Measles rev Jan 2018

BASIC EPIDEMIOLOGY

Infectious Agent
The measles virus-a single-stranded, RNA-encoded paramyxovirus

Transmission
Virus is spread directly from person to person by inhalation of suspended droplet nuclei or by contact with infective nasopharyngeal secretions. It can also be transmitted indirectly by objects (fomites) contaminated with nasopharyngeal secretions. Measles is one of the most contagious of all infectious diseases, with >90% attack rates among susceptible close contacts.

Incubation Period
The incubation period ranges from 7–21 days (average 10–12 days) from exposure to the onset of prodromal symptoms.

Communicability
Measles is most communicable during the 3 - 4 days preceding rash onset. Persons with measles have been shown to shed virus between 4 days prior to rash onset (with the onset of prodromal symptoms) and for 4 days after the rash has appeared.

Clinical Illness
Measles is characterized by a generalized maculopapular rash (a flat, red area on the skin that is covered with small confluent bumps), fever, and one or more of the following: cough, coryza (runny nose), conjunctivitis (eye inflammation or red eyes). There are three stages of illness:

- **Prodrome**
  - Measles has a distinct prodromal stage that begins with a mild to moderate fever (as high as 105°F) and malaise. Usually within 24 hours there is an onset of conjunctivitis, photophobia (sensitivity to light), coryza (sneezing, nasal congestion, and nasal discharge), an increasingly severe cough, swollen lymph nodes (occipital, postauricular and cervical at the angle of the jaw), and Koplik's spots (seen only for a day or two before and after onset of rash). These spots are seen as bluish-white specks on a rose-red background appearing on the cheek and lip mucosa usually opposite the molars.
- **Rash**
  - The rash begins with flat, faint eruptions usually on the upper lateral parts of the neck, behind the ears, along the hairline and on the posterior parts of the cheeks. The rash may appear from 1–7 days after the onset of the prodromal symptoms, but usually appears within 3–4 days. Individual lesions become more raised as the rash rapidly spreads over the entire face, neck, upper arms and chest. In severe cases, the lesions may merge together to form large rash masses. In mild cases, the rash may be macular and more nearly pinpoint, resembling that of scarlet fever.
- **Fever**
  - Fever is mild to moderate early in the prodrome, and goes up when the rash appears. Temperatures may exceed 40°C (104°F), and usually falls 2–3 days after rash onset. High fever persisting beyond the third day of the rash suggests that a complication (e.g., ear infection) may have occurred.

DEFINITIONS

Clinical Case Definition
An illness characterized by all of the following criteria:

- A generalized maculopapular rash lasting at least 3 days, **AND**
- A temperature ≥ 101.0°F (≥ 38.3°C), **AND**
- Cough, coryza, or conjunctivitis.

Laboratory Criteria for Diagnosis

- IgG seroconversion or a significant rise in measles immunoglobulin G antibody level by any standard serologic assay*, **OR**
- Isolation of measles virus from a clinical specimen*, **OR**
- Detection of measles-virus-specific nucleic acid by PCR*, **OR**
- Positive serological test for measles immunoglobulin M* not otherwise ruled out by other confirmatory testing or more specific measles testing in a public health laboratory.

*Not explained by MMR vaccination during the previous 6-45 days.

Case Classification

- **Confirmed**: An acute febrile rash illness (temperature can be lower than 101 ° and rash < 3 days) that is:
  - Laboratory confirmed, **OR**
  - Epidemiologically linked to a laboratory confirmed measles case.
- **Probable**: No probable case definition

SURVEILLANCE AND CASE INVESTIGATION

Case Investigation
In the current setting of measles elimination in the United States, rapid investigation and reporting of all suspected measles cases is extremely important to ensure that measles remains controlled. **Measles investigations are high priority and time sensitive**. The investigation steps below describe public health activities that should be completed when a suspect measles case is reported.

Case Investigation Checklist

- ☐ Immediately isolate anyone with suspected measles.
  - Isolate either at home or in the hospital under airborne precautions (respiratory isolation in negative air pressure room, if possible).
- ☐ Initiate the investigation and contact the provider AND case patient (or proxy) the same day the report is received.
- ☐ Confirm that clinical presentation and laboratory results meet the case definition.
  - If laboratory specimens have not been collected, make arrangements to have them collected as soon as possible.
  - Vaccinated individuals may have atypical symptoms.
  - Someone with known exposure and prodromal symptoms without a rash should be considered a measles suspect.
  - If the suspect case was reported within 3 days of rash onset, there should be appropriate follow-up to establish a rash duration of at least 3 days.
  - See Testing of Suspect Cases Who Have Recently Received Measles-containing Vaccine below.

- Notify DSHS EAIDB and/or your regional office immediately.
- Verify that the laboratory has forwarded viral and serology specimens to the DSHS laboratory. See Laboratory Procedures.
    - Testing at a public health laboratory (e.g., DSHS lab in Austin) is preferred.
        - PCR is not currently available at commercial laboratories.
    - Collection of throat (preferred), NP, and/or urine specimens for PCR are strongly encouraged and as soon as possible.
        - Measles IgM may be falsely positive due to previous vaccination or the use of less accurate tests used in most commercial laboratories.
        - Measles IgM may be falsely negative if collected within the first three days after rash onset.
        - PCR is fast, unlike culture and should be collected as soon as possible after rash onset. Detection of measles via PCR is most successful between the first day of rash through the 3 days following rash onset but may still be detected as late as 10-14 days post rash onset.
        - PCR is preferred for vaccinated individuals,
        - Serum tested at commercial labs can be forwarded to the DSHS lab for confirmatory testing. If this needs to be done notify EAIDB to facilitate this process.
        - Only viral specimens can be genotyped.
- If a private provider/hospital cannot or will not collect specimens, public health staff should make every arrangement to collect specimens instead.
- Interview patient and review medical records or speak to an infection preventionist or physician to verify case exposure, underlying health conditions, course of illness, vaccination status and travel history.
    - Request copies of admission and discharge summaries and laboratory results.
- Determine vaccination status of the case. Sources of vaccination status that should be checked include:
    - Case (or parent), ImmTrac, school records, primary care provider, etc.
- Determine possible **risk factors** and timeframes (within 3 weeks prior to symptom onset):
    - Exposure to a confirmed measles case
    - Travel to a measles endemic/outbreak area or contact with a traveler from a measles endemic/outbreak area
    - Transit through an international airport
    - Exposure to international visitors or venues that may attract international visitors. Previous outbreaks have been identified at:
        - US tourist venues (e.g., Disneyland or Orlando, FL)
        - International sports competitions (e.g., Olympics, Little League World Series)
        - Conferences (e.g., international trade show)
    - Use of public transit in a major U.S. city
    - Check the news or with the VPD team to identify any current outbreaks that the patient may have been exposed to.
- Alert other health departments of exposures that may have occurred in their jurisdictions as soon as possible.
    - Notify EAIDB if other states/counties need to be notified.
- Determine whether a contact investigation should be initiated (See the Determine Whether to Initiate a Contact Investigation Section).

- If applicable, identify all close contacts and manage based on risk level and susceptibility. PEP needs to be given in a short time period, so assess contacts quickly.
    - See Managing Contacts of Confirmed or Highly Suspicious Measles Cases flowchart at the end of this chapter.
    - For details on identification and prioritization of contacts see the following segments:
        - Identify Contacts
        - Prioritize Contacts
    - For details on prophylaxis see the following segments:
        - Provide Post Exposure Prophylaxis for Susceptible Contacts
        - Control Measures
        - Recommendations for Prophylaxis, Quarantine and Monitoring of Measles Contacts table
    - For details on monitoring contacts for development of symptoms, see Monitor Measles Contacts.
- If the case is confirmed, conduct activities outlined in Outreach Activities.
- If more than one case is identified or an outbreak occurs, see Managing Special Situations.
- All confirmed and suspect case investigations must be entered in NBS. Suspect cases should be updated to "not a case" or "confirmed" once status is determined. Confirmed cases should be submitted for notification in the NEDSS Base System (NBS). Please refer to the *NBS Data Entry Guidelines* for disease specific entry rules.

Control Measures

- Susceptible contacts to suspected cases should be vaccinated with measles vaccine within 72 hours of exposure OR should have IG administered within six (6) days of exposure. Contact DSHS EAIDB if IG/vaccine is needed.
- If vaccination of exposed contact is contraindicated (or the PEP window has passed), exclude exposed contact from school or work for at least 21 days after last rash onset. Exclusion from school or daycare of unvaccinated, exposed children for 21 days from last rash onset is required by Texas Administrative Code.
- Table 1 (and its extensive footnotes) has contact and setting specific recommendations for prophylaxis, testing, quarantine/exclusion, and symptom monitoring.

Testing of Suspect Cases Who Have Recently Received Measles-Containing Vaccine

Ten percent of recipients of measles-containing vaccine may develop fever and rash approximately 1 week after vaccination. Vaccination causes production of IgM antibody that cannot be distinguished from the antibody resulting from natural infection.

A positive measles IgM test cannot be used to confirm the diagnosis of measles in persons with measles-like illness who received measles vaccine 6–45 days before onset of rash. A negative test would exclude the diagnosis, however. A viral specimen should be collected for those vaccinated more than 14 days before illness onset to confirm measles diagnosis. For persons receiving vaccine 6–14 days prior to rash onset, testing is not recommended unless the patient is known to be exposed.

Outreach Activities

When health departments confirm a case of measles, they should conduct the following outreach activities. Materials to assist with these activities can be found in the Measles Communication Toolkit at http: http://www.dshs.state.tx.us/idcu/disease/measles/links/

- Issue a health alert to all area providers, hospitals and urgent care clinics.
    - Describe the situation.
    - Provide instructions on ensuring staff immunity.
    - List symptoms to look for.
    - Instruct on what to do if a suspect case is identified (e.g., isolation, testing, reporting, etc.).
- Contact all entities likely to have exposure (e.g., if measles case is school-aged, notify schools).
    - Describe the situation.
    - Provide instructions on checking vaccine records.
    - List symptoms to look for.
    - Instruct on what to do if symptomatic persons are identified.
- Issue a press release if wide-spread community exposure is suspected.
- Have a 24/7 phone for providers to call if measles is suspected (existing reporting/afterhours/on call numbers can be used).
- Initiate active surveillance for additional cases and continue for a minimum of 6 weeks after the onset of the last case.
    - Contact healthcare providers in the jurisdiction to notify them of the situation and request reporting of any suspect case.
- Provide a daily line list of suspects and cases to DSHS EAIDB (during an outbreak).

Determine Whether to Initiate a Contact Investigation

- If a case is highly suspicious for measles (e.g., clinically compatible illness in an under/unvaccinated person with exposure or history of travel), a contact investigation should be initiated even if laboratory confirmation of the case is not yet available.
- If a suspect measles case is not strongly suspicious for measles (e.g., clinically compatible illness in a person who has received two doses of MMR vaccine and does not have measles exposure), the results of laboratory testing should be obtained before initiating a contact investigation.
- If an IgM positive test result has already been obtained on a *vaccinated* suspect case that is not strongly suspicious for measles, repeat IgM testing or additional measles testing (PCR) can be performed at a public health laboratory before a contact investigation is initiated.
- Contact the VPD team
    - if assistance is needed determining whether a contact investigation should be initiated.
    - if a contact investigation is initiated.

Identify Contacts

- A contact of a measles case is anyone who has shared the same airspace with a person who is infectious with measles.
    - Anyone in the same airspace (same room, no minimum amount of time) as the suspected case up to 2 hours after the case has left should be considered exposed,
    - The infectious period is four days before rash onset through four days after rash onset [day of rash onset is day 0].
- No minimum time period has been established for exposure, but it is presumed that longer exposures are more likely to result in measles transmission than brief, transient exposures.

- When exposures have occurred in venues in which it is not possible to identify individuals, it is helpful to notify local health care providers so that they can be on the alert for possible cases. In addition, some health jurisdictions have issued press releases to notify the public.
- If the case was traveling by plane, ship, bus or train during the infectious period, obtain all travel information (obtain boarding pass or e-reservation, if possible) and call EAIDB, who will contact the CDC.
    - Appendix B has more information on how these types of exposures/notifications are handled.

Prioritize Contacts for Investigation

In the event that contacts have to be prioritized, please contact your Regional Office and ask for assistance. Measles is considered a public health emergency and every effort should be made to assess all contacts to interrupt transmission.

However, if it is not feasible to investigate all possible contacts in an exposure setting, possible contacts should be prioritized for investigation.

The following contacts, if susceptible to measles, are at the greatest risk of infection or severe disease, or are more likely to transmit measles to others and should be prioritized for investigation:

- Household contacts
- Healthcare personnel of any age or others with occupations that require interaction with high risk populations (e.g., daycare workers)
- Pregnant women
- Immunocompromised people
- Persons under five years of age in settings with known unvaccinated persons (e.g., childcare settings)
- Infants

There are scant data on factors that make transmission of measles more likely, however if it is necessary to prioritize the investigation further, possible information to consider includes the following:

- Length of time of exposure to case
- Proximity to case
- Ventilation in the exposure setting, and
- The time of exposure related to when the case left the setting

In addition, the infectiousness of the case at the time of exposure may increase or decrease the possibility of transmission. Persons with measles are most infectious at the late prodromal phase of illness immediately prior to rash onset when cough and coryza are at their peak. The presence and frequency of cough in the case may affect the possibility of transmission. Cases who have received measles-containing vaccine in the past may be less symptomatic and also less infectious.

Determine Susceptibility of Contacts

Non high-risk people† can be presumed to be immune to measles for the purposes of measles case investigations if they:

- were born prior to 1957 regardless of nationality; or
- have written documentation with dates of receipt of at least one dose of measles-containing vaccine given on or after their first birthday in 1968 or later; or
- have documented IgG+ test for measles; or
- laboratory confirmation of previous disease; or
- served in the U.S. armed forces; or
- were born in the U.S. in 1970 or later and attended a U.S. elementary school;‡ or
- entered the U.S. in 1996 or later with an immigrant visa or have a green card.‡

†Additional evidence of immunity is required for exposed high-risk persons, e.g., healthcare personnel of any age, pregnant women, immunocompromised people, household contacts of a case, or persons in settings with known unvaccinated persons (e.g., childcare settings). Additional evidence of immunity may also be required during an outbreak. Immunity can be presumed if the exposed person:

  - has documentation of a positive measles IgG test; or
  - has documentation of two doses of measles vaccine given in 1968 or later, separated by at least 28 days, with the first dose on or after the first birthday

‡Unless known to be unvaccinated for measles, e.g., having a medical contraindication to vaccination or being philosophically or religiously opposed to vaccinations.

Managing Close Contacts

Provide Post-Exposure Prophylaxis for Susceptible Contacts

- The MMR vaccine may be given within 72 hours of exposure to persons ≥6 months of age with 1 or no documented doses of MMR, if not contraindicated.
- Children under 1 year of age that receive MMR will still need to have two doses of MMR after 1 year of age.
- Pregnant women should not be given MMR. Give IGIV instead (arrangements will need to be made with the woman's healthcare provider).
- Immune globulin (IG) may be given to exposed susceptible people of any age through day 6 after exposure.
  - The recommended dose of IG is 0.5 mL/kg (maximum dose=15 mL) intramuscularly (IM).
  - Pregnant women and immunocompromised individuals should get IGIV.
  - For persons already receiving IGIV therapy prior to exposure, ≥400 mg/kg <3 weeks before measles exposure should be sufficient to prevent measles infection.
  - It is unknown if administration of IG prolongs the incubation period. If symptoms consistent with measles occur within 28 days of exposure, persons who have received IG should be instructed to isolate themselves immediately and notify their health department.
- DSHS has IG for measles exposures. DSHS does NOT have IGIV.
- Additional information about measles PEP can be found here: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm

Risk Factor	Time from first exposure	
	< 72 hours	72 hours through day 6
Infant less than 6 months old	Give intramuscular IG: 0.5 mL/kg	Give IGIM: 0.5 mL/kg
Infant age 6 through 11 months	Give MMR vaccine if no contraindications	Give IGIM: 0.5 mL/kg
Susceptible pregnant woman	Give IGIV: 400 mg/kg	Give IGIV: 400 mg/kg
Severely immunocompromised	Give IGIV: 400 mg/kg	Give IGIV: 400 mg/kg
Susceptible close contact over 1 year old	Give MMR vaccine if no contraindications	Give IGIM: 0.5 mL/kg of body weight—for those ≥66 pounds, 15 mL is the maximum dose

Administer Immune Globulin

- Screen for contraindications.
  - Immunoglobulin A deficiency (IgA)
  - Severe thrombocytopenia or any coagulating disorder that prevents intramuscular injections
  - History of anaphylactic reaction to a previous dose of IG.
- Provide product information, available at: http://www.fda.gov/downloads/BiologicsBloodVaccines/BloodBloodProducts/ApprovedProducts/LicensedProductsBLAs/FractionatedPlasmaProducts/UCM371376.pdf
- Give immune globulin (IG) intramuscularly (IM) to children and adults with a 1 to 2 inch needle, depending on recipient's weight.
  - Regardless of age, the dose is 0.5 ml/kg.
  - The maximum dose is 15 mL IM (anyone over 66 pounds will get the max dose).
  - Pregnant women and immunocompromised persons should receive IGIV from their healthcare provider.
- Select a large muscle mass that can support the administration of a large volume of IG.
  - For children <3 years of age, administer IG into the vastus lateralis (outer thigh) muscle with a 7/8 to 1 inch needle. For certain very small infants a 5/8 inch needle may be adequate.
  - For persons ≥3 years of age, administer IG into the ventrogluteal or dorsogluteal muscle with a 1-2 inch needle.
  - For adults with sufficient deltoid muscle mass, the deltoid muscle may be used.
- Do not administer more than 3 ml of IG per injection site in children or more than 5 ml of IG per injection site in adults.
- Receipt of MMR after IG or IG after MMR:
  - **MMR after IG:** IG and measles vaccine should not be given at the same time. Any susceptible contacts exposed to measles who received IG should be given MMR vaccine provided the person is 12 months or older (and the vaccine is not contraindicated). MMR vaccine should be administered:
    - No earlier than 6 months after IGIM administration
    - No earlier than 8 months after IGIV administration
  - **IG after MMR:** If IG is administered within 2 weeks following the administration of MMR or varicella vaccine, the individual should be revaccinated. MMR vaccine should be administered:
    - No earlier than 6 months after IGIM administration
    - No earlier than 8 months after IGIV administration

    - For more information: https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm
- IG can be administered simultaneously with, or at any interval before or after, any inactivated vaccine.
- Anyone that receives IG should not receive a live virus vaccine (MMR or varicella vaccine) for at least 6 months.

Monitor Measles Contacts
Measles contacts, even vaccinated contacts, should monitor themselves for measles symptoms from day 5 after first exposure through day 21 after last exposure (day of exposure is day 0). Information containing the recommended follow-up of measles contacts for both low-risk (Table 2) and high-risk (Table 3) contacts is available in the tables portion of the measles Investigation Guidance document. Contacts should be instructed to isolate themselves immediately if measles symptoms develop and notify their health department. If they plan to seek medical care, they should contact the hospital or doctor's office ahead of time to notify them that they might have measles.

Contacts that are unvaccinated should be asked to stay home (children at school or daycare must stay home) and monitored by the health department in addition to self-monitoring. The contacts should be called every few days to ensure they are still feeling well.

Exclusion
According to the Texas Administrative Code (TAC), children in school and childcare settings shall be excluded for 4 days after rash onset or in the case of an outbreak, exclude unimmunized child for at least 21 days after the last date the unimmunized child was exposed.

Susceptible adults should be instructed to stay home from work and any other activities.

MANAGING SPECIAL SITUATIONS

Cases among Employees or Attendees at Schools Exclude persons with suspected measles from school until 4 days have passed since rash onset if not immunocompromised.

- All students and school staff born in or after 1957 who cannot provide adequate evidence of immunity should be vaccinated, regardless of exposure status. A first dose should be given to those who are unvaccinated. Recommend a second MMR to persons who have previously received only one MMR as long as 28 days have passed since the first dose.
- Identify all persons at the school who were potentially exposed to the case.
    - Recommend that susceptible, unimmunized persons receive the MMR vaccine within 72 hours of exposure (or if immunocompromised, pregnant or under one year of age, IGIV or IG within 6 days). Exclude all exposed persons who were susceptible and unimmunized at the time of exposure unless they received PEP (see Table 1).
    - Exposed persons who had received one dose of measles-containing vaccine prior to the exposure can return to school after they receive their second dose of MMR, but should be educated about symptoms of measles and told to stay home if symptoms develop.
    - Susceptible, unimmunized persons who continue to refuse the recommended measles vaccination(s) following exposure to measles should be asked to stay home from school or child care until 21 days after the last date the unimmunized child was exposed.
- Maintain daily active surveillance of all school contacts to assess for prodromal signs and symptoms of rash illnesses compatible with measles for 21 days from the last possible exposure in the school.

Cases among Employees or Attendees at Childcare Facilities
Exclude persons with suspected measles from child care until 4 days have passed since rash onset if not immunocompromised.

- All students and staff born in or after 1957 who cannot provide adequate evidence of immunity should be vaccinated, regardless of exposure status (assuming they are old enough for MMR). A first dose should be given to those who are unvaccinated. Recommend a second MMR to persons who have previously received only one MMR as long as 28 days have passed since the first dose.
- Identify all persons at the childcare facility who were potentially exposed to the case.
    - Recommend that susceptible, unimmunized persons receive the MMR vaccine within 72 hours of exposure (or if immunocompromised, pregnant or under one year of age, IGIV or IG within 6 days).
        - Exclude all exposed persons who were susceptible and unimmunized at the time of exposure (see Table 1), *regardless of PEP*.
    - Exposed persons who had received one dose of measles-containing vaccine prior to the exposure cannot return to child care after they receive their second dose of MMR.
    - Susceptible, unimmunized persons who continue to refuse the recommended measles vaccination(s) following exposure to measles should be asked to stay home from child care until 21 days after the last date the unimmunized child was exposed.
- Maintain daily active surveillance of all child care contacts to assess for prodromal signs and symptoms of rash illnesses compatible with measles for 21 days from the last possible exposure in the school.

Case(s) in a Medical Setting

- To prevent measles outbreaks in health care settings, health care workers (defined as anyone who works, studies or volunteers in a healthcare facility of any kind) should have documented immunity to measles *before* exposure, ideally as a condition of employment.
    - Health care facilities should maintain readily available documentation of immunity.
    - Acceptable evidence of immunity to measles in health care workers includes (MMWR 1998; 47[No. RR-8]:11):
        - Documented administration of 2 doses of live measles virus vaccine given on or after the first birthday (inactivated measles vaccines were in use from 1963–1967), or
        - Laboratory evidence of immunity, or
        - Born before January 1, 1957 – Healthcare facilities should consider recommending measles, mumps, rubella (MMR) vaccination for unvaccinated workers born before 1957 without a history of measles disease or laboratory evidence of immunity, or
        - Documentation of health care provider-diagnosed measles.
- If a person with measles is treated in a health care setting during the contagious period, identify all potentially exposed patients, visitors, health care workers, volunteers and other staff and assess status of their immunity to measles.
- If an exposed healthcare worker has had only one documented dose of measles-containing vaccine, give an additional dose of vaccine. If the second dose can be given with 72 hours of the exposure, consider the person immune. If vaccine cannot be administered within 72 hours, the healthcare facility can test for measles IgG serology and consider the person immune if the test is positive for measles specific IgG. If the serology is not done or negative, the worker should be furloughed for an incubation period.
- If the exposed healthcare worker was born on or after January 1, 1957 and has no documented evidence of immunity, a dose of measles-containing vaccine should be given immediately and no more than 72 hours after exposure. At the same time, a serologic test for measles IgG should be done to verify immunity. If immunity to measles is not serologically confirmed, the person must be furloughed from day 5 after the first exposure to day 21 after the last exposure.
- If the exposed healthcare worker was born before January 1, 1957 and has no documented evidence of immunity, a serologic test for measles IgG should be considered to verify immunity. If immunity is not confirmed, the person must be furloughed from day 5 after the first exposure to day 21 after the last exposure.
- If the exposed healthcare worker has had two documented doses of measles vaccine given on or after the first birthday and at least 28 days apart, consider the person immune.
- In summary, exposed **susceptible** health care workers should be immunized immediately and no more than 72 hours after exposure, and furloughed from day 5 after the first exposure to day 21 after their last exposure. This includes healthcare workers born at any time who have no documented evidence of immunity, and workers born in 1957 or later with only one previous dose of measles-containing vaccine documented who did not receive a second dose within 72 hours of exposure. (If furloughing of this second group is not possible due to large numbers exposed, these staff should have their temperatures taken and be assessed for prodromal symptoms when they come to work on the 5th through 21st day after the exposure. Anyone with a fever, cough, coryza, or conjunctivitis should be furloughed for the duration of symptoms and assessed for measles if a rash develops. This screening procedure must be followed rigorously to prevent staff members with prodromal measles from infecting others.)
- Healthcare workers who develop measles must avoid patient contact until 4 days have passed since the rash onset.

- Only health care workers with documented immunity to measles should enter the room of a suspected measles patient.
- Exposed patients should likewise have their immune status assessed and be given vaccine if they are not immune; school and work restrictions of unimmunized contacts apply.

Activities that a health department may want to do prior to identification of any measles case or outbreak:

- Review measles investigation guidance (this document. Good job!).
- Have a supply of MMR vaccine on hand for outbreak response (check with your department's immunizations staff).
- Have a supply of viral transport media (e.g., Remel) and shipping containers on hand. (See Appendix C Laboratory Resources.)
- Have a DSHS laboratory submitter ID and G2A and G2V forms on hand. (See Appendix C Laboratory Resources.)
- Have draft exposure letters on hand (See Measles Toolkit at http://www.dshs.state.tx.us/idcu/disease/measles/links/)
- Ensure epidemiology, surveillance, preparedness, and field staffs are all immune to measles and that such immunity is documented

Airline Exposures

Occasionally, Texas residents are exposed to measles in other states, often on airplanes. Typically, those notifications will come from the CDC to the Central Office. Central Office will notify each jurisdiction of any residents that have potentially been exposed to measles. Each jurisdiction is expected to make contact with all exposed individuals to verify vaccination history, ascertain or monitor symptoms, provide education on measles, and provide prophylaxis if warranted.

Alternately, Texas measles cases may have exposed people from other states while in transit. All information about the patient's travel (obtain the boarding documents, if possible) should be collected as soon as possible and forwarded to Central Office. Central Office staff will share the information with CDC so exposed passengers can be identified and shared with other states.
For more information on these types of situations, please see Appendix B.

Outbreaks

If an outbreak of measles is suspected, notify the regional DSHS office or EAIDB at **(800) 252-8239 or (512) 776-7676**.

REPORTING AND DATA ENTRY REQUIREMENTS

Provider, School & Child-Care Facilities, and General Public Reporting Requirements
Confirmed and clinically suspected cases are required to be reported **immediately** to the local or regional health department or to DSHS EAIDB at **(800) 252-8239 or (512) 776-7676.**

Local and Regional Reporting and Follow-up Responsibilities
Local and regional health departments should:

- Enter the case into NBS and submit an NBS notification on all **confirmed** cases to DSHS within 30 days of receiving a report of confirmed case.
    - Please refer to the *NBS Data Entry Guidelines* for disease-specific entry rules.
    - A notification can be sent as soon as the case criteria have been met. Additional information from the investigation may be entered upon completing the investigation.
- Fax, send a secure email, or mail a completed investigation form within 30 days of completing the investigation.
    - **In the event of a death, copies of the hospital discharge summary, death certificate, autopsy report and death investigation form should also be sent to DSHS EAIDB.**
    - Investigation forms may be faxed to **512-776-7616 ,** securely emailed to VPDTexas@dshs.texas.gov or mailed to:

      Infectious Disease Control Unit
      Texas Department of State Health Services
      Mail Code: 1960
      PO Box 149347
      Austin, TX 78714-9347

When an outbreak is investigated, local and regional health departments should:

- Report outbreaks within 24 hours of identification to the regional DSHS office or to EAIDB at (800) 252-8239 or 512-776-7676.

LABORATORY PROCEDURES

Laboratory confirmation is essential because in a setting of measles elimination, most cases that meet the clinical case definition are not measles. Additionally, because measles IgM assays may be falsely positive, collection of respiratory and/or urine specimens for PCR are encouraged. Testing at a public health laboratory is preferred. **If a private provider/hospital cannot or will not collect specimens, public health staff should make every arrangement to collect specimens instead.** Collect both virology specimens as well as serology specimens. To obtain testing kits, contact the DSHS Laboratory at **(512) 776-7661**. Before shipping specimens, be sure to notify DSHS EAIDB VPD staff at **(512) 776-7676.** The specimen tracking number (e.g., FedEx or LSO number) should be provided to the DSHS EAIDB VPD staff. This helps to ensure that specimens are received in satisfactory condition and tested as soon as possible.

PCR Assay Specimen Collection and Submission

PCR can confirm the diagnosis of measles, especially in vaccinated persons. The DSHS lab performs measles PCR. Currently, PCR testing for measles is not available at commercial or hospital labs. Additionally, molecular epidemiologic techniques are used to genetically type measles viruses and identify the source of wild viruses and establish chains of transmission. Positive PCR specimens will be forwarded to CDC or other designated public health lab for molecular testing. Viral isolation (i.e. culture) is not needed to perform strain typing.

Serology Specimen Collection and Submission

IgM Serology: A single specimen should be collected as soon as possible. A negative IgM result from a specimen collected before the fifth day of rash onset may not, however, rule out the diagnosis of measles (false negative results). While we encourage early testing of patients with a rash-fever illness, testing may need to be repeated if specimen was collected before the fifth day of rash onset.

IgG Serology: Acute AND convalescent samples are needed. Collect acute sample early in the course of illness and convalescent sample 10-14 days later. DSHS Laboratory can only conduct acute/convalescent testing if the first sample is negative (usually an unvaccinated individual). Otherwise, the acute/convalescent testing will need to be conducted through laboratory commercial or hospital laboratory, or referred to the CDC.

	Measles VIRAL Specimen Collection
Specimen Type	**PCR TESTING** ** Measles Specimens **
Materials 	• Viral transport media (VTM) and tubes • Specimen submission forms (G2V) • Personal protective equipment • Tongue depressors • Polyester fiber tipped swabs - either Dacron or Rayon • NO cotton tipped or wooden shaft swabs or any that contain calcium alginate
Proper Specimen Collection	• Do not use expired media – be sure to check the expiration date • With mouth open, depress tongue • Swab posterior pharynx, avoiding the tonsils • Put tip of swab in the VTM, breaking applicator stick • Seal properly • Freeze or refrigerate • Prepare for shipment • Throat swabs are the preferred specimens for DSHS testing • Nasopharyngeal swabs and urine are also acceptable specimens for measles testing
Specimen Handling	• Transport specimens to the laboratory as soon as possible • Specimens should be placed in a biohazard bag and stored at 4°C or -70° C • If specimens are shipped the same day of collection, ship at 4°C • If specimens will be stored and shipped after the date of collection, freeze at -70° C • DO NOT store samples in a standard freezer – this inactivates the virus • DO NOT have repeated freeze thaw cycles – this inactivates the virus
Specimen Shipping	• Do not ship on Fridays or before federal holidays • Specimens stored at 4°C are shipped using cold packs • Specimens stored at -70° C are shipped on dry ice • Complete the G2V form for each specimen • Check the "Measles PCR" box in Section 4 of the G2V • The name on the tube should match the name on the form exactly • Ship to the physical address ATTN: Lab Services • Record the shipping tracking number and notify IDCU that a specimen is being shipped
Additional Information	• Collect as soon as possible after rash onset • Preferably within three days • Not more than 10-14 days after onset Centers for Disease Control and Prevention– Measles PCR http://www.cdc.gov/measles/lab-tools/rt-pcr.html

	Measles SERUM Specimen Collection
Specimen Type	**IgM and IgG Antibody Testing** ** Measles Specimens **
Materials	• Red top tubes and serum separator tubes OR gold top OR tiger top tubes • Specimen Submission forms (G2A) • Personal Protective Equipment • Centrifuge

Proper Specimen Collection	• Do not use expired tubes – be sure to check the expiration date
	• RED TOP TUBE
	  o Collect at least 5mL of blood in red top tube
	  o Centrifuge the red top tube
	  o Transfer the serum into a serum transport tube
	• GOLD/TIGER TOP TUBE
	  o Collect at least 5mL of blood in gold/tiger top tube
	  o Centrifuge the gold/tiger top tube
	• Seal properly
	• Refrigerate or freeze (do not freeze serum separator tubes, gold top tubes or whole blood)
	• Prepare for shipment

Specimen Handling	• Transport specimens to the laboratory as soon as possible • Specimens should be placed in a biohazard bag and stored at 4°C or -20° C • If specimens are shipped the same day of collection, ship at 4°C • If specimens will be stored and shipped after the date of collection, freeze at -20° C • Do not freeze whole blood in red top tube for shipping • Do not freeze serum in gold top or serum separator tube for shipping
Specimen Shipping	• Do not ship on Fridays or before federal holidays • Do not ship whole blood • Specimens that will arrive at the lab within 48 hours of collection can be stored at 4°C and should be shipped using cold packs • Specimens that will arrive at the lab more than 48 hours after collection should be stored at -20° C and shipped on dry ice • Complete the G2A form for each specimen • Check "Rubeola screen" and "Rubeola IgM" in Section 7 of the G2A • The name on the tube should match the name on the form exactly • Ship to the physical address ATTN: Lab Services • Record the shipping tracking number and notify IDCU that a specimen is being shipped
Additional Information	• Collect as soon as possible after rash onset, up to 30 days • Patients with an MMR vaccine in the past 6-45 days are not recommended for serology testing. Centers for Disease Control and Prevention– Measles serology http://www.cdc.gov/measles/lab-tools/serology.html

UPDATES

January 2018

- VPD team email address added as a method of sending case investigation forms.
- TAC update regarding exclusions
- Edits made throughout for clarity

TABLES

Table 1: Measles Serology Results and Interpretation

IgM result	IgG result	Previous infection history	Current infection/vaccination status	Comments
+	+ or -	Not vaccinated, no history of measles	Wild-type measles	Seroconversion†, classic measles
+	+ or -	Previously vaccinated, primary vaccine failure	Recent 2nd MMR	Seroconversion†
-	+	Previously vaccinated, IgG+	Recent 2nd MMR	IgG level may stay same or boost
+	+	Previously vaccinated, IgG+	Wild-type measles	May have few or no symptoms‡
+	+	Recently vaccinated	Exposed to wild-type measles	Cannot distinguish if vaccine or wild-type, evaluate on epidemiologic grounds§

† IgG response depends on timing of specimen collection.
‡ If so, do not consider contagious unless clinical presentation is consistent with measles.
§ If IgM negative, helpful to rule out wild-type measles infection

Table 2: Recommended Follow-up of Measles Low-Risk Contacts (borrowed from California DPH)

Measles immunity assessment for low-risk contacts *(NOT immunocompromised, infant <12 months, pregnant, healthcare worker or household contact)*	**IgG testing**	**MMR PEP[1]**	**IG PEP[2]**	**Quarantine if no PEP[3]**	**Exclusion if no PEP[4]**	**Symptom watch**
Two documented doses of MMR vaccine (~1% will be susceptible)	No	No	No	No	No	Passive
Known to be measles IgG positive (<1% will be susceptible)	No	No	No	No	No	Passive
Born before 1957 (5% will be susceptible)	No	No	No	No	Yes	Passive
Have 1 documented dose of MMR vaccine (5% will be susceptible)	If desired	Yes	No	No	Yes	Passive
Measles IgG negative[5] or known to be unvaccinated	-	Yes	No[6]	Yes	Yes	Active
Unknown or no documentation of vaccination or immune status, with presumption of immunity[7]	If desired	Yes	No	No	Yes	Passive
History of measles disease (not documented)	Yes	Yes	No	Yes	Yes	Active
Unknown or no documentation of vaccination or immunity status, without presumption of immunity7	Yes	Yes	No	Yes	Yes[8]	Active

1 Postexposure prophylaxis (PEP) with MMR vaccine can be given <72 hours of exposure to persons without contraindications for the vaccine.

2 Contacts at high risk of severe infection (severely immunocompromised people, unvaccinated infants, and susceptible pregnant women) should receive IG (IM or IV) PEP ≤6 days of first exposure to measles. If it can be done rapidly, it is recommended that pregnant women be tested for measles IgG prior to administering IGIV if there is a possibility they may have received vaccine or had disease.

3 Quarantine for 21 days after last exposure unless the exposed person: is measles IgG positive, meets a presumption of immunity, or MMR<72 hours of first exposure. If symptoms consistent with measles develop, exposed person should be isolated. If there is concern about whether measles symptoms will be reported or if there will be compliance with quarantine, active monitoring with periodic calls to the exposed person to monitor for development of measles symptoms is recommended.

4 Unless found to be measles IgG positive or to have two documented MMR, exclude from high-risk settings (e.g., childcare facility with infants or healthcare facility) for 21 days after last exposure. Some jurisdictions may choose to exclude from other settings with large numbers of unvaccinated persons.

5 If patient has two documented MMR and an IgG negative result, base public health decisions on the two documented doses of MMR vaccine.

6 IG can be considered for persons in this category weighing <30 kg (66 lbs).

7 Immunity may be presumed in persons who have served in the U.S. Armed Forces; or were born in the U.S. in 1970 or later and attended a U.S. elementary school; or entered the U.S. in 1996 or later with an immigrant visa or have a green card, unless known to be unvaccinated.

8 If MMR vaccine is given ≥72 hours of first exposure or IG is given > 6 days of first exposure, exclude from high-risk settings.

Table 3: Recommended Follow-up of Measles High-Risk Contacts (borrowed from California DPH)

Measles immunity assessment for high-risk contacts *(immunocompromised, infant <12 months, pregnant, healthcare worker or household contact)*	**IgG testing**	**MMR PEP[9]**	**IG PEP[10]**	**Quarantine if no PEP[11]**	**Exclusion if no PEP[12]**	**Symptom watch**
Unvaccinated infants <12 months of age	No	No[13]	Yes	Yes	Yes	Active
Pregnant women without 2 documented MMR or serologic evidence of immunity	Yes[14]	No	Yes[15]	Yes	Yes	Active
Severely immunocompromised people	No	No	Yes	See footnote[16]	Yes	Active
Household or other contact with prolonged exposure without 2 documented MMR or serologic evidence of immunity	Yes	Yes	No	Yes	Yes	Active

[9] Postexposure prophylaxis (PEP) with MMR vaccine can be given <72 hours of exposure to persons without contraindications for the vaccine.

[10] Contacts at high risk of severe infection (severely immunocompromised people, unvaccinated infants, and susceptible pregnant women) should receive IG (IM or IV) PEP ≤6 days of first exposure to measles. If it can be done rapidly, it is recommended that pregnant women be tested for measles IgG prior to administering IGIV if there is a possibility they may have received vaccine or had disease.

[11] Quarantine for 21 days after last exposure unless the exposed person: is measles IgG positive, meets a presumption of immunity, or MMR<72 hours of first exposure. If symptoms consistent with measles develop, exposed person should be isolated. If there is concern about whether measles symptoms will be reported or if there will be compliance with quarantine, active monitoring with periodic calls to the exposed person to monitor for development of measles symptoms is recommended.

[12] Unless found to be measles IgG positive or to have two documented MMR, exclude from high-risk settings (e.g., childcare facility with infants or healthcare facility) for 21 days after last exposure. Some jurisdictions may choose to exclude from other settings with large numbers of unvaccinated persons.

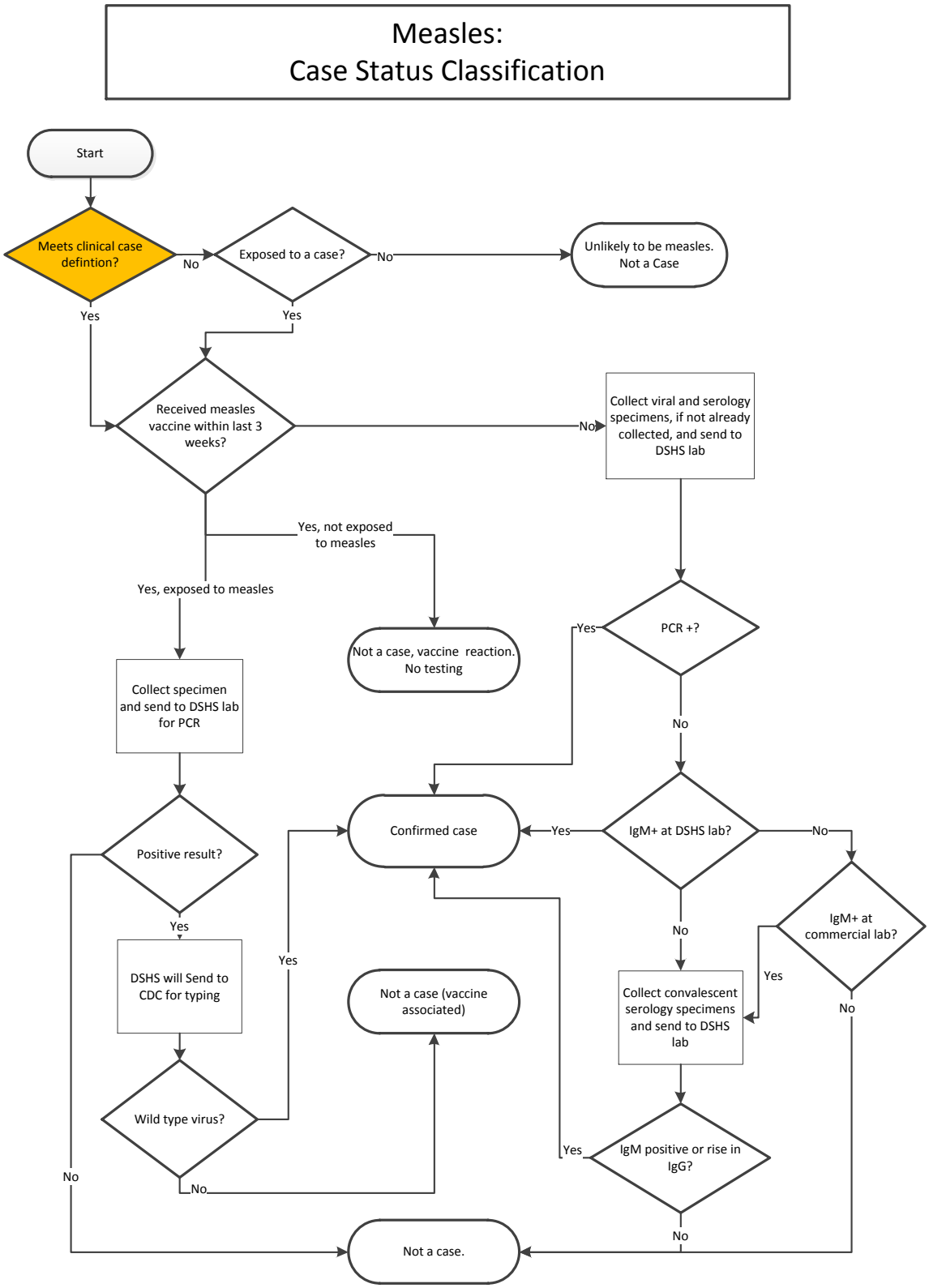
[13] Infants ≥ 6 months of age can receive MMR PEP.

[14] If no documentation of 2 doses of MMR vaccine or measles IgG positivity is available.

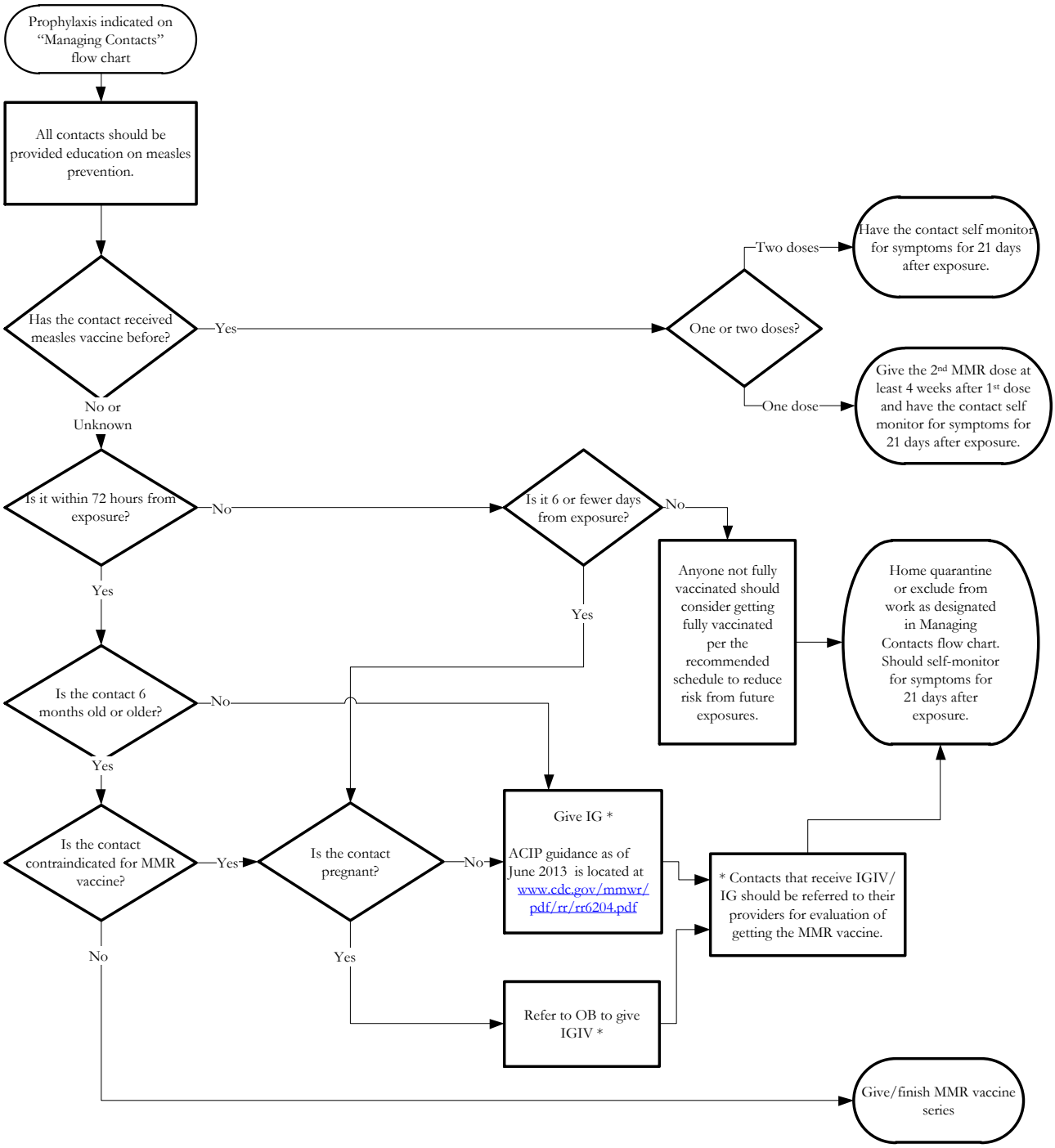
[15] If patient is IgG negative, or if patient has unknown status and testing cannot be completed by day 6 after exposure, administer IGIV.

[16] EAIDB should be consulted about severely immunocompromised measles contacts to assess the need for quarantine.

FLOW CHARTS rev Jan 2018



Prophylaxis for Contacts of Confirmed or Highly Suspicious Measles Cases



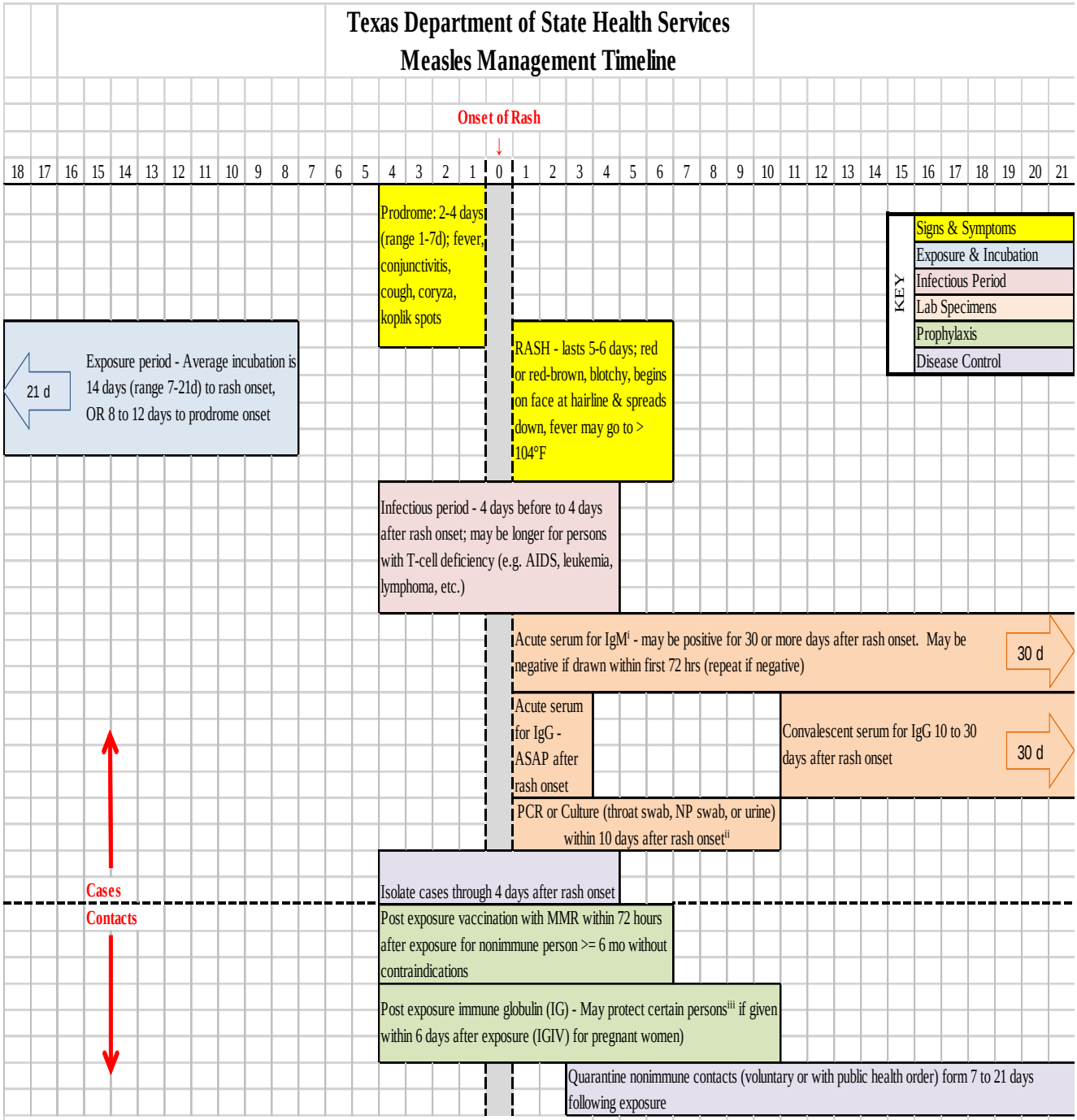


Chart based off of the Colorado Department of Public Health and Environment Measles Management Timeline

[i] Serologic tests may be falsely positive, so positive commercial IgM tests should be confirmed at the DSHS lab. PCR is only available at the DSHS lab.

[ii] For best results with viral culture, collect specimens <= 3 days after rash onset. Diagnostic yield is low for specimens collected > 10 days after rash onset.

[iii] Especially indicated for susceptible household or other close contacts, particularly contacts < 1 year of age, pregnant women, & immunocompromised persons.