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Tobacco Use in Top-Grossing Movies — United States, 2010–2016

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The Surgeon General has concluded that there is a causal relationship between depictions of smoking in the movies and the initiation of smoking among young persons (*1*). The more youths see smoking on screen, the more likely they are to start smoking; youths who are heavily exposed to onscreen smoking imagery are approximately two to three times as likely to begin smoking as are youths who receive less exposure (*1*,*2*). A *Healthy People 2020* objective is to reduce the proportion of youths exposed to onscreen tobacco marketing in movies and television (Tobacco Use Objective 18.3) (*3*). To assess the recent extent of tobacco use imagery in youth-rated movies (G, PG, PG-13*), 2010–2016 data from Thumbs Up! Thumbs Down! (TUTD), a project of Breathe California of Sacramento-Emigrant Trails were analyzed and compared with previous reports.† In 2016, 41% of movies that were among the 10 top-grossing movies in any calendar week included tobacco use, compared with 45% in 2010. Among youth-rated movies, 26% included tobacco use in 2016 (including 35% of PG-13 movies) compared with 31% in 2010 (including 43% of PG-13 movies). The steady decline in the number of tobacco incidents in youth-rated movies from 2005–2010 stopped after 2010. The total number of individual occurrences of tobacco use in a movie (tobacco incidents) in top-grossing movies increased 72%, from 1,824 in 2010 to 3,145 in 2016, with an increase of 43% (from 564 to 809) occurring among PG-13 rated movies. Reducing tobacco use in youth-related movies could help prevent the initiation of tobacco use among young persons.

TUTD counts occurrences of tobacco incidents, defined as the use or implied use of a tobacco product (cigarettes, cigars, pipes, hookah, smokeless tobacco products, and electronic cigarettes) by an actor, in U.S. top-grossing movies each year. Trained monitors count all tobacco incidents in those movies that are among the 10 top-grossing movies in any calendar week of the year. Previous reports have used this criterion because U.S. movies ranked in the 10 top-grossing movies for at least 1 week have accounted for 96% of U.S. ticket sales (*4*–*6*). At least two monitors independently evaluate each film; any differences are resolved by a supervisor who independently watches the film using the same protocol. Incidents of implied use have been rare and occur when a person is handed or is holding, but does not necessarily use, a tobacco product. A new incident was counted each time 1) a tobacco product went off screen and then came back on screen; 2) a different actor was shown with a tobacco product; or 3) a scene changed and the new scene contained the use or implied use of a tobacco product.§

* Ratings assigned by the Motion Picture Association of America (a trade organization that represents the major movie studios) include the following: General Audiences (G): all ages admitted; Parental Guidance Suggested (PG): some material might not be suitable for children; Parents Strongly Cautioned (PG-13): some material might be inappropriate for children under 13; and Restricted (R): under 17 requires accompanying parent or adult guardian.

† https://smokefreemovies.ucsf.edu/.

§ Two common methods used to count smoking incidents in movies are to count the number of scenes in which tobacco use occurs or to count the number of cuts in which tobacco use occurs. Despite the difference in methods, both metrics have consistent results and are valid for comparing the results across ratings, years, companies, etc.

INSIDE

687 Babesiosis Surveillance — Wisconsin, 2001–2015
692 Two Outbreaks of Trichinellosis Linked to Consumption of Walrus Meat — Alaska, 2016–2017
697 Vital Signs: Changes in Opioid Prescribing in the United States, 2006–2015
705 Notes from the Field: An Outbreak of Shiga Toxin–Producing *Escherichia coli* O121 Infections Associated with Flour — Canada, 2016–2017
708 QuickStats

Continuing Education examination available at https://www.cdc.gov/mmwr/cme/conted_info.html#weekly.

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To calculate the percentage of movies with tobacco incidents, the number of movies with tobacco incidents was divided by the total number of movies, and the average number of tobacco incidents per movie was calculated for each motion picture company. For each year during 2010–2016, the number of top-grossing movies with tobacco incidents and overall number of tobacco incidents were calculated. Results were also analyzed by Motion Picture Association of America (MPAA) ratings (G, PG, PG-13, R). Findings were also compared with data from reports from 1991–2010 (*4*,*5*).

In 2016, among 143 top-grossing movies, 59 (41%) had tobacco incidents, compared with 62 (45%) of 137 in 2010; among top-grossing R-rated movies, 35 (67%) of 52 had tobacco incidents in 2016, compared with 35 (71%) of 49 in 2010 (Table 1). Among youth-rated movies (G, PG, or PG-13), 24 (26%) of 91 had tobacco incidents in 2016, compared with 27 (31%) of 88 in 2010. Overall, from 2010 to 2016, the number of top-grossing movies with tobacco incidents ranged from 58 in 2014 to 76 in 2013 (Table 1).

Although the percentage of top-grossing movies with tobacco incidence decreased during 2010–2016, the total number of tobacco incidents in top-grossing movies increased by 72%, from 1,824 to 3,145 (Table 2). The total number of incidents in G or PG movies decreased by 87% (from 30 to 4), whereas the number in PG-13 movies increased 43% (from 564 to 809), and the number in R-rated movies increased 90% (from 1,230 to 2,332). Compared with previous studies (*4*,*5*), smoking incidents had peaked at 3,962 incidents in 2005; the year with the lowest number of recorded smoking incidents (1,613) was 1998 (Figure). During 2010–2016, the lowest number of tobacco incidents (1,743) occurred in 2015; the highest number since 2010 (3,145) occurred in 2016, representing an 80% increase compared with the previous year.

Discussion

The findings in this report indicate that although there were previously reported declines in the number of youth-rated movies with tobacco incidents observed during 2005–2010 (*4*,*5*), since 2010 there has been no progress in reducing the total number of tobacco incidents in youth-rated movies. Had the trend established from 2005 to 2010 continued, all youth-rated films would have been smoke-free by 2015. Although there were fewer top-grossing movies depicting tobacco use in 2016 compared with 2010, an increase in the number of such incidents occurred, thereby concentrating exposure to tobacco use in fewer films. The average number of tobacco incidents increased 55% in youth-rated movies with any tobacco depiction, from 22 incidents in 2010 to 34 incidents in 2016, and increased 91% in R-rated films with any tobacco depictions, from 35 incidents in 2010 to 67 incidents in 2016. Tobacco use depictions are now uncommon in G and PG films; however, the 43% increase in the total number of tobacco-use incidents in PG-13 movies, from 564 in 2010 to 809 in 2016, is of particular public health concern because of the established causal relationship between youths' exposure to smoking in movies and smoking initiation (*1*).

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TABLE 1. Number and percentage of top-grossing movies with any tobacco incidents, by Motion Picture Association of America (MPAA) rating and movie company — United States, 2010–2016

		No. (%)							
Movie company	**MPAA rating***	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Comcast (Universal)	G/PG	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0 (0)**
	PG-13	1 (17)	4 (40)	3 (50)	2 (29)	6 (67)	3 (30)	2 (18)	**21 (36)**
	R	6 (86)	6 (86)	8 (73)	10 (77)	5 (71)	5 (50)	2 (22)	**42 (66)**
Disney	G/PG	1 (11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**1 (2)**
	PG-13	0 (0)	3 (60)	1 (33)	2 (40)	0 (0)	2 (50)	1 (20)	**9 (32)**
	R	0 (0)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	**2 (100)**
Fox	G/PG	0 (0)	2 (29)	1 (17)	0 (0)	0 (0)	0 (0)	0 (0)	**3 (7)**
	PG-13	3 (38)	3 (50)	2 (40)	2 (33)	4 (57)	4 (36)	4 (67)	**22 (45)**
	R	5 (71)	2 (100)	3 (100)	6 (100)	5 (63)	5 (100)	4 (80)	**30 (83)**
Independents†	G/PG	3 (60)	0 (0)	1 (50)	2 (67)	1 (20)	2 (67)	1 (17)	**10 (37)**
	PG-13	6 (55)	6 (46)	12 (52)	10 (50)	9 (47)	10 (59)	6 (38)	**59 (50)**
	R	15 (83)	6 (67)	15 (68)	19 (83)	7 (58)	16 (70)	16 (70)	**94 (72)**
Sony	G/PG	0 (0)	1 (17)	1 (33)	1 (33)	2 (50)	1 (20)	0 (0)	**6 (24)**
	PG-13	8 (67)	7 (58)	6 (60)	4 (57)	5 (71)	3 (50)	3 (33)	**36 (57)**
	R	2 (67)	7 (78)	6 (75)	5 (83)	5 (83)	4 (100)	5 (100)	**34 (83)**
Time Warner (Warner Bros.)	G/PG	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	**1 (8)**
	PG-13	2 (22)	4 (33)	4 (44)	3 (27)	2 (25)	4 (50)	2 (20)	**21 (31)**
	R	4 (50)	3 (50)	5 (83)	3 (50)	3 (33)	6 (60)	4 (67)	**28 (55)**
Viacom (Paramount)	G/PG	0 (0)	3 (60)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**3 (23)**
	PG-13	3 (75)	3 (50)	2 (40)	1 (25)	2 (25)	2 (67)	5 (56)	**18 (46)**
	R	3 (50)	1 (33)	3 (75)	4 (100)	2 (67)	2 (67)	4 (100)	**19 (70)**
Subtotal by ratings	All G/PG	4 (11)	6 (14)	3 (11)	4 (21)	3 (12)	3 (13)	1 (4)	**24 (13)**
	All PG-13	23 (43)	30 (47)	30 (49)	24 (40)	28 (46)	28 (47)	23 (35)	**186 (44)**
	All youth-rated§	27 (31)	36 (37)	33 (37)	28 (35)	31 (36)	31 (38)	24 (26)	**210 (34)**
	All R	35 (71)	26 (70)	40 (74)	48 (81)	27 (60)	38 (69)	35 (67)	**249 (71)**
All ratings		**62 (45)**	**62 (46)**	**73 (51)**	**76 (55)**	**58 (44)**	**69 (50)**	**59 (41)**	**459 (51)**

* G = General Audiences (all ages admitted); PG-13 = Parents Strongly Cautioned (some material might be inappropriate for preteenagers); R = Restricted (under age 17 requires accompanying parent or adult guardian).
† Independent movie companies include producer-distributors that are not members of MPAA, but regularly adhere to MPAA ratings and advertising rules.
§ Youth-rated includes G/PG and PG-13.

The six major motion picture companies have policies to reduce depictions of tobacco use in youth-rated films,¶ which likely contributed to the reduction in the number of movies with tobacco incidents during 2005–2010. TUTD started systematic data collection of onscreen tobacco use in movies in 1991. Occurrences of tobacco use in movies varied from 1991 to 2010, reaching a peak in 2005 then declining by almost half by 2010 (*4*,*5*). Public health organizations, investors, state health departments, and state attorneys general raised concerns regarding tobacco incidents in movies beginning in 2001, which might account, in part, for the decrease in onscreen tobacco incidents after 2005 and before major motion picture companies adopted policies regarding tobacco imagery in youth-rated films (*4*,*5*). However, the lack of progress in recent years suggests that enhanced measures to address tobacco incidents in movies are warranted.

One such intervention would be the assignment of an R rating to any movie with smoking or other tobacco-use imagery (unless the portrayal is of actual historical figures who smoked, a documentary, or if the portrayal includes the negative effects of tobacco use) (*7*–*9*). Other interventions include certifying that no payments have been received by the studio or producers for depicting tobacco use in the movies and ending the onscreen depiction of actual tobacco brands (*7*,*8*). These and additional interventions, if implemented, could help eliminate tobacco incidents in youth-rated movies (*7*–*9*). State and local health departments could also work with state agencies that manage movie subsidies to ensure that such subsidies do not go to films that include depictions of tobacco use. During 2010–2016, approximately 24 states awarded approximately $3.5 billion in public subsidies, such as tax credits, to productions of movies with tobacco incidents, including youth-rated movies.**

Currently the MPAA does not assign R ratings to movies based on tobacco use incidents. In 2007, the MPAA developed a smoking "rating descriptor" that is applied to a few movies that contain smoking. These descriptors can appear in fine print in the box with the letter rating for a movie and can appear on advertisements and promotions to describe the type of content in a movie, such as language, violence, nudity, or sexual content. However, 89% of top-grossing, youth-rated movies with smoking did not carry the MPAA "smoking descriptor" in 2015 (*9*).

¶ https://smokefreemovies.ucsf.edu/sites/default/files/All%20tobacco%20depiction%20policies%200916.pdf.

** https://smokefreemovies.ucsf.edu/policy-solutions/end-public-subsidies/how-you-pay.

TABLE 2. Number of tobacco incidents in top-grossing movies, by Motion Picture Association of America (MPAA) rating and movie company — United States, 2010–2016

Movie company	MPAA rating*	2010	2011	2012	2013	2014	2015	2016	Total
Comcast (Universal)	G/PG	0	0	0	0	0	0	0	**0**
	PG-13	19	78	39	53	173	11	266	**639**
	R	35	154	251	398	76	113	50	**1,077**
Disney	G/PG	10	0	0	0	0	0	0	**10**
	PG-13	0	148	102	57	0	123	6	**436**
	R	0	20	0	4	0	0	0	**24**
Fox	G/PG	0	3	2	0	0	0	0	**5**
	PG-13	96	174	205	3	101	150	145	**874**
	R	274	36	47	278	210	59	47	**951**
Independents†	G/PG	20	0	19	2	15	5	4	**65**
	PG-13	132	22	282	315	625	187	128	**1,691**
	R	582	216	720	511	559	456	889	**3,933**
Sony	G/PG	0	9	2	1	12	83	0	**107**
	PG-13	198	166	178	26	184	15	144	**911**
	R	33	537	246	155	225	156	576	**1,928**
Time Warner (Warner Bros.)	G/PG	0	0	0	5	0	0	0	**5**
	PG-13	4	106	265	309	16	30	40	**770**
	R	80	62	267	233	343	322	541	**1,848**
Viacom (Paramount)	G/PG	0	95	0	0	0	0	0	**95**
	PG-13	115	50	92	12	66	3	80	**418**
	R	226	4	166	217	34	30	229	**906**
Subtotals by ratings	All G/PG	30	107	23	8	27	88	4	**287**
	All PG-13	564	744	1,163	775	1,165	519	809	**5,739**
	All youth-rated§	594	851	1,186	783	1,192	607	813	**6,026**
	All R	1,230	1,029	1,697	1,796	1,447	1,136	2,332	**10,667**
All ratings		**1,824**	**1,880**	**2,883**	**2,579**	**2,639**	**1,743**	**3,145**	**16,693**

* G = General Audiences (all ages admitted); PG-13 = Parents Strongly Cautioned (some material might be inappropriate for preteenagers); R = Restricted (under age 17 requires accompanying parent or adult guardian).
† Independent movie companies include producer-distributors that are not members of MPAA, but regularly adhere to MPAA ratings and advertising rules.
§ Youth-rated includes G/PG and PG-13.

A longitudinal cohort study of smoking onset among youths viewing movies released during 1998–2003 concluded that classifying movies with smoking with an R rating could reduce the number of teen smokers by approximately 18% (*7*). The Surgeon General notes that the magnitude of the effect of an R rating for smoking would be similar to increasing the price of cigarettes from $6.00 to $7.50 per pack (*10*).

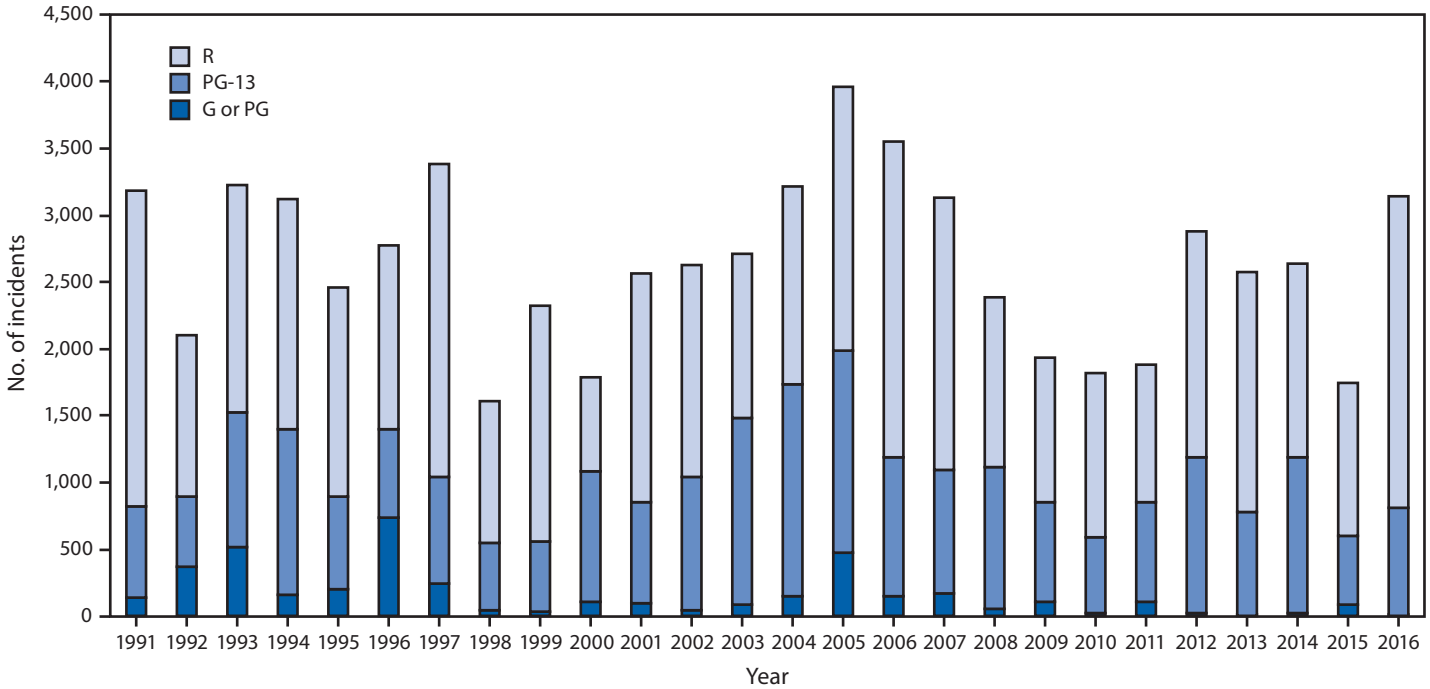
The findings in this report are subject to at least three limitations. First, detailed audience composition data are not publicly available; therefore, the number of tobacco use impressions (one person seeing one tobacco incident one time, a measure of total audience exposure) delivered by a particular movie to children and adolescents could not be determined. Second, the sample did not include all movies. However, the samples of top grossing movies were used because they are expected to account for approximately 95% of theater tobacco-use impressions (*4–6*). Finally, the measure used to assess tobacco exposure from movies should be interpreted cautiously because movies can be viewed through other channels (e.g., recorded media, such as DVDs and Blu-ray; television; and online streaming) that do not contribute to the calculation of in-theater impressions. As viewing platforms expand, it is important to identify whether youths are being exposed to tobacco imagery through other media sources, such as broadcast and cable television, on-demand services, and social media. Further research into youths' exposure to tobacco imagery in these and other forms of media could also help identify the impact that exposure through these sources has on youths' tobacco use.

If current trends continue, 5.6 million youths who are alive today are projected to die from tobacco-related diseases (*10*). Whereas the number of top-grossing movies with tobacco use incidents continued to decline from 2010 to 2016, one in four youth-rated movies featured tobacco imagery, which is harmful to youths and causes youths to start using tobacco. The frequency and increase in tobacco incidents in PG-13 movies is of public health concern because these movies are rated as appropriate for youths. Opportunities exist for movie studios to reduce tobacco incidents that appear in youth-related movies, including rating films with smoking R, which would help prevent or delay the initiation of tobacco use among young persons and prevent premature deaths from tobacco-related diseases.

Conflict of Interest

Jonathan R. Polansky, Kori Titus, and Stanton Glantz report grants from Truth Initiative during the conduct of this study. No other conflicts of interest were reported.

FIGURE. Tobacco incidents in top-grossing movies, by movie rating* — United States, 1991–2016



* Ratings are assigned by the Motion Picture Association of America, the trade organization that represents the six major movies studios. G = General Audiences (all ages admitted); PG = Parental Guidance Suggested (some material may not be suitable for children); PG-13 = Parents Strongly Cautioned (some material may be inappropriate for children under 13); and R = Restricted (under 17 requires accompanying parent or adult guardian).

[1]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Onbeyond LLC, Fairfax, California; [3]Breathe California of Sacramento-Emigrant Trails, Sacramento, California; [4]University of California, San Francisco.

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Summary

What is already known about this topic?

The Surgeon General has concluded that there is a causal relationship between depictions of smoking in the movies and the initiation of smoking among young persons. The more frequently youths see smoking on screen, the more likely they are to start smoking; youths who are heavily exposed to onscreen smoking imagery are approximately two to three times more likely to begin smoking than are youths who are less exposed.

What is added by this report?

Previously reported declines in number of top-grossing movies with tobacco use has continued; however, the decline in the total number of tobacco incidents has not progressed since 2010. From 2010 to 2016, the total number of tobacco incidents in top-grossing movies increased, with a 43% increase occurring among movies rated PG-13.

What are the implications for public health practice?

Although there were fewer youth-rated films with tobacco incidents in 2016 than in 2010, total depictions of tobacco use has remained stable, concentrating such exposure in fewer films. Reducing tobacco incidents that appear in youth-related movies would prevent the initiation of tobacco use among young persons. An R rating for movies with tobacco use could potentially reduce the number of teen smokers by 18% and prevent their premature deaths from tobacco-related diseases.

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Babesiosis Surveillance — Wisconsin, 2001–2015

Elizabeth Stein, MD[1]; Lina I Elbadawi, MD[2,3]; James Kazmierczak, DVM[3]; Jeffrey P. Davis, MD[3]

Babesiosis is an emerging zoonotic disease caused primarily by *Babesia microti*, an intraerythocytic protozoan. *Babesia microti,* like the causal agents for Lyme disease and anaplasmosis, is endemic to the northeastern and upper midwestern United States where it is usually transmitted by the blacklegged tick, *Ixodes scapularis*. Although babesiosis is usually a mild to moderate illness, older or immunocompromised persons can develop a serious malaria-like illness that can be fatal without prompt treatment. The most common initial clinical signs and symptoms of babesiosis (fever, fatigue, chills, and diaphoresis) are nonspecific and present diagnostic challenges that can contribute to delays in diagnosis and effective treatment with atovaquone and azithromycin (*1*). Results of one study revealed a mean delay of 12–14 days from symptom onset to treatment (*2*). Knowledge of the incidence and geographic distribution of babesiosis can raise the index of clinical suspicion and facilitate more prompt diagnosis and lifesaving treatment (*1*). The first known case of babesiosis in Wisconsin was detected in 1985 (*3*), and babesiosis became officially reportable in the state in 2001. Wisconsin babesiosis surveillance data for 2001–2015 were analyzed in 3-year intervals to compare demographic, epidemiologic, and laboratory features among patients with cases of reported babesiosis. To determine possible reasons for an increase in reported *Babesia* infection, trends in electronic laboratory reporting and diagnosis by polymerase chain reaction testing (PCR) were examined. Between the first and last 3-year analysis intervals, there was a 26-fold increase in the incidence of confirmed babesiosis, in addition to geographic expansion. These trends might be generalizable to other states with endemic disease, similar suburbanization and forest fragmentation patterns, and warming average temperatures (*4*). Accurate surveillance in states where babesiosis is endemic is necessary to estimate the increasing burden of babesiosis and other tickborne diseases and to develop appropriate public health interventions for prevention and practice.

White-tailed deer are the primary hosts for adult blacklegged ticks, and white-footed mice and other small mammals are reservoirs of *B. microti*. Most human cases of babesiosis result from tick bites that occur during the spring and summer months, but blood transfusion–related transmission and perinatal transmission have also been reported (*1–3,5*). Blacklegged ticks were first recognized in Wisconsin in 1968, and during the subsequent decade, their range expanded rapidly, particularly in northwestern Wisconsin (*6*). Surveys of blacklegged ticks on hunter-harvested deer conducted since 1979 have demonstrated larger numbers of the blacklegged tick population and expansion in geographic range toward northeastern and southeastern Wisconsin (*6,7*). The concurrent geographic expansion of blacklegged ticks in Wisconsin during recent decades, coupled with observed increases in reported incidence of other tickborne diseases such as Lyme disease and human anaplasmosis in these regions, highlights the need for accurate surveillance for other serious tickborne diseases, including babesiosis (*8*). Predictive modeling of spatial and temporal trends in tickborne disease in neighboring Minnesota suggests that babesiosis will continue to increase under conditions of warming climate and continued forest fragmentation (*4*).

In 2001, the Wisconsin Department of Health Services, Division of Public Health defined a confirmed case of babesiosis as the occurrence of fever, anemia, or thrombocytopenia in a patient with confirmatory laboratory findings (i.e., identification of either intraerythrocytic *Babesia* organisms by blood smear or a fourfold increase or greater in *B. microti* immunoglobulin G [IgG] antibody titers). A probable case was defined as the occurrence of fever, anemia, or thrombocytopenia in a patient with supportive positive tests (*B. microti* indirect fluorescent antibody total Ig or IgG antibody titer of ≥1:256 or positive *B. microti* PCR assay). In 2007, the Division of Public Health expanded the confirmed case definition to include a positive PCR result as confirmatory laboratory evidence, which is consistent with the current Council of State and Territorial Epidemiology babesiosis case definition.* For all reported cases, local health departments interviewed health care providers and patients to assess tick exposure and to document the county of exposure and ascertain the possibility of transfusion-associated transmission.

In 2007, the Wisconsin Electronic Disease Surveillance System (WEDSS) was implemented by the Division of Public Health, and electronic laboratory reporting of babesiosis became possible. During the first 3 years of WEDSS implementation, only 17% of confirmed babesiosis cases were initially reported electronically. However, since 2013, approximately 80% of Wisconsin clinical laboratories use electronic laboratory reporting. All cases with either direct or electronic reporting were included in the analysis. Geographic distribution of reported cases by county of residence was compared during five consecutive 3-year intervals to examine geographic expansion of reported babesiosis cases. Annual incidence rates

* http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/PS/10-ID-27.pdf.

for county and state were calculated using mid-year population estimates provided by the Wisconsin Division of Public Health, Office of Health Informatics. Mean annual incidence was then calculated for successive 3-year intervals.

During 2001–2015, a total of 430 babesiosis cases were reported to the Division of Public Health, including 294 (68%) confirmed and 136 (32%) probable cases. Among confirmed cases, 189 (64%) occurred in males and 199 (68%) in persons aged >60 years (median age = 66 years; range = 10–100 years). Onset of illness occurred during April–October in 283 (96%) reported confirmed cases. Among 242 (82%) patients with confirmed babesiosis for whom sufficient information was available, 158 (65%) were hospitalized. Three deaths occurred, one in a woman aged 88 years, and two in men aged 64 and 72 years; information on comorbid conditions was unavailable. Three confirmed cases of transfusion-associated transmission were detected in 2008 and one in 2011, before implementation of routine screening for babesiosis by Wisconsin blood banks in 2016. Among probable babesiosis cases, 82 (60%) patients were male, 51 (38%) were aged >60 years (median age = 55 years; range = 6–93 years) and 120 (88%) had illness onset during April–October. Among 108 (79%) patients with probable babesiosis for whom information is available, 26 (24%) were hospitalized and none died. The proportion of all cases reported electronically increased to 51% during 2010–2012 and 67% during 2013–2015, compared with 2007–2009 (Figure 1).

From 2001 to 2015 the annual incidence of confirmed babesiosis cases increased during each successive analyzed 3-year interval (Table). During 2001–2003, the mean annual incidence was 0.03 cases per 100,000 Wisconsin residents. During the following 3 years (2004–2006), there was a 400% increase in mean annual incidence to 0.15, followed by a slight (13%) increase to 0.17 during 2007–2009. During 2010–2012, incidence increased sharply, to 0.57, representing a 235% increase compared with the preceding 3 years. During 2013–2015, the mean annual confirmed babesiosis incidence was 0.80 cases per 100,000 Wisconsin residents, representing an overall 26-fold increase compared with 2001–2003.

TABLE. Number and incidence of reported confirmed babesiosis cases by 3-year interval and percentage confirmed using polymerase chain reaction (PCR) — Wisconsin, 2001–2015

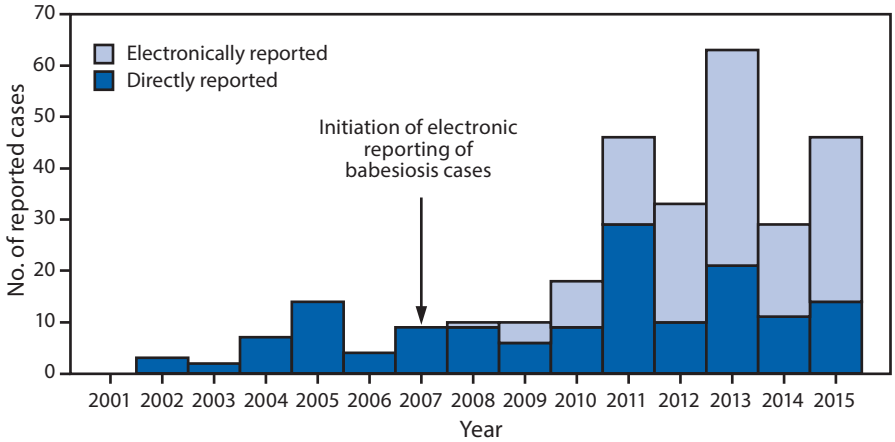
	Confirmed cases of babesiosis		Cases with positive PCR results available*
Years	No.	Mean annual incidence†	No. (% of total cases)
2001–2003	5	0.03	—
2004–2006	25	0.15	3 (38)
2007–2009	29	0.17	8 (28)
2010–2012	97	0.57	53 (77)
2013–2015	138	0.80	95 (86)
Total 2001–2015	**294**	**0.34**	**159 (74)**

* Not all reports had laboratory test information available; percentages represent the portions that were positive by PCR among cases with laboratory information available. PCR-positivity was accepted as a criterion for case confirmation in 2007.

† Per 100,000 state residents.

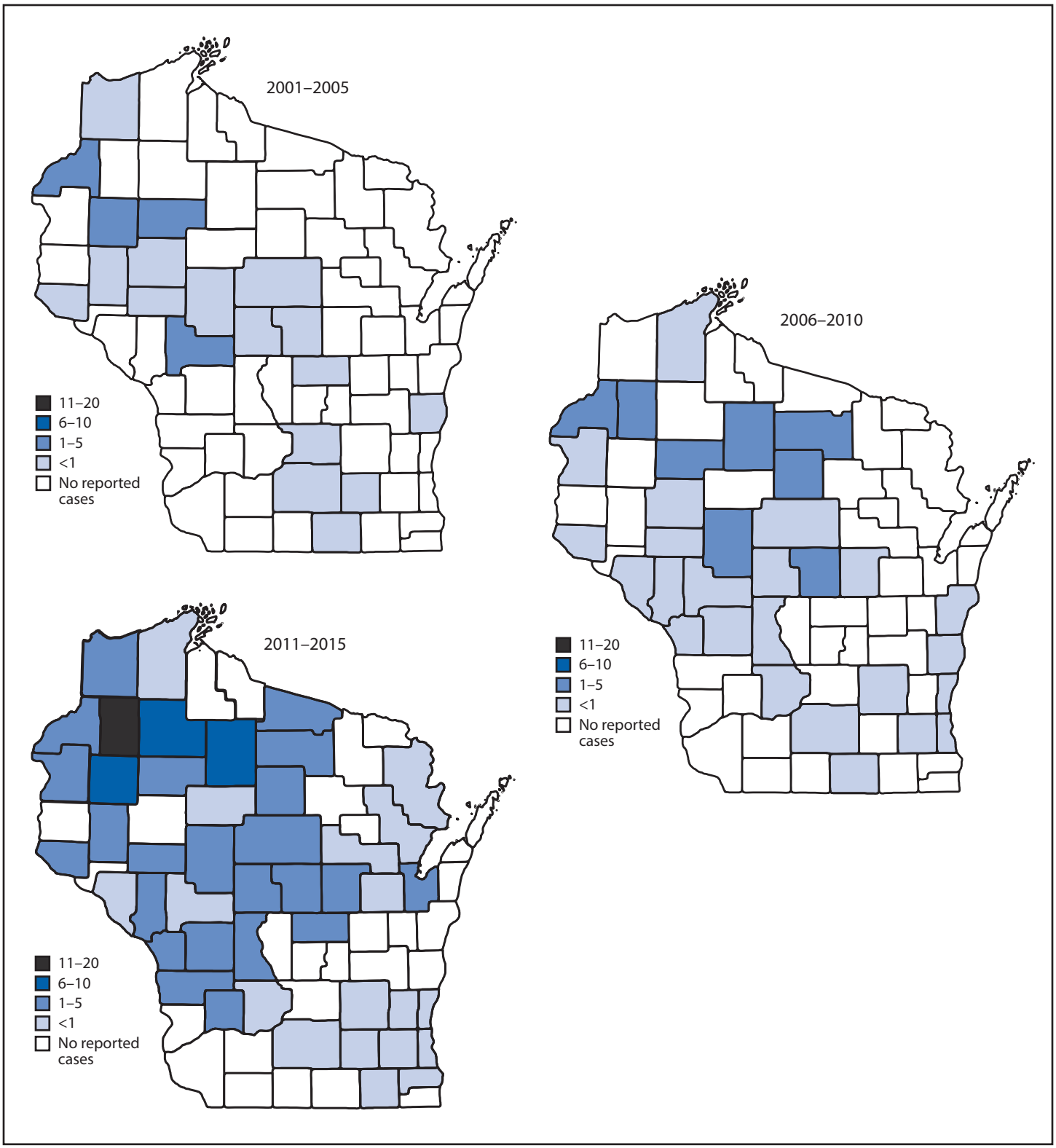
During 2001–2015, the county of residence was known for all 294 confirmed cases; 50 (69%) of Wisconsin's 72 counties were represented. The county of likely acquisition was recorded for 163 (56%) confirmed cases, representing 36 counties and one other state (Massachusetts). Among these 163 confirmed cases, the patient's county of residence and the county of likely tick exposure were the same for 137 cases (84%), representing 33 Wisconsin counties (13 in the northwestern region; nine in the northeastern region, and 11 in the southern region). During 2001–2005, 20 counties (28% of all Wisconsin counties) reported at least one confirmed babesiosis case among residents. The number of counties reporting more than one confirmed babesiosis case among residents increased to 30 during 2006–2010 and to 46 during 2011–2015, representing 42% and 64% of all counties in the state, respectively (Figure 2). This expansion in the geographic range of reported babesiosis cases primarily involved counties to the east and south of the area where babesiosis initially emerged.

FIGURE 1. Total confirmed babesiosis case counts (N = 294) initially reported directly and electronically through the Wisconsin Electronic Disease Surveillance System (WEDSS),* Electronic Laboratory Report (ELR) — Wisconsin, 2001–2015



* The WEDSS system records each case report's first contact source. For example, if a health department or provider notified the Department of Public Health of a case of babesiosis and an electronic report followed, the source would not be categorized as ELR.

FIGURE 2. Geographic distribution of confirmed cases of babesiosis per 100,000 residents, by county of residence — Wisconsin, 2001–2005, 2006–2010, and 2011–2015*



* Twenty counties (28% of all Wisconsin counties) reported at least one confirmed babesiosis case during 2001–2005. During 2006–2010, the number of counties reporting more than one case increased to 30. During 2011–2015, the number of counties reporting more than one confirmed case increased to 46.

Discussion

The reported incidence of confirmed babesiosis in Wisconsin increased 26-fold from 2001 to 2015, with the greatest increase occurring from 2007–2009 to 2010–2012. In addition to progressive increases in incidence of reported babesiosis, the county of residence of confirmed cases during 2005–2009 and 2011–2015 demonstrated geographic spread to the east and south. Although this substantial increase in reported cases probably reflects an actual increase in incidence, improvements in babesiosis detection and surveillance and increased awareness and diagnoses likely also contributed to this increase.

During 2001–2015 two major changes in babesiosis surveillance occurred that might have affected reported babesiosis incidence rates. The first was expansion of the definition of confirmatory laboratory evidence for babesiosis to include PCR and the second was initiation of automatically generated electronic laboratory reports. Before 2007, peripheral blood smear exam was most frequently used to provide confirmatory laboratory evidence. Blood smear exam has a substantially lower sensitivity of detection of parasites (100–500 parasites/μL blood) than does PCR, which can be positive at concentrations as low as one to three parasites per μL of blood. The inclusion of the more sensitive PCR assay as a confirmatory laboratory criterion, combined with increased use of these tests by providers, likely contributed to an increase in babesiosis diagnoses (*9*).

Improved surveillance also affects reported incidence rates. Before 2010, surveillance for babesiosis relied on manual reporting involving phoned, mailed, or faxed reports from health care providers and laboratories to local health departments or to the Division of Public Health, and these practices might have resulted in underreporting of babesiosis. The marked increase in reported annual incidence rates from 0.17 cases per 100,000 Wisconsin residents during 2007–2009 to 0.57 during 2010–2012 suggests that the shift to automatically generated electronic laboratory reports in 2007 resulted in substantially more confirmed cases being reported.

Despite the observed trend toward routine use of PCR and electronic laboratory reporting, corroborating data from tick surveillance and surveillance of other tickborne diseases suggest a simultaneous actual increase in occurrence of babesiosis in Wisconsin. Documentation of blacklegged tick population expansion to southeastern and northeastern regions of the state suggests that babesiosis has spread to areas that had no previous reports of babesiosis. Also aligning with expanding tick population observations are Division of Public Health anaplasmosis and Lyme disease surveillance data that demonstrate parallel increases in reported incidence in northwestern and central Wisconsin and disease spread toward the southeast and northeast. Because of the extent of improvement in surveillance and diagnostic sensitivity that occurred during 2001–2015, it is difficult to assess the true magnitude of the increase in reported babesiosis incidence during this time. With improved reporting mechanisms and a consistent use of updated case definitions, the accuracy of analyses of trends in reported babesiosis is likely to increase.

The findings in this report are subject to at least two limitations. First, an unknown portion of all babesiosis cases are reported. As noted, more underreporting likely occurred before implementation of automatic reporting via electronic health records. Even after the adoption of the electronic reporting system in 2007, underreporting could have occurred because of the reliance on direct reporting by laboratories not participating in electronic laboratory reporting (estimated to be approximately 20% in 2010) and diagnosis of some cases by blood smear (i.e., not sent to electronic reporting facilities). Second, the geographic distribution of babesiosis cases was estimated using county of residence because county of acquisition could be determined for only 56% of confirmed cases. This could result in underestimation of the cases from more forested and rural counties where Wisconsin residents travel for vacation, while overestimating cases from urban counties where travelers later receive a babesiosis diagnosis.

Increases in the prevalence of tickborne illnesses across the United States are likely, given concurrent evidence of black-

Summary

What is already known about this topic?

Babesiosis is an emerging tickborne disease endemic to the northeastern United States and the upper Midwest. Many infected persons are asymptomatic but the disease can be life-threatening, especially among older and immunocompromised persons. Prompt diagnosis and treatment in patients with severe infection can prevent serious complications and death.

What is added by this report?

Analysis of Wisconsin babesiosis surveillance data during 2001–2015 indicates expansion of the geographic range and increased incidence. Routine use of polymerase chain reaction testing and automatic electronic laboratory reporting likely contributed to the increased reported incidence of confirmed babesiosis in Wisconsin; however, evidence of blacklegged tick expansion suggests an actual increase in infection rates.

What are the implications for public health practice?

Babesiosis cases in Wisconsin are increasing in number and geographic range. These trends might be occurring in other states with endemic disease, similar suburbanization and forest fragmentation patterns, and warming average temperatures. Accurate surveillance in states where babesiosis is endemic is necessary to estimate the increasing burden of babesiosis and other tickborne diseases and develop appropriate public health interventions for prevention and practice.

legged tick population growth and geographic expansion, a change that might be attributable to changing weather patterns and increasing forest fragmentation (*10*). Ongoing monitoring of babesiosis incidence using improved surveillance data can help to quantify the burden of disease, prioritize prevention efforts, and raise awareness among health care providers, to ensure timely and correct diagnosis and treatment.

Conflict of Interest

No conflicts of interest were reported.

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Two Outbreaks of Trichinellosis Linked to Consumption of Walrus Meat — Alaska, 2016–2017

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During 1975–2012, CDC surveillance identified 1,680 trichinellosis cases in the United States with implicated food items; among these cases, 1,219 were attributed to consumption of raw or pork products, and 461 were attributed to nonpork products. Although trichinellosis in the United States has historically been associated with consumption of pork, multiple nonporcine species of wild game also are competent hosts for *Trichinella* spp. and have been collectively implicated in the majority of trichinellosis cases since the late 1990s (*1–4*) (Figure 1). During July 2016–May 2017, the Alaska Division of Public Health (ADPH) investigated two outbreaks of trichinellosis in the Norton Sound region associated with consumption of raw or undercooked walrus (*Odobenus rosmarus*) meat; five cases were identified in each of the two outbreaks. These were the first multiple-case outbreaks of walrus-associated trichinellosis in Alaska since 1992 (Figure 2). Health care providers should inquire about consumption of commercially prepared and personally harvested meats when evaluating suspected trichinellosis cases, especially in areas where consumption of wild game is commonplace.

First Outbreak

The index patient (patient A) was an adolescent female who reported severe lower extremity edema and pain, difficulty walking, a pruritic rash, weakness, fever, and myalgia beginning on August 15, 2016 (Table). She was evaluated at a village health clinic on August 31, 2016, and referred to the Alaska Native Medical Center in Anchorage, where she was admitted on September 8. Her adolescent brother (patient B) and father (patient C) accompanied her to the medical center, where they were also evaluated for symptoms of illness (Table). Blood tests indicated that all three patients had eosinophilia, a commonly observed sign of parasitic infection; two patients also had elevated creatine kinase levels, indicative of muscle inflammation (Table). All three patients reported having consumed raw or pan-fried (to "medium" doneness) walrus meat on approximately July 17. Serologic tests from both patients A and C were positive for *Trichinella* immunoglobulin G (IgG) by enzyme-linked immunosorbent assay (ELISA). The three patients received diagnoses of laboratory-confirmed (patients A and C) or probable (patient B) trichinellosis and were prescribed albendazole, an antiparasitic drug recommended for treatment of trichinellosis*; patient A also received prednisone.

On September 19, staff members of Norton Sound Regional Hospital in Nome reported two additional suspected trichinellosis cases from the same community, in the adult aunt (patient D) and uncle (patient E) of patient A. Both patients reported myalgia and fatigue beginning on approximately August 7, about 1 week after consuming raw walrus meat (Table). Blood tests confirmed that both patients had eosinophilia and elevated creatine kinase levels. ELISA testing identified IgG antibodies to *Trichinella* in patient D. Patients D and E received diagnoses of laboratory-confirmed and probable trichinellosis, respectively, and were treated with albendazole; patient E also received prednisone. Leftover walrus meat was not available to test for *Trichinella* larvae, and investigators could not determine when the walrus had been harvested, how widely associated meat had been shared, or whether all five patients had consumed meat from the same animal.

Interviews with patients and potentially exposed persons conducted by community health aides and staff members of the Nome Public Health Center did not identify any additional cases. Information regarding the health risks of consuming raw and undercooked meats was provided directly to the five patients. The risk reduction benefits of fully cooking meat according to U.S. Department of Agriculture recommendations for wild game (160°F [71°C], measured with a meat thermometer)† before consumption, as well as trichinellosis symptoms, health effects, and methods of treatment were explained. The facts that the parasite cannot be reliably killed by smoking, drying, or fermenting meat, and that the arctic species *T. nativa* is freeze tolerant, were clarified. All five patients fully recovered. At the conclusion of the investigation, ADPH began developing a related public service announcement in collaboration with regional and village-based partners, with planned dissemination in multiple communities throughout northern and western Alaska during the 2017 spring walrus harvest.

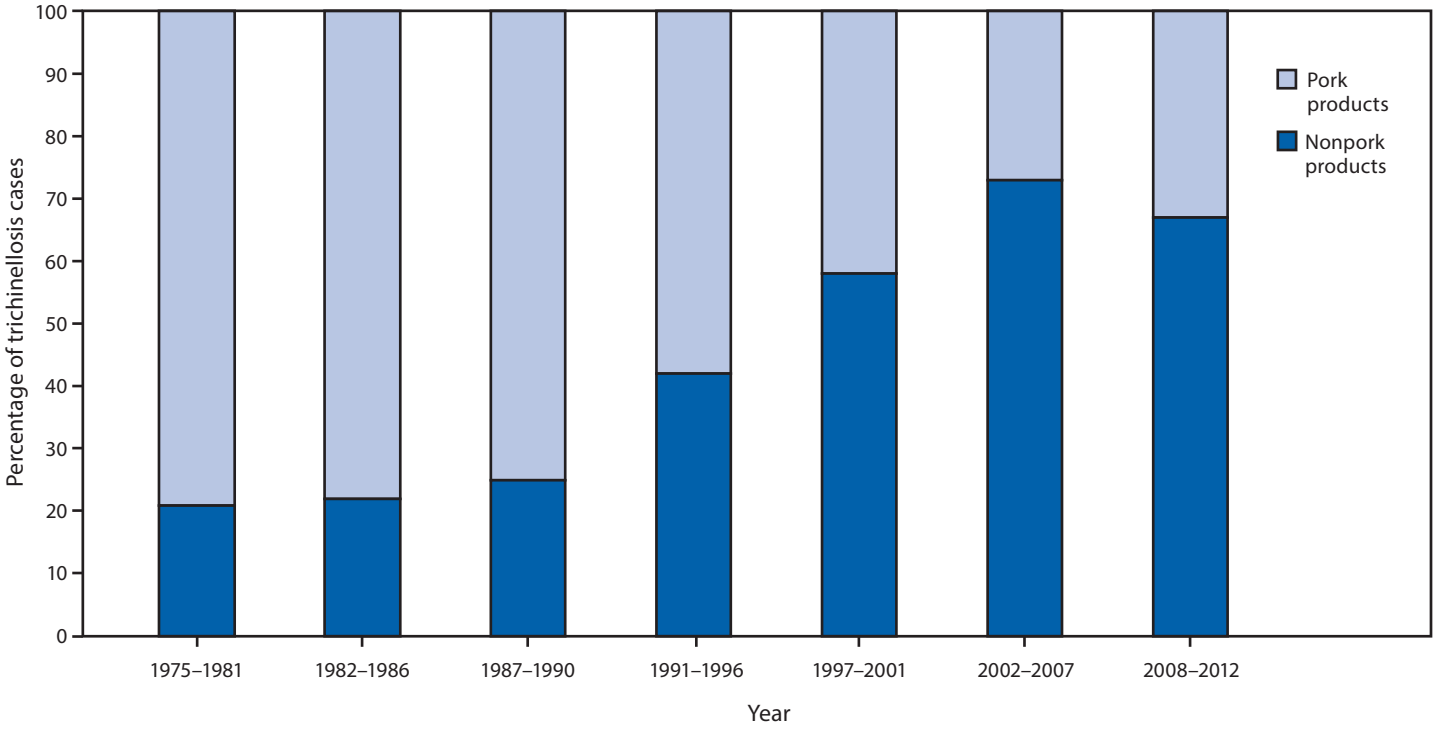
Second Outbreak

On May 12, 2017, as circulation of the public service announcement was beginning, ADPH was notified of another suspected case of walrus-related trichinellosis in a second Norton Sound coastal community, located <100 miles (<161 km) from the community where the first outbreak

* https://www.cdc.gov/parasites/trichinellosis/health_professionals/index.html#tx.

† https://www.aphis.usda.gov/vs/trichinae/docs/fact_sheet.htm.

FIGURE 1. Percentage* of trichinellosis cases resulting from consumption of pork or nonpork products, by surveillance period† among cases with a reported source (N = 1,680) — United States, 1975–2012



* Relative to the total number of cases in each surveillance period for which the food item implicated was identified. Pork products include both domestic pigs and wild boars.
† CDC surveillance.

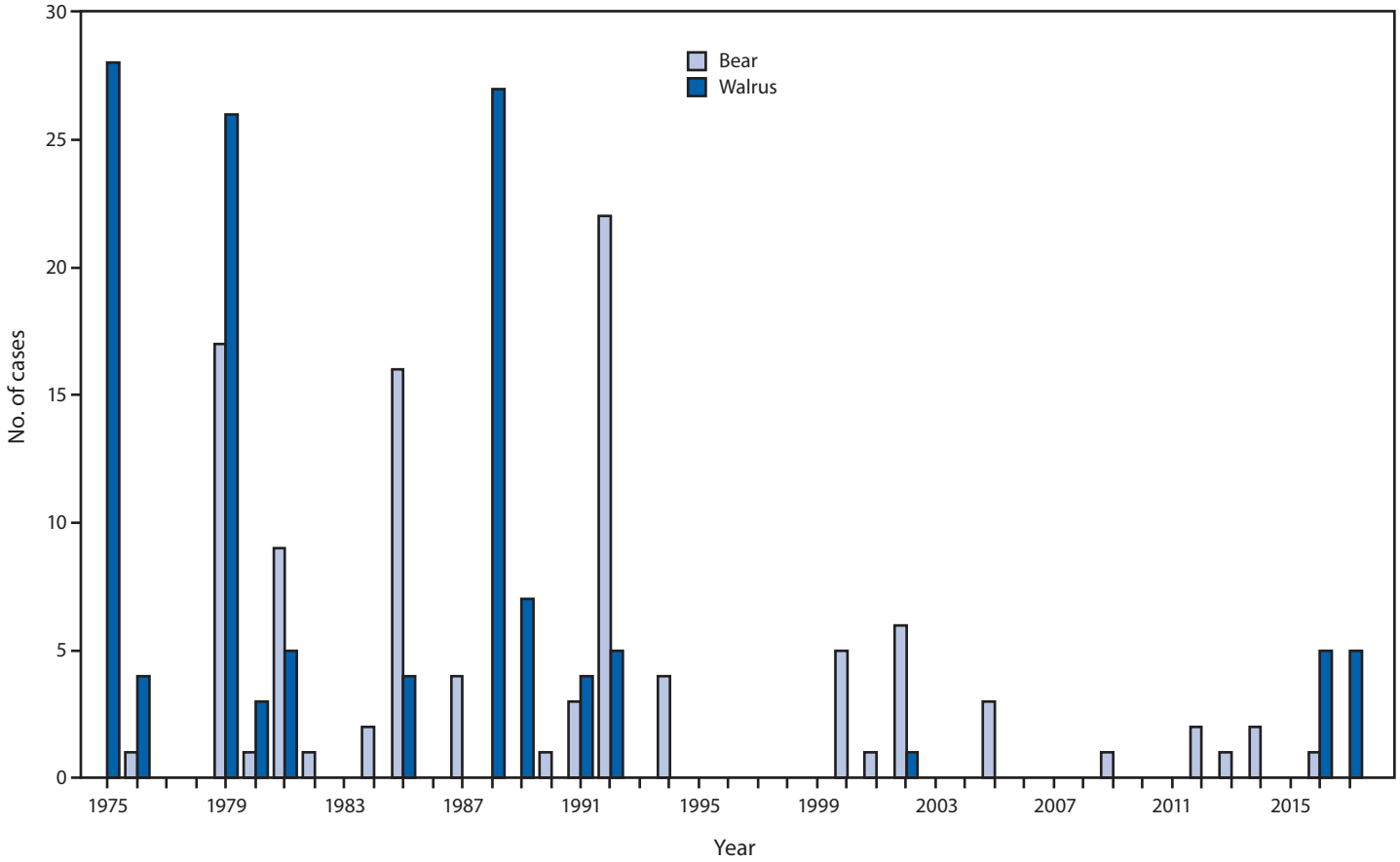
occurred (Table). Residents of both communities harvest walrus from the same hunting grounds in the northern Bering Sea. The index patient in the second outbreak (patient F) was an adult male who had been transported to Norton Sound Regional Hospital on May 12, 2017, after reporting severe muscle and joint pain. Blood tests revealed eosinophilia and elevated creatine kinase levels, but *Trichinella* IgG results by ELISA were negative; he received a diagnosis of probable trichinellosis and was prescribed albendazole and prednisone.

Interviews conducted by staff members of ADPH and the Nome Public Health Center identified four other suspected cases based on reported illness or likely exposure via a shared meal of undercooked walrus meat on approximately April 25, 2017. These patients were from two neighboring households that included members who hunted walrus together and shared the harvested meat. In the first household, the adult sister (patient G) and mother (patient H) of the index patient both had eosinophila, elevated creatine kinase levels, and positive *Trichinella* IgG results by ELISA; both patients were classified as having confirmed cases of trichinellosis. In the second household, an adult male friend and hunting partner of the index patient (patient I) and his adult sister (patient J) had eosinophilia and elevated creatine kinase levels, but negative results for *Trichinella* IgG by ELISA; both were classified as having probable cases. All four patients received treatment with albendazole. Given the high eosinophil counts and creatine kinase levels measured for the three patients with probable trichinellosis, it seems likely that these persons were infected but tested negative for *Trichinella* IgG by ELISA because the time elapsed between infection and testing was insufficient for a measurable humoral response.

The walrus consumed during the implicated meal in the second outbreak had been harvested and butchered by patients F and I during the previous 1–3 months, and the meat had been stored frozen in unlabeled bags in their respective household chest freezers. The meat was prepared by patient H, who reported that she boiled it for approximately 1 hour, after which the exterior was fully cooked, but the interior remained undercooked or raw, which was the desired result; interviewed persons reported that many community members prefer the taste and texture of undercooked or raw walrus meat to that of fully cooked meat.

No meat from the implicated meal was available for testing. Because of concern that some of the meat used to prepare the implicated meal (or from the same source animal) might still be present in bags in household chest freezers, a convenience

FIGURE 2. Number of cases (N = 227) of trichinellosis associated with consumption of bear* or walrus,† by year — Alaska, 1975–2017§



* Bear includes 99 cases (44%) for which the patient reported consuming bear and four cases (2%) for which the patient reported consuming both bear and seal and a single implicated source of infection could not be identified.
† Walrus includes 100 cases (44%) for which the patient reported consuming walrus and 24 cases (11%) for which the patient reported consuming both walrus and seal and a single implicated source of infection could not be identified.
§ As of July 1, 2017.

sample of meat from 11 bags was collected. It was not possible to determine the number and identity of source animals represented in this sample, or whether the sample contained meat from the same animal consumed as part of the implicated meal. Samples were sent to CDC's Division of Parasitic Diseases and Malaria's service for laboratory testing. One sample was positive for larvae of *Trichinella* spp. using differential interference contrast microscopy and polymerase chain reaction (PCR) with primers specific to internally transcribed spacer regions 1 and 2. The parasite was determined to be *T. nativa* by sequencing PCR products.

All patients from the second outbreak made a full recovery, and no additional cases were identified. Information associated with the public service announcement, including risk reduction benefits of cooking meat fully and trichinellosis symptoms, health effects, and methods of treatment, was shared with the patients and the community at large through meetings with multiple groups.

Discussion

Trichinellosis is a parasitic disease that results from consumption of raw or undercooked meat infected by roundworm species in the genus *Trichinella* (*5*). Early signs and symptoms occur 1–2 days after ingestion and include diarrhea, abdominal pain, fatigue, nausea, and vomiting. Systemic signs and symptoms, which typically occur 1–2 weeks after ingestion and last for 1–8 weeks, include facial and periorbital edema, fatigue, fever (remittent) and chills, headache, muscle soreness, pruritus (with or without a rash), nausea, difficulty coordinating movement, neurologic complications, and cardiopulmonary impairment.[§]

The significance of wild game species in the epidemiology of trichinellosis is apparent in Alaska. Among 241 trichinellosis cases reported in the state since 1975, 227 (94%) were attributed to consumption of nonporcine wild game, including ursid species (black bear [*Ursus americanus*], grizzly bear

§ https://www.cdc.gov/parasites/trichinellosis/disease.html.

TABLE. Clinical, laboratory, and epidemiologic characteristics of patients in two trichinellosis outbreaks associated with consumption of walrus meat — Alaska, July–September 2016 and April–May 2017

Patient	Relationship to index patient	Approximate date of walrus meat consumption	Approximate date of symptom onset	Symptoms	Eosinophils/μL (%)*	Creatine kinase/μL (reference)†	ELISA serology (case status)	Treatment
First outbreak: July–September 2016								
A	Self (index patient)	7/17/2016	8/15/2016	Lower extremity edema and pain, difficulty walking, rash, weakness, fever, myalgia	4,420 (17.6)	426 (26–192)	IgG+ (confirmed)	Albendazole, prednisone
B	Brother	7/17/2016	9/2/2016	Fever, myalgia	3,580 (20.7)	Not done	Not done (probable)	Albendazole
C	Father	7/17/2016	9/2/2016	Fever, myalgia, weakness, nausea, diarrhea	11,200 (50.4)	280 (36–174)	IgG+ (confirmed)	Albendazole
D	Aunt	7/31/2016	8/7/2016	Myalgia, fatigue, fever, chills, rash	2,080 (23.5)	3,391 (26–192)	IgG+ (confirmed)	Albendazole
E	Uncle	7/31/2016	8/7/2016	Myalgia, fatigue, nausea, diarrhea, weakness	4,930 (37.4)	3,300 (39–308)	Not done (probable)	Albendazole, prednisone
Second outbreak: April–May 2017								
F	Self (index patient)	4/25/2017	5/5/2017	Severe myalgia	6,850 (37.5)	2,150 (39–308)	IgG- (probable)	Albendazole, prednisone
G	Sister	4/25/2017	5/4/2017	Moderate myalgia	2,490 (22.0)	1,611 (26–192)	IgG+ (confirmed)	Albendazole
H	Mother	4/25/2017	NA	None reported	860 (11.0)	124 (26–192)	IgG+ (confirmed)	Albendazole
I	Neighbor (male friend, hunting partner)	4/25/2017	5/10/2017	Severe myalgia	2,330 (24.6)	854 (39–308)	IgG- (probable)	Albendazole
J	Neighbor (sister of patient I)	4/25/2017	5/10/2017	Moderate myalgia, facial edema	8,250 (51.3)	692 (26–192)	IgG- (probable)	Albendazole

Abbreviations: ELISA = Enzyme-linked immunosorbent assay; IgG = Immunoglobulin G, NA = not available.
* Reference range = 0–450/μL (0.0%–5.0%).
† Reference range varies according to patient's age and sex.

[*Ursus arctos*], and polar bear [*Ursus maritimus*]) and pinniped species (walrus and sea ice–associated seal species). Under the Marine Mammal Protection Act,¶ Alaska Natives may harvest marine mammals for subsistence purposes. Walruses, polar bears, and several sea ice–associated seal species are important for the nutritional, cultural, and economic well-being of many coastal communities in northern and western Alaska.

Since 1975, 100 (41%) of the 241 trichinellosis cases reported in Alaska have been associated with walrus meat and another 24 (10%) with walrus or seal meat. However, the frequency of walrus-associated trichinellosis in Alaska has declined sharply in recent years from an average of 6.3 cases per year (113 cases over 18 years) during 1975–1992, to an average of 0.5 cases per year (11 cases over 24.5 years) during 1993–2017 (as of July 1, 2017). Before the outbreaks described here, only one walrus-associated trichinellosis case had been reported in Alaska in the preceding 23 years. Reasons for this decline in incidence are unknown and might involve changes in parasite burden in walruses; the timing or location of walrus hunting; methods used to store, collect, handle, or prepare walrus meat for consumption; reporting practices among ill persons; and clinical testing methods or practices. These outbreaks underscore the importance of inquiring about consumption of commercially prepared and personally harvested meats, and about methods of meat preparation, when evaluating suspected trichinellosis cases, especially in areas where consumption of wild game in association with recreational or subsistence hunting is common.

These outbreaks also highlight the importance of culturally sensitive public health messaging. In areas where wild game species are harvested for subsistence, traditional methods of collecting, handling, preparing, storing, and consuming meat often have great cultural significance; however, some of these methods can be inconsistent with public health best practices. Rather than promoting or proscribing specific methods, public health messages that focus on communicating risks and explaining the manner and magnitude of risk reduction that can be achieved using different approaches (e.g., alternative methods of preparing meat for consumption) enable members of the target population to make informed decisions that integrate their traditional practices with their awareness and tolerance of risks.

¶ http://www.nmfs.noaa.gov/pr/laws/mmpa/mmpa_2015_revised_2017.pdf.

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Conflict of Interest

No conflicts of interest were reported.

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Summary

What is already known about this topic?

Trichinellosis has historically been a disease most frequently associated with consumption of raw or undercooked pork products; however, nonporcine wild game species are now collectively implicated in the majority of trichinellosis cases in the United States.

What is added by this report?

During July 2016–May 2017, two outbreaks of trichinellosis (five cases each) associated with consumption of raw or undercooked walrus meat occurred in Alaska. Walrus meat has been implicated in half of all trichinellosis cases reported in Alaska since 1975, yet the frequency of walrus-associated trichinellosis in the state has declined in recent years for unknown reasons. The two recent outbreaks were the first associated with consumption of walrus meat since 2002 and the first multiple-case outbreaks since 1992.

What are the implications for public health practice?

Wild game consumption should be considered when evaluating suspected trichinellosis cases. Related public health messaging should be culturally sensitive to traditional methods of food handling and preparation.

Vital Signs: Changes in Opioid Prescribing in the United States, 2006–2015

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Abstract

Background: Prescription opioid–related overdose deaths increased sharply during 1999–2010 in the United States in parallel with increased opioid prescribing. CDC assessed changes in national-level and county-level opioid prescribing during 2006–2015.

Methods: CDC analyzed retail prescription data from QuintilesIMS to assess opioid prescribing in the United States from 2006 to 2015, including rates, amounts, dosages, and durations prescribed. CDC examined county-level prescribing patterns in 2010 and 2015.

Results: The amount of opioids prescribed in the United States peaked at 782 morphine milligram equivalents (MME) per capita in 2010 and then decreased to 640 MME per capita in 2015. Despite significant decreases, the amount of opioids prescribed in 2015 remained approximately three times as high as in 1999 and varied substantially across the country. County-level factors associated with higher amounts of prescribed opioids include a larger percentage of non-Hispanic whites; a higher prevalence of diabetes and arthritis; micropolitan status (i.e., town/city; nonmetro); and higher unemployment and Medicaid enrollment.

Conclusions and Implications for Public Health Practice: Despite reductions in opioid prescribing in some parts of the country, the amount of opioids prescribed remains high relative to 1999 levels and varies substantially at the county-level. Given associations between opioid prescribing, opioid use disorder, and overdose rates, health care providers should carefully weigh the benefits and risks when prescribing opioids outside of end-of-life care, follow evidence-based guidelines, such as *CDC's Guideline for Prescribing Opioids for Chronic Pain,* and consider nonopioid therapy for chronic pain treatment. State and local jurisdictions can use these findings combined with Prescription Drug Monitoring Program data to identify areas with prescribing patterns that place patients at risk for opioid use disorder and overdose and to target interventions with prescribers based on opioid prescribing guidelines.

Introduction

In 2015, drug overdoses accounted for 52,404 deaths in the United States, 63.1% of which involved an opioid (*1*). Among opioid-related deaths, approximately 15,000 (approximately half) involved a prescription opioid (*2*). In addition, an estimated 2.0 million persons in the United States had opioid use disorder (addiction) associated with prescription opioids in 2015 (*3*). The economic burden of prescription opioid overdose, abuse, and dependence is estimated to be $78.5 billion each year in the United States (*4*). Prescription opioid-related overdose deaths and admissions for treatment of opioid use disorder have increased in parallel with increases in opioids prescribed in the United States, which quadrupled from 1999 to 2010 (*5*). This increase was primarily because of an increase in the use of opioids to treat chronic noncancer pain (*6,7*). Previously, opioids had primarily been reserved for severe acute pain, postsurgical pain, and end-of-life care. This change in prescribing practice increased the amount of opioids prescribed for three reasons. First, opioid use for chronic noncancer pain increased the number of opioid prescriptions. Second, the use of opioids to treat ongoing chronic conditions increased the average lengths of time for which opioids were prescribed (*6,7*). Third, average dosages of opioid prescriptions tend to be higher for patients who are prescribed opioids for long periods of time, effectively increasing the average amount of opioids supplied per prescription (*6,7*). Together, these changes placed more persons at risk for opioid use disorder and overdose (*8–11*).

Chronic pain is one of the most common reasons for seeking medical attention in the United States, and prescription opioids are frequently prescribed to manage pain (*12*). However, opioids should only be used when benefits are expected to outweigh risks. Ensuring that patients have access to safe, effective treatment is critical and involves improving the way opioids are prescribed. To improve understanding of opioid prescribing trends in the United States before the release of *CDC's 2016 Guideline for Prescribing Opioids for Chronic Pain*

Key Points

- The amount of opioids prescribed in the United States peaked in 2010 and then decreased each year through 2015. Despite reductions, the amount of opioids prescribed remains approximately three times as high as in 1999.
- Opioid prescribing varied substantially across the country, with average per capita amounts prescribed in the top-prescribing counties approximately six times the amounts prescribed in the lowest prescribing counties in 2015.
- Higher amounts of opioids were prescribed in counties with a larger percentage of non-Hispanic whites; a higher prevalence of diabetes and arthritis; micropolitan counties; and counties with higher rates of unemployment and Medicaid enrollment.
- The substantial variation in opioid prescribing observed at the county-level suggests inconsistent practice patterns and a lack of consensus about appropriate opioid use and demonstrates the need for better application of guidance and standards around opioid prescribing practices.
- Health care providers can follow the CDC's Guideline for Prescribing Opioids for Chronic Pain, which provides evidence-based recommendations about opioid prescribing for primary care clinicians treating adult patients with chronic pain, outside of active cancer treatment, palliative care, and end-of-life care.
- Additional information is available at https://www.cdc.gov/vitalsigns/.

(Guideline), CDC analyzed changes in national and county-level opioid prescribing and characteristics associated with higher prescribing rates at the county-level (*13*).

Methods

Data on opioid prescribing come from the QuintilesIMS Transactional Data Warehouse, which provides estimates of the number of opioid prescriptions dispensed in the United States based on a sample of approximately 59,000 pharmacies, representing 88% of prescriptions in the United States.

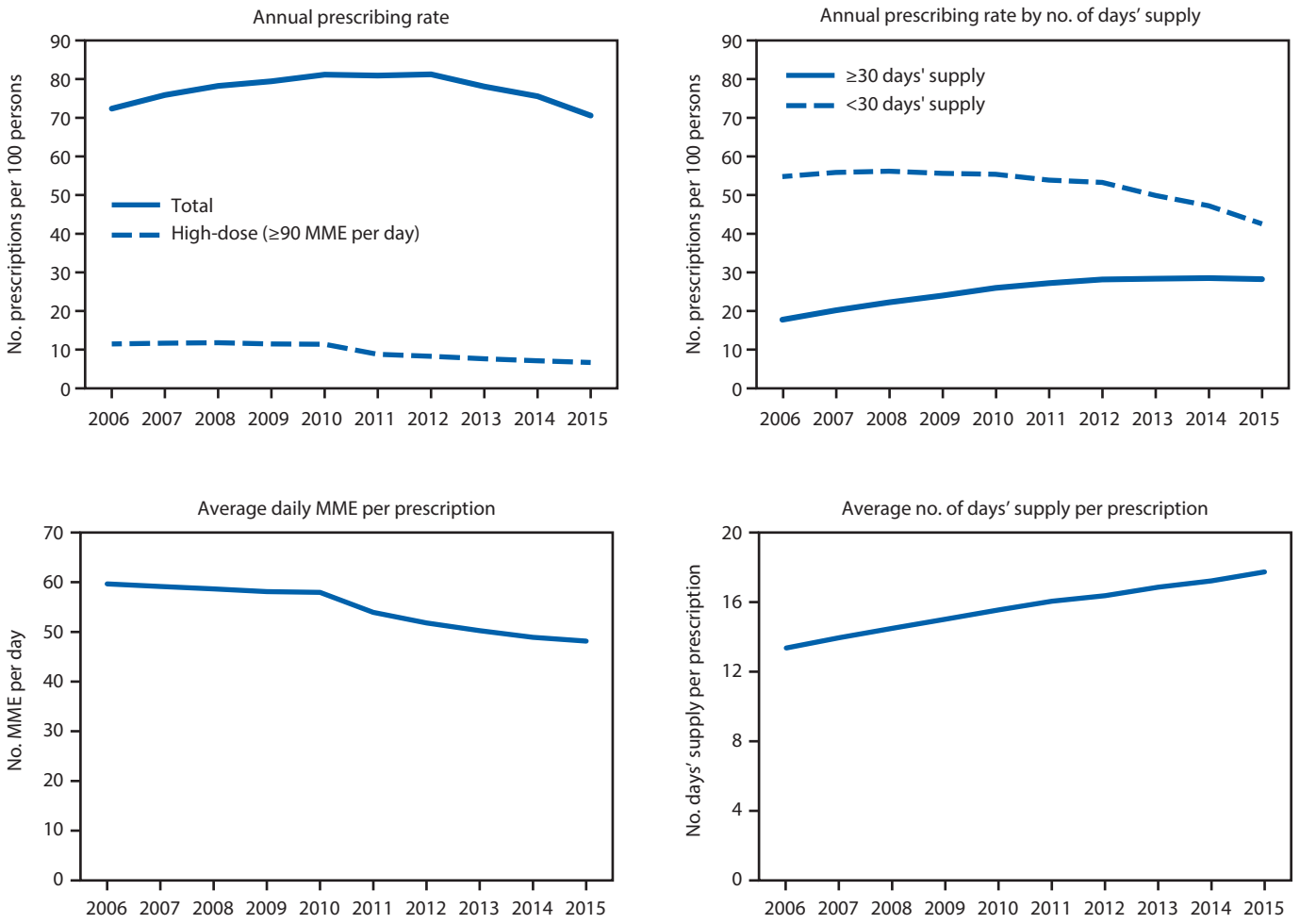
Changes in opioid prescribing at the national level were analyzed from 2006 to 2015. Prescribing rates included overall opioid prescribing rates, high-dose prescribing rates, and prescribing rates by days' supply (≥30 days and <30 days). Annual opioid prescribing rates were calculated by dividing the number of opioid prescriptions by the U.S. Census population estimates each year. High-dose prescribing rates include prescriptions with daily dosage ≥90 morphine milligram equivalents (MME) (*13*). All rates are per 100 persons. Additional measures included MME per capita, average daily MME per prescription, and average days' supply per prescription. Cold and cough products containing opioids and buprenorphine products indicated for conditions other than pain were excluded.

To determine where prescribing changes occurred, opioid prescribing at the county level was examined in 2010 (when prescribing levelled off nationally) and 2015. Quartiles were created using MME per capita to characterize the distribution of opioids prescribed. The percentage of counties experiencing changes in opioid prescribing measures from 2010 to 2015 was calculated. A change of ≥10% was considered to be an increase or decrease, whereas changes <10% were considered stable. County-level characteristics were examined in 2015 by MME per capita quartiles. County characteristics were obtained from the U.S. Census Bureau (age, urban/rural status); American Community Survey (race/ethnicity, percent uninsured, percent unemployed, income); U.S. Diabetes Surveillance System (diabetes prevalence); Dartmouth Atlas of Health Care (provider supply); Centers for Medicare and Medicaid Services (Medicaid and Medicare coverage); Behavioral Risk Factor Surveillance System (arthritis prevalence); and the Area Health Resource File (percent disabled, suicide rate). To identify county-level factors associated with MME per capita in 2015, a stepwise multivariable linear regression model incorporating age, race/ethnicity, insurance status, education, unemployment rates, poverty rates, median income, urban/rural status (metropolitan, micropolitan [i.e., town/city; nonmetro], and noncore [i.e., rural; nonmetro]), suicide rates, dentist and primary care physician density, and diabetes, arthritis, and disability prevalence was estimated.

Results

In the United States, annual opioid prescribing rates increased from 72.4 to 81.2 prescriptions per 100 persons from 2006 to 2010, were constant from 2010 to 2012, and then decreased by 13.1% to 70.6 per 100 persons from 2012 to 2015 (Figure 1). Annual high-dose opioid prescribing rates remained stable from 2006 to 2010 and then declined by 41.4% from 11.4 per 100 persons in 2010 to 6.7 in 2015. Annual prescribing rates for prescriptions of ≥30 days' supply increased 58.9% from 17.6 per 100 persons in 2006 to 28.0 per 100 persons in 2012 and leveled off from 2012 to 2015. Annual prescribing rates for prescriptions of <30 days' supply were stable from 2006 to 2012 and decreased 20.2% from 53.2 per 100 persons in 2012 to 42.4 in 2015. Average daily MME per prescription remained stable from 2006 to 2010 and then decreased 16.9% from 58.0 in 2010 to

FIGURE 1. Annual opioid prescribing rates, by number of days' supply, average daily morphine milligram equivalent (MME) per prescription, and average number of days' supply per prescription — United States, 2006–2015



48.1 in 2015. Average days' supply prescribed increased 33.0% from 13.3 in 2006 to 17.7 in 2015.

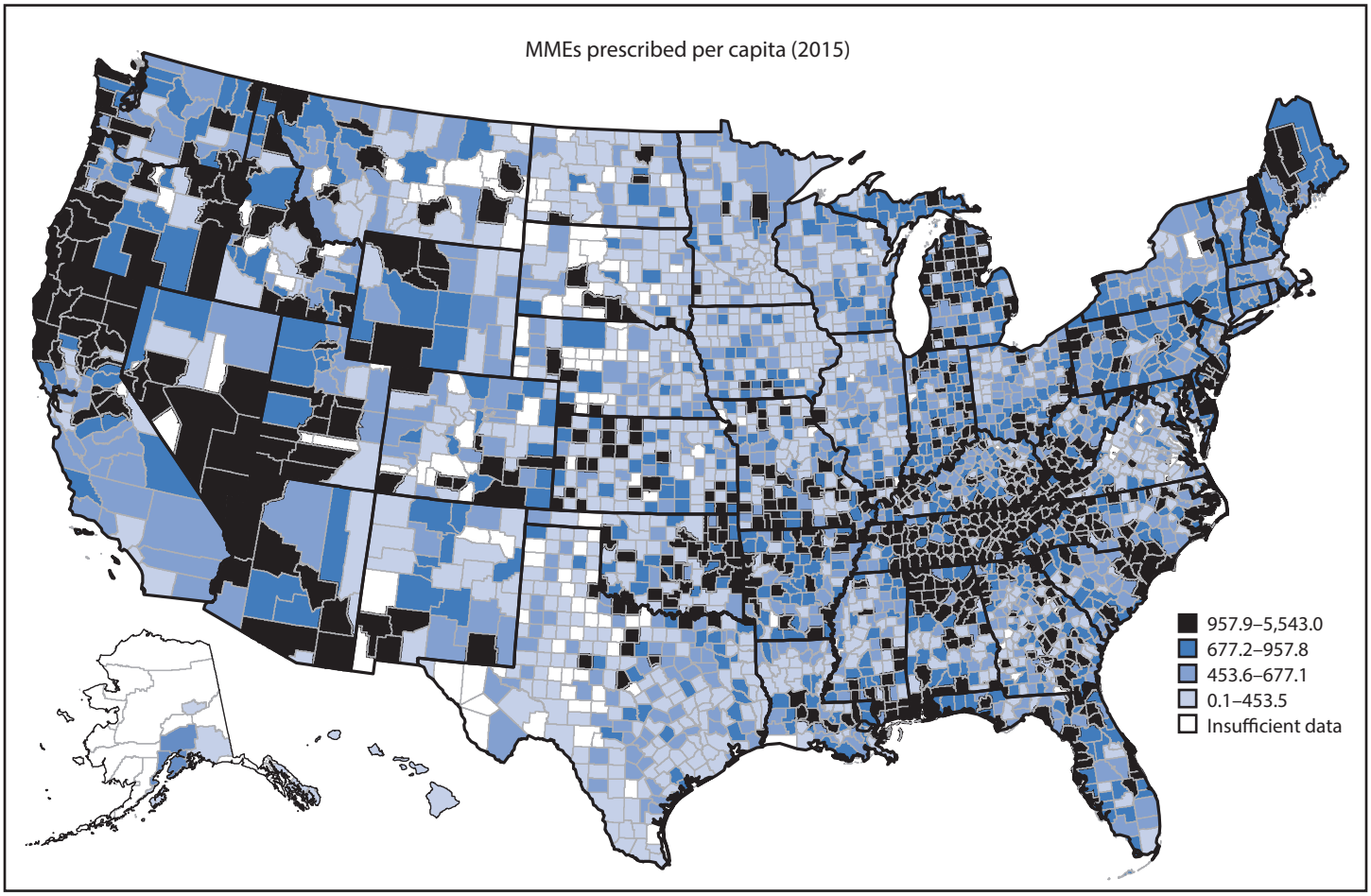
From 2010 to 2015, the amount of opioids prescribed in the United States decreased from 782 to 640 MME per capita (data not shown). In 2010 and 2015, the amount of opioids prescribed across counties varied substantially (Figure 2). From 2010 to 2015, among counties with sufficient data MME per capita decreased in 49.6% of counties, remained stable in 27.8% of counties, and increased in 22.6% of counties (Table 1). Overall prescribing rates decreased in nearly half (46.5%) of counties, whereas high-dose opioid prescribing rates and average daily MME per prescription decreased in the majority of counties, with 86.5% and 72.1% of counties, respectively, experiencing decreases. From 2010 to 2015, average number of days' supply increased in 73.5% of counties.

Despite reductions in prescribing, the amount of opioids prescribed in 2015 remained high relative to 1999 levels and varied substantially across the country, from an average of 203 MME per capita in the lowest quartile to 1,319 MME per capita in the highest quartile. Opioid prescribing amounts varied across several county-level characteristics (Table 2). After adjustment in the multivariable model, the following characteristics were associated with higher amounts of opioids prescribed: a larger percentage of non-Hispanic whites; higher rates of uninsured and Medicaid enrollment, lower educational attainment; higher rates of unemployment; micropolitan status; more dentists and physicians per capita; a higher prevalence of diagnosed diabetes, arthritis, and disability; and higher suicide rates. Together, these factors explain approximately 32% of the variation in the amount of opioids prescribed at the county-level.

Discussion

The amount of opioids prescribed in the United States began to decrease in 2011. However, in 2015, at 640 MME per capita, it remains approximately three times as high as in 1999, when

FIGURE 2. Morphine milligram equivalents (MMEs) of opioids prescribed per capita in 2015 and change in MMEs per capita during 2010–2015, by county — United States, 2010–2015

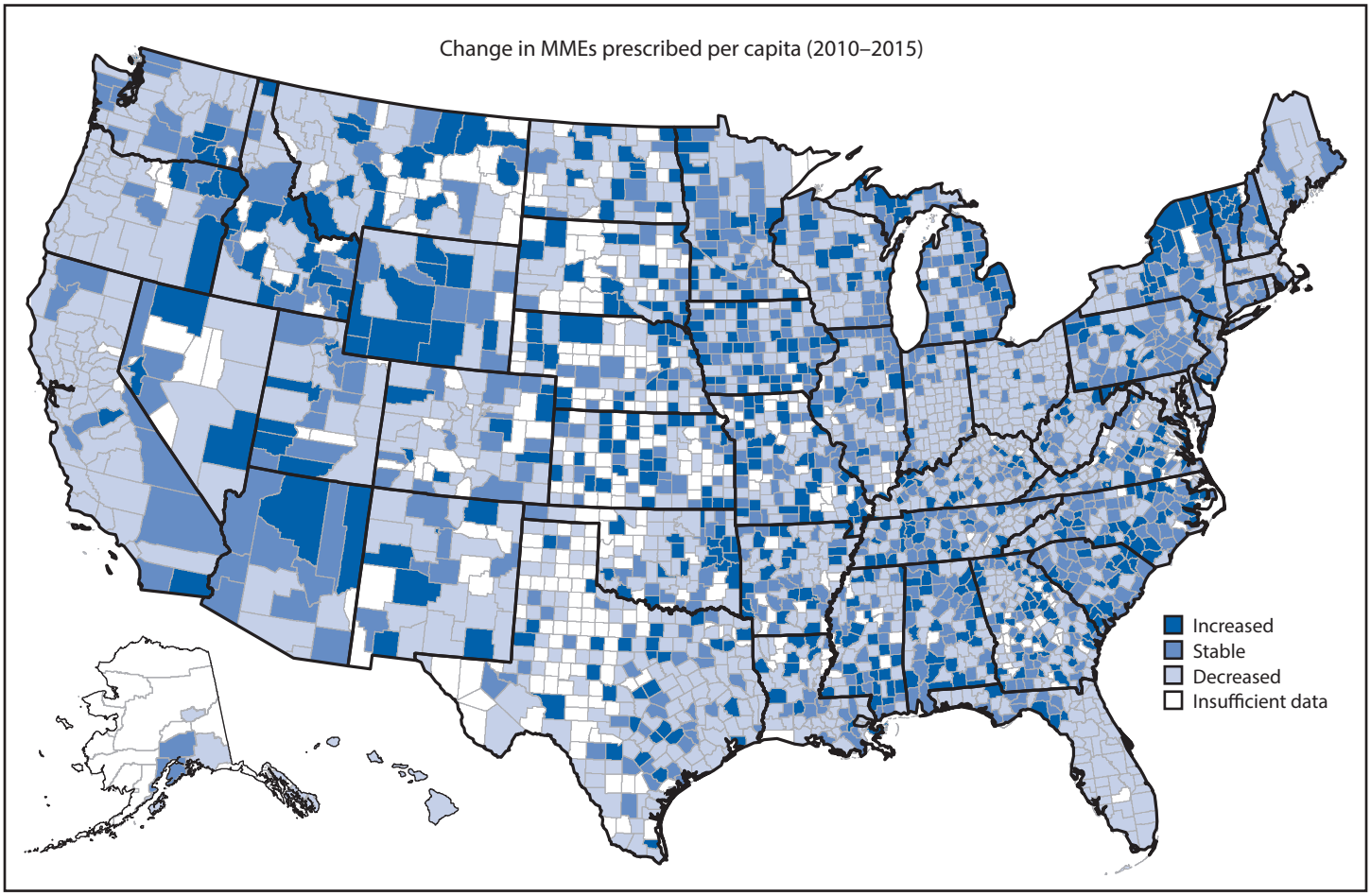


180 MME per capita were sold in the United States (*5*), and nearly four times as high as the amount distributed in Europe in 2015 (*14*).

Two prescribing changes appear to be associated with the decrease in MME prescribed per capita in the United States from 2010 to 2015. First, average daily MME per prescription decreased after 2010, both nationwide and in most counties. The largest decreases occurred from 2010 to 2012, following publication of two national guidelines defining high-dose opioid prescribing as >200 MME/day (*15*,*16*). It also coincided with studies demonstrating progressively increasing overdose risk at prescribed opioid dosages exceeding 20, 50, and 100 MME per day (*9*–*11*) and publications highlighting associations of prescribed opioids with overdose deaths (*5*,*17*). Second, the rate of opioid prescribing decreased nationwide and in many counties. Nationally, opioid prescribing rates leveled off from 2010 to 2012, and then decreased by 13.1% from 2012 to 2015. These decreases might reflect growing awareness among clinicians and patients of the risks associated with opioids. Throughout this period, however, the average duration of opioid prescriptions increased, in part because of the continued increase in longer opioid prescriptions (≥30 days) through 2012, followed by a stabilization of the rate, and a substantial decrease in shorter prescriptions (<30 days) after 2012. This pattern, along with the trends in overall numbers of opioid prescriptions, might reflect fewer patients initiated on opioid therapy after 2012, whereas patients already receiving opioids were more likely to continue receiving them. Patients are at risk for continuing opioids long-term once they have received them for >5 days (*18*), and are unlikely to discontinue opioids after they have received them for 90 days (*19*), highlighting both the importance of minimizing unnecessary initial opioid exposure and potential challenges in reducing opioid use among patients already receiving them.

From 2010 to 2015, half of counties in the United States experienced reductions in the amount of opioids prescribed, with substantial decreases in certain states. In 2011 and 2012, Ohio and Kentucky, respectively, mandated that clinicians review Prescription Drug Monitoring Program (PDMP) data and implemented pain clinic regulation (*20*). MME per capita

FIGURE 2. (*Continued*) Morphine milligram equivalents (MMEs) of opioids prescribed per capita in 2015 and change in MMEs per capita during 2010–2015, by county — United States, 2010–2015



decreased in 85% of Ohio counties and 62% of Kentucky counties from 2010 to 2015. In Florida, where multiple interventions targeted excessive opioid prescribing from 2010 through 2012, (e.g., pain clinic regulation and mandated PDMP reporting of dispensed prescriptions) (*21*), the amount of opioids prescribed per capita decreased in 80% of counties from 2010 to 2015. During this time, Florida also experienced reductions in prescription opioid-related overdose deaths (*21*).

Despite reductions, the amount of opioids prescribed in 2015 remained high relative to 1999 levels and varied substantially across the country, with average per capita amounts prescribed in the top quartile of counties approximately six times the amounts prescribed in the lowest quartile. Larger amounts were prescribed in micropolitan counties and in counties with a higher prevalence of diagnosed diabetes and arthritis. The latter finding might represent treatment for pain associated with these or co-occurring painful conditions. However, there are effective nonopioid treatments for pain whose benefits outweigh the harms (*13*). Reasons for higher opioid use in micropolitan counties might include less access to quality health care and other treatments for pain, such as physical therapy. In addition, persons in rural areas might travel to micropolitan areas, which often serve as an anchor community for a much larger rural region, to receive medical care and pick up medications.

Despite reductions in opioid prescribing in recent years, opioid-involved overdose death rates continue to increase. However, these increases have been driven largely by use of illicit fentanyl and heroin (*1*). There is no evidence that policies designed to reduce inappropriate opioid prescribing are leading to these increases. Combined implementation of mandated provider review of PDMP data and pain clinic laws reduced the amount of opioids prescribed, prescription opioid-involved overdose deaths, and all opioid-involved deaths (*20*). The policies were also associated with reductions in heroin overdose deaths that were not statistically significant (*20*). By reducing the number of persons exposed to opioids and the subsequent risk of opioid use disorder these policies might reduce the number of persons initiating illicit opioid use in the longer term (*20*).

TABLE 1. Percentage of counties with changes* in opioid prescribing — United States, 2010–2015

Opioid prescribing measures	Decrease (%)	Stable (%)	Increase (%)
MME per capita	49.6	27.8	22.6
Overall prescribing rate	46.5	33.8	19.6
High-dose† prescribing rate	86.5	6.7	6.9
Average daily MME per prescription	72.1	25.7	2.2
Average days' supply per prescription	1.1	25.4	73.5

Abbreviation: MME = morphine milligram equivalent.
* Among counties with sufficient data, changes of ≥10% were considered to represent an increase or decrease, whereas changes of <10% were considered stable.
† High-dose prescribing rates include prescriptions with daily dosage ≥90 MME.

The findings in this report are subject to at least four limitations. First, QuintilesIMS estimates of dispensed prescriptions have not been validated, and they do not include prescriptions dispensed directly by prescribers (although this likely represents a small minority of prescribed opioids), potentially biasing opioid prescribing downwards. Second, county-level analyses are aggregated by the county where an opioid is dispensed, and cannot account for prescriptions obtained by persons outside of the county. Third, the analysis does not include clinical outcomes. However, previous analyses have found associations between population-level amounts of opioids prescribed

TABLE 2. Sociodemographic characteristics of counties by MME per capita quartiles* — United States, 2015

Characteristics	Total	Lowest quartile	Second quartile	Third quartile	Highest quartile	Adjusted results†	
						Coefficient	p-value
Population no. (%)	—	**76,225,923 (23.8)**	**108,825,101 (33.9)**	**83,254,830 (26.0)**	**52,330,662 (16.3)**	—	—
Average MME per capita	—	**202.9**	**528.5**	**776.9**	**1,318.7**	—	—
Age group, yrs (%)							
<35	43.3	43.2	44.6	43.3	42.1	NA	—
35–64	38.8	38.6	38.7	38.9	39.0	NA	—
≥65	17.9	18.2	16.7	17.7	18.9	NA	—
Race/Ethnicity (%)							
Non-Hispanic white	80.1	76.9	78.3	81.8	83.6	6.9	<0.001
Non-Hispanic black	9.0	9.3	9.4	9.3	8.0	NA	—
Hispanic§	7.0	9.5	8.3	5.3	4.8	NA	—
Other	3.9	4.4	4.0	3.7	3.6	NA	—
Insurance status (%)							
Uninsured	14.9	15.3	14.3	14.5	15.7	7.5	<0.001
Medicare	16.8	17.2	15.8	16.7	17.7	NA	—
Medicaid	20.6	19.2	19.3	20.7	23.3	5.3	<0.001
Education level (%)							
No high school diploma	16.9	17.3	15.9	16.1	18.4	6.9	<0.001
Employment level (%)							
Unemployed	7.6	6.7	7.3	7.9	8.5	11.0	<0.001
Income							
Income below the Federal Poverty Level (%)	15.5	15.3	14.5	15.2	17.1	-3.8	0.08
Median annual income ($)	22,479	22,339	23,747	22,612	21,216	NA	—
Urban/Rural (%)¶							
Metropolitan	38.5	29.5	47.9	41.9	34.7	0.6	0.003
Micropolitan	21.6	13.6	20.2	24.9	27.6	1.3	<0.001
Noncore	39.9	56.9	31.9	33.2	37.7	NA	—
Provider density per 100,000 residents							
Primary care physicians (no.)	55.2	44.1	57.4	59.5	60.0	2.1	<0.001
Dentists (no.)	38.2	30.5	41.5	41.3	39.5	4.0	<0.001
Disease/Condition prevalence (%)							
Diagnosed diabetes	11.1	10.2	10.6	11.4	12.1	30.5	<0.001
Diagnosed arthritis	24.8	23.7	23.9	25.4	26.3	9.6	0.009
Disabled	15.1	14.4	13.5	15.3	17.4	21.9	<0.001
Selected death rate							
Suicides per 100,000 (no.)	11.3	7.7	15.1	13.5	9.0	10.4	<0.001

Source: U.S. Census Bureau (age, urban/rural status), American Community Survey (race/ethnicity, percent uninsured, percent unemployed, income), U.S. Diabetes Surveillance System (diabetes prevalence), Dartmouth Atlas of Health Care (provider supply), Centers for Medicare and Medicaid Services (Medicaid and Medicare coverage), Behavioral Risk Factor Surveillance System (arthritis prevalence), and the Area Health Resource File (percent disabled, suicide rate).
Abbreviations: MME = morphine milligram equivalents; NA = not applicable (variable was not included in the final model).
* Quartiles were created using MME per capita to characterize the distribution of opioids prescribed.
† Results are from a stepwise multivariable linear regression model of the continuous variable, county-level MME per capita.
§ Hispanic persons could be of any race.
¶ The three classification levels for counties were 1) metropolitan: part of a metropolitan statistical area 2) micropolitan: part of a micropolitan statistical area (has an urban cluster of ≥10,000 but <50,000 population); and 3) noncore: not part of a metropolitan or micropolitan statistical area.

and opioid overdose death rates (*5*), and between prescribed dosages and individual overdose risk (*9–11*). Finally, because data on the indications for which opioids were prescribed were not available, the appropriateness of opioid prescriptions, or whether opioids were prescribed for acute, chronic, or end-of-life pain, could not be determined.

Although some variation in opioid prescribing is associated with characteristics such as the prevalence of possibly painful conditions (e.g., arthritis), differences in these characteristics explain only a fraction of the wide variation in opioid prescribing across the United States. This variation suggests inconsistent practice patterns and a lack of consensus about appropriate opioid use and demonstrates the need for better application of guidance and standards around opioid prescribing practices (*13*). CDC's Guideline provides evidence-based recommendations about opioid prescribing for primary care clinicians treating adult patients with chronic pain outside of active cancer treatment, palliative care, and end-of-life care (*13*). The Guideline can help providers and patients weigh the benefits and risks for opioids according to best available evidence and individual patients' needs and safely taper opioids if risks outweigh benefits. The Guideline recommends the use of nonopioid therapies, such as acetaminophen, nonsteroidal anti-inflammatory medications, exercise therapy, and cognitive behavioral therapy for chronic pain (*13*).

Given associations between opioid prescribing, opioid use disorder, and opioid overdose rates (*5*), states and local jurisdictions can use these findings to target high-prescribing areas for interventions such as academic detailing for clinicians or individual educational visits to clinicians (*22*), and increased access to medication-assisted treatment for patients with opioid use disorder. Innovative approaches such as virtual physical therapy sessions with pain coping skills training (*23*,*24*) can be used to improve access to effective treatment for chronic pain. In addition, states can consider policies that can reduce opioid overdose, including mandated PDMP use and pain clinic laws (*20*). Changes in opioid prescribing can save lives. The findings of this report demonstrate that substantial changes are possible and that more are needed.

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Conflict of Interest

No conflicts of interest were reported.

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Notes from the Field

An Outbreak of Shiga Toxin–Producing *Escherichia coli* O121 Infections Associated with Flour — Canada, 2016–2017

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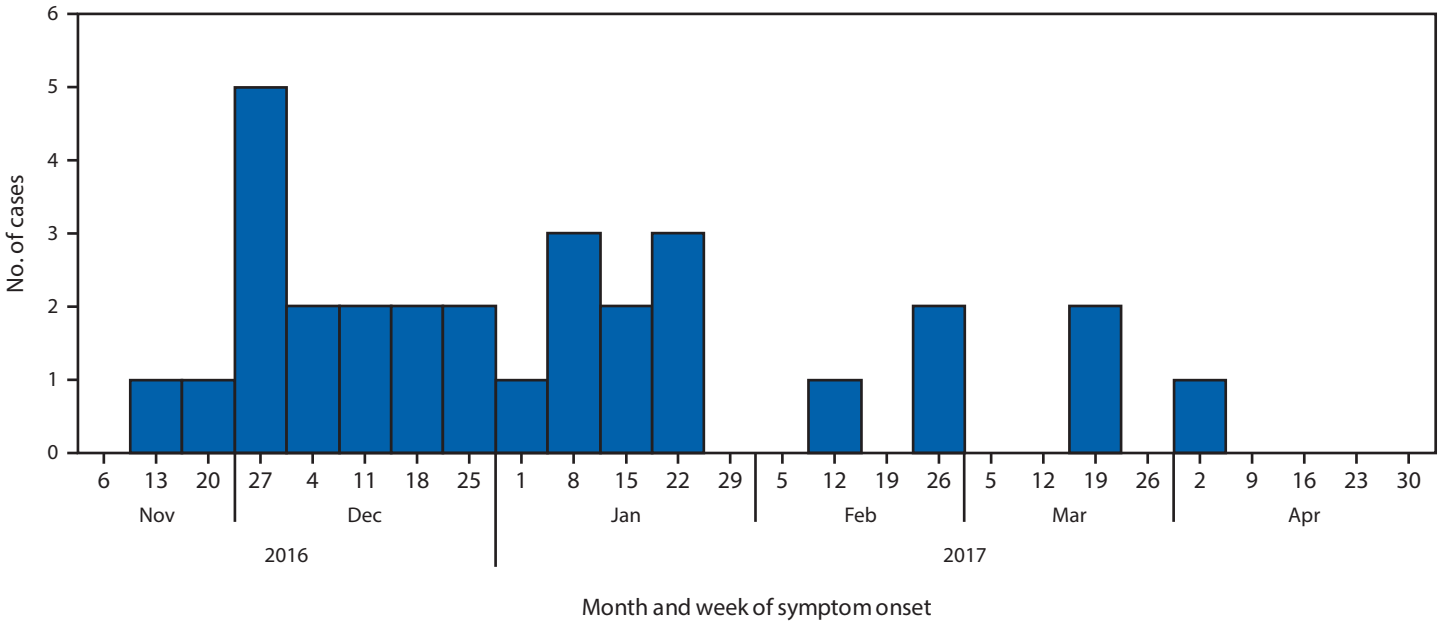
On December 29, 2016, PulseNet Canada identified a cluster of six *Escherichia coli* non-O157 isolates with a matching pulsed-field gel electrophoresis (PFGE) pattern combination that was new to the PulseNet Canada database. The patients resided in three geographically distinct provinces. In January 2017, the Public Health Agency of Canada (PHAC) initiated an investigation with local, provincial, and federal partners to investigate the source of the outbreak.

A case was defined as isolation of *E. coli* non-O157 with the outbreak PFGE pattern or closely related by whole genome sequencing (WGS) in a Canadian resident or visitor with onset of symptoms of gastroenteritis on or after November 1, 2016. Patients' illness onset dates ranged from November 2016 to April 2017 (Figure). As of May 23, 2017, a total of 29 cases were identified in six provinces (Alberta, British Columbia, Newfoundland and Labrador, Ontario, Quebec, and Saskatchewan). One additional case was identified in a U.S. resident who traveled to Canada during the exposure period. Patients' ages ranged from 2–79 years (median = 23.5 years) and 50% were female. Eight patients were hospitalized, and one developed hemolytic uremic syndrome. Clinical isolates were typed as *E. coli* O121:H19 (one case was typed as *E. coli* O121:H undetermined) with Shiga toxin 2–producing genes by in silico toxin testing and had closely related PFGE patterns and WGS.

Initial investigation into the source of the outbreak did not identify any clear hypotheses; common exposures were ground beef, sausage style deli-meats, pizza, and pork, but the data did not converge on any specific products. Patients were reinterviewed by PHAC using an open-ended approach. Knowledge of a recent *E. coli* O121 flour-associated outbreak prompted interviewers to ask about baking and exposure to raw flour or dough (*1*). Patients were also asked if any food items of interest, including flour, were available for testing.

In March 2017, *E. coli* O121 with the outbreak PFGE pattern was isolated from an open flour sample from a patient's home and a closed sample collected at a retail store, both of the same brand and production date. The clinical and flour isolates grouped together, with only 0–6 whole genome multilocus sequence typing allele differences. As a result of these findings, a product recall was issued. Based on possible connections to the recalled lot of flour, market sampling of flour within certain periods was initiated. The investigation led to additional recalls of flour and many secondary products (*2*).

FIGURE. Number of confirmed cases of *Escherichia coli* O121 infection (n = 30),* by week of symptom onset — Canada, November 2016–April 2017



* One case occurred in a U.S. resident who traveled to Canada during the exposure period.

As of May 23, 2017, 22 patients had been asked about flour exposure in the 7 days before illness onset; 16 (73%) reported that the implicated brand of flour was used or probably used in the home during the exposure period. Comparison data on the expected proportion with exposure to this brand of flour were not available. Eleven of these sixteen patients reported they ate or probably ate raw dough during their exposure period.

This is the first national outbreak of non-O157 Shiga toxin–producing *E. coli* infections identified in Canada and the first Canadian outbreak linked to flour. An open-ended interview approach and flour sampling were used to implicate flour as the source. Because of the recent emergence of *E. coli* outbreaks linked to flour, public health professionals should consider flour as a possible source in *E. coli* outbreaks and communicate the risk associated with exposure to flour, raw batter, and dough in public health messaging.

Acknowledgments

Health Canada; British Columbia Centre for Disease Control; British Columbia Centre for Disease Control Public Health Laboratory; Alberta Health; Alberta Health Services; Alberta Agriculture and Forestry; Saskatchewan Ministry of Health; Public Health Ontario; Ontario Ministry of Health and Long-Term Care; Ministère de la Santé et des Services sociaux du Québec; the Newfoundland and Labrador Regional Health Authorities and Department of Health and Community Services; CDC; Washington State Department of Health; local and regional health authorities; Service Newfoundland and Labrador.

Conflict of Interest

No conflicts of interest were reported.

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Erratum

Vol. 60, No. RR-1

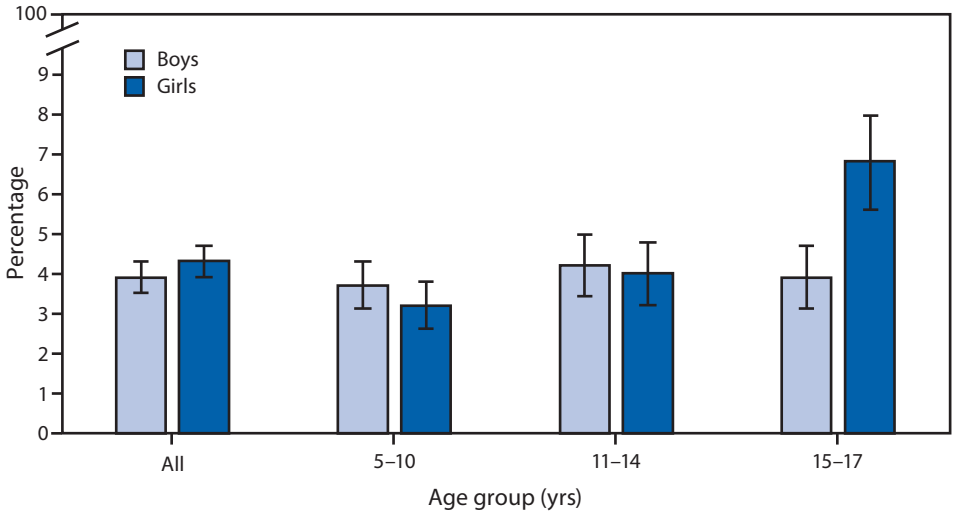
In the *Recommendations and Reports* "Antiviral Agents for the Treatment and Chemoprophylaxis of Influenza" (January 21, 2011, Vol. 60, No. RR-1, https://www.cdc.gov/mmwr/pdf/rr/rr6001.pdf), on page 8, in the first column, in the second paragraph, in the second sentence, the term "pneumonia" was used rather than "lower respiratory tract complications leading to antibiotic use." The corrected sentence should read, "In a study that combined data from 10 clinical trials, the risk for **lower respiratory tract complications leading to antibiotic use** among those participants with laboratory-confirmed influenza receiving oseltamivir treatment was approximately 50% lower than among those persons receiving a placebo and 34% lower among patients at risk for complications ($p<0.05$ for both comparisons) (*22*)."

This correction does not change CDC's influenza antiviral recommendations. A summary of current antiviral guidance is available at https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Children and Teens Aged 5–17 Years Who Missed >10 School Days in the Past 12 Months Because of Illness or Injury,† by Sex and Age — National Health Interview Survey, 2013–2015§



* With 95% confidence intervals indicated with error bars.
† Number of missed school days was based on the following question: "During the past 12 months about how many days did (child) miss school because of illness or injury?" Children who did not attend school were excluded.
§ Estimates are based on household interviews of a sample of the noninstitutionalized U.S. civilian population and are derived from the National Health Interview Survey Sample Child component.

During 2013–2015, 3.9% of boys and 4.3% of girls missed >10 school days in the past 12 months because of illness or injury. Among children aged 15–17 years, girls were more likely than boys to miss >10 school days (6.8% compared with 3.9%). Among girls, those aged 15–17 years were more likely than girls aged 5–10 years and girls aged 11–14 years to miss >10 school days (6.8% compared with 3.2% and 4.0%, respectively). Among boys, there was no difference by age.

Source: National Center for Health Statistics. National Health Interview Survey, 2013–2015. https://www.cdc.gov/nchs/nhis.htm.

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