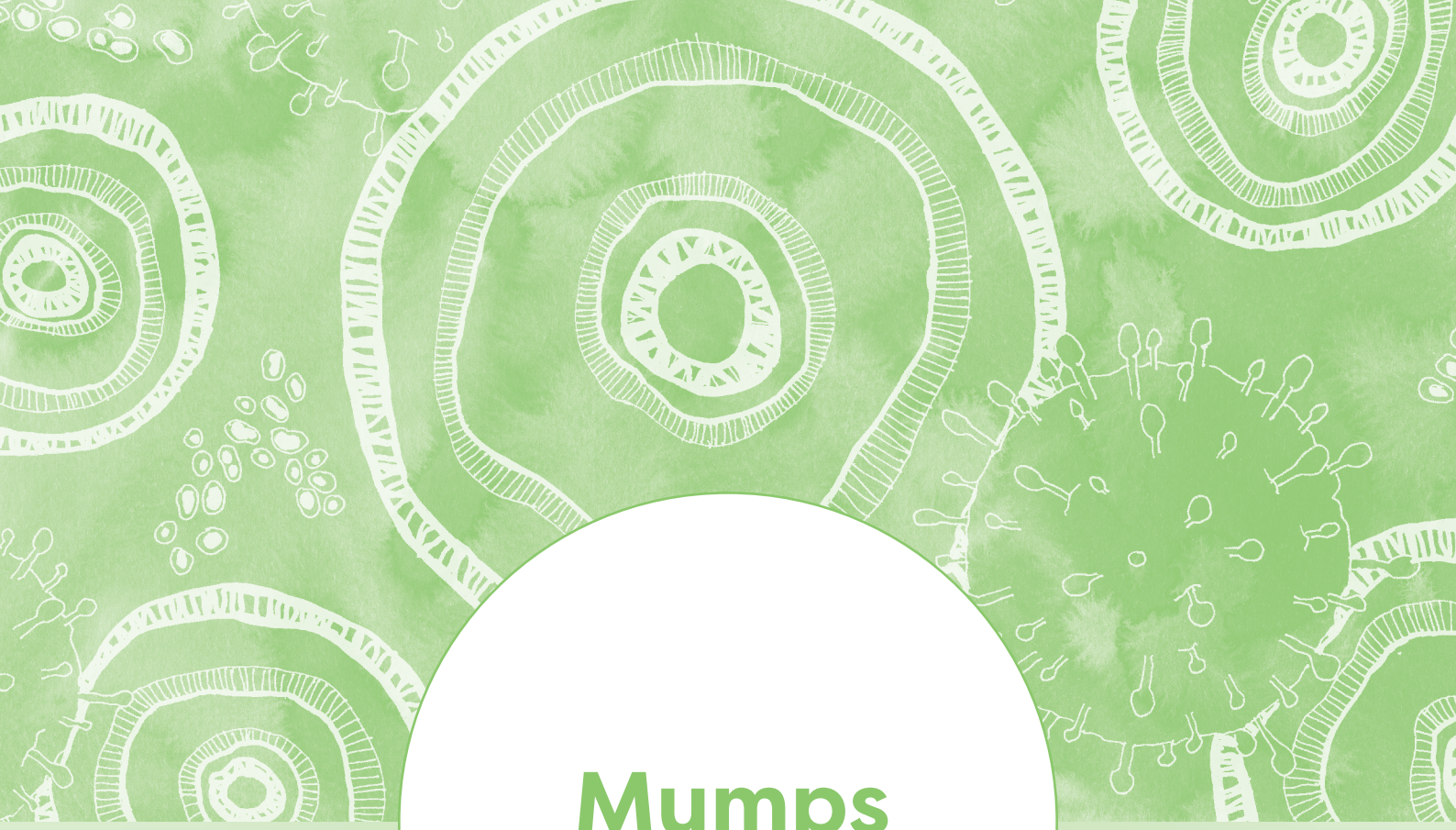


# Mumps

*Last updated: September 5, 2018*

Vaccine Preventable Diseases

**Surveillance Standards**

World Health Organization

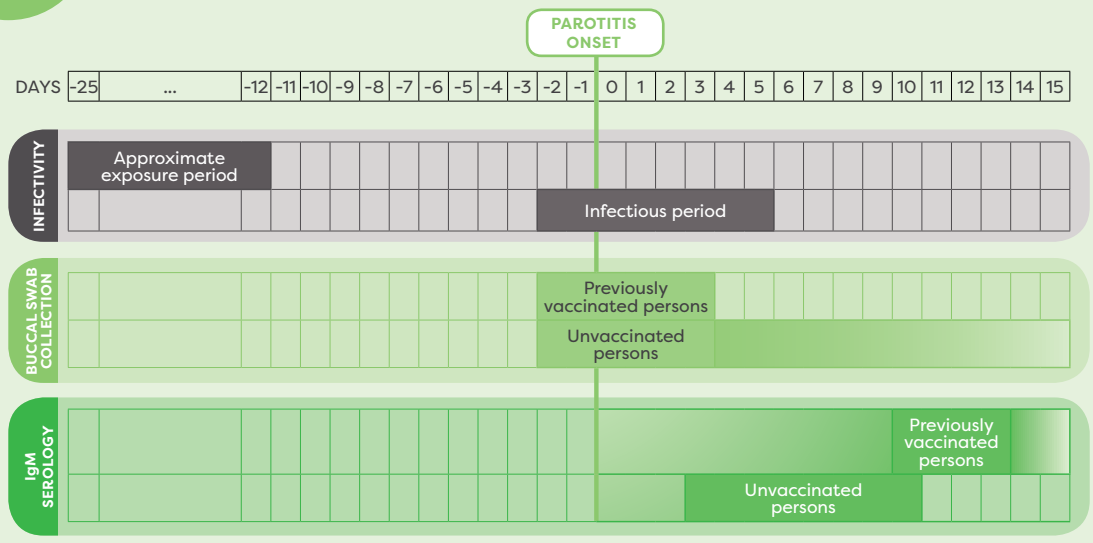
## DISEASE AND VACCINE CHARACTERISTICS

Mumps, caused by a paramyxovirus, is generally a mild disease with fever, headache and swelling of the salivary glands (parotitis); however, complications may occur such as meningitis, encephalitis and orchitis among males, and mastitis and oophoritis among females. Mumps is a leading cause of acquired sensorineural deafness among children. Humans are the only known natural host for mumps virus, which is spread via direct contact or by airborne droplets from the upper respiratory tract of infected individuals.

The mumps vaccine is a live attenuated viral vaccine; several vaccine formulations are available. Mumps vaccine is most often given in combination with measles and rubella (MMR), with two doses recommended. The WHO position paper on mumps states the following: "Routine mumps vaccination is recommended in countries with a well-established, effective childhood vaccination programme and the capacity to maintain high-level vaccination coverage with measles and rubella vaccination (that is, coverage that is > 80%) and where the reduction of mumps incidence is a public health priority" *(1)*.

FIGURE 1

**Timing of mumps infectivity and specimen collection**




*Solid colors indicate optimal time window. Gradient colors indicate when tests may provide accurate results.*

## RATIONALE AND OBJECTIVES OF SURVEILLANCE

The objectives of mumps surveillance are to:

- monitor disease burden and trends over time, pre- and post-vaccine introduction
- identify and respond to outbreaks
- characterize populations requiring additional disease control measures for mumps.

Surveillance for mumps should evolve with the level of control and should be adjusted to match country-specific objectives (either pre-vaccine or post-vaccine introduction). In countries achieving high routine mumps coverage and with low incidence that includes periodic outbreaks, surveillance should be used to identify high-risk populations and prevent potential outbreaks. Countries that aim to completely interrupt mumps transmission require intensive case-based surveillance to detect, investigate and confirm every suspected mumps case in the community.

## TYPES OF SURVEILLANCE RECOMMENDED

### MINIMUM SURVEILLANCE

Countries where mumps is endemic should collect and report aggregated data of clinical mumps cases by district, age group and immunization status. Mumps surveillance should occur in all age groups. Countries implementing routine mumps vaccination or considering vaccine introduction should implement passive surveillance for mumps and include it in their list of notifiable diseases. A basic aggregate case count to track disease burden is sufficient to identify clusters and monitor trends. In such settings, only clusters of suspected cases require investigation and lab confirmation.

### ENHANCED SURVEILLANCE

For countries where a high level of control is achieved (sustained high vaccine coverage) and cases are rare, facility-based, case-based surveillance with laboratory confirmation of sporadic cases should be conducted. Although complete case ascertainment in a country is likely not attainable, every detected case should be investigated immediately and included in the weekly or monthly reporting system in such settings. Though mumps surveillance is mostly passive, active surveillance might be implemented in limited outbreak settings to define the magnitude of the outbreak.

## CASE DEFINITIONS AND FINAL CLASSIFICATION

### SUSPECTED CASE DEFINITION FOR CASE FINDING

A suspected case is a person with acute onset of unilateral or bilateral tender, swelling of the parotid or other salivary gland that lasts two or more days and without other apparent cause (parainfluenza virus, Epstein Barr virus, influenza A virus, HIV and non-infectious causes), or clinical suspicion of mumps because of other mumps-associated symptoms (aseptic meningitis, encephalitis, hearing loss, orchitis, oophoritis, mastitis, pancreatitis) unexplained by another more likely diagnosis.

### FINAL CASE CLASSIFICATION

- **Laboratory-confirmed.** Laboratory-confirmed cases may be confirmed in any of these ways:
  - isolation of mumps virus by culture or reverse transcription-polymerase chain reaction (RT-PCR) from an appropriate clinical specimen (buccal/oral swab, throat swab, urine, and cerebrospinal fluid) from person meeting the suspected case definition
  - seroconversion from IgG negative to IgG positive as determined by any standard serological assay in the absence of mumps immunization in the preceding six weeks
  - in unvaccinated individuals, significant (≥ fourfold) rise in serum mumps IgG titre as determined by any standard serological assay.
- **Probable case.** A probable case is a one who:
  - meets the suspected case definition AND has a positive test for serum anti-mumps IgM antibody

    OR
  - meets the suspected case definition AND has epidemiologic linkage to another probable or confirmed case or linkage to a group/community during an outbreak of mumps.
    - Epidemiologic linkage is defined as contact between two people involving a plausible mode of transmission at a time when ALL of the following are true:
      - one of the persons is likely to be infectious (two days before onset of overt parotitis to five days after)

        AND
      - the other person has an illness that starts within approximately 12 to 25 days after this contact

        AND
      - at least one case in the chain of epidemiologically linked cases (which may involve many cases) is laboratory confirmed.
- **Clinically compatible.** A clinically compatible case is one that meets the suspected case definition without an epidemiological link and without a sample tested or with a negative result without another etiology identified.
- **Discarded cases.** Discarded cases are those that do not meet the above criteria for lab-confirmed with another etiology identified (parainfluenza, Epstein-Barr, adenovirus, etc.).

## CASE INVESTIGATION

No investigation of individual cases is required in aggregate surveillance settings. In case-based surveillance, cases should be investigated by public health authorities within 2 days of notification. Case investigation forms should be completed, with data collected to identify risk factors and vaccination status. A sample for viral isolation and detection should be collected on all sporadic cases, as the clinical case definition is not specific.

Efforts should be made to identify the source of infection for every confirmed case of mumps; cases should be asked about contact with other known patients or persons. If it can be determined when and where transmission likely occurred, investigative efforts should be directed to these locations.

## SPECIMEN COLLECTION

Ideally, both a buccal swab specimen and a serum specimen are collected on every suspected case, irrespective of time since parotitis onset. However, this should be guided by country capacity to conduct viral isolation or serologic testing, with samples for viral isolation (buccal swab) considered a higher priority for collection. Buccal swabs collected as soon as possible post-parotitis onset are most likely to be positive, especially in previously vaccinated individuals. If desired, countries can recommend that buccal swabs be collected among individuals within three days of parotitis onset, while serum is collected more than three days post-parotitis onset.

### SWABS FOR VIRAL DETECTION

Buccal swabs are the best sample for viral detection, particularly when the salivary gland area is massaged approximately 30 seconds prior to swabbing the buccal area (area around Stensen's duct). Buccal or throat swabs can also be used for viral detection, using either a throat swab specimen collection device or a flocked polyester fibre swab rubbed for 10–15 seconds on both sides of the buccal cavity. Details on how to collect a buccal swab can be found at https://youtu.be/ThvoJBjsUvQ *(2)*. Swabs should be placed in at least 2 mL of standard viral transport medium (VTM). Allow the swab to remain in VTM for at least one hour at 4°C. Ream the swab around the rim of the tube to retain cells and fluid in the tube. The swab can be broken off and left in the tube or discarded. In the case of specimens for virus culture or PCR assay, immediately place specimens in a cold storage container and transport to the laboratory. If the sample is a buccal swab for viral isolation, it should be maintained at 4°C and shipped on cold packs (4°C) within 24 hours. If there is a delay in shipment, the sample is best preserved by freezing at -70°C and should be shipped on dry ice.

### SERUM FOR ANTIBODY DETECTION

Collection of whole blood is performed by venipuncture using a sterile, plain tube (no additives) or gel separator tube. It is recommended to collect 5 mL of blood. Whole blood can be stored for six hours at 20–25°C or at 4–8°C for up to 24 hours. Never freeze whole blood. Upon clotting (by spinning or letting it sit upright for one hour), serum should be separated and transferred to a sterile cryovial to avoid hemolysis.

Serum should be stored at 4–8°C until shipment on wet ice packs, but ideally should not be held at 4–8°C for longer than seven days. When held for longer periods, serum samples must be frozen at -20°C or below and transported to the testing laboratory on frozen ice packs. Repeated freezing and thawing can have detrimental effects on the stability of IgM antibodies. As a general rule, serum specimens should be shipped to the laboratory as soon as possible, and shipment should not be delayed for the collection of additional specimens.

CSF can be collected for viral detection in patients with signs of meningitis. Urine can be collected for viral detection in male patients with orchitis.

### TIMING OF COLLECTION

Buccal swabs should be collected within three days after parotitis onset in vaccinated persons. Among unvaccinated persons, virus may be isolated from the buccal mucosa until 11–15 days after salivary enlargement; however, viral isolation is most likely to be successful just prior to and within the first three days of parotitis onset.

Ideally, sera for IgM testing should be collected > 3 days post-parotitis onset. If the serum sample collected ≤ 3 days after parotitis onset is negative, and the case has a negative result for RT-PCR or RT-PCR was not done, a second serum sample can be collected 5–10 days after symptom onset because, in some cases, the IgM response is not detectable until five days after symptom onset. Among unvaccinated persons for IgG detection, acute sera should be collected as soon as possible after illness onset and the convalescent sera obtained 10–14 days later.

## LABORATORY TESTING

### CONFIRMATION METHODS

Three diagnostics methods are recommended to confirm mumps at this time.

- **Culture of clinical samples** (buccal/oral swab, throat swab, urine, CSF). Virus culture is the gold standard for mumps confirmation. However, sample quality must be maintained to ensure viability of the virus. Confirmation of successful isolation of mumps can be performed using immunofluorescent antibody staining or standard RT-PCR. Virus isolation can require several days to several weeks to complete.
- **RT-PCR of clinical samples** (buccal/oral swab, throat swab, urine for male patients with orchitis, and cerebrospinal fluid for patients with meningitis). Both real-time and standard RT-PCR protocols for mumps are available. RT-PCR is rapid and can deliver results within a day. Buccal/oral samples obtained by swabbing the parotid duct and buccal cavity (after a 30 second parotid massage) have the highest yield for viral detection. RT-PCR detection of virus is highest on day one after onset of parotitis (> 80%) dropping by day three (< 50%). The likelihood of obtaining a false-positive test result from a virological specimen is extremely low.
- **Antibody detection with serology**
  - » Seroconversion from mumps IgG negative to IgG positive (in the absence of mumps vaccination in the previous six weeks)
  - » In unvaccinated individuals: significant (≥ fourfold) rise in serum mumps IgG titer as determined by any standard serological assay

  Tests for IgG antibody should be conducted on both acute and convalescent-phase specimens, in which the convalescent serum was collected at least 10–14 days after the acute specimen. Both enzyme immunoassays (EIA) and immunofluorescence assay (IFA) can be used for serologic testing. Single serum samples tested for mumps-specific IgG is not useful for diagnosing acute mumps infections, due to IgG presence from past infection or vaccination.

  Mumps IgM can be used to define a probable case but not to confirm a case. Assays for the detection of mumps-specific IgM antibodies in serum specimens are commercially available; however, these tests have variable sensitivity and specificity, especially among vaccinated persons. Thus, IgM positive results should be classified as probable instead of lab-confirmed, as had been recommended in the previous surveillance standards. For unvaccinated persons, if an acute-phase serum sample collected < 3 days after parotitis onset is negative for IgM, collect a second serum sample at 5–7 days. For vaccinated persons, collecting serum specimens > 3 days after parotitis onset improves ability to detect IgM.

### SPECIAL LABORATORY CONSIDERATIONS

- **Parotitis following vaccination.** Parotitis is a rare adverse event of vaccination (1–3%) with a live attenuated mumps virus. If the case received a vaccine containing the mumps virus in the six weeks prior to symptom onset then serologic testing is not valid for confirmation of acute infection. Laboratory confirmation requires detection of virus through culture or RT-PCR, with a wild-type virus strain obtained through genetic characterization.
- **Other false positive serologic results.** In both unvaccinated and vaccinated persons, false positive results can occur due to assays affected by other viruses (parainfluenza viruses 1, 2, and 3, Epstein-Barr virus, influenza adenovirus, etc.).
- **False negatives.** Negative laboratory results among vaccinated persons do not necessarily rule out the diagnosis of mumps, particularly if there is an outbreak of parotitis. With previous contact with mumps virus either through vaccination (particularly with two doses) or natural infection, serum mumps IgM test results may be negative, IgG test results may be positive at initial blood draw, and viral detection in RT-PCR or culture may have low yield if the buccal swab is collected too long after parotitis onset or if the collection method was suboptimal. Therefore, mumps cases should not be definitively ruled out by negative laboratory results unless another etiology is confirmed.

### LABORATORY NETWORKS

No global laboratory network for mumps currently exists. However, specialized labs exist which can conduct genotyping on mumps viral isolates in order to determine if the virus is vaccine-type or wild-type.

## DATA COLLECTION, REPORTING AND USE

### RECOMMENDED DATA ELEMENTS

If conducting aggregate data collection, collect the number of total cases by age group, month and geographical area. If vaccine is used in national programme, collect number of total cases by immunization status.

If conducting case-based data collection, collect the following data elements:

- Name (if confidentiality is a concern the name can be omitted so long as a unique identifier exists)
- Unique identifier
- Date of birth (or age if date of birth not available)
- Sex
- Place of residence (city, district, and province)
- Date of parotitis onset
- Signs and symptoms
  - Parotitis or other salivary gland involvement and duration
  - Other symptoms (headache, anorexia, fatigue, fever, body aches, stiff neck, etc.)
  - Complications (deafness, encephalitis, mastitis, orchitis, meningitis, oophoritis, etc.)
- Number of mumps vaccine doses received
- Date of mumps vaccine doses
- Date of notification to public health
- Date of case investigation
- Laboratory methods and results
  - Specimen(s) collected?
  - Date(s) of specimen collection
  - Specimen type (urine, throat swab, CSF, blood)
  - Date(s) specimen sent to laboratory
  - Date(s) specimen received at laboratory
  - Date mumps serology results reported
  - Type (IgM or IgG) and results of mumps serology (positive, negative, indeterminate, no specimen, unknown)
  - Results of mumps viral culture or PCR (positive, negative, unknown)
- Final case classification (laboratory-confirmed, probable, discarded)
- Contact with a mumps lab-confirmed case, probable case or epidemiologically linked case?

### REPORTING REQUIREMENTS AND RECOMMENDATIONS

Designated reporting sites at all levels should report at a specified frequency (weekly or monthly) even if there are zero cases ("zero reporting"). This should take place both in aggregate and case-based surveillance settings. Mumps is reported annually by every WHO Member State in the Joint Reporting Form (JRF). Mumps is not currently reportable under International Health Regulations (IHR) (2005).

### RECOMMENDED DATA ANALYSES

- Number of cases and incidence rate by month/year and geographical area
- Age-specific, gender-specific, and district-specific incidence rates by year
- Proportion of cases by age group and immunization status (0, 1, 2 doses); suggested age groups (< 12 months, 1–4 years, 5–9 years, 10–14 years, 15–19 years, ≥ 20 years)
- Proportion of cases that are lab-confirmed, probable, discarded

### USING DATA FOR DECISION-MAKING

- Countries where mumps is endemic: Monitor incidence to assess progress and to identify areas of high risk or with poor programme performance. Describe changing epidemiology of mumps. Monitor vaccine effectiveness. Use data to determine vaccination policy.
- Countries with high level of control: Monitor the epidemiology (age groups at risk, immunization status) of mumps and accelerate immunization activities accordingly to avert a potential outbreak.

## SURVEILLANCE PERFORMANCE INDICATORS

Regular monitoring of surveillance indicators might identify specific areas of the surveillance system that need improvement. Some suggested surveillance indicators to monitor are listed in Table 1.

TABLE 1

### Surveillance performance indicators for mumps

| SURVEILLANCE ATTRIBUTE | INDICATOR | TARGET | HOW TO CALCULATE (NUMERATOR / DENOMINATOR) | COMMENTS |
|---|---|---|---|---|
| **COMPLETENESS OF REPORTING** | Percentage of designated sites reporting mumps data, even in the absence of cases | ≥ 80% | # designated reporting sites reporting mumps data / # designated reporting sites for mumps surveillance x 100 (for a given time period) | |
| **TIMELINESS OF REPORTING** | Percentage of designated sites reporting mumps data to the national level on time, even in the absence of cases | ≥ 80% | # of designated reporting sites in the country reporting by the deadline / # of designated reporting sites in the country x 100 | At each level reports should be received on or before the requested date. |
| **TIMELINESS OF INVESTIGATION** (in case-based surveillance only) | Percentage of all suspected mumps cases that have had an investigation initiated within 48 hours of notification | ≥ 80% | # of suspected cases of mumps for which an investigation initiated within 48 hours of notification / # of suspected mumps cases x 100 | |
| **SPECIMEN COLLECTION ADEQUACY** (in case-based surveillance only) | Percentage of suspected mumps cases with at least one specimen collected | ≥ 80% | # of suspected cases of mumps with at least one specimens collected / # of suspected mumps cases x 100 | During outbreak investigations where epi-linkage increases, epi-linked cases should be removed from the denominator. Only applicable if conducting lab testing on most cases. |
| **TIMELINESS OF SPECIMEN TRANSPORT** | Percentage of specimens received at the laboratory within 4 days of collection | ≥ 80% | # of specimens received within 4 days of collection by laboratory / # of specimens x 100 | Indicator only applies to public laboratories. |
| **TIMELINESS OF REPORTING LABORATORY RESULTS** | Percentage of specimens tested with results reported within 5 days of receipt of specimen | ≥ 80% | # of specimens tested by culture with results reported within 5 days of specimen receipt / # of specimens tested by culture x 100 | |

## CLINICAL CASE MANAGEMENT

No specific therapy for mumps exists. Symptomatic treatment can be given. Mumps is a self-limited illness that can last a few weeks. It is recommended that mumps cases be isolated from other patients for five days post-parotitis onset. Standard contact and droplet precautions should be put in place.

## CONTACT TRACING AND MANAGEMENT

The potential for further transmission should be assessed. Contacts of the case during the two days prior through nine days after onset of parotitis should be identified as potentially infected (see definition of epidemiological linkage in **Case definition** section). All contacts should be educated about signs and symptoms of mumps.

## SURVEILLANCE, INVESTIGATION AND RESPONSE IN OUTBREAK SETTINGS

### DEFINITION OF AN OUTBREAK

There is no standard definition of a mumps outbreak, and the definition should be tailored to the priority of detecting and responding to a mumps outbreak in the country. In endemic countries, an increase over baseline should be considered an outbreak; in countries with a high-level of control, a mumps outbreak is defined as three or more cases linked by time and place. Given that the vast majority of mumps vaccine is used in combination with measles and rubella vaccines (MMR), outbreaks of measles, rubella and congenital rubella syndrome signal under-vaccination and potential risk for mumps outbreaks as well.

### CHANGES TO SURVEILLANCE DURING AN OUTBREAK

During an outbreak, aggregate surveillance should move to case-based, with cases being line listed. Data elements that are relevant to the particular outbreak should be added. Specimens should be collected from 5–10 cases, and once a majority are determined to be mumps, individuals should be epidemiologically linked to known laboratory-confirmed cases. To ensure that the outbreak continues to be a mumps outbreak, laboratory testing should be done every two months on an additional 5–10 cases.

### PUBLIC HEALTH RESPONSE

The main strategy for controlling a mumps outbreak is to define the population(s) at risk and transmission setting(s), and to rapidly identify and vaccinate persons without presumptive evidence of immunity to prevent exposure and transmission. Mumps-containing vaccine should be administered to persons without evidence of immunity or vaccination and based on the local epidemiology of the outbreak.

## REFERENCES

### REFERENCES CITED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### ADDITIONAL REFERENCES


3. *Centers for Disease Control and Prevention. Questions and answers about mumps lab testing. Mumps [website]. Atlanta, USA: Centers for Disease Control and Prevention; 2017 (*https://www.cdc.gov/mumps/lab/qa-lab-test-infect.html*)*.
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