Mumps is an acute viral illness. Although parotitis and orchitis were described by Hippocrates in the 5th century BCE, until relatively recently mumps was viewed primarily as an illness that affected armies during times of mobilization. In 1934, Johnson and Goodpasture showed that mumps could be transmitted from infected patients to rhesus monkeys and demonstrated that mumps was caused by a filtrable agent present in saliva. This agent was later shown to be a virus. Mumps was a frequent cause of outbreaks among military personnel in the prevaccine era, and was one of the most common causes of aseptic meningitis and sensorineural deafness in childhood. During World War I, only influenza and gonorrhea were more common causes of hospitalization among soldiers. Outbreaks of mumps have been reported among military personnel as recently as 1986.

**Mumps**

- Acute viral illness
- Parotitis and orchitis described by Hippocrates in 5th century B.C.
- Viral etiology described by Johnson and Goodpasture in 1934
- Frequent cause of outbreaks among military personnel in prevaccine era

## MUMPS VIRUS

Mumps virus is a paramyxovirus in the same group as parainfluenza and Newcastle disease virus. Parainfluenza and Newcastle disease viruses produce antibodies that cross-react with mumps virus. The virus has a single-stranded RNA genome.

The virus can be isolated or propagated in cultures of various human and monkey tissues and in embryonated eggs. It has been recovered from the saliva, cerebrospinal fluid, urine, blood, milk, and infected tissues of patients with mumps.

Mumps virus is rapidly inactivated by formalin, ether, chloroform, heat, and ultraviolet light.

**Mumps Virus**

- Paramyxovirus
- RNA virus
- One antigenic type
- Rapidly inactivated by chemical agents, heat and ultraviolet light

## PATHOGENESIS

The virus is acquired by respiratory droplets. The virus replicates in the nasopharynx and regional lymph nodes. After 12-25 days a viremia occurs which lasts from 3 to 5 days. During the viremia, the virus spreads to multiple tissues, including the meninges, and glands such as the salivary, pancreas, testes, and ovaries. Inflammation in infected tissues leads to characteristic symptoms of parotitis and aseptic meningitis.

**Mumps Pathogenesis**

- Respiratory transmission of virus
- Replication in nasopharynx and regional lymph nodes
- Viremia 12-25 days after exposure with spread to tissues
- Multiple tissues infected during viremia

## CLINICAL FEATURES

The incubation period of mumps is 14-18 days (range, 14-25 days). The **prodromal symptoms** are nonspecific, and include myalgia, anorexia, malaise, headache, and low-grade fever.

**Parotitis** is the most common manifestation, and occurs in 30%-40% of infected persons. Parotitis may be unilateral or bilateral and any combination of single or multiple salivary glands may be affected. Parotitis tends to occur within the first 2 days and may first be noted as earache and tenderness on palpation of the angle of the jaw. Symptoms tend to decrease after 1 week and have usually resolved after 10 days.

**Mumps Clinical Features**

- Incubation period 14-18 days
- Nonspecific prodrome of low-grade fever, headache, malaise, myalgias
- Parotitis in 30%-40%
- Up to 20% of infections asymptomatic
- May present as lower respiratory illness, particularly in preschool-aged children

Up to 20% of mumps infections are asymptomatic. An additional 40%-50% may have only nonspecific or primarily respiratory symptoms.

## COMPLICATIONS

**Central nervous system (CNS) involvement** in the form of aseptic meningitis is common, occurring asymptomatically (inflammatory cells in cerebrospinal fluid) in 50%-60% of patients. Symptomatic meningitis (headache, stiff neck) occurs in up to 15% of patients and resolves without sequelae in 3-10 days. Adults are at higher risk for this complication than children, and boys are more commonly affected than girls (3:1 ratio). Parotitis may be absent in up to 50% of such patients. Encephalitis is rare (less than 2 per 100,000).

**Orchitis (testicular inflammation)** is the most common complication in postpubertal males. It occurs in up to 50% of postpubertal males, usually after parotitis, but may precede it, begin simultaneously, or occur alone. It is bilateral in up to 30% of affected males. There is usually abrupt onset of testicular swelling, tenderness, nausea, vomiting, and fever. Pain and swelling may subside in 1 week, but tenderness may last for weeks. Approximately 50% of patients with orchitis have some degree of testicular atrophy, but sterility is rare.

**Oophoritis (ovarian inflammation)** occurs in 5% of postpubertal females. It may mimic appendicitis. There is no relationship to impaired fertility.

**Pancreatitis** is infrequent, but occasionally occurs without parotitis; the **hyperglycemia** is transient and is reversible. While some single instances of **diabetes mellitus** have been reported, a causal relationship has yet to be conclusively demonstrated; many cases of temporal association have been described both in siblings and individuals, and outbreaks of diabetes have been reported a few months or years after outbreaks of mumps.

**Deafness** caused by mumps virus occurs in approximately 1 per 20,000 reported cases. Hearing loss is unilateral in approximately 80% of cases and may be associated with vestibular reactions. Onset is usually sudden and results in permanent hearing impairment.

Electrocardiogram (EKG) changes compatible with **myocarditis** are seen in 3%-15% of patients with mumps, but symptomatic involvement is rare. Complete recovery is the rule, but deaths have been reported.

Other less common complications of mumps include arthralgia, arthritis, and nephritis. An average of 1 death from mumps per year was reported in 1980-1999.

**Mumps Complications**

| | |
|---|---|
| CNS involvement | 15% of clinical cases |
| Orchitis | 20%-50% in post-pubertal males |
| Pancreatitis | 2%-5% |
| Deafness | 1/20,000 |
| Death | 1-3/10,000 |

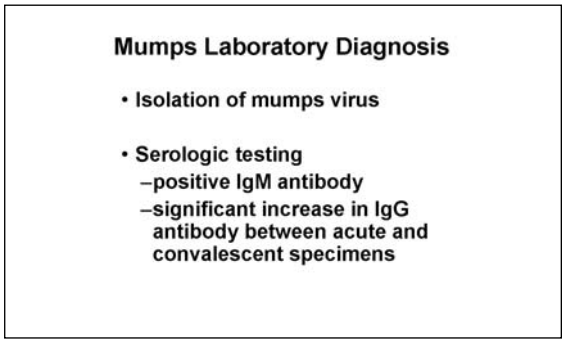
## LABORATORY DIAGNOSIS

The diagnosis of mumps is usually suspected based on clinical manifestations, in particular the presence of parotitis.

**Mumps virus** can be isolated from clinical specimens, including saliva, urine, and cerebrospinal fluid. If virus isolation is attempted, the specimen should be collected within the first 5 days of illness.

**Serology** is the most common method used to diagnose mumps. Complement fixation (CF) and hemagglutination inhibition (HI) antibody tests for mumps are relatively insensitive, and results may not be reliable. Tests that have demonstrated reliability include neutralization, enzyme immunoassay (EIA), and radial hemolysis antibody tests. Neutralization assays are time consuming and not generally available for routine diagnostic use.

The EIA is widely available commercially and is more sensitive than the CF, HI, or radial hemolysis. It is available for both IgM and IgG. IgM antibodies usually become detectable during the first few days of illness and reach a peak about a week after onset. IgG testing usually requires two specimens separated by several weeks. The convalescent (second) specimen should show a significant increase in antibody compared with the acute (first) specimen.



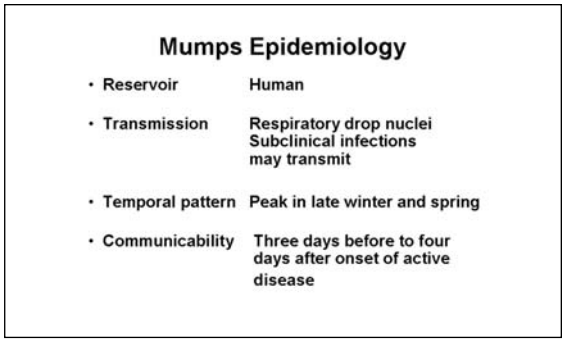

## EPIDEMIOLOGY

### *OCCURRENCE*

Mumps occurs worldwide.

### *RESERVOIR*

Mumps is a human disease. While persons with asymptomatic or nonclassical infection can transmit the virus, no carrier state is known to exist.




### *TRANSMISSION*

Transmission of mumps occurs through airborne transmission or direct contact with infected droplet nuclei or saliva.

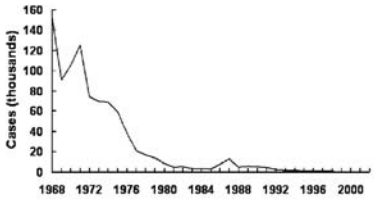
### *TEMPORAL PATTERN*

Mumps incidence peaks predominantly in late winter-spring, but the disease has been reported throughout the year.

### *COMMUNICABILITY*

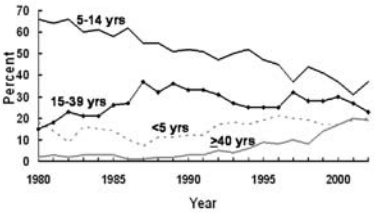
Contagiousness is similar to that of influenza and rubella, but less than that for measles or varicella. The infectious period is considered to be from 3 days before to the 4th day of active disease; virus has been isolated from saliva 7 days before to 9 days after onset of parotitis.

Mumps – United States, 1968- 2002




Mumps – United States, 1980-2002


Mumps - United States, 1980-2002
Age Distribution of Reported Cases




Mumps Clinical Case Definition

- Acute onset of unilateral or bilateral tender, self-limited swelling of the parotid or other salivary gland lasting >2 days without other apparent cause.

## SECULAR TRENDS IN THE UNITED STATES

Mumps became a nationally reportable disease in the United States in 1968. However, an estimated 212,000 cases occurred in the United States in 1964. Following vaccine licensure, reported mumps decreased rapidly. Approximately 3,000 cases were reported annually in 1983-1985 (1.3-1.55 cases per 100,000 population).

In 1986 and 1987 there was a relative resurgence of mumps. The peak was in 1987, when 12,848 cases were reported. The highest incidence of mumps during the resurgence was among older school-age and college-age youth (10-19 years of age) who were born before recommendations for routine mumps vaccination. Mumps incidence in this period correlated with absence of comprehensive state requirements for mumps immunization. Several mumps outbreaks among highly vaccinated school populations were reported, indicating that high coverage with a single dose of mumps vaccine did not always prevent disease transmission, probably because of vaccine failure.

Since 1989, there has been a steady decline in reported mumps cases, from 5,712 cases to a provisional total of 231 cases in 2001, the lowest annual total ever reported. As more children, adolescents, and adults received two doses of MMR vaccine, the number of reported cases of mumps has continued to decrease. Because many reported cases are not confirmed by laboratory testing, it is likely that many of the cases lacking laboratory confirmation are, in fact, not due to infection with mumps virus. Experience in states that have conducted more complete laboratory testing for confirmation suggests that case investigation, combined with appropriate laboratory testing, will result in many suspected cases being discarded and a resulting decrease in reported mumps morbidity. Laboratory confirmation helps ensure that only true mumps cases are reported.

Prior to vaccine licensure in 1967, and during the early years of vaccine use, most reported cases occurred in the 5-9 year age group; 90% of cases occurred among children 15 years of age and younger. In the late 1980s there was a shift towards older children. Since 1990, persons age 15 years and older have accounted for 30% - 40% of cases per year (42% in 2002). Males and females are affected equally.

Eighty percent or more of adults in urban and suburban areas with or without a history of mumps have serologic evidence of immunity.

## CASE DEFINITION

The clinical case definition of mumps is an acute onset of unilateral or bilateral tender, self-limited swelling of the parotid or other salivary gland lasting >2 days without other apparent cause.

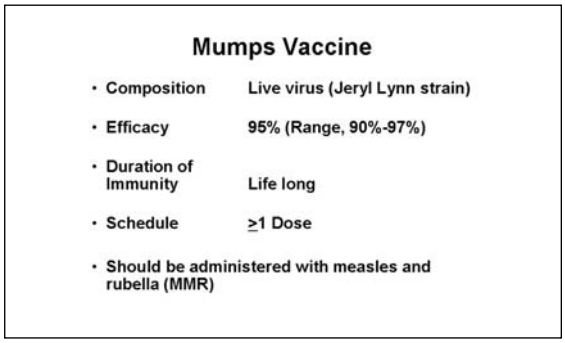
## MUMPS VACCINE

### *CHARACTERISTICS*

Mumps virus was isolated in 1945 and an inactivated vaccine was developed in 1948. This vaccine produced only short-lasting immunity, and its use was discontinued in the mid-1970s. The currently used Jeryl Lynn strain of live attenuated mumps virus vaccine was licensed in December 1967.

Mumps vaccine is available as a single antigen preparation, combined with rubella vaccine, or combined with measles and rubella vaccines. The ACIP recommends that combined measles-mumps-rubella vaccine (MMR) be used when any of the individual components is indicated.

Mumps vaccine is prepared in chick embryo fibroblast tissue culture. MMR is supplied as a lyophilized (freeze-dried) powder and is reconstituted with sterile, preservative-free water. The vaccine contains small amounts of human albumin, neomycin, sorbitol, and gelatin.

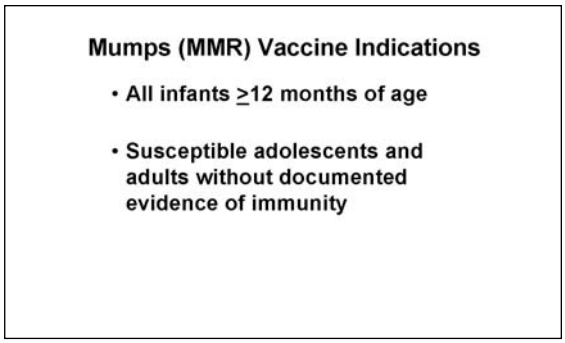



### *IMMUNOGENICITY AND VACCINE EFFICACY*

Mumps vaccine produces an inapparent, or mild, noncommunicable infection. More than 97% of recipients of a single dose develop measurable antibody. Clinical efficacy has been estimated to be 95% (range, 90%-97%). The duration of vaccine-induced immunity is believed to be greater than 25 years, and is probably life long in most vaccine recipients.

## VACCINATION SCHEDULE AND USE

At least one dose of mumps vaccine, as combination MMR vaccine, separated by at least 4 weeks, are routinely recommended for all children. All persons born in or after 1957 should have documentation of at least one dose of MMR. The first dose of MMR should be given on or after the first birthday. Mumps-containing vaccine given before 12 months of age should not be counted as part of the series. Children vaccinated with mumps-containing vaccine before 12 months of age should be revaccinated with two doses of MMR vaccine, the first of which should be administered when the child is at least 12 months of age.




A second dose of MMR is recommended to produce immunity to measles in those who failed to respond to the first dose. Data indicate that almost all of the persons who do not respond to the measles component of the first dose will respond to a second dose of MMR. Few data on the immune response to the rubella and mumps components of a second dose of MMR are available. However, most persons who do not respond to the rubella or mumps component of the first MMR dose would be expected to respond to the second dose of MMR.

The second dose of MMR is not generally considered a booster dose because a primary immune response to the first dose provides long-term protection. Although a second dose of vaccine may increase antibody titers in some persons who responded to the first dose, available data indicate that these increased antibody titers are not sustained**.** The combined MMR vaccine is recommended for both doses to assure immunity to all three viruses.

The second dose of MMR vaccine should be given routinely at age 4-6 years, before a child enters kindergarten or first grade. The adolescent health visit at age 11-12 years can serve as a catch-up opportunity to verify vaccination status and administer MMR vaccine to those children who have not yet received two doses of MMR. The second dose of MMR may be administered as soon as 4 weeks (*i.e.*, 28 days) after the first dose.

**Adults born in 1957 or later** who do not have a medical contraindication should receive at least one dose of MMR vaccine unless they have documentation of vaccination with at least one dose of measles, rubella, and mumps-containing vaccine or other acceptable evidence of immunity to these three diseases. Some adults at high risk of measles exposure may require a second dose of measles vaccine. This second dose should be administered as combined MMR vaccine (see Measles chapter for details).



### *MUMPS IMMUNITY*

**Mumps Immunity**

- Born before 1957
- Documentation of physician-diagnosed mumps
- Serologic evidence of mumps immunity
- Documentation of adequate vaccination

Generally, persons can be considered immune to mumps if they were born before 1957, have serologic evidence of mumps immunity, have documentation of physician-diagnosed mumps, or have documentation of vaccination with at least one dose of live mumps vaccine on or after their first birthday. The demonstration of mumps IgG antibody by any commonly-used serologic assay is acceptable evidence of mumps immunity. Persons who have an "equivocal" serologic test result should be considered susceptible to mumps unless they have other evidence of mumps immunity.

Live mumps vaccine was not used routinely before 1977 and the peak incidence was in 5 to 9-year-olds before the vaccine was introduced. Most persons born before 1957 are likely to have been infected naturally between 1957 and 1977. As a result, persons born before 1957 generally may be considered to be immune, even if they did not have clinically recognizable mumps disease. However, as with measles and rubella, this 1957 cutoff date for susceptibility is arbitrary and vaccination with MMR should be considered during mumps outbreaks for persons born before 1957 who may be exposed to mumps and may be nonimmune. Laboratory testing for mumps susceptibility before vaccination is not necessary.

### *POSTEXPOSURE PROPHYLAXIS*

Neither mumps immune globulin nor immune globulin (IG) is effective postexposure prophylaxis. Vaccination after exposure is not harmful and may possibly avert later disease.

## ADVERSE REACTIONS FOLLOWING VACCINATION

Mumps is a very safe vaccine. Most adverse events reported following MMR vaccine (such as fever, rash, and joint symptoms) are attributable to the measles or rubella components. No adverse reactions were reported in large-scale field trials. Subsequently, **parotitis** and **fever** have been reported rarely. A few cases of orchitis (all suspect) also have been reported.

Rare cases of **CNS dysfunction**, including cases of deafness, within 2 months of mumps vaccination have been reported. The calculated incidence of CNS reactions is approximately one per million doses of antigen, a rate lower than the reported background encephalitis rate of 2-6/10,000. The Institute of Medicine (1993) concluded that evidence is inadequate to accept or reject a causal relationship between the Jeryl Lynn strain of mumps vaccine and aseptic meningitis, encephalitis, sensorineural deafness, or orchitis.

**Allergic reactions**, including rash, pruritus, and purpura have been temporally associated with vaccination, but are transient and generally mild.

**MMR Adverse Reactions**

| | |
|---|---|
| • Fever | 5%-15% |
| • Rash | 5% |
| • Joint symptoms | 25% |
| • Thrombocytopenia | <1/30,000 doses |
| • Parotitis | rare |
| • Deafness | rare |
| • Encephalopathy | <1/1,000,000 doses |

## CONTRAINDICATIONS AND PRECAUTIONS TO VACCINATION

Persons who have experienced a severe allergic reaction (*i.e.*, hives, swelling of the mouth or throat, difficulty breathing, hypotension, shock) following a prior dose of mumps vaccine or to a vaccine component (*e.g.*, gelatin, neomycin), should generally not be vaccinated with MMR.

**MMR Vaccine**
**Contraindications and Precautions**

- Severe allergic reaction to vaccine component or following prior dose
- Pregnancy
- Immunosuppression
- Moderate or severe acute illness
- Recent blood product

In the past, persons with a history of anaphylactic reactions following egg ingestion were considered to be at increased risk of serious reactions after receipt of measles- or mumps-containing vaccines, which are produced in chick embryo fibroblasts. However, recent data suggest that most anaphylactic reactions to measles- and mumps-containing vaccines are not associated with hypersensitivity to egg antigens, but to other components of the vaccines (such as gelatin). The risk for serious allergic reactions such as anaphylaxis following receipt of these vaccines by egg-allergic persons is extremely low and skin-testing with vaccine is not predictive of allergic reaction to vaccination. As a result, MMR may be administered to egg-allergic children without prior routine skin-testing or the use of special protocols.

**Measles and Mumps Vaccines and Egg Allergy**

- Measles and mumps viruses grown in chick embryo fibroblast culture
- Studies have demonstrated safety of MMR in egg allergic children
- Vaccinate without testing

MMR vaccine does not contain penicillin. A history of penicillin allergy is not a contraindication to MMR vaccination.

**Pregnant women** should not receive mumps vaccine for theoretic reasons. There is no evidence that mumps vaccine virus causes fetal damage. Pregnancy should be avoided for 4 weeks after vaccination with MMR vaccine.

Persons with **immunodeficiency or immunosuppression** result-

ing from leukemia, lymphoma, generalized malignancy, immune deficiency disease, or immunosuppressive therapy should not be vaccinated. However, treatment with low dose (<2 mg/kg/day), alternate day, topical, or aerosolized steroid preparations is not a contraindication to mumps vaccination. Persons whose immunosuppressive therapy with steroids has been stopped for 1 month may be vaccinated.

Persons with **moderate or severe acute illness** should not be vaccinated until the illness has resolved. Minor illness (*e.g.*, otitis media, mild upper respiratory infections), concurrent antibiotic therapy, and exposure or recovery from other illnesses, are not contraindications to mumps vaccination.

Receipt of **antibody-containing blood products** (*e.g.*, immune globulin, whole blood or packed red blood cells, intravenous immune globulin) may interfere with seroconversion following mumps vaccination. Vaccine should be given 2 weeks before, or deferred for at least 3 months following, administration of an antibody-containing blood product (see chapter on General Recommendations on Immunization, p. 7, for details).

A family history of diabetes is **not** a contraindication for vaccination.



## VACCINE STORAGE AND HANDLING

Measles-mumps-rubella (MMR) vaccine must be shipped with refrigerant to maintain 10°C (50°F) or less at all times. Vaccine must be refrigerated immediately on arrival and protected from light at all times. The vaccine must be stored at refrigerator temperature (2°-8°C [35°-46°F]), but may be frozen. Diluent may be stored at refrigerator temperature or at room temperature.

After reconstitution, MMR vaccines must be stored at refrigerator temperature and protected from light. Reconstituted vaccine should be used immediately. If reconstituted vaccine is not used within 8 hours it must be discarded.

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