

# Surveillance and outbreak reports

## AN OUTBREAK OF MEASLES IN AN ULTRA-ORTHODOX JEWISH COMMUNITY IN JERUSALEM, ISRAEL, 2007 - AN IN-DEPTH REPORT

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Measles elimination in Europe is hindered by recurrent outbreaks, typically in non-immunised specific sub-populations. In 2003 and 2004, two measles outbreaks occurred in Jewish ultra-orthodox communities in Jerusalem, Israel. In 2007, another measles outbreak emerged in Jerusalem. Epidemiological investigation and control activities were initiated. Three measles cases (15 years old, 22 years old and an infant; all unvaccinated) were diagnosed in Jerusalem in August 2007. All three belonged to Jewish ultra-orthodox communities in London, United Kingdom, and had had contact with patients in London. The epidemiological investigation did not reveal any connection between these cases other than their place of origin. The disease spread rapidly in extremely ultra-orthodox sub-groups in Jerusalem. Until 8 January 2008, 491 cases were reported. Most patients (70%) were young children (0-14 years old), 96% unimmunised. Frequently, all the children in a large family were infected; two thirds of the cases belonged to family clusters of more than two patients per family (in part due to non-compliance with post-exposure prophylaxis recommendations). The high age-specific incidence among infants 0-1-year- (408.5/100,000) and 1-4-year-olds (264.1/100,000) is a cause for concern. The hospitalisation rate was 15% (71/491), mainly due to fever, vomiting and dehydration. The median age of hospitalised patients was 3.6 years; 19 patients (26.7%) presented with pneumonitis or pneumonia and two patients presented with encephalitis. There have not been any deaths to date. The outbreak was apparently caused by measles importation into unprotected groups. Despite a high national immunisation coverage (94-95%), programmes to increase and maintain immunisation coverage are essential, with special focus on specific sub-populations.

### Introduction

Measles presents a major global disease burden and is still the number one killer among vaccine-preventable diseases, causing almost half a million deaths a year [1-3].

Measles elimination in Europe is hindered by recurrent outbreaks, typically in non-immunised sub-populations. In 1999 and 2000, such an outbreak was reported in the Netherlands, with three measles-related deaths and 68 hospitalisations among 2,961 cases; 84 percent of the cases (2,317 people) were eligible for vaccination, but were not vaccinated for religious reasons [4]. Under-vaccination was also reported in Bavaria, Germany [5] and in the United Kingdom (UK) and Ireland, where the coverage declined due to fears of side-effects such as autism and inflammatory bowel disease [6,7]. In recent years, the nomad Roma/Sinti population has been associated with the spread of measles in several regions of Europe [8,9].

Kremer et al. described the measles virus genotypes in Europe during 2005 and 2006 as being mainly D4, D6 and B3 [9]; the largest outbreaks considered in that paper happened in the Ukraine, Romania, Germany and the Russian Federation.

In 2003 and 2004, two measles outbreaks occurred in ultra-orthodox Jewish communities in Jerusalem, Israel [10]. The index case of the outbreak in 2003 was a two-year-old unvaccinated child from Switzerland. Within five months, 107 people in Jerusalem had become infected. The outbreak in 2004 started in a different ultra-orthodox community and saw a total of 117 cases within five months. The first cases were three girls aged four to five years who attended the same kindergarten. The virus genotypes were D8 in 2003 and D4 in 2004. Altogether, these two outbreaks affected 96 households, with 79% of the cases belonging to family clusters of more than two patients per family. Most cases (91.5%) were unvaccinated, and 87% were children under 14 years of age. The immunisation coverage in the neighbourhoods affected by the outbreaks was lower than in the district overall. An intervention programme subsequently increased the coverage with the first dose of the measles/mumps/rubella (MMR) vaccine to an average of 95.2% in Jerusalem and of 94.2% in ultra-orthodox neighbourhoods.

Despite these efforts, non-compliant communities still exist. We are currently in the throes of another, even larger measles outbreak that started in August 2007 among extremely ultra-orthodox groups in Jerusalem. A preliminary report was published in *Eurosurveillance* in September 2007 [11,12]. The first cases in this outbreak came from London, United Kingdom (UK), and, as in 2004, the genotype involved (in Israel and in the UK) was D4. In November 2007, clusters of measles cases linked to the UK were also reported in Jewish orthodox communities in Antwerp [13].

### Methods

In Israel, the notification of measles is mandatory by law. The case investigation includes demographic characteristics, clinical and laboratory data and vaccination status in terms of the national MMR vaccine routine schedule (first dose at one year of age, second dose at six years or in the first school year). Household, school/ kindergarten, and community contacts are also investigated. A clinical case is defined as having a generalised rash for more than three days, temperature of over 38.3°C and cough, coryza or conjunctivitis. A confirmed case is a clinical case with either laboratory confirmation (positive measles IgM antibody test) or an epidemiological link to another case (two epidemiologically-linked clinical cases are considered confirmed). Serological tests

are performed at the laboratories of the health maintenance organisations. Serology validation, virus isolation, RT-PCR and genotyping are carried out at the Ministry of Health's central national virology laboratory using methods described previously [10].

Routine measles immunisation in Israel started in 1967. In 1990, concerns of under-immunisation and primary vaccine failure (in circa 5%) led to the introduction of a two-dose regime. Since 1994, two doses of MMR are provided at the ages of 12 months and six years.

### Results

The population in the Jerusalem district in late 2007 was 860,700. Children aged 0 to 14 years made up 31% of the population.

In August 2007, three measles cases (15 years, 22 years, and an infant; all unvaccinated) were diagnosed in Jerusalem. They had arrived from Jewish ultra-orthodox communities in London, where they reported having had contact with measles patients. The epidemiological investigation did not reveal any connection between these cases other than their place of origin. On 31 August 2007, six secondary cases were reported in Jerusalem. By the end of the year, 491 cases (61% males, 39% females) – almost exclusively in the ultra-orthodox population – had been reported to the Jerusalem District Health Office.

Most cases were confirmed, either serologically (78 cases, 15.9%) or by clinical-epidemiological association (361 cases, 73.5%). The weekly distribution of reported cases is shown in Figure 1.

The age distribution is shown in Figure 2. Most of the patients were children, with a median age of 5.8 years and an average age of  $9.6 \pm 10.2$  years (range: two weeks to 54.6 years). It should be noted that 70% of the cases occurred in children under the age of 14 years, while children in the group of one- to four year-olds accounted for a third (31%) of the patients.

Those children should have been immunised against measles as part of the routine paediatric immunisation schedule in Israel. However, 96% were not vaccinated. Frequently, all the children in a large family were infected; two thirds of the cases belonged to family clusters of more than two patients per family. This was at least partly due to the fact that patients did not comply with the recommendations of timely post-exposure prophylaxis.

A striking feature of the current outbreak has been the very high incidence of measles in infants under one year of age (Figure 3).

The age-specific measles incidence among children under one year of age was 408.5 per 100,000. This is much higher than the incidence in any other age group, and significantly higher than that of the next age group, the one- to four-year-olds, who had an incidence of 264.1/100,000 (relative risk=1.55, 95% confidence interval 1.32-1.80,  $p=0.0001$ ).

Seventy-one patients (15%) required hospitalisation, most of them due to fever, vomiting or dehydration. The median age of hospitalised patients was 3.6 years, their average age  $12 \pm 13.8$  years. Nineteen (26.7%) patients presented with pneumonitis or pneumonia, and two patients presented with encephalitis. A

FIGURE 1

Weekly epidemiological curve of measles cases reported in the Jerusalem district from 3 August 2007 to 8 January 2008 (n=491).

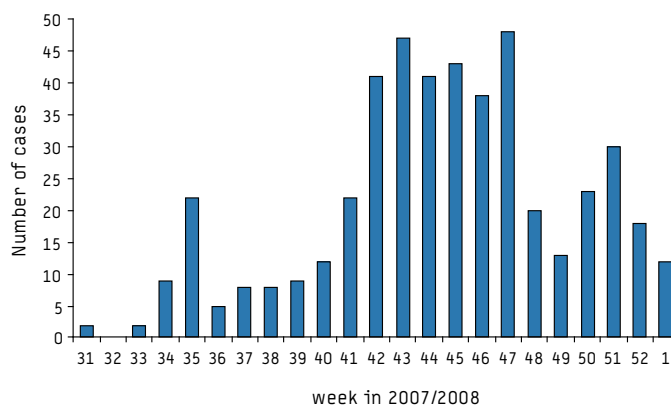


FIGURE 2

Age groups of reported measles cases in the Jerusalem district from 3 August 2007 to 8 January 2008 (n=491)

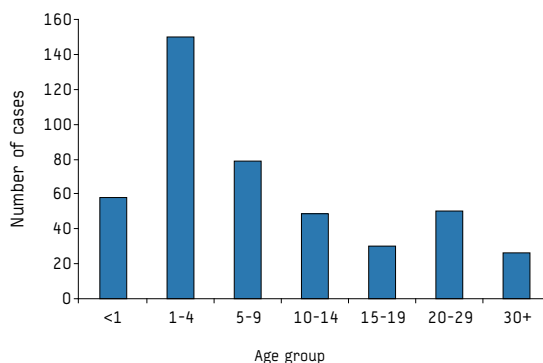
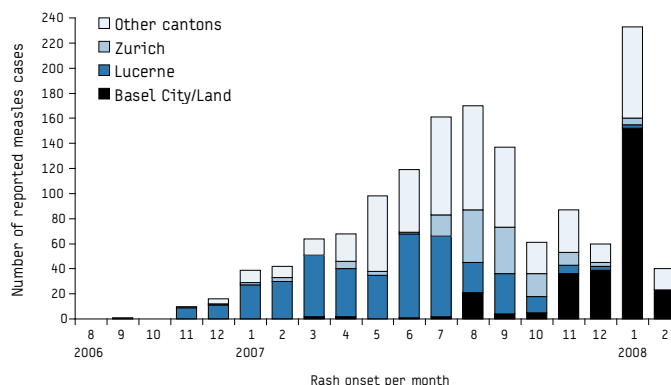


FIGURE 3

Age-specific incidence per 100,000 population of reported measles cases, Jerusalem district from 3 August 2007 to 8 January 2008 (n=491)



13-year-old girl, one of nine children in a single household who were all clinically diagnosed with measles, was hospitalised due to severe respiratory distress. In the past she had been diagnosed with bronchial asthma and atrial septal defect. She was put on mechanical ventilation, and as her condition did not improve transferred to extra-corporeal membrane oxygenation (ECMO). She recovered, and was released within two weeks.

To date, there have not been any deaths.

Five cases involved pregnant women. Four delivered healthy, full-term infants, and one delivered a premature infant at 29 weeks of gestation, who survived. There were no reports of intra-uterine foetal death (IUID).

Outbreak control policy included the administration of the MMR vaccine to those aged between six and 12 months within three days of their exposure to a case, and to susceptibles aged one year and older at any time following exposure. From August to December 2007, circa 5,000 doses of vaccine were administered in the Jerusalem district – three times the average in the same period in the 2006, a year without an outbreak. We interpret these numbers as suggesting that two thirds of the doses (circa 3,300) were used for post-exposure prophylaxis.

Children younger than six months were given immunoglobulin (IG) within six days of exposure to a case. IG was also given to children aged six to 11 months within four to six days of exposure to a case. In addition, individuals with contraindications to MMR vaccine (immunocompromised vaccinees and pregnant women) received IG.

Since most of the cases were children and had mild disease, with very few becoming ill following post-exposure immunisation, our data did not allow an assessment of the effect of post-exposure vaccination on the clinical course of the disease.

To date, measles cases are almost exclusively confined to the ultra-orthodox groups in Jerusalem and to several similar communities of ultra-orthodox Jews in other towns in the country. Several sporadic cases were reported in non-orthodox communities. The source of infection for some of them was exposure to measles cases, but remains unclear for others.

## Discussion

The past five years have seen a plethora of reports on measles outbreaks from different countries and geographic regions throughout Europe. In the past two to three years, clusters of measles were reported in the Bavaria region of Germany [5], Puglia in Italy [14], the Geneva region in Switzerland [15], and London in the UK [6,12]. In addition, there have been reports of morbidity among the ethnic group of Irish Travellers in the UK and Norway [16,17].

The member states of the World Health Organization European Region (WHO EURO) reported approximately 90,000 measles cases during 2005 and 2006 [9], with large outbreaks in the Ukraine, Romania, Germany and the Russian federation accounting for over half the cases. The most frequent scenario is importation of measles virus from an unimmunised community that has cultural, religious or family ties with communities in other regions.

Globalisation has resulted in increasing mobility of people, which facilitates the spread of the virus between countries and continents. As a consequence, epidemiological investigation is rendered much more difficult, as is the investigation and prevention

of further cases, be it by post-exposure immunisation of contacts, or by outbreak control measures such as mass immunisation.

Not infrequently, these difficulties are compounded by lack of cooperation from communities who are recalcitrant in the first place. There is often implicit or explicit stigmatisation of such populations, who are judged as being difficult to treat and obstructive to the ingress of public health personnel. As we have described previously [10], these communities do not take kindly to what they perceive as “intervention in their internal affairs”.

Recently, voices have been heard in Israel calling for the introduction of legislation or governmental directives requiring proof of immunisation as a precondition to school entry, as is the case for example in the United States, some European countries (e.g. Italy) and most Australian jurisdictions. It should be noted, however, that in Israel, the communities in question are allowed to conduct independent educational systems, based on religious and ideological principles, and it is possible that even if legislation requiring proof of immunisation were to be introduced, those institutions would not necessarily fully comply with such requirements. Incentives to encourage immunisation are more likely to bear fruit than sanctions.

The goal set by the World Health Organization (WHO) for the eradication of measles by 2010-2015 [18] is likely to be extremely difficult to achieve. It has recently been suggested that elimination, or perhaps merely control of the disease is a more realistic target. Since the measles virus is one of the most contagious viruses known, prevention of spread requires maximal herd immunity. As long as homogeneous groups who are unimmunised remain, we can expect to see repeated penetration of the virus, in spite of high immunisation coverage (of the order of 95% in many countries). In those regions in London where the disease occurs, vaccine coverage is assessed as 77% for the first dose and 52% for the second dose [12]; during the large measles outbreak in 2000 in Dublin, the coverage was estimated as 76% [7].

It is important to continue to maintain herd immunity, targeting first those populations that cooperate and comply with immunisation requirements, and to minimise as much as possible “missed opportunities” for immunisation in young children. As can be seen from Figure 2 and 3, infants and young children were the major victims of the recent outbreak in Jerusalem. The high incidence (408.5/100,000) in infants under one year of age is worrying. As opposed to the previous outbreaks, in which young infants did not figure prominently (five infants (4.7%) in 2003, and six (5.1%) in 2004), 58 infants have been reported to the District Health Office to date in the current outbreak, representing 12.1% of all the patients. In addition, there have been several instances of the disease in pregnant women.

Among young adult females and women of childbearing age (particularly among populations with high fecundity, as are the ultra-orthodox Jews), MMR vaccination should be encouraged as part of the policy of prevention of congenital rubella. The protection of pregnant woman is crucial in view of the recent report from Japan of *in utero* foetal demise (IUID) [19]. The vaccination policy in Europe has recently been re-evaluated in view of the evidence of low passive antibody levels due to waning maternal immunity [20].

Children contracting measles at a young age are at increased risk for subacute sclerosing panencephalitis (SSPE) [21]. This is not a notifiable disease in Israel and perhaps a special follow-up programme should be instituted for those children.

The outbreaks we witnessed among the ultra-orthodox population of Jerusalem were imported in 2003 from Switzerland and in 2007 from London. These outbreaks were apparently caused by separate importations of measles virus into unprotected groups and to date have not extended to the general population, but remained confined to these communities. This may be attributable to adequate overall herd immunity in the general population. Outbreaks in Israel reflecting a similar pattern have been reported among unvaccinated Bedouins in southern Israel during the 1990s [22] and among the military [23]; in those cases, successful immunisation campaigns were implemented.

Outbreak control necessitates a culture-sensitive approach and appropriate outreach activities. Despite high national immunisation coverage (94-95%), programmes to increase and maintain immunisation coverage are essential, with special attention to specific sub-populations. The great writer of sententiae in the first century BC, Publilius Syrus, wrote: *"He is most free from danger who, even when safe, is on his guard"* – he could well have been referring to the challenges facing public health authorities in the 21st century.

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