reported from mainland China and Hong Kong (online Technical Appendix Figure, panel A). Porcine liver has been implicated as a possible HEV transmission vehicle in that region (*6*); although we do not know whether the patient ate food that carried HEV, the possibility underscores the importance of avoiding eating inadequately cooked animal-derived food products during international travel (*2*).

Chronic hepatitis with accelerated cirrhosis has been reported in solid-organ transplant recipients infected with HEV genotype 3, but not with genotype 4 (*7*). Serial liver biopsy specimens from the patient showed persistent and worsening hepatitis and rapid onset of fibrosis that intensified (online Technical Appendix Figure, panel B).

Testing for HEV infection is recommended during initial assessments of posttransplant hepatic dysfunction because histologic appearances in liver biopsy specimens may not clearly distinguish between graft rejection and acute viral hepatitis (Figure, panels A, B). Early diagnosis of hepatitis E should lead to prompt administration of antiviral therapy and appropriate adjustments to the immunosuppressant drug regimen, particularly because some drugs can exert opposing effects on HEV replication (*8*).

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References

1. Drobeniuc J, Greene-Montfort T, Le NT, Mixson-Hayden TR, Ganova-Raeva L, Dong C, et al. Laboratory-based surveillance for hepatitis E virus infection, United States, 2005–2012. Emerg Infect Dis. 2013;19:218–22. http://dx.doi.org/10.3201/eid1902.120961
2. Teo CG. Hepatitis E. In: Brunette GW, editor. CDC health information for international travel 2014. New York: Oxford University Press; 2014. P. 197–200.
3. Center for Public Health Surveillance and Information Service, Chinese Center for Disease Control and Prevention. National data of class A, B and C communicable diseases in December 2013. Dis Surveill. 2014;29:1.
4. Centre for Health Protection, Department of Health, Hong Kong Special Administrative Region, People's Republic of China. Surveillance of viral hepatitis in Hong Kong—2012 update report [cited 2015 Feb 10]. http://www.info.gov.hk/hepatitis/doc/hepsurv12.pdf
5. Lam WY, Chan RCW, Sung JJY, Chan PK. Genotype distribution and sequence variation of hepatitis E virus, Hong Kong. Emerg Infect Dis. 2009;15:792–4. http://dx.doi.org/10.3201/eid1505.081579
6. Centre for Health Protection, Department of Health, Hong Kong Special Administrative Region, People's Republic of China. Hepatitis E virus in fresh pig livers [cited 2015 Feb 10]. http://www.cfs.gov.hk/english/programme/programme_rafs/files/RA_44_HEV_pig_liver_e.pdf
7. Zhou X, de Man RA, de Knegt RJ, Metselaar HJ, Peppelenbosch MP, Pan Q. Epidemiology and management of chronic hepatitis E infection in solid organ transplantation: a comprehensive literature review. Rev Med Virol. 2013;23:295–304. http://dx.doi.org/10.1002/rmv.1751
8. Wang Y, Zhou X, Debing Y, Chen K, Van Der Laan LJ, Neyts J, et al. Calcineurin inhibitors stimulate and mycophenolic acid inhibits replication of hepatitis E virus. Gastroenterology. 2014;146:1775–83. http://dx.doi.org/10.1053/j.gastro.2014.02.036

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Measles Reemergence in Ceará, Northeast Brazil, 15 Years after Elimination

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To the Editor: Measles was endemic in Brazil before 2000 and caused large outbreaks every 2 or 3 years (*1*). Although measles was eliminated in Brazil in 2000, cases have continued to be imported (*2*,*3*). During 2001–2014, the median annual number of measles cases reported in Brazil was 50 (range 2–712). The median annual number of Brazilian states with reported cases was 2.5 (range 1–7). Since elimination, the highest numbers of cases reported in Brazil occurred in 2013 (220) and in 2014 (712) (*3*–*5*). According to the Pan American Health Organization, endemic transmission is reestablished when epidemiologic and laboratory evidence indicate that a chain of transmission of a virus strain has continued uninterrupted for ≥12 months in a defined geographic area (*6*).

From December 2, 2013, through December 31, 2014, in the state of Ceará, Brazil, 681 measles cases were reported. A measles case was considered confirmed when a patient exhibited fever, rash, and ≥1 of 3 symptoms and signs (i.e., cough, runny nose, conjunctivitis); was positive for IgM and negative for IgG against measles virus; and had not been vaccinated in the previous 21 days. D8 genotype, the same virus genotype that was circulating in Europe, was the only genotype identified, and how the virus was introduced into the region was not clear (*4*,*5*). From 2000 to 2013, vaccine coverage among children 12 months of age remained >95% in Ceará, although that coverage was not homogeneous for the whole state. In 14.7% (27/184) of municipalities, the vaccination coverage was much lower

(*4*). Pernambuco, the state that borders southern Ceará, reported a measles outbreak with 222 confirmed cases from March 2013 through March 2014 (*4*,*5*,*7*). Thus, the timing of the 2 outbreaks overlapped.

During December 2013–December 2014, Ceará's outbreak seemed to evolve in 2 waves: the first from epidemiologic weeks 3 through 6 (mainly in Fortaleza, the capital of Ceará) and the second from epidemiologic weeks 27 through 53 (mainly on the northwest side of Ceará, an economically disadvantaged region, which also included the capital). Cases were confirmed in 15.8% (29/184) of all municipalities. Most patients (47.3%; 322) were from Fortaleza, followed by Massapê (18.6%; 127) and Sobral (12.2%; 83) (Figure).

Children <12 months of age were the most affected group (27.5%; 187), followed by patients 20–29 years (19.2%; 131) and those 15–19 years (14.4%; 98). The age distribution was significantly different between Fortaleza and the 2 inner cities (together), with more cases reported among those <12 months of age (37.6% [121/322] vs. 14.3% [30/210], respectively) and for those 15–29 years (25.2% [81/322] vs. 43.8% [92/210], respectively) (p<0.001 for both comparisons) (*5*). Vaccination status of affected patients (data through August 8, 2014) was the following: unvaccinated, 22.2% (55/252) <1 year of age and 31.3% (79/252) ≥1 year of age; unknown vaccination status, 27.4% (69/252); and received only 1 dose of vaccine, 18.7% (47/252) (*8*). No deaths were reported (*4*). The main reported symptoms were rash (100%), fever (100%), cough (84.5%), runny nose (68.2%), and conjunctivitis (60.3%) (*8*).

Response vaccination activities have taken 10–20 weeks to be initiated in some municipalities after the first cases were recognized. Vaccination campaigns involving children 6–60 months of age are being intensified and surveillance for suspected cases has increased, but as of January 1, 2015, the chain of transmission appeared ongoing (*4*,*5*). In addition, one cannot underestimate the fact that health professionals in Ceará had not seen cases of measles for 15 years. Younger health professionals had never seen even 1 case, and this lack of familiarity may have had some effect on surveillance, rapid recognition of new cases, and adoption of control measures. This difficulty of recognition should be taken into account in regions that have been free of endemic measles transmission for many years.

In conclusion, the measles outbreak in Ceará was probably imported directly from Europe or from there

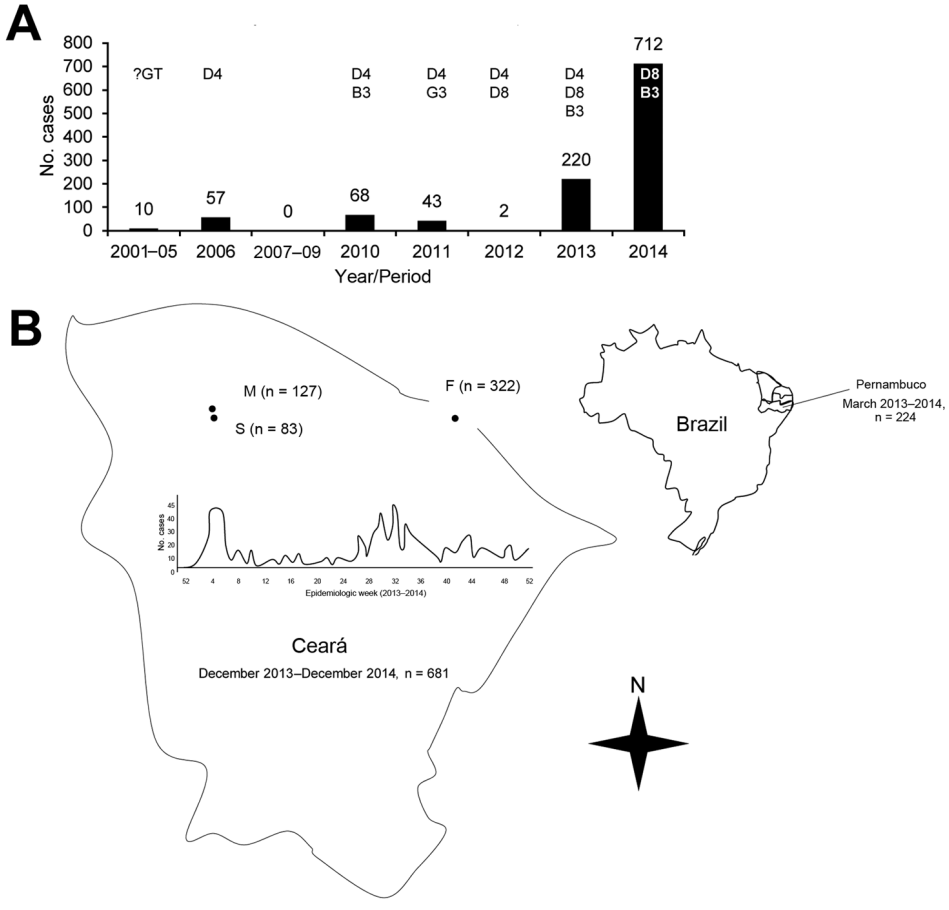

Figure. Measles cases reported in Brazil after elimination, 2001–2014. A) Cases and genotypes identified, by year. B) Spatial distribution of measles outbreaks in the states of Pernambuco and Ceará during 2013–2014, in which only genotype D8 was identified. Genotypes B3 and D4, observed during 2013–2014, were reported in other Brazilian states. The cities with the highest number of cases are highlighted on the map, as well as the evolution of its outbreak, which had 2 waves with peaks in the first and second halves of 2014. Data through December 31, 2014. F, Fortaleza; M, Massapê; S, Sobral; B3 , genotype B3; D4, genotype D4; D8, genotype D8; G3, genotype G3; ?GT, unknown genotype. Sources: (*3*,*5*,*7*).

through the bordering state of Pernambuco (*4*,*5*,*9*). Cases were concentrated in Fortaleza and the northwest region of the state. Patient age distribution was significantly different between the capital, where the infection most affected children <12 months of age, and the inner cities, where it most affected persons 15–29 years of age. Current heterogeneous measles vaccine coverage (*4*,*5*); a delayed response and insufficient vaccination coverage in the past, particularly in socially disadvantaged populations from the inner cities; and difficulties in the prompt recognition and surveillance of suspected cases may explain why this outbreak occurred in a population with a vaccine coverage historically >95%. In addition, vaccination campaigns directed at children <5 years of age may not have been sufficient to interrupt the outbreak because a substantial number of older persons were susceptible. Most notably, because it has lasted >12 months, Ceará's current outbreak may represent the reestablishment of endemic transmission of measles in the Americas.

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References

1. Risi JB Jr. Control of measles in Brasil. Rev Infect Dis. 1983;5:583–7. http://dx.doi.org/10.1093/clinids/5.3.583
2. Prevots DR, Parise MS, Segatto TCV, Siqueira MM, Santos ED, Ganter B, et al. J Infect Dis. 2003;187(Suppl 1):S111–20. http://dx.doi.org/10.1086/368030
3. Ministry of Health, Brazil. Confirmed cases of measles. Brazil, major regions and federal units, 1990 to 2014 [in Portuguese]. 2014 May 11 [cited 2014 Nov 8]. http://portalsaude.saude.gov.br/images/pdf/2014/junho/05/Casos-confirmados-de-Sarampo-2014.pdf
4. Health Department of the State of Ceará. Measles epidemic update 10/31/14 [in Portuguese].
5. Health Department of the State of Ceará. Measles epidemic update 01/23/15 [in Portuguese].
6. Castillo-Solórzano C, Reef SE, Morice A, Andrus JK, Matus CR, Tambini G, et al. Guidelines for the documentation and verification of measles, rubella, and congenital rubella syndrome elimination in the region of the Americas. J Infect Dis. 2011;204:S683–9. http://dx.doi.org/10.1093/infdis/jir471
7. Ministry of Health, Brazil. Measles epidemiologic status/data, 2014 May 11 [in Portuguese] [cited 2014 Nov 8]. http://portalsaude.saude.gov.br/index.php/situacao-epidemiologica-dados-sarampo
8. Health Department of the State of Ceará. Measles epidemic update 08/08/14 [in Portuguese].
9. Oliveira MI, Afonso AMS, Adelaide CF, Lemos XRMR, Almeida J, Frugis Yu AL, et al. Genetic diversity of measles virus. Ressurgence of new genotype D8 in São Paulo, Brazil. Rev Inst Med Trop Sao Paulo. 2014;56:366. http://dx.doi.org/10.1590/S0036-46652014000400018

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Chikungunya Virus in Macaques, Malaysia

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To the Editor: In the past 10 years, chikungunya virus (CHIKV) has caused global epidemics of fever, rash, and arthralgia affecting millions of humans, most recently in the Americas (*1*). CHIKV is an alphavirus transmitted by *Aedes* spp. mosquitoes. This virus has been isolated from wild vertebrates, particularly nonhuman primates (NHPs), in Africa (*2*). This sylvatic cycle might maintain the virus during interepidemic periods. The role of sylvatic cycles in Asia is less clear.

Encroachment of human settlements into forests has caused increased conflict between humans and macaques for space and resources in urban and rural areas. This interface exposes humans to zoonotic pathogens found in monkeys, such as CHIKV, dengue virus, and *Plasmodium knowlesi*. The most common macaque species in Peninsular Malaysia is the long-tailed macaque (*Macaca fascicularis*); an estimated population of >130,000 monkeys live in human-populated areas (*3*). We determined the potential role of long-tailed macaques in conflict with humans as a reservoir of CHIKV in Malaysia.

In response to reports of long-tailed macaques in human-populated areas, the Malaysian Department of Wildlife and National Parks traps monkeys in these areas and relocates them to forest areas. As part of the Wildlife Disease Surveillance Program conducted by Outbreak Response Team of this department, with assistance from the EcoHealth Alliance, serum samples were collected from 147 long-tailed macaques at >20 sites in the states of Selangor (88 monkeys), Negeri Sembilan (21), Perak (18), Pahang (17), and Penang (3) (Figure). Samples were collected in October–November 2009 and October 2010, just after a nationwide outbreak of CHIKV that affected >13,000 persons in 2008–2009 (*4*). These samples represent 0.05%–0.29% of estimated populations of long-tailed macaques in human-populated areas in these 5 states (*3*).

A seroneutralization assay was performed by using baby hamster kidney cells to screen for neutralizing antibodies against CHIKV in heat-inactivated monkey serum