



# Measles transmission during air travel, United States, December 1, 2008–December 31, 2011<sup>☆</sup>



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## KEYWORDS

Measles;  
Contact tracing;  
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**Summary** *Background:* Flight-related measles contact investigations in the United States are coordinated by the Centers for Disease Control and Prevention (CDC). To evaluate the efficiency of CDC's measles protocol, we analyzed data from contact investigations conducted December 2008–December 2011.

*Methods:* Cases were defined as travelers diagnosed with measles that were infectious at the time of the flight. Passengers seated within 2 rows of the case-traveler and all babies-in-arms were defined as contacts. Contact information obtained from airlines was distributed to US health departments; reporting of outcomes was requested. We cross-referenced the National Notifiable Diseases Surveillance System and CDC's National Center for Immunization and Respiratory Diseases to identify unreported cases in passenger-contacts and in passengers not identified as contacts.

*Results:* Our evaluation included 74 case-travelers on 108 flights. Information for 2673 (79%) of 3399 passenger-contacts was provided to health departments; 9 cases of secondary measles were reported. No additional cases were identified.

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*Conclusion:* Our evaluation provided evidence of measles transmission related to air travel. CDC's protocol efficiently identifies passengers most at risk of exposure and infection for flights into and within the United States.  
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## Introduction

Measles is an acute viral disease transmitted by direct contact with infectious droplets or, less commonly, by airborne spread. It is characterized by a prodrome of fever and malaise, cough, coryza, and conjunctivitis, followed by a maculopapular rash.<sup>1,2</sup> Complications can include pneumonia, encephalitis, and death.

The measles vaccine was introduced in the United States in 1963, and a second dose was recommended in 1989.<sup>3</sup> In 2000, measles was declared no longer endemic in the United States, an achievement attributed to high rates of vaccination coverage.<sup>4</sup> Cases and outbreaks of measles continue to occur, however, as a result of importation from other countries and lack of adherence to recommendation for measles prevention.<sup>5–12</sup> Postexposure prophylaxis (PEP) with measles-containing vaccine (within 72 h) or immune globulin (within 6 days) may prevent infection.<sup>1</sup>

A number of studies have demonstrated that measles has been transmitted during air travel.<sup>13–18</sup> To prevent the introduction and spread of measles into and within the United States, contact investigations (CIs) involving air travel are conducted by the US Centers for Disease Control and Prevention's (CDC) Division of Global Migration and Quarantine (DGMQ), in collaboration with state and local health departments. After being notified of a measles case-traveler who traveled while infectious, DGMQ obtains passenger contact information from airlines and US Customs and Border Protection (international flights), and distributes it to state health departments based on address and telephone area code. Health departments notify and evaluate the passenger-contacts, provide prophylaxis when indicated, and voluntarily report results to DGMQ.<sup>19</sup>

The first standard CDC protocol for flight-related measles contact investigations was developed in 2005 by DGMQ in conjunction with subject-matter experts in CDC's National Center for Immunization and Respiratory Diseases (NCIRD), based on published<sup>17,18,20</sup> and unpublished data and expert opinion. That protocol defined contacts as passengers seated within 1 row of an infectious measles case-traveler, with aisles considered barriers. A 1995 investigation in which 189/484 (39%) passengers on 2 flights were interviewed and serologic testing was performed on 65 was especially influential in developing the original protocol [unpublished data: Memorandum regarding measles cases aboard an airplane investigated during an EPI-AID, 26 July 1995, Centers for Disease Control and Prevention]. One asymptomatic contact was identified through serology, and none of those interviewed had symptoms consistent with measles following their exposure.

The 2005 protocol was revised in December 2008 based on the following rationale: measles transmission related to air travel was reported in Brazil in 2006<sup>14</sup>; 2 measles cases

believed to be due to in-flight transmission were reported to DGMQ in 2007 (both were identified by the protocol in place at the time); and some health departments had voiced concerns that the seating criteria for passenger-contacts were too narrow, with the potential to miss opportunities to notify exposed passengers and provide PEP or to facilitate early recognition of secondary cases and minimize further spread. In addition, the protocol for flight-related tuberculosis contact investigations identified contacts as passengers seated within 2 rows of a case, and the highly infectious nature of measles warranted identification of passenger-contacts to be at least as inclusive as the tuberculosis protocol.

The CDC 2008 measles protocol defines contacts on aircraft with >30 passenger capacity as all passengers seated in the same row as and the 2 rows in front of and behind the case-traveler (with bulkheads considered barriers, but not aisles), plus "babies-in-arms" (children usually aged 2 years or younger, held by a ticketed adult) seated anywhere on the plane, and crew members serving passengers in the same cabin as the case-traveler. Babies-in-arms were included because they would likely not yet have begun or completed the primary vaccine series for measles, and, unlike other high-risk travelers such as pregnant women and the immunocompromised, the airlines can identify them. Travel companions of a case-traveler, regardless of seating, are also identified as contacts because of their exposure to the case-traveler other than during air travel. On aircraft with ≤30 passenger capacity, all passengers and crew are identified as contacts because these aircraft have more compact passenger seating and air flow patterns may differ from those on larger planes. In addition, the criteria for identifying a contact may be modified on a case-by-case basis if there are unusual circumstances.

This 2008 protocol has not been systematically evaluated. The purpose of this investigation was to identify the risk of measles transmission during air travel and determine whether the 2008 protocol efficiently identifies passengers most at risk of exposure and infection.

## Materials and methods

### Investigation criteria and case definitions

Our investigation included measles CIs for case-travelers who traveled by air from December 1, 2008, through December 31, 2011, and who met CDC's measles air travel protocol criteria for initiating a CI: the case-traveler was defined as a passenger in whom measles was diagnosed, either laboratory-confirmed, epidemiologically linked, or probable (based on clinical case definition and other information, such as travel history); was infectious at the

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