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Consumption of Cigarettes and Combustible Tobacco — United States, 2000–2011

Smoking cigarettes and other combustible tobacco products causes adverse health outcomes, particularly cancer and cardiovascular and pulmonary diseases (*1*). A priority of the U.S. Department of Health and Human Services is to develop innovative, rapid-response surveillance systems for assessing changes in tobacco use and related health outcomes (*2*). The two standard approaches for measuring smoking rates and behaviors are 1) surveying a representative sample of the public and asking questions about personal smoking behaviors and 2) estimating consumption based on tobacco excise tax data (*3*). Whereas CDC regularly publishes findings on national and state-specific smoking rates from public surveys (*4*), CDC has not reported consumption estimates. The U.S. Department of Agriculture (USDA), which previously provided such estimates, stopped reporting on consumption in 2007 (*5*). To estimate consumption for the period 2000–2011, CDC examined excise tax data from the U.S. Department of Treasury's Alcohol and Tobacco Tax and Trade Bureau (TTB); consumption estimates were calculated for cigarettes, roll-your-own tobacco, pipe tobacco, and small and large cigars. From 2000 to 2011, total consumption of all combustible tobacco decreased from 450.7 billion cigarette equivalents to 326.6, a 27.5% decrease; per capita consumption of all combustible tobacco products declined from 2,148 to 1,374, a 36.0% decrease. However, while consumption of cigarettes decreased 32.8% from 2000 to 2011, consumption of loose tobacco and cigars increased 123.1% over the same period. As a result, the percentage of total combustible tobacco consumption composed of loose tobacco and cigars increased from 3.4% in 2000 to 10.4% in 2011. The data suggest that certain smokers have switched from cigarettes to other combustible tobacco products, most notably since a 2009 increase in the federal tobacco excise tax that created tax disparities between product types.

USDA's previous consumption estimates were based on 1) information from TTB, including data on products that are produced domestically or imported and taxed for legal sale in the United States; 2) tobacco industry reports; and 3) information from industry advisors. CDC developed a method to estimate consumption exclusively by using publicly available federal excise tax data available from TTB on products taxed domestically and imported into the United States (*6*). Using monthly tax data, CDC calculated the per unit (e.g., per cigarette or per cigar) consumption for each product. To enable comparisons with pipe tobacco and roll-your-own tobacco, CDC converted the tax data from pounds of tobacco to a per cigarette equivalent, based on the conversion formula contained in the Master Settlement Agreement (0.0325 oz [0.9 g] = one cigarette).* Adult per capita cigarette consumption was estimated by dividing total consumption by the number of persons aged ≥18 years in the United States each year using data from the U.S. Census Bureau. When compared with USDA's previous calculations for adult per capita cigarette consumption during 2000–2006, CDC's estimates differed each year by a median of only 0.15% and a mean of 0.76%.

From 2000 to 2011, total cigarette consumption declined from 435.6 billion to 292.8 billion, a 32.8% decrease (Table 1). Per capita cigarette consumption declined from 2,076 in 2000 to 1,232 in 2011, a 40.7% decrease. Conversely, total consumption of noncigarette combustible products increased

* Available at http://www.naag.org/backpages/naag/tobacco/msa/msa-pdf.

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from 15.2 billion cigarette equivalents in 2000 to 33.8 billion in 2011, a 123.1% increase, and per capita consumption increased from 72 in 2000 to 142 in 2011, a 96.9% increase. Total consumption of all combustible tobacco decreased from 450.7 billion cigarette equivalents to 326.6, a 27.5% decrease from 2000 to 2011, and per capita consumption of all combustible tobacco products declined from 2,148 to 1,374, a 36.0% decrease.

Consumption of loose tobacco (i.e., roll-your-own cigarette tobacco and pipe tobacco) changed substantially from 2000 to 2011. Roll-your-own cigarette equivalent consumption decreased by 56.3%, whereas pipe tobacco consumption increased by 482.1% (Table 2). The largest changes occurred from 2008 to 2011, when roll-your-own consumption decreased from 10.7 billion to 2.6 billion (a 75.7% decrease), whereas pipe tobacco consumption increased from 2.6 billion to 17.5 billion (a 573.1% increase).

Substantial changes also were observed in consumption of small cigars[†] and large cigars (Figure 1). From 2000 to 2011, consumption of small cigars decreased 65.0%, whereas large cigar consumption increased 233.1% (Table 2). The largest changes occurred from 2008 to 2011, when small cigar consumption decreased from 5.9 billion to 0.8 billion (an 86.4% decrease), whereas large cigar consumption increased from 5.7 billion to 12.9 billion (a 126.3% increase).

[†] 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.

Annual cigarette consumption declined each year during 2000–2011, including a 2.6% decrease from 2010 to 2011, but total consumption of combustible tobacco decreased only 0.8% from 2010 to 2011, in part because of the effect of continued increases in the consumption of noncigarette combustible tobacco products (Figure 2). From 2000 to 2011, the percentage of total combustible tobacco consumption composed of loose tobacco and cigars increased from 3.4% (15.2 billion cigarette equivalents out of 450.7 billion) to 10.4% (33.8 billion of 326.6 billion).

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Editorial Note

Despite continued decreases in cigarette smoking in the United States, consumption of pipe tobacco and large cigars has increased substantially since the federal tobacco excise tax was increased in 2009, creating tax disparities that made 1) pipe tobacco less expensive than roll-your-own tobacco and manufactured cigarettes, and 2) large cigars less heavily taxed than small cigars and manufactured cigarettes (*7,8*). Because loose tobacco products are classified based on how they are labeled, the loose tobacco tax disparity of $21.95 per pound

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TABLE 1. Total consumption and adult per capita consumption* of cigarettes, all combustible tobacco,† and noncigarette combustible tobacco products§ — United States, 2000–2011

	Cigarettes				All combustible tobacco				Noncigarette combustible tobacco			
Year	Total consumption (in millions)	% change	Adult per capita consumption	% change	Total consumption (in millions)	% change	Adult per capita consumption	% change	Total consumption (in millions)	% change	Adult per capita consumption	% 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	>-0.1	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	16,15	-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
% change, from 2000 to 2011		**-32.8**	—	**-40.7**	—	**-27.5**	—	**-36.0**	—	**123.1**	—	**96.9**

* Adults aged ≥18 years as reported annually by the U.S. Census Bureau.
† Includes cigarettes, small cigars and large cigars, and per-cigarette equivalents for pipe tobacco and roll-your-own tobacco based on the conversion rate in the Master Settlement Agreement: 0.0325 oz (0.9 g) of tobacco = one cigarette.
§ Includes all combustible products other than cigarettes.

TABLE 2. Total consumption of noncigarette combustible tobacco product, by product category and type — United States, 2000–2011

	Loose tobacco				Cigars			
Year	Roll-your-own* (in millions)	% change	Pipe* (in millions)	% change	Small cigars (in millions)	% change	Large cigars (in millions)	% change
2000	5,995	—	2,999	—	2,279	—	3,882	—
2001	4,714	-21.4	2,915	-2.8	2,239	-1.8	4,105	5.7
2002	5,737	21.7	2,757	-5.4	2,343	4.6	4,203	2.4
2003	6,207	8.2	2,389	-13.3	2,474	5.6	4,533	7.9
2004	6,600	6.4	2,314	-3.2	2,917	17.9	4,935	8.9
2005	8,614	30.5	2,423	4.7	3,968	36.0	5,084	3.0
2006	8,594	-0.2	2,322	-4.2	4,434	11.7	5,299	4.2
2007	9,326	8.5	2,463	6.1	5,161	16.4	5,548	4.7
2008	10,721	15.0	2,586	5.0	5,881	14.0	5,657	2.0
2009	6,006	-44.0	6,256	142.0	2,343	-60.2	9,784	73.0
2010	3,168	-47.2	12,351	97.4	983	-58.1	12,287	25.6
2011	2,622	-17.2	17,459	41.4	798	-18.8	12,929	5.2
% change, from 2000 to 2011		**-56.3**	—	**482.1**	—	**-65.0**	—	**233.1**

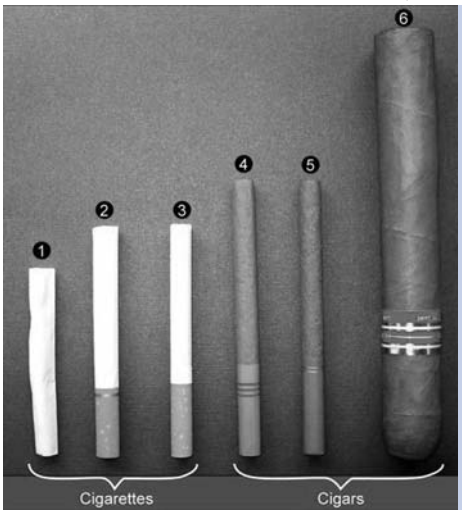
* These data are the per-cigarette equivalent based on the conversion rate in the Master Settlement Agreement: 0.0325 oz (0.9 g) of tobacco = one cigarette.

led manufacturers to relabel roll-your-own tobacco as pipe tobacco and then market this relabeled pipe tobacco for roll-your-own use (*7–9*). In addition, manufacturers were able to increase the per-unit weight of certain small cigars to take advantage of a tax benefit when classified as large cigars, which are taxed based on the product price rather than per cigar (*7*). As a result of relatively minor increases in per-unit weight, the new "large cigar" can appear almost identical to a "small cigar," which resembles a typical cigarette and can cost as little as 7 cents per cigar (Figure 1) (*7*).

This analysis shows that cigarette consumption continues to decline in the United States, a trend that has persisted since the 1960s. However, recent changes in consumption patterns, particularly increases in large cigar and pipe tobacco use, have resulted in a slowing of the decline in consumption of all combustible tobacco, and indicate that certain cigarette smokers have switched to using lower-taxed noncigarette combustible products. Moreover, a 2012 Surgeon General's report found that youths and young adults had even higher rates of cigar use and simultaneous use of multiple tobacco products (*10*).

Recent analysis of excise tax data for pipe tobacco, roll-your-own cigarette tobacco, small cigars, and large cigars reveals that the tobacco industry is adapting the marketing and production of cigars and roll-your-own tobacco products to minimize federal excise tax and thus reduce these tobacco products' prices compared with cigarettes (*7–9*). Reducing the effective federal and state excise tax rates on tobacco lessens the impact of cost on reducing smoking and preventing smoking

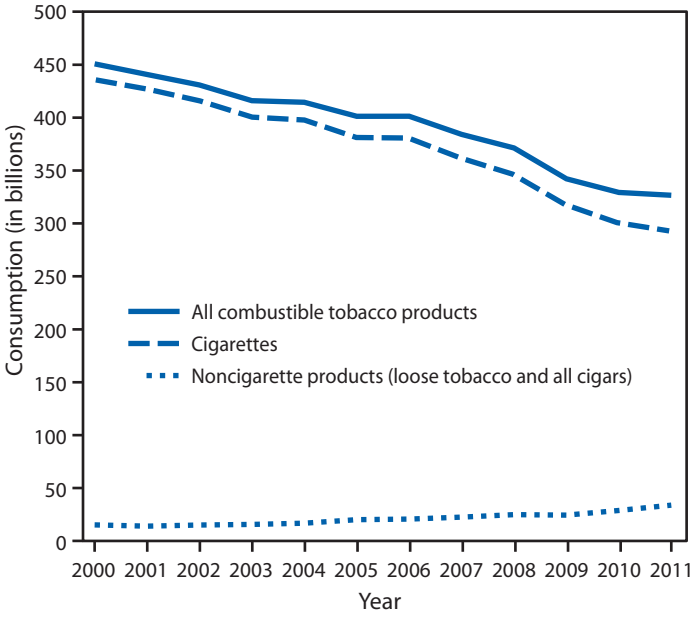
FIGURE 1. Physical differences between combustible tobacco products — Government Accountability Office, United States



1. Roll-your-own cigarette made by hand with roll-your-own tobacco
2. Roll-your-own cigarette made in a commercial roll-your-own machine with pipe tobacco
3. Factory-made cigarette
4. Small cigar
5. Filtered large cigar
6. Traditional large cigar

Source: Government Accountability Office. Tobacco taxes: large disparities in rates for smoking products trigger significant market shifts to avoid higher taxes. Available at http://www.gao.gov/products/gao-12-475.

FIGURE 2. Consumption of cigarettes and other combustible tobacco products — United States, 2001–2011



initiation. The Government Accountability Office (GAO) recommends modifying federal tobacco taxes to eliminate large tax differentials between roll-your-own and pipe tobacco and small and large cigars (*7*). In addition, because Food and Drug Administration (FDA) regulations currently do not apply to cigars and pipe tobacco, these products can be produced with flavoring, can be labeled with misleading descriptors such as "light" or "low tar," and can be marketed and sold with fewer restrictions than apply to cigarettes.

What is already known on this topic?

Cigarette use continues to decline in the United States, a trend that has persisted since the 1960s.

What is added by this report?

From 2000 to 2011, consumption of all combustible tobacco products decreased from 450.7 billion cigarette equivalents to 326.6 (a 27.5% decrease), and per capita consumption of all combustible tobacco products declined from 2,148 to 1,374 (a 36.0% decrease). However, whereas consumption of cigarettes decreased 32.8%, consumption of noncigarette combustible tobacco increased 123.1%. As a result, the percentage of combustible tobacco consumption composed of loose tobacco and cigars increased from 3.4% in 2000 to 10.4% in 2011.

What are the implications for public health practice?

The increase in cigar and pipe tobacco use is a public health concern because all combustible tobacco use causes cancer, heart disease, and other smoking-related diseases. A switch from cigarettes to other, lower-taxed, combustible tobacco products blunts the effect of increasing prices, one of the most effective ways to reduce smoking and prevent youth smoking initiation.

The findings in this report are subject to at least one limitation. CDC's measure for cigarette and combustible tobacco consumption only accounts for products taxed for legal sale in the United States and 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.

Smoke from pipes and cigars contains the same toxic chemicals as cigarette smoke (*1*). The evidence that the increase in cigar and pipe tobacco use is the result of offering cigarette smokers a low-priced alternative product is a particular public health concern, because the morbidity and mortality effects of other forms of combustible tobacco are similar to those of cigarettes. Increasing prices has been one of the most effective ways to reduce tobacco use and prevent youth smoking initiation (*10*). In addition, combustible tobacco products that are similar in design but not legally considered to be cigarettes are not subject to FDA regulations related to manufacturing, flavoring, labeling, and marketing. The availability of low-priced and less regulated alternative products appears to have led certain cigarette smokers to switch to other combustible tobacco products. This group also might include persons who otherwise might have quit smoking as a result of the 2009 federal tobacco excise tax increase and FDA cigarette regulations. Diminishing the public health impact of excise tax increases and regulation can hamper efforts to prevent youth smoking initiation, reduce consumption, and prompt quitting.

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Public Health Interventions Involving Travelers with Tuberculosis — U.S. Ports of Entry, 2007–2012

Every day, approximately 950,000 international travelers arrive in the United States (*1*). The Secretary of the U.S. Department of Health and Human Services is authorized to prevent the introduction, transmission, and spread of communicable diseases by travelers into and within the United States (*2*). The Secretary, through the CDC director, delegates this authority to CDC's Division of Global Migration and Quarantine (DGMQ). Of the communicable diseases for which federal quarantine and isolation are authorized by executive orders of the president (*2*), infectious tuberculosis (TB) is encountered most commonly by DGMQ's network of quarantine stations at major U.S. ports of entry (Table). Although legal immigrants and refugees undergo U.S. State Department–mandated TB screening overseas, CDC receives approximately 125 reports each year of arriving travelers with active TB, including foreign visitors, foreign students, and temporary workers (CDC, unpublished data, 2012). This report describes two cases that illustrate the TB control and prevention activities of quarantine stations. Such activities, including issuing federal isolation orders, restricting travel, arranging safe transport for patients across state lines, and conducting airline contact investigations, support CDC's mission to limit the spread of infectious disease from travelers.

Case Reports

Case 1. On March 24, 2010, the Nevada State TB Program notified the CDC Los Angeles Quarantine Station about an elderly legal immigrant from Mexico with infectious TB. The patient was admitted to a Nevada hospital in October 2009. Sputum smears revealed the presence of acid-fast bacilli (AFB), and standard four-drug treatment (isoniazid, rifampin, pyrazinamide, and ethambutol) was started empirically. The local TB clinic provided outpatient treatment under directly observed therapy until December 2009, when the patient abruptly left the United States for Mexico without notifying the clinic, and before drug susceptibility tests showed isoniazid resistance. Local public health officials referred the case to Cure-TB,* a binational TB program that facilitates continuity of care for patients with TB who travel between the United States and Mexico.

The patient returned briefly to the United States in March 2010, but made no contact with local TB control officers and departed again to Mexico. After discussions with state and local public health partners, CDC issued a federal isolation order and placed the patient on public health travel restriction lists (Do Not Board [DNB] and lookout lists) because of the risk for infectiousness resulting from suboptimal treatment, continued nonadherence with public health recommendations, and recent history of international travel. Persons included on the DNB list are assigned a public health lookout record, which alerts Customs and Border Protection (CBP) officers if the person attempts to enter the United States through any port of entry (*3*).

In September 2010, the patient was detected by CBP at a border crossing in El Paso, Texas. The CDC El Paso Quarantine Station served a federal isolation order, and the patient was transported to a nearby Texas hospital under CBP custody for evaluation and treatment. After three sputum specimens tested AFB smear-negative, the patient was escorted by a CDC quarantine public health officer to Nevada. The federal isolation order was rescinded, and the patient was transferred to the custody of a local health department for court-ordered home isolation. Compliance with an effective treatment regimen, administered through directly observed therapy, permitted removal of federal travel restrictions in November 2010.

Case 2. On October 18, 2011, the Ohio Department of Health TB Program reported a college student from China with AFB smear-positive, cavitary TB disease to the CDC Detroit Quarantine Station. In August 2011, the student had traveled from Japan to California on a commercial flight that exceeded 8 hours, and then flew on two connecting domestic flights (California to Illinois and Illinois to Ohio, each of which was <8 hours).

When DGMQ protocol conditions for TB airline contact investigations are met, including infectiousness criteria and flight duration of ≥8 hours, the jurisdictional quarantine station obtains the flight manifest and locator information for potentially exposed passengers on the flight (*4*). State health departments then are notified of contacts in their jurisdictions via the Epidemic Information Exchange (Epi-X), CDC's secure electronic communications network for public health professionals.

The CDC Detroit Quarantine Station obtained the international flight manifest and identified 15 passengers as contacts based on their seat assignments (passengers in the same row, two rows in front of, and two rows behind the index case). DGMQ notified nine state health departments of 11 U.S. resident passenger-contacts and the ministries of health of two countries about four passenger-contacts who lived outside the United States. Outcomes were reported to DGMQ by U.S. health departments for five passenger-contacts. Of those, two

* Additional information available at http://www.sdcounty.ca.gov/hhsa/programs/phs/cure_tb.

TABLE. CDC quarantine stations and the jurisdictions in which they monitor ports of entry, 2012*

Quarantine station	Jurisdiction
Anchorage, Alaska	Alaska
Atlanta, Georgia	Georgia, North Carolina, South Carolina, and Tennessee
Boston, Massachusetts	Massachusetts, Maine, New Hampshire, and Rhode Island
Chicago, Illinois	Illinois, Indiana, Iowa, and Wisconsin; preclearance port in Toronto, Canada
Dallas, Texas	Kansas, Missouri, Oklahoma, Arkansas, and northern Texas (Health districts 1, 2, and 3)
Detroit, Michigan	Michigan, Kentucky, and Ohio
El Paso, Texas (U.S.–Mexico unit)	Western Texas (Health districts 8, 9, 10, and 11) and New Mexico
Honolulu, Hawaii	Hawaii, Guam, and Pacific Trust Territories
Houston, Texas	Eastern Texas (Health districts 4, 5, 6, and 7) and Louisiana
Los Angeles, California	Southern California (Los Angeles, Orange, San Bernardino, Riverside, Ventura, Santa Barbara, San Luis Obispo, Inyo, and Kern counties), Nevada, Utah, and Colorado
Miami, Florida	Florida, Alabama, and Mississippi; preclearance ports in the Bahamas
Minneapolis-St. Paul, Minnesota	Minnesota, Nebraska, North Dakota, and South Dakota
New York, New York	New York, Connecticut, and Vermont; preclearance ports in Montreal, Canada; Bermuda; and Shannon and Dublin, Ireland
Newark, New Jersey	New Jersey
Philadelphia, Pennsylvania	Pennsylvania and Delaware
San Diego, California (U.S.–Mexico unit)	Arizona, California (San Diego and Imperial counties)
San Francisco, California	Central and northern California (46 counties) and Wyoming
San Juan, Puerto Rico	Puerto Rico and the U.S. Virgin Islands
Seattle, Washington	Washington, Idaho, Montana, and Oregon; preclearance ports in Edmonton, Calgary, Vancouver, and Victoria, Canada
Washington, DC	District of Columbia, Maryland, Virginia, and West Virginia

* Additional information available at http://www.cdc.gov/quarantine/quarantinestations.html.

were evaluated and determined not to have been infected with TB; attempts to notify the other three were unsuccessful.

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Editorial Note

In 2011, 10,521 new TB cases were reported in the United States, with rates 12 times higher in foreign-born persons than in U.S.-born persons (*5*). From June 2007 to December 2011, 632 cases of active TB among travelers were reported to CDC quarantine stations (CDC, unpublished data, 2012). TB transmission during air travel has been documented (*4,6*), but the risk for transmission has not been determined and is believed to be low. One model estimates the risk for transmission from a highly infectious passenger on an 8.7-hour commercial flight as 1 per 1,000 for all passengers, with higher risk to those seated closer to the infectious passenger (*7*). Delegated authority permits DGMQ's use of public health travel restriction tools and federal isolation orders to prevent persons known or suspected of having infectious TB from traveling. These tools can facilitate the safe transport of travelers with TB to local hospitals or their home states for testing and continued treatment. Since June 2007, five federal isolation orders have been served to persons with TB (inclusive of case 1), four of whom were foreign-born; before 2007, the last federal isolation order was issued in 1963.

Domestic or international public health officials may request that a person be placed on the DNB and lookout lists, which have been managed jointly by CDC and the Department of Homeland Security since formalization of the process in June 2007 (*3*). If persons on the lists are identified at ports of entry, CBP notifies the jurisdictional quarantine station to facilitate public health clearance or action. From June 2007 to December 2011, 205 persons with known or suspected TB were added to the DNB and lookout lists; 173 (84%) have since been removed after meeting criteria indicating noninfectiousness (CDC, unpublished data, 2012). The first case report, involving multiple health jurisdictions and CDC quarantine stations, exemplifies the successful use of the lookout record to intercept a TB-infected traveler at a land border and return the patient to public health management. The federal isolation order had been drafted months before the patient was encountered at the port of entry, facilitating immediate medical evaluation and return of the patient to health care in his home state.

The second case report highlights CDC quarantine stations' response to notifications of travelers with infectious TB who traveled by commercial aircraft. From June 2007 to December 2011, CDC quarantine stations, in collaboration with U.S. health departments, performed airline contact investigations for 390 travelers with infectious TB, involving 508 flights with approximately 15,650 potentially exposed contacts. DGMQ also notified foreign public health authorities in more than 50 countries of at least 3,000 international contacts

What is already known on this topic?

The global burden of tuberculosis (TB) and the tremendous volume of travelers to the United States increase the risk for TB importation and transmission during travel. Significant resources are expended during public health responses to travelers with TB disease, including passenger contact investigations, legal measures, and implementation of federal travel restriction tools.

What is added by this report?

The case studies in this report illustrate the use of federal legal measures and travel restriction tools to help return noncompliant TB-infected persons to public health care, and highlight revised guidelines to optimize the cost-benefit ratio of airline TB contact investigations.

What are the implications for public health practice?

TB control in travelers into and within the United States can be promoted through ongoing state and local public health practitioner partnerships with their jurisdictional CDC quarantine stations and referral of immigrants with noninfectious TB conditions at ports of entry to TB clinics in their destination states.

(CDC, unpublished data, 2012). However, because outcome reporting to CDC is voluntary, contact tracing outcome reports typically are received for <20% of passenger contacts (*4*). In 2011, DGMQ used the results of epidemiologic and economic impact evaluations to revise its criteria for conducting airline contact investigations (Box). The policy changes conserve state and federal public health resources by assigning priority for tracing to the passenger-contacts of travelers who are most likely to transmit *Mycobacterium tuberculosis* (those with both positive sputum AFB smears and cavitation identified on chest radiograph) or who have multidrug-resistant TB. CDC quarantine stations also provide guidance to crews on ships regarding TB contact investigations when notified of travelers with infectious TB on maritime vessels.

In addition to responding to reports of infectious TB in travelers, four CDC quarantine stations meet immigrants arriving at U.S. ports of entry who have been diagnosed with admissible, noninfectious TB conditions during their pre-immigration medical screening, and provide them with a TB clinic referral in the states of their destination. Immigrants receiving referrals are four times more likely to initiate follow-up evaluation than those receiving no referral (p<0.001; CDC, unpublished data, 2012). Immigrants typically are not charged for these medical evaluations; the costs usually are borne by state and local health departments. Follow-up is important because newly arrived U.S. immigrants with a history of TB infection or previously treated disease have an increased risk for disease activation or reactivation during their first few years after arrival (*8*). DGMQ is developing a system to expand the referral program to include more CDC quarantine stations.

BOX. CDC criteria for initiating flight-related tuberculosis contact investigations, June 2011

- Index case was diagnosed within 3 months of the flight AND the flight occurred within 3 months of notification to the Division of Global Migration and Quarantine.
- Flight lasted ≥8 hours gate-to-gate.*
- Diagnosis of the index case was confirmed by sputum culture or nucleic acid amplification test for *Mycobacterium tuberculosis* AND is:
  1. Sputum smear-positive for acid-fast bacilli AND cavitation is present on a chest radiograph; OR
  2. Confirmed to have a multidrug-resistant isolate (regardless of the smear or chest radiograph results).

Note: A contact investigation will be considered on a case-by-case basis for situations that are unusual or not clearly addressed by the criteria. Examples include, but are not limited to, situations in which an unusually high proportion of close contacts have positive tuberculin skin test or interferon-gamma release assay test screening results, an index case has laryngeal tuberculosis, or cavitation is detected on chest computed tomography scan but no chest radiograph was performed.

* Gate-to-gate means all time spent on the aircraft, including boarding and deplaning time or delays on the tarmac.

The network of CDC quarantine stations provides national leadership and coordination of public health responses to TB in travelers. DGMQ also communicates with foreign health authorities about TB patients or contacts who are no longer in the United States, and collaborates with U.S. health departments to work with TB patients who have left the United States but could return. Effective collaboration between CDC quarantine stations and international, state, and local public health practitioners can help reduce the spread of TB during travel by intercepting TB patients at ports of entry, returning patients to treatment, and identifying contacts for possible intervention.

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Applied Epidemiology Fellowship Program, Council of State and Territorial Epidemiologists. State and local health departments. Quarantine stations, Joaquin Rueda, Chris Schembri, MPH, Rebecca Wong, MPH, Div of Global Migration and Quarantine, CDC.

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Infant Lead Poisoning Associated with Use of Tiro, an Eye Cosmetic from Nigeria — Boston, Massachusetts, 2011

Lead is highly toxic and can damage the brain, kidneys, bone marrow, and other body systems; high levels can cause convulsions, coma, and death (*1*). Young children are especially susceptible to lead exposures because of their floor-hand-mouth activity, greater gut absorption, and developing central nervous systems. In June 2011, a male infant aged 6 months of Nigerian descent was referred to the Pediatric Environmental Health Specialty Unit (PEHSU) at Boston Children's Hospital because of an elevated blood lead level (BLL). An investigation found no lead exposure except for "tiro," a Nigerian cosmetic that also is used as a folk remedy to promote visual development. The tiro applied to the infant's eyelids contained 82.6% lead. Products similar to tiro, such as "surma" and "kajal" in Asia and kohl in the Middle East, also might contain lead. This case adds to the medical literature documenting nonpaint lead sources as causes of elevated BLLs in children (*2,3*) and highlights persons of certain immigrant populations as a risk group. Educational efforts are needed to inform immigrants from Africa, Asia, and the Middle East that tiro and similar products can cause lead poisoning in children. Health-care providers and public health workers should ask about eye cosmetics and folk remedies when seeking a source of exposure in children with elevated BLLs from certain immigrant populations.

In June 2011, during a well-child visit of a male infant aged 6 months born in the United States to Nigerian parents, the physician noted that an imported cosmetic had been applied to the child's eyelids. Capillary blood testing performed by the physician indicated a BLL of 13 μg/dL, more than twice the CDC's reference value of 5 μg/dL, based on the 97.5th percentile of the BLL distribution in U.S. children aged 1–5 years. The next day, a confirmatory venous BLL measured by graphite furnace atomic absorption spectroscopy was 12 μg/dL. Additional laboratory evaluation revealed a normal hemoglobin level and 2+ erythrocyte microcytosis on an automated blood smear. In accordance with CDC recommendations aimed to help reduce the absorption of lead and mitigate the severe adverse health effects of lead exposure,* the pediatrician prescribed supplemental iron, contacted the Massachusetts Department of Public Health, and referred the family to the regional PEHSU.

When the infant was brought to the PEHSU 1 week later, his venous BLL, as measured by the same laboratory, was 13 μg/dL. His whole blood zinc protoporphyrin (30 μg/dL whole blood [normal: 0–35 μg/dL]), hemoglobin (12.1 g/dL [normal: 10.4–12.5 g/dL]), erythrocyte mean cell volume (74.2 fL [normal: 68.0–83.1 fL]), plasma iron (81 μg/dL [normal: 40–100 μg/dL]), and ferritin (65.0 ng/mL [normal: 10.0–75.0 ng/mL]) were in the normal range for his age. A manual blood smear showed 2+ erythrocyte microcytosis. The parents reported no health concerns for the infant, and a detailed review of systems was normal. The infant had no relevant past medical history, was growing well, and had met all developmental milestones. No other children lived in the home. Both parents had sickle cell trait; the infant had a normal hemoglobin electrophoresis. No abnormalities were noted on the physical examination.

Since 2008, the family had lived in a townhouse originally built in 2004. PEHSU staff members inspected the residence and found it to be in excellent condition, without lead hazards. Other sources of lead exposure were ruled out, including take-home exposure from parental occupations, kitchenware, family hobbies, and diet. The infant was breastfed exclusively and did not consume any imported herbs, spices, or dietary supplements. Additional questioning revealed that since age 2 weeks, a Nigerian cosmetic and folk remedy had been applied to the infant's eyelids three to four times weekly to improve attractiveness and promote visual development. A grandparent had purchased the powder, called tiro (Figure 1), from a street vendor in Ilorin, a city in Kwara State, Nigeria. The PEHSU recommended immediately discontinuing the use of tiro on the infant and continuing iron supplementation. The parents agreed to submit the suspected tiro powder for laboratory analysis.

Quantitative analysis by the PEHSU showed that the tiro consisted of 82.6% lead. A single application of 10 mg of tiro would deliver 8 mg of lead to the infant's eyelids. The most likely routes of exposure were eyelid-hand-mouth and absorption from the conjunctival surfaces of the eyes or in ingested tears. Analysis of the tiro by the U.S. Geological Survey, using scanning electron microscopy (SEM), showed that the sample was dominated by lead sulfide, known as galena (Figure 2), which has relatively low bioavailability (*1*). No other minerals were observed by SEM, although small amounts of other minerals commonly found as microscopic inclusions in lead sulfide might have escaped detection.

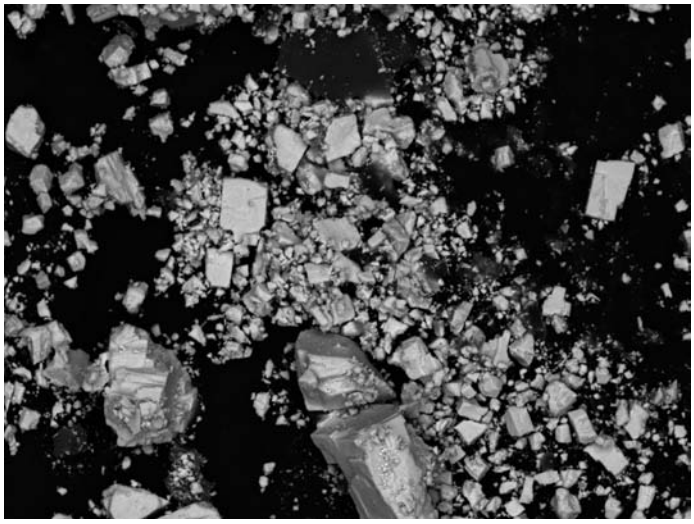
Three months after the family stopped applying tiro to the infant's eyelids, his venous BLL had fallen from 13 μg/dL to 8 μg/dL.

* Recommendations available at http://www.cdc.gov/nceh/lead/casemanagement/casemanage_chap4.htm.

FIGURE 1. The Nigerian tiro container and the powder that was applied to the lead-poisoned child's eyelids — Boston, Massachusetts, 2011

Photo/Pediatric Environmental Health Specialty Unit, Boston Children's Hospital

FIGURE 2. Scanning electron microscopy* of the tiro eye cosmetic powder that was applied to the lead-poisoned child's eyelids, revealing the presence of cubic shapes and stair-step cleavage, both of which indicate presence of lead sulfide (also known as galena) — Boston, Massachusetts, 2011



Photo/U.S. Geological Survey, Crustal Geophysics and Geochemistry Science Center
* Field of view is approximately 100 μm wide.

Reported by

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Editorial Note

Although the primary source of lead exposure in the United States is lead-based paint, nonpaint sources of lead increasingly are being identified in lead poisoning cases (*2,3*). These nonpaint exposures include recent travel to a foreign country, take-home exposure when persons exposed to lead at their workplace contaminate their homes or vehicles, and use of imported products such as spices, food, candy, cosmetics, health remedies, ceramics or pottery, and jewelry.

This report describes an eye cosmetic and folk remedy as the source of lead poisoning in a child of Nigerian descent; a similar case has been reported in the United Kingdom (*4,5*). Although Nigeria switched to unleaded gasoline by the end of 2003, Nigerian children might also be exposed to the lead that remains in the soil from years of use of leaded gasoline. In addition, lead contamination resulting from gold mining has caused many child deaths in Nigerian villages where artisanal gold ore processing takes place (*6,7*).

Tiro is the Yoruba name for this eye cosmetic implicated in the case described in this report. In another Nigerian language, Hausa, it is called "tozali" or "kwalli." Similar products intended to darken the eyes are known as kohl in English and Arabic and as "surma" or "kajal" in languages spoken in India and Pakistan. These preparations are not standardized, and not all contain lead. One alternative to lead sulfide is another toxic compound, antimony sulfide. Imported cosmetics are one of the relatively few sources of significant lead exposure for infants too young to crawl or walk; however, exposure to lead in tiro represents an additional burden to groups who might be exposed to other sources of lead. The contribution that tiro might make to the cumulative burden of lead poisoning should not be overlooked.

This fine powder is applied to the dermal surfaces of the eyelid. In addition to its use by the patient's family for improving attractiveness and promoting visual development, tiro has been used to ward off "the evil eye"; to relieve eyestrain, pain, or soreness; to prevent infection of the umbilical stump or a circumcision wound by local application; and to prevent sun glare (*8,9*).

This case identifies tiro as a potential lead exposure among not only Nigerians living in the United States, but also among African, Asian, and Middle Eastern populations who use similar products. Public health educational campaigns can help identify and prevent further cases (*10*).† Obstetricians, pediatricians, midwives, and allied health-care professionals

† Examples of such campaigns are described at http://www.nyc.gov/html/doh/html/lead/lead-import-eyecos.shtml.

should discuss this potential risk factor during prenatal and early childhood medical visits by families for whom these cultural practices might apply. Although CDC recommends blood lead testing for internationally adopted and refugee children,[§] blood lead testing in children of certain immigrant populations also might be important because of the increased risk for exposure to lead-containing foreign products.

The Nigeria Centre for Disease Control is working with the vendors of products such as tiro to find possible safer alternatives. Discussions involve the perceived benefit of tiro, and evidently, strong beliefs are attached to its use. The Nigeria Centre for Disease Control plans to launch a national public health awareness campaign.

[§] Guidelines available at http://www.cdc.gov/nceh/lead/tips/populations.htm.

Acknowledgment

Geoffrey S. Plumlee, PhD, US Geological Survey, Crustal Geophysics and Geochemistry Science Center, Denver, Colorado.

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What is already known on this topic?

Although the most common source of lead poisoning for young children in the United States is lead-based paint, nonpaint sources of lead are being identified increasingly in lead poisoning cases, particularly in immigrant communities.

What is added by this report?

A male infant aged 6 months was found to have an elevated blood lead level (BLL) attributed to application of "tiro," a Nigerian eye cosmetic, to his eyes by his parents. Tiro, also known as "tozali" and "kwalli" in Nigeria, is similar to kohl, "surma," and "kajal" used in the Middle East, India, and Pakistan. These products often are made with lead. In this case, the lead content was 82.6%. This case adds to the medical literature documenting nonpaint lead sources as causes of elevated BLLs in children and highlights persons of certain immigrant populations as a risk group.

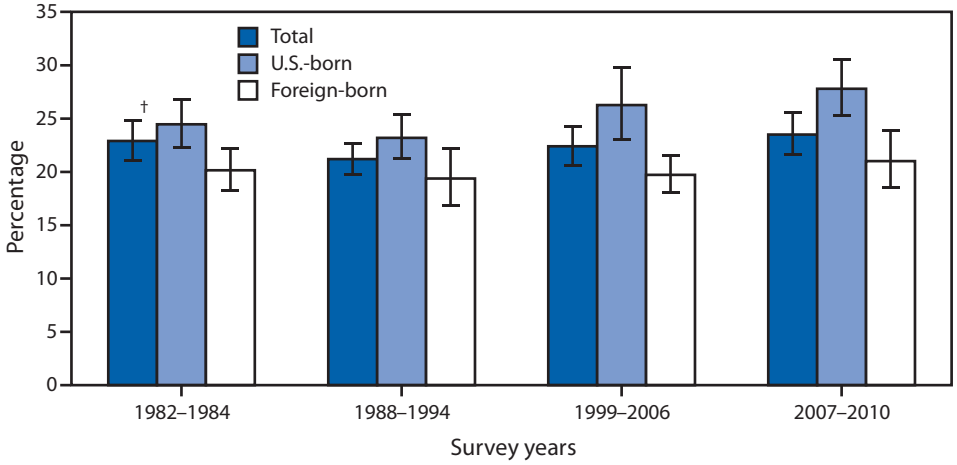
What are the implications for public health practice?

Educational and other primary prevention efforts are needed to inform immigrants from Africa, Asia, and the Middle East that tiro and similar products can cause lead poisoning in children. Health-care providers and public health workers should ask about eye cosmetics and folk remedies when seeking a source of exposure in children with elevated BLLs from certain immigrant populations.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Prevalence of Hypertension Among Mexican-American Adults Aged 20–74 Years, by Country of Birth — United States, 1982–1984 to 2007–2010*



* Age-adjusted to year 2000 U.S. Census Bureau estimates using age groups 20–39 years, 40–59 years, and 60–74 years. Hypertension is defined as a systolic blood pressure ≥140 mmHg, a diastolic blood pressure ≥90 mmHg, or currently taking medication to lower high blood pressure.

† 95% confidence interval.

Mexican-American adults who were born in the United States were more likely to have hypertension compared with those born outside of the United States. From 1982–1984 to 2007–2010, a statistically significant increase in hypertension (from 24.5% to 27.8%) was observed only among those who were born in the United States.

Sources: Fryar CD, Wright JD, Eberhardt MS, Dye BA. Trends in nutrient intakes and chronic health conditions among Mexican-American adults, a 25-year profile: United States, 1982–2006. Natl Health Stat Rep 2012(50).

CDC. Hispanic Health and Nutrition Examination Survey, data for 1982–1984.

CDC. National Health and Nutrition Examination Survey, data for 1988–1994, 1999–2006, and 2007–2010.

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