

SHORT REPORT

An outbreak of measles in a prison in Yorkshire, England, December 2012–January 2013

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Measles is a highly infectious disease with a high reproduction rate [1]. For every index case occurring in a susceptible population, 15–17 secondary cases will occur [1]. The most effective way to control measles is by active immunization of a high proportion of the population [2]. MMR vaccine was introduced in the UK in October 1988 and achieved coverage levels in excess of 90% [3]. Prior to this measles vaccination coverage was low and transmission was largely unaffected. According to seroprevalence studies <1% of individuals born before 1970 and <10% born between 1970 and 1989 are antibody negative to measles [4, 5]; however, despite measles vaccination programmes residual susceptibility is present in young adults [6]. We describe an outbreak of measles occurring in a prison in Yorkshire that began in December 2012.

The involved prison was a male, category C/D facility that predominantly receives offenders serving the final part of their sentence. The prison accommodates offenders aged ≥ 18 years. As part of the prison regime some offenders are released on temporary licence to undertake community restorative work as part of their sentence. During the period December 2012 to February 2013 the prison had 210 offenders registered, aged 18–64 years (median age 26 years). The age profile at that time is illustrated in [Figure 1](#),

with 49.5% of the prison's population being aged <25 years. In keeping with regional demographics, 91% of the population of the prison identified themselves as white British.

On 24 December 2012 a member of the prison staff developed a coryzal, febrile illness. This individual had free access to all areas of the prison and continued to work throughout the prodromal period. They were admitted to a local hospital when they developed a rash in addition to their coryzal illness on 28 December 2012. At this time measles was not known to be circulating in the local area although numbers of cases were known to be increasing further north in England.

An assessment was made of the degree of contact that the index case would have had during the course of a working day with staff and offenders. Contact was described as likely to be short, lasting no longer than a few minutes, and generally consisted of brief conversations. The index case was involved in supervising offenders on a daily basis. Due to the physical environment of the prison, all offenders had to file past the index case when collecting meals during the prodromal period. However, no individual was thought to have spent ≥ 15 min in the company of the index case. The index case had unrestricted access to both the facility and the offenders and the prison accommodated a relatively small population that mixed extensively. In view of these two factors it was not possible to identify a cohort smaller than the whole prison population to be considered as potential contacts.

Public health advice was given to the prison at this stage to ensure that all vulnerable contacts

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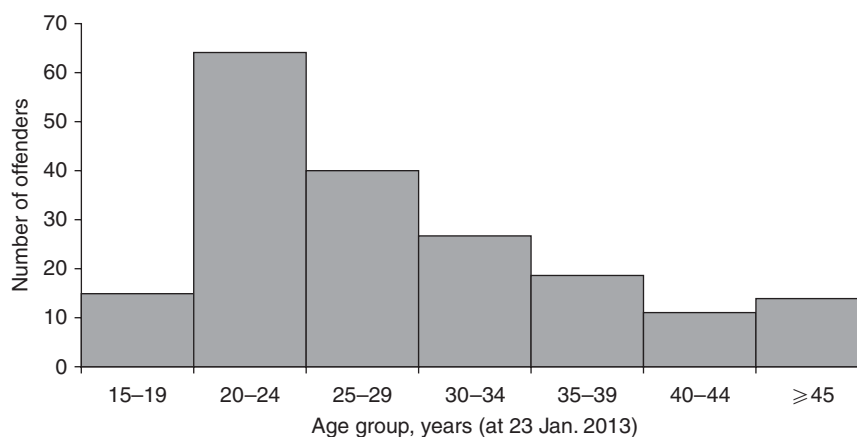


Fig. 1. Age distribution of the prison population.

including staff were followed up according to national guidelines and isolation was advised for any offender reporting new coryzal symptoms. The prison healthcare team were also requested to ascertain the MMR status for the prison population to inform decisions regarding consideration of mass vaccination.

In view of the infectious potential of measles and the assumed low vaccine coverage in the offender population an incident control team (ICT) was convened. To assist the prison healthcare team the ICT agreed on a set of case definitions:

For isolation for 4–5 days: An individual with a temperature of $>37.5^{\circ}\text{C}$ \pm sore throat, conjunctivitis, cough and Koplik's spots with no documented evidence of having received two MMR vaccines or previous confirmed measles.

Probable case: An individual with symptoms described above plus rash.

Locally confirmed case: Measles IgM positive from local laboratory.

Confirmed case: Measles PCR positive from reference laboratory.

Between 5 January 2013 and 9 January 2013 four offenders presented to the prison healthcare team with non-specific coryzal symptoms and low-grade fever and were isolated within their cells in line with the case definitions. A fifth offender (case 2) presented to the healthcare team on 7 January 2013 with a rash. Although this had been preceded by 4 days of coryzal symptoms he had not reported this to the healthcare team and had continued to associate freely with staff and other offenders. Based on his symptoms and link to the index case he was classified as a probable case of measles.

An outbreak was declared on the basis of one confirmed and one probable case of measles. The ICT advised the prison to formally cease the transfer of offenders in and out of the prison to minimize the risk of spreading measles to other parts of the prison system.

Ascertainment of the measles vaccination status for both offenders and staff had proven to be challenging, at the time that the outbreak was declared this information was largely unknown. It was considered that uptake of measles vaccination in the offender population may be lower than in the general population and a strategy to vaccinate all those without documented history of two measles-containing vaccines or a documented history of previous measles infection was adopted. Vaccination was offered to all prisoners regardless of age and not limited to those aged <25 years as this was perceived as more acceptable to the prison and staff population by the prison management. Vaccination of both staff and offenders with MMRVaxPro[®] (Sanofi Pasteur MSD, UK) commenced on 11 January 2013.

A smaller third wave of infection was identified on 22 January 2013 consisting of two cases. These cases presented with a rash and milder symptoms following the mass vaccination and were confirmed by the reference laboratory by presence of measles RNA from oral fluid samples. The clinical symptoms for both of these cases may have been attenuated by the administration of the MMR vaccine on 11 January 2013 [7].

In total eight individuals were locally confirmed cases of measles. All of the cases were confirmed by the reference laboratory on oral fluid samples. The final results from the reference laboratory are illustrated in Table 1.

Table 1. Summary of results of cases

Case no.	Date oral swab kit sent	Date oral swab performed/ submitted	Date received at reference laboratory	Date of result from reference laboratory	Measles genotype	Measles vaccination status	Remarks
1	n.a.	–	3 Jan. 2013	14 Jan. 2013	D8	No record of vaccination	Index case – swab obtained during admission
2	7 Jan. 2013	9 Jan. 2013	11 Jan. 2013	25 Jan. 2013	D8	No record of vaccination	2nd wave infection
3	7 Jan. 2013	9 Jan. 2013	11 Jan. 2013	25 Jan. 2013	D8	No record of vaccination	2nd wave infection
4	10 Jan. 2013	14 Jan. 2013	21 Jan. 2013	4 Feb. 2013	D8	No record of vaccination	2nd wave infection
5	10 Jan. 2013	14 Jan. 2013	22 Jan. 2013	4 Feb. 2013	D8	No record of vaccination	2nd wave infection
6	10 Jan. 2013	14 Jan. 2013	21 Jan. 2013	4 Feb. 2013	D8	No record of vaccination	2nd wave infection
7	10 Jan. 2013	24 Jan. 2013	28 Jan. 2013	31 Jan. 2013	D8	Known MMR on 11 Jan. 2013	3rd wave infection
8	10 Jan. 2013	24 Jan. 2013	28 Jan. 2013	31 Jan. 2013	D8	Known MMR on 11 Jan. 2013	3rd wave infection

n.a., Not applicable.

Table 2. Attack rate for prison and staff populations

Population	Attack rate
All	2.2% (8/370)
Staff	0.6% (1/160)
Offenders	3.3% (7/210)
Aged ≥ 25 years	1.9% (2/106)
Aged < 25 years	4.8% (5/104)
Aged < 25 years with no record of measles-containing vaccine	62.5% (5/8)

The mass vaccination campaign resulted in the vaccination of 191 (91%) offenders, and 90 (56%) staff. A total of 16 (8%) offenders declined vaccination.

All cases were confirmed as measles genotype D8 by the reference laboratory which was the predominant strain circulating in the population at the time.

Work conducted following the outbreak identified that 89.4% of those offenders housed in the prison at the time of the outbreak that were born after 1987 had a record of receiving at least one measles vaccination.

Between the onset of illness in the index case and an outbreak being declared, four offenders were transferred to other custodial facilities. These offenders were kept under observation by their receiving establishments and did not develop symptoms. Final releases into the community were not restricted and follow-up monitoring did not identify any further cases.

Attack rates as high as 75% have previously been reported for measles [8]. The attack rates in this outbreak are illustrated in Table 2. Of the eight offenders aged < 25 years identified as having no record of having received measles vaccination, five developed infection giving an attack rate of 62.5% in this group. The remaining two cases in offenders occurred in individuals aged ≥ 25 years.

As this is the first measles outbreak to be described in a prison in England it illustrates some important considerations regarding the management of outbreaks in custodial settings.

It can be seen from the timeline in Figure 2 that the window of opportunity for preventing a second and third wave of cases was small. While the strategy of mass vaccination was implemented rapidly once an outbreak had been declared, in retrospect it is more likely that the size of the outbreak was limited by the prior immunization status of the staff and offender population.

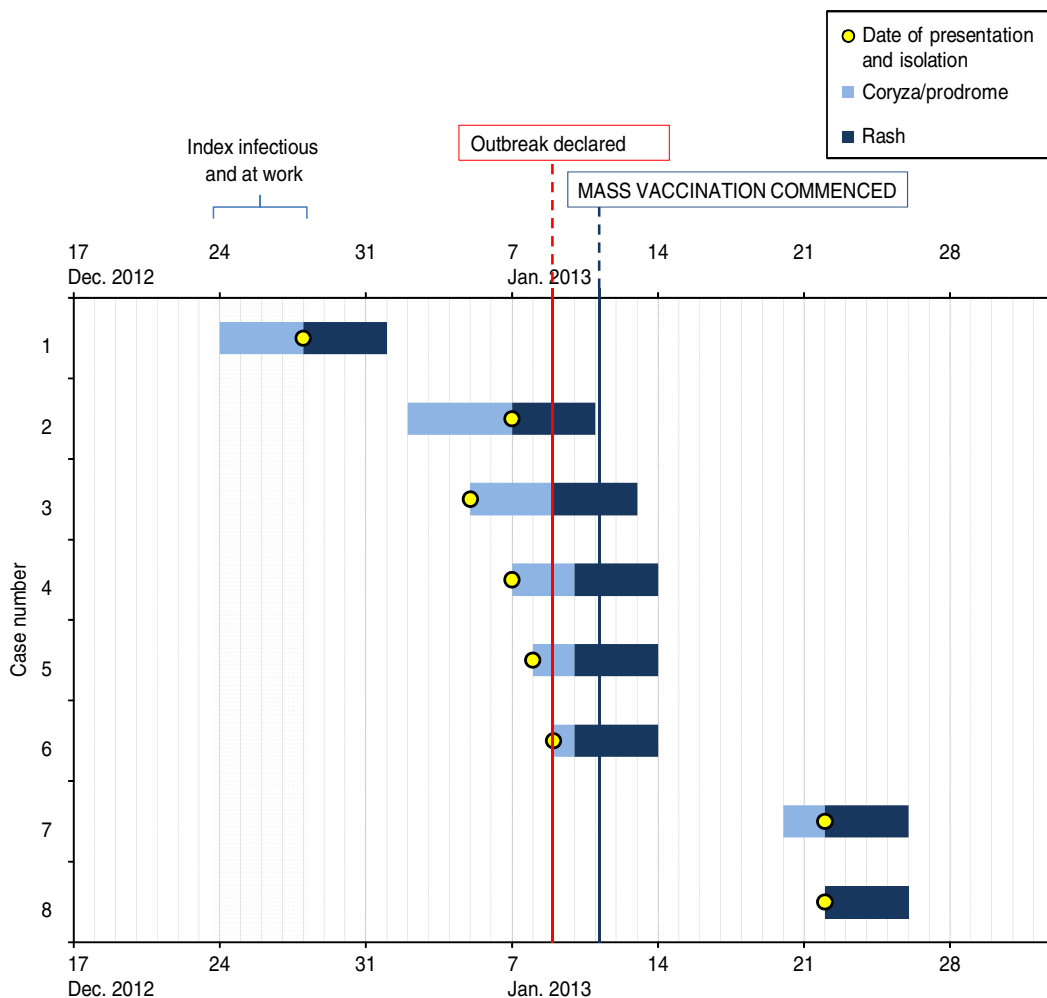


Fig. 2 [colour online]. Timeline of measles cases.

The ICT was primarily concerned with managing the outbreak in the prison but also recognized that the larger risk would have been from spread within the prison system while confirmation of an outbreak was awaited. Advice to close a prison on the basis of a single case of measles has not been part of current UK policy to date and may be difficult to justify as a standard intervention. However, where a risk assessment for an index case identifies that exposure for a large proportion of the prison population is possible, early advice to cease transfers in and out of the prison may be appropriate on the basis of a single case to prevent spread within the prison system. This could at least be justified as a holding measure until the immunization status of the prison population could be ascertained. If the outbreak occurred in a remand facility, or a prison that undertook a large number of transfers in and out it is possible that the outbreak could have spread rapidly within the prison system.

Isolation of suspected cases may also be effective in reducing further spread within the prison setting but can be logistically difficult for prisons to manage. Isolation in the prison setting is often used as a form of punishment and therefore it is unsurprising that offenders would not freely volunteer for a period of isolation. Prior knowledge that isolation was likely might have discouraged offenders from declaring symptoms at an early stage and reduced its effectiveness as a strategy. To be effective, isolation advice had to be given to include the start of the infectious period when symptoms would be mild and non-specific and may or may not be due to evolving symptoms of measles. In this outbreak this did result in a slightly larger number of offenders being placed in isolation. Availability of isolation facilities is also likely to be a common problem for any prison therefore in-cell isolation was employed as a method to limit the spread.

In each of these first two points, knowledge of the immunization status for both staff and offenders is clearly valuable and systems should be designed to ensure that this information is routinely and reliably documented in healthcare records as this can be time consuming to retrieve during an incident and can delay appropriate action.

This can also inform appropriate activity within the prison setting when measles is known to be circulating in the general population in the locality of the prison and there is a risk of spread into the prison from staff and visitors.

This outbreak illustrates that measles can be spread very easily in a prison where the index case is a member of staff.

Mass vaccination is an appropriate public health response but good systems for ensuring that the immunization histories of staff and offenders are well documented, and any missing doses given as routine would considerably reduce the risk and improve the effectiveness of any response to an outbreak.

Spread within the prison system may be the greater risk and advice to close the prison to transfers should be considered on the basis of a single confirmed case of measles.

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DECLARATION OF INTEREST

None.

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