Shedding of Vaccine-Derived Virus following Vaccination

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What is viral shedding?

- Infectious diseases can spread through various transmission routes, including direct person-to-person contact and exposure to contaminated respiratory droplets, blood, and other bodily fluids.
- The transfer of infectious pathogens, primarily viruses and bacteria, from an infected individual to the environment—known as 'shedding'—can occur before, during, and after the individual becomes symptomatic, depending on the specific pathogen.

What is vaccine-derived viral shedding?

- Live attenuated vaccines (rotavirus, varicella, measles, mumps, and rubella (MMR), and live attenuated influenza vaccine (LAIV)) contain weakened versions of the viruses they protect against that replicate within the vaccinated individual. In comparison, all forms of inactivated vaccines are incapable of viral replication and cannot cause shedding.
- Much like infection with wild-type viruses, vaccines using live attenuated viruses also replicate and create an immune response. However, they are sufficiently weakened, infrequently causing symptoms of clinical disease.

Can a person who is recently vaccinated with a live attenuated vaccine develop disease symptoms from the virus in the vaccine?

- Infrequently, persons vaccinated with live attenuated vaccines will have disease symptoms.
- For instance, five percent of people who receive the MMR vaccine may develop fever or a rash 7-10 days following vaccination.[1]
- Depending on the rotavirus vaccine used, one in five children may develop diarrhea and one in ten children may develop vomiting following vaccination.[1]
- Following varicella vaccination, a varicella-like like rash at the injection site has been reported in 3% of children and 1% of adolescents and adults within two weeks following the second dose.[1] A generalized varicella-like rash is reported by 4-6% of recipients of varicella vaccine.[1] Rarely, zoster caused by the varicella vaccine virus has been reported, and the majority of cases are mild, without complications.[1]
- Immunocompromised persons are at increased risk of experiencing disease symptoms following receipt of live attenuated vaccines. For this reason, it is very important to closely adhere to precaution and contraindication guidelines when administering live attenuated vaccines.
- Importantly, disease symptoms do not occur following administration of inactivated vaccines.

Can a person who is recently vaccinated with a live attenuated vaccine transmit the virus to another person?

- Vaccine-derived viral shedding has been documented following administration of oral rotavirus, varicella, and MMR vaccine. Even though shedding occurs after vaccination, it does not mean the shed virus will make another person sick. Individuals with weakened immune systems are more at risk for infection than healthy individuals.
- Following rotavirus vaccination, some infants will shed vaccine-derived virus in their stool for several weeks. Studies have shown the risk for rotavirus vaccine-derived viral transmission remains extremely low.[2]
- Following varicella vaccination, transmission of vaccine virus is very rare and only reported from vaccine recipients who developed a varicella-like rash after vaccination[1]. The secondary cases caused by vaccine virus are typically mild.[1]
- MMR vaccine-derived viral shedding, measured by vaccine-derived measles RNA in the nasopharynx, has been observed in approximately one-third of children after their first MMR dose and rarely observed following the second MMR dose[4]. However, likely due to the very low levels of virus found in the vaccinated individual's nasopharynx, vaccine-derived viral shedding following MMR vaccination does not lead to transmission of the vaccine-virus to others and is not contagious.[4]

In summary, vaccine-derived viral shedding may occur following administration of live attenuated vaccines. Vaccine-derived virus rarely spreads to other contacts and very rarely causes illness.

In light of the recent measles outbreak, parents may have additional concerns regarding the MMR vaccine. Does vaccine-strain viral shedding occur following MMR vaccination and is it harmful?

- Following MMR vaccination, attenuated measles virus replication occurs, mirroring wild-type infection. As a result, approximately 5% develop fever and/or rash 7-10 days later and measles RNA may be detectable by PCR in respiratory samples of vaccinated children; this occurs in approximately one-third of children after receipt of their first dose of MMR vaccine.[4]
    - In a study that examined nasopharyngeal swabs of twenty 1-year olds before and after receipt of a first dose of MMR vaccine, 5 of 20 (25%) patients had vaccine strain measles RNA detected 7-14-days post MMR vaccination.[3]
    - Another study examined 127 children after receiving either dose 1 (n = 96) or dose 2 (n = 31) of MMR vaccine and found:[4]
        1. Nasopharyngeal swabs in 34% were PCR positive for vaccine strain measles (type A) between 6- and 29-days (median 11 days) following a first dose of MMR;
        2. Only 1 child (3%) was PCR positive for vaccine strain measles after dose 2, which occurred 19 days post vaccination
        3. The quantity of measles virus detected by PCR in the recently vaccinated children was very low (median PCR cycle threshold (Ct) levels of ≥ 30).
    - A recent study examined the results of 1,548 multi-pathogen PCR panels testing for causes of rash; 17 (1.1%) were positive for measles virus. 14 of the 17 persons with a positive test had case investigation and vaccination records available; all had received a dose of MMR a median of 12 days prior to specimen collection.[5]
- Vaccine-strain measles virus shedding in the nasopharynx is not contagious:
    - Vaccine-strain measles RNA detected in the nose after vaccination was unable to replicate in inoculated cells.[3]
    - Rhesus macaques who were PCR+ for vaccine-strain RNA in the nasopharynx did not transmit virus to unvaccinated macaques.[3]
    - No cases of human-to-human transmission of measles vaccine virus were found in a systematic review of 773 articles to determine if human to human transmission occurred following live attenuated measles vaccination, no confirmed cases of human-to-human transmission of measles vaccine virus were found.[6]

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