935**	8.9	22	7.6
2005	**9,052**	15.3	41	14.0	**3,968**	36.0	18	34.5	**5,084**	3.0	23	1.9
2006	**9,733**	7.5	43	6.3	**4,434**	11.7	20	10.4	**5,299**	4.2	24	3.0
2007	**10,708**	10.0	47	8.7	**5,161**	16.4	23	15.0	**5,548**	4.7	24	3.5
2008	**11,538**	7.7	50	6.5	**5,881**	14.0	26	12.6	**5,657**	2.0	25	0.8
2009	**12,127**	5.1	52	4.0	**2,343**	-60.2	10	-60.6	**9,784**	73.0	42	71.1
2010	**13,269**	9.4	56	8.2	**983**	-58.1	4	-58.5	**12,287**	25.6	52	24.1
2011	**13,727**	3.5	58	2.4	**798**	-18.8	3	-19.6	**12,929**	5.2	54	4.1
2012	**13,787**	0.4	57	-0.6	**762**	-4.5	3	-5.5	**13,025**	0.7	54	-0.3
2013	**13,159**	-4.6	54	-5.5	**659**	-13.5	3	-14.3	**12,499**	-4.0	52	-5.0
2014	**13,695**	4.1	56	2.9	**564**	-14.4	2	-15.4	**13,131**	5.1	54	3.9
2015	**11,411**	-16.7	46	-17.5	**556**	-1.3	2	-2.3	**10,855**	-17.3	44	-18.2
% change, 2000–2015	—	**85.2†**	—	**56.8†**	—	**-75.6†**	—	**-79.3†**	—	**179.6†**	—	**136.8†**

See table footnotes on next page.

the most commonly used combustible tobacco product, this offset decreases in pipe tobacco and cigar consumption, slightly increasing total combustible tobacco consumption in 2015 relative to 2014. Furthermore, total smokeless tobacco consumption increased during 2000–2015, in part because of the steady increase in snuff consumption. Sustained implementation of proven tobacco prevention and control strategies is critical to reduce the use of tobacco product consumption in the United States.

The reason for higher cigarette consumption in 2015 compared with 2014 is uncertain. It might be attributable, in part, to changing U.S. economic conditions; increased electronic cigarette (e-cigarette) use; or dual use of conventional cigarettes and e-cigarettes, which could contribute to continued consumption among smokers who do not quit smoking completely (*1*,*7*). Continued monitoring is needed to evaluate the presence of a long-term trend. Research is warranted to assess how gross domestic product, unemployment, and other economic indicators might affect cigarette consumption, cessation, and initiation. Further research on the affect of e-cigarette use on patterns of conventional cigarette smoking,

TABLE. (*Continued*) Total and per capita* consumption of cigarettes, all combustible tobacco, noncigarette combustible tobacco, and smokeless tobacco products — United States, 2000–2015

Year	Total loose tobacco (roll-your-own, and pipe [cigarette equivalents])				Roll-your-own loose tobacco (cigarette equivalents)				Pipe tobacco (cigarette equivalents)			
	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change
2000	**8,994**	—	43	—	**5,995**	—	29		**2,999**	—	14	—
2001	**7,629**	-15.2	36	-16.2	**4,714**	-21.4	22	-22.3	**2,915**	-2.8	14	-4.0
2002	**8,494**	11.3	40	10.1	**5,737**	21.7	27	20.3	**2,757**	-5.4	13	-6.5
2003	**8,596**	1.2	40	0.1	**6,207**	8.2	29	7.0	**2,389**	-13.3	11	-14.3
2004	**8,914**	3.7	41	2.5	**6,600**	6.40	30	5.1	**2,314**	-3.2	11	-4.3
2005	**11,037**	23.8	50	22.4	**8,614**	30.5	39	29.1	**2,423**	4.7	11	3.6
2006	**10,915**	-1.1	49	-2.2	**8,594**	-0.2	38	-1.4	**2,322**	-4.2	10	-5.3
2007	**11,788**	8.0	52	6.7	**9,326**	8.5	41	7.3	**2,463**	6.1	11	4.8
2008	**13,307**	12.9	58	11.6	**10,721**	15.0	47	13.6	**2,586**	5.0	11	3.8
2009	**12,261**	-7.9	53	-8.9	**6,006**	-44.0	26	-44.6	**6,256**	142.0	27	139.3
2010	**15,519**	26.6	66	25.1	**3,168**	-47.3	13	-47.9	**12,351**	97.4	53	95.2
2011	**20,081**	29.4	85	28.8	**2,622**	-17.2	11	-18.1	**17,459**	41.4	73	39.9
2012	**21,422**	6.7	89	4.9	**2,240**	-14.6	9	-15.5	**19,183**	9.9	80	8.7
2013	**22,697**	5.9	94	4.9	**1,898**	-15.3	8	-16.1	**20,799**	8.4	86	7.4
2014	**21,820**	-3.9	89	-4.9	**1,594**	-16.0	6	-16.9	**20,226**	-2.8	82	-3.8
2015	**21,483**	-1.5	87	-2.5	**1,797**	12.7	7	11.6	**19,687**	-2.7	79	-3.6
% change, 2000–2015	—	**138.9†**	—	**102.2†**	—	**-70.0†**	—	**-74.6†**	—	**556.4†**	—	**455.7†**

Year	Total smokeless (chewing tobacco and snuff [lbs])				Chewing tobacco (lbs)				Snuff (lbs)			
	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change	Total (millions)	% change	Per capita	% change
2000	**111,746**	—	0.533	—	**45,594**	—	0.217	—	**66,152**	—	0.315	—
2001	**119,316**	6.8	0.562	5.5	**49,500**	8.6	0.233	7.3	**69,816**	5.5	0.329	4.3
2002	**118,564**	-0.6	0.552	-1.7	**47,311**	-4.4	0.220	-5.5	**71,253**	2.1	0.332	0.9
2003	**120,790**	1.9	0.556	0.8	**46,080**	-2.6	0.212	-3.6	**74,709**	4.9	0.344	3.7
2004	**121,149**	0.3	0.552	-0.8	**43,149**	-6.4	0.197	-7.4	**78,000**	4.4	0.355	3.2
2005	**119,452**	-1.4	0.538	-2.5	**39,199**	-9.2	0.177	-10.2	**80,253**	2.9	0.361	1.8
2006	**125,738**	5.3	0.560	4.1	**39,098**	-0.3	0.174	-1.4	**86,640**	8.0	0.386	6.7
2007	**123,672**	-1.6	0.544	-2.8	**35,304**	-9.7	0.155	-10.8	**88,368**	2.0	0.389	0.8
2008	**128,265**	3.7	0.558	2.5	**33,446**	-5.3	0.145	-6.4	**94,819**	7.3	0.412	6.0
2009	**125,479**	-2.2	0.540	-3.2	**30,425**	-9.0	0.131	-10.0	**95,054**	0.2	0.409	-0.8
2010	**127,527**	1.6	0.542	0.5	**27,615**	-9.2	0.117	-10.3	**99,912**	5.1	0.425	3.9
2011	**128,363**	0.7	0.540	-0.4	**24,801**	-10.2	0.104	-11.1	**103,562**	3.7	0.436	2.6
2012	**132,351**	3.1	0.551	2.0	**24,146**	-2.6	0.101	-3.7	**108,205**	4.5	0.451	3.4
2013	**135,440**	2.3	0.558	1.3	**22,434**	-7.1	0.092	-8.0	**113,007**	4.4	0.466	3.4
2014	**136,333**	0.7	0.556	-0.5	**21,965**	-2.1	0.090	-3.2	**114,368**	1.2	0.466	0.1
2015	**137,581**	0.9	0.555	-0.1	**20,156**	-8.2	0.081	-9.2	**117,425**	2.7	0.473	1.6
% change, 2000–2015	—	**23.1†**	—	**4.2**	—	**-55.8†**	—	**-62.6†**	—	**77.5†**	—	**50.3†**

* Adults aged ≥18 years as reported annually by the U.S. Census Bureau.
† Statistically significant (p<0.05) based on Joinpoint analysis.

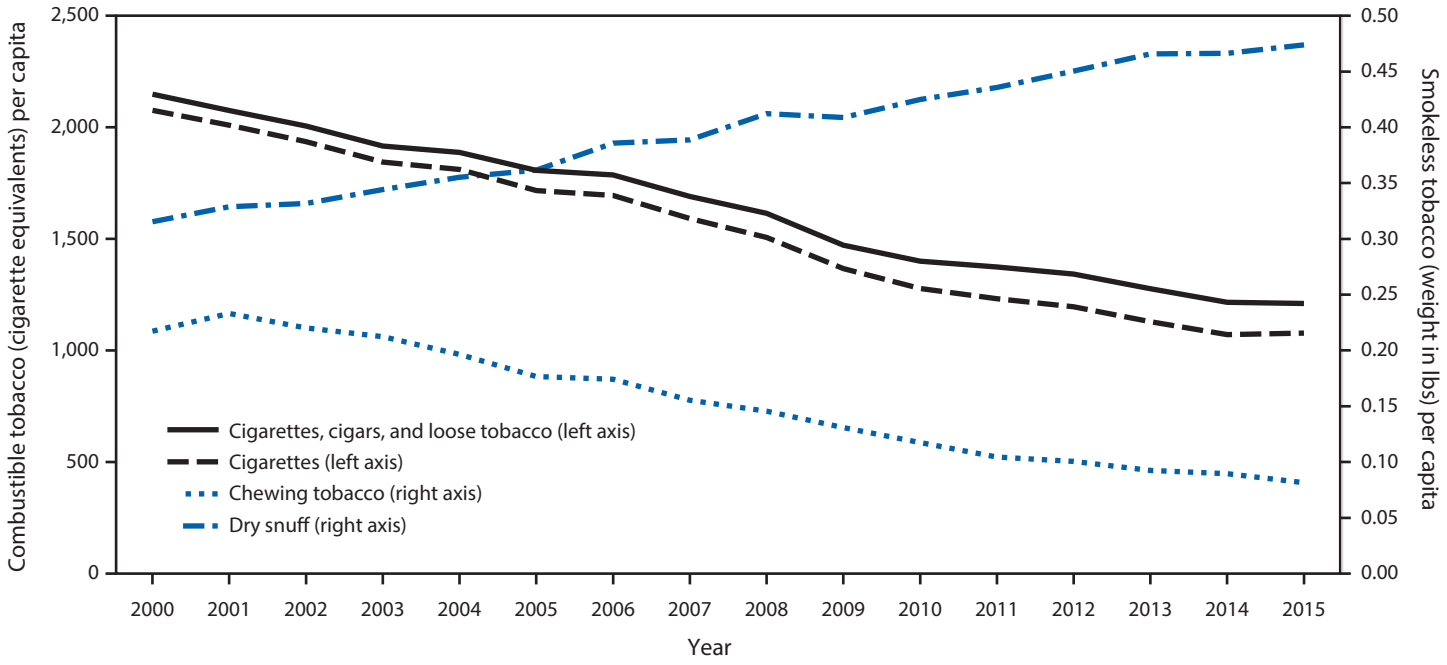
including consumption and dual use, could also help inform public health policy, planning, and practice.

Smokeless tobacco consumption has modestly increased during 2000–2015. These data provide insight into the diverging pattern of smokeless tobacco product consumption; during 2000–2015, the decline in chewing tobacco consumption was offset by a steady increase in snuff consumption. This increase might be attributable to advertising and promotion of these products. In 2013, tobacco companies spent $410.9 million promoting moist snuff, compared with $11.8 million for loose leaf chewing tobacco, $234,000 for plug/twist chewing tobacco, $485,000 for scotch/dry snuff, and $51.2 million for snus.¶ These findings underscore the importance of sustained efforts to monitor and reduce all forms of smokeless tobacco product use in the United States.

Recent changes in consumption patterns, particularly in large cigar and pipe tobacco use, have continued through 2015. Previous studies show that the tobacco industry adapted

¶ Federal Trade Commission Smokeless Tobacco Report for 2013. https://www.ftc.gov/system/files/documents/reports/federal-trade-commission-smokeless-tobacco-report-2013/2013tobaccorpt.pdf.

FIGURE 1. Consumption of combustible* and smokeless tobacco† — United States, 2000–2015



* Combustible tobacco includes cigarettes, cigars, and loose roll-your-own and pipe tobacco, and is measured as cigarette equivalents per capita.
† Smokeless tobacco includes chewing tobacco and dry snuff, and is measured as weight (lbs) per capita.

the marketing of roll-your-own products and designed cigars to minimize the burden of the federal excise tax, and thus, reduced these tobacco products' cost to the consumer (*8*–*10*). Because of these changes, roll-your-own tobacco was labeled and sold as lower-taxed pipe tobacco, and cigarette-like cigars were classified as lower-taxed large cigars (*8*,*10*). However, although consumption of pipe tobacco and cigars increased dramatically during 2009–2011, those product categories declined in recent years. There have been federal and state efforts to address product-switching tax avoidance activities (*9*,*10*). For example, a federal law** requires retailers to register as cigarette manufacturers if they offer consumers use of cigarette rolling machines (*10*). States have also taken steps to classify such retailers as manufacturers (*9*). Further evaluation and monitoring of these and other tax avoidance strategies could be beneficial at the state and national level, including monitoring any changes in consumption patterns that might emerge as tobacco product regulatory actions are implemented at the federal level.††

Summary

What is already known about this topic?

Combustible and smokeless tobacco use causes adverse health outcomes, including cardiovascular disease and multiple types of cancer. Cigarette consumption in the United States has declined overall since the 1960s, but consumption of other tobacco products has not.

What is added by this report?

During 2000–2015, total combustible tobacco consumption decreased 33.5%. Although total cigarette consumption decreased 38.7%, cigarettes remained the most commonly used combustible tobacco product. Notably, total cigarette consumption was 267.0 billion cigarettes in 2015 compared with 262.7 billion in 2014, or seven more cigarettes per capita. Consumption of noncigarette combustible tobacco (cigars, roll-your-own, pipe tobacco) increased 117.1%, or 83.8% per capita, during 2000–2015. For smokeless tobacco, total consumption increased 23.1%, or 4.2% per capita.

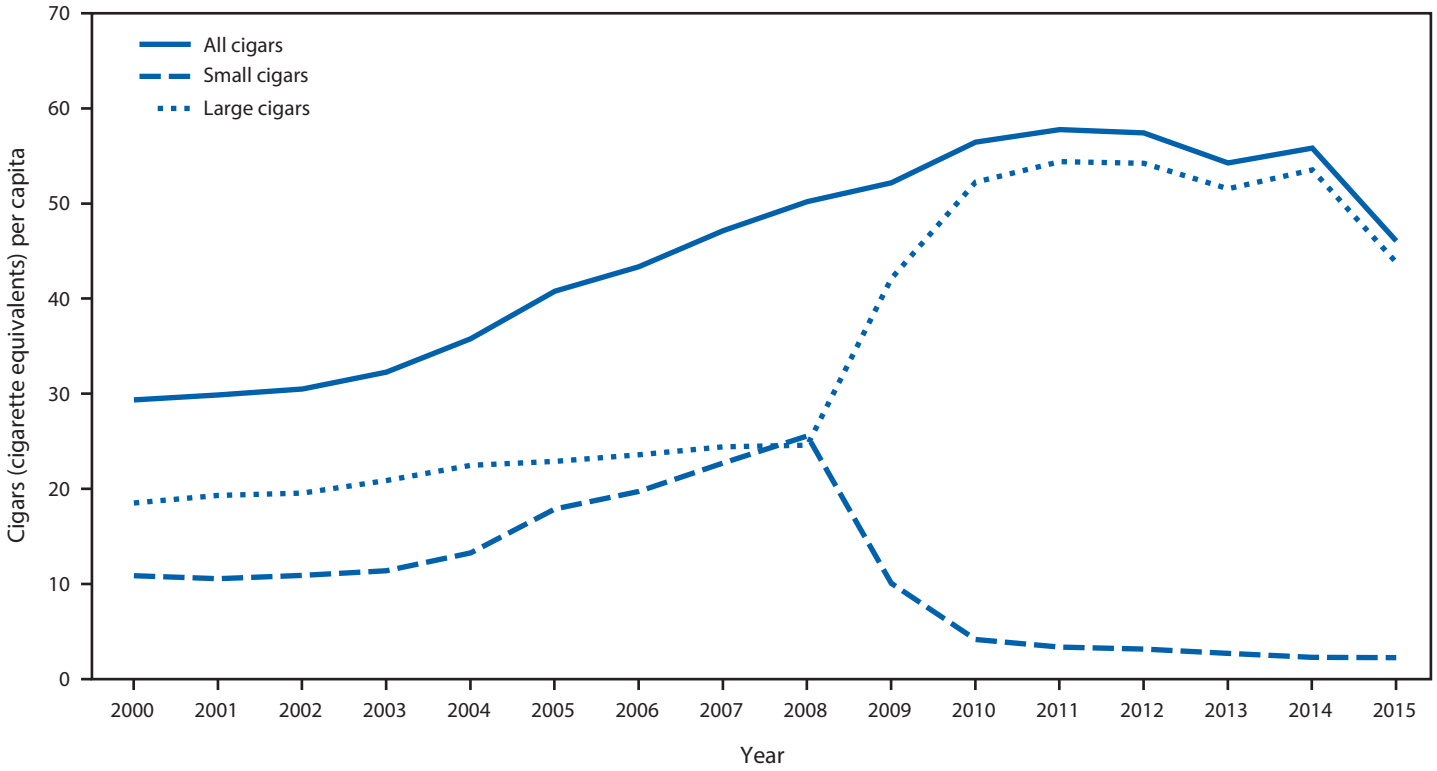
What are the implications for public health practice?

These changes in tobacco consumption demonstrate the importance of sustained tobacco prevention and control interventions, including price increases, comprehensive smoke-free policies, aggressive media campaigns, and increased access to cessation services. The implementation of evidence-based strategies addressing the diversity of tobacco products consumed in the United States can reduce tobacco-related disease and death.

** Congress. Pub. L. No. 112-141, 2012. Moving Ahead for Progress in the 21st Century Act of 2012 (MAP-21). http://www.gpo.gov/fdsys/pkg/BILLS-112hr4348enr/pdf/BILLS-112hr4348enr.pdf.

†† On May 5, 2016, the Food and Drug Administration finalized a rule extending its authority to all tobacco products, including cigars and pipe tobacco. https://www.federalregister.gov/documents/2016/05/10/2016-10685/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the.

FIGURE 2. Consumption of cigars* — United States, 2000–2015



* Cigars are measured as cigarette equivalents per capita. Small cigars are defined as cigars that weigh ≤3 lbs (1.36 kg) per 1,000 cigars, and large cigars are defined as cigars that weigh >3 lbs per 1,000 cigars.

The findings in this report are subject to at least four limitations. First, the measure for cigarette and combustible tobacco consumption does not account for illicit cigarette sales, such as those smuggled into or out of the country, or for untaxed cigarettes that are produced or sold on American Indian sovereign lands. Currently, no method exists for measuring or estimating illicit or untaxed tobacco trade in the United States. Second, it was not possible to assess consumption of other tobacco products, including e-cigarettes, hookah, or dissolvable tobacco, because federal taxes are not reported for those products. Third, sales data do not provide information on consumer demographics (e.g., age). Finally, sales data might not reflect actual consumption, because all purchased products might not be used by the consumer because of loss, damage, or tobacco cessation.

The overall decline in cigarette consumption is a pattern that has persisted in the United States since the 1960s (*1*). However, notable shifts have occurred in the tobacco product landscape in recent years, including an upward trend in consumption during 2014–2015. Smokeless tobacco consumption also increased steadily during 2000–2015. These changes in overall tobacco consumption demonstrate the importance of sustained tobacco prevention and control interventions, including price increases, comprehensive smoke-free policies, aggressive media campaigns, and increased access to cessation services (*5*). To further reduce tobacco product appeal and access, emerging strategies, such as prohibiting the sale of flavored tobacco products or increasing the legal age of tobacco purchase to 21 years, might also be beneficial.[§§] The implementation of evidence-based strategies addressing the diversity of tobacco products consumed in the United States can reduce tobacco-related disease and death.

[§§] Some communities, including New York City, New York, Chicago, Illinois, and Providence, Rhode Island, have prohibited the sale of flavored tobacco products. Furthermore, California, Hawaii and at least 200 communities have raised the legal age for purchasing tobacco to 21 years. More information can be found at Campaign for Tobacco Free Kids. http://www.tobaccofreekids.org/content/what_we_do/state_local_issues/sales_21/states_localities_MLSA_21.pdf.

[1]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Epidemic Intelligence Service, CDC.

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State Medicaid Expansion Tobacco Cessation Coverage and Number of Adult Smokers Enrolled in Expansion Coverage — United States, 2016

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In 2015, 27.8% of adult Medicaid enrollees were current cigarette smokers, compared with 11.1% of adults with private health insurance, placing Medicaid enrollees at increased risk for smoking-related disease and death (*1*). In addition, smoking-related diseases are a major contributor to Medicaid costs, accounting for about 15% (>$39 billion) of annual Medicaid spending during 2006–2010 (*2*). Individual, group, and telephone counseling and seven Food and Drug Administration (FDA)–approved medications are effective treatments for helping tobacco users quit (*3*). Insurance coverage for tobacco cessation treatments is associated with increased quit attempts, use of cessation treatments, and successful smoking cessation (*3*); this coverage has the potential to reduce Medicaid costs (*4*). However, barriers such as requiring copayments and prior authorization for treatment can impede access to cessation treatments (*3*,*5*). As of July 1, 2016, 32 states (including the District of Columbia) have expanded Medicaid eligibility through the Patient Protection and Affordable Care Act (ACA),*,† which has increased access to health care services, including cessation treatments (*5*). CDC used data from the Centers for Medicare and Medicaid Services (CMS) Medicaid Budget and Expenditure System (MBES) and the Behavioral Risk Factor Surveillance System (BRFSS) to estimate the number of adult smokers enrolled in Medicaid expansion coverage. To assess cessation coverage among Medicaid expansion enrollees, the American Lung Association collected data on coverage of, and barriers to accessing, evidence-based cessation treatments. As of December 2015, approximately 2.3 million adult smokers were newly enrolled in Medicaid because of Medicaid expansion. As of July 1, 2016, all 32 states that have expanded Medicaid eligibility under ACA covered some cessation treatments for all Medicaid expansion enrollees, with nine states covering all nine cessation treatments for all Medicaid expansion enrollees. All 32 states imposed one or more barriers on at least one cessation treatment for at least some enrollees. Providing barrier-free access to cessation treatments and promoting their use can increase use of these treatments and reduce smoking and smoking-related disease, death, and health care costs among Medicaid enrollees (*4*,*6*–*8*).

A *Healthy People 2020* objective (TU-8) calls for all state Medicaid programs to adopt comprehensive coverage of smoking cessation treatments.§ A previous study reported on state Medicaid coverage of cessation treatments during 2014–2015 in the population traditionally eligible for Medicaid coverage (*9*), but cessation coverage has not been reported among the population newly eligible for Medicaid expansion coverage in the 32 states (including the District of Columbia) that expanded Medicaid eligibility through ACA as of July 1, 2016. These states elected to expand coverage to a new eligibility group of adults aged <65 years known as the Medicaid expansion population (also known as the VIII group).

To estimate the number of adult cigarette smokers enrolled in Medicaid expansion coverage, 2014 BRFSS¶ estimates of state-specific smoking prevalence among self-reported Medicaid enrollees were multiplied by MBES** enrollment data for December 2015. Newly eligible Medicaid enrollees were defined as persons who were newly enrolled in Medicaid because of ACA Medicaid expansion. Some states expanded Medicaid eligibility to varying extents before ACA was enacted. The overall Medicaid expansion population estimates (Table 1) include persons who enrolled in Medicaid because of these previous state expansion actions, as well as persons who enrolled in Medicaid because of state Medicaid expansions under ACA. The newly eligible Medicaid population estimates include the latter group only.

* http://kff.org/health-reform/slide/current-status-of-the-medicaid-expansion-decision.

† Coverage for the adult expansion population must be offered through an alternative benefit plan. States generally have expanded coverage in one of two ways: by extending traditional Medicaid coverage to the Medicaid expansion population or by creating a benefit package that is not aligned with the state's traditional Medicaid state plan and using managed care for the expansion population. States can also provide subsidies to this population that are used to purchase coverage offered in the state or federally facilitated marketplace created by the Patient Protection and Affordable Care Act.

§ https://www.healthypeople.gov/2020/topics-objectives/topic/tobacco-use/objectives.

¶ Data were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) 2014 health care access module (http://www.cdc.gov/brfss/). Smoking prevalence estimates were calculated for 2014 BRFSS respondents aged 18–64 years who reported the following: 1) smoking ≥100 cigarettes during their lifetimes and smoking every day or some days at the time of the interview, and 2) having Medicaid or another state program as the primary source of their health care coverage. The relevant BRFSS question did not distinguish between traditional and expansion Medicaid coverage.

** https://www.medicaid.gov/medicaid-chip-program-information/program-information/medicaid-and-chip-enrollment-data/medicaid-enrollment-data-collected-through-mbes.html and http://kff.org/medicaid/issue-brief/an-overview-of-new-cms-data-on-the-number-of-adults-enrolled-in-the-aca-medicaid-expansion/.

To assess cessation coverage available to the state Medicaid expansion population as of July 1, 2016, the American Lung Association collected data on coverage of, and barriers to accessing, all evidence-based cessation treatments except telephone counseling[††] (a total of nine treatments) for state Medicaid expansion populations. The American Lung Association compiled data from Medicaid member websites and handbooks; Medicaid provider websites and handbooks; policy manuals; plan formularies and preferred drug lists; Medicaid state plan amendments; and relevant regulations and legislation. Personnel from state Medicaid agencies and health departments or other state government agencies were consulted to confirm the accuracy of collected information, retrieve missing documents, and reconcile discrepancies. Data were collected during July 19–August 18, 2016.

As of December 2015, approximately 3.3 million adult cigarette smokers were enrolled in Medicaid expansion coverage, including approximately 2.3 million adults who were newly eligible for Medicaid expansion coverage (Table 1). The number of adult smokers enrolled in Medicaid expansion coverage ranged from 2,567 in Alaska to 618,395 in New York; the number of newly eligible adult smokers enrolled in this coverage ranged from 2,567 in Alaska to 291,351 in Pennsylvania (Table 1).

As of July 1, 2016, nine of the 32 states that have expanded Medicaid eligibility (Colorado, Connecticut, Indiana, Massachusetts, Minnesota, North Dakota, Ohio, Pennsylvania, and Vermont) covered all nine cessation treatments for all Medicaid expansion enrollees (Table 2). Of the 32 states, 17 states covered individual counseling for all Medicaid expansion enrollees, 11 covered group counseling for all enrollees, and 19 covered all seven FDA-approved cessation medications for all enrollees. All 32 states imposed at least one barrier (e.g., copayments or prior authorization) on at least one treatment for at least some enrollees (Table 3). Six states required copayments for at least one cessation treatment for all enrollees, with an additional seven states requiring copayments for some enrollees. Twelve states required prior authorization to obtain at least one cessation treatment for all enrollees, with an additional 14 states requiring prior authorization for some enrollees.

[††] Telephone cessation counseling is available free to callers to state quitlines (including Medicaid enrollees) in all 50 states and the District of Columbia through the national quitline portal 1-800-QUIT-NOW, and therefore is not included in this report. In June 2011, the Centers for Medicare & Medicaid Services (CMS) announced that it would offer a 50% federal administrative match to state Medicaid programs for the cost of state quitline counseling provided to Medicaid enrollees. Although not discussed in this report, some state Medicaid programs cover or otherwise provide access to telephone counseling for at least some Medicaid enrollees.

Summary

What is already known about this topic?

Medicaid enrollees smoke cigarettes at a higher rate than do privately insured U.S. residents. States that expand Medicaid eligibility are able to extend coverage to large numbers of adult smokers who are not eligible for traditional Medicaid cessation coverage, thereby substantially increasing the potential impact of Medicaid cessation coverage.

What is added by this report?

By expanding Medicaid eligibility under the Affordable Care Act, 32 states have extended Medicaid cessation coverage to about 2.3 million adult smokers who were not previously eligible for Medicaid. All 32 of these states covered some cessation treatments for all Medicaid expansion enrollees. Nine states covered all nine cessation treatments considered in this study for all Medicaid expansion enrollees, and 19 states covered all seven FDA-approved cessation medications for all enrollees. All 32 states imposed one or more barriers to accessing at least one cessation treatment for at least some enrollees.

What are the implications for public health practices?

States that have expanded Medicaid can take further steps to help smokers quit by covering proven cessation treatments more fully, removing barriers to accessing covered treatments, making Medicaid enrollees and their health care providers aware of these treatments, and monitoring use of these treatments.

Discussion

Under the Medicaid expansion provision of ACA, states can expand Medicaid eligibility to include adults aged <65 years with incomes ≤138% of the Federal Poverty Level.[§§,¶¶] As of July 1, 2016, 32 states have expanded Medicaid eligibility, a step which has made Medicaid cessation coverage available to approximately 2.3 million adult smokers who were not previously eligible for Medicaid. Moreover, all of these states covered some cessation treatments for all Medicaid expansion enrollees, and 19 states covered all seven FDA-approved cessation medications for all enrollees. However, only nine states covered all nine cessation treatments, and all 32 states imposed one or more barriers to accessing cessation treatments for at least some enrollees. Several states, including Michigan and Minnesota, have made notable progress in removing barriers to cessation coverage for both their expansion and traditional (i.e., nonexpansion) Medicaid populations in recent years. Other states have made more recent progress in this regard. For example, Maryland removed copayments for cessation

[§§] http://housedocs.house.gov/energycommerce/ppacacon.pdf.

[¶¶] Although a June 2012 Supreme Court ruling held that a state cannot lose federal funding for its existing Medicaid program if it does not participate in the expansion, financial incentives exist for all states to expand eligibility for Medicaid coverage (National Federation of Independent Business, et al. v. Kathleen Sebelius, Secretary of Health and Human Services, et al.; 132 S. Ct. 2566 [2012]).

TABLE 1. Estimated number of current smokers aged 18–64 years in Medicaid Expansion—32 states,* December 2015

State	Adults enrolled in Medicaid				Adult smokers in Medicaid expansion	
	Total no.†	No. in Medicaid expansion†	No. newly eligible in Medicaid expansion†,§	Medicaid smoking prevalence¶	Total no.**	No. newly eligible**
Alaska	**124,883**	8,500	8,500	30.2	**2,567**	2,567
Arizona	**1,873,397**	412,957	105,711	30.4	**125,622**	32,157
Arkansas	**919,768**	291,602	266,741	NA	**NA**	NA
California	**NA**	NA	NA	NA	**NA**	NA
Colorado	**NA**	NA	NA	27.4	**NA**	NA
Connecticut	**840,619**	200,988	186,967	37.0	**74,426**	69,234
Delaware	**210,636**	60,006	9,280	37.4	**22,460**	3,474
District of Columbia	**243,612**	61,946	61,946	40.7	**25,224**	25,224
Hawaii	**313,126**	107,485	33,427	NA	**NA**	NA
Illinois	**2,869,749**	641,439	616,265	35.8	**229,892**	220,869
Indiana	**1,244,321**	361,687	222,364	48.3	**174,550**	107,313
Iowa	**585,978**	146,310	135,963	43.4	**63,499**	59,008
Kentucky	**1,274,166**	439,044	439,044	50.1	**219,785**	219,785
Louisiana	**1,444,601**	NA	NA	35.9	**NA**	NA
Maryland	**1,061,749**	231,484	231,484	30.3	**70,140**	70,140
Massachusetts	**1,805,041**	384,390	0	32.8	**126,157**	0
Michigan	**2,287,620**	613,761	579,378	40.9	**250,844**	236,792
Minnesota	**1,186,498**	208,492	207,683	32.6	**68,031**	67,767
Montana	**138,970**	NA	NA	51.3	**NA**	NA
Nevada	**NA**	NA	NA	35.6	**NA**	NA
New Hampshire	**187,999**	49,040	48,759	48.8	**23,946**	23,809
New Jersey	**NA**	NA	NA	23.0	**NA**	NA
New Mexico	**840,108**	235,425	235,425	30.4	**71,522**	71,522
New York	**5,768,918**	2,276,859	285,564	27.2	**618,395**	77,559
North Dakota	**NA**	NA	NA	43.8	**NA**	NA
Ohio	**2,930,308**	653,434	607,139	47.4	**309,466**	287,541
Oregon	**1,055,080**	518,904	452,269	35.8	**185,768**	161,912
Pennsylvania	**2,670,350**	603,335	547,962	53.2	**320,793**	291,351
Rhode Island	**279,851**	59,280	59,280	29.8	**17,671**	17,671
Vermont	**207,146**	60,678	0	36.8	**22,323**	0
Washington	**1,813,800**	592,114	577,422	34.2	**202,562**	197,536
West Virginia	**554,210**	174,999	174,999	48.9	**85,627**	85,627
Total	**34,732,504**	**9,394,159**	**6,093,572**	**NR**	**3,311,270**	**2,328,858**

Abbreviations: NA = not available; NR = not reported.

* Includes the District of Columbia.

† Enrollment estimates were drawn from the Centers for Medicare and Medicaid Services Medicaid Budget and Expenditure System (MBES) CMS 64 Total Medicaid Enrollees - VIII Group Break Out Report, October–December 2015, Updated June 2016 (https://www.medicaid.gov/medicaid/program-information/downloads/cms-64-enrollment-report-oct-dec-2015.pdf). MBES was missing information for seven expansion states for the period in question.

§ The total VIII group category includes persons who enrolled in Medicaid because of actions in some states that expanded Medicaid eligibility before enactment of the Patient Protection and Affordable Care Act (ACA) and persons who enrolled in Medicaid because of state Medicaid expansions under ACA. The total VIII group newly eligible category only includes the latter group.

¶ Data were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) 2014 health care access module (http://www.cdc.gov/brfss/). Smoking prevalence estimates were calculated for 2014 BRFSS respondents aged 18–64 years who reported: 1) smoking ≥100 cigarettes during their lifetimes and smoking every day or some days at the time of the interview, and 2) having Medicaid or another state program as the primary source of their health care coverage. The relevant BRFSS question did not distinguish between traditional and expansion Medicaid coverage.

** BRFSS smoking prevalence estimates from 2014 were applied to December 2015 enrollment data to generate estimates of smokers with expansion Medicaid coverage. Although one decimal point prevalence estimates are reported here, two decimal point prevalence estimates were used in calculating the total and newly eligible numbers of smokers in the VIII group.

medications for enrollees in both expansion and traditional Medicaid, effective October 21, 2016. In September 2016, California enacted legislation requiring the state Medicaid program to cover a comprehensive cessation benefit for both the expansion and traditional Medicaid populations, effective January 1, 2017. Providing and promoting evidence-based cessation coverage has been found to be a cost-effective way to help smokers quit. Among the Medicaid population in Massachusetts, an evidence-based, heavily promoted Medicaid cessation benefit was associated with a reduction in smoking prevalence, from 38.3% to 28.3% over a 3-year period (*7*). For each dollar spent on the benefit over a 3-year period, an estimated $3.12 in medical savings occurred from averted cardiovascular hospitalizations alone (*4*).

With regard to tobacco cessation coverage, Medicaid expansion coverage is subject to different ACA provisions than

TABLE 2. Medicaid expansion coverage of tobacco cessation treatments — 32 states,* July 1, 2016

State	Treatment								
	Individual counseling	Group counseling	Nicotine patch	Nicotine gum	Nicotine lozenge	Nicotine nasal spray	Nicotine inhaler	Bupropion	Varenicline
Alaska	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arizona	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arkansas	V	No	V	V	V	V	V	Yes	Yes
California	V	V	Yes	Yes	Yes	V	V	Yes	Yes
Colorado	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Connecticut	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delaware	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District of Columbia	NA	NA	Yes	Yes	Yes	V	V	Yes	Yes
Hawaii	Yes	V	Yes	Yes	V	V	V	Yes	Yes
Illinois	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiana	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iowa	V	V	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kentucky	V	V	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Louisiana	No	V	V	V	V	Yes	Yes	Yes	Yes
Maryland	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Massachusetts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Michigan	V	V	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minnesota	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Montana	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nevada	No	V	V	V	V	Yes	Yes	Yes	Yes
New Hampshire	V	No	V	V	V	Yes	Yes	Yes	Yes
New Jersey	V	V	Yes	V	Yes	V	V	Yes	Yes
New Mexico	V	V	Yes	Yes	Yes	V	V	Yes	Yes
New York	Yes	Yes	Yes	Yes	V	V	V	Yes	V
North Dakota	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ohio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oregon	V	V	Yes	Yes	V	V	V	Yes	Yes
Pennsylvania	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rhode Island	Yes	Yes	Yes	Yes	Yes	V	V	Yes	Yes
Vermont	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Washington	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
West Virginia	No	No	Yes	Yes	V	V	V	Yes	V
Totals									
Yes	**17**	**11**	**28**	**27**	**24**	**22**	**22**	**32**	**30**
No	**5**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	**9**	**10**	**4**	**5**	**8**	**10**	**10**	**0**	**2**
NA	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Abbreviations: NA = not available; V = varies by plan.
* Includes the District of Columbia.

traditional Medicaid coverage (*5*). Unlike traditional Medicaid coverage, Medicaid expansion coverage is subject to Section 1001 of ACA, which requires coverage without cost-sharing of preventive services receiving an A or B rating from the U.S. Preventive Services Task Force (USPSTF) (*5*). Tobacco cessation intervention has received an A-grade from USPSTF.***,†††

Guidance issued by the departments of Health and Human Services, Labor, and Treasury in May 2014 defines how this provision applies to cessation coverage.§§§ To assist with compliance with Section 1001, CMS is contacting states to ensure that they understand the previous guidance and to provide technical assistance for states to achieve compliance. Several states that currently require copayments for some cessation treatments for Medicaid expansion enrollees have indicated that they are planning to remove this requirement.

More comprehensive state Medicaid coverage of cessation treatments is associated with increased use of cessation medications and increased quit rates among smokers enrolled in Medicaid (*6*,*8*). Moreover, removing barriers such as

*** https://www.uspreventiveservicestaskforce.org/Page/Document/UpdateSummaryFinal/tobacco-use-in-adults-and-pregnant-women-counseling-and-interventions1.

††† The federal prohibition on cost-sharing for tobacco cessation services for the Medicaid expansion population in the new eligibility group for adults was explained in CMS guidance issued to state Medicaid agencies in 2012 (https://www.medicaid.gov/Federal-Policy-Guidance/downloads/SMD-12-003.pdf). CMS also issued an Information Bulletin in January 2016 on changes in Essential Health Benefit standards affecting Medicaid Alternative Benefit Plans, which reiterates the cost-sharing prohibition (https://www.medicaid.gov/federal-policy-guidance/downloads/cib-01-28-16.pdf).

§§§ https://www.dol.gov/ebsa/faqs/faq-aca19.html.

TABLE 3. Barriers to Medicaid expansion coverage of tobacco cessation treatments — 32 states,* July 1, 2016†

State	Copayments required	Prior authorization required	Counseling required for medications	Stepped-care therapy§	Limits on duration	Annual limits on quit attempts	Lifetime limits on quit attempts
Alaska	Yes	Yes	No	No	Yes	Yes	No
Arizona	No	No	No	No	Yes	Yes	No
Arkansas	V	V	No	No	V	V	No
California	No	V	No	V	V	V	No
Colorado	V	V	V	No	Yes	Yes	No
Connecticut	No	Yes	No	No	No	Yes	No
Delaware	Yes	Yes	Yes	Yes	Yes	Yes	No
District of Columbia	No	V	No	No	V	V	No
Hawaii	No	V	V	V	V	Yes	No
Illinois	Yes	No	No	No	No	No	No
Indiana	No	Yes	V	V	Yes	Yes	No
Iowa	No	Yes	Yes	Yes	Yes	Yes	No
Kentucky	No	Yes	No	V	Yes	Yes	No
Louisiana	V	V	V	V	V	V	No
Maryland	NA	Yes	No	Yes	No	Yes	No
Massachusetts	Yes	Yes	No	No	No	Yes	No
Michigan	No	No	No	No	V	No	No
Minnesota	No	NA	No	No	V	No	No
Montana	No	Yes	No	NA	NA	NA	No
Nevada	No	Yes	No	V	Yes	Yes	No
New Hampshire	V	No	No	No	V	V	No
New Jersey	No	V	No	V	No	V	V
New Mexico	No	V	V	No	V	V	No
New York	Yes	V	No	V	Yes	Yes	No
North Dakota	No	No	No	No	Yes	Yes	No
Ohio	V	V	No	V	V	V	No
Oregon	No	V	V	V	V	V	No
Pennsylvania	V	V	No	No	Yes	Yes	No
Rhode Island	No	Yes	V	V	Yes	Yes	No
Vermont	Yes	Yes	No	Yes	Yes	Yes	No
Washington	No	V	V	V	Yes	Yes	No
West Virginia	V	V	V	No	V	V	No
Totals							
Yes	**6**	**12**	**2**	**4**	**14**	**18**	**0**
No	**18**	**5**	**21**	**15**	**5**	**3**	**31**
V	**7**	**14**	**9**	**12**	**12**	**10**	**1**
NA	**1**	**1**	**0**	**1**	**1**	**1**	**0**

Abbreviations: NA = not available; V = varies by plan.
* Includes the District of Columbia.
† Barriers apply to one or more cessation treatments.
§ Refers to a requirement that a person try and fail to quit with one cessation medication before being able to access another cessation medication.

copayments, which pose a financial obstacle, and prior authorization, which can delay accessing services unless a process is in place to expedite authorization, further increases access to these treatments (*3*,*5*). Communicating to smokers and health care providers that cessation treatments are covered is also important to ensure that they are aware of and use covered treatments (*5*,*7*). A recent study found that only approximately 10% of Medicaid enrollees who smoked received a prescription for a tobacco cessation medication in 2013, with wide variation in use of cessation medications across states (*10*). Medicaid cessation coverage has the greatest effect when it is available to large numbers of smokers and is widely used (*5*,*7*).

The findings in this report are subject to at least four limitations. First, enrollment estimates were drawn from a new CMS reporting system whose primary purpose is to allow states to claim the enhanced Medicaid expansion federal matching rate; this system was missing information for seven expansion states for the assessment period. Second, the state smoking prevalence estimates were based on respondents who reported that they smoked and were enrolled in Medicaid; these estimates were not available for three states, and the relevant BRFSS question did not distinguish between traditional and Medicaid expansion coverage. In addition, 2014 smoking prevalence estimates were applied to December 2015 enrollment data to generate estimates of smokers enrolled in Medicaid expansion. Third, in cases where official coverage documents were not publicly available, were outdated, or conflicted with one another, state government personnel were consulted to provide additional

documentation or resolve discrepancies; this information might be inaccurate in some cases. Finally, cessation coverage can vary widely across Medicaid expansion managed care plans, making it challenging to determine coverage.

The 32 states that have expanded Medicaid eligibility under ACA are providing Medicaid cessation coverage to approximately 2.3 million adult smokers who were not previously eligible for Medicaid. These states can take further steps toward helping these smokers quit by more fully covering cessation treatments, removing barriers to accessing covered treatments, making Medicaid enrollees and providers aware of these treatments, and monitoring use of these treatments (*3*,*5*–*7*). State Medicaid programs that take these actions can substantially reduce tobacco use and tobacco-related disease and health care costs among a vulnerable population (*4*–*7*). Opportunities exist for the 19 states that have not expanded Medicaid eligibility to reduce smoking among low-income adults by making their cessation coverage more broadly available. Providing barrier-free access to cessation treatments and promoting their use are important components of a comprehensive approach to reducing tobacco use (*3*,*5*–*7*).

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Influenza Vaccination Coverage During Pregnancy — Selected Sites, United States, 2005–06 Through 2013–14 Influenza Vaccine Seasons

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Seasonal influenza vaccine is recommended for all pregnant women because of their increased risk for influenza-associated complications. In addition, receipt of influenza vaccine by women during pregnancy has been shown to protect their infants for several months after birth (*1*). As part of its case-control surveillance study of medications and birth defects, the Birth Defects Study of the Slone Epidemiology Center at Boston University has recorded data on vaccinations received during pregnancy since the 2005–06 influenza vaccination season. Among the 5,318 mothers of infants without major structural birth defects (control newborns) in this population, seasonal influenza vaccination coverage was approximately 20% in the seasons preceding the 2009–10 pandemic H1N1 (pH1N1) influenza season. During the 2009–10 influenza vaccination season, influenza vaccination coverage among pregnant women increased to 33%, and has increased modestly since then, to 41% during the 2013–14 season. Among pregnant women who received influenza vaccine during the 2013–14 season, 80% reported receiving their vaccine in a traditional health care setting, (e.g., the office of their obstetrician or primary care physician or their prenatal clinic) and 20% received it in a work/school, pharmacy/supermarket, or government setting. Incorporating routine administration of seasonal influenza vaccination into the management of pregnant women by their health care providers might increase coverage with this important public health intervention.

Influenza poses a serious threat to public health. In the United States, millions of persons are sickened, and thousands die each year of influenza and influenza-related illness (*2*,*3*). Because pregnant women infected with influenza are at increased risk for severe illness, hospitalization, and complications (*4*), in 2004, the Advisory Committee on Immunization Practices (ACIP) updated their guidance with the recommendation that "women who will be pregnant during the influenza season" receive the seasonal influenza vaccine, regardless of pregnancy trimester (*5*). In the influenza seasons after the ACIP recommendation (2006–07 through 2008–09), CDC estimated influenza vaccination coverage among pregnant women to be approximately 15%; coverage did not exceed 30% until it increased markedly (to 38%) during the 2009 H1N1 influenza pandemic (*6*). The most recent CDC study on influenza vaccination among pregnant women (2015–16 influenza season) reported overall coverage of 50%; an estimated 14% of women were vaccinated ≤5–6 months before pregnancy and 36% were vaccinated during pregnancy (*7*).

In 2006, the Birth Defects Study began to inquire specifically about receipt of influenza vaccine and other vaccines during pregnancy. The current report describes secular trends in seasonal influenza vaccination coverage among pregnant women in the Birth Defects Study during the nine seasons from 2005 through 2014, along with the settings in which pregnant women received their vaccinations.

The Birth Defects Study conducted surveillance during 1976–2015 using a case-control methodology described previously (*8*). Infants with major structural birth defects (cases) were identified at study centers that, for the present analysis, included participating hospitals in the areas surrounding Boston, Massachusetts, Philadelphia, Pennsylvania, and San Diego, California, as well as birth defects registries in New York and Massachusetts. Infants without structural defects (controls) were randomly selected each month from study hospitals' discharge lists or statewide vital statistics records. Within 6 months of delivery, mothers of case and control infants were invited to participate in a computer-assisted telephone interview conducted by trained study nurses. Data were collected on demographic characteristics, lifestyle factors, reproductive history, illnesses, and medications used from 2 months before the last menstrual period (LMP) through the end of pregnancy. Medication data included prescription and over-the-counter drugs and, for pregnancies that began in 2005 or later, any vaccines received during pregnancy. Women were asked to provide an exact date of vaccination or, if the vaccination date was not available, a range of possible dates, along with the setting or facility where the vaccine was administered (e.g., doctor's office/prenatal clinic, workplace, school, pharmacy/supermarket, or government site). All women who reported receiving a vaccine were asked to provide a release allowing study personnel to contact the vaccine provider to validate their vaccine report. If vaccine records were not available, the maternal report was accepted (*9*).

This analysis of influenza vaccination coverage was limited to pregnancies in control women that overlapped with the 2005–06 through 2013–14 influenza vaccine seasons. Each influenza vaccine season was defined as beginning on August 1 and continuing through July 31 of the following year. Among women who reported receiving influenza vaccine during

pregnancy, the exact date of vaccination obtained from the vaccination record was used to assign the influenza vaccination season during which vaccine was received, if the record was available; otherwise, the vaccination date the woman provided or the midpoint of the reported date range was used. To ensure equivalent opportunity for vaccination during each influenza season, the range of LMP dates among women who received each season's vaccine was identified; women whose LMPs fell within that range but did not receive the vaccine were included in the analysis as unvaccinated women.

Among the 5,318 pregnant women who participated in the study during the nine influenza vaccination seasons (2005–06 through 2013–14), 73% of vaccine doses administered were validated by provider records; the remaining 27% were ascertained by maternal self-report. Influenza vaccination coverage varied by season (Figure). During the 2009–10 influenza vaccination season, pH1N1 vaccine became available late in the season as a separate product; in subsequent seasons, pH1N1 vaccine has been included as a component of seasonal influenza vaccines. During the 2005–06 through 2008–09 influenza vaccination seasons, coverage ranged from 17%–20%. Seasonal influenza vaccination coverage increased to 33% during the 2009–10 season and to 35% for the pH1N1 vaccine. Coverage declined slightly during the next two influenza vaccination seasons (2010–11 and 2011–12), to 31% and 27% respectively; subsequently, in the 2012–13 and 2013–14 seasons, coverage increased again to 35% and 41%, respectively.

Overall, 79% of influenza vaccinations received by pregnant women were administered in a traditional health care setting (e.g., the office of their obstetrician or primary care physician or their prenatal clinic). During the nine influenza vaccination seasons, the proportion of vaccine doses received by pregnant women in these settings increased from 73% during the 2005–06 season to 80% during the 2013–14 season. The proportion of vaccine doses received in pharmacy/supermarket settings increased from 4% in 2005–06 to 8% in 2013–14; the proportion of doses received at work or school decreased from 23% in 2006–07 to 10% in 2013–14.

Summary

What is already known about this topic?

Pregnant women and their infants are at increased risk for complications from influenza infection. Influenza vaccination during pregnancy has been found to protect pregnant women and their infants for several months after birth; thus, increasing vaccination rates among women who are pregnant or might become pregnant during the influenza season is a core public health and clinical practice goal. CDC has estimated that influenza vaccination in this population increased during the 2009–10 pandemic H1N1 vaccination season and increased modestly since then.

What is added by this report?

Among participants in the Birth Defects Study, which included pregnant women in New York and Massachusetts and the areas surrounding Philadelphia, Pennsylvania, and San Diego, California, influenza vaccination coverage increased during the 2012–13 and 2013–14 influenza vaccination seasons, to 35% and 41%, respectively. Most influenza vaccines received by pregnant women were administered in physicians' offices or clinics.

What are the implications for public health practice?

Incorporating counseling and education about influenza vaccination during pregnancy and administration of seasonal influenza vaccine into the routine management of pregnant women would offer a potential opportunity to increase influenza vaccination coverage among this vulnerable group and help prevent influenza-associated morbidity and mortality among pregnant women and their infants.

Discussion

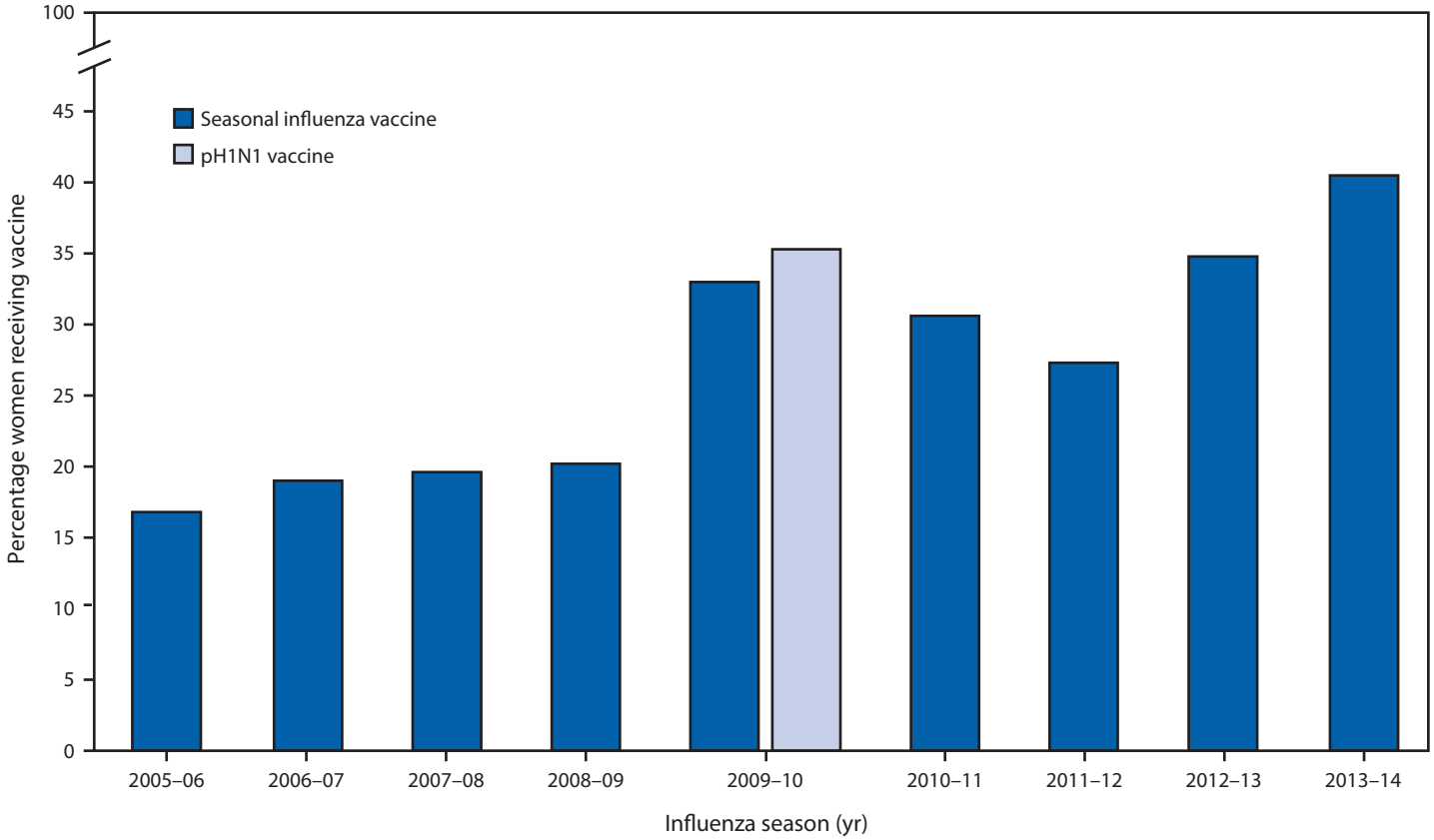
During the 2005–06 through 2008–09 influenza vaccination seasons, coverage with the seasonal influenza vaccine among pregnant women in the Birth Defects Study sites was approximately 20%. Coverage increased during the 2009–10 pH1N1 pandemic influenza vaccine season to approximately 33%, declined slightly in the next two seasons, and increased again during the 2012–13 and 2013–14 seasons, to 35% and 41%, respectively.

Approximately 21% of vaccine doses were administered in settings where the dose might not be recorded in the patient's medical record; thus, studies that obtain coverage estimates exclusively from medical record databases might underestimate actual coverage, and, in etiologic studies, this approach could lead to potential misclassification of vaccination status.

The findings in this report are subject to at least three limitations. First, this analysis identified vaccination during pregnancy only, whereas other studies included doses received ≤5–6 months before pregnancy; therefore, the coverage estimates from this analysis might be lower than estimates obtained in other studies. Second, influenza vaccination histories were ascertained by self-report and could be subject to misclassification; however, maternal reports in the Birth Defects Study were previously found to be accurate within a given trimester for 83% of women in this population (*10*), and 73% of reported vaccinations in the current study were confirmed by the vaccine providers' records. Finally, the study sites included in this analysis are not representative of the U.S. population and small numbers might have affected season-to-season variability.

Seasonal influenza vaccination during pregnancy among women living in the area of the Birth Defects Study sites more than doubled during the nine influenza vaccination seasons covered in this analysis, and although the trend is encouraging, coverage still falls far short of the 2016 ACIP recommendation

FIGURE. Receipt of seasonal influenza vaccine by pregnant women* participating in the Birth Defects Study† — United States, 2005–06 through 2013–14 influenza seasons



* Women participating as controls (i.e., mothers of infants without a structural birth defect).
† Participating hospitals in areas surrounding Boston, MA; Philadelphia, PA; and San Diego, CA; and birth defects registries in New York and Massachusetts.

that all pregnant women who are or might become pregnant during flu season be vaccinated. CDC found that during the 2015–16 influenza season, 63% of pregnant women whose health care provider recommended and offered influenza vaccination received the vaccine compared with 38% who received a recommendation but no offer, and only 13% of pregnant women who received no recommendation (*7*). Incorporating counseling and administration for seasonal influenza vaccine into the routine management of pregnant women can offer the best option for increasing influenza vaccination coverage among this vulnerable group to prevent influenza-associated morbidity and mortality among pregnant women and their infants.

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CDC Grand Rounds: Modeling and Public Health Decision-Making

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Mathematical models incorporate various data sources and advanced computational techniques to portray real-world disease transmission and translate the basic science of infectious diseases into decision-support tools for public health. Unlike standard epidemiologic methods that rely on complete data, modeling is needed when there are gaps in data. By combining diverse data sources, models can fill gaps when critical decisions must be made using incomplete or limited information. They can be used to assess the effect and feasibility of different scenarios and provide insight into the emergence, spread, and control of disease. During the past decade, models have been used to predict the likelihood and magnitude of infectious disease outbreaks, inform emergency response activities in real time (*1*), and develop plans and preparedness strategies for future events, the latter of which proved invaluable during outbreaks such as severe acute respiratory syndrome and pandemic influenza (*2*–*6*). Ideally, modeling is a multistep process that involves communication between modelers and decision-makers, allowing them to gain a mutual understanding of the problem to be addressed, the type of estimates that can be reliably generated, and the limitations of the data. As models become more detailed and relevant to real-time threats, the importance of modeling in public health decision-making continues to grow.

Predicting the Likelihood, Timing, and Magnitude of Infectious Disease Outbreaks

Federal agencies and academic partners are working to produce models with short- and long-term projections of when and where outbreaks will occur (*7*). For example, the "Predict the Influenza Season" challenge, started in 2013, moved influenza forecasting forward by engaging the scientific community to develop innovative and cost-effective methods to predict influenza activity and to more clearly identify areas of uncertainty in forecasting flu activity (*8*). This ongoing project encourages participants to predict the timing, peak, and intensity of influenza seasons by combining social media data (e.g., Twitter, internet search data, web surveys, etc.) and data from CDC's routine influenza surveillance systems (*9*). As part of the Influenza Virologic Surveillance Right Size project, a public health-academic partnership developed models that determine the minimum weekly number of specimens to be screened per public health laboratory to efficiently detect emerging viruses and select strains for inclusion in the next seasonal influenza vaccine (*10*).

This is another in a series of occasional MMWR *reports titled CDC Grand Rounds. These reports are based on grand rounds presentations at CDC on high-profile issues in public health science, practice, and policy. Information about CDC Grand Rounds is available at http://www.cdc.gov/about/grand-rounds.*

Providing Real-Time Insight During Public Health Emergencies

During public health emergencies, decision-makers need to quantify the risk to the public, delineate priorities with a clear and narrow focus, and maintain flexibility in considering options. During outbreak responses, modelers are asked to estimate the size of populations at risk for disease or death and the potential impact of interventions on both the timing and public health burden of an outbreak (Figure). By facilitating dialogue about what data are available and what data are needed to answer these questions, modelers can aid decision-makers as an outbreak situation evolves (*11*). Framing and addressing such questions via models helps leadership understand the appropriate size, type, time frame, and scale of resources needed to deploy interventions to maximize their impact. For example, one model produced during the Ebola virus disease (Ebola) response predicted the likelihood of the spread of Ebola from districts with reported Ebola cases to specific districts and neighboring countries with no reported cases. This forecast of geographic spread of Ebola allowed decision-makers to prioritize where to direct resources to improve surveillance (*12*).

To provide insight, modelers often must extract and combine useful information from diverse data sources, including traditional surveillance data, laboratory data, and social media, and collate them into meaningful information. Early in the West African Ebola epidemic, researchers at the University of Texas at Austin and Yale University used a combination of viral sequence data and case counts reported on the Sierra Leone Ministry of Health Facebook page to estimate the rate of spread and the clustered nature of Ebola transmission (*13*). During the 2009 H1N1 influenza pandemic, CDC modelers provided leaders, policy makers, and the public with near real-time modeled estimates of cases, hospitalizations, and deaths, corrected for underreporting (*14*,*15*). Before sufficient epidemiologic data existed, the modeled data allowed public health officials to more

readily appreciate the magnitude of the disease transmission and understand the dynamic of the pandemic as risk patterns changed over time. Knowing where influenza is spreading in near real time and anticipating the timing and severity of the peak can improve clinical practice by facilitating plans for hospital and laboratory surge capacity and the implementation of pharmaceutical and nonpharmaceutical interventions (*16*). This insight gives decision-makers more flexibility to match resources to needs during public health emergencies.

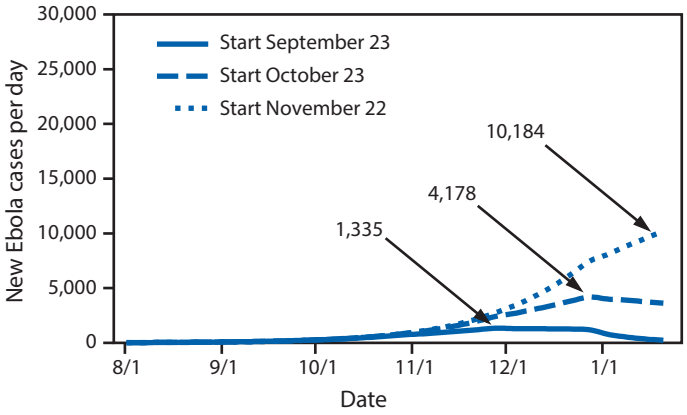
Modelers have provided critical support for emergency response activities by estimating the size and potential growth of outbreaks before large amounts of data were available, assessing the potential impact of interventions, identifying important data needs (e.g., value of what is known, value of what is not known, prioritization of data collection), and developing simple decision-support tools for broad dissemination (*11*)

Looking Back to Plan Ahead

Models can improve preparedness planning for infectious disease outbreaks and emergencies by providing critical information for quantitative public health decisions, such as those related to stockpiling and allocating public health resources and medical countermeasures (*17*). For example, during the Ebola response, modelers developed a tool to estimate the resources that might have been needed at any one time to treat Ebola patients if Ebola became widespread in the United States (*18*). Modelers also produced estimates to answer many post-H1N1 pandemic questions, including which groups experienced the most risk. Building on the modeling developed during that pandemic, modelers were able to confirm that influenza-related deaths and hospitalizations in children aged <18 years reached pandemic levels, when compared with influenza-related deaths during nonpandemic influenza seasons (*14*). Other valuable data estimating the number of cases, hospitalizations, and deaths averted because of vaccination and the use of influenza antiviral drugs can be used to allow public health officials to prepare for the next influenza pandemic.

Comparing model predictions with observations of real-life events can yield improvements in both model structure and parameter estimates. In this way, models "learn" from past outbreaks to improve data collection, situational awareness, and outbreak prediction. For example, after modelers assessed the effects of the 2009–2010 H1N1 influenza virus vaccination program by estimating the number of clinical cases, hospitalizations, and deaths prevented (*19*,*20*), CDC implemented a standardized data set and annual assessment of estimated seasonal influenza illnesses and hospitalizations averted because of vaccination, which can be used to improve model predictions.

FIGURE. Estimated impact of delaying intervention on daily number of Ebola virus disease (Ebola) cases — Ebola Response modeling tool, Liberia, 2014–2015*



Source: Meltzer MI, Atkins CY, Knust B, et al. Estimating the future number of cases in the Ebola epidemic—Liberia and Sierra Leone, 2014–2015. MMWR Suppl 2014;63(No. Suppl 3).
* Data are not corrected for underreporting.

Facilitating Communication

In addition to offering insight, modeling can assist communication among the multiple decision-makers involved with public health emergencies. Because models should only be used for the purpose for which they were intended, the back-and-forth dialogue required to ensure decision-makers understand the limitations of a specific model creates opportunities for leaders to articulate public health goals and better understand factors contributing to the dynamics of the modeled outbreak. These dialogues also allow decision-makers to explore the feasibility of interventions and estimate the resources required to implement such options.

Challenges and Limitations

A number of challenges can occur with the use of models for emergency response, planning, and preparedness. The technical challenges modelers typically encounter include a lack of quality and real-time data. Many models, such as those that predicted case counts of Ebola, are developed for a specific purpose, and thus might not be necessary for future planning. However, models that can be used repeatedly over time need clear plans for maintenance and future availability (*20*). The continued relevance and utility of models also can be impeded by evolving operating systems, web software, format of data inputs, and practical requirements for direct manipulation by model developers.

Other challenges that modelers and decision-makers confront relate to a lack of understanding about the modeling process and its limitations. The modeling process relies upon the questions that direct the development of estimates and projections produced (Box). An awareness of these guiding

BOX. Ten questions to guide model development, assessment, and improvement

1. What question or problem will the model address?
2. What information is needed to address the problem?
3. What information is already available?
4. What can be assumed?
5. What perspective will be used (e.g., societal, insurer/payer, employer)?
6. What will the model predict?
7. How will model predictions be used?
8. How will the predictions be tested?
9. Are the predictions valid?
10. Can the model be improved?

questions helps decision-makers better interpret and understand the limitations of models.

Models can help frame decision choices, but will seldom tell decision-makers which specific choices to make. Like every other tool, models can be misused, intentionally or unintentionally. Models are stylized representations of the world operating under specific assumptions; therefore, models capture only a part of the world's complexity. Decision-makers should be careful not to draw conclusions outside of the problem areas the model was designed to address.

Looking Ahead

Mathematical models are valuable decision-support tools that reveal outbreak dynamics, improve planning and preparedness, and aid communication between modelers and decision-makers. Future modeling possibilities are broad; for example, real-time genomic and antigenic virus fitness forecasting for selection of the best vaccine virus candidates is a possibility. As data availability and the accuracy of predictions improve, models will continue to provide valuable information to guide public health decision-makers. However, to sustain and advance modeling, attention and resources must be dedicated to improving data access, codifying best practices, and improving the nation's capacity to do modeling work. Modeling serves as an increasingly valuable resource for decision-makers in the emergence, spread, and control of outbreaks, and continued investments will pay large dividends over the long-term.

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Notes from the Field

Plague in Domestic Cats — Idaho, 2016

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In May 2015, *Yersinia pestis*, the bacterium that causes plague, was identified in dead Piute ground squirrels (*Urocitellus mollis*) reported through the Idaho Department of Fish and Game's wildlife mortality monitoring program; in June 2015, the Idaho Division of Public Health (DPH) sent an advisory to veterinarians in four southwestern Idaho counties requesting that they notify their local public health officials of suspected plague in animals.* *Y. pestis* was not confirmed in any pets during 2015.

During May 30–July 26, 2016, local veterinarians notified public health officials that five dogs and 12 cats were being evaluated for possible plague. Local veterinarians also performed necropsies, when applicable, to establish the diagnosis. Idaho's Central District Health Department and Eastern Idaho Public Health coordinated with DPH on submission of specimens to the DPH Bureau of Laboratories for *Y. pestis* testing and interviewed veterinary staff and pet owners. Specimens from blood, spleen, liver, and lymph nodes were screened using real–time polymerase chain reaction and confirmed by culture and phage lysis testing.

Among evaluated animals, *Y. pestis* was isolated from six of 12 cats; five of the six were from areas in southwestern Idaho where dead ground squirrels with confirmed *Y. pestis* had been reported in May 2016, and one was from from eastern Idaho. Among these six cats, specimen collection occurred during May 31–July 12, 2016; cats ranged in age from 10 months to 14.5 years (median = 4 years), four (67%) were male, five (83%) resided both indoors and outdoors, and one resided outdoor only. All six cats were domestic shorthair breed and had been neutered or spayed. Fever and lymphadenopathy (n = 4, 67%) were the most commonly reported signs of illness. None of the cats had known pulmonary involvement. Three of the six cats were treated with appropriate antibiotics (*1*); of these, two survived and one was euthanatized. The three other cats had died or had been euthanatized. All six cats reportedly had contact with ground squirrels and other wild rodents or rabbits before becoming ill; one had flea control administered before illness onset.

Cat owners, their household members, and veterinary staff were advised to be alert for fever and other plague symptoms (*2*) in themselves and other pets that might have had contact with the ill cats. Veterinary staff members were reminded about methods to prevent occupational exposure when managing pets suspected of having plague (*1*). In June 2016, an updated plague advisory was sent to veterinarians in four southwestern Idaho counties and eight eastern Idaho counties.† Local public health districts used the Idaho Health Alert Network to enhance situational awareness among health care providers and issue guidance on management and reporting of plague cases. Public communication strategies to raise awareness about the risk for and prevention of *Y. pestis* transmission to persons and pets included an online map of plague-affected areas, warnings posted in affected public areas, and press releases advising residents about preventive measures. No human plague cases were reported.

Cat-associated human plague cases, including fatalities, have been reported in the western United States since 1977 (*3*). Compared with dogs, cats are highly susceptible to plague illness and can transmit disease to humans directly through exposure to respiratory droplets and infectious body fluids associated with bites or scratches (*1*). Cats could also carry infected fleas into households. *Y. pestis*–infected cats usually develop fever, anorexia, lethargy, and lymphadenitis (submandibular in approximately 75% of cases); approximately 10% of cases are pneumonic (*4*) and present the most risk to pet owners and veterinary staff members. During 1926–2012, six (43%) of all primary pneumonic cases of human plague that occurred in the United States had contact with domestic cats (*5*). No plague vaccine for pets is available.

Veterinarians should consider the diagnosis of plague in pets, including cats, with compatible signs and exposure to rodent habitats, rodents, or ill pets in areas where plague is endemic or epizootic. Suspicion of plague should trigger the following actions by veterinary staff: 1) implementation of personal protective measures, including wearing masks and gloves; 2) isolation of the ill pet; 3) assessment of pulmonary involvement; 4) initiation of diagnostic testing for *Y. pestis*; 5) prompt administration of antibiotic therapy; 6) implementation of flea control for affected animals and the hospital environment; 7) provision of advice on household flea control to pet owner; and 8) notification of public health officials (*1*).

* http://www.healthandwelfare.idaho.gov/Portals/0/Health/Epi/105073_HW_ID_Disease_Bulletin_SEPT_2015_WEB.pdf.

† http://healthandwelfare.idaho.gov/Health/Epidemiology/tabid/111/ItemId/11032/Default.aspx.

Pet owners can reduce the risk for plague in pets by controlling pet roaming, implementing a flea control program, and minimizing rodent habitats and food sources inside and outside the home. Additional information on prevention of plague is available at http://www.cdc.gov/plague/prevention/index.html.

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Sarah Correll, DVM, Central District Health Department, Idaho; William Bosworth, Mark Drew, DVM, Idaho Department of Fish and Game.

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Notes from the Field

Investigation of *Elizabethkingia anophelis* Cluster — Illinois, 2014–2016

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Elizabethkingia spp., formerly known as *Flavobacterium* and *Chryseobacterium*, are multidrug-resistant, Gram negative bacilli found in the environment that can cause health care–associated outbreaks (*1*). *Elizabethkingia meningoseptica* was first identified by Elizabeth King in 1959 as a cause of meningitis outbreaks among hospitalized newborns (*2*). *Elizabethkingia anophelis* (EKA) was first identified in 2011 from the midgut of a mosquito (*3*); a recent series of cases from Hong Kong indicate that EKA health care–associated infections cause significant morbidity and have a high case-fatality rate (23.5%) (*4*).

In February 2016, the Wisconsin Department of Health Services notified the Illinois Department of Public Health (IDPH) and other neighboring health departments of an ongoing outbreak of EKA among Wisconsin residents. To determine if Illinois had related cases, IDPH sent memos on February 10 and March 29, 2016 to Illinois health care providers, infection preventionists and laboratories, requesting all available isolates of *Elizabethkingia spp.* dating back 2 years, to January 1, 2014. Twelve isolates from 11 patients were sent to CDC for testing; specimen collection dates ranged from June 23, 2014 to March 31, 2016.

On April 14, 2016, CDC informed IDPH that all submitted isolates were identified as EKA and that a genetic cluster (11 isolates from 10 patients) distinct from the Wisconsin outbreak strain had been identified, based on pulsed-field gel electrophoresis (PFGE) and whole genome sequencing (WGS). The eleven isolates were an average of 39.6 single nucleotide polymorphisms (SNPs) apart by WGS, with a range of 9–60 SNPs in the core of the genomic sequence shared across the isolates (80% of the genome). This SNP range corresponded to PFGE patterns with zero (indistinguishable) to three (closely related) band pattern differences. By comparison, some historic EKA isolates tested by CDC have differed by approximately 1,000 SNPs, with the more distantly related EKA strains differing by tens of thousands of SNPs. Phylogenetic analysis followed by bootstrapping statistical analysis provided strong support that these Illinois isolates clustered together and were genetically distinct from other EKA isolates submitted to CDC.

During April–June 2016, IDPH conducted an investigation to identify risk factors and a potential source of infection among the 10 EKA cases. Cases were defined as the culture of EKA from sterile sites or the respiratory tract of Illinois patients from January 1, 2014 onward, and at least one specimen that was <60 SNPs distance by WGS to the cluster pattern identified by CDC. Eight patients had positive blood cultures and two had positive respiratory specimens.

Medical records of the 10 patients for the 30 days before collection of the EKA-positive specimen were reviewed. The median age at patient diagnosis was 68 years (range = 35–83 years), and seven of the patients were male. Patients resided in three nonneighboring counties in Northern Illinois. Comorbidities were common: nine patients had chronic obstructive pulmonary disease, eight patients had diabetes and seven patients had unhealed wounds. Eight patients were intubated and mechanically ventilated at the time of the first positive culture and seven patients had a percutaneous endoscopic gastrostomy tube in place. The case fatality rate was high: seven of the 10 patients died before June 2, including six who died within 30 days of positive EKA specimen collection.

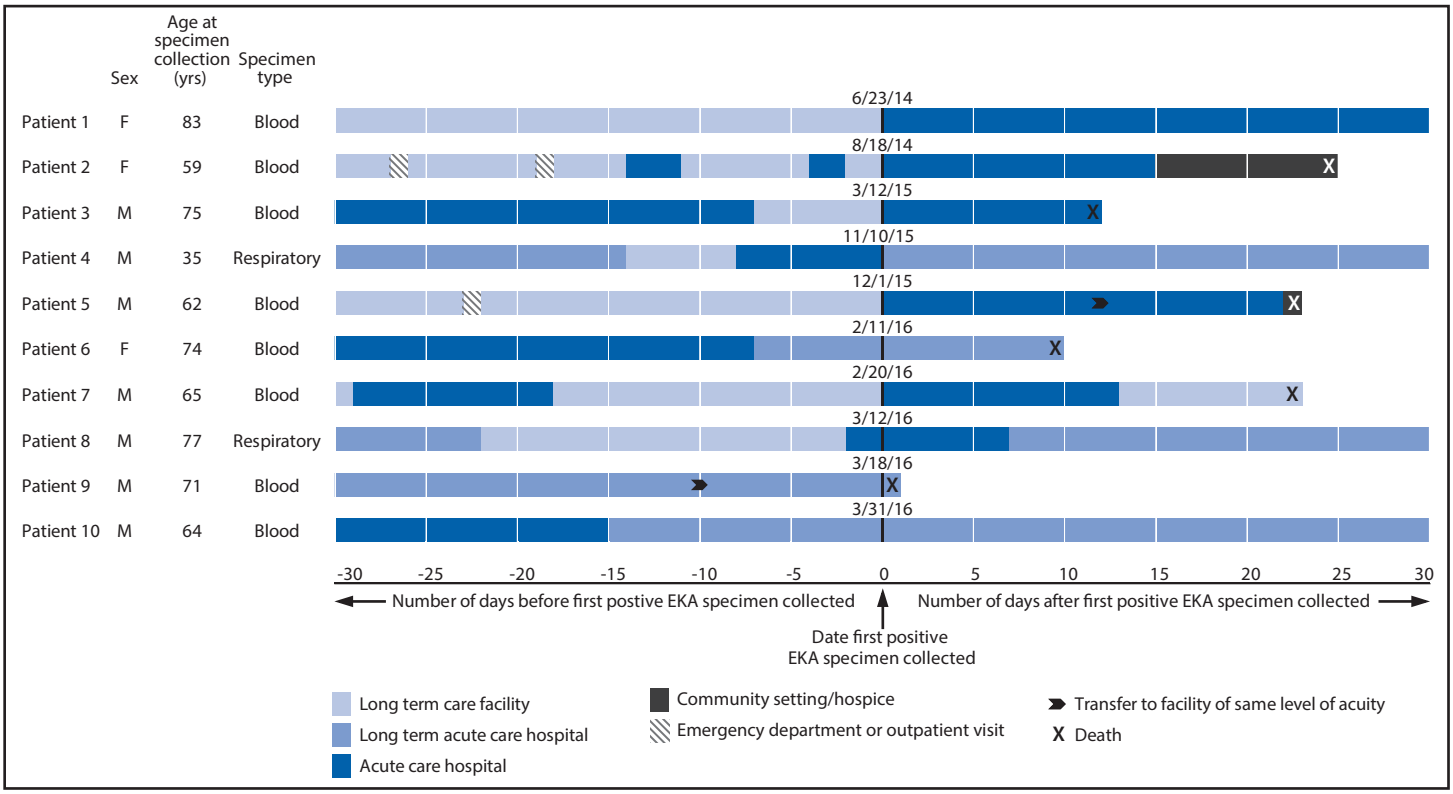
In the 30 days preceding the first positive culture, all 10 patients resided in a health care facility and nine had received care at two or more facilities (Figure). Patients received inpatient care in a total of 19 facilities, including eight hospitals, seven nursing homes, and two long-term acute care hospitals. Facility overlap was limited; two facilities provided care to two patients each.

Because isolated *Elizabethkingia spp.* infections are not reportable to IDPH, baseline incidence data were not available. To determine whether the 10 identified cases represented an increase in EKA infections, the 19 facilities with patients in the cluster were asked to report all patients with *Elizabethkingia spp*. infections from January 1, 2012 to May 16, 2016. Fifteen facilities responded and reported a total of 77 patients, with an average of 17.1 infections per year (range = 13–19). The average number of infections per facility was 5.1 (range = 1–16).

Three outbreaks (2008, 2009, and 2012–2013) of *Elizabethkingia meningoseptica* have been reported previously in Illinois healthcare facilities. Environmental isolates collected and stored from the 2012–2013 outbreak were sent to CDC for testing to better understand the genetic diversity of *Elizabethkingia spp.* in Illinois. WGS indicated that the 2012–2013 environmental isolates were actually EKA and that their genomes clustered with the 2014–2016 case isolates by both PFGE and WGS.

The evidence does not support a finding that the recently identified cluster represents an acute, point source outbreak, given the lack of common facility exposure among patients, and that the number of infections in 2014–2016 reported by facilities did not appear to be higher than in previous years and

FIGURE. Patient* and specimen characteristics and health care facility exposures and outcomes 30 days before and after first positive specimen collection — *Elizabethkingia anophelis* (EKA) cluster, Illinois, 2014–2016



* After the investigation was completed, the isolate from patient 5 was determined to be 160–170 single nucleotide polymorphisms distance from the isolates in the genetic cluster.

the isolates from the 2014–2016 cluster matched environmental isolates from the 2012–2013 outbreak. Instead, this more likely represents ongoing sporadic infection among critically ill patients. Of note, after the investigation was completed, additional genetic analysis conducted by CDC indicated that one of the isolates initially identified as part of the cluster had a distinct PFGE pattern and by WGS, differed from the cluster genomes by 160–170 SNPs.

Molecular typing methods can identify clusters that might not be recognized by epidemiologic factors alone, and advanced techniques, such as WGS, can provide an additional level of discrimination compared with more established approaches, such as PFGE. However, molecular typing results must be interpreted cautiously, particularly for rare organisms for which there is limited information about mutation rates and genetic diversity. The findings of this cluster investigation emphasize that epidemiologic and clinical data remain critical to defining outbreaks and informing investigations.

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Erratum

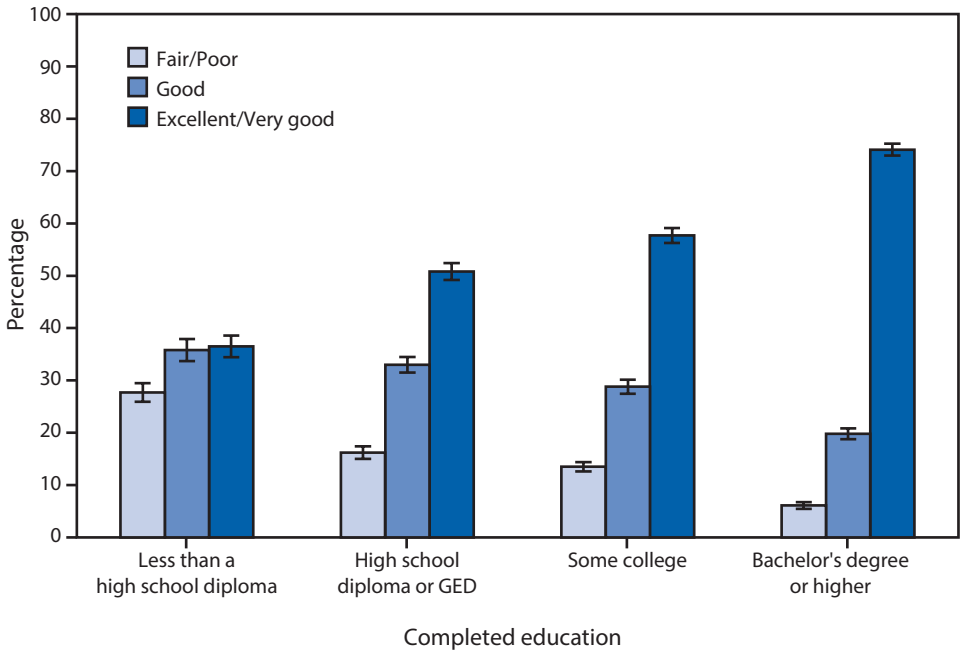
Vol. 65, No. 44

In the report, "Incidence of Zika Virus Disease by Age and Sex — Puerto Rico, November 1, 2015–October 20, 2016," on page 1219 the following person should have been included as an author: **Luisa I. Alvarado, MD, Ponce Health Sciences University-Saint Luke's Episcopal Hospital Consortium, Puerto Rico.**

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage Distribution* of Respondent-Assessed Health Status† Among Adults Aged ≥25 Years, by Completed Education — National Health Interview Survey,§ United States, 2015



Abbreviation: GED = General Educational Development high school equivalency diploma.

* With 95% confidence intervals indicated with error bars.

† Based on a survey question that asked respondents, "Would you say [subject name's] health in general was excellent, very good, good, fair, or poor?" This information was obtained during a part of the interview that allowed proxy responses, such that a knowledgeable adult family member could respond on behalf of sample adults not taking part in this interview. "Excellent" and "very good" are combined as are "fair" and "poor."

§ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population, are shown for sample adults aged ≥25 years, and are age-adjusted to the projected 2000 U.S. population as the standard population using four age groups: 25–44, 45–64, 65–74, and ≥75 years.

In 2015, health status improved as the level of education increased; 74% of adults with a bachelor's degree or higher were in excellent or very good health compared with almost 37% of adults with less than a high school diploma. Nearly 28% of adults with less than a high school diploma were in fair or poor health compared with 6% of adults with a bachelor's degree or higher.

Source: Blackwell DL, Villarroel MA. Tables of summary health statistics for U.S. adults: 2015 National Health Interview Survey. National Center for Health Statistics 2016. http://www.cdc.gov/nchs/nhis/SHS/tables.htm.

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