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Outbreak report

Measles secondary vaccine failure in a childcare setting: an outbreak report

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Abstract

The Sunshine Coast Public Health Unit (SCPHU) identified a measles case in a childcare educator (CE) with secondary vaccine failure (SVF). The CE had been exposed to a confirmed measles case in a hospital emergency department and later developed symptoms including fever, cough, malaise, and a rash. Diagnostic tests confirmed measles virus infection. Sunshine Coast Public Health Unit (SCPHU) mplemented control measures including contact tracing, vaccination, post-exposure prophylaxis, and quarantine for susceptible contacts. Out of 372 identified contacts, 72 were identified as susceptible, all of whom were infants and children. Despite the CE having close contact to all susceptible infants and children, no onward transmission occurred. This suggests that SVF cases pose a lower risk of spreading measles compared to immunologically naïve individuals. This report highlights the importance of prioritising immunologically naïve cases in outbreak responses.

Keywords: measles; secondary vaccine failure; transmission; outbreak

Background

Measles virus (MV) is known to be a highly infectious illness which can lead to other health complications such as pneumonia and encephalitis.[1] Secondary vaccine failure (SVF) may occur if the response to a measles-containing vaccine is suboptimal, which can lead the vaccinated individual to become infected with MV.[2] SVF is thought to occur largely due to immunity waning over time.[3,4] It is estimated that waning immunity occurs in 2–10% of measles vaccine recipients worldwide, between six and twenty-six years following the last administered dose.[2] SVF is associated with illness that is less severe[5] and occurs more commonly in elimination settings.[2]

Australia is an elimination setting for measles. Due to high vaccination rates, sustained community transmission does not occur. Cases of measles are mostly overseas acquired.[6] This outbreak report demonstrates a case where SVF occurred and no transmission resulted despite exposure to susceptible children in a childcare centre setting. The aim of this report is to discuss the outbreak retrospectively to contribute to existing knowledge about SVF and onward transmission of measles.

Outbreak detection

On 9 April 2023, the Sunshine Coast Public Health Unit (SCPHU) was notified of a suspected measles case in a female childcare educator (CE), aged 22 years. On March 21, 2023, the CE had unknowingly been exposed to a confirmed measles case in a tertiary hospital's emergency department (ED) when she presented to the ED with an unrelated condition. The primary case was an unvaccinated 4-year-old who had recently returned from Pakistan and at the time, the CE was considered immune to measles, with reliable evidence of two MMR vaccines documented on the Australian Immunisation Register (AIR). These two cases were in separate sections of the ED and there was no known contact between them.

Fourteen days following exposure, the CE developed a fever, cough, malaise, and shortness of breath. This was followed five days later by a rash on her face, chest, and arms. On 9 April 2023, the CE presented to the ED, where blood was collected for MV serology. Anti-MV immunoglobulin M (IgM) testing performed on a Diesse Chorus instrument was high-equivocal (1.10 TV, where a value of >1.1 TV is considered positive). Anti-MV immunoglobulin G (IgG) performed on the Diasorin Liaison XL instrument was noted to be strongly positive at 191 AU/mL, where a value ≥ 16.5 AU/mL is categorised as positive by the manufacturer. Based on these results, MV reverse transcription-polymerase chain reaction (RT-PCR) testing was retrospectively added to a nasopharyngeal swab (NPS) collected for respiratory virus testing, and urine collected for microscopy, culture, and susceptibility testing. Measles virus nucleic acid was detected in both the urine and NPS specimens, confirming acute MV infection and SVF in this patient.

The CE had been exposed to the primary case (overseas acquired) in a tertiary ED. Partial genome amplicon sequencing (based on 450 nucleotides of the MV nucleocapsid gene)[7] was performed using the urine sample from CE and an NPS from the primary case. The sequences from both patients demonstrated 0 single nucleotide polymorphisms (SNPs) difference, suggesting possible genetic similarity, and may further indicate a possible transmission link in the context of the known epidemiology and contact tracing data. Both sequences were phylogenetically grouped within MV genotype B3. The CE had no history of being immunocompromised or having significant comorbidities and, according to AIR, CE was vaccinated with two doses of MMR in 2002 and 2006.

Contact tracing

The CE had worked, unmasked, for six (8 hour) days, throughout her infectious period, at a childcare centre across multiple rooms. Her duties included all direct care activities required for looking after small children, e.g., feeding, soothing, toileting.

A total of 372 childcare contacts were identified: 143 children; 29 staff; 179 parental close contacts; and 21 other close contacts. In accordance with the Communicable Diseases Network Australia (CDNA) guidelines classification of susceptible and non-susceptible close contacts,[8] 72 susceptible close contacts were identified. This included 16 unvaccinated children, twelve of whom were under the age of 12 months and therefore not eligible for vaccination, and four of whom were over 12 months of age, yet remained unvaccinated; 19 children with one documented MMR due to age; and 37 others, with one documented MMR vaccine. There were 214 close contacts considered non-susceptible. There were 86 persons with unknown susceptibility, i.e., parents of attendees with no documented evidence of previous vaccination or disease. Vaccination status of these individuals could not be determined, as vaccination may have occurred outside Australia or prior to the establishment of the computerised vaccination database in Australia.

Outbreak control measures

The public health response was performed by SCPHU and guided by CDNA guidelines[8] to prevent further transmission and included vaccination, post exposure prophylaxis or recommending quarantine to susceptible close contacts. The public health response included closing two childcare centre rooms and excluding those determined as 'susceptible' close contacts. This included 35 children, of whom 16 were unvaccinated. In addition, SCPHU set up two testing clinics offsite over two days and tested 59 symptomatic and asymptomatic susceptible close contacts from the childcare centre. All unvaccinated children, and those partially vaccinated and eligible, were offered post-exposure MMR vaccination. This resulted in 10/16 unvaccinated children (63%) and 12/19 partially vaccinated children (63%) accepting vaccines, including one child who was eligible for normal human immunoglobulin (NHIG). This response approach aligns with that described by Gastañaduy et al.[9] The remaining families declined vaccination. No additional infections were identified in these susceptible close contacts.

Regular phone and email communication with the families and childcare centre was maintained until up to 23 days since last exposure,[10] with the centre assisting to alert parents and monitor children who might present with symptoms and notifying SCPHU. There were no further clinical presentations and, overall, there is strong evidence against onward transmission from this index case.

Discussion

This case of measles SVF with no onward transmission is noteworthy because the case exposed 72 susceptible persons, throughout six days of working, while infectious. Measles SVF occurs commonly in outbreak settings with high vaccination coverage, and although measles transmission from such persons has been documented,[11] it is considered unusual.[12,13] Other summary series have demonstrated that SVF may be an all-or-nothing phenomenon, some with onward transmission as usual,[12,14] and some with no onward transmission at all.[2,15–17]

Measles SVF is thought to result in reduced viral RNA loads in bodily fluids compared with primary disease, with various studies using semi-quantitative real-time RT-PCR cycle threshold (Ct) values as indicators of viral load.[14] In a study of 11 SVF cases, measles RNA Ct values in NSP and in urine were higher compared to the control group of 40 unvaccinated people.[18]

A limitation of this outbreak response is that defining SVF relied on vaccination records rather than avidity testing.[19] It should be noted that primary vaccine failure could have been possible due to failure to develop immunity following vaccination; or—although unlikely in Australia—due to cold chain compromise at the health centre where the CE received both doses of measles containing vaccine.

Overall, this report lends support to the notion that persons experiencing a measles SVF infection are less likely to transmit the disease[17] and may have a lower effective reproductive number compared to persons who are immunologically naïve. During outbreak responses in countries with high vaccine coverage rates, persons with SVF could be considered to have lower transmission risk. In the early stages of an outbreak, investigation of immunologically naïve cases should be prioritised.

Ethics exemption

Ethics exemption was granted by Metro North Health Human Research Ethics Committee (HREC) B (EC00168).

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