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Recognizing Measles, Mumps, and Rubella in the Emergency Department

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Abstract
Measles, mumps, and rubella have impacted millions of American lives over the last 100 years. During the last century, researchers have identified viral diseases, developed a combination vaccine, and have continued ongoing research when outbreaks have occurred. Despite the high incidence of vaccinated individuals, these highly communicable diseases continue to flourish within clusters of outbreaks throughout the United States. Emergency medicine providers play a key role in early recognition and diagnosis of the disease. The proper management and reporting reflect the emphasis on prevention of widespread outbreaks. **Key words:** infectious disease, MMR, rash, vaccine

MEASLES, MUMPS, AND RUBELLA, otherwise known as (MMR), are three separate contagious diseases that have been identified at different time periods throughout the last century. Adverse outcomes from MMR have been documented to have impacted millions, both nationally and globally. According to the Centers for Disease Control and Prevention ([CDC]; 2017e), current vaccine schedules advise that the MMR vaccine be administered between 12 and 18 months of age, with higher risk populations receiving the first dose between 6 and 9 months of age. A second dose is required for immunity between 4 and 6 years of age (CDC, 2017e). As of 2018, the CDC Advisory Committee of Immunization Practices (ACIP) recommends a third dose of the MMR vaccine be administered to individuals who have been previously vaccinated and are at increased risk of acquiring mumps due to an outbreak (Marin, Marlow, Moore, & Patel, 2018). Within recent years, there have been clusters of measles and mumps outbreaks (Cardemil et al., 2017; Clemmons, Gastanaduy, Parker Fiebelkorn, Redd, & Wallace, 2015). As these outbreaks occur, patients present to the emergency department where emergency nurse practitioners (ENPs), and other providers, play a pivotal role in early recognition, treatment, management, and reporting of MMR.

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VACCINE BACKGROUND AND SIGNIFICANCE

In 1967, the MMR vaccine was introduced in response to significant morbidity and mortality related to "measles, mumps, and rubella." Although reporting deficiencies existed, prior to the MMR vaccine, the United States reported the estimated incidence of these diseases between 3 million and 4 million cases of measles in 1963, 186,000 cases of mumps in 1967, and 57,686 cases of rubella in 1969 (CDC, 2017b, 2017c).

Measles

Measles was first recognized in 1912 as a "reportable" disease in the United States. Within the first decade of reporting, 6,000 measles-related deaths were documented annually. In the 1950s, nearly all children contracted measles by the age of 15 years, with an estimated 3–4 million infected children per year (CDC, 2017a). Forty-five years after the first reported case of measles, a vaccine was tested within a small sample of children. A rash occurred in nine of 11 individuals similar in appearance to the measles exanthem. Other symptoms such as fever were also noted (The College of Physicians of Philadelphia, 2018c). Because of these side effects, researchers concluded the vaccination was not safe to administer and a weaker strain was pursued (The College of Physicians of Philadelphia, 2018a). The Rubeovax vaccine was created with recommendations to include concurrent administration of γ-globulin antibodies to reduce reactions such as fever and rash (The College of Physicians of Philadelphia, 2018b). In 1967, an improved vaccine containing a weaker strain was discovered and accepted for use, with more than 19 million doses administered within the first year (The College of Physicians of Philadelphia, 2018a).

Mumps

Prior to the introduction of the MMR vaccine in 1967, mumps exposure within the first trimester of pregnancy was associated with fetal demise, spontaneous abortion, orchitis, and child deafness (CDC, 2018).

Rubella

A major health concern of contracting rubella is the risk of congenital rubella syndrome (CRS) acquired in utero. Children born with CRS often suffered from anomalies including deafness, blindness, and mental retardation (World Health Organization [WHO], 2011). In addition, prior to the MMR vaccine, there was a high incidence of fetal demise and reported spontaneous and induced abortions following the diagnosis of rubella (CDC, 2017f; WHO, 2011).

INCIDENCE AND VACCINE EFFECTIVENESS

Measles

The elimination of measles within the United Stated was declared in 2000. However, because of foreign travel, both in and out of the country, clusters of measles outbreaks are occurring within the United Stated (Clemmons et al., 2015). Most recent data from the National Center for Health Statistics (2017) reported the incidence of measles within the United Stated to be 63 cases in 2010 and 667 cases in 2014. The latter associated with an outbreak, of 111 persons, at the Disneyland theme park in California. In 2015, there were 159 reported cases of the measles, 28 of these occurred in vaccinated individuals, 60 with unknown vaccination status, and 71 in unvaccinated persons, 68 of which lived within the United States. Although 27 of the unvaccinated individuals were not of appropriate age to receive the vaccine, or had medical conditions not allowing vaccination, leaving three individuals who missed their vaccination schedule and nine individuals not wanting vaccination (Clemmons et al., 2015).

The WHO (2017) reported a total of 109,239 cases of the measles globally in 2017, though given decreased access to care, most patients do not seek treatment and therefore are not accounted for. Worldwide vaccination strategies have decreased measles-associated death by 84%, 89,780 in 2016 from an estimated 550,100 in 2000. The greatest regions of measles outbreaks occurring in Southeast

Asia and Africa (WHO, 2017a). The CDC (2017a) reports 97% efficacy against contracting the measles virus after two doses of the MMR vaccine and 93% after the first dose.

Mumps

The CDC (2017c) reported 5,833 cases of mumps in 2016 and 4,980 in 2017, yet there were fewer than 1,500 cases the five proceeding years. The increased incidence of mumps, nationally, has been attributed to environments where people reside within close proximity to one another, such as a college dormitory. The two-dose MMR vaccine is reported to be 88% effective in preventing mumps; however, diminishing immunity, as well as close proximity and residential settings, may further enable transmission (CDC, 2017c). Waning immunity is thought to have attributed to 259 previously vaccinated University of Iowa college students who contracted mumps in the 2015–2016 academic school year (Cardemil et al., 2017). Vaccinating for mumps started in 1967, and at the time the annual incidence within the United States was 186,000 cases (CDC, 2017c). In comparison, the WHO reported 583,199 cases of mumps worldwide in 2016 (WHO, 2017b).

Rubella

In 2004, the United States declared rubella elimination or absence of unremitting disease transmission for 12 months. The CDC reports fewer than 10 cases of rubella within the United States annually (CDC, 2017f). Worldwide, the incidence of rubella reduced by 97%. There were 22,361 cases reported, across 102 different countries, in 2016 compared with 670,894 cases in 2000 (WHO, 2017c).

CLINICAL FEATURES, ASSESSMENT, AND DIAGNOSIS

Measles

Measles is an acute viral illness caused by a paramyxovirus, genus *Morbillivirus*. The illness starts with malaise, fever, cough, coryza, and conjunctivitis (Premaratna et al., 2017). The appearance of Koplik's spots on the buccal mucosa during Days 1–2 is transient and disappears within 48 hr after the onset of the rash (see Figure 1; CDC, 2017a; Takhar & Moran, 2016).

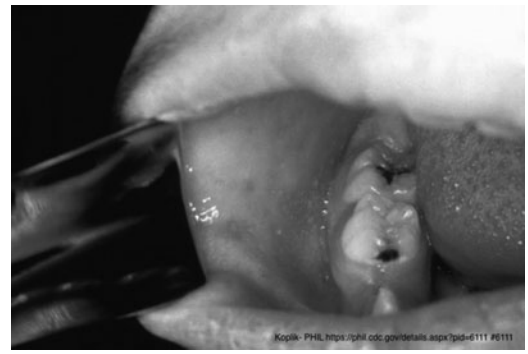

Figure 1. Measles.

Active disease is characterized by a fever greater than 101 °F/38.3 °C and a red maculopapular, blanching rash that becomes confluent and spreads from the head centrifugally downward (see Figure 2). Palms of the hands and soles of the feet are rarely involved, and petechia may be present (CDC, 2017a; Chai, 2015a). The disease is classified as a mild to moderately severe illness where complications include pneumonia, encephalitis, and death (Gastanaduy et al., 2017). Diagnosis is based on clinical findings; however,

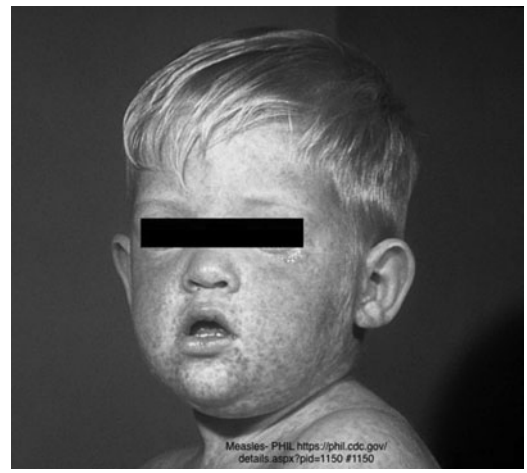

Figure 2. Koplik's spots.

confirmation of infection in the emergency department is achieved with positive serological test for measles immunoglobulin (Ig) M antibody or polymerase chain reaction (PCR) performed on urine or a throat or nasopharyngeal swab (Gastanaduy et al. 2017). Comprehensive workup for complications would include cerebral spinal fluid analysis for suspected encephalitis and chest radiography for suspected pneumonia.

Mumps

Mumps is a paramyxovirus, a single-stranded RNA virus. It presents as a systemic febrile infection with upper respiratory tract symptoms, including malaise, anorexia, low-grade fever, jaw pain, otalgia, and headache (Koenig, Shastry, Mzahim, Almadhyan, & Burns, 2016). The classic presentation of unilateral or bilateral swelling of the parotid glands will occur 48 hr after the onset of the prodromal period and can last for 10 days (see Figure 3; Bockelman, Frawley, Long, & Koyfman, 2018; CDC, 2017c). Parotitis is not present in all cases and is not mandatory for diagnosis. Presentation also includes orchitis, oophoritis, aseptic meningitis, pancreatitis, and encephalitis (Chai, 2015b). Vaccinated individuals are less likely to present with severe symptoms.

Similar to measles, this is a clinical diagnosis, though PCR and Ig testing are available for confirmation. Positive serum IgM antibody can be utilized to confirm active infection; however, vaccinated individuals may not mount an IgM response to mumps. Therefore, a high number of false-negatives are likely (Bockelman et al., 2018). Reverse transcriptase-PCR (RT-PCR) performed on serum, buccal, or oral swab is extremely sensitive and should be conducted within 3–8 days after the onset of parotitis. A negative PCR in a vaccinated person does not rule out the diagnosis of mumps, and clinical judgment is indicated (CDC, 2017c).

Rubella

Rubella, also known as German measles, is classified as a *Rubivirus* in the Togaviridae family (Lambert, Strebel, Orenstein, Icenogle, & Poland, 2015). This acute viral disease is characterized by low-grade fever, lymphadenopathy, malaise, and a red macular rash that evolves to a pink-red maculopapular rash with occasional pruritus (see Figure 4; (CDC, 2017g). The rash begins in the face with rapid caudal spread and characteristically disappears in 3 days. Complications are uncommon, and up to 50% of cases may be subclinical (CDC, 2017g; Lee, 2015). Although this is a clinical diagnosis as well, RT-PCR and enzyme-linked immunoassay (ELISA) are used to detect rubella IgM antibodies in order to confirm diagnosis (Dimech et al., 2005).

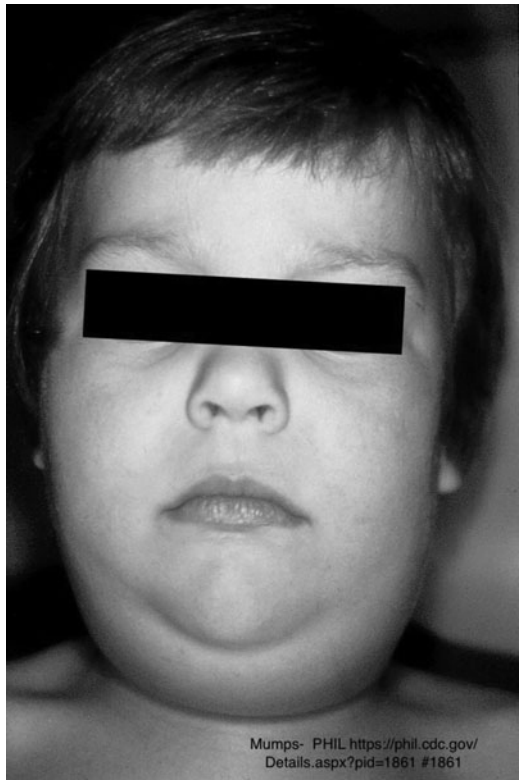

Figure 3. Mumps.

MANAGEMENT AND EDUCATION

Emergency management is generally supportive, with emphasis on isolation to prevent widespread outbreak and major complications such as encephalitis, pneumonia, and CRS. Antipyretics, analgesics, and antiemetics

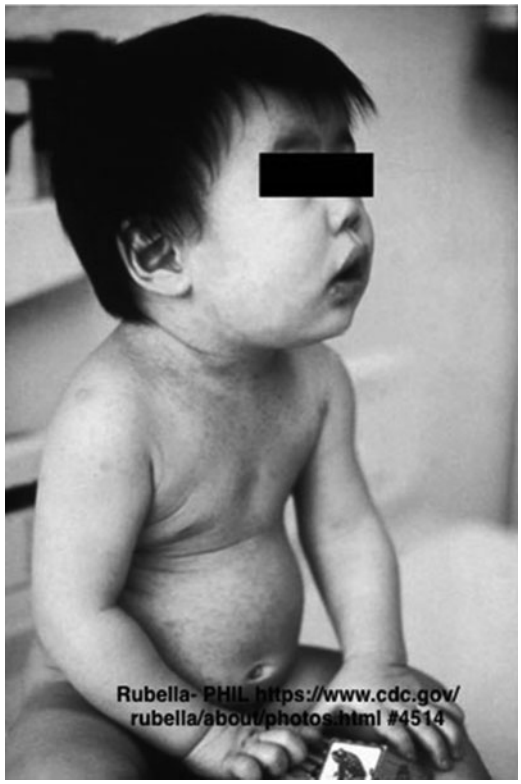

Figure 4. Rubella.

for vomiting and dehydration should be provided for all illnesses. The WHO (2009) recommends that vitamin A be administered to all children with acute measles, as a deficiency in this vitamin contributes to higher rates of measles complications, delayed recovery, and increased mortality. The MMR vaccine should be administered to those who cannot readily provide evidence of immunity to measles as postexposure prophylaxis (CDC, 2017a). Although vaccination after exposure poses no harm to most individuals, it should not be administered to pregnant women or immunocompromised persons because it is a live vaccine (Bockelman et al., 2018; Fiebelkorn, Barskey, Hickman, & Bellini, 2017). Instead, measles Ig should be administered to all persons who are at risk for severe illness, including pregnant women, infants, and immunosuppressed persons (CDC, 2017a). Hospital admission is warranted for severe illness and should be considered for immunocompromised patients, elderly patients with comorbid conditions, patients with encephalitis or meningitis, and severely dehydrated patients (Chai, 2015a, 2015b).

As noted, measles, mumps, and rubella are transmitted through direct contact with saliva or respiratory droplets (Bockelman et al., 2018). Thus, patient education not only addresses the needs of the patient but also echoes the needs of the community and focuses on decreasing the risk of widespread outbreak. Persons with measles are most contagious from 4 days prior until 4 days after the onset of the rash (Gastanaduy et al., 2017). Mumps is most infectious several days before and at least 5 days after the onset of parotitis, and patients with rubella should be isolated for 7 days after they develop the rash (Chai, 2015a, 2015b; CDC, 2017g).

Vaccinated and unvaccinated individuals who have contracted measles, mumps, or rubella will typically follow the general incubation and presentation course as outline in Table 1. With all cases, standard and droplet precautions should be initiated and isolation should be attempted. These attempts can often be challenging due to the significant amount of viral shedding that can occur prior to the onset of symptoms. Furthermore, vaccinated individuals may not present with severe illness. With mumps in particular, the infection may be subclinical and the patient may present with only nonspecific respiratory symptoms (Bockelman et al., 2018). Nonetheless, precautions and isolation measures should be considered.

As emergency medicine providers, early recognition and diagnosis of the disease are key, followed by recommended testing, treatment, patient education, and isolation measures. In addition to proper patient management, the emergency practitioner should adhere to the state regulations and laws governing the reporting of MMR (Takhar & Moran, 2016). Most states require reporting of confirmed or suspected cases of MMR within 1–3 days. Local health departments provide the appropriate means of reporting.

Table 1. Disease description

Agent (Disease)	Transmission	Incubation	Presentation	Exanthem	Period contagious
Measles virus (rubeola)	Droplet or airborne	7–21 days	Conjunctivitis, coryza, cough, high fever, Koplik's spots on buccal mucosa (2–3 days after symptoms start, blue-white with a red halo), malaise	3–5 days after symptom initiation; splotchy red confluent rash, which may blanche with pressure Spread cephalocaudal, which may start behind the ears	4 days prior to rash and 4 days after rash resolves
Mumps virus	Droplet or airborne	12–25 days	Malaise, myalgia, fever, headache, parotitis, anorexia	N/A	2 days before and 5 days after parotid swelling
Rubella virus (German measles)	Droplet	14–23 days	Low-grade fever, headache, mildly injected conjunctiva, cough, coryza, posterior auricular or suboccipital lymphadenopathy	Fine pink macules that initiate, spreading to the rest of the body; exanthem may coalesce on the trunk	7 days before and 7 days after rash resolves

Note. Data MMR Disease Description of transmission, incubation, presentation, and period contagious came from the CDC (2017a, 2017b, 2017d). Data on exanthem came from Chamberlain, (2013).

CONCLUSION

The data demonstrate a great reduction of MMR both within the United States and globally as a result of the administration of the MMR vaccine; however, global incidence of MMR continues to be a threat to the U.S. population, given large exchanges of persons in and out of the country. Over the past several years, data have demonstrated outbreaks of measles and mumps within the United States, many of these cases occurring in both vaccinated and unvaccinated individuals (Cardemil et al., 2017; Clemmons et al., 2015). There are several thoughts as to why vaccinated individuals may be at risk for contracting these illnesses, one of which is waning immunity as evidenced by the University of Iowa outbreak. As the community ages, the number of individuals with immunity acquired only by vaccine, a lesser immune response than actual disease immunity, is increasing, lending to lower antibody concentrations within the population (Kontio, Jokinen, Paunio, Peltola, & Davidkin, 2012).

The ENP should be knowledgeable that all populations are at risk for the contraction of MMR despite known positive vaccination status, and early recognition of the disease is paramount. Measles should be considered a preferred differential in patients presenting with febrile illness and rash, especially in those with known foreign travel or contact with foreign travelers. Suspected patients will require immediate isolation (Clemmons et al., 2015). Mumps should be considered in all patients who present with parotitis and respiratory symptoms, though mumps can occur without parotitis. Vaccinated individuals may have false-negative findings on the diagnostic studies conducted for mumps. Therefore, the nurse practitioner should educate patients with associated mumps symptoms on the high degree of communicability of the disease (Trotz-Williams et al., 2017). Per 2018 ACIP guidelines, persons at risk of contracting mumps, due to outbreak activity, should receive a third dose of the MMR vaccine (Marin et al., 2018).

The ENP should continue to advocate for vaccination in order to increase herd immunity, decrease life-threatening disease in our vulnerable patient population, and decrease transmission to those who are unable or unwilling to receive vaccination.

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