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Deaths Associated with Hurricane Sandy — October–November 2012

On October 29, 2012, Hurricane Sandy* hit the northeastern U.S. coastline. Sandy's tropical storm winds stretched over 900 miles (1,440 km), causing storm surges and destruction over a larger area than that affected by hurricanes with more intensity but narrower paths. Based on storm surge predictions, mandatory evacuations were ordered on October 28, including for New York City's Evacuation Zone A, the coastal zone at risk for flooding from any hurricane (*1*). By October 31, the region had 6–12 inches (15–30 cm) of precipitation, 7–8 million customers without power, approximately 20,000 persons in shelters, and news reports of numerous fatalities (Robert Neurath, CDC, personal communication, 2013). To characterize deaths related to Sandy, CDC analyzed data on 117 hurricane-related deaths captured by American Red Cross (Red Cross) mortality tracking during October 28–November 30, 2012. This report describes the results of that analysis, which found drowning was the most common cause of death related to Sandy, and 45% of drowning deaths occurred in flooded homes in Evacuation Zone A. Drowning is a leading cause of hurricane death but is preventable with advance warning systems and evacuation plans. Emergency plans should ensure that persons receive and comprehend evacuation messages and have the necessary resources to comply with them.

Red Cross tracks deaths during disasters to provide services to surviving family members, including crisis counseling, assistance with disaster-related expenses, locating emergency housing, identifying recovery resources, and addressing disaster-related health needs. Red Cross volunteers search for reports of disaster-related deaths from sources such as funeral home directors, the Federal Emergency Management Agency (FEMA), hospitals, and news reports. Volunteers then obtain information about these deaths from sources including the medical examiner/coroner, physician, fire department/police, and family of the decedent (*2*).

*Sandy evolved from a Category 3 hurricane in the Caribbean to an intense post-tropical cyclone before landfall in the United States.

Deaths included in this analysis were any Sandy-related death recorded on a Red Cross mortality form with a date of death up to November 30, 2012. Mortality forms included the decedent's age, sex, race (white, black, Asian, other, or unknown), and date and location of death. Disaster-related deaths were categorized as direct or indirect. Directly related deaths are deaths caused by the environmental force of the disaster (e.g., wind or flood) or by the direct consequences of these forces (e.g., structural collapse). Indirectly related deaths are defined as deaths occurring in a situation in which the disaster led to unsafe conditions (e.g., hazardous roads) or caused a loss or disruption of usual services that contributed to the death (e.g., loss of electrical services) (*2*). Deaths without direct or indirect classification were reported as unknown or possibly related deaths. Daily counts of direct, indirect, and unknown/possibly related deaths were calculated based on the dates of each death. The characteristics of drowning deaths were compared with all deaths using chi-square tests of trend and t-tests. Home addresses of decedents whose drowning death occurred in the

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What is already known on this topic?

Despite advances in hurricane warning and evacuation systems, drowning remains one of the leading causes of hurricane-related deaths.

What is added by this report?

A total of 117 deaths related to Hurricane Sandy were reported via the American Red Cross mortality tracking system. Drowning was the leading cause, accounting for approximately one third of the deaths. More than half (52.5%) of the drowning deaths occurred in the decedent's home; the majority of these homes were located in New York City's Evacuation Zone A.

What are the implications for public health practice?

Drowning is a preventable cause of hurricane-related death. Hurricane response plans should ensure that persons receive and comprehend evacuation messages and have the necessary resources to comply with them.

home were examined with respect to FEMA's hurricane storm surge area (field-verified as of November 11, 2012 [*3*]) and known, geographically defined areas under evacuation order (i.e., New York City's Evacuation Zone A) (*1*).

A total of 117 deaths were reported on Red Cross mortality forms. The source of information for the mortality forms was a medical examiner/coroner for 94 (80.3%) cases and the family of the decedent for 10 (8.5%) cases (Table). Most deaths occurred in New York (53 [45.3%]) and New Jersey (34 [29.1%]); the other deaths occurred in Pennsylvania, West Virginia, Connecticut, and Maryland. The deaths occurred during October 28–November 29, 2012 (Figure 1). Approximately half of the deaths (60 [51.3%]) occurred on the first 2 days of the storm's landfall, with a peak of 37 deaths on October 30, 2012.

Decedents ranged in age from 1 to 94 years (mean: 60 years, median: 65 years); 60.7% were male, and 53.8% were white. Of the 117 deaths, 67 (57.3%) were classified as directly related deaths, and 38 (32.5%) were indirectly related to the storm. Of the directly related deaths, the most common mechanism was drowning (40 [59.7%]), followed by trauma from being crushed, cut, or struck (19 [28.4%]). Poisoning was the most common indirectly related cause of death; of the 10 poisonings, nine were caused by carbon monoxide. Most directly related deaths occurred during the first few days of the storm, whereas indirectly related deaths continued from the day before the storm into the middle of November.

Comparing the 40 drowning deaths to all Sandy-related deaths, the age, sex, and race distributions of decedents were similar (Table). The majority of drowning deaths (29 [72.5%]) also occurred in the initial phase of the storm, during October 29–31. Twenty-one (52.5%) drowning deaths occurred in the decedent's home, and 11 (27.5%) occurred outside; one person drowned in a flooded commercial building lobby, and another person drowned while intentionally swimming off a storm-affected beach. For six deaths, circumstances of the drowning were not available. The location of drowning

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TABLE. Characteristics of reported deaths related to Hurricane Sandy for all deaths and drowning deaths — Connecticut, Maryland, New Jersey, New York, Pennsylvania, and West Virginia, October 28–November 30, 2012

Characteristic	All deaths (N = 117) No.	(%)	Drowning deaths (n = 40) No.	(%)
Age				
Mean (yrs)	60		59	
Median (yrs)	65		62	
Range (yrs)	1–94		2–90	
Unknown	5	(4.3)	3	(7.5)
Sex				
Male	71	(60.7)	26	(65.0)
Female	40	(34.2)	12	(30.0)
Unknown	6	(5.1)	2	(5.0)
Race				
White	63	(53.8)	22	(55.0)
Black	15	(12.8)	6	(15.0)
Asian	1	(0.9)	1	(2.5)
Other	8	(6.8)	1	(2.5)
Unknown	30	(25.6)	10	(25.0)
State (location of death)*				
New York	53	(45.3)	32	(80.0)
New Jersey	34	(29.1)	4	(10.0)
Pennsylvania	12	(10.3)	0	—
West Virginia	6	(5.1)	0	—
Connecticut	4	(3.4)	1	(2.5)
Maryland	1	(0.9)	0	—
Unknown	7	(6.0)	3	(7.5)
Source				
Medical examiner/Coroner	94	(80.3)	38	(95.0)
Family of decedent	10	(8.5)	1	(2.5)
Fire department/Police	4	(3.4)	0	—
Other	3	(2.6)	0	—
Unknown	6	(5.1)	1	(2.5)
Mechanism of death				
Directly related	67	(57.3)		
Drowning	40	(34.2)		
Trauma-crush/cut/struck	19	(16.2)		
Fall	4	(3.4)		
Motor vehicle	2	(1.7)		
Unknown	2	(1.7)		
Indirectly related	38	(32.5)		
Poisoning	10	(8.5)		
Fall	7	(6.0)		
Burn/Electric current	6	(5.1)		
Trauma-crush/cut/struck	5	(4.3)		
Motor vehicle	4	(3.4)		
Other	4	(3.4)		
Unknown	2	(1.7)		
Unknown/Possibly related	12	(10.3)		

* p<0.05 between all deaths and drowning deaths.

deaths by state was significantly different (p<0.05) compared with all Sandy-related deaths. The majority of drowning deaths (32 [80.0%]) occurred in New York, whereas deaths in New York accounted for only 27.3% of nondrowning deaths. Twenty decedents drowned in flooded homes in New York, and home addresses for 18 (90.0%) of them were located in Evacuation Zone A (Figure 2); the other two decedents' homes were in or near areas of flooding and near Evacuation Zone A. Notes written by Red Cross volunteers on these 20 deaths captured decedents' reasons for not evacuating, such as "afraid of looters," "thought Hurricane Irene was mild," and "unable to leave because did not have transportation."

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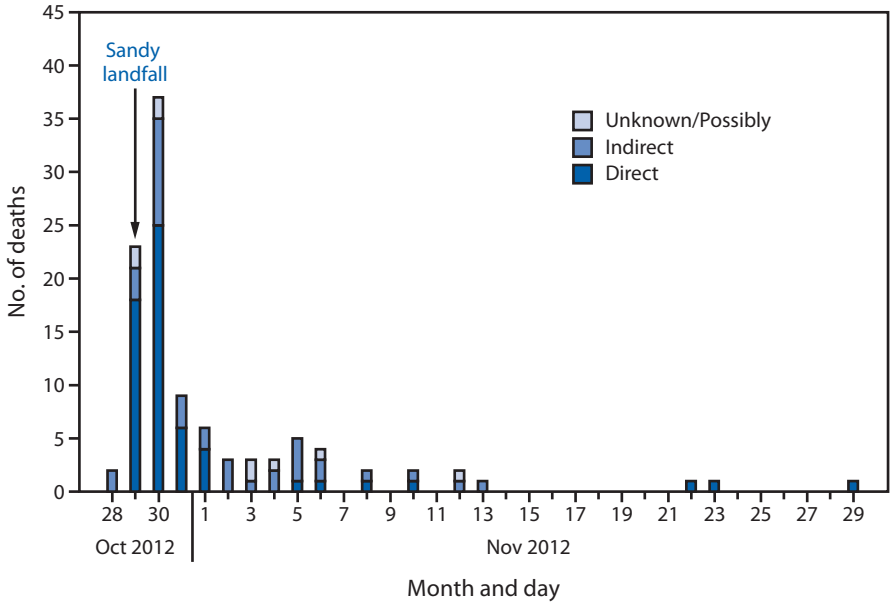
Editorial Note

The "perfect storm" weather conditions of Hurricane Sandy resulted in extensive damage to infrastructure and large flood zones (*4*). The direct and indirect impacts of the storm led to challenging, and sometimes deadly, conditions for residents, including prolonged power outages, storm surges, and disrupted services. More than half (51.3%) of deaths from Sandy occurred within the first 2 days of the storm, and the most common cause of death was drowning. Approximately half of the drowning deaths were in flooded homes located in areas that were under mandatory evacuation orders as of October 28, 2012, the day before Sandy's landfall (*1*).

Before the 1970s, drowning from wind-driven storm surges was by far the most common cause of hurricane-related death (*5*). Advances in hurricane warning and evacuation systems have helped to reduce drowning deaths. Since that time, hurricanes have had other leading causes of death, such as trauma for the Florida hurricanes in 2004 and 2005, and carbon monoxide poisoning for Hurricane Ike in 2008 (*6,7*). However, drowning continues to be an important cause of death, and was the leading cause for Hurricane Katrina (2005) and Sandy (*8*).

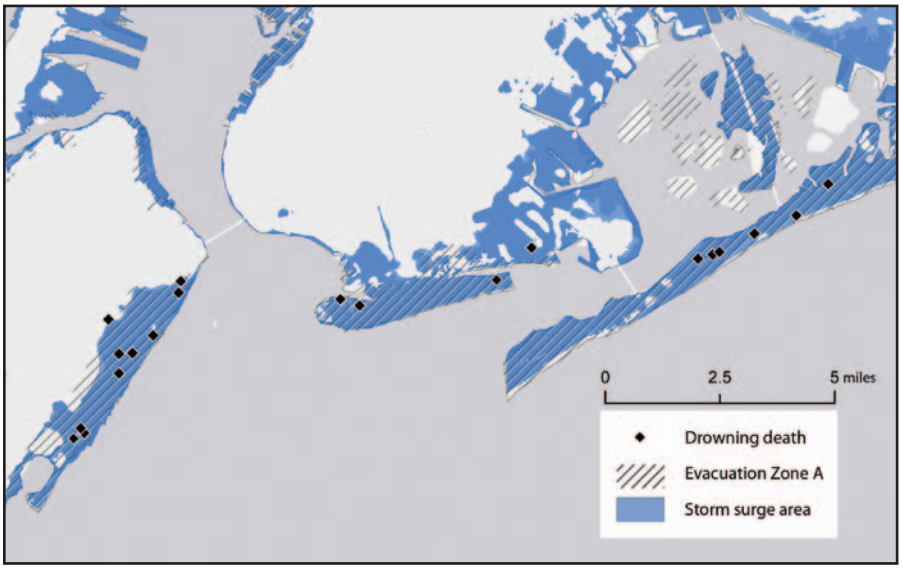
The findings in this report are subject to at least two limitations. First, the number of deaths reported is limited to those captured through Red Cross mortality tracking, which is only activated in areas with a Red Cross Disaster Relief Operation. In an evaluation of Red Cross mortality tracking versus Texas' active disaster-related mortality surveillance during Hurricane Ike, Red Cross had a sensitivity of 47% (Red Cross cases compared with Texas cases) and positive predictive value of 92% (Red Cross Ike cases compared with all Red Cross cases); thus, the cases presented in this report are likely to be actual cases but are unlikely to include all Sandy-related deaths (*2*). Media sources have reported 131 fatalities in the United States from the storm (*9*); Sandy mortality statistics, including death certificates, are pending official release. Second, the

FIGURE 1. Number of reported deaths related to Hurricane Sandy (direct, indirect, and unknown/possibly), by date — Connecticut, Maryland, New Jersey, New York, Pennsylvania, and West Virginia, October 28–November 30, 2012*



* Excludes deaths with an unknown date of death (n = 12).

FIGURE 2. Drowning deaths attributed to Hurricane Sandy that occurred in the decedent's home (n = 20), in New York state, in relation to the Federal Emergency Management Agency storm surge area and New York City's Evacuation Zone A — October 28–November 30, 2012



specific location of death was only available for decedents who died at home, limiting other geographic comparisons. Additionally, New York City's Evacuation Zones provided the only geographic data available for identifying areas of evacuation; however, 95% of all drowning deaths at home were in or near these areas.

Hurricane-related drowning deaths in evacuation zones are preventable. A successful evacuation depends on officials providing timely messaging to all affected persons, on persons receiving those messages, and on persons having the capacity, resources, and willingness to evacuate. The penetration of evacuation messages to decedents or their communities was not assessed in this report, but future research should evaluate the effectiveness of the hurricane evacuation orders. Given the inability and unwillingness of some residents to evacuate, additional research is needed to identify barriers and motivators for persons during an evacuation and the effectiveness of interventions designed to assist these persons.

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References

1. Saul MH. Parts of New York City evacuated for Hurricane Sandy. Wall Street Journal; 2012. Available at http://online.wsj.com/article/SB10001424052970203880704578084701930663668.html.
2. Farag NH, Rey A, Noe R, Bayleyegn T, Wood AD, Zane D. Evaluation of the American Red Cross disaster-related mortality surveillance system using Hurricane Ike data—Texas 2008. Disaster Med Public Health Prep 2012; December 7 [Epub ahead of print]
3. Federal Emergency Management Agency. FEMA MOTF-Hurricane Sandy impact analysis. Washington, DC: US Department of Homeland Security, Federal Emergency Management Agency; 2012. Available at http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=307dd522499d4a44a33d7296a5da5ea0.
4. Federal Emergency Management Agency. Hurricane Sandy: timeline; 2012. Washington, DC: US Department of Homeland Security, Federal Emergency Management Agency; 2012. Available at http://www.fema.gov/hurricane-sandy-timeline.
5. National Oceanic and Atmospheric Administration. Hurricanes and tropical meteorology. Washington, DC: US Department of Commerce, National Oceanic and Atmospheric Administration; 2000. Available at http://www.aoml.noaa.gov/general/WWW000/nhurr00.html#imp2.
6. Ragan P, Schulte J, Nelson SJ, Jones KT. Mortality surveillance: 2004 to 2005 Florida hurricane-related deaths. Am J Forensic Med Pathol 2008;29:148–53.
7. Zane DF, Bayleyegn TM, Hellsten J, et al. Tracking deaths related to Hurricane Ike, Texas, 2008. Disaster Med Public Health Prep 2011;5:23–8.
8. Brunkard J, Namulanda G, Ratard R. Hurricane Katrina deaths, Louisiana, 2005. Disaster Med Public Health Prep 2008;2:215–23.
9. Reuters. Factbox: storm Sandy blamed for at least 132 deaths in U.S., Canada; 2012. Reuters; 2012. Available at http://www.reuters.com/article/2012/11/16/us-storm-sandy-deaths-idusbre8af0zx20121116.
10. Fairchild AL, Colgrove J, Jones MM. The challenge of mandatory evacuation: providing for and deciding for. Health Aff (Millwood) 2006;25:958–67.

Impact of a Shortage of First-Line Antituberculosis Medication on Tuberculosis Control — United States, 2012–2013

Tuberculosis (TB) disease is treated in most cases with a regimen of several drugs taken for 6–9 months. Currently, 10 drugs are approved by the Food and Drug Administration (FDA) for treatment of TB. Of these, the four drugs that form the core for first-line treatment regimens are isoniazid (INH), rifampin, ethambutol, and pyrazinamide. In November 2012, the United States began to experience a severe interruption in the supply of INH. To assess the extent of the problem and its impact on TB control programs, a nationwide survey of programs was conducted in January 2013 by the National Tuberculosis Controllers Association (NTCA). The results indicated that the INH shortage* was interfering with patient care and could contribute to TB transmission in the United States. This report summarizes the findings of that survey, which showed that 79% of the responding health departments reported difficulties with procuring INH within the last month, with 15% reporting that they no longer had INH and 41% reporting that they would no longer have a supply within 1 month of the survey. Because of local interruptions in INH supply, responding TB programs were changing INH suppliers (69%), prioritizing patients for treatment of latent TB infection (LTBI) (72%), delaying LTBI treatment (68%), and changing to alternative LTBI treatment regimens (88%). Potential solutions for alleviating the INH shortage and averting future shortages include maintaining a national supply of first-line drugs, sharing INH among jurisdictions, working with the World Health Organization's Global Drug Facility to obtain INH from foreign manufacturers, and strengthening reporting of shortages and impending shortages by drug suppliers to FDA.

Mycobacterium tuberculosis is transmitted person-to-person via the airborne route. Before the introduction of anti-TB medications, patient isolation was the principal public health intervention to minimize the risk for TB transmission. The introduction of anti-TB medications, beginning with para-aminosalicylic acid in 1944 and followed by INH in 1951, revolutionized the treatment of TB and the approach to TB control (*1*). Although TB continues to be a leading infectious cause of death globally (*2*), most patients with TB can be cured with treatment. Standard treatment worldwide for confirmed or suspected TB disease is based on the four first-line bactericidal drugs (INH, rifampin, ethambutol, and pyrazinamide), of which INH and rifampin are the most effective. Treatment of TB disease with second-line drugs can be less effective, more toxic, and more costly than treatment with first-line drugs; thus, second-line drug treatment regimens are reserved for persons with TB disease caused by INH- and rifampin-resistant strains. Additionally, INH is the recommended prophylaxis to prevent active TB disease in persons with LTBI. Alternative regimens for LTBI include rifampin and a combination of INH and rifapentine.

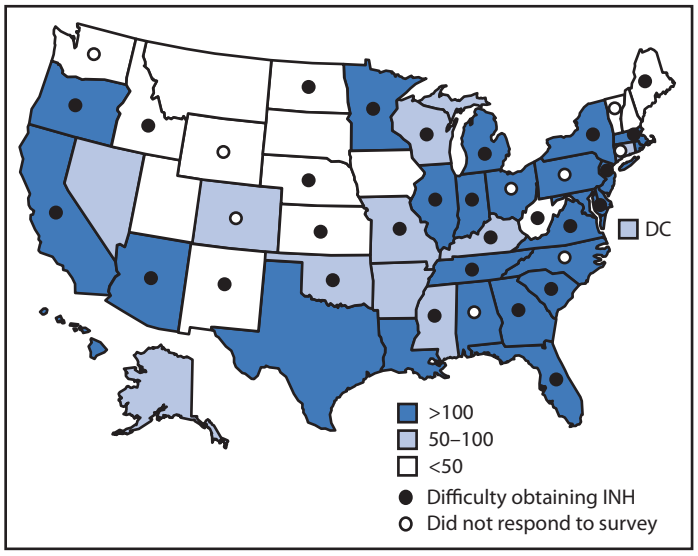
In 2012, three suppliers provided INH in the United States: Teva, VersaPharm, and Sandoz. A shortage of INH 300 mg tablets was first reported to CDC in November 2012; one supplier attributed the shortage, in part, to difficulty in procuring the active ingredient. The suppliers first reported an anticipated release of INH in late December 2012, but that forecast was changed to mid-January 2013. In December 2012, INH was available in 100 mg tablets, and CDC encouraged TB control programs to work with their pharmacies to obtain this formulation until the shortage of 300 mg tablets was resolved. The anticipated additional release by mid-January did not materialize, and the supply of INH 100 mg tablets also became limited.

On January 11, 2013, NTCA, an organization of state, local, and territorial public health officials and professionals, surveyed 68 jurisdictions in 50 states, 10 large cities, five territories, and three freely associated island states, using a web-based questionnaire. The questionnaire addressed issues regarding medication procurement, medication supply, and TB treatment practices related to the INH shortage.

Of the 68 surveyed jurisdictions, 42 (62%) responded. Of those responding, 38 (90%) represented state TB programs, and four (10%) represented large cities; respondents represented areas with low, medium, and high numbers of TB cases in 2011 (Figure). Of those responding to the individual questions, 33 of 42 (79%) stated they had difficulty obtaining INH within the last month, with 18 of 30 (60%) able to obtain the 100 mg INH formulation and 20 of 29 (69%) changing suppliers to obtain INH (Table). At the time of the survey, six of 39 (15%) had run out of INH, and 12 of 29 (41%) anticipated running out within 1 month. Because of the shortage, 18 of 25 (72%) programs were prioritizing only high-risk patients for LTBI treatment, 22 of 25 (88%) had changed to alternative LTBI treatment regimens (e.g., rifampin for 4 months), and 17 of 25 (68%) were delaying LTBI treatment. Because of interruptions in the INH supply, 14 of 32 (44%) programs switched to regimens that were more expensive, 37 of 37 (100%) were engaged in other activities (i.e., contacting medication distributors, issuing health alerts, modifying protocols, or answering calls), and 32 of 39 (82%) were answering calls of concern about INH supplies from the community (Table).

* Defined as situations in which supplies of all clinically interchangeable versions of a Food and Drug Administration (FDA)–regulated drug become inadequate to meet current or projected user demand.

FIGURE. States reporting difficulty obtaining isoniazid (INH) during 2012–2013* and state tuberculosis case counts in 2011 — National Tuberculosis Controllers Association survey, United States



* As of January 2013.

TABLE. Number and percentage of jurisdictions reporting difficulty obtaining isoniazid (INH) during 2012–2013,* by effects on tuberculosis control program — National Tuberculosis Controllers Association survey, United States

Effect	No./ Respondents†	(%)
Procurement		
Difficulty obtaining INH in last month	33/42	(79)
Able to obtain 100 mg INH tablets during 300 mg tablet shortage	18/30	(60)
Changed suppliers to procure medications	20/29	(69)
Anticipated supply		
No longer had supply of INH at time of survey	6/39	(15)
Would no longer have supply of INH within 1 months of survey	12/29	(41)
Would no longer have supply of INH within 1–3 months of survey	13/29	(45)
LTBI management		
Prioritizing certain populations for LTBI therapy	18/25	(72)
Changed to alternative LTBI regimen	22/25	(88)
Delaying treatment of LTBI	17/25	(68)
Program resources		
Increased cost to change regimens	14/32	(44)
Additional activities to address drug shortage§	37/37	(100)
More than one of the additional activities	31/37	(84)
Answering calls from patients, providers, nursing homes, or corrections facilities	32/39	(82)

Abbreviation: LTBI = latent tuberculosis infection.
* As of January 2013.
† Denominators varied because respondents were not required to answer all questions.
§ Any of the following: contacting medication distributors, issuing health alerts, modifying protocols, or answering calls.

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Editorial Note

Interruptions in the supply of second-line anti-TB medications have been ongoing in the United States for several years (*3*), but since November 2012, TB control programs have experienced the first sustained generalized supply interruption of a first-line anti-TB medication. In January 2013, VersaPharm announced it would not be producing INH until 2014, leaving two manufacturers in the U.S. market. Although the two remaining manufacturers were able to begin supplying limited quantities of INH as of February 2013, the INH shortage has continued to affect TB programs. In collaboration with CDC and FDA, Teva reserved 10% of its INH supply for emergency allocation for public health programs that have been unable to access INH through their usual procurement channels. CDC and NTCA assisted Teva with developing guidance for distribution of this emergency allocation and communicated the guidance to TB programs on February 1, 2013.

The NTCA survey results show that the INH shortage has affected TB control efforts nationally. An INH shortage can directly affect patients and the community by necessitating treatment with alternative regimens that can be more expensive and, for the treatment of TB disease, more toxic. Currently a shortage also exists for two combination preparations of INH and rifampin (IsonaRif, VersaPharm; and Rifamate, Sanofi-Aventis). Increasing the use of rifampin as an alternative treatment regimen could lead to additional shortages of rifampin, the most effective drug for treating active TB.† Additionally, using an alternative preparation of INH, such as a combination INH/rifampin capsule, or using INH procured from a compounding pharmacy could be more expensive to TB programs. In many states, community health workers are unable to administer compounded drugs, requiring health departments to redirect nurses from other tasks to deliver TB therapy. If access to INH continues to be problematic, more delays or interruptions in treatment would be likely as TB programs switch to different regimens that require new protocols and additional staff training. Many programs continue to prioritize INH usage and defer treatment for many

† In an informal webinar survey conducted February 5, 2013, 6% of respondents reported experiencing shortages of rifampin.

What is already known on this topic?

Drug shortages, defined as situations in which the total supply of all clinically interchangeable versions of a given Food and Drug Administration–regulated drug are inadequate to meet the current or projected user demand, are a well-documented problem. Interruptions in supplies of second-line anti-tuberculosis drugs have been reported in recent years.

What is added by this report?

A nationwide survey of U.S. tuberculosis (TB) control programs in January 2013 showed that 79% of responding jurisdictions had experienced difficulty obtaining the first-line anti-tuberculosis drug, isoniazid (INH), with 15% saying they no longer had INH at the time of the survey and 41% reporting that they expected to have a shortage of INH within 1 month. The survey indicated that the INH shortage had forced TB programs to change suppliers, prioritize patients at high risk, delay treatment of persons with latent TB infection (LTBI), and change to alternative LTBI treatment regimens.

What are the implications for public health practice?

Potential solutions for improving continuity of first-line anti-TB drug supplies include the sharing of drugs in short supply among state and local TB programs, creating a drug shortage early warning system, centralized drug distribution, obtaining drugs from foreign manufacturers when drugs are unavailable in the United States, and improving the timeliness of the reporting of drug shortages by drug suppliers.

LTBI patients in accord with CDC recommendations issued on January 28, 2013, for programs with limited INH supplies (*4*). However, deferment of treatment for LTBI can lead to missed opportunities for TB case prevention because asymptomatic persons might be less likely to return at a later date to initiate LTBI treatment and might progress to TB disease.

CDC, NTCA, state and local TB programs, the Treatment Action Group, and the TB Drug Shortage Working Group of the Advisory Council for the Elimination of TB are collaborating to identify short-term and long-term solutions to address the INH shortage. In addition to issuing a health advisory (*4*) and assisting with guidance regarding Teva's emergency allocation, CDC, NTCA, and state and local TB programs have been implementing short-term solutions to minimize the impact of the INH shortage by using strategies such as sharing of drugs among state and local programs, using alternative formulations (e.g., substituting INH 100 mg tablets for INH 300 mg tablets), and using alternative regimens for treatment of LTBI (e.g., rifampin 600 mg daily for 4 months or INH 900 mg plus rifapentine 900 mg once weekly for 12 weeks, instead of INH 300 mg daily for 9 months). CDC reported on the shortage in December 2012 (*5*) and has collaborated with FDA to provide real-time updates on INH availability to TB programs through the FDA drug shortage website. CDC also has collaborated with the Southeastern National Tuberculosis Center and Treatment Action Group to conduct national meetings regarding the U.S. drug shortage. Additionally, CDC is investigating the prospect of obtaining INH from the Global Drug Facility that provides anti-TB medications to TB programs internationally. Such activities require significant investment of time and resources that could be used for other important TB control activities (*6*).

A 2011 presidential executive order, Reducing Prescription Drug Shortages, requires "drug manufacturers to provide adequate advance notice of manufacturing discontinuances that could lead to shortages of drugs that are life supporting or life sustaining, or that prevent debilitating disease" (*7*). Such advance notification of a potential INH shortage could have helped TB programs anticipate the shortage and begin making programmatic modification. Some possible long-term solutions include CDC maintaining a surveillance system to identify shortages and a U.S. distribution system for anti-TB drugs similar to the Global Drug Facility and to CDC's Vaccines for Children Program, which supplies routinely used vaccines for eligible children and adolescents. Another possible strategy might be collaborating with FDA to determine whether anti-TB drugs in the pipeline might qualify for orphan-drug designation, which provides incentives for manufacturers to develop products for the treatment, diagnosis, or prevention of rare diseases or conditions.

The INH shortage was unexpected, has affected U.S. TB control efforts, and has lasted months longer than predicted. How the increased use of alternative regimens and the rising cost of INH driven by increased demand might affect the future supply of INH and other first-line anti-TB medications is uncertain. CDC is continuing to work on developing a sustainable solution that will maintain an uninterrupted supply of anti-TB drugs in the United States.

References

1. Keshavjee S, Farmer PE. Tuberculosis, drug resistance, and the history of modern medicine. N Engl J Med 2012;367:931–6.
2. Mandell G, Bennett J, Raphael D. Mandell, Douglas, and Bennett's principles and practice of infectious diseases. 7th ed. Philadelphia, PA: Churchill Livingstone; 2009.
3. CDC. Interruptions in supplies of second-line antituberculosis drugs—United States, 2005–2012. MMWR 2013;62:23–6.
4. CDC. CDC health advisory: recommendations for drug allocation, tuberculosis prevention, and patient care during isoniazid shortages. Atlanta, GA: US Department of Health and Human Services, CDC; 2013. Available at http://www.bt.cdc.gov/han/han00340.asp.
5. CDC. Notes from the field: national shortage of isoniazid 300 mg tablets. MMWR 2012;61:1029.
6. Tuberculosis Elimination Plan Committee. A call for action on the tuberculosis elimination plan for the United States. Atlanta, GA: Stop TB USA; 2010. Available at http://stoptbusa.org/tepexecsummary.pdf.
7. White House. Executive order 13588—reducing prescription drug shortages. Washington, DC: White House; 2011. Available at http://www.whitehouse.gov/the-press-office/2011/10/31/executive-order-reducing-prescription-drug-shortages.

Value of Pharmacy-Based Influenza Surveillance — Ontario, Canada, 2009

As part of ongoing efforts by the Public Health Agency of Canada (PHAC) to enhance disease surveillance, a retrospective epidemiologic study was undertaken to investigate the usefulness for influenza surveillance of data on changes in the volume of prescriptions for antiviral medications. The weekly numbers of dispensed prescriptions for the antiviral medications oseltamivir and zanamivir, as a proportion of all dispensed prescriptions, were compared with the numbers of confirmed laboratory reports of influenza A(H1N1) at the local health authority level in Ontario, Canada, during the second wave of the outbreak of pandemic influenza A(H1N1) in 2009. Qualitative and quantitative analyses demonstrated that antiviral prescription dispensing dates were a reasonable proxy for influenza A(H1N1) onset dates at the local health authority level. This report describes the results of those analyses, which indicated that 1) antiviral prescription proportions increased in advance of laboratory reports of influenza and 2) antiviral dispensing data can be available in near real-time. These findings suggest that pharmacy prescription data can provide timely intelligence to help characterize local influenza activity.

The value of influenza surveillance depends in part on the timeliness of the generated information. Traditional methods of influenza surveillance, including FluWatch (Canada's national surveillance system), rely on the collection and aggregation of laboratory results and clinical observations from physicians and public health authorities. Typical for infectious diseases, it can take several days to weeks from symptom onset to data being collected, aggregated, and analyzed (*1,2*). Pharmacy-based surveillance uses near real-time dispensing data of pharmaceuticals (prescription and over-the-counter drugs) as a proxy for illness in the population. The potential for pharmacy-based surveillance to detect changes in community illness levels earlier than traditional laboratory-based surveillance methods is premised on the fact that the public will routinely seek over-the-counter medications to relieve or alleviate common symptoms of illness, and physicians often will prescribe medications before receiving laboratory confirmation (*3,4*). Retrospective disease outbreak studies have demonstrated increases in pharmaceutical sales before the recognition of increased illness frequency using traditional public health surveillance methods (*5,6*).

In this study, the proportion of dispensed prescription medications that were oseltamivir or zanamivir were compared each week with the number of confirmed laboratory reports of influenza A(H1N1) at the local health authority level. Prescription medication data (from 2009) were provided to PHAC by Rx Canada, Inc., and included individual-level prescription data from approximately 75% of Ontario's community pharmacies (n = 1,202). Each prescription identified the drug, date of dispensing, and the patient's sex and age. Laboratory reports of influenza A(H1N1) (from 2009) were provided to PHAC by the Ontario Ministry of Health and Long-Term Care.* Each laboratory report provided one of three dates: illness onset date, date specimen was submitted to the laboratory, and date laboratory results were reported to a public health authority. When case onset date was not available, it was estimated based on the mean time differences between date types. Each laboratory report included patient age and sex, and was linked to one of Ontario's 36 local health authorities.

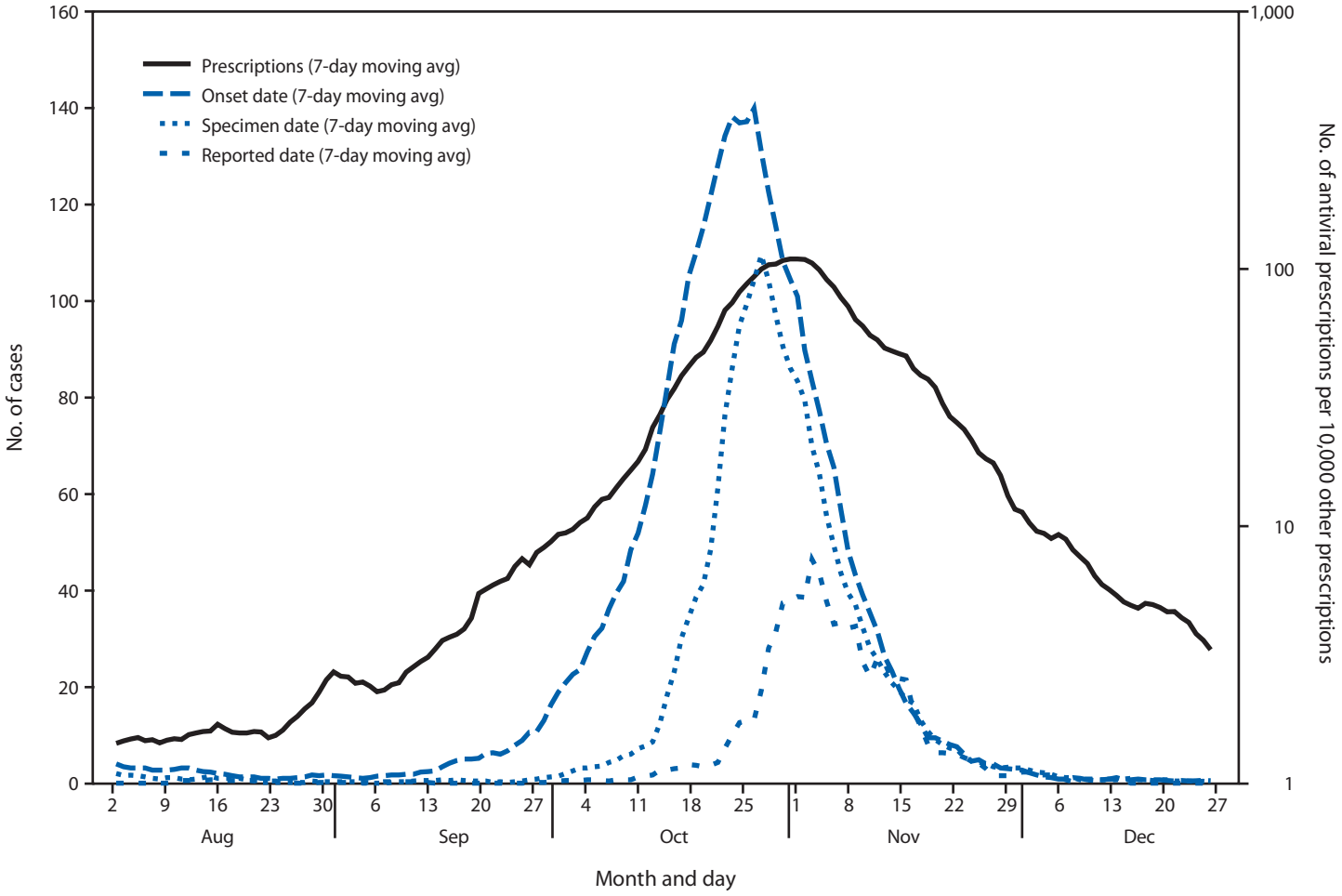
The relationship between antiviral prescriptions and influenza A(H1N1) laboratory-confirmed cases was investigated using a Poisson regression model. Potential correlation at the local health authority level was accommodated using a generalized estimating equation approach to determine parameter estimates. Weekly antiviral prescriptions dispensed (antivirals per 10,000 other prescriptions) were compared with weekly influenza A(H1N1) case counts. Prescription proportions were used (rather than absolute prescription counts) in an effort to adjust for a number of potential factors, including day-of-the week, holidays, and regional variation in physician prescribing patterns. Lagged weekly influenza A(H1N1) case counts were used to investigate the potential time-lag between influenza A(H1N1) symptom onset dates and antiviral prescription dispensing dates.

During July 1–December 31, 2009, information was available on approximately 43,000 Ontario oseltamivir and zanamivir prescriptions. Patient age and sex were available for 82% of antiviral prescriptions: mean age was 34 years, median age was 33 years, and 57% of patients were female. During this period, information was available on approximately 7,300 Ontario influenza A(H1N1) laboratory confirmations: mean age of patients was 24 years; median age was 18 years, and 47% were female patients. Symptom onset date was available for 56% of the cases, laboratory specimen date for 32% of the cases, and laboratory reporting date for 12% of the cases. The average time difference from mean (median) onset date to mean (median) specimen date was 6 (5) days, and from mean (median) specimen date to mean (median) reporting date was 6 (8) days.

Very little if any lag was observed between the influenza A(H1N1) case onset trend line and the antiviral prescription trend line (Figures 1 and 2). Poisson regression analysis demonstrated a statistically significant relationship between weekly influenza A(H1N1) case counts and antiviral prescriptions at the local health authority level ($p<0.001$). Statistical

*Extracted by Public Health Ontario from the Integrated Public Health Information System database on March 21, 2011.

FIGURE 1. Seven-day moving average number of reported influenza A(H1N1) cases and number of antiviral prescriptions per 10,000 other prescriptions — Ontario, Canada, August–December 2009



What is already known on this topic?

Traditional methods of influenza surveillance rely on the collection and aggregation of laboratory results and clinical observations from physicians and public health authorities. It can take several days to weeks from symptom onset to data being collected, aggregated, analyzed, and reported.

What is added by this report?

Changes in the ratio of prescriptions for two drugs prescribed for the prophylaxis and treatment of influenza to all other prescriptions coincided with the second wave of the influenza pandemic in Ontario, Canada, during July 1–December 31, 2009. Prescriptions tracked dates of symptom onset ahead of dates of positive influenza laboratory reports at the local health authority level.

What are the implications for public health practice?

Infectious disease mitigation strategies are most effective when implemented early. Real-time surveillance of pharmacy data might be more useful than laboratory data for guiding early implementation of these strategies.

significance was greatest when influenza A(H1N1) cases counts were not lagged by time. Analysis results were similar when only the 56% of cases with known onset date were considered.

Reported by

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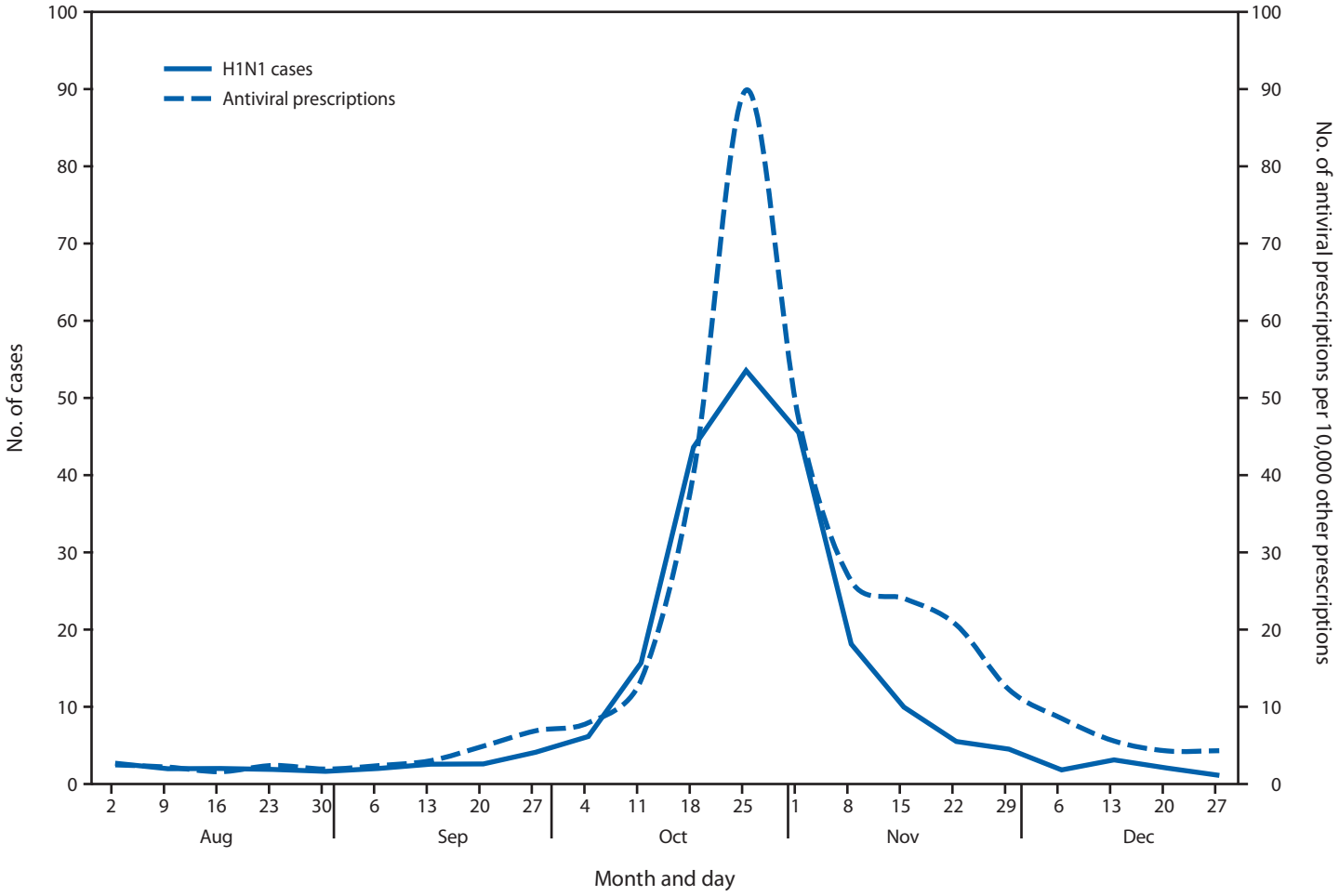
Editorial Note

The findings in this report demonstrate that during the second wave of the influenza A(H1N1) epidemic in 2009 in Ontario, antiviral prescription dispensing mirrored influenza A(H1N1) onset activity at the local level with no appreciable lag time. These results suggest that pharmacy-based surveillance can provide a mechanism to monitor and detect influenza-like activity regardless of whether the underlying pathogen is

FIGURE 2. Average weekly number of influenza A(H1N1) cases and number of antiviral prescriptions per 10,000 other prescriptions reported at the local health authority level — Ontario, Canada, August–December 2009



laboratory confirmed. This might be especially important if the pathogen is not routinely tested for.

The time lag between symptom onset and laboratory reporting to public health officials of a known pathogen can be substantial (*2*). Even during the second wave of the influenza A(H1N1) outbreak, when public health authorities in Ontario were prepared, an average time lag from symptom onset to reporting of an influenza A(H1N1) confirmation to public health authorities was estimated to be 12 days. If the cause of an influenza-like illness is unknown or not routinely tested for (e.g., a novel coronavirus), the gains achieved in timeliness with pharmacy-based surveillance might be much greater.

The reporting of positive influenza laboratory results in a community likely contributed to increased physician prescribing of antivirals. However, given an estimated 12-day lag time from symptom onset to laboratory reporting to public health authorities, publicized influenza laboratory confirmations likely did not influence prescription patterns during the early phases of increased community activity.

The findings in this report are subject to at least three limitations. First, although analysis results were similar regardless of whether the 44% of cases with estimated onset dates were considered, the validity of estimating onset dates based on specimen or reported date cannot be assessed. Second, the proportion of prescriptions administered for prophylaxis versus treatment is not known, neither is the effect this might have had on the temporal association between onset dates and prescription dispensing dates. Finally, this study focused on one event, the 2009 influenza A(H1N1) pandemic. Additional investigation involving more years of data and more geographic locations are required before any findings can be generalized.

Although laboratory-based surveillance remains a cornerstone of influenza surveillance, the need for more timely surveillance data has never been greater. With the routine and

daily movement of persons between communities, an infectious disease can rapidly spread around the world in a matter of days. In addition, much has been learned about how infectious diseases like influenza spread and what methods can and should be used to help minimize spread and potential impacts. Successful results of most mitigation strategies (e.g., cough etiquette, hand washing, staying home when sick, and vaccination reminders) are best achieved if implemented in the community as early as possible.

The contribution of pharmacy-based surveillance to an overall influenza surveillance strategy primarily depends on the timeliness of the pharmacy data. In Canada, as in most industrialized nations, the pharmacy industry maintains sophisticated information systems to manage drug inventory and client data. An ongoing PHAC real-time pharmacy-based surveillance project demonstrates that the collection, aggregation, and analysis of near real-time prescription data from thousands of community pharmacies from across Canada is readily achievable.

Acknowledgments

Rx Canada, Inc., Ontario Ministry of Health and Long-Term Care, Public Health Ontario, and participating Ontario Public Health Units.

References

1. Public Health Agency of Canada. About FluWatch. Ottawa, Canada: Public Health Agency of Canada; 2013. Available at http://www.phac-aspc.gc.ca/fluwatch/index-eng.php.
2. Jajosky RA, Groseclose SL. Evaluation of reporting timeliness of public health surveillance. BMC Public Health 2004,4:29.
3. Buehler JW, Sonricker A, Paladini M, Sope P, Mostashar F. Syndromic surveillance practice in the United States: findings from a survey of state, territorial, and selected local health departments. Adv Dis Surveill 2008;6(3).
4. CDC. Experimental surveillance using data on sales of over-the-counter medications—Japan, November 2003–April 2004. MMWR 2005; 54(Suppl):47–52.
5. Vergu E, Grais RF, Sarter H, et al. Medication sales and syndromic surveillance, France. Emerg Infect Dis 2006;12:416–21.
6. Edge VL, Pollari F, Lim G, et al. Syndromic surveillance of gastrointestinal illness using over-the-counter sales: a retrospective study of waterborne outbreaks in Saskatchewan and Ontario. Can J Public Health 2004; 95:446–50.

Progress Toward Elimination of Onchocerciasis in the Americas — 1993–2012

Onchocerciasis (river blindness) is caused by the parasitic worm *Onchocerca volvulus*, transmitted to humans by the bite of infected black flies of the genus *Simulium*, and is characterized by chronic skin disease, severe itching, and eye lesions that can progress to complete blindness. Currently, among approximately 123 million persons at risk for infection in 38 endemic countries, at least 25.7 million are infected, and 1 million are blinded or have severe visual impairment (*1*). Periodic, communitywide mass drug administration (MDA) with ivermectin (Mectizan, Merck) prevents eye and skin disease and might interrupt transmission of the infection, depending on the coverage, duration, and frequency of MDA. The Onchocerciasis Elimination Program for the Americas (OEPA) was launched in response to a 1991 resolution of the Pan American Health Organization (PAHO) calling for the elimination of onchocerciasis from the Americas. By the end of 2012, transmission of the infection, judged by surveys following World Health Organization (WHO) guidelines, had been interrupted or eliminated in four of the six endemic countries in the WHO Americas Region. Thus, in 2013, only 4% (23,378) of the 560,911 persons originally at risk in the Americas will be under ivermectin MDA. Active transmission currently is limited to two foci among Yanomami indigenes in adjacent border areas of Venezuela and Brazil.

In 2001, WHO established a set of technical guidelines to help onchocerciasis programs determine whether interruption of transmission has occurred and whether MDA with ivermectin could be stopped (*2,3*). The process includes three key phases: 1) suppression of transmission, when infective-stage larvae are no longer introduced into the human population by the vectors, but the parasite population in the human reservoir maintains the ability to recover if treatments are withdrawn; 2) interruption of transmission, when the parasite population is thought to be unable to recover and treatments can be halted; and 3) elimination of transmission, when a posttreatment surveillance period of at least 3 years confirms that the parasite population has not recovered in the absence of interventions (*4*). Ocular morbidity is considered eliminated when the prevalence of acute eye lesions attributable to onchocerciasis falls below 1% (*3*). When all the foci in a country reach the elimination stage, final country verification can be considered by an independent international team of experts convened under the auspices of WHO.

OEPA* was launched in response to a 1991 PAHO resolution that called for the elimination of onchocerciasis morbidity from the Americas by 2007 (*5*). In 2008, based on significant OEPA achievements, PAHO and its member states renewed the call to eliminate onchocerciasis throughout the region and set a goal to interrupt transmission of the parasite throughout the region by 2012.† A PAHO resolution in 2009 that calls for the elimination or control of 12 neglected, poverty-related infectious diseases in the Americas by 2015 includes onchocerciasis as one of its elimination targets.§

The primary strategy for eliminating onchocerciasis from the Americas has been ivermectin MDA every 6 months, with health education and community mobilization, in all affected communities of the 13 endemic foci in the six affected countries (Figure) (*5,6*). MDA aims to achieve at least 85% coverage of the population at risk and eligible for treatment. Communities targeted for MDA are divided by baseline onchocerciasis prevalence into hyperendemic (≥60%), mesoendemic (≥20%, but <60%), and hypoendemic (evidence of autochthonous cases, but with prevalence <20%). Transmission is most difficult to break in hyperendemic areas, where MDA might need to be given every 3 months (*7*).

A total of 11,069,285 MDA ivermectin treatments were administered in the Americas during 1993–2012. By the end of 2012, transmission of the infection, as judged by surveys following established guidelines, had been interrupted or eliminated in four of the six countries, and ivermectin MDAs were halted in 11 of the 13 foci, with active transmission occurring only in two foci among Yanomami indigenous populations in adjacent border areas of southern Venezuela and northern Brazil. In 2013, only 4% (23,378) of the 560,911 persons originally at risk in the Americas will be targeted for ivermectin MDA. Ocular morbidity was detected only in southern Venezuela (Table). Since 1995, no new blindness has been attributed to onchocerciasis in the Americas.

Country Reports

Venezuela. The Northcentral, Northeast, and South foci in Venezuela comprised 119,358 persons at risk for onchocerciasis infection, the third highest national total in the Americas. The South focus in Venezuela had the second highest rate of microfilariae measured in the skin at baseline among the 13 foci in the Americas (Table). Venezuela has conducted MDA semiannually in 100 hyperendemic, 212 mesoendemic, and 297 hypoendemic communities, beginning in 2000. In 2010,

*Additional information available at http://www.oepa.net.

†Resolution CD48.R12. Towards the elimination of onchocerciasis (river blindness) in the Americas. Available at http://www1.paho.org/english/gov/cd/cd48.r12-e.pdf.

§Resolution CD49.R19. Elimination of neglected diseases and other poverty-related infections. Available at http://new.paho.org/hq/dmdocuments/2009/CD49.R19%20(Eng.).pdf.

FIGURE. Thirteen onchocerciasis foci — World Health Organization Region of the Americas, 2005

the program began conducting MDA quarterly in 66 hyperendemic communities in the South and Northeastern foci, eventually extending this to an additional 35 hyperendemic and five mesoendemic communities. When transmission was interrupted in the Northcentral and Northeast foci in 2010 and 2012, respectively, programs in those two foci had administered 17 and 20 rounds of mass treatment, with reported coverage of ≥85%. In 2013, treatments will be halted in the Northeast focus. The main challenges for the South focus (which had completed 14 rounds of MDA during 2006–2012) now are to search the remaining suspect areas for any still-unidentified endemic Yanomami communities and immediately increase MDA frequency to quarterly in all hyperendemic villages.

Brazil. The single focus of onchocerciasis in Brazil is among the Yanomami population living in an area contiguous with the endemic focus of South in Venezuela. Brazil's focus includes 12,988 persons in 22 endemic administrative areas (seven hyperendemic, nine mesoendemic, and six hypoendemic) called "polos bases." As in Venezuela, the affected area is remote and densely forested, and the migratory Yanomami move across the border at will. The Brazilian program administered 24 semiannual MDAs with at least 85% coverage during 2001–2012. The program began administering MDA treatments quarterly to seven hyperendemic and three mesoendemic polo bases in 2011. The latest surveys suggest that Brazil is close to suppressing onchocerciasis transmission in its part of the shared Yanomami area.

Guatemala. With four foci and 231,467 persons at risk, Guatemala had the greatest number of persons at risk for onchocerciasis in the Americas. The four foci encompass a total of 518 endemic communities (42 hyperendemic, 15 mesoendemic, and 461 hypoendemic). During 2001–2011, Guatemala conducted MDA and health education semiannually, achieving a reported 21 rounds of coverage of ≥85%. In 2006 and 2007, respectively, Guatemala's Santa Rosa and Escuintla foci were the first in the region to interrupt transmission in the Americas, (Table), followed by the Huehuetenango focus in 2008. MDA ended in Guatemala with cessation of treatment in the Central focus in 2012.

Mexico. The second-highest number of persons at risk for onchocerciasis (169,869) in the Americas were in three foci and 670 communities (39 hyperendemic, 220 mesoendemic,

TABLE. Baseline indices and current transmission status of onchocerciasis — 13 foci, World Health Organization Region of the Americas, 1979–2012

Identifier*	Focus area	Population at risk	Vector (*Simulium*)	Baseline indices				Transmission and ocular morbidity status		
				Mf in skin		MfAC				
				(%)	Year	(%)	Year	Interrupted	Eliminated	Ongoing
1	Oaxaca, Mexico	44,919	*S. ochraceum*	(7.3)	1983	(0)	1995	2008	2011	
2	North Chiapas, Mexico	7,125	*S. ochraceum*	(1.5)	1995	(0.6)	1995	2007	2010	
3	South Chiapas, Mexico	117,825	*S. ochraceum*	(14.5)	1995	(1.5)	1995	2011		
4	Huehuetenango, Guatemala	30,239	*S. ochraceum*	(2.9)	1987	(7.2)	1981	2008	2011	
5	Central, Guatemala	126,430	*S. ochraceum*	(52.2)	1994	(20.7)	1981	2011		
6	Escuintla, Guatemala	62,590	*S. ochraceum*	(29.5)	1979	(6.2)	1979	2007	2010	
7	Santa Rosa, Guatemala	12,208	*S. ochraceum*	(3.0)	1983	NA	—	2006	2010	
8	Northcentral, Venezuela	14,385	*S. metallicum*	(44.3)	1999	(31.0)	1999	2010		
9	Northeast, Venezuela	94,583	*S. metallicum*	(28.0)	1999	(21.7)	1999	2012		
10	South, Venezuela	10,390	*S. guianense* *S. oyapockense*	(75.0)	1998	(10.5)	1998			Ongoing†
11	Amazonas, Brazil	12,988	*S. guianense* *S. oyapockense* *S. incrustatum*	(63.3)	1995	(31.2)	1995			Ongoing§
12	Lopez de Micay, Colombia	1,366	*S. exiguum*	(39.6)	1995	(0)	1996	2007	2010	
13	Esmeraldas, Ecuador	25,863	*S. exiguum* *S. quadrivittatum*	(78.7)	1991	(24.7)	1991	2009	2012¶	
	Total (Mean)	**560,911**		**(33.8)**		**(12.9)**				

Abbreviations: NA = not available; Mf = microfilariae; MfAC = microfilariae in anterior chamber of the eye.
* Matches numbers shown on map in Figure.
† Only focus with demonstrable ocular morbidity.
§ Possibly suppressed.
¶ Pending review by Ecuador Ministry of Health.

and 411 hypoendemic) in Mexico (Table). Mexico has achieved 25 consecutive rounds of MDA with coverage of ≥85% during 2001–2011. In 2003, Mexico began quarterly MDA in 37 hyperendemic communities in the largest of its foci (South Chiapas) in an effort to accelerate interruption of transmission, becoming the first country to adopt this innovation. North Chiapas became the third focus to interrupt transmission in the Americas and Oaxaca was the sixth. MDA ended in Mexico with cessation of treatment in South Chiapas in 2012.

Ecuador. The single focus of onchocerciasis in Ecuador includes 119 communities (42 hyperendemic, 23 mesoendemic, and 54 hypoendemic) distributed among three river valleys in the Province of Esmeraldas. Although Ecuador's population at risk for onchocerciasis was relatively small (25,863), this focus had the highest prevalence of microfilariae in the skin at baseline of the 13 American foci. One of the two black fly vectors here, *Simulium exiguum*, is one of the most efficient transmitters of onchocerciasis in the Americas, comparable to *Simulium damnosum*, the major vector in Africa. Ecuador completed 23 MDA semiannual rounds of ≥85% coverage before interrupting transmission in 2009 and halting MDA in 2010. Posttreatment surveillance was completed successfully throughout the country in 2012. In 2013, Ecuador should become the second country in the Americas to request verification of elimination of onchocerciasis from WHO.

Colombia. The single focus of onchocerciasis in Colombia was a mesoendemic community. Colombia conducted 20 rounds of MDA coverage of at least 85% before it interrupted transmission in 2007 and halted MDA in 2008. Colombia successfully completed posttreatment surveillance in 2010, and applied to WHO for verification of elimination of onchocerciasis in 2012 (*7*).

Reported by

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What is already known on this topic?

In 1991, the Pan American Health Organization called for the elimination of onchocerciasis (river blindness) transmission in the Americas. Since then, the population under mass drug treatment in the Americas for onchocerciasis has been decreasing each year, from an estimated 500,000 to approximately 23,000.

What is added by this report?

Transmission of *Onchocerca volvulus* has been interrupted in 11 of the 13 foci in the Americas, leaving only 4% of the previous at risk population still needing continued mass drug administration. Colombia, Ecuador, Guatemala, and Mexico have all interrupted transmission. Transmission continues among the Yanomami indigenes in the Amazonian forest area on the border between Brazil and Venezuela.

What are the implications for public health practice?

Although earlier target dates of 2007 and 2012 for elimination of onchocerciasis in the Americas were missed, progress is accelerating, and elimination is likely within the next few years. Success in the final transmission zone will require intensified efforts and cross-border collaboration. Preliminary results from the Brazilian side are encouraging and indicate that transmission also can be interrupted in this region. Successful elimination of onchocerciasis in the Americas has and will continue to provide strong impetus and lessons learned for pursuing elimination of onchocerciasis in Africa.

Editorial Note

By the end of 2012, *O. volvulus* transmission was interrupted or eliminated in 11 of the 13 foci in the Americas. The current OEPA goal, under PAHO Resolution CD49.R19, is to interrupt transmission throughout the Americas by 2015. The challenges, therefore, are the two remaining endemic crossborder foci of Amazonas in Brazil and South in Venezuela. These are, in fact, a single epidemiologic unit that needs to be addressed through closely coordinated activities by the two countries. To accelerate the elimination process, the OEPA strategy is to increase ivermectin MDA to quarterly administration in the most highly endemic communities alongside the border, and identify and intensively treat any as yet unknown endemic communities.

The OEPA program is distinguished by the substantial proportion (38%) of its costs (approximately $121 million over the past 2 decades, which includes the value of the donated medicines) that was contributed by the six endemic countries. This was supplemented by critical support from external partners. The program also has benefited from its strong emphasis on data-driven decision processes, strong community mobilization, and innovative health education methods.[¶] OEPA's achievements have encouraged reorientation of onchocerciasis goals in the disease's main stronghold (Africa) from morbidity control to transmission elimination.

[¶] Additional information is available at http://new.paho.org/blogs/arteysalud.

References

1. Crump A, Morel CM, Omura S. The onchocerciasis chronicle: from the beginning to the end? Trends Parasitol 2012;28:208–88.
2. World Health Organization. Certification of elimination of human onchocerciasis: criteria and procedures. Geneva, Switzerland: World Health Organization; 2001. Available at http://whqlibdoc.who.int/hq/2001/WHO_CDS_CPE_CEE_2001.18b.pdf.
3. Lindblade KA, Arana B, Zea-Flores G, et al. Elimination of *Onchocerca volvulus* transmission in the Santa Rosa focus of Guatemala. Am J Trop Med Hyg 2007;77:334–41.
4. Program Coordinating Committee and OEPA staff. Guide to detecting a potential recrudescence of onchocerciasis during the posttreatment surveillance period: the American paradigm. Res Rep Trop Med 2012;3:21–33.
5. Blanks J, Richards F, Beltran F, et al. The Onchocerciasis Elimination Program of the Americas: a history of partnership. Rev Panam Salud Publica 1998;3:367–74.
6. Sauerbrey M . The Onchocerciasis Elimination Program for the Americas (OEPA). Ann Trop Med Parasitol 2008;102 (Suppl 1):S25–9.
7. World Health Organization. InterAmerican Conference on Onchocerciasis, 2011: interruption of transmission in Guatemala and Mexico. Wkly Epidemiol Rec 2012;87:309–15.

Building Laboratory Capacity to Support the Global Rotavirus Surveillance Network

In 2001, in anticipation of rotavirus vaccine licensure and introduction, the World Health Organization (WHO) and partners established regional laboratory surveillance networks for rotavirus detection and strain type monitoring among hospitalized children aged <5 years (*1*). In 2006, two WHO-prequalified oral rotavirus vaccines were licensed: a 2-dose, single-strain vaccine (Rotarix, GlaxoSmithKline Biologicals) and a 3-dose, multistrain vaccine (RotaTeq, Merck). Both vaccines provide protection against a range of rotavirus strain types, generally classified as G and P types based on specific viral proteins (*2*). Based on results of clinical trial data, disease burden data from surveillance networks, and findings from vaccine impact studies, WHO recommends that all countries include rotavirus vaccination in national immunization programs (*3*). Vaccination is recommended to help reduce the morbidity and mortality associated with rotavirus, a leading cause of diarrhea in children aged <5 years that was responsible for approximately 450,000 deaths in 2008 (*4*). This report describes the expansion of the regional rotavirus laboratory surveillance networks to a global surveillance network, the implementation of data quality assurance measures to ensure quality laboratory data reporting to support rotavirus surveillance activities, and data reporting through the surveillance network. Timely, quality surveillance data can provide baseline estimates of rotavirus disease burden to inform decisions regarding rotavirus vaccine introduction in national immunization programs and can help monitor the impact of vaccine introduction on disease trends.

Background

In 2008, the Global Rotavirus Surveillance Network (GRSN) was established to 1) generate local data for decision making regarding rotavirus vaccine introduction and sustained use, 2) assess and monitor disease trends and genotype distribution over time, 3) develop a platform for vaccine effectiveness studies, and 4) highlight the value of surveillance data. The transition of regional laboratory network coordination to WHO for a global laboratory network within the GRSN then began, with GAVI Alliance funding for surveillance in eligible countries. The Global Rotavirus Laboratory Network (GRLN) is a fundamental component of the GRSN designed to conduct high-quality diagnostic testing for rotavirus diarrhea and characterize the most prevalent genotypes among strains isolated in different countries and regions. As of April 2013, the network includes 107 sentinel hospital laboratories, 36 national laboratories, nine regional reference laboratories, and one Global Reference Laboratory.

Implementation

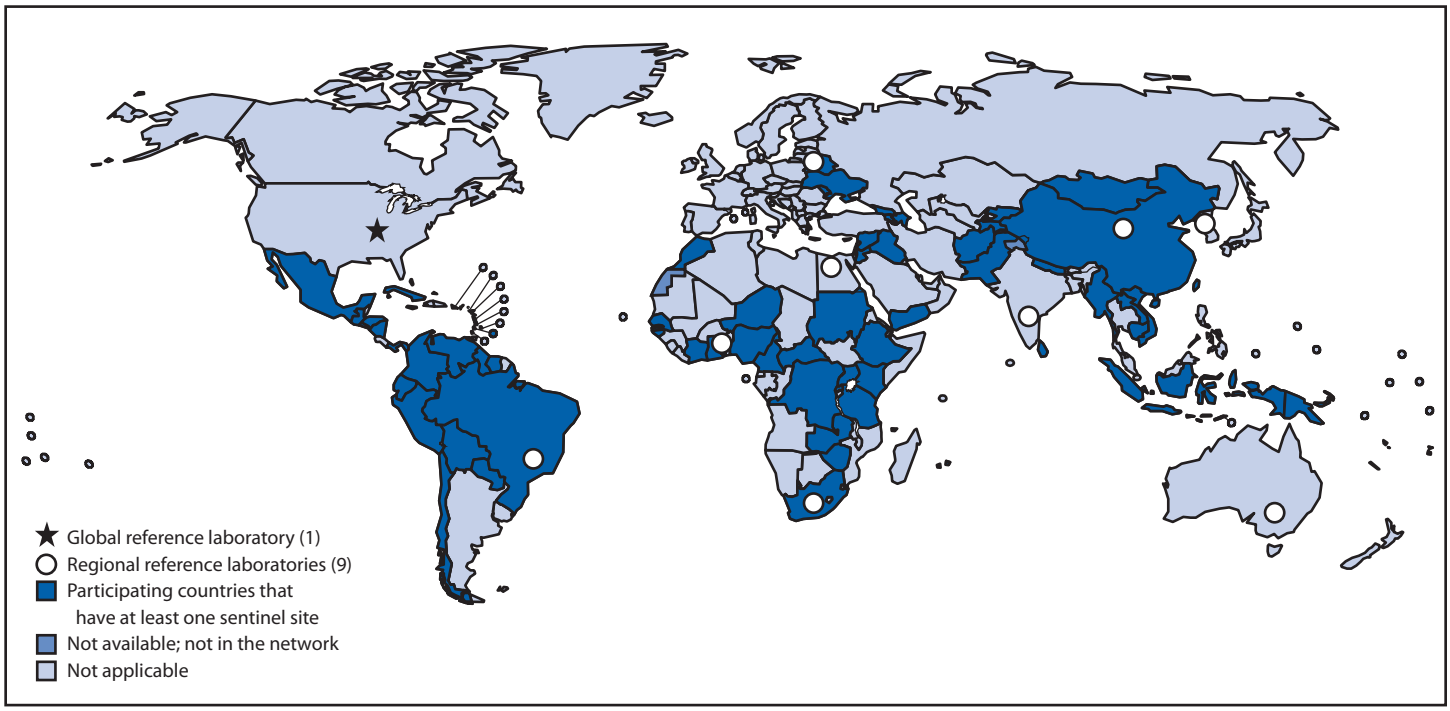
WHO coordinates the operations of the GRLN and GRSN. WHO surveillance focal persons and laboratory coordinators work closely with ministries of health in participating countries to support surveillance activities, including initial sentinel hospital site selection, specimen and data flow management, laboratory performance monitoring, and regional meeting planning. WHO, partners, and participating countries hold regular meetings at the global and regional levels to discuss surveillance results and progress in network development and to set an agenda of priority activities.

Sentinel hospital sites within participating countries enroll children <5 years of age hospitalized with acute gastroenteritis who meet a standard case definition.* The GRLN, a tiered laboratory structure, supports laboratory testing of stool specimens collected from enrolled children (Figure). Capable sentinel hospital laboratories use antigen-detecting enzyme immunoassay kits to test for presence of rotavirus in stool specimens (*5*). National laboratories in participating countries provide support to the sentinel hospital laboratories and are responsible for rotavirus testing, specimen storage, and selection and distribution of positive specimens for genotyping (i.e., strain characterization). Rotavirus regional reference laboratories (RRLs), selected for expertise in rotavirus detection and genotyping methods and capacity to provide technical assistance to countries in their region, support the national laboratories. RRLs conduct the bulk of the rotavirus genotyping using reverse transcription–polymerase chain reaction and nucleic acid sequencing methods. However, in some countries, especially larger ones with high sample volume, national laboratories and sometimes sentinel hospital laboratories have genotyping capacity. The Global Reference Laboratory provides technical support to the RRLs, including training in genotyping methods, development and implementation of quality assurance and quality control systems with collaborating partners, provision of standardized laboratory reagents and procedures, and assistance in regional capacity building activities as needed and requested by the RRLs. The Global Reference Laboratory and RRLs also undertake research to improve essential laboratory methods used in the GRSN.

The GRLN has adapted several approaches from the WHO-coordinated global laboratory networks for poliovirus and for

* Any child aged 0–59 months admitted for treatment of acute (i.e., ≤14 days) watery gastroenteritis/diarrhea to a sentinel hospital conducting surveillance. Excluded are children with bloody diarrhea and children transferred from another hospital.

FIGURE. Global Rotavirus Laboratory Network — World Health Organization (WHO), 2013*



* As of March 21, 2013.

measles and rubella to confirm and improve the accuracy of collected data (*6,7*). These include proficiency testing, standardization of laboratory methods, and laboratory assessments. To help ensure the quality of reported data, a formal external quality assessment program began in 2011 after development of a proficiency testing panel of rotavirus specimens consisting of common genotypes and negative controls. The panel tests the ability of network laboratories to correctly identify positive and negative specimens by antigen enzyme immunoassay and determine the genotypes in positive specimens. Laboratories must achieve a score of at least 80% on each test to pass. In 2011, a proficiency testing pilot survey included nine RRLs from all WHO regions. This was expanded to 10 RRLs, 16 national laboratories, and 17 provincial laboratories during 2012. WHO laboratory coordinators work closely with laboratories with identified weaknesses, based on performance results, to implement corrective actions and improve testing performance.

In 2012, WHO established a rotavirus laboratory technical working group to develop approaches to improve laboratory network capacities and increase standardization of key laboratory methods and procedures. Progress on standardization issues includes recommendations to 1) revise standard genotyping data collection forms to record all detected strains; 2) define approaches to reduce the number of untypeable strains; 3) develop standard procedures for sample handling, storage, and shipping that can be adapted in each region; and 4) implement routine confirmation for a subset of genotypes.

Monitoring of individual laboratory performance occurs through site assessments using standardized assessment tools for the national laboratories and RRLs; a standard tool for sentinel hospital laboratories is in development. Performance indicators for sentinel hospital laboratories and national laboratories include minimum number of rotavirus tests performed, RRL-confirmed testing accuracy, successful completion of yearly proficiency testing, timely sample analysis, and application of standard operating procedures. Additionally, reviewers assess the biosafety procedures and infrastructure of all laboratories. Site visits offer opportunities to assist laboratories with problem solving and often are combined with trainings.

Laboratory data reported through the GRSN include the percentage of hospitalized children positive for rotavirus and strain prevalence in each WHO region and country. The number of reporting countries has grown from 44 in 2008, to 64 in 2011 (*8–10*). During the same period, the number of participating sentinel hospitals expanded from 132 to 185, and the annual number of enrolled children increased from 41,414 to 48,947. Median global rotavirus detection rates in stool specimens varied from 36% to 41% during 2008–2011; data collection on strain prevalence began in 2009. During 2009–2011, the most frequent genotypes observed were the five considered globally prevalent (G1P[8], G2P[4], G3P[8], G4P[8], and G9P[8]). However, regional differences in genotype prevalence were evident, especially for Africa and South-East Asia where other genotypes constituted a significant proportion of rotavirus genotypes (Table).

TABLE. Number and percentage of rotavirus-positive specimens (N = 14,902) from hospitalized patients aged <5 years with rotavirus diarrhea, by strain and World Health Organization (WHO) region — worldwide, 2009–2011

	WHO region												Global	
	African		Americas		Eastern Mediterranean		European		South-East Asia		Western Pacific		Total	
Strain	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
G1P[8]	435	(19)	1,108	(27)	52	(4)	665	(36)	169	(18)	1,965	(47)	**4,394**	**(29)**
G2P[4]	210	(9)	879	(21)	282	(19)	250	(14)	99	(10)	319	(8)	**2,039**	**(14)**
G3P[8]	41	(2)	327	(8)	31	(2)	218	(12)	9	(1)	1,065	(25)	**1,691**	**(11)**
G4P[8]	35	(2)	14	(0)	58	(4)	385	(21)	0	(0)	3	(0)	**495**	**(3)**
G9P[8]	231	(10)	313	(8)	23	(2)	84	(5)	76	(8)	167	(4)	**894**	**(6)**
Others*	759	(33)	1,067	(26)	308	(21)	174	(9)	338	(35)	268	(6)	**2,914**	**(20)**
Mixed†	316	(14)	131	(3)	637	(43)	37	(2)	150	(16)	224	(5)	**1,495**	**(10)**
Untypeable§	246	(11)	322	(8)	94	(6)	35	(2)	112	(12)	171	(4)	**980**	**(7)**
Total	**2,273**	**(100)**	**4,161**	**(100)**	**1,485**	**(100)**	**1,848**	**(100)**	**953**	**(100)**	**4,182**	**(100)**	**14,902**	**(100)**

Source: World Health Organization. Global rotavirus information and surveillance bulletin. Vols. 2, 4, and 6. Geneva, Switzerland: World Health Organization; 2010, 2011, and 2012. Available at http://www.who.int/nuvi/surveillance/HQBulletin_Rota_2009_final.pdf, http://www.who.int/nuvi/surveillance/Final_RV_bulletin_Jan_Dec_2010_Data.pdf, and http://www.who.int/nuvi/rotavirus/RV_bulletin_Jan_Dec_2011_FINAL.pdf.

* Strains with G and P genotypes other than globally prevalent types G1P[8], G2P[4], G3P[8], G4P[8], and G9P[8]. During 2009 and 2010, the genotypes of these strains were recorded in a data category designated as uncommon and the individual genotypes were not always submitted to WHO. Consequently, only the reported absolute numbers and percentages of these strains are shown. The data table was changed in 2011 so that all genotypes could be recorded and submitted to WHO.

† Strains for which more than one G, P, or G and P genotypes were detected. The individual genotypes of these mixed infections were not always submitted to WHO. Consequently, only the reported absolute numbers and percentages of these strains are shown.

§ Includes strains whose G or P genotype, or G and P genotypes were indeterminate. The individual genotypes of these mixed infections were not always submitted to WHO. Consequently, only the reported absolute numbers and percentages of these strains are shown.

Comment

The GRLN is an integral part of the GRSN that provides timely rotavirus disease burden data, which can help guide decisions regarding rotavirus vaccine introduction into national immunization programs. These data also can provide a baseline for assessing the impact of rotavirus vaccines on severe rotavirus disease resulting in hospitalization and on strain prevalence.

Substantial progress has been made in expanding the reach of the GRLN, developing standardized data collection procedures, and implementing quality assurance procedures to improve data collection. Lessons learned and applied from the other WHO-coordinated laboratory networks have resulted in a system of national, regional, and global laboratories proficient in rotavirus diagnosis and genotyping. Efforts are underway to optimize critical laboratory procedures used at the global and regional reference laboratories to facilitate interlaboratory data comparability and improve genotyping data quality.

Although 2009–2011 data indicate that G1P[8], G2P[4], G3P[8], G4P[8], and G9P[8] strains remain the most prevalent globally, regional and temporal differences in genotypes exist. Strain changes are seen naturally. Careful interpretation is necessary to associate any changes with vaccine use, especially because both vaccines have demonstrated good cross-protection to date. Close monitoring is required and can be accomplished through the GRLN.

WHO, in collaboration with key partners, has begun an in-depth review of the past 5 years of data and experience collected through the GRSN. This review will identify strengths and weaknesses of the GRSN, including the GRLN, and will guide decisions on strategies and actions to ensure the network is responsive to information needs of all immunization stakeholders. The review also will provide recommendations related to the potential use of the network for surveillance needs around vaccines in development and other important gastroenteric pathogens.

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References

1. CDC. Rotavirus surveillance—worldwide, 2001–2008. MMWR 2008; 57:1255–7.
2. Patel MM, Glass RG, Desai R, Tate JE, Parashar UD. Fulfilling the promise of rotavirus vaccines: how far have we come since licensure? Lancet Infect Dis 2012;12:361–70.
3. World Health Organization. Rotavirus vaccines: WHO position paper—January 2013. Wkly Epidemiol Rec 2013;88:49–64.

4. Tate JE, Burton AH, Boschi-Pinto C, et al. 2008 estimate of worldwide rotavirus-associated mortality in children younger than 5 years before the introduction of universal rotavirus vaccination programmes: a systematic review and meta-analysis. Lancet Infect Dis 2012;12:136–41.
5. World Health Organization. Manual of rotavirus detection and characterization methods. Geneva, Switzerland: World Health Organization; 2008. Available at http://whqlibdoc.who.int/hq/2008/who_ivb_08.17_eng.pdf.
6. Hull BP, Dowdle WR. Poliovirus surveillance: building the global polio laboratory network. J Infect Dis 1997;175(Suppl 1):S113–6.
7. Featherstone DA, Rota PA, Icenogle J, et al. Expansion of the global measles and rubella laboratory network 2005–09. J Infect Dis 2011; 204(Suppl 1):S491–8.
8. World Health Organization. Global rotavirus information and surveillance bulletin. Vol. 2. Geneva, Switzerland: World Health Organization; 2010. Available at http://www.who.int/nuvi/surveillance/HQBulletin_Rota_2009_final.pdf.
9. World Health Organization. Global rotavirus information and surveillance bulletin. Vol. 4. Geneva, Switzerland: World Health Organization; 2011. Available at http://www.who.int/nuvi/surveillance/Final_RV_bulletin_Jan_Dec_2010_Data.pdf.
10. World Health Organization. The global rotavirus information and surveillance bulletin. Vol. 6. Geneva, Switzerland: World Health Organization; 2012. Available at http://www.who.int/nuvi/rotavirus/RV_bulletin_Jan_Dec_2011_FINAL.pdf.

Notes from the Field

Ascariasis Associated with Pig Farming — Maine, 2010–2013

During April 2010–March 2013, the Maine Department of Health and Human Services investigated multiple cases of ascariasis that had been reported by health-care providers, veterinarians, and patients. All of the cases were in persons who had lived or worked on Maine farms and had frequent exposure to pigs. Ascariasis, a parasitic roundworm infection caused by *Ascaris* species, is the most common human intestinal worm infection globally.* However, because ascariasis is not a reportable disease, limited data exist regarding the incidence of this infection in the United States (*1*), and the number of annual cases in Maine is unknown. After investigation, 14 persons on seven farms in Maine were identified with *Ascaris* infection.

To better assess the extent of the ascariasis problem, state health officials conducted field investigations at four of the seven farms with reported cases and collected worms from humans and pigs and from pooled pig feces. Human worm and pig worm specimens were sent to CDC for identification and analysis. Confirmed cases were among persons who had excreted in stool at least one worm laboratory-identified as *Ascaris* species. Probable cases were among persons who reported excreting at least one worm in stool and who were epidemiologically associated with a confirmed case. Suspected cases were among persons with symptoms consistent with larval migration (e.g., coughing up larvae) and who were epidemiologically associated with a confirmed case or who had excreted at least one worm in stool without laboratory confirmation or epidemiologic association with a confirmed case.

A total of 14 patients aged 1–53 years (median: 25 years) from seven farms in six Maine counties had an *Ascaris* infection (eight confirmed, four probable, and two suspected) during 2010–2013. Thirteen (93%) patients were female. Ten (71%) patients reported no international travel history; of the four patients with a history of international travel, two reported previous treatment for parasites, and two reported no previous screening or treatment. All patients sought medical care and were prescribed anthelminthic medication (e.g., albendazole).

Private reference and university laboratories confirmed *Ascaris* species in human samples from three farms and in pooled pig feces from two farms. CDC confirmed as *Ascaris* species four worms collected from humans at four different farms and worms collected from pigs at one of those farms. Transmission from pigs to humans has been reported in other countries and likely occurred on the seven farms in Maine (*2*). Occurrence of infections among persons with no other likely source of infection and common exposure to pigs suggests that pigs were the source of human infections.

Ascariasis is transmitted by the fecal-oral route. *Ascaris* eggs and adult worms are excreted in stool. *Ascaris* infections often are asymptomatic among humans, but symptoms can include gastrointestinal discomfort and cough. Adverse health outcomes can include lung inflammation, intestinal obstruction, and growth delays.

The seven implicated farms grew either organic or conventional produce and raised livestock for household consumption and/or local sale. This unusual disease cluster holds implications for limited-scale agriculture with respect to farming practices and concern over foodborne transmission. Investigators recorded field notes from each of the four farm visits and conducted case investigation interviews regarding international travel history, farming practices, animal husbandry, and hand hygiene. Recommendations to prevent human illness at farms where *Ascaris* infection has been confirmed include improved hand hygiene, growing vegetables away from areas where pigs are penned, discontinuing use of pig manure as fertilizer, and thoroughly washing produce.

*Additional information available at http://www.cdc.gov/parasites/ascariasis/index.html.

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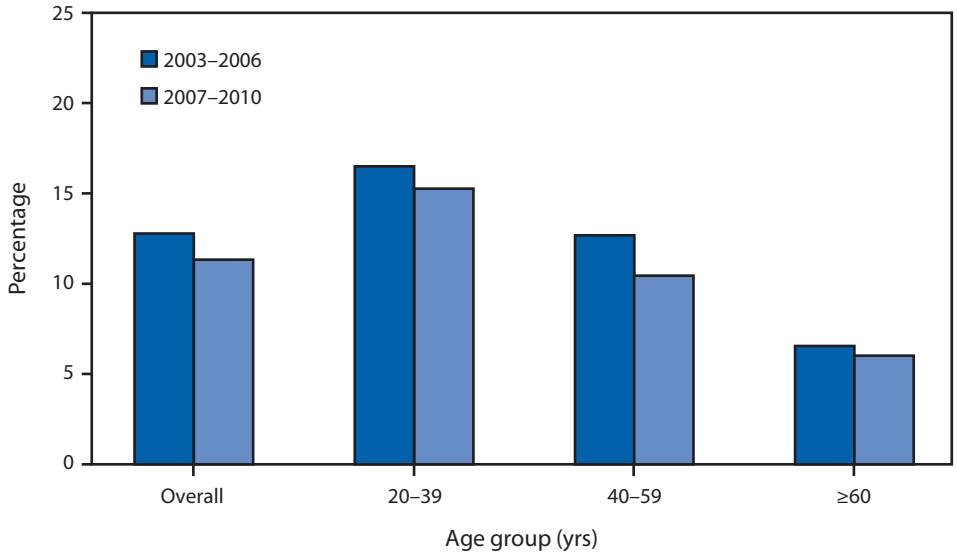
References

1. Starr MC, Montgomery SP. Soil-transmitted helminthiasis in the United States: a systematic review—1940–2010. Am J Trop Med Hyg 2011; 85:680–4.
2. Zhou C, Min L, Yuan K, Deng S, Peng W. Pig *Ascaris*: an important source of human ascariasis in China. Infect Genet Evol 2012;12:1172–7.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Daily Calories Consumed from Fast Food* Among Adults Aged ≥20 Years, by Age Group† — National Health and Nutrition Examination Survey, United States, 2003–2006 and 2007–2010



* Food usually sold at eating establishments for quick availability or takeout.
† Overall estimates age adjusted to year 2000 U.S. Census standard population using age groups 20–39 years, 40–59 years, and ≥60 years.

From 2003–2006 to 2007–2010 the percentage of daily calories consumed from fast foods among adults aged ≥20 years declined from 12.8% to 11.3%. A decrease from 12.7% to 10.5% also was observed for those aged 40–59 years, but no statistically significant change was noted for persons aged 20–39 years or ≥60 years. During both periods, the percentage of daily calories from consumption of fast foods was highest among those aged 20–39 years.

Source: Fryar CD, Ervin RB. Caloric intake from fast food among adults: United States, 2007–2010. NCHS data brief no. 114. Hyattsville, MD: US Department of Health and Human Services, CDC; 2013. Available at http://www.cdc.gov/nchs/data/databriefs/db114.pdf.

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