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Outbreak of measles in Central and Eastern Cheshire, UK, October 2008–February 2009

S. GHEBREHEWET[1]*, G. HAYHURST[2], A. KEENAN[1] AND H. MOORE[3]

[1] *Cheshire and Mersey Health Protection Unit, Liverpool, UK*
[2] *NHS Central and Eastern Cheshire, Nantwich, Cheshire, UK*
[3] *Countess of Chester NHS Foundation Trust, Chester, UK*

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SUMMARY

We describe the largest outbreak of measles in Central and Eastern Cheshire (North West England) since the MMR vaccine was introduced in 1988, the majority of cases were not vaccinated and more than 20% of the cases belonged to the travelling community. Over 4 months, 147 clinical cases of measles were notified locally to the Cheshire & Merseyside Health Protection Unit (CMHPU). Of these, 67 (45·6%) were laboratory confirmed, 42 (28·6%) were negative, and one was equivocal, leaving 23 probable and 14 possible cases. The primary case was probably an 8-year-old unvaccinated travelling child, symptomatic on 1 October 2008. Measles spread locally and within school-aged children until early February 2009. Most of Central and Eastern Cheshire, including 23 educational institutions (playgroups, nurseries, primary schools, secondary schools, colleges), were affected, showing that there were enough susceptible/unvaccinated children to sustain an outbreak. Nearly a quarter of the confirmed cases (15/67, 22·4%) were aged <13 months and too young to be vaccinated under the UK immunization schedule. This outbreak is a reminder of the importance of achieving herd immunity to prevent spread and protect those at risk of severe illness or complications. There were no fatalities in this outbreak and no significant complications were reported.

Key words: Measles (rubeola), outbreaks, vaccine-preventable diseases.

INTRODUCTION

Measles has been a notifiable disease in the UK since 1940 [1]. The measles-mumps-rubella (MMR) vaccine was introduced in 1988 and the first dose is offered at age 13 months with a second dose at 3 years 4 months to ensure long-term protection [2].

* Author for correspondence: Dr S. Ghebrehewet, Cheshire & Merseyside Health Protection Unit, 5th Floor, Rail House, Lord Nelson Street, Liverpool L1 1JF, UK.
(Email: sam.ghebrehewet@hpa.org.uk)

Measles is spread by airborne or droplet transmission and individuals are infectious from the beginning of the prodromal stage to 4 days after appearance of the rash [2]. The incubation period is about 10 days (range 7–18 days) with a further 2–4 days before the rash appears [3].

The clinical features and complications of measles in children and adults are well established and include fever, malaise, disseminated rash, coryza, conjunctivitis, otitis media (7–9% of cases), pneumonia (1–6% of cases) and convulsions (0·5% of cases) [2, 4]. Subacute sclerosing pan-encephalitis (SSPE) is a rare,

fatal, late complication of measles infection and occurs in 1/25 000 measles infections [5]. In affected children aged <2 years, the rate is 1/8000 measles infections [5, 6]. Developing measles at <1 year carries a risk of SSPE 16 times greater than those infected at age 5 years [6].

MMR is a safe and effective vaccine that provides long-term immunity to measles. To ensure immunity, the World Health Organization (WHO) recommends that two doses of MMR must be given as between 5% and 15% of children do not respond to the first dose [2, 7].

In October 2008, 83 cases of measles were confirmed in England and Wales, marginally higher than the previous month (72 cases), and attributable to an increase in reports from outside London, although, outbreaks of measles were also reported from Wales, South East, East and West Midlands [8].

MMR vaccine rates have been low for many years in England following a high profile paper in 1998 linking the MMR vaccine to autism and the development of bowel disorders [9]. The paper was later discredited and has since been retracted by the publisher [10]. However, it appears that some parents remain reluctant to give their child the MMR vaccine [9–13]. There have subsequently been many outbreaks across England with some areas still considered high risk. The reported rate of measles across the UK in 2006 and 2007 put the UK in the high incidence category (1·3 and 1·6 cases/100 000 inhabitants, respectively) [14].

In 2008 Central and Eastern Cheshire experienced the largest measles outbreak for over 20 years, i.e. since the start of MMR immunization programme in 1988. In Cheshire in 2005, 2006 and 2007 there were 18 (2·6/100 000 population), 39 (5·6/100 000) and 24 (3·4/100 000) reports of measles, respectively. During this 3-year period there were only three confirmed measles cases throughout Cheshire. However in 4 months (October 2008–February 2009), 147 clinical cases of measles were notified (67 confirmed) from the Cheshire area.

In this paper we describe the outbreak investigation findings, discuss the results and the implications for the UK MMR immunization programme.

METHODS

Detailed epidemiological, microbiological and public health investigations were undertaken to control and prevent the spread of measles infection.

Case definition

The following case definitions were applied to any individual who became symptomatic between 1 September 2008 and 28 February 2009 (as agreed by the outbreak control group).

A confirmed case was any person that met the clinical case definition and was laboratory confirmed either by: measles IgM in oral fluid or blood; isolation of measles virus or detection of RNA in clinical samples, e.g. blood, urine, conjunctival or nasopharyngeal secretions; a ⩾fourfold rise in measles IgG in blood or a single high level and no history of measles-containing vaccine in the 6 weeks prior to onset of illness.

A probable case was any person with fever and maculopapular rash (i.e. non-vesicular) and one of the following: cough, coryza or conjunctivitis, from the affected geographical area or who had an epidemiological link to a confirmed case.

A possible case was any person in whom a clinician suspected measles infection or any person with a fever (>38 °C) and a maculopapular rash (i.e. non-vesicular), with no epidemiological link to a confirmed or probable case.

Case finding

Case finding was conducted by routine surveillance throughout Cheshire and Merseyside. Individual letters describing the outbreak and outlining the need for increased awareness, prompt notification and investigation of potential cases were distributed to GP practices, Acute Trust clinicians including consultant microbiologists, GP out-of-hours and walk-in centre staff. Vaccination status of cases was collated and verified with GP practices.

Laboratory investigations

For all possible and probable cases, the first line of investigation for rapid confirmation of measles was an oral fluid (saliva) specimen for IgM, 1–6 weeks from the date of onset. Serology and culture were the other methods used to confirm or exclude measles.

RESULTS

In total, 147 cases were notified to CMHPU. Salivary kits were sent to all cases and 110 laboratory results were received, of which 67 were confirmed, 42 were

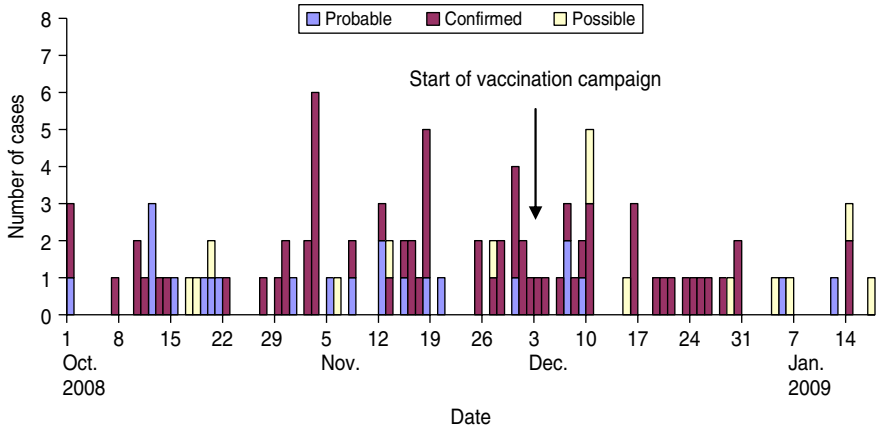

Fig. 1 [*colour online*]. Epidemic curve: measles cases by date of onset ($n = 104$).

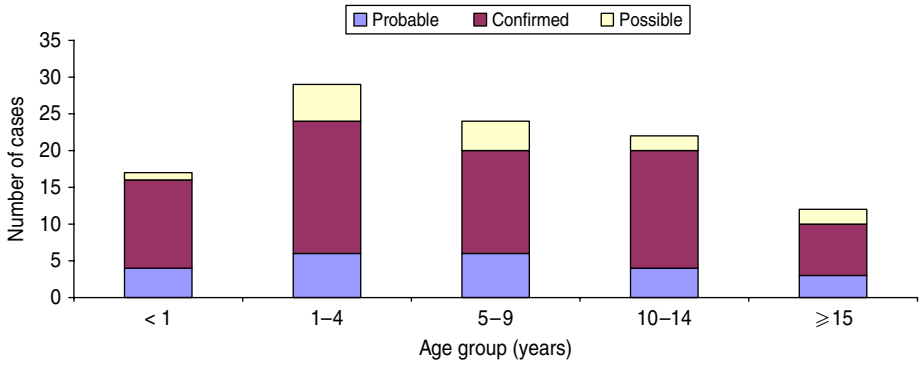

Fig. 2 [*colour online*]. Distribution of measles cases by age ($n = 104$).

negative, with one further case test result reported as equivocal, i.e. indeterminate as is consistent with either recent measles or vaccination. It is likely that the laboratory did not receive samples from the remaining 37 cases (23 probable, 14 possible). All samples were tested by Health Protection Agency Viral Reference Department (HPA VRD), Immunization & Diagnosis Unit. Figure 1 shows the epidemic curve for 104 (67 confirmed, 23 probable, 14 possible) cases based on estimated dates of onset from clinical reports and history from parents of the cases. The first case developed symptoms on 1 October 2008. The number of new cases increased thereafter and peaked in the first week of November 2008. Measles infection continued to spread within school-aged children in Central and Eastern Cheshire until the beginning of February 2009. The shape of the epidemic curve suggests person-to-person transmission or a continuing common-source outbreak.

The majority of cases were aged 1–4 years (27·9%) followed by 5–9 years (23·1%), 10–14 years (21·2%) and those aged <1 year (16·3%) (Fig. 2). The remaining cases were aged >15 years (teenagers and young adults). Males and females were equally affected in the outbreak (ratio 1:1). Of the confirmed cases, 24 (23%) were from the travelling community.

Nearly a quarter of the confirmed cases (15/67, 22·4%) were children aged <13 months and therefore too young to be vaccinated, according to the UK childhood immunization schedule. Over half (8/15, 53·3%) had contact with a confirmed measles case, five at nursery and three in the household; and 10/15 (67%) children aged <13 months were aged between 9 and 12 months (Fig. 3).

During this outbreak, 30/104 (29%) measles cases were admitted to local hospitals, mainly Leighton Hospital, with a few admitted to Macclesfield General Hospital; no fatalities were reported.

MMR vaccination status was known for all notified cases ($n = 147$). Of the confirmed cases ($n = 67$), 52 and 37 cases were eligible for one and two doses of the MMR vaccine, respectively. However, only 14 (26·9%) of those eligible for one dose and four

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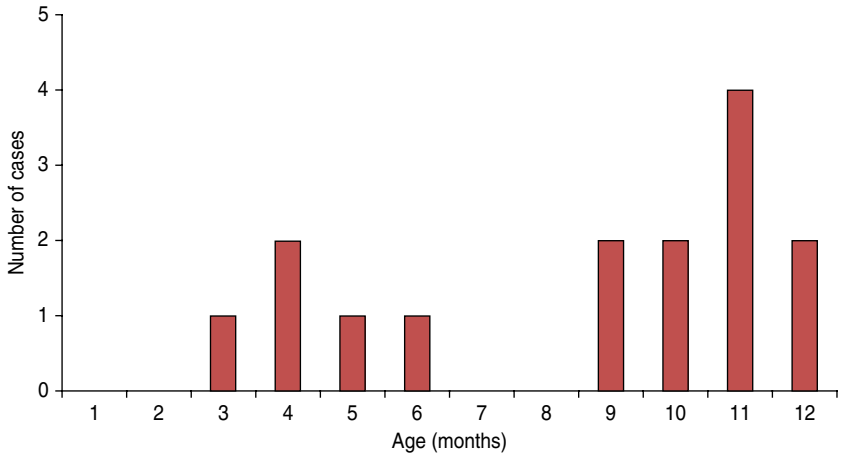

Fig. 3 [*colour online*]. Number of cases by age (months) at date of onset ($n = 15$).

(10·8%) of those eligible for two doses received the MMR vaccine before they developed illness (Table 1).

Laboratory data

Clinical specimens (oral fluid/saliva) were obtained from 74·8% (110/147) of reported cases. Of these, 60·9% (67/110) were positive for measles IgM/IgG by PCR if samples were taken early enough, 38·2% (42/110) were negative and the result for one case was indeterminate (equivocal).

Further testing (genotyping) was done at HPA VRD (Colindale) if there was a history of recent vaccination (to distinguish between vaccine or wild-type measles), or for hospitalized patients or if there was a new area of the country affected (Dr K. Brown, personal communication). Genotyping results for one of the initially probable cases showed that this was vaccine related and accordingly the child was reclassified as negative.

Further genotyping on three more PCR-positive isolates showed that they were all D4 genotypes. All recent indigenously acquired measles cases in England and Wales had been found to have the same D4 sequence (15 MVs/enfield.GBR/14·07), a genotype first identified in April 2007 and which is now endemic in the UK [15]. The presence and identification of the same measles virus genotype, D4, from all the three confirmed cases in this outbreak supports the epidemiological links between the cases from different schools and distinct geographical areas of Central and Eastern Cheshire.

Control measures

NHS Central and Eastern Cheshire, Cheshire & Merseyside Health Protection Unit (CMHPU), HPA North West, the two local authorities and local educational institutions worked closely to control this outbreak. Several actions were agreed upon following the initial meeting.

Following notification of individual cases, comprehensive contact tracing was undertaken by CMHPU with MMR vaccination and HNIG (human normal immunoglobulin) being offered via the local GP practices, as per UK guidelines [2]. Rapid testing of suspected cases was initiated with cooperation from local hospitals and laboratories and the Health Protection Agency Centre for Infections (CfI). Letters were sent out to parents with children at local schools and nurseries, GP practices and local hospitals; press statements were also released to raise awareness of the outbreak. MMR vaccination was offered to 10 534 children and teenagers between 3 and 17 December 2008 in order to prevent further spread of the outbreak. Of these 3582 (34%) received a dose of MMR (65% of these were vaccinated in schools and 35% in GP practices). Of those who received MMR vaccination, 20% (716/3582) were receiving the first dose. Across Central and Eastern Cheshire, during this campaign 15% of the unimmunized children/young adults received the first MMR dose (MMR1), and 49% of those partially immunized received the second MMR dose (MMR2).

The Primary Care Trust (PCT) also distributed 65 000 leaflets via schools to inform all parents about the immunization campaign. Following this, the parents of 1354 children telephoned the PCT helpline for advice, stating that their child had received a single dose of vaccine previously, which for some had not been recorded in the child health system.

Unvaccinated teachers and healthcare workers in high-risk areas such as oncology, obstetric, neonatal

Table 1. *All measles cases by age group and MMR vaccination status*

Diagnosis ($n=104$)	Age group	Expected no. of MMR doses		Actual no. of MMR doses, received (% vaccinated)	
		1 dose	2 doses	1 dose	2 doses
Confirmed	<13 months ($n=15$)	0	0	0	0
	13–39 months ($n=15$)	15	0	6	n.a.
	>40 months ($n=37$)	37	37	8	4
	Total ($n=67$)	52	37	14 (27%)	4 (11%)
Probable	<13 months ($n=3$)	0	0	0	0
	13–39 months ($n=6$)	6	0	1	n.a.
	>40 months ($n=14$)	14	14	2	0
	Total ($n=23$)	20	14	3 (15%)	0
Possible	<13 months ($n=1$)	0	0	0	0
	13–39 months ($n=5$)	5	0	4	n.a.
	>40 months ($n=8$)	8	8	3	3
	Total ($n=14$)	13	8	7 (54%)	3 (38%)
	Grand total ($n=104$)	**85**	**59**	**24 (28%)**	**7 (12%)**

n.a., Not applicable.
* One unvaccinated 15-month-old child's laboratory result was reported as equivocal.

and paediatric wards were also offered the MMR vaccine. A total of 171 doses of MMR vaccine were given to schoolteachers from 49 schools.

Following the 2-week vaccination campaign, there were no further peaks in reported measles cases and the overall number reported decreased.

DISCUSSION

In June 2008, the HPA acknowledged that, as a result of almost a decade of low MMR vaccination coverage across the UK, the number of children susceptible to measles was sufficient to support the continuous spread of measles [16]. MMR vaccine uptake has remained at <90% nationwide since the paper linking the vaccine to autism and bowel disorders, falling to as low as 79·9% for MMR1 by 24 months in 2003–2004 [17]. Interestingly, the lowest MMR2 rates for 5 years were 72·8% in 2006–2007 which was likely to be the same cohort of children who had the low MMR1 uptake in 2003–2004 [17]. This cohort is most likely to have been influenced by the media surrounding the paper linking the MMR vaccine to autism and bowel disorders and may explain the low uptake rates in those years. MMR vaccine uptake rates have slowly recovered since then, and although rates are increasing every year they are still below the WHO target of >95% coverage (89·1% MMR1 by the second birthday; 84·2% MMR2 by the fifth birthday in 2010/2011) [17]. However, Central and Eastern Cheshire figures for the same time period are higher (91·8% MMR1 at the second birthday and 87·4% MMR2 by the fifth birthday). Four years prior to this outbreak (2003–2004), MMR vaccine uptake rates, which had been declining since 1998, were at their lowest level in England (80% at 24 months) since the vaccine was introduced in 1988 [17, 18].

In this outbreak, most of the confirmed cases were not vaccinated. Of those who were expected to receive one dose (MMR1), only 14/52 had received the first dose.

Furthermore, 15/67 confirmed cases were aged <13 months (too young to receive the MMR vaccine), which is a potent reminder of the importance of achieving herd immunity to prevent measles outbreaks and protect those at risk of severe illness or complications. Children aged <12 months often have high titres of maternal antibodies which reduce the effectiveness of the measles vaccine to produce a sufficient antibody response [19, 20]. It is for this reason the UK schedule recommends MMR to be given at 13 months. However, recent studies have indicated that MMR can be given safely without affecting response to the vaccine at an earlier age, i.e. before 12 months [21, 22]. Therefore close monitoring of surveillance and future measles outbreak data is required in order to gauge the impact on children aged <12 months. Further evidence from well-designed studies are also

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required if the timing of the first routine dose of MMR is to be reviewed. The worldwide elimination of measles is a significant target for WHO, requiring two doses of measles-containing vaccine to achieve 95% herd immunity [7].

Ongoing low MMR uptake rates continue to play a role in the increase in the population susceptible to measles. However, this outbreak is more likely to be the result of low/suboptimal levels of MMR uptake rates 4–10 years ago, i.e. prior to this outbreak, as 44·8% of the confirmed cases were school-aged children (aged 5–15 years). Some measles cases who were eligible for two doses of the MMR vaccine had only received one dose, demonstrating the importance of the second MMR dose for long-term protection.

In total, 147 cases were reported and these were mainly infants, pre-school and school-aged children. The epidemiological investigation suggests the primary case in this outbreak was an unvaccinated 8-year-old child from the travelling community in the Sandbach area who developed symptoms on 1 October 2008. The number of new cases increased thereafter, peaking in the first week of November 2008. Of the 104 cases (confirmed, probable, possible), 24 (23%) were from the travelling community who are known to have poorer access to health services including immunizations; with a number of them also holding strong views against certain immunizations [20, 23]. Health visitors visited local travelling families to advise them about the importance of MMR vaccination and to encourage vaccination of their children, but the response was poor. The remaining cases were from the local (non-travelling) community indicating that there were a large number of susceptible individuals across both communities.

Most areas of Central and Eastern Cheshire, including 23 educational institutions (including playgroups, nurseries, primary schools, secondary schools, colleges), were affected by this outbreak. A significant proportion of the cases did not attend school or nursery reflecting the large number of children aged <5 years infected with measles (44·2% 46/104). The two schools and the nursery with the highest number of cases were located in Sandbach and Crewe which along with Middlewich was where the majority of cases lived (>20 cases each). The three areas of Sandbach, Crewe and Middlewich are situated within 20 miles of each other; although other areas within a similar distance reported lower numbers of cases suggesting the close proximity of these areas is not significant. A significant number of educational institutions and distinct geographical areas were affected, reflecting the fact that every area, school or nursery in Central and Eastern Cheshire had a sufficient number of susceptible/unvaccinated children to sustain an outbreak.

Although there was considerable media interest in the outbreak, with good coverage in the local newspapers and radio, this did not result in a significant rise in the number of MMR vaccinations prior to the schools' immunization campaign. This raises questions about the value of media messages targeting parents who have repeatedly refused MMR. In this outbreak, direct action in terms of taking immunization provision into the schools was more successful, and this emphasizes the importance of including formal catch-up provision for MMR within the teenage immunization programme.

It is possible that the vaccination campaign contributed to ending the outbreak by reducing the number of vulnerable children.

Parents of non-immune children appeared to be reluctant to have their children vaccinated with MMR vaccine even though there was an immediate and serious threat from measles.

During this outbreak, 30 (29%) measles cases were admitted to local hospitals. The hospitalization rate for measles in this outbreak is similar to that previously reported in Europe [14]. The majority of the cases in this outbreak were admitted for observation lasting <1 day, apart from two cases who were admitted for a few days. There were no fatalities in this outbreak, and no significant complications were reported. Of the hospitalized cases, 29 were aged <5 years, and ten of these were aged <1 year. The median interval from measles infection to onset of SSPE symptoms is around 7 years but can be as long as 2–3 decades and SSPE may follow an unrecognized measles infection [2]. Wild measles virus has been found in the brain of individuals with SSPE including those with no history of measles infection [5, 6]. Therefore, it is important that appropriate monitoring arrangements are in place for follow-up of measles cases, especially those aged <5 years.

NHS Central and Eastern Cheshire in conjunction with Cheshire & Merseyside HPU and the two local councils have undertaken a comprehensive MMR immunization campaign in all educational institutions and the wider community in the Central and Eastern Cheshire area. The information presented in this report indicates that the above actions were not only

necessary but timely in order to control progression of this outbreak and prevent similar outbreaks from occurring in the future. It is essential to continue to promote and encourage MMR vaccination if 95% herd immunity is to be achieved, and ultimately the elimination of measles. Further consideration needs to be given to the strategies and approaches that are currently being implemented to improve vaccination uptake in travelling communities.

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DECLARATION OF INTEREST

None.

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