# Emerging Global Epidemiology of Measles

## and Public Health Response to Confirmed Case in Rhode Island

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**ABSTRACT**

Measles is a highly contagious viral disease and rapid identification and control of cases/outbreaks are important global health priorities. Measles was declared eliminated from the United States in March 2000. However, importations from endemic countries continued through out the last decade and in 2011, the United States reported its highest number of cases in 15 years. With a global snapshot of current measles epidemiology and the persistent risk of transnational spread based on population movement as the backdrop, this article describes the rare event of a measles case identification in the state of Rhode Island and the corresponding public health response. As the global effort for measles elimination continues to make significant progress, sensitive public health surveillance systems and strong routine immunization programs will be important to ensure we maintain local and regional control.

**KEYWORDS:** measles, eradication, outbreak investigation, Rhode Island, GIS

## INTRODUCTION

Measles is one of the most contagious diseases known to mankind. In spite of the progress achieved over the past few decades in eliminating and controlling the disease from many parts of the world through immunization, regions of high measles transmission still exist. Global migration and international travel to and from such regions pose a constant threat of re-introduction of virus transmission in regions that have eliminated measles. This article describes the rare event of detection of a confirmed measles case in Rhode Island and the public health response that followed. Focusing on the current re-emergence of measles in parts of Europe and the United States, it also reviews the critical importance of maintaining surveillance competence in the medical and public health community to disease events that are sporadic in terms of local and regional transmission, but are still relevant from a global epidemiological perspective.

Measles was declared eliminated from the United States in March 2000, nearly three decades after the initial control efforts began in the early 1960s when the first measles vaccine was licensed in the country.[1,2] In 2002, the World Health Organization (WHO) geographical Region of the Americas achieved measles elimination by interrupting transmission of the endemic strain of measles virus.[3] However, importations from endemic countries continued throughout the last decade and a median of 56 cases of measles were reported in the United States during the 2001-2008 period.[4] A major resurgence of measles occurred in the WHO European Region in 2011, with more than 13,000 laboratory-confirmed cases, nearly three times higher than the total number of laboratory-confirmed cases reported in 2010.[5] Ninety percent of the measles cases reported from the WHO European Region in 2011 had not been vaccinated or had no documentation of prior vaccination.[6] Two-hundred and sixteen laboratory-confirmed cases were reported in the United States in 2011, the highest number of cases since 1996.[7] Rhode Island reported its first case of measles since 1996 in April 2011.

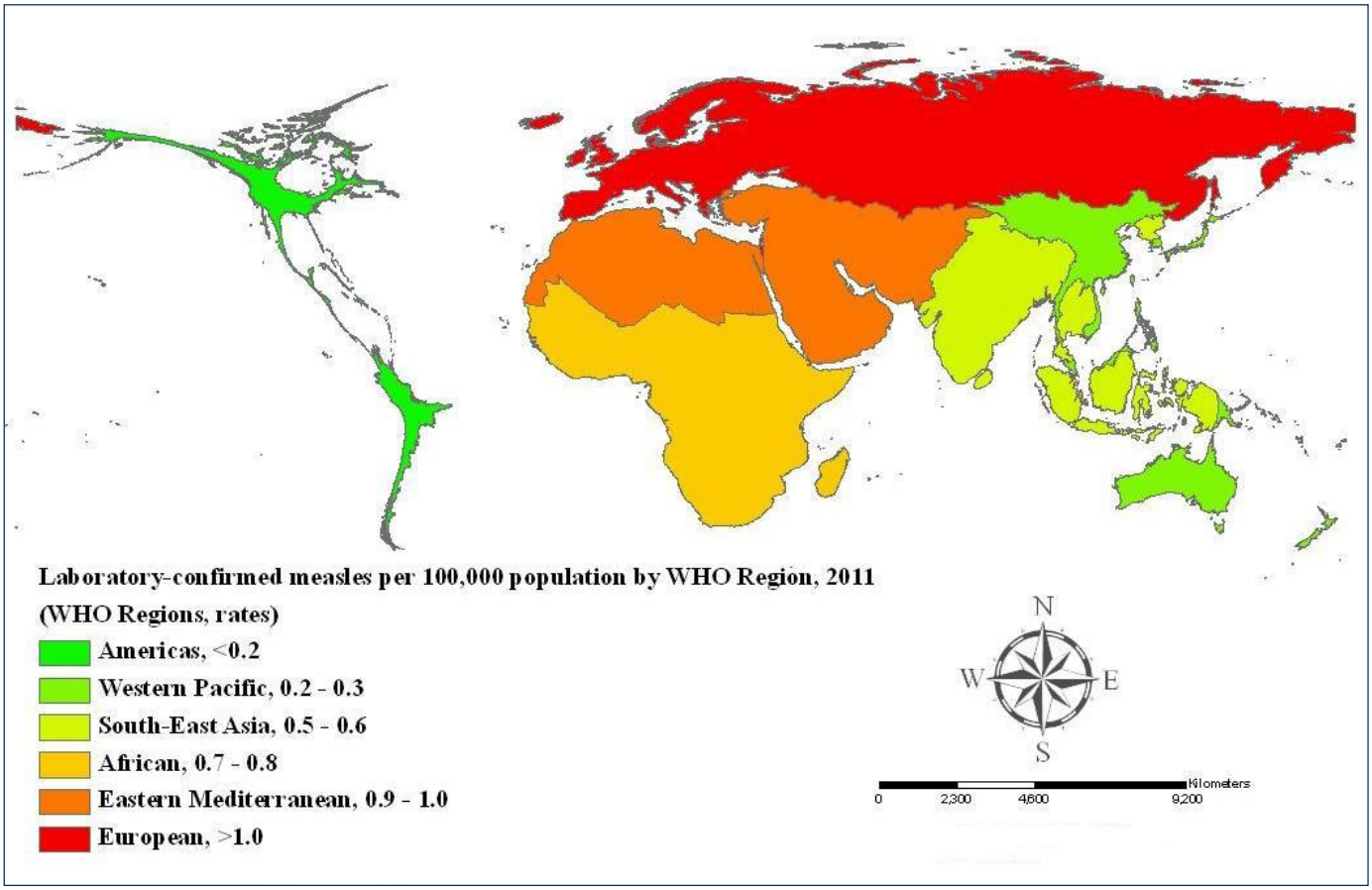
## CASE REPORT

On April 13, 2011, the RI Department of Health (HEALTH) received a call from a primary care physician reporting a suspected case of measles in a foreign traveler. The patient was a 28-year-old female who flew from Italy and landed at John F. Kennedy International Airport in New York City at around 2 pm on April 12. A friend picked her up and then they drove towards Rhode Island. Their only stop while in transit was at a restaurant in Connecticut. At 7 pm she checked into a hotel in Newport. Approximately 2 hours later, she developed a generalized, non-pruritic, maculopapular rash on the face and trunk, with moderate fever. On April 13, she visited the reporting physician with complaints of cough and coryza, beginning April 9. Clinical examination did not reveal any Koplik's spots. There was no history of exposure to a known case of measles. No documented evidence of prior immunization could be elicited. Serum tested courtesy of the Massachusetts State Laboratory on April 14 yielded a positive IgM result. Two weeks later, the Centers for Disease Control and Prevention (CDC) confirmed the genotype of the measles virus from this case as D4 (Enfield Strain), the predominant strain circulating in Europe in 2011.[6]

## EPIDEMIOLOGY

A virus of the paramyxovirus family causes measles. It is characterized by a prodrome of 3-4 days with fever, cough,

**Figure 1.** Distribution of Laboratory-Confirmed Measles Cases by WHO Region, 2011.*




* As of January 11, 2012. The six WHO regions have been resized based on rates of laboratory-confirmed measles, using the cartogram tool of ArcGIS. Data Source: World Health Organization

coryza and conjunctivitis followed by a maculopapular rash that usually appears first on the face and then spreads distally. A case of measles is infectious for a period of 4 days prior to the onset of rash until 4 days after the onset of rash.[2] Airborne spread through aerosolized droplet nuclei has been documented in closed environments (e.g., clinics or waiting rooms) for up to 2 hours after the infected person has left the area.[2] The incubation period is 7 to 21 days with an average of 14 days.[2] The rates of hospitalization due to complications can be as high as 40% even in developed countries, as noted during the first quarter of 2011 in United States.[4] The $R_0$ (expected number of secondary cases resulting from a primary case in the absence of community immunity) for measles is approximately 15, more than 10 times higher than that of the swine-origin H1N1, and three times higher than smallpox.[8,9] Thus, controlling the spread of such a contagious disease that has an 8-9 day-long period of infectiousness remains a major public health challenge. In addition to the isolation of all laboratory-confirmed cases, post-exposure immunization of susceptible contacts with a single dose of measles-containing vaccine within 72 hours of exposure has been demonstrated to decrease transmission and is a standard recommendation.[2] Both serologic and epidemiologic evidence suggest that the immunity induced by the vaccine remains effective long term and possibly for life, in most individuals.[2]

## PUBLIC HEALTH RESPONSE

Within a few hours of the case notification, HEALTH activated an emergency public health response to ensure efficient coordination among the operational areas (case management and isolation of index patient, laboratory testing, contact evaluation and immunization). Voluntary isolation was negotiated with the patient and she was kept confined to her hotel room April 13-17, after which she was allowed to board a flight to return to Italy. Immediate notifications were made on April 13 to CDC Quarantine Stations in New York City and Boston, which took on the responsibility of tracking all airline passengers exposed. The Department of Public Health in Connecticut was notified on the same day for tracking contacts at the restaurant where the patient and her friend had stopped for dinner. In-state contacts were rapidly identified by a team of HEALTH investigators and included her friend, staff at the doctor's office, and hotel staff. Exposed susceptible individuals (n=3) in the doctor's office

and her friend were vaccinated with one dose of Measles, Mumps and Rubella (MMR) vaccine within 24 hours of initial exposure. An immunization clinic was set up in the hotel in Newport on April 15, and all 14 hotel staff who were considered exposed and susceptible were vaccinated with one dose of MMR. Enhanced surveillance with regular telephone calls was implemented for exposed in-state contacts for 2 incubation periods (42 days from April 17). No secondary cases were identified in any RI resident.

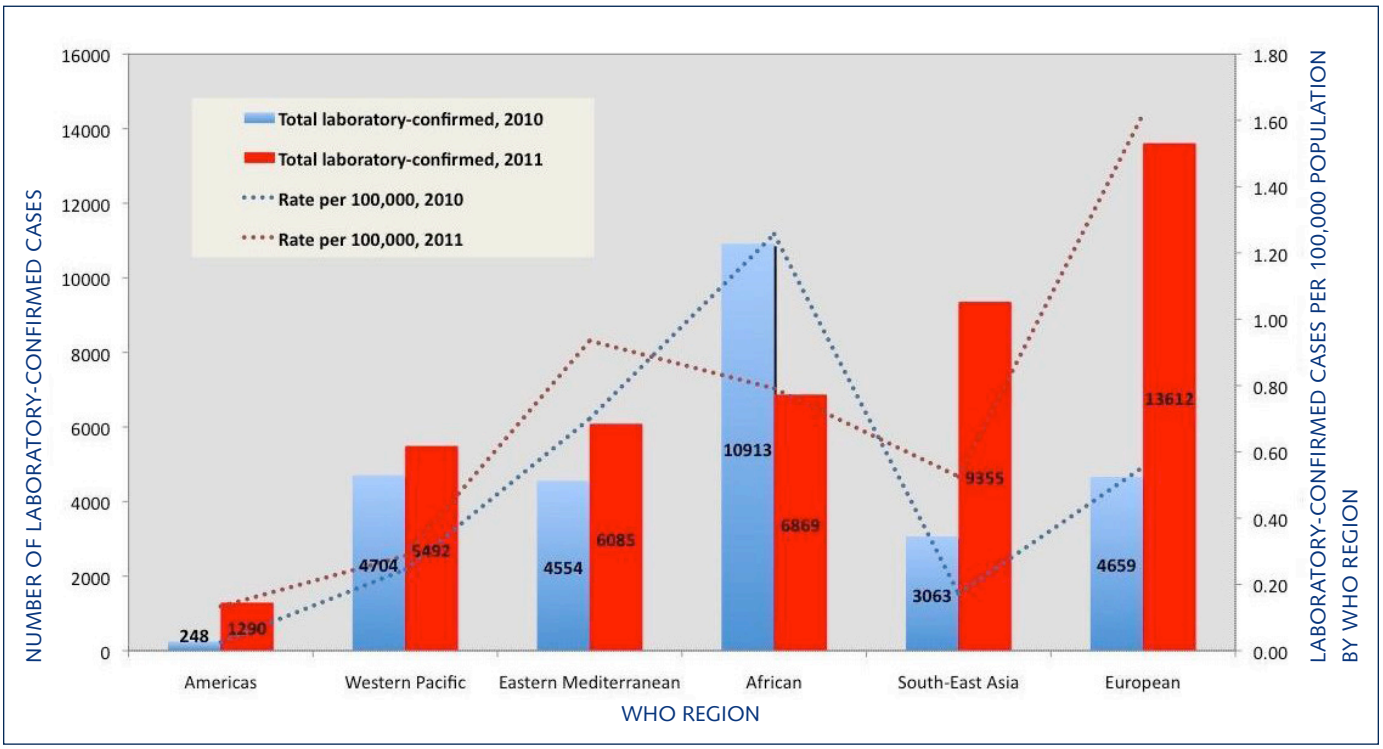
## GLOBAL SITUATION AND RISK OF U.S. IMPORTATION

In 2011, more than 40,000 laboratory-confirmed cases of measles were reported globally.[5] Global data were processed in Microsoft Excel® and ArcGIS® version 9.3.1 to calculate rates by WHO Regions and a map was created using the cartogram tool of ArcGIS® following the Gastner-Newman method (Figure 1). In this map, WHO Regions have been resized using ArcGIS® based on the number of laboratory-confirmed measles in each Region, adjusted for the population. Thus, European and the Eastern Mediterranean Regions appear larger and more prominent than the other Regions because of the high rates of laboratory-confirmed cases in 2011. The highest number of clinically confirmed and epidemiologically linked cases of measles was still reported from the African Region.[5] Also, there has been a striking increase in the proportion of cases in the Region of Americas, and the European Region from 2010 to 2011 (Figure 2). Approximately 32% of all laboratory-confirmed cases were reported from the European Region in the year 2011, compared to 17% in 2010.[5] Similarly, there has been a near three-fold rise in proportion of laboratory-confirmed cases from the Region of the Americas from 2010 to 2011.[5] Thus, although the rates of laboratory-confirmed measles were low in the Americas compared to the other Regions, the United States reported its highest number (n=216) of cases in 15 years during 2011. Fifty-five percent (n=118) of these cases were reported during the first 5 months of 2011 and 90% of these cases were associated with importation from other countries.[4] The resurgence of measles in Europe coupled with the ever-increasing trend of global migration and international travel poses a continued threat to measles control in the United States, and emphasizes the need for pre-travel vaccinations.

## DISCUSSION

Measles is highly communicable and can cause complications such as otitis media, pneumonia, severe diarrhea, and encephalitis leading to hospitalization and death in severe cases.[2,10] Due to its high communicability, even a minor drop in immunization coverage can result in rapidly spreading outbreaks and re-establishment of endemic transmission, as noted in the United Kingdom in the recent past.[11] Unvaccinated children and young adults are at a higher risk of developing measles and they place vulnerable groups such as infants and persons with contraindications to immunization at risk. During the first half of 2011, 15% of all measles cases and 15% of all post-measles hospitalizations in the

**Figure 2.** Laboratory-Confirmed Measles Cases by WHO Region, 2010 and 2011.*




*As of January 11, 2012, Data Source: World Health Organization

United States were noted in infants.[4] Similarly in Europe, measles has caused high fatality in recent years in children and adolescents who could not be vaccinated due to underlying immune-compromised conditions.[6,11] Maintaining high immunization levels with MMR vaccine is of critical importance to prevent the re-introduction of measles transmission in countries that are considered measles-free. Currently Rhode Island has a 91% immunization rate by age 36 months and a 2-dose rate at kindergarten entrance of 92%, and the goal is to improve on this rate.[12] Rhode Island is a universal vaccine supply state and mandates completion of a 2-dose schedule for children entering kindergarten and university, as well as mandated age-appropriate vaccination for day care attendees.

Swift control efforts by public health agencies, as described here, are time and resource intensive, and costly. Moreover, appropriate inter-sectoral coordination is essential to ensure rapid communication and implementation of control strategies, as noted in this case response that involved coordination among multiple state agencies, physician and laboratory networks, regional quarantine stations and Federal disease control staff. Although this was the first case of laboratory-confirmed measles in Rhode Island since 1996, timely reporting by an astute clinician followed by a prompt public health investigation and response completed within 3 days of notification ensured there were no secondary cases in the state. This response underscores the importance of maintaining awareness in the clinician community and the need to sustain epidemiologic capacity for rapid detection and control of rare but serious disease events such as measles.

Due to the continued risk of importations of measles into the United States, health-care practitioners should "think measles" in patients of any age presenting with a febrile rash illness associated with cough, coryza, or conjunctivitis, particularly those with a history of recent travel abroad. Such suspected cases should be isolated and reported immediately to public health authorities, so that an urgent mitigation response can be initiated. As well, exposures to measles might occur in various settings during travel. Therefore, physicians should recommend vaccination before travel for international travelers including for infants aged ≥6 months.[13] These actions will assure maintenance of local control while the global eradication strategy is being implemented.

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## Disclosures

The authors have no financial interests to disclose.

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