Chapter 14: Rubella

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I. Disease Description

Rubella is a viral illness caused by a togavirus of the genus *Rubivirus* and is characterized by a mild, maculopapular rash. The rubella rash occurs in 50%–80% of rubella-infected persons and is sometimes misdiagnosed as measles or scarlet fever. Children usually develop few or no constitutional symptoms, but adults may experience a 1–5-day prodrome of low-grade fever, headache, malaise, mild coryza, and conjunctivitis. Postauricular, occipital and posterior cervical lymphadenopathy is characteristic and precedes the rash by 5–10 days. Arthralgia or arthritis may occur in up to 70% of adult women with rubella. Rare complications include thrombocytopenic purpura and encephalitis.[1] The average incubation period is 14 days with a range of 12–23 days. Persons with rubella are most infectious when rash is erupting, but they can shed virus from 7 days before to 5–7 days after rash onset (i.e., the infectious period).

When rubella infection occurs during pregnancy, especially during the first trimester, serious consequences can result. These include miscarriages, fetal deaths/stillbirths, and a constellation of severe birth defects known as congenital rubella syndrome (CRS). The most common congenital defects are cataracts, heart defects and hearing impairment.[1] See Chapter 15, "Congenital Rubella Syndrome," for more details.

II. Background

During the 1962–1965 global rubella pandemic, an estimated 12.5 million rubella cases occurred in the United States, resulting in 2,000 cases of encephalitis, 11,250 therapeutic or spontaneous abortions, 2,100 neonatal deaths, and 20,000 infants born with CRS.[1]

In 2004, an independent panel of internationally recognized experts in public health,.... unanimously agreed that rubella is no longer endemic in the United States.

In 1969, live attenuated rubella vaccines were licensed in the United States. The goal of the rubella vaccination program was to prevent congenital infections, including CRS.[2] Following vaccine licensure, the number of reported cases of rubella in the United States has declined more than 99%, from 57,686 cases in 1969 to 10 cases in 2005 (CDC, unpublished data). Since 2001, the largest number of annual reported cases was 23 in 2001, and since 2003, 10 or fewer cases have been reported annually.[3] During the 1990s, the incidence of rubella among children younger than 15 years decreased (0.63 versus 0.06 per 100,000 population in 1990 versus 1999), whereas the incidence among adults aged 15 to 44 years increased (0.13 versus 0.24 per 100,000 in 1990 versus 1999).[4] However, since 2001, the incidence both among persons younger than 15 years and those age 15 to 44 years has been less than 10/1,000,000 population.[3]

Between mid-1990 and 2000, most of the reported cases occurred among persons of Hispanic ethnicity; most of these persons were born outside the United States. In 1992, incidence among Hispanics was 0.06, and rose to a high in 1998 of 0.97 per 100,000 population. Since 2001, fewer than 50% of cases were among persons of Hispanic ethnicity. During the 1990s and in 2000, rubella outbreaks occurred among members of religious communities that traditionally refuse vaccination and among adults from countries without a history of routine rubella vaccination programs.[3, 4] Since 2001, two outbreaks have been reported, each with five or fewer cases.

In 2004, an independent panel of internationally recognized experts in public health, infectious diseases and immunizations reviewed available data and unanimously agreed that rubella is no longer endemic in the United States.[2]

Despite this, rubella continues to be endemic in many parts of the world. It is estimated more than 100,000 cases of CRS occur annually globally. According to a survey of the member countries in the World Health Organization, the number of countries that have incorporated rubella-containing vaccines into their routine national immunization programs increased from 65 (12% of the birth cohort) in 1996 to 117 countries (26% of the birth cohort) in 2005. As of September 2006, two WHO regions (European, The Americas) have established rubella elimination goals for the year 2010.

III. Importance of Rapid Case Identification

Prompt identification of suspected, probable, or confirmed cases of rubella is important to avoid exposure of susceptible pregnant women. Rapid case identification and investigations are also important so that control measures can be initiated to prevent spread of the disease.

IV. Importance of Surveillance

Surveillance data are used to identify groups of persons or areas in which additional disease control efforts (such as immunization) are required to reduce disease incidence and to evaluate the effectiveness of disease prevention programs and policies.

V. Disease Reduction Goals

The proposed *Healthy People 2010* objectives include a goal to eliminate indigenous rubella and CRS in the United States by the year 2010.[5]

VI. Case Definition

The following case definition for rubella has been approved by the Council of State and Territorial Epidemiologists (CSTE) and was published in 1997.[6] The following case classifications for importation status were approved by CSTE in 2006.[7]

Clinical case definition

Rubella is an illness that has all of the following characteristics:

- Acute onset of generalized maculopapular rash
- Temperature >99°F (37.2°C), if measured
- Arthralgia or arthritis, lymphadenopathy, or conjunctivitis

Laboratory criteria for diagnosis

Laboratory criteria for diagnosis consist of the following:

- Isolation of rubella virus, or
- Significant rise between acute- and convalescent-phase titers in serum rubella immunoglobulin G antibody level by any standard serologic assay, or
- Positive serologic test for rubella immunoglobulin M (IgM) antibody, or
- PCR positive for rubella virus

Case classification

Suspected: Any generalized rash illness of acute onset

Probable: A case that meets the clinical case definition, has no or noncontributory serologic or virologic testing, and is not epidemiologically linked to a laboratory-confirmed case

Confirmed: A case that is laboratory confirmed or that meets the clinical case definition and is epidemiologically linked to a laboratory-confirmed case

Comment: Serum rubella IgM test results that are false positives have been reported in persons with other viral infections (e.g., acute infection with Epstein-Barr virus [infectious mononucleosis], recent cytomegalovirus infection, and parvovirus infection) or in the presence of rheumatoid factor. Patients who have laboratory evidence of recent measles infection are excluded.

Importation status

Internationally imported case: An internationally imported case is defined as a case in which rubella results from exposure to rubella virus outside the United States as evidenced by at least some of the exposure period (12–23 days before rash onset) occurring outside the United States and the onset of rash within 23 days of entering the United States and no known exposure to rubella in the United States during that time. All other cases are considered U.S.-acquired cases.

U.S.-acquired case: A U.S.-acquired case is defined as a case in which the patient had not been outside the United States during the 23 days before rash onset or was known to have been exposed to rubella within the United States.

U.S.-acquired cases are subclassified into four mutually exclusive groups:

Import-linked case: Any case in a chain of transmission that is epidemiologically linked to an internationally imported case.

Because many rash illnesses may mimic rubella infection and 20%–50% of rubella infections may be subclinical, laboratory testing is the only way to confirm the diagnosis.

Imported-virus case: A case for which an epidemiologic link to an internationally imported case was not identified but for which viral genetic evidence indicates an imported rubella genotype, i.e., a genotype that is not occurring within the United States in a pattern indicative of endemic transmission. An endemic genotype is the genotype of any rubella virus that occurs in an endemic chain of transmission (i.e., ≥12 months). Any genotype that is found repeatedly in U.S.-acquired cases should be thoroughly investigated as a potential endemic genotype, especially if the cases are closely related in time or location.

Endemic case: A case for which epidemiologic or virologic evidence indicates an endemic chain of transmission. Endemic transmission is defined as a chain of rubella virus transmission continuous for ≥12 months within the United States.

Unknown source case: A case for which an epidemiologic or virologic link to importation or to endemic transmission within the United States cannot be established after a thorough investigation. These cases must be carefully assessed epidemiologically to assure that they do not represent a sustained U.S.-acquired chain of transmission or an endemic chain of transmission within the United States.

Note: *Internationally imported, import-linked, and imported-virus cases are considered collectively to be import-associated cases.*

States may also choose to classify cases as "out-of-state-imported" when imported from another state in the United States. For national reporting, however, cases will be classified as either internationally imported or U.S.-acquired.

VII. Laboratory Testing

Diagnostic tests used to confirm acute or recent rubella infection or CRS include serologic testing and virus cultures. Because many rash illnesses may mimic rubella infection and 20%–50% of rubella infections may be subclinical, laboratory testing is the only way to confirm the diagnosis. Acute rubella infection can be confirmed by the presence of serum rubella IgM, a significant rise in IgG antibody titer in acute- and convalescent-phase serum specimens, positive rubella virus culture, or detection of the rubella virus by RT-PCR. Detection of wild-type virus is considered the gold standard.

Sera should be collected as early as possible (within 7–10 days) after onset of illness. IgM antibodies may not be detectable before day 5 after rash onset. In case of a negative rubella IgM in specimens taken before day 5, serologic testing should be repeated. If testing is for documentation of seroconversion (IgG), a second serum sample should be collected about 14–21 days after the first specimen. In most rubella cases, rubella IgG is detectable by 8 days after rash onset.[8] Virus may be isolated from 1 week before to 2 weeks after rash onset. However, maximum viral shedding occurs up to day 4 after rash onset.

As rubella incidence decreases, the predicative positive value of rubella IgM results decreases. False-positive serum rubella IgM tests have occurred in persons with parvovirus B19 infections or infectious mononucleosis or with a positive rheumatoid factor (indicating rheumatologic disease).[9, 10] When a false-positive rubella IgM is suspected, a rheumatoid factor, parvovirus IgM, and heterophile test may be used to rule out a false-positive rubella IgM test result. Avidity testing is another method of ruling out false-positive IgM results. Properly done identification of wild-type rubella virus also can resolve uncertainties in the serologic evaluation of suspected cases.

Immunity to rubella may be documented by determining the presence of serum IgG rubella-specific antibodies by enzyme immunoassay, hemagglutination inhibition, latex agglutination, and immunofluorescent antibody assays. (See below.)

For additional information on laboratory testing for the surveillance of vaccine-preventable diseases, see Chapter 22, "Laboratory Support for Surveillance of Vaccine-Preventable Diseases."

Serologic testing

The serologic tests available for laboratory confirmation of rubella infections and immunity vary among laboratories. The following tests are widely available and may be used to screen for rubella immunity and laboratory confirmation of disease. The state health department can provide guidance on available laboratory services and preferred tests.

Enzyme immunoassay (EIA): Most diagnostic testing done for rubella IgG and IgM antibodies uses some variation of the EIA, which is sensitive, widely available, and relatively easy to perform. EIA is the preferred testing method for IgM, using the capture technique; indirect assays are also acceptable.

Hemagglutination inhibition (HI) test: HI was once the standard and most commonly used technique and allows for either screening or diagnosis (if paired acute- and convalescent-phase sera are tested). A fourfold or greater rise in HI antibody titer in paired sera is diagnostic of recent infection. The test may be modified to detect rubella-specific IgM antibody.

Latex agglutination (LA) test: LA appears to be sensitive and specific for screening when performed by experienced laboratory personnel.

Immunofluorescent antibody (IFA) assay: IFA is an option for detection of IgG and IgM antibodies to rubella virus. Commercial assays are available in the United States. Typically, cells expressing rubella virus proteins and control cells are reacted with test serum, and any rubella virus-specific antibodies are then detected with fluorescent dye-labeled goat anti-human IgG (or IgM) and fluorescent microscopy. Negative human sera are useful for monitoring nonspecific signal. Fluorescence should be cell associated. Staining restricted to the periphery of the cell monolayer is not indicative of a true-positive result.[8]

Avidity test: The avidity assay is not a routine test and should be performed in reference laboratories. A number of avidity assays have been described.[11, 12] The purpose is to distinguish the difference between recent and past rubella infections. Low avidity is associated with recent primary rubella infection, whereas high avidity is associated with past infection or reinfection.

Virus detection/isolation

Rubella virus can be isolated from nasal, blood, throat, urine and cerebrospinal fluid specimens from persons with rubella and CRS (see Appendix 15). The best results come from throat swabs. Cerebrospinal fluid specimens should be reserved for persons with suspected rubella encephalitis. Efforts should be made to obtain clinical specimens for virus isolation from all case-patients (or from at least some patients in each outbreak) at the time of the initial investigation. Virus may be isolated from 1 week before to 2 weeks after rash onset. However, maximum viral shedding occurs up to day 4 after rash onset.

Molecular typing

Rubella virus isolates are very important for surveillance.[13] Molecular epidemiologic surveillance provides important information on

- Origin of the virus,
- Virus strains circulating in the United States, and
- Whether these strains have become endemic in the United States.

For molecular typing, throat swabs should be collected within 4 days of rash onset and sent to CDC as directed by the state health department.

Reverse transcription polymerase chain reaction (RT-PCR)

RT-PCR has been extensively evaluated for its usefulness in detecting rubella virus in clinical specimens.[14] Clinical specimens obtained for virus isolation and sent to CDC are routinely screened by RT-PCR

VIII. Reporting

Each state and territory has regulations or laws governing the reporting of diseases and conditions of public health importance.[15] These regulations and laws list the diseases to be reported and describe those persons or groups who are responsible for reporting, such as healthcare providers, hospitals, laboratories, schools, daycare and childcare facilities, and other institutions. Persons reporting should contact the state health department for state-specific reporting requirements.

Reporting to CDC

Provisional reports of rubella and CRS cases should be sent to CDC by the state health department via the National Notifiable Diseases Surveillance System (NNDSS). Reporting should not be delayed because of incomplete information or laboratory confirmation; following completion of case investigations, data previously submitted to NEDSS should be updated with the available new information.

The following data elements are epidemiologically important and should be collected in the course of a case investigation. Additional information may be collected at the direction of the state health department.

- Demographic information
- Name
- Address
  - Age
  - Sex
  - Ethnicity
  - Race
  - Country of birth
  - Length of time in United States
- Reporting Source
  - County
  - Earliest date reported
- Clinical
  - Date of illness onset
  - Duration of rash
  - Symptoms
    - Fever
    - Arthralgia or arthritis
    - Lymphadenopathy
    - Conjunctivitis
  - Complications
    - Encephalitis
    - Arthralgia or arthritis
    - Thrombocytopenia
  - Hospitalizations and duration of stay

- Outcome (patient survived or died)
  - Date of death
- If female, pregnancy history
  - If pregnant, pregnancy status
    - Number of weeks gestation at onset of illness
    - Prior evidence, date of serologic immunity, or both
    - Prior diagnosis and date of rubella
    - Date and specific titer result of prior serum rubella IgG titer
    - Number and dates of previous pregnancies and location (e.g., state or country) of these pregnancies
    - Pregnancy outcome, when available (e.g., normal infant, termination, CRS)

- Laboratory
  - Serology
  - Virus isolation
- Vaccine Information
  - Number of doses of rubella-containing vaccine received
  - Dates of vaccination
  - If not vaccinated, reason
- Epidemiologic
  - Transmission setting (infection acquired in daycare, school, workplace)
  - Relationship to outbreak (Is case part of an outbreak or is it sporadic?)
  - Source of exposure and travel history (indigenous case or imported; if imported, international out-of-state import; include state name, country name, and dates of travel)

IX. Vaccination

Live attenuated rubella virus vaccine is recommended for persons 12 months of age and older unless one of these conditions applies: a medical contraindication such as severe immunodeficiency or pregnancy; documented evidence of rubella immunity as defined by serologic evidence (e.g., a positive serum rubella IgG); documented immunization with at least one dose of rubella vaccine on or after first birthday; or birth before 1957 (except women who could become pregnant). Clinical diagnosis of rubella is unreliable and should not be considered in assessing immune status.

Because two doses of combined measles-mumps-rubella (MMR) vaccine are recommended in the current schedule for measles vaccination, most children and adolescents now receive two doses of rubella vaccine. Rubella vaccine, as MMR, is recommended at 12–15 months of age. A second dose of MMR is recommended at 4–6 years of age.[16]

Healthcare providers who treat women of childbearing age should routinely determine rubella immunity and vaccinate those who are susceptible and not pregnant. Women found to be susceptible during pregnancy should be vaccinated immediately postpartum.[16]

In 2001, the Advisory Committee on Immunization Practices (ACIP) reviewed data from several sources indicating that no cases of CRS had been identified among infants born to women who were vaccinated against rubella within 3 months prior to conception or early in pregnancy. However, a small theoretical risk of 0.5% cannot be ruled out. On the basis of these data, ACIP recommended that pregnancy be avoided for 28 days after receipt of a rubella-containing vaccine instead of 3 months, as previously recommended.[17]

X. Enhancing Surveillance

The following activities may be undertaken to improve the comprehensiveness and quality of surveillance for rubella. Additional guidelines for enhancing surveillance are presented in Chapter 19, "Enhancing Surveillance."

Promoting awareness of rubella and CRS in the United States

Although only 68 cases of rubella and 5 cases of CRS were reported between 2001 and 2005, it is likely that not all cases were identified. Efforts should continue to promote physicians' awareness of the possibility of rubella and CRS, especially when evaluating patients with suspected measles who have negative serologic tests for acute measles infection, (i.e., negative serum measles IgM).

Many persons who received childhood immunizations in other countries may never have had the opportunity to receive rubella vaccine.

Promoting awareness of high-risk groups for rubella infection and CRS birth

Rubella vaccine is not administered routinely in many countries, and in others rubella vaccine was only recently added to the childhood immunization schedule. Thus, many persons who received childhood immunizations in other countries may never have had the opportunity to receive rubella vaccine. Healthcare providers should have a heightened index of suspicion for rubella and CRS births in persons from countries without a history of routine rubella vaccination programs or recently implemented programs.

Expanding laboratory testing

Serologic tests for measles and rubella may be done sequentially or simultaneously. All persons with suspected cases of measles who have a negative serum measles IgM test should be tested for rubella IgM and IgG. All persons with suspected cases of rubella should be tested for serum rubella IgM and, if negative and measles is suspected, tested for measles IgM.

Searching laboratory records

Audits of laboratory records may provide reliable evidence of previously unreported, serologically confirmed or culture-confirmed cases of rubella. This activity is particularly important during outbreaks as an aid to defining the scope of disease transmission in an area.

Conducting active surveillance

In outbreak settings, active surveillance for rubella should be maintained for at least two incubation periods (46 days) following rash onset of the last case. Two incubation periods allow for the identification of transmission from a subclinical case. Surveillance for CRS should be implemented when confirmed or probable rubella cases are documented in a setting where pregnant women might have been exposed.

Monitoring surveillance indicators

Regular monitoring of surveillance indicators, including time intervals between diagnosis and reporting of cases and completeness of reporting, may identify specific areas of the surveillance and reporting system that need improvement. The following indicators should be monitored:

- The median interval between rash onset and notification of a public health authority, for confirmed cases
- The proportion of confirmed cases reported to the NNDSS with complete information
- The proportion of confirmed cases that are laboratory confirmed
- The proportion of confirmed cases among women of child-bearing age with known pregnancy status

XI. Case Investigation

The goal of rubella case investigation is to prevent exposure of susceptible pregnant women, and thereby prevent cases of CRS. It is essential that potentially susceptible, exposed pregnant women be identified, evaluated, and counseled. The Rubella Surveillance Worksheet (see Appendix 16) may be used as a guideline in conducting a case investigation, as well as the *MMWR* Recommendations and Reports issue entitled "Control and Prevention of Rubella:

Evaluation and Management of Suspected Outbreaks, Rubella in Pregnant Women, and Surveillance for Congenital Rubella Syndrome."[18]

Establishing a diagnosis of rubella

Because clinical diagnosis of rubella is unreliable, cases must be laboratory confirmed, especially if the reported cases are not epidemiologically linked to a laboratory-confirmed case.

The occurrence of a rubella-like illness in recently vaccinated persons can pose particular difficulties in the outbreak setting. Five percent of recipients of rubella-containing vaccine may develop rash approximately 1 week after vaccination, and vaccination of susceptible persons results in production of IgM antibody that cannot be distinguished from that resulting from natural infection. Cases in persons vaccinated within 7 days of a rubella-like illness who are IgM positive should be classified as confirmed cases of wild-type rubella if they are epidemiologically linked to a laboratory-confirmed case. Molecular typing techniques can distinguish between vaccine and wild-virus rash for those vaccinated 7–10 days before rash onset. Specimens for molecular typing should be obtained within 4 days of rash.

Obtaining accurate pregnancy status for adult women

All women of childbearing age who are contacts of a person with a suspected or confirmed case should have their pregnancy status determined. If a pregnant woman is infected with rubella, immediate medical consultation is necessary. If a pregnant woman is susceptible to rubella, precautions should be taken to prevent any type of exposure to persons infected with rubella; these precautions may include ensuring rubella immunity of household contacts and isolating women from settings where rubella virus has been identified.[17]

Obtain accurate and complete immunization histories

Rubella case investigations should include complete immunization histories that document any doses of rubella-containing vaccine.

Identifying the source of infection

Efforts should be made to identify the source of infection for every confirmed case of rubella. Case-patients or their caregivers should be asked about contact with other known cases. Since many rubella cases (20%–50%) are asymptomatic, identification of a source will not always be possible. When no history of contact with a known case can be elicited, opportunities for exposure to unidentified cases in high-risk populations (e.g., foreign-born persons) should be sought. Investigating sources of exposure should be directed to the place and time period in which transmission would have occurred. Such exposures may occur in colleges or universities, workplaces, and communities where unvaccinated persons congregate.

Assessing potential for transmission and identifying contacts

In recent outbreaks, transmission has occurred in households, communities, workplaces, and prisons. As part of the case investigation, the potential for further transmission should be assessed, and contacts (particularly susceptible pregnant women) of the case-patient during the infectious period (7 days before to 7 days after the onset of rash) should be identified.

Obtaining specimens for virus isolation

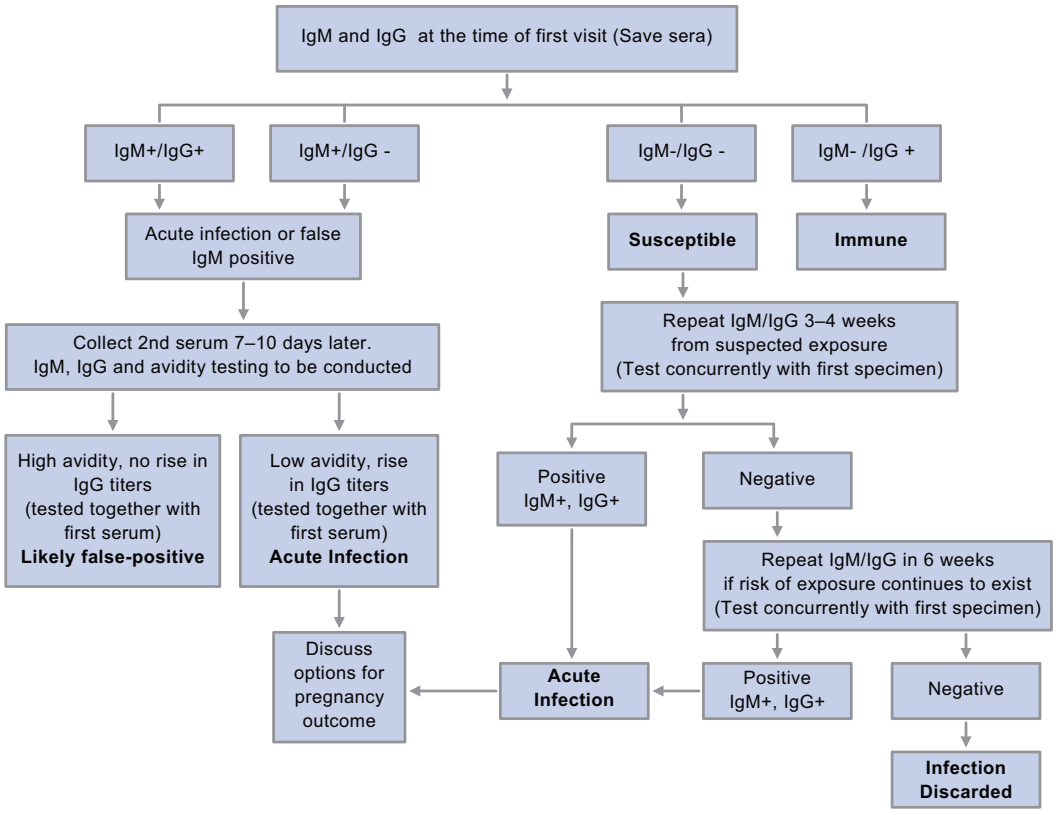
Efforts should be made to obtain clinical specimens (throat swabs and urine) for virus isolation from all case-patients (or from at least some patients in each outbreak) at the time of the initial investigation. These specimens for isolation of rubella virus should be obtained within 4 days after rash onset. Isolates are essential for tracking the epidemiology of rubella in the United States, now that rubella virus may no longer continuously circulate in this country. By comparing isolates from new case-patients with other virus samples, the origin of particular virus types in this country can be tracked.[13] Furthermore, this information may help in documenting the interruption of indigenous transmission. See Appendix 15 for the procedure to follow in collection of specimens.

Conducting laboratory evaluation of exposed pregnant women

The algorthim in Figure 1 shows a stepwise process for laboratory evaluation of pregnant women exposed to rubella. A blood specimen should be taken as soon as possible and tested for rubella IgG and IgM antibody. The specimen should be stored for possible retesting. If the IgM is positive regardless of the IgG response, this may indicate recent or acute infection or a false-positive IgM. The next step is to repeat the test in 7–10 days. Testing will include IgM, IgG, and avidity (if IgG is present). If the repeat IgM is positive with low avidity or a significant rise in IgG titers, acute infection is likely. If the IgM and IgG are positive and the avidity is high, this may indicate either a false-positive result or a reinfection. With the low incidence of rubella in the United States, false-positive tests are common. Reinfection with rubella occurs more frequently with vaccine-induced immunity than with natural disease; however, the risk of fetal infection is extremely rare. If the IgM is negative and the IgG is positive at the time of exposure (the first specimen), this mostly likely indicates immunity. If the IgM and IgG are negative in the first specimen, a second specimen should be taken 3 to 4 weeks after exposure and tested concurrently with the first specimen for IgM, IgG, and avidity (if IgG is present). A negative IgG response with the first specimen and a positive IgG response with the second specimen indicate that infection has occurred. If the IgG and IgM remain negative and there are no additional exposures, an IgG negative result at 4 weeks indicates that infection has not occurred. As long as the exposure to rubella continues, it is important to continue testing for IgG and IgM responses.

Although this is not recommended, many pregnant women with no known exposure to rubella are tested for rubella IgM as part of their prenatal care. If rubella IgM test results are positive for persons who have no or low risk of exposure to rubella, additional laboratory evaluation should be conducted. Laboratory evaluation is similar to that described in the IgM-positive section of Figure 1. The difference is that the timing of exposure to rubella is unknown.

Figure 1. Algorithm for serologic evaluation of pregnant women exposed to rubella



Establishing a pregnancy outcome registry for women diagnosed with rubella during pregnancy.

All pregnant women infected with rubella during pregnancy should be followed to document the pregnancy outcome (e.g., normal infant, termination, CRS). Outcomes that are documented should be reported to CDC.

XII. Outbreak Control

Aggressive response to rubella outbreaks may interrupt disease transmission and will increase vaccination coverage among persons who might otherwise not be protected. The main strategies are to define at-risk populations, to ensure that susceptible persons are rapidly vaccinated (or excluded from exposure if a contraindication to vaccination exists), and to maintain active surveillance to permit modification of control measures if the situation changes.

Control measures should be implemented as soon as at least one case of rubella is confirmed in a community. In settings where pregnant women may be exposed, control measures should begin as soon as rubella is suspected and should not be postponed until laboratory confirmation. All persons at risk who cannot readily provide laboratory evidence of immunity or a documented history of vaccination on or after their first birthday should be considered susceptible and should be vaccinated if no contraindications exist.

In schools and other educational institutions, exclusion of persons without valid evidence of immunity may limit disease transmission and may help to rapidly raise the vaccination level in the target population. All persons who have been exempted from rubella vaccination for medical, religious, or other reasons also should be excluded from attendance. Exclusion should continue until 3 weeks after the onset of rash of the last reported case-patient in the outbreak setting.

Mandatory exclusion and vaccination of adults should be practiced during rubella outbreaks occurring in medical settings because pregnant women may be exposed.

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