# An ongoing measles outbreak linked to a suspected imported case, Ireland, April to June 2016

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**We report an outbreak of measles which started in April 2016 and which, by 13 June, has resulted in 22 confirmed and five probable measles cases occurring in four regions of Ireland. Genotype B3 was identified. We describe the identification, ongoing investigation and control measures being implemented. This outbreak occurs during a period of very low measles transmission in Ireland, with only one confirmed case (imported) notified in 2016 before this event.**

In this report we describe an outbreak of measles that started in Ireland in April 2016, with 22 confirmed and five probable cases recorded as at 13 June. The investigation is ongoing and here we present the preliminary findings and the control measures implemented. A national outbreak control team was convened following the identification of the first three laboratory-confirmed measles cases, in three regions, over the preceding four week period. Data for this report were extracted from the national computerised infectious disease reporting (CIDR) system on 13 June 2016. In Ireland, measles incidence has declined in the last decade, from 8.4 cases per 100,000 in 2004 to 0.7 cases per 100,000 in 2014 [1,2]. The most recent national measles outbreaks occurred over four years ago [3,4].

## Case classification

In Ireland, measles cases are defined as possible, probable or confirmed, depending on clinical criteria, epidemiological links and laboratory criteria [5]. For this report, we limit the description of cases to probable and confirmed cases. A probable case was defined as any person who met clinical criteria (fever, maculopapular rash, and any of cough/coryza/conjunctivitis) and had an epidemiological link to a confirmed case. A confirmed case was defined as any probable case with laboratory evidence of infection with measles virus i.e. viral RNA on PCR testing of clinical samples and/or positive IgM result from serum or oral fluid.

## Diagnostic testing

The National Virus Reference Laboratory (NVRL) in Dublin performed all diagnostic testing for suspect cases. A variety of samples were used to confirm or rule out diagnosis: primarily oral fluid samples, serum, or throat swabs. The type of sample obtained from patients was determined by the time between onset of rash and time of sample collection, and availability of buccal swabs.

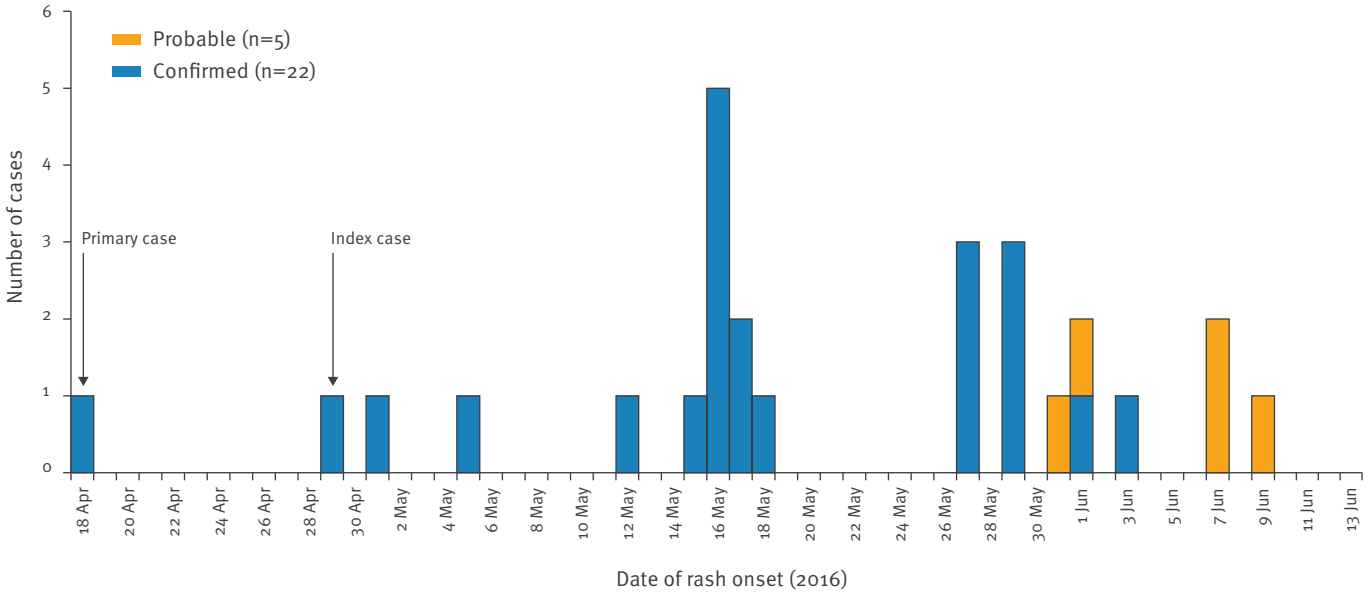
A measles IgM capture enzyme immunoassay (EIA) (Microimmune, Hounslow, Middlesex, United Kingdom, catalogue number MeVM010) was used to detect measles IgM in oral fluid samples or serum specimens. Oral fluid samples collected five days or more after rash onset were tested for measles IgM, whereas serum specimens collected more than three days after rash onset were tested for measles IgM. In addition, oral fluid specimens collected within seven days of rash onset were investigated for measles RNA using RT-PCR directed against a conserved 68-bp region within the haemagglutinin gene.

## Progress of the outbreak and contact tracing

The number of cases over time is described in the epidemic curve (Figure 1).

**Figure 1**

Cases of measles by date of rash onset, Ireland, April–June 2016 (n=27)




The first identified case (Case B) was notified on 9 May 2016. Case B was an Irish adult who reported travel to Hungary for a short visit in mid-April. Case B travelled within Dublin and from Dublin to south-west Ireland, at the end of April 2016 while symptomatic.

After Case B was reported, Case D was notified on 13 May (onset of rash beginning of May). Case D had been in hospital in Kerry for two days in mid-April for an unrelated illness. Seven further cases were reported in Kerry and one case in Limerick (neighbouring county) during one week in mid-May. Extensive contact tracing was undertaken for each case. These cases were all linked to towns in south-west Ireland where confirmed cases had been while infectious, or else were nosocomial infections. The links between cases are shown in Figure 2.

Retrospective investigation of two family members (Cases F and G) identified that they were related to a child (Case A) who had also been admitted to the same hospital in Kerry in mid-April for an unspecified febrile illness. Case C, another relative, had visited Case A in hospital. The parents reported that Case A had travelled from Romania to Ireland via Hungary in mid-April, on the same flight as Case B. Case A had been unwell with a fever and rash on the flight to Ireland, travelled from Dublin to south-west Ireland on arrival, and was then hospitalised. Case A was not investigated for measles on admission, and was not immediately isolated. A buccal swab was obtained three weeks after hospitalisation and sent for PCR testing but was negative. When Case A was suspected as the primary case, the NVRL retrieved a nasal swab for influenza taken from the child's admission which returned as measles PCR positive.

## Additional outbreak investigation

The Health Protection Surveillance Centre (HPSC) issued an alert about the outbreak to other European countries through the European Union (EU) Early Warning and Response System (EWRS). Following confirmation that the primary case had visited western Romania before return to Ireland, the HPSC liaised with Romanian authorities regarding the areas visited. One of the villages which Case A had visited was confirmed as having a measles outbreak. Case A had been in contact with a child with fever and rash while there, and was thus confirmed as the primary case in the outbreak in Ireland.

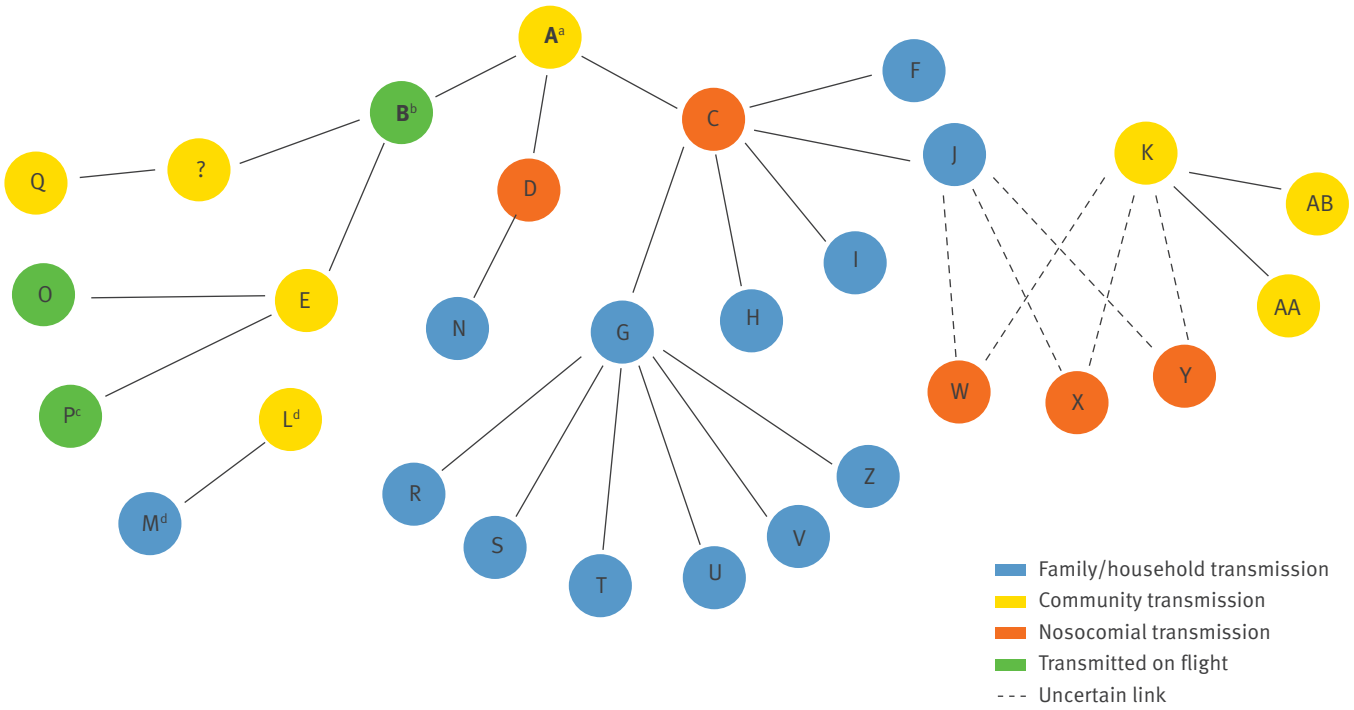
As at 13 June, cases have spread to four counties in Ireland, and one linked case has been reported in Slovenia. The disease has been transmitted via four different routes: household, community, nosocomial and in-flight (Figure 2). Thus, in order to investigate this outbreak, public health authorities had to liaise with patients, hospital staff and airline companies.

## Molecular surveillance

Measles genotyping was performed by sequencing a 450 nt region at the C-terminal of the N-gene in accordance with the World Health Organization (WHO) guidelines. Case A (MVs/Kerry.IRL/18.16, MeaNS sample ID 87266, sequence ID 90316) was genotyped as B3. As at 17 June, all cases sequenced and uploaded into MeaNS from the outbreak were genotype B3 and 100% identical.

**Figure 2**

Epidemiological links between cases, measles outbreak, Ireland, April–June 2016 (n=27)




Identical sequences have been identified in Manchester (week 16, 2016), Tennessee (week 16, 2016) and British Columbia (week 9, 2016). It was not possible to directly link the B3 N-gene sequence identified in the primary case to measles cases in Romania. The three strains in MeaNS database from Romania this year (week 8, 12 and 13) do not cluster to our outbreak B3 strains.

In the absence of endemic measles in Ireland before this event in 2016, and, as the child was in Romania for 17 days before symptom onset, we consider that it is most likely that exposure occurred in Romania, particularly as measles transmission was reported in the village visited by the case during their stay in Romania. However, given that the incubation period can range from seven to 21 days, we cannot rule out that transmission may have occurred in transit while travelling to Romania from Ireland.

## Demographic characteristics of cases

As at 13 June 2016, there were 27 notified cases of measles linked to the outbreak, of which 22 were confirmed. Twenty of the cases were in Kerry, in the south-west (Figure 3).

Most cases (19/27) were under 15 years (Table).

Of the 27 cases, 24 were confirmed as unvaccinated; one had documentary evidence of two doses of measles-mumps-rubella (MMR) vaccination; and two cases self-reported two doses of MMR vaccination but this could not be confirmed. Thirteen cases belonged to the Roma population, all of whom were unvaccinated. Five cases were infected through nosocomial transmission. No healthcare workers were infected. Three cases were infected while on two separate international flights.

## Control measures

Local public health teams have undertaken extensive contact tracing for all cases. We issued letters and information leaflets to contacts to warn about symptoms of measles and to communicate individual level of risk based on MMR vaccination status. As at 17 June, we have arranged prophylactic MMR vaccination for 14 unvaccinated contacts identified within 72 hours of exposure. We advised parents to isolate infectious children and any unvaccinated contacts who may be incubating the virus. We requested immediate isolation of any suspected cases in hospital emergency departments, paediatric wards, and primary care services. We also advised occupational health departments to ensure that all healthcare professionals were appropriately vaccinated.

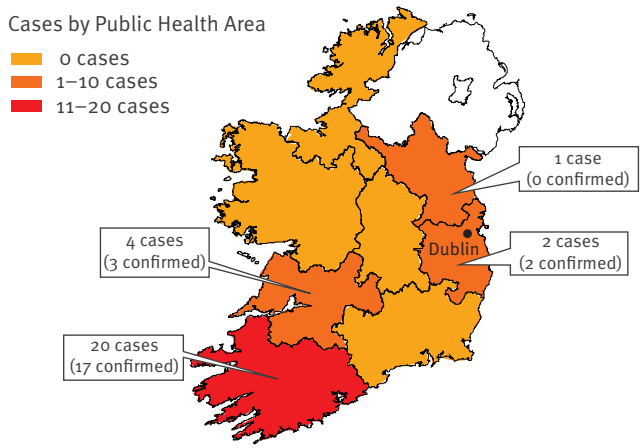
The HPSC and public health departments have raised public awareness through multiple local and national press releases, radio interviews and social media messages. We worked together with community partners to produce information leaflets about measles in English, Czech, Polish, Romanian, and Slovakian.

## Discussion

This ongoing measles outbreak has highlighted a number of challenges and learning points for Irish public health authorities. Like many European countries, Ireland suffered poor uptake of MMR vaccine in the early years of the century, and in 2001–02 less than

**Figure 3**

Cases of measles by public health area, Ireland, April–June 2016 (n=27)




**Table**

Demographic characteristics of measles cases, Ireland, April–June 2016 (n=27)

| Variable | Total (n=27) |
|---|---|
| Age group (years) | |
| <1 | 3 |
| 1–2 | 2 |
| 3–4 | 2 |
| 5–9 | 8 |
| 10–14 | 4 |
| 15–19 | 6 |
| 20–24 | 0 |
| 25–34 | 2 |
| >34 | 0 |
| **Sex** | |
| Male | 12 |
| Female | 15 |
| MMR vaccination status | |
| Vaccinated (two doses) | 3 |
| Vaccinated (one dose) | 0 |
| Not vaccinated | 24 |

MMR: measles-mumps-rubella.

80% of children had received one dose of MMR vaccine by 24 months of age. There have been gradual improvements in the last decade, and 93% of Irish children currently receive one dose of MMR vaccine by their second birthday [6]. This remains lower than the national target of 95% [3,7]. The second dose of MMR vaccine is recommended for all children at 4-5 years of age. In 2014–15, the uptake for the MMR dose at this age was 91%, but for a minority of children it may have been a first dose [8]. For any child in need of another dose, it is recommended subsequently. However, immunity gaps persist among recent birth cohorts, as well as older children.

Previous outbreaks in Ireland and Europe have highlighted the vulnerability of unvaccinated populations [4,9-12], and most cases in the current outbreak were unvaccinated. Uptake of MMR vaccine is known to be low among ethnic minorities such as Roma, Travellers, and migrant groups. Reported barriers to vaccination may include administrative barriers accessing healthcare, language and communication difficulties, poor education, cultural differences, geographical mobility, and discrimination [13]. Cultural mediators may play important roles in improving access to healthcare and vaccination uptake [13,14]. Other groups may refuse vaccination due to religious reasons, anthroposophic ideology, or strong preference for complementary or alternative medicine [13], although these reasons were not prominent in the current outbreak.

The introduction of MMR vaccine in Ireland in 1988 and improvements in measles control have contributed to a lack of familiarity with measles among some healthcare professionals. In this outbreak, diagnostic delay occurred for some of the early cases due to lack of recognition. This contributed to delayed isolation of cases and further nosocomial transmission. Similar issues have been highlighted in episodes of nosocomial measles elsewhere [10,15,16]. A delay in diagnosis also reduced the number of contacts who were eligible for prophylactic MMR vaccination and immunoglobulin.

Effective control measures rely on a high rate of case reporting and targeted responses. In Kerry, targeted information leaflets and social media/text alerts have resulted in catch-up vaccination of at least 10 vulnerable children, and many families have sought further information about measles. Of the 14 contacts who received prophylactic MMR vaccination, only one went on to develop measles, suggesting that this may have helped to reduce the number of cases. However, the number of notified cases is likely to underestimate the true number of cases in the community, as direct epidemiological links could not be established for all confirmed cases.

Investigations of measles outbreaks are costly and resource-intensive. The full costs associated with the control of this ongoing outbreak are likely to be considerable, as hundreds of contacts were investigated, and as at 17 June there were 45 staff members involved in managing the outbreak nationally. Direct health costs include the costs of hospitalisation, consultation with physicians, serologic testing, RNA testing, vaccination, telephone costs, and staff costs [17]. Staff time is likely to comprise the greatest cost component in this outbreak, like elsewhere [18]. The costs of vaccination for measles prevention may be relatively small when compared with outbreak control efforts.

This outbreak has shown the benefits of rapid information exchange between multiple agencies involved

in control efforts and between EU Member States. International communication through the EWRS enabled public health teams to trace the likely source of infection for the primary case and also the travel history of other cases. In the coming months, millions of Europeans will travel across the continent and further afield, and spread infectious diseases in their home countries and abroad. This outbreak is a reminder of the potential infectiousness of a single case of measles, and of the need for collaborative control measures. Continued efforts are required to identify and vaccinate susceptible groups with gaps in immunisation records in order to prevent further onward spread.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## Conflict of interest

None declared.

## Authors' contributions

P. Barrett, K. Chaintarli, F. Ryan, S. Cotter and J. Connell drafted the manuscript. K. Chaintarli and P. Barrett prepared and analysed the data. S. Cotter headed the national OCT and oversaw control activities in each region. F. Ryan led the outbreak investigation and control activities in Kerry. P. Barrett, A. Cronin, L. Carlton, M. MacSweeney and M. McDonnell also coordinated outbreak control and investigation measures in Kerry, and conducted epidemiological linking of cases. R. Fitzgerald and D. Hamilton coordinated outbreak control and investigation activities in Limerick. M. Ward, C. Migone and R. Glynn coordinated outbreak control and investigation activities in Dublin. J. Connell oversaw testing and management of clinical samples in the National Virus Reference Laboratory and provided advice in this regard. All authors reviewed and approved the final manuscript.

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