The Impact of Imported Measles

Prior to the 15th century, when population density was low and world trade limited, measles occurred as explosive epidemics affecting both adults and children. From the 16th century until the middle of the 20th century when a measles vaccine was developed, measles had become an endemic disease primarily affecting children. Today, travel-associated measles and imported measles cases are the primary reason for periodic outbreaks in the United States.

Public Health Discussion Points

Here are three discussion points related to evaluation of measles reporting. The answers are contained in the text, or you may refer to the answers at the end of the article.

1. Arrange the following viral diseases in order of least transmissible to most transmissible: influenza, smallpox, measles, mumps, SARS

2. Which of the following statements is true?
   a. Basic reproductive number does not affect the vaccination coverage (the proportion of a population vaccinated) that must be achieved to stop community transmission.
   b. A high basic reproductive number means that vaccination coverage does not have to be very high to stop transmission.
   c. A high basic reproductive number means that vaccination coverage must be very high to stop community transmission.

3. True or False. When considering vaccination a child less than 1 year old who will be traveling, travel to Europe is considered “safe” and the child should NOT be immunized.
A Case Report

In January, 2011, an unvaccinated eight-month-old Washington resident and his mother traveled to India. They left India on February 13 to return to Washington. The mother reported that the child had a cough prior to departure. While in transit the child developed a rash and a fever. On February 14, the child was evaluated and serologically tested at a pediatric clinic in Clark County, Washington. The serology test was positive for IgM antibody to measles. Unfortunately, despite attempts at isolation, no virus was recovered. Clinical specimens were submitted to CDC for molecular testing to attempt determination of a measles genotype. At the time of publication, Clark County had reported at least one secondary measles case and several additional reports of rash illnesses among contacts of this child were under investigation.

Measles: The Disease

Measles is a highly infectious viral disease that usually causes fever, mild respiratory symptoms and rash in more than 95% of cases.\(^1\) Contrary to the belief of some parents, measles is not always just a mild childhood rash. Unfortunately, measles complications, such as pneumonia and encephalitis, can be fatal and are still a significant source of morbidity and mortality in developing countries and among young, unvaccinated children.\(^2\)

In an unvaccinated or poorly vaccinated community, up to 16 secondary cases will occur from a single case on average. This is known as the basic reproductive number \(R_0\) and is an estimated but important description of how transmissible a disease is. For example, measles is more transmissible than smallpox and mumps (\(R_0s\) of 5-7) and influenza and SARS (\(R_0s\) of 2-4).

Epidemiology

In the decade before national measles vaccine programs began in 1963, an estimated 3-4 million U.S. residents got measles each year with 500,000 cases formally reported. Annually 48,000 (9.6%) measles cases were hospitalized, 1000 (0.2%) had permanent residual brain damage due to encephalitis, and 500 (0.1%) died.\(^3\) Since 1963, the number of reported measles cases in the United States has decreased by more than 99%: from 2001 through 2008, a total of 438 U.S.-resident cases (average 58 per year) were reported making the annual incidence of measles less than 1 case per million population.\(^4\) Among these cases, infants 6-11 months of age had the highest incidence of measles of any age group (3.5 cases/1 million person-years) and children 12-15 months of age had the second highest incidence (2.6 cases/1 million person-years).

Of the 438 U.S.-resident case-patients, 119 (27%) had traveled internationally. Among these travelers 94 (79%) were unvaccinated or had an unknown vaccination

Continued page 3
status, including 20 who were 6-11 months of age. Because the Advisory Committee on Immunization Practices (ACIP) recommends that infants 6-11 months of age traveling outside the United States receive at least one dose of vaccine, measles in these 20 case patients must be considered preventable cases.

In the United States during 2001-2008, 232 measles cases among both U.S. residents and non-residents were imported from 44 countries. Of these, roughly 85% were imported from countries in the western Pacific, Southeast Asia (including India), and Europe. During 2005-2008, the number of cases from European countries greatly increased and, in 2008, roughly 75% of the imported cases came from European countries. Europe remains a source of imported cases because high-level endemic transmission continues in several countries.

**Prevention Methods**

Measles is a vaccine-preventable disease. Because measles is highly transmissible (i.e., has a high $R_0$), only very high measles vaccination coverage (high “herd immunity”) prevents outbreaks. By 1982, every state had a law that required children to have proof of a measles vaccination or immunity to measles at school entry. Currently two doses of measles, mumps, and rubella (MMR) vaccine are recommended for all children in the United States. The first dose should be given at 12-15 months of age, and the second when the child is 4-6 years of age.

Measles incidence dropped dramatically since the late 1960s due to immunization policies, with the exception of a resurgence during 1989-1991 that resulted in the recommendation that all children receive a second dose of measles-containing vaccine. This second dose recommendation greatly contributed to the success of the measles vaccine program in maintaining high coverage in children residing in the United States. Using molecular techniques, it was demonstrated that transmission of indigenous measles largely ceased in the United States by 1993. Since that time, most cases of measles in the United States have resulted from international importation because measles is still endemic among children in much of the world; in 2009, over 20 million cases were estimated to have occurred worldwide.

Continued page 4
Measles is repeatedly reintroduced by U.S. travelers returning from foreign travel and among foreign visitors to the United States. Local transmission then may occur at airports, on airplanes, or in local communities. The risk of subsequent transmission is greatest in communities with low “herd immunity”.

Since importation of measles is now the primary reason for measles transmission in the United States, special consideration should be given to children 6–11 months of age traveling outside this country. They should receive at least one dose of measles-containing vaccine (generally given as MMR vaccine) before departure and children aged 12 months and older should receive two doses separated by at least 28 days.  

Number of Reported Measles Cases with onset date from Aug 2010 to Feb 2011

Image courtesy of WHO

NB: From Jan-2009 to Feb-2011, there have been 18,404 laboratory confirmed measles cases in South Africa

Continued page 5
Summary

Because of the volume of international travel and the high incidence of measles in some countries, importation of measles will continue in the United States. It is increasingly important to assure that all U.S. residents, and especially children, who travel internationally, are up to date for measles vaccination. Several countries in Europe have higher measles rates than the United States and present a risk of infection for travelers. In addition, to prevent local transmission of measles when cases are imported, high levels of measles vaccination coverage should be maintained.

Answers to Public Health Discussion Points

1. Transmissibility can be noted by the basic reproductive number of an infectious organism – the average number of secondary cases result from one ill person (designated $R_0$). From lowest to highest transmissibility, the diseases are in the following order ($R_0$ in parentheses): influenza ($R_0=2-3$), SARS (3-4), mumps (5-7), smallpox (5-7), and measles (12-16). This means that measles is one of the most infectious viruses for humans.
2. The correct answer is “c”. If a vaccine-preventable disease is more easily transmitted, higher vaccination rates are needed to stop community transmission. For example, vaccination of coverage of 50-60% can stop influenza transmission but coverage of at least 95% is needed to stop an outbreak of measles.
3. The correct answer is “false”. Although most imported cases to the United States come from the western Pacific and India, Europe accounted for nearly 40% of the imported cases to this country. Endemic transmission still occurs in some countries and many of these countries also have imported cases from other regions in the world.

References
