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World Polio Day — October 24, 2014

World Polio Day was established for annual observance on October 24 by Rotary International more than a decade ago to commemorate the fight against poliomyelitis. Widespread use of poliovirus vaccine led to an increasing number of polio-free countries and to establishment of the Global Polio Eradication Initiative (GPEI) in 1988. As of October 14, a total of 243 polio cases had been reported in 2014, with 92% of the cases reported from Nigeria, Afghanistan, and Pakistan, the only three countries where transmission of indigenous wild poliovirus has continued uninterrupted (*1*).

On December 2, 2011, the CDC Emergency Operations Center was activated to strengthen the agency's partnership engagement through GPEI. In April 2012, the World Health Assembly declared completion of polio eradication a programmatic emergency for global public health (*2*). In May 2014, the international spread of poliovirus was declared a public health emergency of international concern (*3,4*). Additional information regarding CDC's polio eradication activities is available at http://www.cdc.gov/polio/updates, and additional information about GPEI and the global partnership is available at http://www.polioeradication.org.

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Polio-Free Certification and Lessons Learned — South-East Asia Region, March 2014

Sunil Bahl, MD[1], Rakesh Kumar, MD2, Nata Menabde, PhD3, Arun Thapa, MBBS[4], Jeffrey McFarland, MD[4], Virginia Swezy, MPH[4], Rudolph H. Tangermann, MD[5], Hamid S. Jafari, MD[5], Linda Elsner[6], Steven G.F. Wassilak, MD[6], Olen M. Kew, PhD[7], Stephen L. Cochi, MD[6] (Author affiliations at end of text)

In 1988, the World Health Assembly resolved to interrupt wild poliovirus (WPV) transmission worldwide. By 2006, the annual number of WPV cases had decreased by more than 99%, and only four remaining countries had never interrupted WPV transmission: Afghanistan, India, Nigeria, and Pakistan (*1*). The last confirmed WPV case in India occurred in January 2011 (*2*), leading the World Health Organization (WHO) South-East Asia Regional Commission for the Certification of Polio Eradication (SEA-RCC) in March 2014 to declare the 11-country South-East Asia Region (SEAR), which includes India,* to be free from circulating indigenous WPV. SEAR became the fourth region among WHO's six regions to be

* Bangladesh, Bhutan, Burma, Indonesia, India, Maldives, Nepal, North Korea, Sri Lanka, Thailand, and Timor-Leste.

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certified as having interrupted all indigenous WPV circulation; the Region of the Americas was declared polio-free in 1994 (*3*), the Western Pacific Region in 2000 (*4*), and the European Region in 2002 (*5*). Approximately 80% of the world's population now lives in countries of WHO regions that have been certified polio-free. This report summarizes steps taken to certify polio eradication in SEAR and outlines eradication activities and lessons learned in India, the largest member state in the region and the one for which eradication was the most difficult.

Steps Toward Regional Certification

Certification of polio eradication is conducted by WHO regions (*1,3–5*). The Regional Certification Commission (RCC) is an independent body that certifies a region polio-free when all countries in the region meet three conditions: 1) the absence of indigenous WPV transmission for at least 3 consecutive years, monitored by a sensitive, certification-standard surveillance system; 2) the capacity to detect, report, and rapidly respond to any imported WPV; and 3) documentation of substantial progress toward the eventual laboratory containment (at an appropriate biosafety level) of WPV. Each country has an independent National Certification Committee for Polio Eradication to verify and submit country documentation related to polio eradication activities.

SEA-RCC, comprised of experts in public health, epidemiology, virology, clinical medicine, and related specialties, reviewed the documentation for each SEAR country. The last confirmed indigenous WPV cases in SEAR countries were as follows: Nepal, 2000; Bangladesh, 2000, Burma, 2000; Thailand, 1997; North Korea, 1996; Timor-Leste, 1995 (recognized as independent in 2002); and Indonesia, 1995. Bhutan, Maldives, and Sri Lanka reported their last cases of polio before 1995. India was the final country in the region to successfully interrupt indigenous WPV transmission, reporting the most recent indigenous WPV type 1 (WPV1) case in SEAR in January 2011. Importation of WPV and subsequent spread occurred in four countries after their last indigenous cases: Nepal reported 26 importation-associated cases during 2005–2010, and outbreaks occurred in Indonesia during 2005–2006 (351 cases), Bangladesh in 2006 (18 cases), and Burma during 2006–2007 (11 cases) (Figure 1). In SEAR, the last identified WPV type 2 (WPV2) case occurred in India in October 1999; this was also the last WPV2 case reported globally. The most recent WPV type 3 (WPV3) case in India and the region occurred in October 2010. After careful review of all documentation, SEA-RCC certified that every SEAR country had met the requirements, and the region was declared polio-free on March 27, 2014 (*6*).

Immunization Activities in India

Using the most recent population-based survey data available, India estimated nationwide coverage with 3 doses of oral poliovirus vaccine (OPV) delivered by routine childhood

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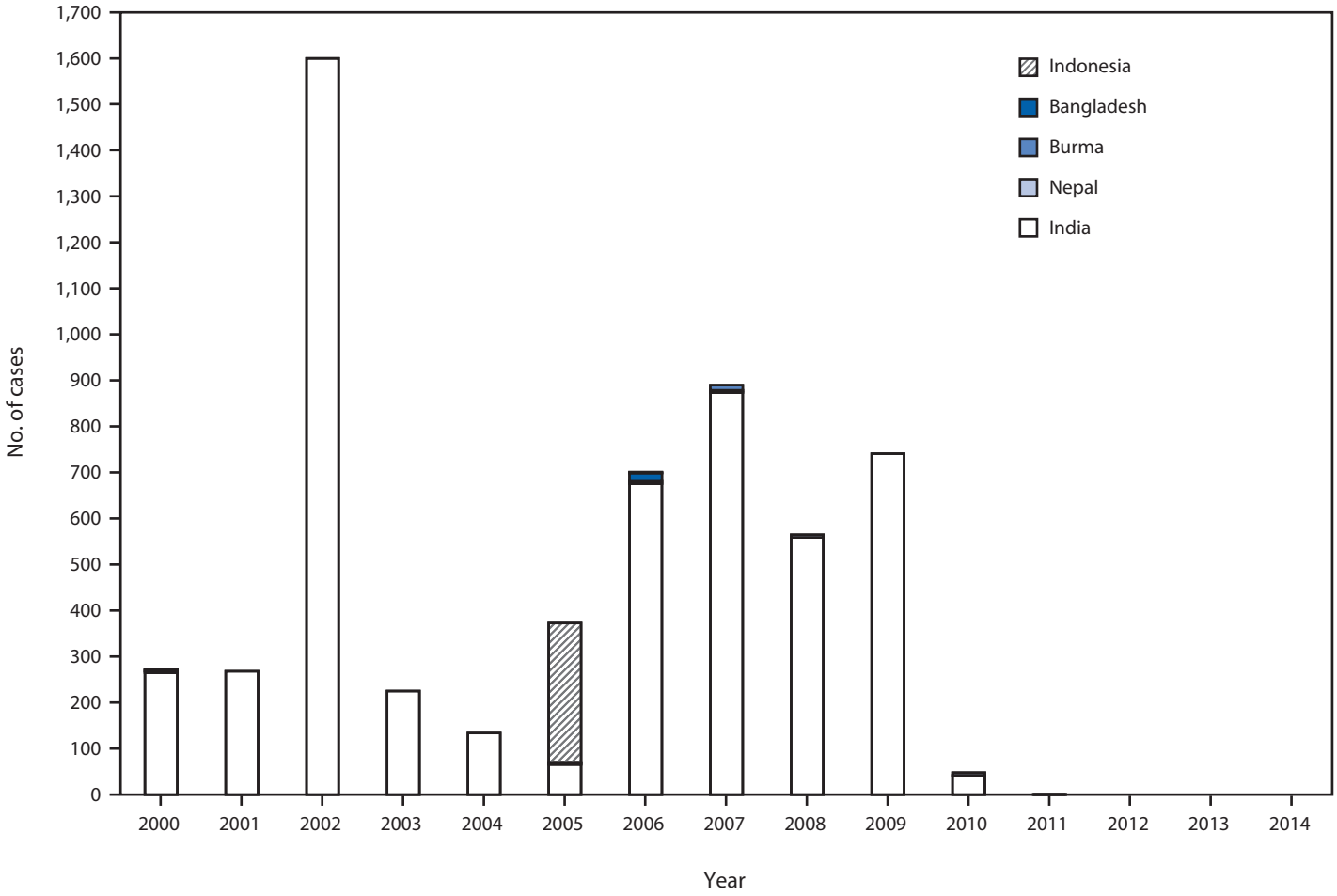
FIGURE 1. Number of confirmed polio cases from wild poliovirus (WPV) transmission, by country — World Health Organization South-East Asian Region, 2000–2014*



* Cases after 2000 in Bangladesh, Burma, and Nepal were associated with WPV imported from India; a 2005–2006 outbreak in Indonesia was associated with WPV type 1 originating in Nigeria.

immunization services to be 70.4% among children aged 12–23 months during 2009–2010. Routine coverage estimates in Bihar (61.6%) and Uttar Pradesh (53.9%), two polio-endemic states, were among the lowest in the country (*7*). Estimated routine coverage improved substantially from estimated levels reported in 2006 in Bihar (47.6%) and Uttar Pradesh (43.8%).

Supplemental immunization activities (SIAs)† in India were introduced as National Immunization Days (NIDs) in 1995, targeting children aged <3 years. NIDs during subsequent years targeted children aged <5 years. NIDs were reinforced by subnational immunization days and large-scale mop-up activities in endemic and other high-risk areas, as well as by introducing house-to-house vaccination as part of the efforts to identify and vaccinate children who were not being brought to the fixed sites providing OPV during SIAs. Since 2000, during NIDs, more than 2.3 million vaccinators visited approximately 209 million households to vaccinate more than 170 million children aged <5 years. Also, surveillance and monitoring data were used to identify high-risk populations and areas for which innovative strategies were designed and implemented. These included strategies to reach mobile and transitory populations by stationing vaccinators at bus stops and train stations, on trains, and at important road intersections, as well as in markets, in migrant camps, at brick kilns, and at construction sites. Transit teams vaccinated nearly 10 million children in each campaign, more than 100,000 of them while on trains. Innovative strategies also were designed

† Mass campaigns conducted during a short period (days to weeks), during which a dose of OPV is administered to all children (generally those aged <5 years) regardless of previous vaccination history. Campaigns can be conducted nationally or in portions of the country (i.e., subnational SIAs).

to reach children in access-compromised areas in the Kosi river flood plain in Bihar state and in the traditionally highest-risk areas in western Uttar Pradesh and central Bihar. Monitoring data[§] were used to estimate the proportion of children missed in each SIA; since 2010, SIAs in India are estimated to have achieved >95% coverage among targeted children, even in remote areas (*2*).

India introduced monovalent OPV type 1 (mOPV1) and type 3 (mOPV3) in 2005 (*8*). Predominant use of mOPV1 greatly reduced the incidence of WPV1 but allowed increased WPV3 incidence until bivalent OPV types 1 and 3 (bOPV) was introduced in 2010 (*9*). The intensification of the migrant and transit strategies coupled with predominant use of bOPV was associated with a reduction in both WPV1 and WPV3 (Figure 2).

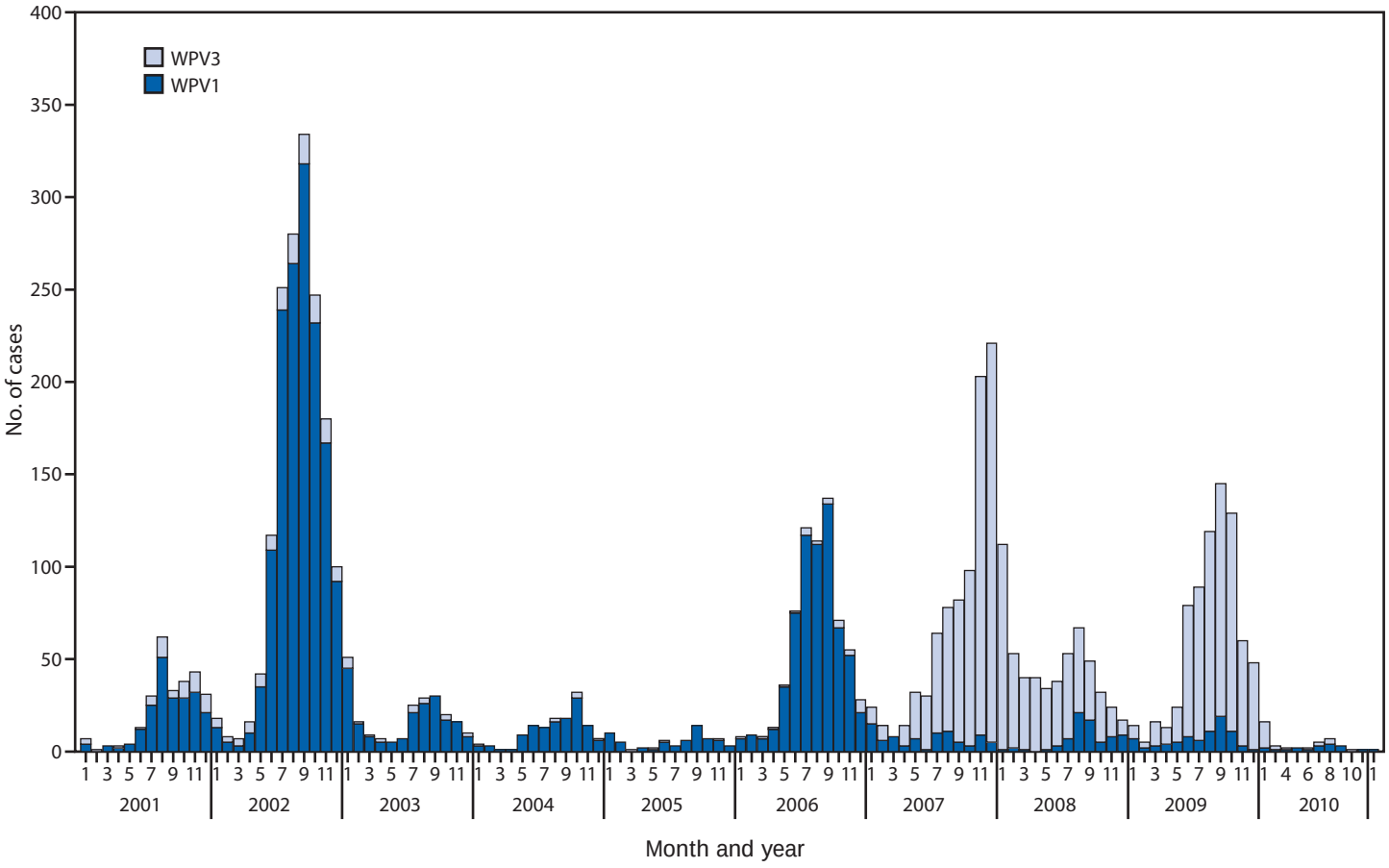
Wild Poliovirus Surveillance in India

Acute flaccid paralysis (AFP) surveillance. To demonstrate that WPV circulation has been interrupted, the global standard in endemic countries for sensitive AFP surveillance is an annual rate of at least two nonpolio AFP (NPAFP)[¶] cases per 100,000 children aged <15 years. In India, the national NPAFP rate was 13.9 per 100,000 children aged <15 years in 2012 and 12.5 per 100,000 in 2013. The highest state-level NPAFP rates

[§] SIA monitoring data are obtained from systematic surveys conducted after every SIA in high-risk areas to identify children aged <5 years who were missed with vaccination.

[¶] GPEI sets operational targets for countries with current or recent WPV transmission, both nationally and in each province or state. Targets are NPAFP ≥2 per 100,000 population aged <15 years per year, and adequate stool specimen collection from ≥80% of AFP cases, in which two specimens are collected ≥24 hours apart, both within 14 days of paralysis onset, shipped on ice or frozen ice packs, and arriving in good condition (without leakage or desiccation) at a WHO-accredited laboratory.

FIGURE 2. Number of polio cases from wild poliovirus types 1 (WPV1) and 3 (WPV3), by month — India, January 2001–January 2011



What is already known on this topic?

Extensive regions of the world were certified as free from indigenous wild poliovirus (WPV) transmission during 1994–2002. Until 2011, only four countries remained that had never interrupted WPV transmission: Afghanistan, India, Nigeria, and Pakistan. These four countries are located in three World Health Organization (WHO) regions. WPV exportations from these reservoirs have occurred into many countries that had previously interrupted their indigenous WPV transmission.

What is added by this report?

India, a member of the WHO South-East Asia Region, had its last WPV case in January 2011, which was also the last case in the region. In March 2014, the South-East Asia Region was declared to be free from circulating indigenous WPV and became the fourth WHO region to be so certified. About 80% of the world's population now lives in countries of regions that have been certified as polio-free.

What are the implications for public health practice?

Stopping indigenous WPV transmission in India required commitment at every level of government, provision of adequate fiscal and human resources, implementation of innovative strategies and approaches, and engagement with the private sector. Specific lessons learned have been successfully applied to address the challenges to polio eradication activities in other countries and are being used to improve immunization services in India.

were in Bihar (34.2) and Uttar Pradesh (21.5) Adequate stool specimen collection in India was 87% nationally in 2012 and 86% in 2013, exceeding the performance standard of 80%.

Environmental surveillance. Systematic (weekly or biweekly) testing of wastewater samples for poliovirus began in Mumbai, Maharashtra state, in June 2001, in Delhi in May 2010, in Patna, Bihar, in April 2011, in Kolkata, West Bengal, in December 2011, and expanded further to include sampling in the states of Punjab and Gujarat in 2013. Both WPV1 and WPV3 were detected in wastewater sampled at Delhi sites during 2010; WPV3 was most recently detected in July 2010, and WPV1 was most recently detected in August 2010. The most recent WPV isolated from wastewater in India was WPV1 sampled in November 2010 in Mumbai. No WPV has ever been isolated from wastewater sampled in Patna, Kolkata, Punjab, or Gujarat. All WPV1 and WPV3 isolates from wastewater during 2010 were closely related to WPV1 and WPV3 circulating in central Bihar state during 2009.

Discussion

The certification of SEAR as polio-free conclusively demonstrated that polio can be eradicated in the most challenging settings where the risks for WPV transmission are highest, namely in countries with 1) high population densities, 2) large birth cohorts, 3) high population mobility, 4) poor sanitation, and 5) tropical/subtropical climates. Although such conditions prevail in parts of several SEAR countries, the magnitude and intensity of risks were greatest in India, especially in Uttar Pradesh and Bihar, which have a combined population of approximately 300 million, a monthly birth cohort of approximately 500,000, frequent migration between and outside the states, and lower per-dose effectiveness of trivalent OPV (*8,9*). Stopping indigenous WPV transmission in India required sustained commitment at every level of government, the provision of adequate fiscal and human resources, the implementation of innovative strategies and approaches, and private sector engagement. Specific lessons learned about ensuring the success of immunization programs throughout India have been successfully applied to address the challenges to polio eradication activities in other countries and are being used to improve immunization services in India (Box).

Strong surveillance is essential for polio eradication. In India, highly sensitive AFP surveillance was supported by a national network of eight fully accredited laboratories capable of basic and advanced molecular virologic detection methods to provide near real-time genetic information, and supplemented by environmental surveillance at key sites. The surveillance system, including the laboratory component, operated highly effectively, as evidenced by performance that consistently surpassed the WHO-recommended standards for global indicators.

Many national and international partners took part in the effort in India. Multiple funding partners helped to supplement the substantial financial investment made to the polio eradication initiative by the Government of India.** Volunteers and community mobilizers played a huge role in the success of India's eradication efforts, especially to identify the country's newborns and track their immunization status. In particular, local Rotary International members provided volunteers and funding and engaged with local and national officials to advocate for the country's immunization programs, including current efforts to improve the routine immunization of infants and young children. The complementary partnership among government and international polio implementing partners contributed to the success of the India polio eradication program.

** Major international partners include WHO, Rotary International, the World Bank, the Bill and Melinda Gates Foundation, UNICEF, and the governments of Germany, Japan, the United Kingdom, and the United States, including CDC.

BOX. Critical lessons learned from India's polio eradication effort

- **Engage every level of government and make local authorities accountable.** District administrators ("magistrates") led task forces to review supplemental immunization activity (SIA) planning and implementation and ensured that all district government sectors were involved in the program.
- **Develop robust communication strategies to ensure program effectiveness.**
- **Optimize vaccination team composition and ensure objective supervision**. Vaccination teams should include at least one female and one member from the local community to facilitate entry into households.
- **Develop and validate detailed plans ("microplans").** Microplans in India, in which all houses in the area were numbered and realistic workloads established for each vaccination team, were regularly validated and updated. Meticulous planning and implementation of SIAs led to high coverage, even in areas with weak health systems.
- **Accurately monitor data on campaign quality in real time and assess coverage independently at the end of each round.** Monitoring data can drive immediate corrective actions and ensure accountability.
- **Engage the private sector to increase program visibility and reach maximal impact.**
- **Innovate to identify and vaccinate children who were previously being missed.** Significant innovations, strategies, and tactics used in India's immunization program included the following:
  - Engaging community and religious leaders in planning and implementing SIAs in areas with reluctant participants.
  - Instituting finger marking of vaccinated children to help identify those not yet vaccinated and marking the dwellings of households visited by vaccination teams to increase the likelihood of follow-up.
  - Identifying and tracking newborns.
  - Targeting high-risk areas with multiple health interventions and additional resources.
  - Implementing a strategy for reaching children at public gatherings and in mobile and transitory populations (*10*).
- **Conduct research to help overcome technical and operational barriers.** Technical research led to introduction of more efficacious vaccines (i.e., monovalent OPV in 2005 and bivalent OPV in 2010). Research included seroprevalence and immunogenicity studies and operational studies such as social network analysis to provide evidence for decision-making.

[1]National Polio Surveillance Project, World Health Organization; [2]Ministry of Health and Family Welfare, Government of India; [3]World Health Organization Country Office; [4]Immunization and Vaccine Development Department, South-East Asia Regional Office, New Delhi, India; [5]Polio Eradication Department, World Health Organization, Geneva, Switzerland; [6]Global Immunization Division, Center for Global Health, CDC; [7]Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, CDC (Corresponding author: Steven G. F. Wassilak, swassilak@cdc.gov, 404-639-1867)

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Influenza Outbreak in a Vaccinated Population — USS Ardent, February 2014

Theodore L. Aquino, DO[1], Gary T. Brice, PhD[2], Sherry Hayes, MPH[3], Christopher A. Myers, PhD[2], Jaqueline McDowell, MD[3], Brenda White, MSPH, MPH[2], Rebecca Garten, PhD[4], Daniel Johnston[5] (Author affiliations at end of text)

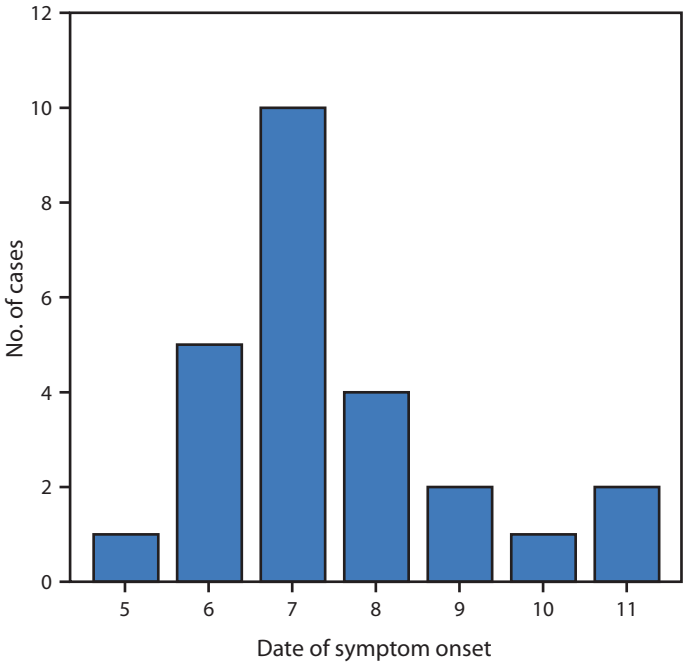
On February 10, 2014, the USS Ardent, a U.S. Navy minesweeper, was moored in San Diego, California, while conducting training. Over the course of 3 days, 25 of 102 crew members sought medical care because of influenza-like illness (ILI). Nasal swab specimens were collected from each patient, and initial rapid influenza testing indicated 16 cases of influenza A. Ultimately, polymerase chain reaction (PCR) testing conducted by the Naval Health Research Center determined that 20 specimens were influenza A, of which 18 were subtype H3N2. Two specimens could not be subtyped. The HA gene sequence of an outbreak isolate was 99% identical to strains circulating during the 2013–14 influenza season and antigenically similar to the H3N2 component of the 2013–14 influenza vaccine. At the time of the outbreak, 99% of the crew had received influenza vaccine. Through the duration of the outbreak, the minesweeper squadron medical officer collaborated with Navy Environmental and Preventive Medicine Unit Five, higher-level Navy authorities, and County of San Diego Public Health Services to implement the outbreak response, which included disseminating outbreak information to surrounding Navy units, disinfecting the ship, sending home infected crew members, identifying family members at high risk, and providing antiviral medications and guidance. No crew member had onset of symptoms >6 days after the first crew member became ill. This outbreak highlights the risk for an H3N2 influenza outbreak among vaccinated and otherwise healthy young persons.

ILI was defined as illness with two or more of the following symptoms: fever >100.4°F (>38.0°C), chills, sore throat, cough, shortness of breath, congestion, headache, body aches, and nausea. Twenty crew members reported sick on February 10, one on February 11 and four more on February 12. Symptom onset dates were February 5–11 (Figure). All ILI patients were interviewed and examined aboard ship by both an independent duty corpsman (i.e., shipboard medical provider) and a physician. Two nasal swab specimens were taken from each ILI patient by staff members from the Naval Health Research Center. Nasal swab specimens and influenza A and B rapid influenza tests were used for immediate influenza testing. The remaining nasal swab specimens were screened by the Naval Health Research Center for influenza A and B using the CDC PCR assay (*1*), and DNA sequencing of the HA1 portion of the hemagglutinin gene was performed as previously described (*2*). Data on demographics and symptomatology were collected using questionnaires and personal interviews.

All 25 crew members with ILI symptoms were otherwise healthy men aged 21–44 years. ILI cases occurred in all ranks, departments, job types, and work shifts. The ship had been in port since being transported from Bahrain to San Diego 2 months before the outbreak. No sailors reported any recent travel. Rapid influenza testing indicated 16 cases of influenza A and nine negative results. Nasal swab specimens from 20 of the 25 ILI patients were positive by PCR for influenza A, with 18 specimens confirmed as A (H3) and two as A (untyped). Influenza A virus was isolated from seven of 11 nasal swab specimens selected for viral culture. These seven specimens had HA1 protein sequences that were identical to each other and differed from the 2013–14 influenza A (H3N2) A/Texas/50/2012 vaccine strain by 5 amino acid substitutions (N128A, R142G, N145S, P198S, and V347K). Sequence analysis (*3*) of the HA1 portion of the hemagglutinin gene showed 99% homology to typical H3N2 strains circulating in the United States and worldwide during the 2013–14 northern hemisphere influenza season and were found to be antigenically similar to A/Texas/50/2012 (*4*). Ninety-nine of 102 USS Ardent crew members, 24 of the 25 with ILI symptoms, and 17 of 18 crew members with confirmed influenza A (H3N2) infection had received the 2013–14 influenza vaccine ≥3 months before the outbreak. Vaccinations had been administered at local naval health clinics and at a vaccination fair conducted by Naval Medical Center San Diego. Of the 25 crew members with ILI symptoms, 16 were vaccinated via intradermal injection, eight via intranasal mist, and one had not received vaccination.

Interviews revealed a possible source of the outbreak to be an Ardent crew member (patient A), aged 26 years, who had been evaluated at a local emergency room for fever and cough on January 30, 11 days before the first ILI case was diagnosed. A chest radiograph and computed tomographic scan were performed because of suspicion of pulmonary embolism; both were negative. The patient had been receiving treatment for pyelonephritis, and the clinical impression was that the cough was related to the pyelonephritis. No testing for influenza was performed, and the patient was discharged. Patient A's roommate in a shore apartment, also a USS Ardent sailor, experienced ILI symptoms on February 5. Because patient A's roommate was the first of the 25 crew members to experience

FIGURE. Number of cases (N = 25) of influenza-like illness, by date of symptom onset — USS Ardent, February 5–11, 2014



What is already known on this topic?

The single best way to prevent influenza infection is to receive vaccination every year. Some organizations have a mandatory vaccination policy. Despite this, influenza outbreaks can occur in highly vaccinated populations, especially in confined settings.

What is added by this report?

In February 2014, a total of 25 of the 102 crew members of a U.S. Navy minesweeper sought medical care because of influenza-like illness attributed to an influenza A (H3N2) virus antigenically similar to the H3N2 component of the 2013–14 vaccine. Among the crew members, 99% had received influenza vaccination, including 24 of 25 ill persons. Outbreak management included use of an antiviral medication, exclusion of the ill from the ship for 48 hours, disinfection, hand washing, and cough etiquette. No crew member had onset of symptoms >6 days after the first crew member had symptoms.

What are the implications for public health practice?

This influenza outbreak highlights the risk for an outbreak of influenza A (H3N2) in a cohort of vaccinated and otherwise healthy young persons.

ILI, and no other probable cause for the outbreak was found, it is possible that patient A actually had influenza. Since patient A did not board USS Ardent because he was ill, it is likely he infected his roommate, who then spread influenza to other USS Ardent crew members.

In an effort to reduce spread and impact of disease, oseltamivir (75 mg twice a day for 5 days) was prescribed to each ILI patient who reported that symptoms had developed within 48 hours of their medical visit, regardless of their vaccination status and rapid influenza testing results. In addition to antiviral medication, rapid identification of the influenza outbreak, and immediate isolation of affected persons (crew members with ILI symptoms were sent off ship to their homes for 48 hours), additional steps to control the outbreak were taken: thorough cleaning of spaces throughout the ship by the crew and use of the ship's public address system to instruct personnel to wash hands frequently, use hand sanitizer, cover their mouths when coughing, and report for medical evaluation if they were experiencing ILI symptoms. Similar announcements were made aboard three other minesweepers sharing the same pier as USS Ardent. Following a policy implemented by the independent duty corpsman, all patients experiencing ILI symptoms were required to wear an N95 filtering facepiece respirator while shipboard until 5 days after onset of symptoms. Cleaning of spaces was done by regularly disinfecting all commonly touched surfaces with disinfecting wipes and mopping all decks with an iodophor disinfectant diluted to 150 ppm of iodine. E-mails and reports regarding the outbreak, with an emphasis on rapidly identifying patients with ILI, were distributed to all ships on Naval Base San Diego and to high-level Navy officials and County of San Diego Public Health Services. No additional cases were identified after February 14. A total of 43 working days were lost by the 25 ILI patients.

Discussion

USS Ardent, an Avenger class minesweeper, is one of the smallest ships in the U.S. Navy. It has one shared space in which the entire crew eats meals. Work areas are spread throughout the ship, and there are nine sleeping spaces. Military populations, especially those living and working in confined settings, are susceptible to respiratory disease outbreaks (*5*). Shipboard personnel are at especially high risk because of constant close quarter exposure to a large number of crew members (*6*). Virtually all areas onboard ships are shared, and movement frequently requires touching handrails, door knobs, and other objects that can be contaminated with nasal secretions. In addition, ventilation systems can circulate infectious pathogens throughout a ship (*7*).

As the ship was moored in San Diego, the entire crew worked onboard during the day, and 25% remained onboard through each night. The roster of crew members who remained onboard at night rotated daily. There were 16 cases of confirmed influenza A (H3N2)infection in San Diego County (Brit H. Colanter, MPH, Health and Human Services Agency County of San Diego, personal communication, 2014) during the 6 weeks leading to the ship outbreak, making it likely that the virus was acquired from the local community.

Since the 1950s, a policy of mandatory annual vaccination against influenza for active duty personnel has been largely successful in limiting influenza epidemics in the military (*8*). The current U.S. Department of Defense influenza vaccination policy mandates that all uniformed personnel receive seasonal influenza vaccination, unless medically exempt, or face punishment under the Uniform Code of Military Justice. The policy specifically directs all Navy operational units to be at least 90% vaccinated. However, despite vaccination measures, influenza outbreaks can still occur in highly vaccinated military populations (*9,10*).

[1]Mine Counter Measures Squadron Three, U.S. Navy; [2]Naval Health Research Center, U.S. Navy; [3]Navy Environmental and Preventive Medicine Unit Five, U.S. Navy; [4]World Health Organization Collaborating Center for Influenza, CDC; [5]Independent Duty Corpsman, USS Ardent (Corresponding author: Theodore L. Aquino, taquino@health.usf.edu, 850-284-1046)

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Nonfatal Injuries 1 Week After Hurricane Sandy — New York City Metropolitan Area, October 2012

Robert M. Brackbill, PhD[1], Kimberly Caramanica, MPH[1], Maret Maliniak[1,2], Steven D. Stellman, PhD[1,3], Monique A. Fairclough, MPH[1], Mark R. Farfel, ScD[1], Lennon Turner, MS[1], Carey B. Maslow, DrPH[1], Amanda J. Moy, MPH[1], David Wu, MS[1], Shengchao Yu, PhD[1], Alice E. Welch, DrPH[1], James E. Cone, MD[1], Deborah J. Walker, PhD[1] (Author affiliations at end of text)

On October 29, 2012, Hurricane Sandy (Sandy) made landfall in densely populated areas of New York, New Jersey, and Connecticut. Flooding affected 51 square miles (132 square kilometers) of New York City (NYC) and resulted in 43 deaths, many caused by drowning in the home, along with numerous storm-related injuries (*1*). Thousands of those affected were survivors of the World Trade Center (WTC) disaster of September 11, 2001 (9/11) who had previously enrolled in the WTC Health Registry (Registry) cohort study. To assess Sandy-related injuries and associated risk factors among those who lived in Hurricane Sandy–flooded areas and elsewhere, the NYC Department of Health and Mental Hygiene surveyed 8,870 WTC survivors, who had provided physical and mental health updates 8 to 16 months before Sandy. Approximately 10% of the respondents in flooded areas reported injuries in the first week after Sandy; nearly 75% of those had more than one injury. Injuries occurred during evacuation and clean-up/repair of damaged or destroyed homes. Hurricane preparation and precautionary messages emphasizing potential for injury hazards during both evacuation and clean-up or repair of damaged residences might help mitigate the occurrence and severity of injury after a hurricane.

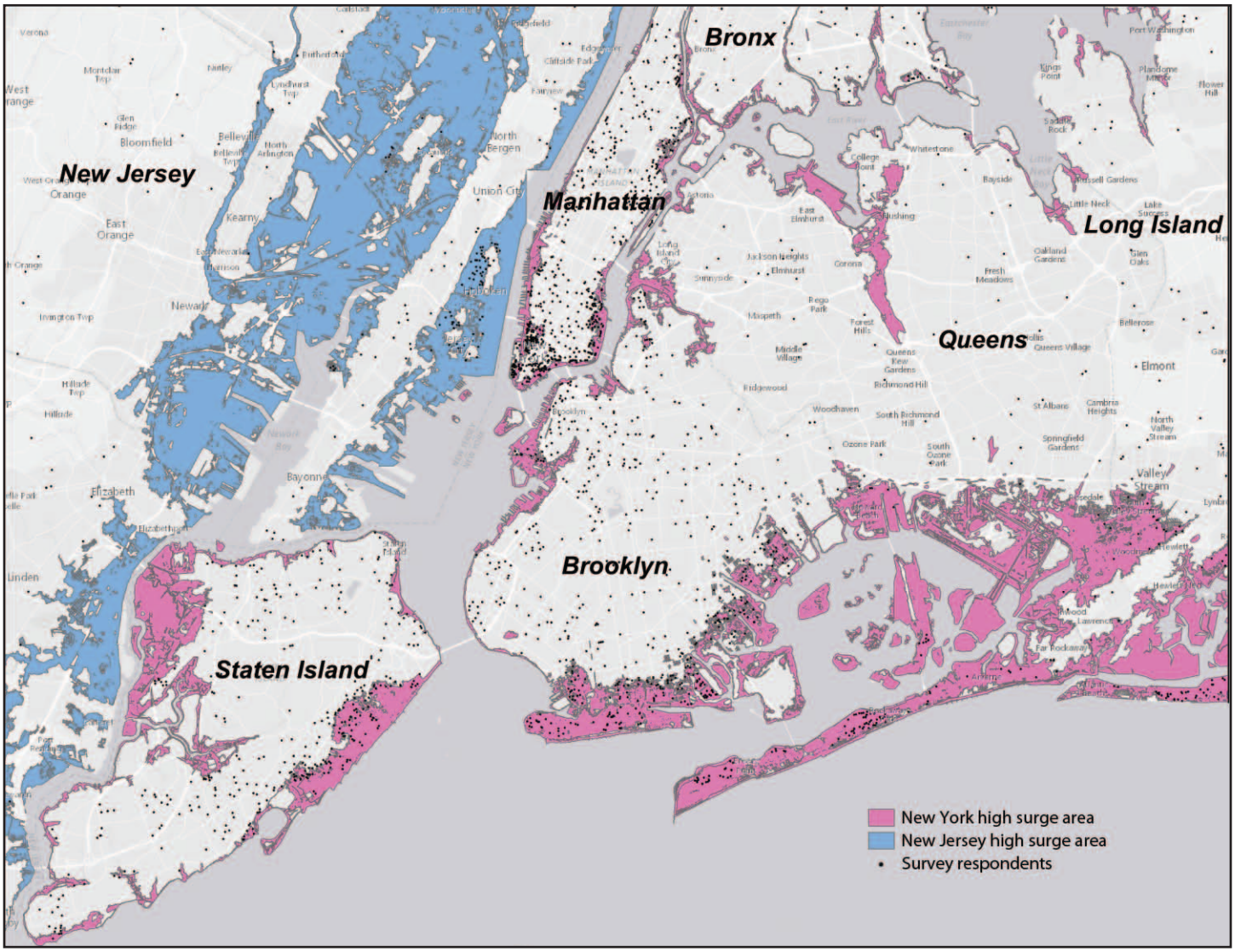
The Registry contains records of a cohort of 71,431 persons affected by events related to the WTC disaster in NYC, for which three waves of health data were collected during 2003–2012. Because Sandy occurred shortly after Wave 3 of data collection, which provided recent pre-hurricane health data, the Sandy survey was restricted to eligible enrollees who had completed a Wave 3 survey. The Sandy study sample included persons with a current address within an inundation zone in New York, New Jersey, or Connecticut (n = 4,435), as defined by the Federal Emergency Management Agency Modeling Task Force (*2*), and a comparison group of enrollees with addresses in the same states who resided outside the inundation zones (n = 4,435). Approximately 5 months after the storm (March 28, 2013), enrollees who met the selection criteria were contacted via e-mail and invited to participate in an Internet survey. Persons who did not complete the Internet survey (n = 6,353) were subsequently mailed paper questionnaires. Multiple mail and e-mail reminders were sent to nonrespondents, as well as three rounds of paper questionnaires. At the close of data collection (November 7, 2013), 4,558 surveys had been completed by 55.1% of enrollees in the inundation zones and 47.7% of enrollees not in an inundation zone (Figure).

The Sandy survey included questions on home evacuation, height of flood waters in home, degree of damage to home, activities related to storm response (e.g., rescue, clean-up, and repair), and a health assessment that included details of Sandy-related injury restricted to the first week after the hurricane to provide the respondent a distinct period for recall of the injury. Additional information was obtained about body part (e.g., arm/hand, leg, or foot), type of injury (e.g., cut, fracture, or strain), and whether medical care was received. The analysis was restricted to persons who provided complete injury information on the survey (n = 4,174).

In the NYC inundation zone alone, approximately 500 homes were destroyed, and 26,000 homes and businesses were registered for repairs (*3*). Of the 2,224 respondents who lived in an inundation zone, 42.1% reported home flooding, 48.9% evacuated from their home before, during, or after the storm, 19.2% had a home that was made uninhabitable or destroyed by the storm, and 10.4% sustained an injury in the first week after Sandy (Table 1). A much smaller proportion of the 1,950 respondents living in areas that were not inundated experienced Sandy-related exposures (i.e., 7.6% reported any flooding in the home, 13.8% evacuated, and 3.4% reported injuries).

Because of the elevated incidence of injuries among persons who resided in an inundation zone, analyses focused on those 231 injured persons. Over 70% (71.4%) reported two or more injuries (Table 2), representing 706 different injuries or an average of 3.1 injuries per injured person. The most common injury reported was arm/hand cut, followed by back strain/sprain and leg cut. Injuries were reported by 15.3% of men and 5.0% of women; the most common injury among men was arm/hand cut (n = 102), whereas among women it was foot strain (n = 23). Injury was also more commonly reported by persons aged 45–64 years (12.3%) and by those with household income of >$150,000 in 2010 (12.2%). Among the 231 injured persons, 25.1% reported they received treatment for their most serious injury at a hospital, emergency department (ED), or doctor's office, although this differed by household

FIGURE. Hurricane Sandy inundation zones — New York City metropolitan area, October 2012*



Source: New York City Department of Health and Mental Hygiene, World Trade Center Health Registry.
* Map depicts 80% (n = 1,970) of respondents in the inundation zone sample and 47% (n = 991) of respondents in the sample of persons not in an inundation zone.

income; 31.0% of injured persons with a household income of >$75,000 reported receiving treatment at a hospital, ED, or doctor's office, compared with 17.5% among those with a household income of ≤$25,000. Persons might have been prevented from going to hospitals or other care facilities because of flooding, and those with higher income had the resources to go somewhere else (*4*).

Persons in inundation zones who reported flooding in their homes were more likely to report being injured, with likelihood of injury increasing with depth of flood water in the home. Rates of injury were lowest among those who had no flooding in their home and did not evacuate (3.0%), and highest among those who reported ≥3 feet (≥91 cm) of flooding in their home, regardless of whether they evacuated (26.1%) or did not evacuate (25.3%). Over 35% of injured persons who evacuated before (40.0%) or after (35.7%) the storm received treatment at a hospital, ED, or doctor's office for their most serious injury. In addition, 39.3% of those who reported evacuating by walking or swimming through water reported an injury, and nearly half (45.5%) of this group reported seeking treatment for their injury at a hospital, ED, or doctor's office. However, less than 9% of those injured who did not evacuate and had ≥3 feet of water in their homes sought treatment at a hospital, ED, or doctor's office (8.3%). Hand/arm injuries, cuts or lacerations of the lower extremities, and back strains were frequent among persons who evacuated and had ≥3 feet

TABLE 1. Comparison of demographic and selected exposure characteristics of persons in inundations zones and not in inundation zones — Hurricane Sandy study, World Trade Center Health Registry, March 28–November 7, 2013

Characteristic	Inundation zone		Not in an inundation zone	
	No.*	(%)†	No.*	(%)†
Overall	**2,224**	**(100.0)**	**1,950**	**(100.0)**
Sex				
Male	1,164	(52.3)	1,174	(60.2)
Female	1,060	(47.7)	776	(39.8)
Age on October 29, 2012 (yrs)				
19–29	50	(2.2)	26	(1.3)
30–44	327	(14.7)	356	(18.3)
45–64	1,403	(63.1)	1,235	(63.3)
≥65	444	(20.0)	333	(17.1)
Residence before Hurricane Sandy				
New York City	1,782	(80.1)	1,056	(54.2)
Long Island	266	(12.0)	323	(16.6)
New Jersey	167	(7.5)	335	(17.2)
Other (e.g., New York state and Connecticut)	9	(0.4)	236	(12.1)
Household income in 2010				
≤$25,000	446	(20.1)	410	(21.0)
$25,001–$50,000	725	(32.6)	764	(39.2)
$50,001–$75,000	349	(15.7)	328	(16.8)
$75,001–$150,000	324	(14.6)	234	(12.0)
>$150,000	278	(12.5)	142	(7.3)
Height of flood waters inside home				
No flood water in home	1,238	(55.7)	1,770	(90.8)
<3 feet in living area or any flooding in nonliving area	602	(27.1)	137	(7.0)
≥3 feet	333	(15.0)	11	(0.6)
Evacuated from home				
Yes	1,087	(48.9)	270	(13.8)
No	1,127	(50.7)	1,664	(85.3)
Degree of damage to home because of Hurricane Sandy				
None or minimal damage	1,301	(58.5)	1,652	(84.7)
Damaged but habitable	455	(20.5)	231	(11.8)
Damaged and uninhabitable or destroyed	428	(19.2)	35	(1.8)
Persons reporting injuries sustained in first week after Hurricane Sandy				
Yes	231	(10.4)	67	(3.4)
No	1,993	(89.6)	1,883	(96.6)

* Includes sample with complete injury information.
† Denominator of percentages includes persons with missing data.

of water in their homes. Among those whose homes were damaged or destroyed, injuries were reported almost exclusively by those who engaged in clean-up/repair (166 persons with clean-up/repair related injuries versus 17 without).

Discussion

Typically, reports on hurricane-related morbidity are based on *ad hoc* active surveillance systems set up because of damage to or loss of public health infrastructure (*5*–*7*). The incidence of injury among survey respondents residing in inundation zones (10.4%) was similar to the 9% incidence of injuries reported among a random sample of 91 residents of Rockaway Peninsula, an inundated area of NYC heavily affected by Sandy (*8*). The actual incidence of Sandy-related injuries was likely higher because reporting of injuries was limited to those sustained in the first week after the storm and recovery has been a long-term process. Although multiple injuries were very common among injured enrollees, previous reports on hurricane-related injuries did not assess multiple injuries, but focused on serious injuries reported by EDs or other locations set up for immediate treatment (*7*). Many persons with injuries likely were unable to seek immediate treatment, and the finding that 25.1% sought treatment for their most serious injury likely underestimates the actual need for injury treatment. This would be consistent with the fact that less than 9% of those who did not evacuate and had ≥3 feet of water in their home reported receiving treatment for their most serious injuries.

The findings in this report are subject to at least four limitations. First, the findings are based on self-reported data collected 5–12 months after the event. Second, the overall response rate was 51.4%, leaving open the possibility of nonresponse bias; however, respondents and nonrespondents

TABLE 2. Injuries sustained in the first week after Hurricane Sandy and treatments received among those who lived in an inundation zone, by demographic characteristics and selected exposures — Hurricane Sandy study, World Trade Center Health Registry, March 28–November 7, 2013

Characteristic	No. of respondents*	Injury			Treatment for most serious injury of those injured		Most common body area and type of injury (No. of reports)		
		No. of injured persons	% of persons with ≥1 injury	% of injured persons with >1 injury	% visiting hospital, emergency department, or doctor	% receiving other treatment			
Total	**2,224**	**231**	**10.4**	**71.4**	**25.1**	**16.9**	**Arm/Hand cut (116)**	**Back strain (113)**	**Leg cut (74)**
Sex									
Male	1,164	178	15.3	73.6	25.3	19.1	Arm/Hand cut (102)	Back strain (91)	Leg cut (62)
Female	1,060	53	5.0	64.2	24.5	9.4	Foot strain (23)	Back strain (22)	Leg strain (16)
Age on October 29, 2012 (yrs)†									
30-44	327	24	7.3	83.3	25.0	0.0	Arm/Hand cut (18)	Leg cut (14)	Back strain (10)
45-64	1,403	170	12.3	72.4	23.5	18.8	Arm/Hand cut (90)	Back strain (87)	Leg cut (53)
≥65	444	36	8.1	61.1	33.3	19.4	Back strain (16)	Foot strain (16)	Leg strain (11)
Household income in 2010									
≤$25,000	446	40	9.0	80.0	17.5	27.5	Arm/Hand cut (30)	Back strain (25)	Foot cut (12)
$25,001–$50,000	725	83	11.4	74.7	22.9	12.0	Back strain (45)	Arm/Hand cut (40)	Leg cut (31)
$50,001–$75,000	349	33	9.5	69.7	27.3	21.2	Back strain (16)	Arm/Hand cut (16)	Leg strain (12)
$75,001–$150,000	324	24	7.4	66.7	37.5	12.5	Arm/Hand cut (13)	Back strain (12)	Leg strain (9)
>$150,000	278	34	12.2	64.7	26.5	11.8	Foot strain (17)	Leg cut (10)	Arm/Hand cut (10)
Did not evacuate home									
No flooding in home	771	23	3.0	56.5	34.8	4.3	Back strain (14)	Leg strain (7)	Arm/Hand cut (6)
<3 feet in living area or any flooding in nonliving area	243	28	11.5	82.1	25.0	28.6	Arm/Hand cut (14)	Back strain (11)	Leg cut (9)
≥3 feet	95	24	25.3	79.2	8.3	25.0	Arm/Hand cut (16)	Back strain (13)	Foot cut (12)
Evacuated home									
No flooding in home	466	27	5.8	51.9	29.6	11.1	Back strain (11)	Leg strain (8)	Arm/Hand cut (7)
<3 feet in living area or any flooding in nonliving area	359	57	15.9	71.9	19.3	19.3	Back strain (26)	Arm/Hand cut (23)	Leg cut (16)
≥3 feet	238	62	26.1	83.9	30.6	16.1	Arm/Hand cut (41)	Leg cut (29)	Back strain (29)
Among those who evacuated and had ≥3 feet of flooding when evacuated from flooded home (n = 238)									
Before Sandy arrived	78	15	19.2	80.0	40.0	13.3	Leg cut (9)	Back strain (9)	Arm/Hand cut (8)
During the storm	62	19	30.6	78.9	26.3	21.1	Arm/Hand cut (12)	Leg cut (9)	Back strain (7)
After Sandy had hit	44	11	25.0	72.7	18.2	27.3	Arm/Hand cut (9)	Foot cut (6)	Foot strain (5)
After Sandy passed	45	14	31.1	100.0	35.7	7.1	Arm/Hand cut (9)	Back strain (6)	Body cut (5)
How evacuated from flooded home									
Walked, drove, rode not through water	131	28	21.4	85.7	21.4	17.9	Arm/Hand cut (17)	Back strain (13)	Leg cut (11)
Walked or swam through water	28	11	39.3	63.6	45.5	9.1	Arm/Hand cut (7)	Leg cut (6)	Back strain (4)
Drove or road through water, including in a boat	49	17	34.7	94.1	35.3	17.6	Arm/Hand cut (14)	Leg cut (9)	Back strain (9)
Degree of damage to home and clean up/repair effort among those who lived in an inundation zone									
No or minimal damage									
Clean up/Repair	217	14	6.5	64.3	21.4	7.1	Back strain (10)	Leg strain (5)	Arm/Hand cut (5)
No clean up/repair	1,084	26	2.4	38.5	26.9	11.5	Back strain (10)	Leg strain (7)	Foot strain (7)
Damaged but habitable									
Clean up/Repair	323	66	20.4	72.7	27.3	13.6	Arm/Hand cut (37)	Back strain (34)	Leg cut (21)
No clean up/repair	132	10	7.6	40.0	20.0	0.0	Foot strain (3)	Back strain (3)	Neck strain (2)
Damaged and uninhabitable or destroyed									
Clean up/Repair	349	100	28.7	85.0	24.0	22.0	Arm/Hand cut (67)	Back strain (50)	Leg cut (45)
No clean up/repair	79	7	8.9	57.1	14.3	42.9	Arm strain (3)	Foot strain (3)	Back strain (3)

* Restricted to persons with complete injury information.
† Because only one injury was reported among respondents aged 19–29 years, data for this age group were excluded.

What is already known on this topic?

Hurricanes are known to cause physical injuries either directly, often as a result of strong winds causing persons to fall or be hit with blown objects, or indirectly, when persons return to affected areas to conduct clean-up and repair activities. The most common types of hurricane-related injuries are cuts to upper extremities and back strain.

What is added by this report?

The degree of flooding in the home or surrounding area was directly related to the occurrence of injury, with 39% of those who evacuated by walking through water or swimming being injured, and 25% of those whose homes were flooded with ≥3 feet of water, regardless of whether they did or did not evacuate. Additionally, the greatest number of injuries occurred among persons who had a damaged or destroyed home and attempted to do clean-up or repair work (n = 166).

What are the implications for public health practice?

After hurricanes, injuries, particularly multiple injuries, are common and underreported. Injury surveillance and early precautionary messages concerning evacuation and clean-up or repairs of damaged residences would further enhance public health response by helping mitigate the occurrence and severity of injury after a hurricane.

did not differ by income or socioeconomic status, and thus, misrepresentation of socioeconomic groups was less likely. Third, the sample is limited to those who experienced the 9/11 disaster in the NYC metropolitan area and cannot be used to make inferences about other populations affected by Sandy. Nevertheless, the survey was sent to 4,435 Registry enrollees identified by residence in well demarcated inundation zones. Fourth, information about the source or immediate cause of reported injuries, such as being struck by an object or falling, was not obtained. This limits interpretation of findings associated with specific Sandy-related exposures, such as evacuating, having a flooded home, or doing home repairs. Despite these limitations, the Registry provided a unique opportunity to rapidly survey large numbers of persons exposed to Sandy's devastation by using a previously assembled cohort. For future storms with similar profiles, framing of prevention messages can be developed from these findings (e.g., that home repair can be hazardous).

Similar to reports regarding earlier hurricanes (e.g., Hurricanes Andrew, Katrina, and Irene), most reported injuries occurred after Sandy had passed and were associated with clean-up and repair activities (*6,7*). The types of injuries observed after other storms, including lacerations of upper extremities and back strains, were also the most frequently reported in this study of Sandy (*9*); this analysis did not include carbon monoxide poisonings or electrocution injuries which often occur after storm disasters. The NYC Department of Health and Mental Hygiene issued guidance via a press release on November 13, 2012, that contained precautions concerning debris removal and repair of homes after Sandy, including injury prevention advice (*10*). The findings on injuries sustained during the first week post-hurricane suggest the need for dissemination of injury-prevention advisories as early as possible post-hurricane, as well as before future hurricanes, if possible.

[1]World Trade Center Health Registry, New York City Department of Health and Mental Hygiene, New York, New York; [2]School of Public Health, Emory University, Atlanta, Georgia; [3]Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, New York (Corresponding author: Robert Brackbill, rbrackbi@health.nyc.gov, 347-396-2882)

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History and Evolution of the Advisory Committee on Immunization Practices — United States, 1964–2014

Jean Clare Smith, MD[1], Alan R Hinman, MD[2], Larry K. Pickering, MD[1] (Author affiliations at end of text)

The Advisory Committee on Immunization Practices (ACIP) is chartered as a federal advisory committee to provide expert external advice to CDC and the Secretary of the U.S. Department of Health and Human Services (DHHS) on the use of vaccines in the civilian population of the United States. (*1–3*) This report summarizes the evolution of ACIP over the 50 years since its establishment in 1964 by the Surgeon General of the U.S. Public Health Service (USPHS).

During the 1940s and 1950s, USPHS relied on committees convened intermittently to address various biologics-related issues. For example, in 1955, the first effective polio vaccine was developed by Jonas Salk, at which time experts from public health, medicine, academia, the vaccine industry, and other areas were brought together on an *ad hoc* basis to deliberate on use of the vaccine. Other *ad hoc* groups were created shortly thereafter to assist the Surgeon General during the "Cutter incident," in which cases of paralytic polio resulted from incomplete inactivation of live poliovirus in the vaccine of one manufacturer, and to review matters such as vaccine safety, effectiveness, field trials, and disease trends. By the early 1960s, with the licensure of additional new vaccines (monovalent oral poliovirus vaccine, 1961; trivalent oral poliovirus vaccine, 1963; and measles vaccine, 1963) and increased federal investment of resources in vaccines and immunization programs, it was evident that decision making on use of vaccines required a greater degree of continuity of expert technical advice rather than formation of *ad hoc* committees to address national immunization policy (*4,5*).

The Advisory Committee on Immunization Practice* was appointed in March 1964 by the Surgeon General of USPHS, 2 years after a proposal to establish such a committee was sent to the Surgeon General by the Secretary of the Department of Health, Education, and Welfare (DHEW†), Anthony J. Celebrezze. At the first ACIP meeting, held on May 25–26, 1964, at the Communicable Disease Center (CDC),§ the ACIP Chair, CDC Director Dr. James Goddard, presented an overview of the intended role and responsibility of the newly established committee. Other agenda topics included influenza, rubeola (measles), rubella, and smallpox, as well as the relationship of ACIP to the American Academy of Pediatrics (AAP). Minutes of that meeting included the following description of the ACIP's responsibilities: "The Committee is charged with the responsibility of advising the Surgeon General regarding the most effective application in public health practice of specific preventive agents which may be applied in communicable disease control. Included among the agents to be considered by the Committee are inactivated and live-attenuated bacterial, rickettsial and viral agents; toxoids; anti-toxins; chemoprophylactic agents; and immune globulins. The Committee shall concern itself with immunization schedules, dosages and routes of administration and indications and contraindications for the use of these agents. The Committee shall also provide advice as to the relative priority of various population groups to whom the agents should be made available and shall advise regarding the relative merits and methods for conducting mass immunization programs. It shall also advise appropriately regarding needed programs in research." In the 50 years since establishment of ACIP, the language of the ACIP charter has been modified, but these responsibilities remain essentially unchanged (*1,6*).

When ACIP was established in March 1964, it was designated as a technical advisory committee to USPHS, and comprised eight members, including the Director of CDC, who served as Chair. Members were appointed by the Secretary of DHEW, bringing expertise in public health, pediatrics, epidemiology, immunology, and preventive medicine. CDC staff contributed data on disease surveillance and epidemiology during meetings that were held at CDC's Roybal Campus in Atlanta, Georgia, two or three times each year. In 1964, ACIP included only three liaison organizations: the AAP Committee on Infectious Diseases, the American Medical Association, and the National Advisory Committee on Immunization, Canada; and three *ex officio* members representing other federal government bodies: the Food and Drug Administration, the National Institutes of Health, and the U.S. Department of Defense.

An important change in committee procedures occurred in 1972, when the ACIP was designated a federal advisory committee. The Federal Advisory Committee Act (enacted by Public Law 92-463) is the legal foundation defining procedures for creation and operations of federal advisory committees. The law has special emphasis on open meetings, chartering, public involvement, and reporting (*7*). Also occurring in 1972

* Renamed Advisory Committee on Immunization Practices in 1965.
† Renamed U.S. Department of Health and Human Services in 1979.
§ Renamed Centers for Disease Control in 1970, and Centers for Disease Control and Prevention in 1992.

was a change in the reporting line of ACIP, from the Surgeon General of USPHS to the Secretary of DHEW through the Director of CDC. Two additional changes were made in 1978: the number of appointed members was increased from eight to 10 to allow participation of experts in law, ethics, and the social sciences, and it was decided that a member external to the federal government would be appointed as Chair instead of the CDC Director. The committee has continued to expand over the years and now includes 15 voting members (U.S. citizens external to the federal government), eight *ex officio* members, and 29 liaison organizations (*8*). Stringent measures and rigorous screening of members are used to avoid both real and perceived conflicts of interest. Vaccine manufacturers and lobbying groups do not provide financial or other support to ACIP or its members. The ACIP meets three times yearly at CDC, and may convene an emergency meeting if warranted, as was done in 2009 with the emergence of novel influenza A (H1N1).

In the 50 years since inception of ACIP, the number of vaccines included in the recommended child/adolescent immunization schedule (for persons aged 0 through 18 years) has increased from vaccines targeting six vaccine-preventable diseases to vaccines for the prevention of 16 such diseases, and the recommended immunization schedule for adults (persons aged ≥19 years) includes vaccines targeting 15 vaccine-preventable diseases (Table). The increase in the number of vaccines recommended for routine use in children and adults is reflected in the steadily increasing work load and visibility of ACIP. In 1995, the child/adolescent immunization schedule, which is updated annually, was first approved and harmonized by ACIP, the American Academy of Family Physicians (AAFP), and AAP (Figure) (*9*). Currently the child/adolescent immunization schedule is updated, harmonized, and approved by ACIP and professional societies including AAFP, AAP, and the American College of Obstetricians and Gynecologists (*10*). The recommended adult immunization schedule is updated annually and approved by ACIP, AAFP, AAP, the American College of Physicians, and the American College of Nurse Midwives (*11*).

Enactment of the Vaccines for Children (VFC) program in 1993 gave ACIP a new role. VFC provides an entitlement to free vaccine for all children aged 0 through 18 years who are uninsured, Medicaid eligible, American Indian/Alaska Native, or underinsured who receive vaccines at a federally qualified health center or rural health clinic; approximately 50% of U.S. children aged 0 through 18 years are VFC-eligible (*12,13*). If ACIP recommends that a vaccine be administered routinely to children, ACIP is then empowered to declare that the vaccine will be included in VFC.

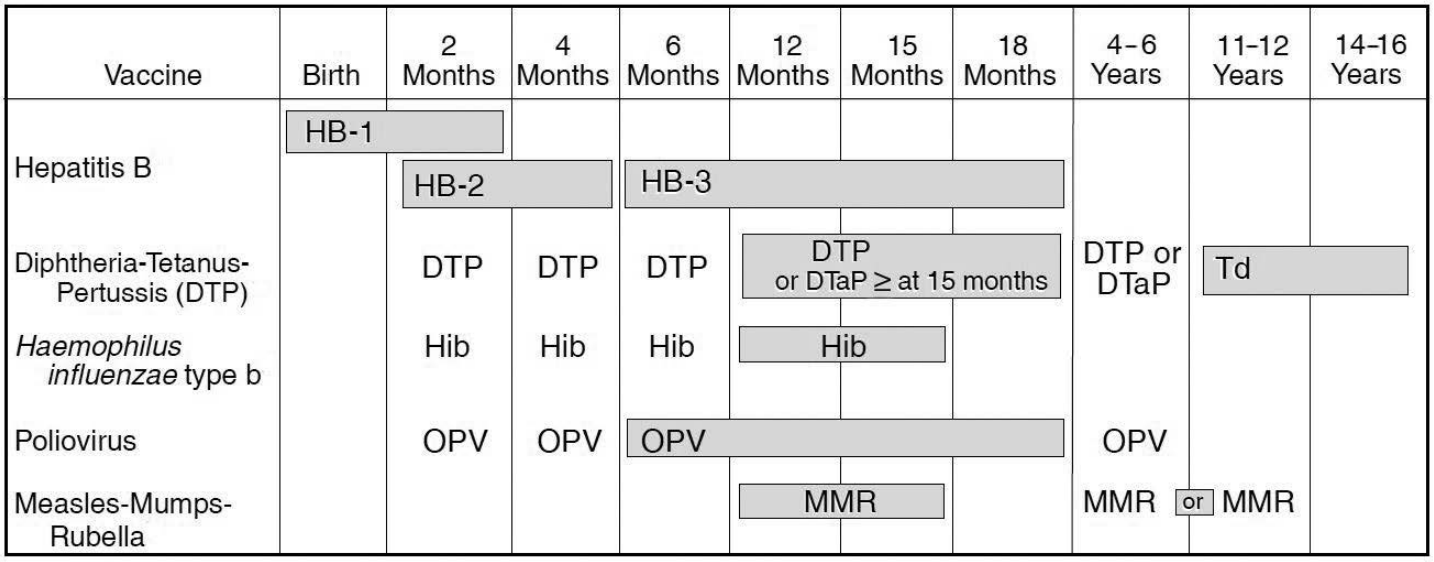
Two additional changes have affected the work of ACIP: 1) more systematic consideration of economic analyses in development of vaccine recommendations, and 2) use of an explicit evidence based format for presentation of recommendations. Although economic data have been presented to ACIP for decades, the ACIP Charter was updated in 2004 to formally reference economic analyses. The ACIP Charter is updated and renewed by DHHS every 2 years, and the current charter (2014–2016) includes the following statement: "Committee deliberations on use of vaccines to control disease in the U.S. shall include consideration of disease epidemiology and burden of disease, vaccine efficacy and effectiveness, vaccine safety, economic analyses and implementation issues. The committee may revise or withdraw their recommendation(s) regarding a particular vaccine as new information on disease epidemiology, vaccine effectiveness or safety, economic considerations or other data becomes available." In recent years, as the number and cost of vaccines have increased steadily, the importance of economic analyses in establishing policy for addition of new vaccines to routine immunization schedules has received increasing recognition. To ensure that economic data presented to the Committee are uniform in presentation, understandable, and of the highest quality, lead economists and the Health Economics Research Group at CDC in 2008 developed *Guidance for Health Economics Studies Presented to*

TABLE. Diseases prevented by vaccines in the child/adolescent immunization schedule — United States, 1964–2014*

1964 (6 diseases)	1985 (7 diseases)	1995 (10 diseases)	2014 (16 diseases)	
Polio	Polio	Polio	Polio	Hepatitis B
Diphtheria	Diphtheria	Diphtheria	Diphtheria	Hepatitis A
Pertussis	Pertussis	Pertussis	Pertussis	Varicella
Tetanus	Tetanus	Tetanus	Tetanus	Pneumococcal
Measles	Measles	Measles	Measles	Influenza
Smallpox	Rubella	Rubella	Rubella	Meningococcal
	Mumps	Mumps	Mumps	Rotavirus
		Hib	Hib	HPV
		Hepatitis B		
		Varicella		

Abbreviations: Hib = *Haemophilus influenzae* type b; HPV = human papillomavirus.
* Current child/adolescent immunization schedule available at http://www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html.

FIGURE. The first harmonized vaccine schedule: Recommended Childhood Immunization Schedule — United States, January 1995*



Source: CDC. Recommended childhood immunization schedule—United States, 1995;44(No. RR-5).
* Endorsed by Advisory Committee on Immunization Practices, American Academy of Pediatrics, and American Academy of Family Physicians.

the ACIP. The guidance specifically mandates technical review of any economic study that is presented to ACIP (*14*).

Another shift in ACIP's approach to development of vaccine policy occurred in 2010, when the Committee voted to adopt the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system to enhance transparency, continuity, and communication, and make explicit the quality of evidence reviewed (*15*). ACIP systematically assesses the type and quality of evidence about a vaccine's expected health impacts and the balance of health benefits and risks, along with the values and preferences of persons affected. Evidence is grouped into four categories, with the order reflecting the level of confidence in the estimated effect of vaccination on health outcomes. Data tables used for development of ACIP vaccine recommendations are posted on the ACIP website (*16*).

Discussion

The 50 years of ACIP's progress reflects the steady increase in the number of vaccines recommended for the civilian population of the United States: from six routine childhood vaccines in 1964, to today's 16 separate antigens that are recommended for routine use in children and adolescents, as well as the vaccines recommended for the adult population. With the passage of the Federal Advisory Committee Act in 1972, ACIP meetings became open to the public, and committee records were required to be made available to the public, thereby increasing transparency and visibility of the decision-making process. An important change was made in 1978, when the chair of the committee was appointed from among the ACIP members, none of whom is a federal government employee, thereby ensuring independence from government. Inclusion of liaison organizations representing various important professional societies or associations facilitates discussion of implementation aspects of introducing a new vaccine to the immunization program, harmonization of recommendations among stakeholders, and rapid dissemination of the recommendations back to the membership of the professional organization. The role played by ACIP in adding childhood vaccines to the VFC program has contributed to the strength of the U.S. immunization program, which has seen increases in vaccination coverage ever since the program was implemented in 1994. Although ACIP does not consider financing of vaccine programs, over the past decade the committee has regularly considered economic evaluations. Although GRADE is not applied to cost-effectiveness analyses, these considerations are taken into account by the committee, along with disease epidemiology, vaccine efficacy and effectiveness, and vaccine safety. Because of the lengthy process of data presentation and review that typically occurs over months and years before an ACIP vote is ever taken, and because of the extensive input by concerned stakeholders, ACIP immunization schedules, which summarize ACIP recommendations for routine use of vaccines in children and adults, are endorsed by medical professional organizations in the United States (*10,11*). In recent years, with the creation of the Bill and Melinda Gates Foundation–funded Supporting National Independent Immunization and Vaccine Advisory Committees initiative, including technical support from the World Health Organization, delegations from countries around the world

have attended ACIP meetings to observe procedures followed by ACIP as they establish or enhance their own immunization advisory committees (*17*). Delegations from ministries of health of several countries, including Argentina, China, Japan, Mexico, Republic of Korea, Taiwan, and Turkey, have attended ACIP meetings to learn more about use of evidence in developing vaccine recommendations (*18*).

ACIP faces challenging issues, including optimal ways to incorporate consumer perspectives and community values. The committee also has had challenging deliberations on economic analyses in the development of vaccine recommendations and accommodating an ever increasing number of vaccines in the recommended child/adolescent immunization schedule.

Acknowledgments

Samuel L. Katz, MD (ACIP 1982–1993 [Chair 1985–1993], Infectious Diseases Society of America liaison 1998–2011). Wilburt Cornell, MD, Davison Professor and Chair *Emeritus,* Department of Pediatrics, Duke University Medical School, Durham, North Carolina.

[1]National Center for Immunization and Respiratory Diseases, CDC; [2]Center for Vaccine Equity, Task Force for Global Health, Decatur, Georgia (Corresponding author: Jean C. Smith, jis6@cdc.gov, 404-639-6227)

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Control of Ebola Virus Disease — Firestone District, Liberia, 2014

Erik J. Reaves, DO[1], Lyndon G. Mabande, MD[2], Douglas A. Thoroughman, PhD[3], M. Allison Arwady, MD[1], Joel M. Montgomery, PhD[4] (Author affiliations at end of text)

On October 21, 2014, this report was posted as an MMWR *Early Release on the* MMWR *website (http://www.cdc.gov/mmwr).*

On March 30, 2014, the Ministry of Health and Social Welfare (MOHSW) of Liberia alerted health officials at Firestone Liberia, Inc. (Firestone) of the first known case of Ebola virus disease (Ebola) inside the Firestone rubber tree plantation of Liberia. The patient, who was the wife of a Firestone employee, had cared for a family member with confirmed Ebola in Lofa County, the epicenter of the Ebola outbreak in Liberia during March–April 2014. To prevent a large outbreak among Firestone's 8,500 employees, their dependents, and the surrounding population, the company responded by 1) establishing an incident management system, 2) instituting procedures for the early recognition and isolation of Ebola patients, 3) enforcing adherence to standard Ebola infection control guidelines, and 4) providing differing levels of management for contacts depending on their exposure, including options for voluntary quarantine in the home or in dedicated facilities. In addition, Firestone created multidisciplinary teams to oversee the outbreak response, address case detection, manage cases in a dedicated unit, and reintegrate convalescent patients into the community. The company also created a robust risk communication, prevention, and social mobilization campaign to boost community awareness of Ebola and how to prevent transmission. During August 1–September 23, a period of intense Ebola transmission in the surrounding areas, 71 cases of Ebola were diagnosed among the approximately 80,000 Liberians for whom Firestone provides health care (cumulative incidence = 0.09%). Fifty-seven (80%) of the cases were laboratory confirmed; 39 (68%) of these cases were fatal. Aspects of Firestone's response appear to have minimized the spread of Ebola in the local population and might be successfully implemented elsewhere to limit the spread of Ebola and prevent transmission to health care workers (HCWs).

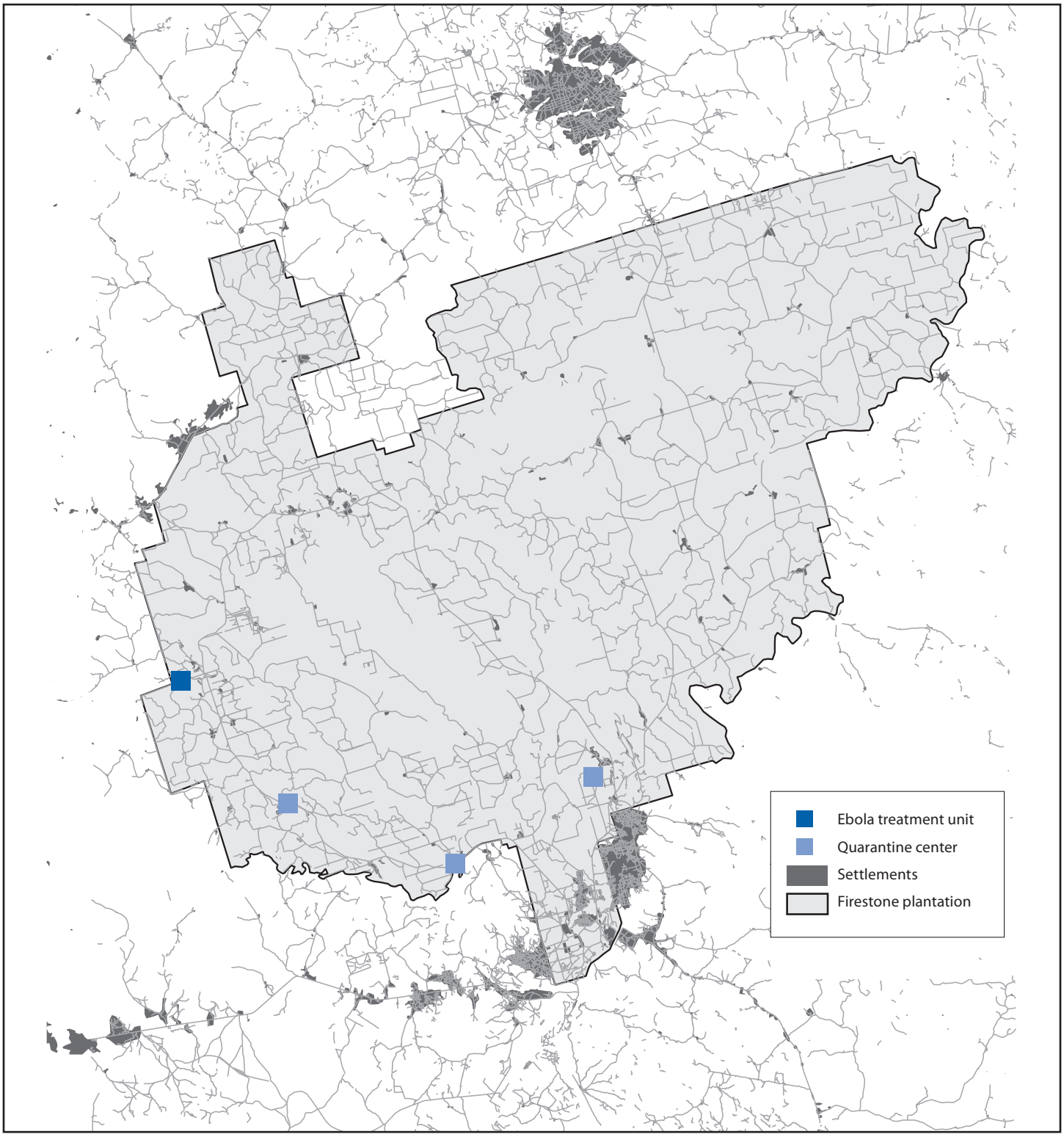
Firestone Liberia, Inc. is an affiliate of Firestone Natural Rubber Company, LLC, a division of Bridgestone Americas, Inc., that operates rubber tree plantations in Liberia. The original plantation was established in 1926 by the Firestone Tire & Rubber Company. The company harvests natural rubber and wood from a plantation area of approximately 120,000 acres (185 square miles) in the Firestone District of Margibi County (Figure 1). The populations of Margibi County and Firestone District are 238,000 and 69,000, respectively (Government of Liberia 2014 population estimates). Employees and their dependents reside within 121 communities inside the Firestone plantation. Nearly 16,000 students matriculate at 27 schools operated by Firestone. Although Firestone manages the plantation, the area is accessible to non-company residents from surrounding communities and includes roadways permitting passage of people and commerce.

Firestone operates a referral hospital, two clinics, and seven health posts, with 181 health care providers within the plantation area. The main hospital has an emergency department, labor and delivery department, intensive care unit, and 170-bed routine inpatient capacity with an additional 130-bed surge capacity for both adult and pediatric patients. Health posts are located within housing communities and staffed by non-physician primary care providers who reside in those communities. Firestone also operates a mobile medical unit that follows a daily route through the plantation area and surrounding communities. Firestone's reported health care catchment population of roughly 80,000 includes employees, retirees, dependents, and the residents of the densely populated surrounding communities in Margibi and Montserrado counties. Firestone provides perinatal care (representing 70% of all deliveries at Firestone's main hospital), routine vaccinations, primary care through the mobile medical unit, and emergency care for members of the communities surrounding Firestone's plantation area. The total number of patient visits to Firestone facilities averages nearly 5,500 per month.

Outbreak Response

On March 31, 2014, following the report of the first Ebola case diagnosed in the Firestone plantation, the company established an incident management system to coordinate a comprehensive response to the outbreak using the existing organizational framework of the company in Liberia (Figure 2). The response continuum included services for case identification, case management, and reintegration of convalescent patients into the community. A robust risk communication, prevention, and social mobilization campaign also was implemented using radio messages and community meetings.

FIGURE 1. Map of the Firestone rubber tree plantation showing the location of the Ebola treatment unit and quarantine centers — Firestone District, Margibi County, Liberia, August 1–September 23, 2014



The national Ebola case definitions were created by MOHSW and used by Firestone to classify cases. A suspected case of Ebola was defined as an illness characterized by a history of acute fever and three or more symptoms,* or by fever with acute clinical symptoms or signs of hemorrhage,† or death of a person with such a history, or any unexplained death. A probable case of Ebola was defined as an illness meeting the suspected case definition or a fever in a person who had contact§ with a person with a probable or confirmed case of Ebola in the past 21 days. A confirmed case of Ebola was defined as a suspected or probable case confirmed by laboratory testing using a real-time reverse transcription–polymerase chain reaction assay at the Liberian Institute of Biomedical Research.

* Symptoms included headache, nausea, vomiting, diarrhea, intense fatigue, abdominal pain, general muscular or joint pain, difficulty swallowing, difficulty breathing, or hiccups.

† Signs of hemorrhage were defined as epistaxis, conjunctival injection, petechia, hematemesis, hematachezia, or melena.

§ A contact was defined as a person with no symptoms who had physical contact with an Ebola patient or the body fluids of an Ebola patient within the past 21 days. Physical contact could be proven or highly suspected, such as having shared the same room or bed, cared for a patient, touched body fluids, or closely participated in a burial (e.g., physical contact with the corpse).

Cases of Ebola were detected through 1) enhanced passive surveillance by investigation of reports from family or community members, 2) active surveillance during the activities conducted by the health promotion, contact-tracing, and monitoring teams in Firestone communities, and 3) by clinical screening during care for any illness at all health facilities. Cases and contacts were reported to MOHSW through the Firestone District and Margibi County health officers using the national Ebola case and contact reporting forms.

Firestone implemented administrative and environmental modifications to convert an outpatient health clinic separated from the main hospital to meet the infection control standards of an Ebola treatment unit (ETU) following guidance developed by Médecins Sans Frontières (Figure 3) (*1*). The facility can house 23 patients, including those separated as having confirmed, probable, or suspected Ebola (Figure 3). By April 9, Firestone had completed the construction and certification of its ETU.

Prevention of Transmission to Health Care Workers

Following the initial Ebola case in March 2014, no additional cases were identified in the Firestone plantation area until early

FIGURE 2. Organization chart for the Firestone Health Services Ebola Outbreak Response Group

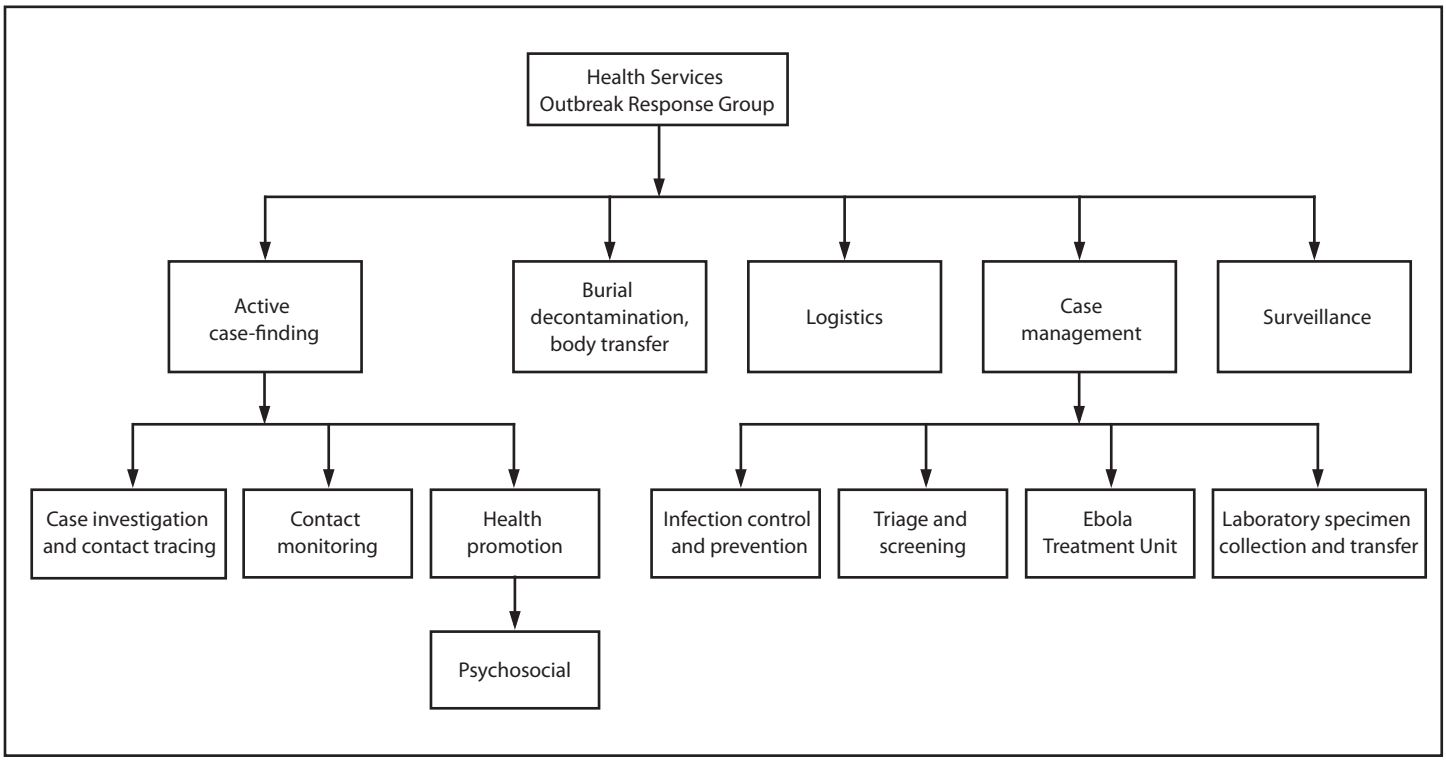
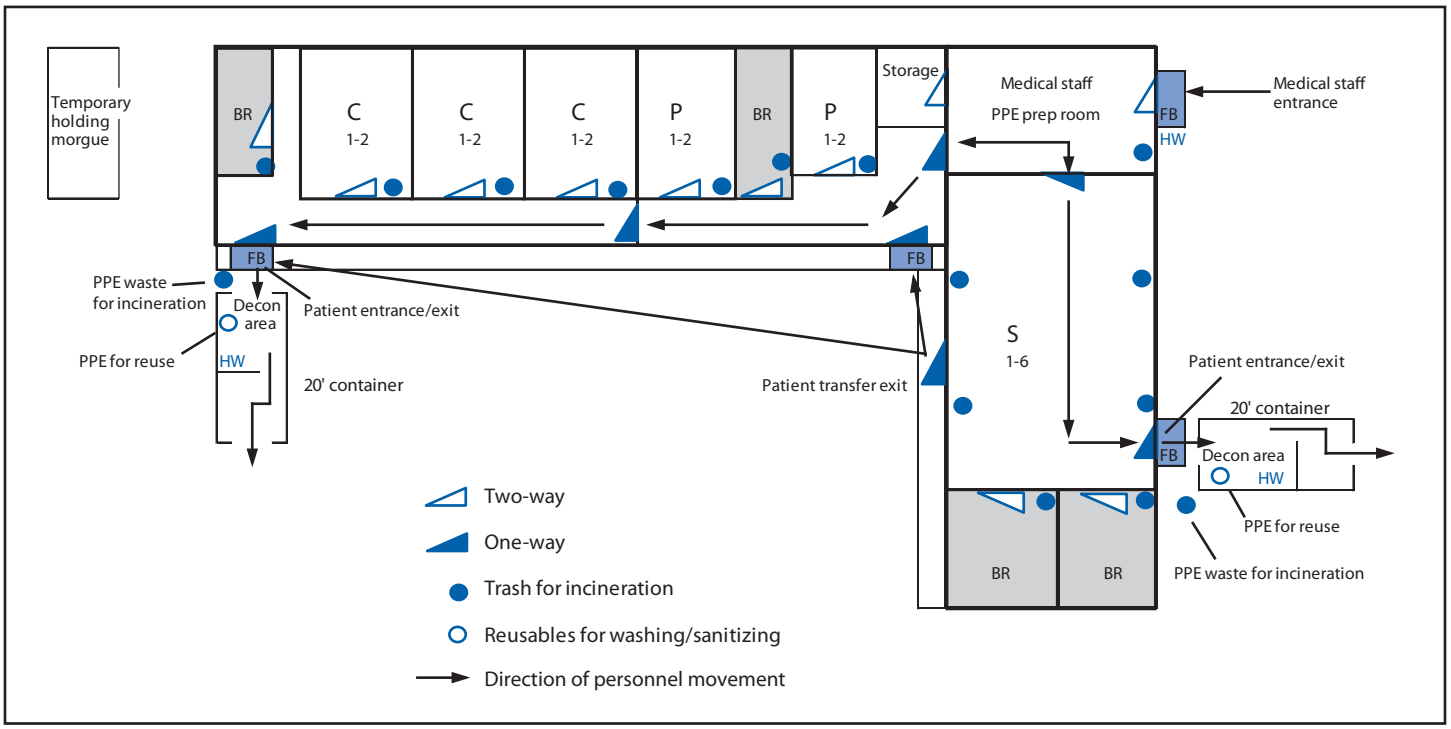


FIGURE 3. Floor plan for the Firestone Ebola treatment unit — Firestone District, Margibi County, Liberia, 2014



Abbreviations: S = suspected; P = probable; C = confirmed; BR = bathroom; FB = footbath; HW = handwash decon; PPE = personal protective equipment; Decon = decontamination.

August, at which time 17 Firestone HCWs had high-risk[¶] exposures to two patients with Ebola confirmed by postmortem testing. Both Ebola patients initially sought care for non-Ebola health matters and were not recognized as having Ebola. One had an obstetric emergency and died in the emergency department; the second patient was admitted to the general medical ward for suspected drug toxicity following a 7-day outpatient treatment regimen for presumptive malaria infection but was recognized as having signs and symptoms of Ebola within 48 hours after admission, and later died.

No HCWs developed Ebola following these high-risk exposures. However, as a consequence of these exposures, additional clinical screening and triage measures were implemented. Firestone established a single, gated access point to the hospital compound that included a screening station staffed by trained HCWs. Screening included temperature readings with noncontact infrared thermometers and verbal responses to a questionnaire about Ebola signs and symptoms irrespective of history of contact with an Ebola patient. Patients with suspected Ebola were sent to the ETU. From August 1 to September 23, three patients were sent to the ETU with suspected Ebola following this screening protocol; one of the three had confirmed Ebola.

[¶]A high-risk exposure was defined as a percutaneous or mucous membrane exposure to, or direct skin contact with blood or body fluids of an Ebola patient or a corpse in Liberia without appropriate personal protective equipment.

Additional triage was conducted to prioritize patients who required hospitalization but were not suspected of having Ebola based on their signs and symptoms. Patients who had some signs or symptoms of Ebola but not those meeting the national Ebola case definition were isolated in a single, dedicated room. HCWs used standard precautions (combined features of universal precautions and body substance isolation depending on levels of care required during hospital admission) (*2*) and periodically screened for additional signs and symptoms of Ebola throughout the hospital admission. Patients with illnesses subsequently meeting criteria for suspected Ebola were transferred to the ETU. During August 1–September 23, 10 patients initially admitted for care at the hospital with non-Ebola diagnoses were housed in individual rooms. Among the 10 patients, four had suspected Ebola and were transferred to the ETU; three of the four were eventually confirmed as having Ebola. After establishing this secondary triage of patients admitted for standard non-Ebola care, no additional high-risk exposures were identified among HCWs.

Active Case-Finding

On April 1, the husband and children of the first Ebola patient at the Firestone plantation were voluntarily quarantined in a guesthouse on the main hospital compound. Within 48 hours of quarantine, the youngest child, aged 18 months,

What is already known on this topic?

Currently, Liberia has the highest number of reported cases of Ebola virus disease (Ebola) in West Africa, with the number of cases increasing rapidly, limiting efforts to use standard Ebola outbreak control measures.

What is added by this report?

Firestone Liberia, Inc. implemented several unique elements of Ebola control procedures for the early recognition and isolation of Ebola patients, including management of Ebola contacts depending on their exposure, and community reintegration of convalescent patients. During August 1–September 23, there were 71 Ebola cases among the population of approximately 80,000 Liberians for whom Firestone provides health care (cumulative incidence = 0.09%). Among the 71 cases, 57 (80%) were laboratory-confirmed, and 39 of those cases were fatal (mortality rate = 68%).

What are the implications for public health practice?

Aspects of Firestone's response to the current Ebola epidemic appear to have limited its growth among the local population and might be successfully implemented elsewhere. The experience of Firestone in Liberia also might provide successful strategies for interrupting Ebola transmission to health care workers.

transiently experienced signs and symptoms consistent with Ebola (persistent fever, vomiting, and diarrhea) and was separated from the other siblings within the guesthouse because at the time there were no available ETUs in Liberia. Because the father and siblings had varying levels of exposure to the youngest child, Firestone staff members provided education on the prevention of Ebola transmission and modified barrier protection equipment (i.e., latex gloves, surgical masks with face shield, and gowns) so the father could provide care for the child while laboratory diagnostic results were pending. The family was monitored for 21 days, during which time no member of the family, including the child, developed Ebola.

When subsequent Ebola cases were identified in August, contacts were monitored daily by two mobile teams, totaling 16 staff members and each including a medical officer, nurses, a behavioral/mental health provider (e.g., social worker or religious leader), a health counselor, and security personnel. Contacts, including HCWs, with high-risk exposures were encouraged to agree to voluntary quarantine for 21 days. Firestone organized three schools to serve as quarantine centers to permit each quarantined family to reside and remain in a separate classroom during the entire observation period. Most often, entire families were categorized as contacts of Ebola patients because they had assisted in the care of an Ebola patient in the household. Firestone provided essential services (e.g., meals, communications, psychosocial visits, and prayer services) for contacts in voluntary quarantine. All contacts were offered voluntary quarantine, but contacts with low-risk** exposures could choose to remain in their home, retaining freedom of movement within the community.

In addition to monitoring contacts, Ebola cases were identified in the community by the three case-identification and contact-tracing teams, the health promotion and active case-finding team, and the psychosocial team. Including security personnel, a total of 23 staff members were on these teams. Among the 121 communities in the Firestone plantation area, 110 community supervisors and an additional 360 influential community members were educated and compensated to serve as community leaders in identifying suspected Ebola cases. Some community members self-reported signs and symptoms of Ebola, encouraged in part by community radio messages and educational meetings, as well as by high community acceptance of the quarantine and patient treatment facilities.

Ebola Cases at Firestone Facilities

During August 1–September 23, there were 71 Ebola cases (cumulative incidence 0.09%) in 39 families within Firestone's health care catchment population, of which 57 (80%) were confirmed cases. Fifty-three Ebola cases were fatal, of which 39 were confirmed cases (mortality rate among confirmed cases = 68%). The proportion of deaths that occurred by location among the 39 confirmed Ebola case deaths were as follows: 27 (69%) at the ETU, six (15%) at the main hospital, and six (15%) in the community. The 14 remaining deaths were among suspected Ebola cases, of which 11 (79%) occurred in the community and three (21%) in the ETU. During the same period, there were 536 Ebola cases in Margibi County (cumulative incidence = 0.23%). Among the 62 patients isolated in Firestone's ETU, 45 (73%) had confirmed Ebola. Thirty-five patients admitted to the ETU died. Among those were 27 with confirmed Ebola (ETU mortality rate = 60%) and three with suspected Ebola. Twenty-four (39%) patients admitted to the ETU were members from the densely populated communities surrounding Firestone's plantation area.

Among 233 identified contacts monitored for 21 days, 74 (32%) were classified as having high-risk exposures and adhered to voluntary quarantine within three school facilities. Twenty-one (28%) quarantined contacts from high-risk exposures developed Ebola. The number of days between when these contacts initiated quarantine and when they were isolated in the ETU with suspected Ebola averaged 6.3 days (range = 1–20 days). Nineteen (90%) of the 21 contacts were

** A low-risk exposure was defined as household contact that did not involve providing care to an Ebola patient or having close contact with an Ebola patient in health care facilities or in the community that was not otherwise characterized as a high risk exposure.

isolated in the ETU as patients with suspected Ebola within 10 days following initial quarantine as a contact. No community contacts with low-risk exposures developed Ebola.

Community Reintegration of Ebola Survivors

Since implementation of Firestone's Ebola response, 18 survivors have been discharged from the Firestone ETU. To prepare communities for the return of Ebola survivors and minimize potential stigmatization, Firestone established a survivor reintegration program. The program consisted of community education, whereby members of the reintegration team explained that the survivor had been declared Ebola-free and no longer contagious, and a survivor welcome celebration. The celebrations were prepared by the community with assistance from the reintegration team and attended by MOHSW, Firestone staff, and clergy. Each survivor was presented a medical certificate and an opportunity to share his or her experience. The celebrations were broadcast on radio and recorded for future programs for Ebola education in the community. In addition, Firestone donated a solidarity package to the survivor, which included essential household items (e.g., mattress, bedding material, and mosquito net).

Discussion

Currently, Liberia has the highest number of reported Ebola cases in West Africa. The high case load is making standard Ebola outbreak control measures difficult to implement (*3*). The experience of Firestone in Liberia might provide successful strategies for interrupting Ebola transmission, particularly transmission to HCWs. Important features of Firestone's Ebola outbreak response were 1) rapid establishment of an incident management system; 2) active and enhanced passive surveillance for Ebola; 3) immediate isolation of Ebola patients in a dedicated unit; 4) management of contacts according to the nature of their exposure; and 5) allowing for voluntary quarantine in dedicated facilities for exposed, asymptomatic contacts with provision of health education, personal protective equipment, sanitary supplies, and essential resources to maintain a sense of normalcy (e.g., meals, communications, and prayer services).

There are several unique elements of the Firestone response that enhance existing Ebola control guidelines. The first is differing levels of management for contacts during the 21-day period following last-known exposure based on the type of Ebola exposure risk, including options for quarantine. Higher-risk contacts were encouraged to voluntarily quarantine themselves in a dedicated facility. These arrangements facilitated engagement of health educators, mental health professionals, and religious leaders with contacts of Ebola patients. Importantly, of the 21 contacts at Firestone who developed Ebola, all had experienced high-risk exposures and were voluntarily quarantined. In addition, 90% of these contacts were identified as having suspected Ebola cases within 10 days following initiation of their monitoring as contacts. The contact-management process used by Firestone might be useful in identifying those contacts at greatest risk for developing Ebola. This is particularly important as the number of Ebola cases, and consequently the number of contacts, increase in Liberia, making the monitoring of all contacts for an entire 21-day observation period less feasible. The extent to which contacts of Ebola patients from the surrounding communities developed Ebola was unknown because Firestone did not monitor them. Nonetheless, Firestone's provision of resources and monitoring of contacts in both the plantation community and quarantine facility settings likely facilitated prompt identification of Ebola cases during the 21-day observation period.

A second unique element of the response is that Firestone successfully integrated both education and distribution of personal protective and waste disposal equipment to family members (i.e., contacts) of suspected Ebola patients. Without sufficient numbers of ETUs to meet the demand to provide even minimal supportive care to Ebola patients in Liberia, a previously untested strategy of home-based care in Liberia might be necessary. The experience of Firestone might both support the prompt recognition of Ebola cases and limit transmission among family members who provide care to Ebola patients in the household.

Liberia has established a decentralized, county-led response to the Ebola outbreak; however, following several Ebola clusters among HCWs throughout Liberia, many county referral hospitals in Liberia have been closed. Strategies to implement effective infection control practices are currently being developed to ensure safe reopening of these facilities. A third unique element of the response, whereby Firestone established Ebola-screening protocols and a separate dedicated ETU, might serve as a model for infection control practices to other county health care facilities providing both non-Ebola and Ebola-related care. Since implementation of screening protocols at the Firestone hospital, no HCWs have had high-risk exposures to patients subsequently identified as Ebola patients in the hospital setting.

An important result of Firestone's response is the success with which community members identified suspected Ebola cases, agreed to voluntary quarantine in dedicated facilities, and minimized stigmatization of Ebola survivors. The education, social mobilization, and reintegration programs, as well as the visibility of supervisors and leaders in the community likely contributed to these successes.

Before this outbreak, counties in Liberia lacked incident management and crisis response systems. Although Firestone also had to establish an incident management system to respond to Ebola cases in their plantation area, the company

relied on a preexisting organizational framework and was able to redirect existing resources for the response. Whereas the integrated strategies for the management of both Ebola cases and contacts were feasible at Firestone, the necessary capabilities and resources to replicate these efforts are often lacking elsewhere in Liberia, especially in rural areas. These might limit the ability to use the company's experience as a model for the Ebola response.

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Edmundo L. Garcia, Firestone Liberia, Inc.; Don Darden, Bridgestone Americas, Inc.; Steve Bullard, JD, Geospatial Research, Analysis, and Services Program, CDC.

[1]Epidemic Intelligence Service, CDC; [2]Firestone Health Services, Firestone Liberia, Inc.; [3]Career Epidemiology Field Officer, CDC; [4]Division of Global Health Protection-Kenya, CDC (Corresponding author: Erik J. Reaves, ereaves@cdc.gov, 404-639-5309)

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Announcement

World Stroke Day — October 29, 2014

This year on World Stroke Day (October 29), the World Stroke Organization is launching a global campaign focusing on women and stroke. More women than men die from stroke each year (*1*). Stroke is the second leading cause of death for persons aged >60 years and the third leading cause of disability-adjusted life-years worldwide (*2,3*). In the United States, each year approximately 795,000 persons have a stroke (*4*). High blood pressure is the leading risk factor for stroke (*1*).

CDC is working to help promote stroke awareness and prevention in multiple ways, including the WISEWOMAN program, the Paul Coverdell National Acute Stroke Program (PCNASP), and the Million Hearts initiative. WISEWOMAN helps women with little or no health insurance reduce their risk for heart disease, stroke, and other chronic diseases. PCNASP funds 11 states to improve the quality of care and transition of care from first contact with emergency medical services through in-hospital care and transition to next care provider. Million Hearts, which is co-led by CDC and the Centers for Medicare & Medicaid Services, aims to prevent 1 million heart attacks and strokes by 2017.

CDC encourages everyone to know the signs and symptoms of stroke and to call 9-1-1 right away if they think they or someone else might be having a stroke. Getting fast treatment is important to prevent death and disability from stroke. Healthy lifestyle changes and medication also can reduce the risk for stroke for some persons. Additional information regarding World Stroke Day is available at http://www.strokeassociation.org/STROKEORG/General/World-Stroke-Day-2012_UCM_444999_SubHomePage.jsp. Additional information regarding CDC's efforts to address stroke is available at http://www.cdc.gov/stroke/cdc_addresses.htm, and additional information about Million Hearts is available at http://millionhearts.hhs.gov/index.html.

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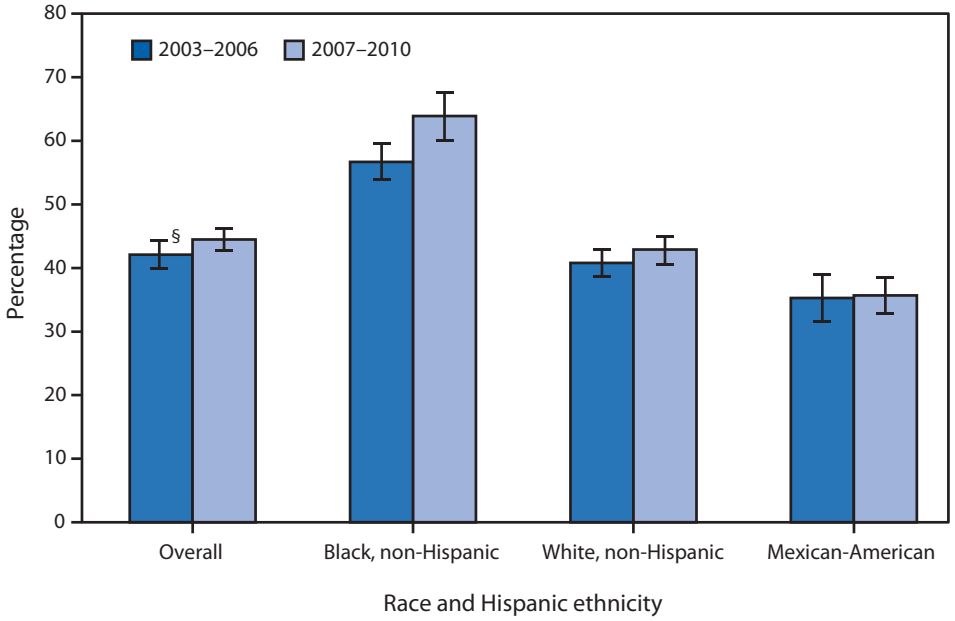
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Aged 18–59 Years Who Were Ever Tested for Human Immunodeficiency Virus (HIV),* by Race and Hispanic Ethnicity — United States, National Health and Nutrition Examination Survey, 2003–2006 to 2007–2010†



* Based on response to the question, "Except for tests you may have had as part of blood donations, have you ever had blood tested for the AIDS virus infection?"
† Statistical significance determined by t-test ($p<0.05$).
§ 95% confidence interval.

Approximately 44% of adults aged 18–59 years had ever been tested for HIV (other than blood donations) during 2007–2010, nearly the same as during 2003–2006. From 2003–2006 to 2007–2010, no significant change was observed for non-Hispanic white and Mexican-American adults in this age group. A significant increase was observed in the percentage of non-Hispanic black adults aged 18–59 years (from 57% to 64%) who had ever been tested for HIV. During both periods, non-Hispanic black adults had a significantly higher prevalence of any lifetime HIV testing compared with non-Hispanic white and Mexican-American adults.

Source: Woodring JV, Kruszon-Moran D, Oster AM, McQuillan GM. Did CDC's 2006 revised HIV testing recommendations make a difference? Evaluation of HIV testing in the U.S. household population, 2003–2010. J Acquir Immune Defic Syndr 2014;67:331–40.

Reported by: Joseph V. Woodring, DO, jwoodring@cdc.gov, 301-458-4599; Deanna Kruszon-Moran, MS; Geraldine M. McQuillan, PhD; Alexandra M. Oster, MD; Steven M. Frenk, PhD.

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