Water Environment Federation
the water quality people®

August 14, 2025

Measles Information for Water Professionals

Key Take-Home Messages

Measles is an extremely contagious, vaccine-preventable viral disease that can spread even after brief exposure. While most people in the U.S. recover without complications, the risks remain serious. Although measles was declared eliminated in the U.S. in 2000, more cases have been reported in 2025 than in any other year since 1992.

What we know from clinical surveillance

- Measles is a nationally notifiable disease in the U.S., tracked through the National Notifiable Diseases Surveillance System, with weekly updates provided by CDC.
- Widespread vaccination since the 1960s has led to a dramatic decline in measles cases and deaths.
- As of August 5, 2025, a total of 1,356 measles cases, 171 hospitalizations, and 3 deaths have been reported in the U.S. in 2025; this is the highest number of cases since 1992.
- Because measles symptoms resemble those of other febrile rash illnesses, laboratory confirmation is recommended for all suspected cases.
- The classic measles rash typically appears about 14 days after exposure (range: 7 to 21 days), following a prodrome of high fever, cough, runny nose, and conjunctivitis.
- Complications can include diarrhea, ear infections, pneumonia, croup, febrile seizures, encephalitis, subacute sclerosing panencephalitis, immune suppression ("immune amnesia"), and death.
- Vaccinated individuals remain at low risk and are less likely to transmit the virus if infected.

How wastewater surveillance plays a role

- Measles virus (MeV) RNA has been detected in wastewater using PCR and sequencing methods in multiple studies across Europe and North America.
- In the U.S., wastewater testing for wild-type MeV RNA is conducted through both WastewaterSCAN and the National Wastewater Surveillance System national testing contract.
- Some state and local health departments have launched additional testing in response to the 2025 measles outbreaks, with CDC providing assay validation and technical support.
- Wastewater surveillance can provide early warning of measles circulation, help monitor community-level trends, and complement clinical case reporting—although it cannot identify individual cases or provide exact infection counts.

What wastewater workers need to know

- Vaccination is the best protection against measles, and 2 doses of the MMR vaccine are approximately 96% effective at preventing infection.
- Workers born in 1957 or later should verify their measles vaccination status through their state health department or their immunity status through their healthcare provider to determine if vaccination is warranted.
- MeV RNA may be present in wastewater in areas with active transmission, but its infectivity in wastewater remains uncertain.
- Exposure to pathogens in untreated wastewater can occur through inhalation of aerosols, splashes to the eyes or mouth, or contact with contaminated surfaces.
- Risk can be minimized by conducting job hazard assessments, wearing appropriate personal protective equipment (PPE), practicing good hygiene, and disinfecting surfaces using EPA-registered products (List Q).
- Anyone who thinks they may have measles should contact a healthcare provider for evaluation.

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Contents

Why It's a Concern

Measles was declared eliminated in the United States in 2000, because there had been no documented community transmission for 12 months and all reported cases that year were linked to international travel (U.S. CDC 2025b). This public health milestone was made possible by widespread immunization following the introduction of the first measles vaccines in 1963[1].

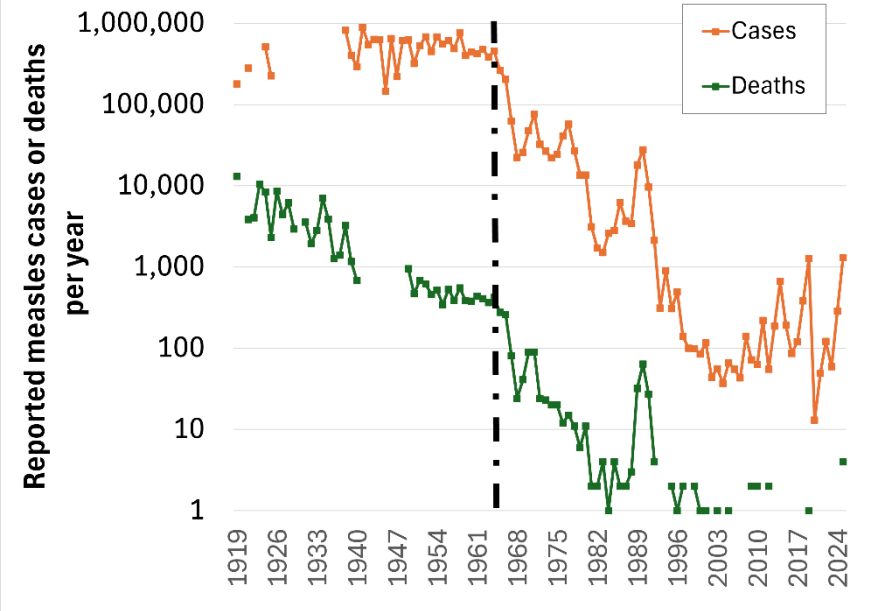


Figure 1. Reported Measles Cases and Deaths in the U.S., January 1919 to July 2025. Note the log scale on the y-axis. The dashed line indicates the year (1963) in which the first measles vaccines were available. Data source: U.S. Census Bureau; Public Health Reports; and Centers for Disease Control and Prevention via Our World in Data (2025).

Figure 1 (note the logarithmic scale) illustrates the dramatic decline in measles cases and deaths before and after the vaccine became available. It's important to note that the pre-vaccine case data shown are likely undercounts. The CDC estimates that 3 to 4 million people were infected with measles annually in the decade prior to the vaccine's introduction (U.S. CDC 2025b).

[1] The first measles vaccines were licensed in the U.S. on March 21, 1963: an inactivated vaccine developed by Pfizer (Pfizer-Vax Measles-K) and a live-attenuated vaccine developed by Merck (Rubeovax). However, widespread uptake of measles immunization did not begin until 1965, when the renewed Vaccination Assistance Act included measles among the immunizations eligible for federal funding, significantly expanding access and public health infrastructure for vaccine delivery (Ratner 2025).

Despite the significant success of the measles vaccination program, the U.S. has recently seen a resurgence in cases. Between January 1 and August 5. 2025, there have been 1,356 confirmed measles cases, 3 deaths from measles, and 32 measles outbreaks—amounting to the worst measles year in the U.S. since 1992 (U.S. CDC 2025b).

Measles is an extremely contagious viral disease that can spread after even brief exposure. While most people in the U.S. recover without complications, the risks remain serious, especially for children (APHA 2022). According to the CDC (U.S. CDC 2025d):

- About 1 in 5 unvaccinated individuals with measles require hospitalization
- 1 in 20 children with measles develop pneumonia
- 1 in 1,000 children with measles develop encephalitis
- 1 to 3 out of every 1,000 children with measles die

Additionally, measles infection can impair immune memory, thereby reducing immunity to other diseases (Griffin 2010) and leading to an increased risk of death from other infectious diseases in the 2 to 3 years that follow measles infection (Mina et al. 2015).

About the Virus

Measles virus (MeV) is a spherical, enveloped, single-stranded RNA virus in the Morbillivirus genus of the Paramyxoviridae family (see **Figure 2**). Each virion is usually 100 to 200 nm in length and contains a genome with 15,894 nucleotides (Phan et al. 2018; Bankamp et al. 2024). There is only one serotype (or antigenic type) of MeV, which means that measles vaccines—originally licensed in 1963—continue to be effective (U.S. CDC 2021). There are 24 genotypes across 8 clades (A through H), with all A genotypes derived from vaccines and B through H corresponding to "wild-type" MeV (Riddell et al. 2005). Of the wild-type genotypes, only B and D are thought to be currently circulating (Mathis et al. 2025).

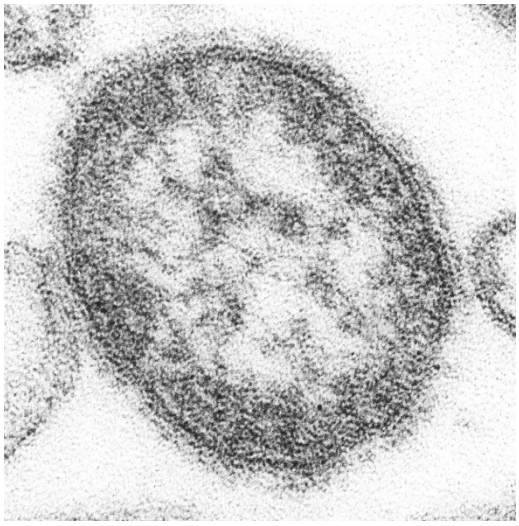


Figure 2. Transmission Electron Micrograph of Measles Virus. Source: U.S. Centers for Disease Control and Prevention Public Health Image Library; in the public domain.

Disease Overview

Animal reservoirs: There are no known non-human reservoirs for measles (APHA 2022).

Incubation period: The time between exposure to measles and the appearance of the characteristic measles rash averages 14 days, with a range of 7 to 21 days (U.S. CDC 2021). As described below, symptoms usually appear before the rash onset, and someone infected with measles can transmit the disease starting up to 4 days before developing the rash (APHA 2022).

Clinical features: Infection with measles progresses through a "prodome" before onset of the characteristic rash (U.S. CDC 2021; APHA 2022):

- The prodome can last from 1 to 7 days, but is usually 2 to 4 days, and is associated with a fever (peaking as high as 103 to 105°F), cough, runny nose (coryza), and inflammation of the transparent membrane covering the white part of the eye (conjunctivitis).
- The rash initially appears along the hairline and on the face before proceeding downward to the hands and feet. Persisting for 4 to 7 days, the rash can lead to peeling of lesions in severely affected areas.

Potential complications from measles infection that can occur up to 4 weeks after the rash include: diarrhea, ear infection (otitis media), pneumonia (occurring in 1 out of every 20 children with measles), croup (laryngotracheobronchitis), febrile seizures, brain swelling (encephalitis; occurring in 1 out of every 1,000 children with measles), and death (occurring in 1 to 3 children out of 1,000 with measles). Between 1987 and 2000 in the U.S., 30% of measles cases were reported to have 1 or more complications, and complications most commonly occurred in children younger than 5 years and in adults (U.S. CDC 2021; APHA 2022). About 20% of unvaccinated people who get measles are hospitalized. In addition, subacute sclerosing panencephalitis (SSPE)—a rare, progressive, and fatal neurological disease—develops in about 1 in 10,000 measles cases 5 or more years after infection (APHA 2022). The risk of SSPE is higher when measles infection occurs at a young age (Mubbashir et al. 2025).

Another complication from measles infection relates to the immune amnesia—or loss of acquired immunity against other diseases—induced by the MeV. Mina et al. (2019) documented an elimination of 11 to 73% of antibodies to other pathogens in 77 unvaccinated children 2 months after natural measles infection. These immune system effects were not observed in vaccinated children. There is an increased risk of death from other infectious disease in the 2 to 3 years after measles infection, likely due to this immune amnesia (Mina et al. 2015).

Transmission: Measles is one of the most easily transmitted infectious diseases (APHA 2022). Every person infected with measles can potentially infect an additional 12 to 18 unvaccinated people or more (Guerra et al. 2017), and it is thought that a short period of limited contact can result in transmission. The measles virus is primarily spread through respiratory droplets—including nasal and throat secretions and saliva—over short distances, but it can also be transmitted via small aerosol particles that linger in the air for several hours (Moss and Griffin 2024). Additionally, it can spread through direct contact with the nasal and throat secretions of infected individuals, and potentially through contact with articles freshly soiled with nasal and throat secretions (e.g., clothing, tissues; APHA 2022). Infected individuals can transmit the virus up to 4 days before the characteristic rash appears—even while asymptomatic. People who are vaccinated against measles are less likely to transmit the virus to others if they become infected (Evans et al. 2024; Tranter et al. 2024).

***Diagnosis*:** Diagnosis of measles requires specialized testing from a healthcare professional with laboratory confirmation. Apart from measles, there are many causes of febrile illness with rash, including chikungunya, dengue, roseola, rubella, scarlet fever, toxoplasmosis, varicella (chickenpox), and others (APHA 2022). Therefore, CDC recommends the collection of clinical samples for laboratory confirmation of all suspected measles cases (U.S. CDC 2024). Diagnostic testing is usually accomplished through either serological testing for measles-specific immunoglobulin class M (IgM) antibodies, or through real-time reverse

transcription polymerase chain reaction (RT-PCR) testing for measles RNA from a nasopharyngeal or throat swab, or a urine or blood specimen (APHA 2022). Both serological and RT-PCR testing can give false negatives, depending on the timing of the test. MeV isolation from nasopharyngeal swab, throat swab, urine, or blood in cell culture within the first 8 days of rash onset can also be used for confirmation of a measles diagnosis.

Risk groups: Anyone who is not protected against measles—either through previous infection or vaccination—is susceptible to measles infection. Based on a systematic review, measles vaccine effectiveness is estimated to be 95% after a single dose and 96% after two doses (Di Pietrantonj et al. 2021). Groups at risk of severe complications from measles include: children younger than 5 years, adults older than 20 years, pregnant women, and people with compromised immune systems (APHA 2022).

Mortality: The case fatality rate (CFR) for measles is thought to be 0.1% in high-income countries, but up to 1 to 3% in low- and middle-income countries and 10 to 30% in refugee camps and other communities with chronic undernutrition and poor access to health services (APHA 2022; Sbarra et al. 2023). The CFR for measles so far in 2025 in the U.S. is 0.2% (3 deaths out of 1,356 confirmed cases) as of August 5, 2025 (U.S. CDC 2025b). Measles infection in pregnancy can cause stillbirths and miscarriages (APHA 2022).

Clinical surveillance: Since 1912, measles has been a nationally notifiable disease in the U.S. and cases are currently tracked as part of the National Notifiable Diseases Surveillance System (NNDSS). The NNDSS relies on voluntary reporting of cases for about 120 diseases, including cases that meet the measles/rubeola case definition. Measles is an immediately notifiable disease. Measles cases should be reported promptly by state health departments to CDC within 24 hours. Information on measles cases and outbreaks can be found on the CDC website: Measles Cases and Outbreaks | Measles (Rubeola) | CDC.

Presence in Wastewater

Shedding from infected individuals: Individuals infected with measles can shed MeV in pharyngeal exudates, saliva, sputum, and urine—all of which can enter wastewater systems. Both MeV RNA (Mosquera et al. 2005; Hummel et al. 2006; Magurano et al. 2012; Takao et al. 2012; Michel et al. 2013) and infectious virus (Gresser and Katz 1960; Mosquera et al. 2005) have been recovered in excretions from infected persons. For example:

- Gresser and Katz (1960) recovered infectious MeV from urine in 6 of 11 pediatric patients, starting 1 day before rash onset and up to 4 days after.
- Mosquera et al. (2005) found MeV RNA in pharyngeal exudate, serum, and urine in 75% of patients 6 days after rash onset, and recovered infectious virus from pharyngeal exudate (75%) and urine (25%) at the same time point.
- Magurano et al. (2012) detected MeV RNA in 48% (199 out of 414) of saliva and urine specimens from infected individuals using RT-PCR.
- Takao et al. (2012) detected MeV RNA in nasopharyngeal swabs and urine from 8 of 26 confirmed measles cases, 4 to 8 days after rash onset.

Chen and Bibby (2025), for the purposes of assessing the feasibility of wastewater testing for measles surveillance, estimated MeV RNA concentrations (in gene copies per mL) in excretions as follows:

- Saliva: mean = $10^{6.4}$; range = $10^{0.62}$ to 10^{11}
- Sputum: mean = $10^{5.5}$; range = $10^{0.84}$ to $10^{9.0}$
- Urine: mean = $10^{9.3}$; range = $10^{2.4}$ to $10^{9.3}$
- Feces: no published data currently available

Detection in wastewater: Molecular (i.e., culture-independent) methods are commonly used to detect MeV RNA in wastewater. These include digital PCR (Gan et al. 2025), droplet digital PCR (Wu et al. 2024), and quantitative/real-time PCR (Benschop et al. 2017; Hayes et al. 2023; Kasprzyk-Hordern et al. 2023; Joseph et al. 2025; Rector et al. 2025; Tomalty et al. 2025). PCR assays can be designed to differentiate between wild-type and vaccine strains, with PCR approaches used to detect wild-type genotype D8 in Brussels wastewater (Rector et al. 2025) and the vaccine strain (genotype A) in Ottawa wastewater (Tomalty et al. 2025). In addition to PCR methods, sequencing-based approaches have also been used to confirm the presence of MeV RNA in wastewater and identify the virus genotype. For example, the wild-type genotype B3 was detected in Houston wastewater using sequencing-based approaches (Javornik Cregeen et al. 2025).

The detection of MeV RNA with PCR-based methods does not necessarily mean that infectious virus is present. To our knowledge, no studies have attempted to culture MeV from untreated wastewater.

Persistence in the environment and untreated wastewater: Although we are not aware of any data on the persistence of infectious MeV in environmental waters or wastewater, Wu et al. (2024) demonstrated that MeV RNA spiked into influent wastewater persisted over days to weeks, with the degree of persistence dependent on initial spiked concentration (low = $10^{6.2}$ gene copies/L vs. high = $10^{7.1}$ gene copies/L) and temperature (4°C vs. room temperature). The time required for decay of 10% of the spiked MeV RNA ranged from 6.2 days (low spiked concentration at room temperature) to 41 days (high spiked concentration at 4°C), suggesting that MeV RNA could be reasonably persistent in wastewater. This study provides no information on the persistence of infectious virus, however.

Fate in wastewater treatment processes: Most research on virus behavior in wastewater treatment has focused on non-enveloped enteric viruses[2] (e.g., norovirus, adenovirus), which are known for their environmental persistence (Katayama et al. 2008; Kitajima et al. 2014; Schmitz et al. 2016). In contrast, enveloped viruses—such as MeV, influenza virus, respiratory syncytial virus, and SARS-CoV-2—are generally considered more susceptible to inactivation due to their lipid envelope (Chaqroun et al. 2024). To date, no studies have directly evaluated the fate of MeV RNA or infectious MeV in wastewater treatment processes. Wu et al. (2024) found that MeV RNA partitions to the solids fraction of wastewater, with a partition coefficient (Kd) of 219.1 ± 99.3 mL/g. This means that 2 to 11% of the MeV RNA would be associated with the solids fraction in raw influent (assuming TSS = 150 to 400 mg/L). Understanding this partitioning behavior is important because it helps determine how MeV moves through and is removed by treatment processes.

Further research is needed to understand the fate of infectious MeV in wastewater systems. Nonetheless, current wastewater and drinking water treatment and monitoring practices are expected to be sufficient to protect public and environmental health.

[2] Enteric viruses are defined by their habitat, namely, the gastrointestinal tract of mammals. They include viruses in the *Enterovirus* genus (such as coxsackieviruses, echoviruses, enteroviruses, polioviruses, and rhinoviruses), but also adenoviruses, astroviruses, noroviruses, rotaviruses, and others.

Suitability for Wastewater Surveillance

Multiple studies have demonstrated the detection of measles virus (MeV) RNA in wastewater using PCR- and sequencing-based methods in Europe and North America, as summarized in **Table 1**. In contrast, studies in Canada, Korea, and Malawi did not detect MeV RNA in wastewater samples from collection systems or water resource recovery facilities (WRRFs), although the prevalence of measles in the community at the time of sampling was often unknown (Hayes et al. 2023a; Kim et al. 2024; Holm et al. 2025). The size of the sewershed, the number of infected individuals, and the method sensitivity may all influence whether measles is detected in wastewater or not. Chen and Bibby (2025) estimate that, for the average U.S. WRRF, detecting measles virus in wastewater with a 50% probability would require 1 infected person for every 1,300 people in the sewershed (or 78 cases per 100,000 people)[3].

In the U.S., wastewater testing for measles is conducted through both WastewaterSCAN and the NWSS national testing contract.

- WastewaterSCAN (2025) began analyzing wastewater samples for wild-type MeV RNA from all their program sites as of May 13, 2025. Between May 13 and August 8, 2025, 39 positive detections of wild-type MeV RNA were reported across 15 sites in California, Colorado, Connecticut, Florida, Idaho, Iowa, Indiana, Kansas, Maryland, Michigan, Nevada, and Utah. Most of these sites (11 out of 15) had only a single positive detection during this period. These detections occurred out of a total of 5,457 samples collected and tested for MeV across 147 WRRFs in 40 states (A. Bidwell, personal communication, August 11, 2025).
- The CDC NWSS program added wild-type MeV RNA testing to its national testing contract on July 28, 2025. As of August 11, 2025, this national testing contract covers over 200 sites across 38 jurisdictions. When measles is detected in a wastewater sample, CDC alerts the wastewater coordinator, lead state/jurisdiction epidemiologist, and other trusted partners within 24 hours of identification of the detection who are, in turn, encouraged to communicate the results with the relevant utility partner.

In addition, some state and local health departments have begun testing wastewater for MeV RNA in response to the ongoing multi-state measles outbreaks. CDC is actively supporting these communities through technical assistance and assay validation efforts.

Wastewater surveillance can serve as an early warning tool, complementing clinical data to help track transmission trends and inform public health responses. Positive detections of wild-type MeV RNA indicate the presence of measles virus in the community and may indicate community-level transmission, though they cannot identify individual cases or quantify the number of infections.

Utilities are encouraged to coordinate with their public health partners to learn whether MeV is included in wastewater testing within their community and, if so, whether the analysis is specific to the wild-type MeV or includes the vaccine strain. Utilities are encouraged to provide samples for MeV testing if they feel comfortable doing so because these efforts can help protect public health and support timely decision-making at the community level.

[3] This assumes a process limit of detection of detection of 10^3 gene copies per L (Chen and Bibby 2025).

Table 1. Detections of Measles Virus RNA in Wastewater Samples, 2013 to 2025

Sample Location(s)	Sample Collection Year(s)	Sampling Scale	Sample Type	Analytical Method	Detection Rate (%)	Strain and Genotype (if determined)	Reference
Multiple locations in the Netherlands	2013	Secondary schools; neighborhoods	Septage	RT-PCR & sequencing	6/56 (11%)	Wild-type; D8	Benschop et al. (2017)
Ottawa, Canada	2020-2024	WRRF	4-hour composite primary sludge	RT-PCR & sequencing	11/135 (8.1%)	Vaccine strain; A	Tomalty et al. (2025)
Chicago, Illinois	2024	Manhole capturing flows from a facility	Raw wastewater	ddPCR	1/1 (100%)	Wild-type; not differentiated between B3 and D8	Wu et al. (2024)
Lausanne, Switzerland	2024	WRRF	24-hour composite influent	dPCR	9/64 (14%)	Wild-type; not differentiated between B3 and D8	Gan et al. (2025)
Houston, Texas	2025	WRRF	Influent	ddPCR & sequencing	2/2 (100%)	Wild-type; B3	Javornik Cregeen et al. (2025)
2 unnamed cities, Texas	2025	WRRF	24-hour composite influent	RT-PCR & sequencing	13/22 (59%)	Wild-type; D8	Joseph et al. (2025)
Brussels, Belgium region	2024	WRRF (5 total)	24-hour composite influent	RT-PCR & sequencing	5/29 (17%); all at 1 WRRF	Wild-type; D8	Rector et al. (2025)

Abbreviations: *dPCR = digital PCR; ddPCR = droplet digital PCR; RT-PCR = real-time PCR; PCR = polymerase chain reaction; WRRF = water resource recovery facility*

Preventing Infection When Working with Wastewater

Routes of exposure: Uncertainty remains regarding the presence and persistence of infectious MeV in wastewater and what that means for wastewater workers. However, exposure to MeV and other pathogens may occur through inhalation of aerosols during wastewater collection and treatment, or via splashes that contact the eyes, mouth, or other mucous membranes (WEF 2020). Fomite transmission is also possible. Therefore, contact with contaminated surfaces followed by touching the face, especially the eyes or nose, may lead to infection. Surfaces near wastewater equipment are often contaminated, and the risk of transmission of any infectious pathogen may increase in individuals with cuts, abrasions, or open wounds.

Wastewater workers may be exposed to measles through contact with infected individuals. As described above, measles is among the most contagious infectious diseases, requiring only brief exposure for transmission (APHA 2022). The virus spreads via respiratory droplets, nasal or throat secretions, and possibly through contaminated personal items such as clothing or bedding. Notably, infected individuals can transmit the virus up to 4 days before the characteristic rash appears—even while asymptomatic—making it difficult to identify and isolate contagious individuals.

Infection prevention measures: Vaccination is the most reliable way to prevent measles infection. In addition, the worker safety recommendations of the WEF Blue-Ribbon Panel (WEF 2020) remain relevant for wastewater workers for all infectious agents in wastewater. These recommendations are consistent with the CDC's guidance for reducing health risks to workers handling human waste or sewage (U.S. CDC 2023) Understanding appropriate disinfectant products, conducting job safety assessments, practicing good hygiene, and using personal protective equipment all play a role in preventing pathogen infection from wastewater.

Vaccination

- Vaccination is the best way to prevent measles infection: In the U.S., the measles vaccine is only available in combination formulations: either with mumps and rubella (MMR) or with mumps, rubella, and varicella (MMRV). The MMRV vaccine is licensed only for children aged 1 to 12 years.
- Two live-attenuated MMR vaccines are currently licensed in the U.S.:
    - M-M-R II® (Merck & Co., Inc.)
    - PRIORIX® (GlaxoSmithKline Biologicals)
- Vaccine effectiveness is high: According to CDC estimates, two doses of a measles-containing vaccine (typically MMR) are 97% effective (range: 67%–100%) at preventing measles, while a single dose is 93% effective (range: 39%–100%) (U.S. CDC 2025c). These figures align with a systematic review by Di Pietrantonj et al. (2021), which found vaccine effectiveness of 95% after one dose and 96% after two doses.
- Adverse reactions to the MMR vaccine are uncommon: Between 2015 and 2024, a total of 46,305 adverse events were reported for all MMR vaccine types in the Vaccine Adverse Event Reporting System (VAERS) (U.S. HHS 2025). During the same period, an estimated 65.6 million MMR doses were administered in the U.S., based on birth cohort data (Statista 2025) and assumed uptake rates of 90% for one MMR dose and 85% for two MMR doses (U.S. CDC 2025a). This corresponds to an adverse

reaction incidence of 0.07% or 1 out of every ~1,400 MMR vaccine recipients. The most common adverse reactions were mild, including fever and rash, and localized redness, swelling, and pain at the injection site (U.S. HHS 2025).

- CDC vaccine recommendations for adults are as follows:
    - Adults born before 1957 are presumed to be immune due to prior infection and do not need MMR vaccination.
    - For adults born in 1957 or later who have received 2 doses of live measles-containing vaccine, no further doses are needed. Anyone unsure of their vaccination status can request records from their state health department.
    - If records indicate receipt of only one dose of an inactivated measles vaccine (used in ~5% of doses between 1963 and 1967), 2 doses of the current MMR vaccine are recommended, spaced ≥28 days apart.
    - Individuals who have had laboratory-confirmed measles infection do not need vaccination.
    - Those unsure of their immune status and unable to locate records may request measles IgG antibody testing and, if non-immune, should receive 2 MMR doses, spaced ≥28 days apart.
    - No booster is needed for individuals who are fully vaccinated.

Disinfectant products

- Like other enveloped viruses, MeV is expected to have less intrinsic resistance to inactivation by chemical and physical modes of disinfection compared to non-enveloped viruses. Per the U.S. Environmental Protection Agency (EPA) virus designation, MeV would be a Tier 1, easy-to-disinfect virus due to the fact that it is enveloped. Numerous disinfectants on EPA's "List Q" are effective against Tier 1 viruses (U.S. EPA 2023). The products on this list contain chlorine dioxide, citric acid, ethanol, hydrogen peroxide, isopropyl alcohol, quaternary ammonia, sodium hypochlorite and other common disinfectants as active ingredients.
- For measles, Sanekata et al. (2010) demonstrated antiviral (>99.99% inactivation of infectious MeV virus) activity with 100 ppm sodium hypochlorite after 30 seconds and with 1000 ppm after 15 seconds. This is in the range of CDC's recommendation for disinfection of surfaces (1:50 dilution of 5.25% sodium hypochlorite [0.1% final sodium hypochlorite strength, or 1,000 pm], or about 75 mL [1/3 cup] of household bleach in a total of 1 gallon of water) with a contact time of 1 minute.

Job safety assessments (JSAs)

- JSAs should follow the protocols outlined in WEF (2020). Please email nwbe@wef.org for JSA templates if needed.
- To inform their JSAs, utilities should coordinate with local public health agencies and healthcare institutions to understand the risk of MeV in their wastewater.

Hygiene

- After handling wastewater or touching surfaces potentially contaminated with wastewater, hands should be washed with soap and water or cleaned with an alcohol-based hand sanitizer (ABHS), although soap and water should be used if hands are visibly soiled. It is worth noting that, as explained in Weber et al. (2023), "[w]earing gloves is not a substitute for hand hygiene".

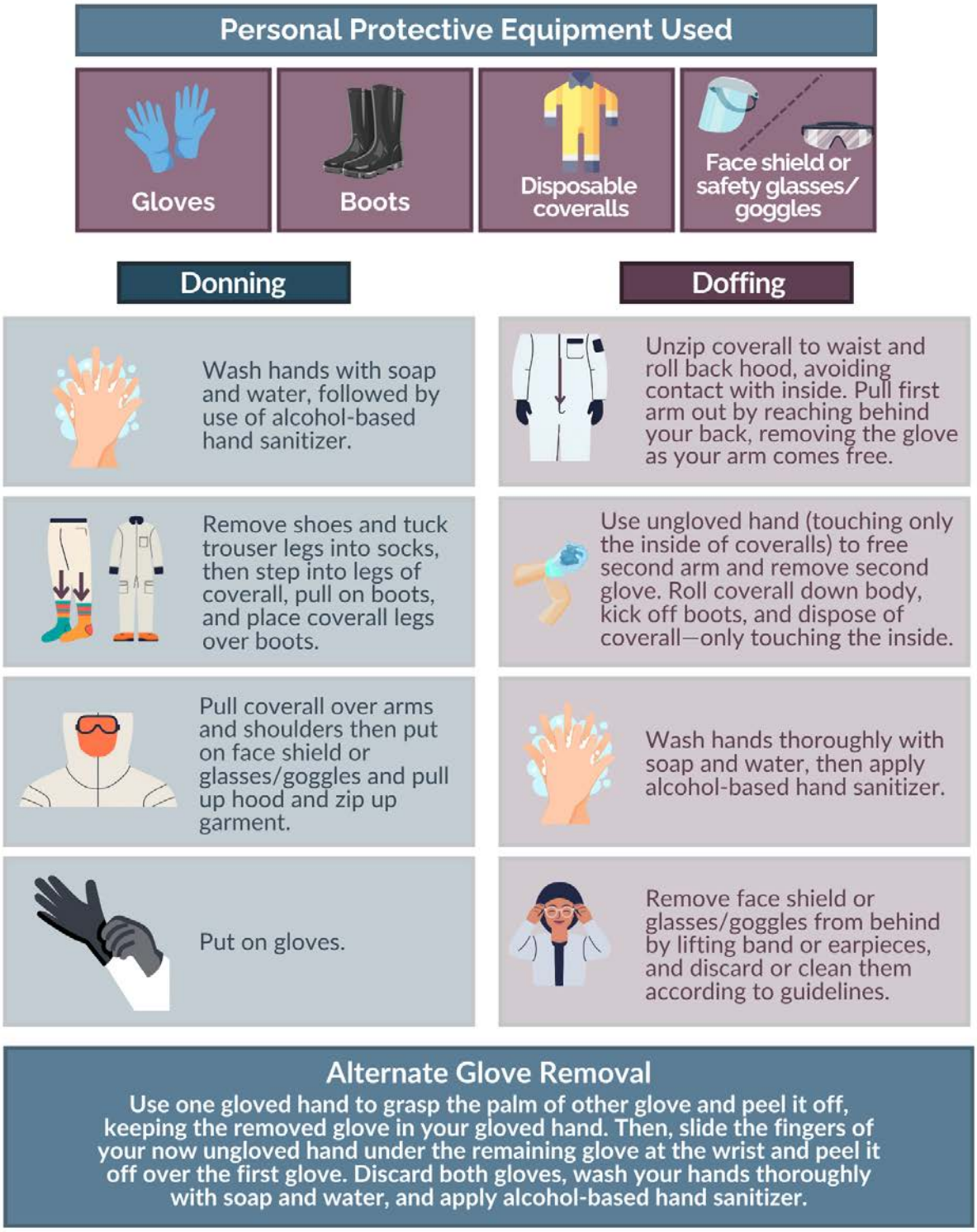
- While working with wastewater and near surfaces potentially contaminated with wastewater, avoid touching the face, mouth, eyes, nose, or open sores or cuts, and do not smoke or chew tobacco or gum. In addition, sores and cuts should be covered with water-resistant band aids.

Personal protective equipment (PPE)

- PPE should be selected to prevent contact with wastewater, either directly (through splashes, contact transfer, or whole-body contact) or indirectly (through touching contaminated surfaces).
- Appropriate PPE may include gloves, boots, coveralls (such as Tyvek suits), face shields, and safety glasses/goggles (LeChevallier et al. 2020).
- Care should also be taken to prevent cuts or punctures when handling wastewater through the use of durable gloves. Gloves should be changed when torn or heavily contaminated.
- Proper procedures for donning (putting on) and doffing (removing) PPE to minimize pathogen exposure should be followed. **Figure 3** provides an example of donning and doffing gloves, boots, disposable coveralls, and a face shield or safety glasses/goggles, including steps on how to remove gloves when not wearing a disposable coverall.
- Reusable PPE, such as boots, face shields and goggles, should be cleaned after each use. Visibly soiled PPE can be cleaned with soap and water, followed by a dilute bleach solution (1 part 5.25% sodium hypochlorite with 49 parts water) or a disinfectant on EPA's "List Q". For PPE that is not visibly soiled, or not amenable to washing with soap and water, a disinfectant on EPA's "List Q" can be used. In addition, PPE should also be inspected before each use.

Figure 3. Donning and Doffing Personal Protective Equipment for Reducing Pathogen Exposure

To reduce pathogen exposure, follow the right steps for donning (putting on) and doffing (removing) personal protective equipment (PPE). Here is a short guide on how to properly don and doff the PPE listed, along with tips on how to remove gloves when not wearing a disposable coverall.



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