Outbreak of Measles in Wales
Nov 2012 – July 2013

Report of the agencies which responded to the outbreak

(Abertawe Bro Morgannwg University Health Board, Powys Health Board, Hywel Dda Health Board and Public Health Wales)

October 2013

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1. Summary

From November 2012 to July 2013 Wales experienced the largest measles outbreak since the introduction of the Measles, Mumps and Rubella vaccine (MMR). Public Health Wales received 1,202 notifications from the Health Board areas of Abertawe Bro Morgannwg, Hywel Dda and Powys in South West and Mid Wales, with 88 hospital admissions and one death.

At the peak of the outbreak the majority of confirmed cases were in children under 15 years of age although there were a considerable number in young adults. Over 100 school or child care establishments were affected.

In November 2012 approximately one in six children aged 11 years in the Swansea area were unprotected by the (MMR) vaccine. This compared to one in nine for this age cohort across the rest of Wales. The poor uptake of

the MMR vaccine in this age cohort, a result of parental concern over safety of the vaccine, was a national phenomenon. However, data shows that the decline in MMR uptake in the Swansea and Neath Port Talbot areas occurred both earlier and was greater than in the rest of Wales. In November 2012, of the highest risk target age-group of 10 to 18 year olds, there were an estimated 50,887 in Wales requiring one or two doses of MMR – about one in five lived in the Abertawe Bro Morgannwg University (ABMU) Health Board area.

The measles virus was introduced to the ABMU Health Board area in November 2012 by four children returning from a holiday camp in the South West of England over the autumn half term school holiday. These children were not related and did not attend the same school. Two of these first cases spread the measles virus to 29 other individuals.

Early interventions by the Health Board and Public Health Wales, in addition to case management and identification of unvaccinated and vulnerable contacts, included letters to parents, letters to health professionals, media and social media engagement and targeted school immunisation sessions.

Recently obtained results of measles virus genotyping demonstrate that, in early January 2013, the circulating genotype D8-Taunton was almost eliminated (Figure 9). This was followed by a second virus strain D8-Swansea (differing from D-Taunton by a single nucleotide base) which was the circulating virus in the ABMU Health Board outbreak from late January to July 2013.

As measles notifications continued to be reported (168 by 7 Feb 2013), and in acknowledgement of the seriousness of this viral illness to so many unprotected children and young adults, all agencies agreed that this was a public health emergency and increased effort was needed to vaccinate those at risk and halt the outbreak. A Senior Response Team (SRT) was established, led by Public Health Wales and with membership from all health agencies involved.

At the same time, ABMU Health Board set up a Silver Command group to organise the complicated logistics of delivering very large numbers of MMR vaccinations in the measles outbreak epicentre area, and manage local communications.

Every opportunity was taken by health professionals to communicate with parents and young adults so that they could understand the seriousness of the illness and be assured of the safety of the MMR vaccine. Social media played a large part in this communication plan.

Across Wales children and vulnerable adults were offered the MMR vaccine in schools, in hospital-based drop-in clinics, in primary care, other health care settings and prisons. Intelligence was provided weekly by Public Health Wales to show progress and inform further local action.

By August 2013, across Wales, at least 77,805 catch-up doses of MMR had been delivered in response to the outbreak. General practitioners (GPs) in Wales had delivered 47,988 of these. Almost a quarter were given to children and teenagers aged between 10 and 18 years. However, despite all these efforts, of the 50,887 children and teenagers who required one or two doses of MMR only 21,493 received them.

The combined efforts of primary care, Health Boards, Local Authorities and public health were effective in halting the outbreak which was declared over on July 3 2013. That so much was achieved in such a short time frame is a testament to the commitment, collaborative working and support provided by all agencies involved.

As always when reviewing and documenting a multiagency response to an outbreak, there is an opportunity for reflection and for identification of improvements that could be made in either their prevention or their management. Lessons learnt from this outbreak and recommendations for the future are set out at the end of this report.

In July 2013 the Health and Social Care Committee, at the National Assembly for Wales, conducted a short inquiry into the outbreak, its causes and management, and highlighted areas for further action. These include renewed focus on the 30,000 10-18 year olds who missed out on the opportunity to be vaccinated during the outbreak and further examination of communication methods in reaching parents and especially children and young people themselves.

2. Abbreviations

ABMU HB**:** Abertawe Bro Morgannwg University Health Board

CCDC: Consultant in Communicable Disease Control

CMO: Chief Medical Officer

CHIPS: Child Health Immunisation Process Standards

COVER: Cover of Vaccination Evaluated Rapidly

GP: General Practitioner

LES: Local Enhanced Service (agreement)

LMC: Local Medical Committee

MMR: Measles, Mumps and Rubella vaccine

NCCHD: National Child Health Database

NVRL: National Virus Reference Laboratory

NWIS: NHS Wales Informatics Service

OCT: Outbreak Control Team

PCR: The polymerase chain reaction

SRT: Senior Response Team

WAST: Welsh Ambulance Service Trust

WHO: World Health Organization

3. Glossary

Audit +: Audit+ is a freely available software product, managed by the NHS Wales Informatics Service (NWIS) and used in 98% of General Practice to ensure Primary Care data quality and automate reporting of required public health data. Audit+ interrogates General Practice systems using specified Read-codes and automatically relays relevant anonymous aggregate data to Public Health Wales, via NWIS, for the purposes of public health surveillance. This provides the information required to monitor specific disease diagnoses and uptake of a number of immunisations in Wales, whilst minimising impact on General Practice.

Case: Any person whose clinician described signs and symptoms of measles.

Case definition: A list of criteria that must be fulfilled in order to identify a person as a case of a particular disease. It is used in outbreaks of illness to identify who should be included on a list of cases. The criteria can include the symptoms of the illness, laboratory test results, the time and place of illness.

Child Health System (NCCHD): The Child Health System refers to the databases and software which manage scheduling, appointing and recall of children for routine immunisations in Wales; and also recording of immunisation statuses for Wales resident children. The Child Health System is the source for all COVER immunisation uptake statistics in Wales, which are calculated and reported by Public Health Wales.

Communicable disease: Any disease that can be passed from one person to another.

Consultant Epidemiologist: A doctor/public health specialist, specialising in communicable disease epidemiology in a population, working at the all Wales level.

Consultant in Communicable Disease Control (CCDC): A fully trained doctor/public health specialist in a branch of medicine that is responsible for the prevention and control of communicable disease in the community.

COVER: (Cover of Vaccination Evaluated Rapidly) is a national reporting system for immunisation uptake used in all four UK countries. In Wales, reports are currently published on a quarterly and annual basis.

Descriptive epidemiology: Describing the characteristics of cases i.e. time, place or person characteristics such as date of onset of illness, place of residence, age or sex.

DNA: Deoxyribonucleic acid (DNA) is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses.

Encephalitis: Encephalitis is an uncommon but serious condition that causes inflammation of the brain.

Epidemiology: The study of the patterns, causes, and control of disease in groups of people.

Epidemiological link: Cases linked by close social or household contact.

HNIG: Normal Human immunoglobulin (also called normal immune globulin) is a concentrated antibody-containing solution prepared from plasma obtained from normal donors.

IgG: Immunoglobulin G is an antibody isotype. One of the five major classes of immunoglobulins; the main antibody defence against bacteria.

IgM: Immunoglobulin M (IgM), which is found mainly in the blood and lymph fluid, is the first to be made by the body to fight a new infection.

Incubation period: This is the time elapsed between exposure to a pathogenic organism and when symptoms and signs are first apparent. The incubation period for measles is between 6 and 21 days.

Measles: Measles is an acute viral illness. It starts with fever, tiredness, coryza (runny nose), conjunctivitis (red eyes) and cough. The rash appears two to four days later. It usually starts behind the ears, spreads around the head and neck and then to the body and limbs. Individuals are infectious from when the first symptoms start until four days after the rash appears. It is one of the most highly infectious communicable diseases.

Microbiological sampling: Taking a sample e.g. saliva/blood and testing it to see if an infectious agent is present.

Microbiologist: A non medical or medical trained scientist mainly laboratory based, who specialises in the diagnosis, treatment and control of infectious agents such as parasites, bacteria, viruses and fungi.

MMR: Measles Mumps and Rubella vaccine. One MMR dose gives around 90% protection against measles, but two doses are required for full protection. The first MMR dose is routinely offered to all children at 12-13 months of age and a second dose at between three years four months and five years of age (before school entry).

Notifiable disease: A notifiable disease is any disease that is required by law to be reported to government authorities. The collation of information allows the authorities to monitor the disease and take appropriate public health action. It also provides early warning of possible outbreaks.

Otitis media: Otitis media is an infection of the middle ear common in younger children, more common in boys than girls.

Outbreak: An increase in the number of people with a disease that is above what would normally be expected in a defined community, geographical area, or time period.

Outbreak area: An outbreak area is a concept that applies to situations when there is widespread transmission of a virus in the population. The term outbreak area would normally apply to large populations, for example greater than 100,000. Local outbreaks may be occurring without widespread transmission in the population. Epidemiological indicators suggesting widespread transmission in the population are:

- Local outbreaks involving more than three geographically distinct unlinked schools or institutions.
- Most confirmed cases occurring in the general population without identifiable links to known local outbreaks or other outbreak area.
- Laboratory confirmation of more than 30% of reported cases.

In this outbreak the outbreak area was defined as Swansea, Bridgend and Llanelli. This was the area where measles was widely circulating in the community.

Outbreak Control Team (OCT): A team of people from different, usually public bodies, brought together, according to official guidance primarily to control the spread of disease during an outbreak. This is done through assessing the range and extent of the outbreak: identifying the source of the problem if possible, implementing prevention and control measures and communicating with relevant parties and the public.

PCR: The polymerase chain reaction (PCR) is a laboratory test to analyse a short sequence of DNA even in samples containing only minute quantities of genetic material. It is a very rapid, efficient, and sensitive test for measles.

Pneumonia: Pneumonia is inflammation (swelling) of the tissue in one or both of your lungs. It is usually caused by an infection.

RNA: Ribonucleic acid (RNA) is a ubiquitous family of large biological molecules that perform multiple vital roles in the coding, decoding, regulation, and expression of genes.

Serological testing: Any of several laboratory procedures carried out on a sample of blood serum, the clear liquid that separates from the blood when it is allowed to clot.

The Senior Response Team (SRT): The senior Public Health Wales team that manages and co-ordinates the Public Health Wales response to an incident or outbreak.

4. Introduction

Measles is an acute highly infectious viral illness caught through direct contact with an infected person or through the air by way of droplets from coughs or sneezes. Symptoms include fever, cold-like symptoms, fatigue, conjunctivitis and a distinctive red-brown rash.

The most common complications of measles infection are otitis media (9% of cases), diarrhoea (8%), pneumonia (1%) and convulsions (0.5%). Other rarer complications include encephalitis and sub-acute sclerosing pan-encephalitis.

Measles infection can be prevented by a highly effective and safe vaccine that is part of the Measles, Mumps and Rubella (MMR) immunisation.

In the late 1990s uptake of (MMR) vaccine fell in the UK. This was in response to a paper published in The Lancet in 1998 and claims of a few researchers that MMR, autism and bowel cancer were linked and the extensive media coverage of them. Between 1997 and 2002, national annual

uptake of one dose of MMR in two year olds fell 11% (from 91% to 80%). In the Abertawe Bro Morgannwg University Health Board area the decrease was 19% (from 92% to 73%). It fell even lower in those areas which, for local reasons, were most affected by the controversy, such as Swansea and Neath Port Talbot. The Lancet paper has since been formally withdrawn and confidence in the MMR vaccine has been restored in parents of younger children. However, despite all the work undertaken by health services and the Welsh Government to improve the uptake of MMR since 1999 (see Appendix 4) a small but significant proportion of the child population had no protection against Measles, Mumps and Rubella. They were not routinely vaccinated over the years because of the controversy, and many are now secondary school age.

Based on information from the National Community Child Health Database (NCCHD, correct as at February 2013), Public Health Wales estimated that in November 2012 there were 41,129 children in Wales from 2 to 18 years of age who had not received any MMR vaccination (Table 1) and a further 35,926 from 4 to 18 years of age who had only received an incomplete course of MMR vaccination. Introduction of the measles virus in this susceptible cohort had a very real chance of resulting in an outbreak.

Between 9 and 16 of November 2012 three notifications of possible measles were received by the health protection team in Swansea. All three individuals had attended a holiday camp in the South West of England over the autumn half term school holiday. No other connection between the three cases was identified. On 26 November 2012 a fourth case was notified. All were unknown to each other.

Contact with health protection services in England was established after the second case was notified but, at this time, no outbreak had been declared and no confirmed cases were identified. For two of the first four cases there was no spread beyond the immediate family. The other two had been in environments where transmission of measles was facilitated – playing football, attending school, etc. There is evidence that these two cases transmitted the virus to 14 and 15 new cases respectively.

On 27 November 2012 evidence of transmission in a school became evident. This was the first time a secondary case in a school was laboratory confirmed. The next day, 28 November 2012, an Outbreak Control Team (OCT) meeting was held including staff from Public Health Wales and ABMU Health Board. At this meeting an outbreak was declared. It was agreed to communicate with schools, parents, General Practitioners (GPs), the media and NHS Direct Wales (Welsh Ambulance Service Trust). It was agreed to offer the Measles, Mumps and Rubella vaccine (MMR) to all unvaccinated or partially vaccinated children in the school where transmission occurred.

From this time on, until July 2013, Wales experienced the largest measles outbreak since the introduction of the MMR vaccine. It resulted in 1,202 notifications from the Health Board areas of Abertawe Bro Morgannwg, Hywel

Dda and Powys in South West and Mid Wales, with 88 hospital admissions and one death.

This report is a record of all the actions taken to control the outbreak and reduce the risk of spread of measles across Wales.

5. Methods of investigation

5.1 Case definition

This was agreed at the Outbreak Control Team (OCT) meeting on 28 November 2012 as follows:

- **Possible cases** - clinical presentation of measles.
- **Probable cases** - clinical presentation of measles and linked in some way to a known case, with the likelihood of clinical diagnosis increased.
- **Laboratory confirmed cases -** positive serology or saliva test.

5.2 Epidemiology

Measles is a notifiable disease and when a doctor makes a clinical diagnosis of measles he/she notifies the health protection team so that appropriate public health action can be undertaken. In this outbreak all cases notified were contacted by members of the health protection team or on-call staff and interviewed using standard questionnaires. The questionnaires collect basic demographic details such as age, gender, address and occupation/school. Information was gathered on symptoms, vaccination status and possible links to other probable or confirmed cases.

Local monitoring of reported cases of measles was carried out by staff in the Health Protection Teams in the Mid and West Wales offices (Swansea and Carmarthen), supported by the central Health Protection Division including the Communicable Disease Surveillance Centre, both based in Cardiff, which also carried out wider surveillance of both notified and confirmed cases.

Situation updates on cases reported from the outbreak area, the wider Mid and West Wales area and other areas of Wales were prepared on a daily basis. The situation updates were distributed to members of the measles Senior Response Team (SRT), with headline figures also provided to the Welsh Government. These figures were also used as the basis for pro-active press releases every Tuesday and Thursday. Latest data on numbers of confirmed cases, broken down by age group and area were released to the general public every Tuesday and Thursday to coincide with press releases.

5.3 Microbiology

Clinically diagnosing measles is inherently problematic for several reasons. Firstly, because similar rashes are seen with a wide array of illnesses. Secondly, as measles is not commonly seen in primary or secondary care practice, clinician experience in identifying and differentiating measles from these other rash illnesses varies considerably. Thirdly, even if measles is introduced into the community the combination of these two factors can lead to misidentification and lost opportunities to detect these very early cases.

As part of the World Health Organization (WHO) enhanced surveillance for the measles eradication programme every effort must be made to confirm measles infection by laboratory testing. Where a clinician suspects an acute measles infection the local health protection team should be notified. It in turn will notify the WHO measles reference laboratory in London. For each notified case, the UK testing algorithm for measles confirmation involves the collection of a saliva sample which is forwarded by post to the WHO laboratory.

Although the case is encouraged to submit a sample, not all cases will do so. In the absence of a sample, if the case can be epidemiologically linked to other cases or has visited an area where measles is endemic, then there is allowance for that case to be classed as confirmed, based on clinical presentation rather than laboratory results.

From 9 November 2012 to 28 February 2013 notified cases of measles were confirmed using the standard notification and centralised testing algorithm in London. However, it became clear early on in the outbreak that the UK measles enhanced surveillance scheme was insufficient for the purpose of outbreak management due to the time lag in receiving results. Therefore, an alternative protocol was developed that incorporated a rapid and sensitive local testing algorithm that was implemented from 28 February 2013.

Early cases of measles presenting to hospitals in Swansea had been confirmed in the Cardiff laboratory using measles specific Immunoglobulin M (IgM) testing on a blood sample. Serological testing is costly and relies on the appearance of circulating IgM in the patient's blood by which time onward transmission of measles may have occurred. It also requires that the patient attends either primary or secondary care to have a blood sample taken. This would be contrary to clinical advice that recommends patients avoid contact outside the home setting during the acute phase of infection due to the high transmissibility of measles.

To assist the outbreak management, it was agreed that local testing should be enhanced using a sensitive and specific polymerase chain reaction (PCR) assay to detect measles virus RNA as a frontline screen. The molecular assay used was validated for dry mouth swabs, respiratory samples, urine and blood. The dry swab technique was also used for detecting measles in the post mortem samples from the fatal case (see below). As measles virus RNA can be detected four to five days before onset of the rash and for up to 14 days afterwards, this allows for very early and rapid confirmation of suspected cases. This meant that timely, well informed intervention could be undertaken by the health protection team including the appropriate prescribing of human normal immunoglobulin (HNIG) for especially vulnerable contacts. Additionally, by having the test available locally, urgent samples could be delivered directly to the laboratory allowing same day results.

When cases of measles were notified to the health protection team, a swab was sent to the case at home. Instructions were included on how to take a mouth swab from the case and return it to the Cardiff laboratory in a prepaid

envelope. On receipt in the laboratory, the sample was processed and nucleic acid was extracted and tested for the measles virus. This entire process concluding with a result could be achieved within three hours in emergency situations. The results were telephoned to the health protection team usually on the same day as the sample was received in the laboratory as testing was carried out Monday to Friday throughout the peak of the outbreak with weekend testing available for emergency cases.

6. Results

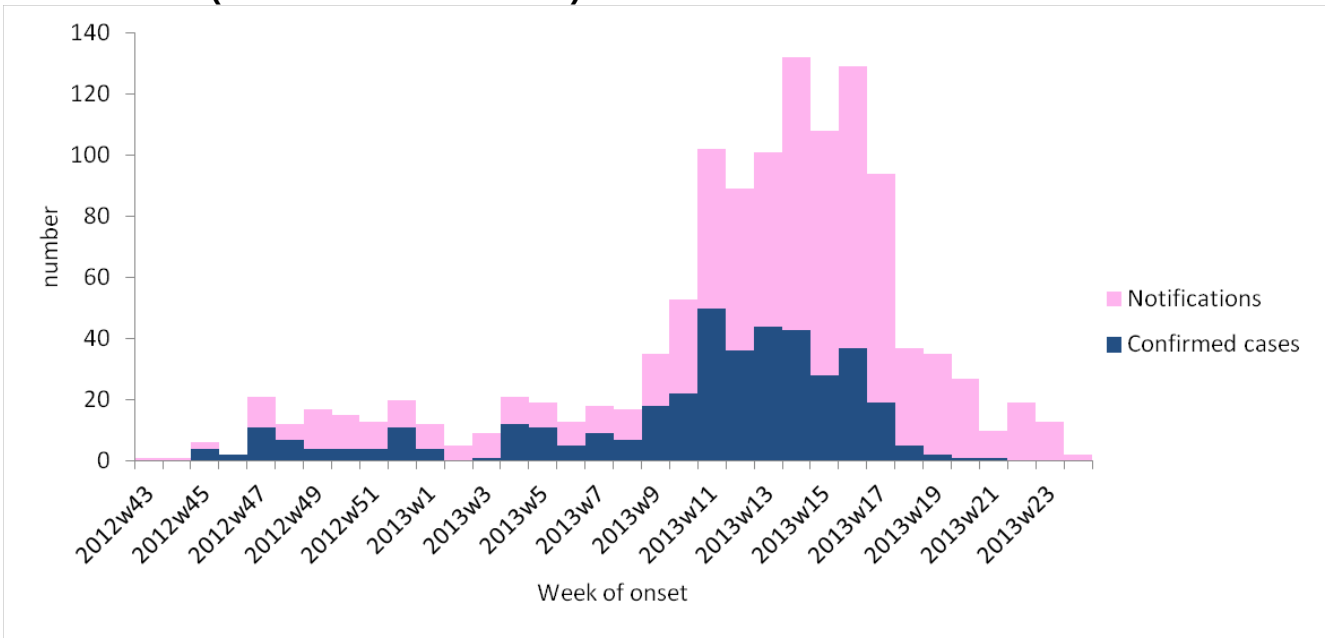
6.1 Descriptive epidemiology of the 2012-13 Measles Outbreak mainly affecting the Mid and West Wales area

Between 1 November 2012 and 3 July 2013, there were 1,430 notifications of measles in Wales, of which 1,202 were from the Health Board areas of Abertawe Bro Morgannwg, Hywel Dda and Powys in South West and Mid Wales. Notifications from this area, designated the outbreak area, were at around 20 per week from November 2012 to February 2013. They increased sharply in early March 2013, peaking during March and April 2013 (Figure 1).

Analysis of linked laboratory and notification data indicate that the distribution of confirmed cases from the outbreak area reflects that of notifications, with the peak in laboratory confirmations at around the same period, possible peaking slightly earlier.

The outbreak was officially declared over on 3 July 2013. Between 16 June 2013 (the last confirmed case of measles) and the end of the outbreak, an additional nine cases were notified from the Mid and West Wales area, none of which were confirmed as cases of measles by the laboratory in Cardiff.

Figure 1. Epidemic curve: notified cases from Abertawe Bro Morgannwg University Health Board, Hywel Dda Health Board and Powys Teaching Health Board (01/11/2012 to 16/6/2013).



Similar numbers of male and female cases were notified from the outbreak area (620 males, 574 females, 8 gender not recorded). Notifications were most frequently in those aged 5 to 14 years (Figure 2). However, when notification rates were calculated, incidence was highest in those aged under one year (Figure 3).

Analysis of linked laboratory and notification data indicate that the distribution of confirmed cases from the outbreak area was different in that more confirmed cases were identified in older children and young adults. This may

reflect different testing patterns or different background rates of rash-illness in different age groups.

Figure 2. Age distribution of cases: numbers of notified and confirmed cases from Abertawe Bro Morgannwg University Health Board, Hywel Dda Health Board and Powys Teaching Health Board (01/11/2012 to 16/6/2013).

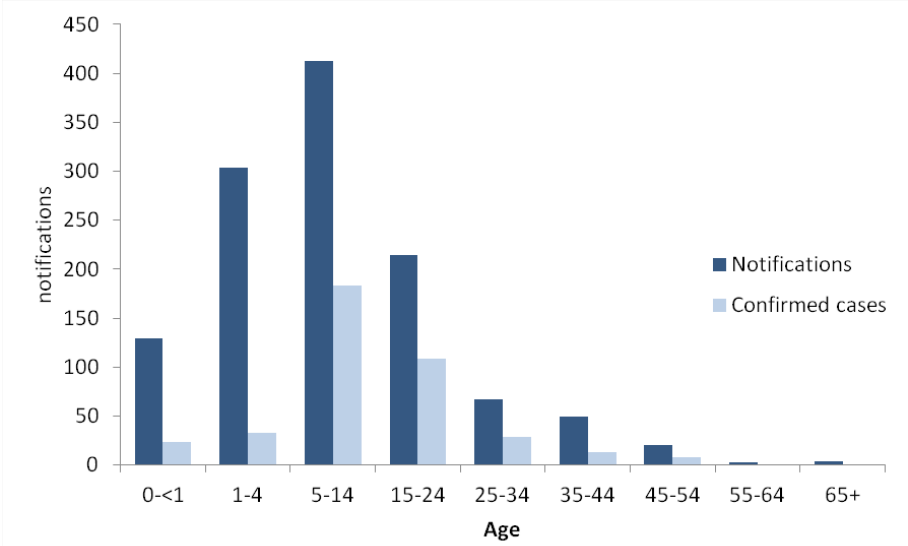
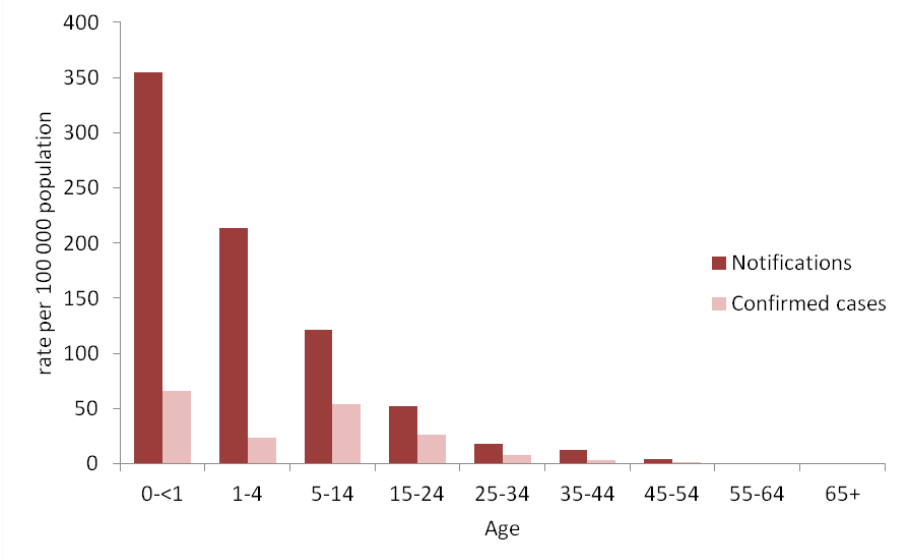
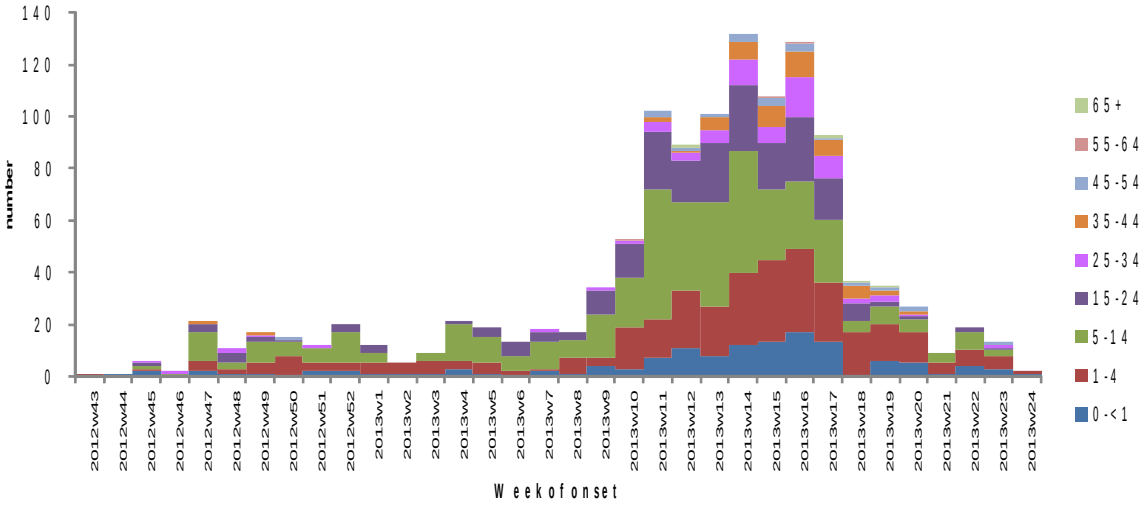


Figure 3. Age distribution of cases: notified and confirmed cases from Abertawe Bro Morgannwg University Health Board, Hywel Dda Health Board and Powys Teaching Health Board (01/11/2012 to 16/6/2013), expressed as rates per 100 000 population.



The peak of the epidemic curve was primarily cases in children, although there was a significant burden of infection in younger adults (Figure 4).

Figure 4. Epidemic curve by age group: notified cases from Abertawe Bro Morgannwg University Health Board, Hywel Dda Health Board and Powys Teaching Health Board (01/11/2012 to 16/6/2013).



Local authority of residence was known for 1,177 of the 1,202 notifications (98%). Between 1 November 2012 and 16 June 2013, notifications from the outbreak area were most frequently from Swansea (650 notifications) and Neath Port Talbot (232). Smaller numbers were notified from Powys (99), Carmarthenshire (66), Pembrokeshire (60), Bridgend (49) and Ceredigion (21). Notification rates are shown in Figure 5. Notifications from Pembrokeshire were associated with the initial increase in cases in November 2012. The main peak in the epidemic curve comprised cases mainly from Swansea and Neath Port Talbot local authority areas (Figure 6). Figure 7 highlights the spread of measles cases notified from the Mid and West region of Wales between 1 November 2012 and 16 June 2013.

Figure 5. Incidence by local authority of residence: notified cases (01/11/2012 to 16/6/2013) expressed as rates per 100 000 population.

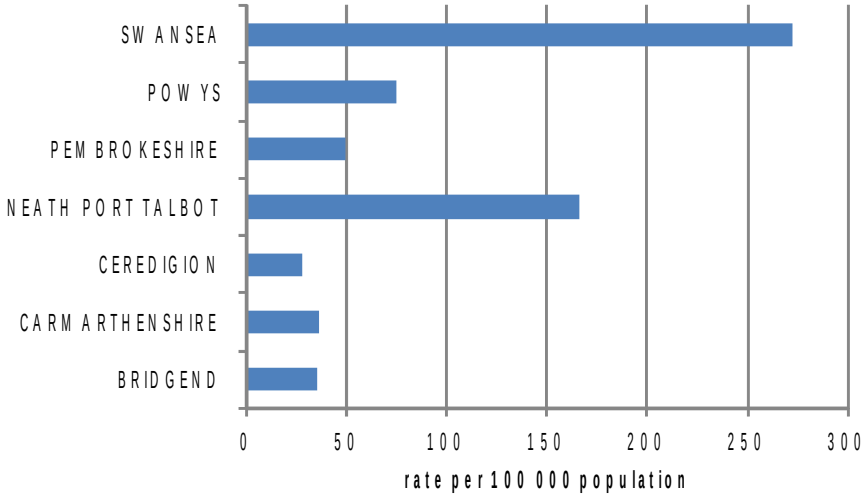


Figure 6. Contribution of each local authority area of residence to the epidemic curve, notified cases (01/11/2012 to 16/6/2013).

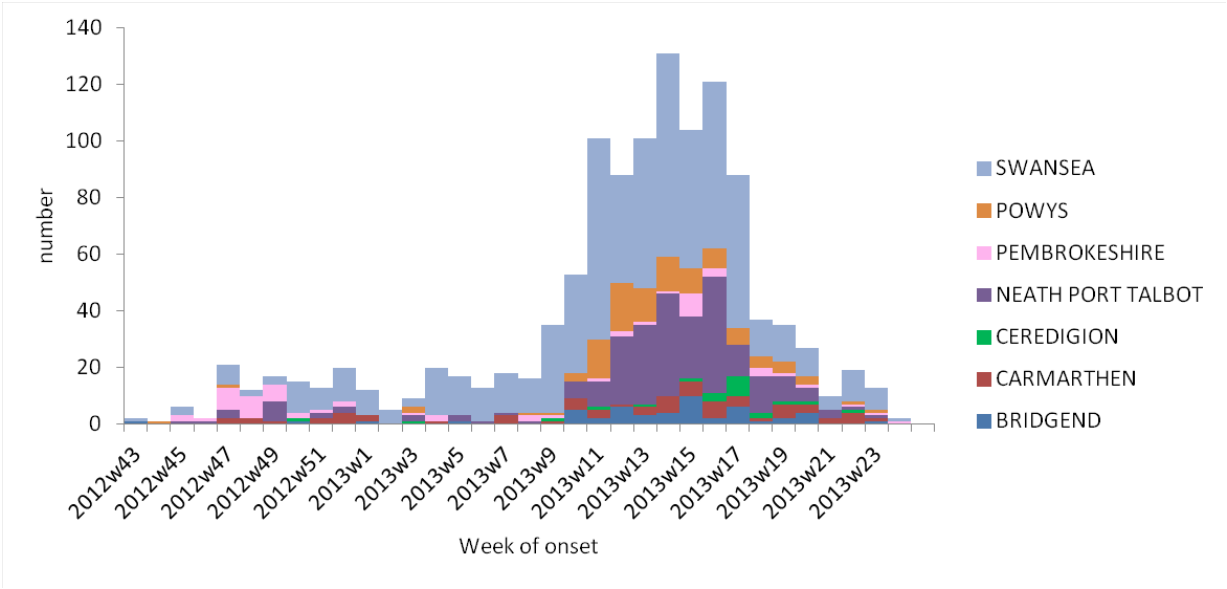


Figure 7. Geographic spread: Postcodes of cases notified to the Health Protection Team from Abertawe Bro Morgannwg University Health Board, Hywel Dda Health Board and Powys Teaching Health Board (01/11/2012 to 16/6/2013).

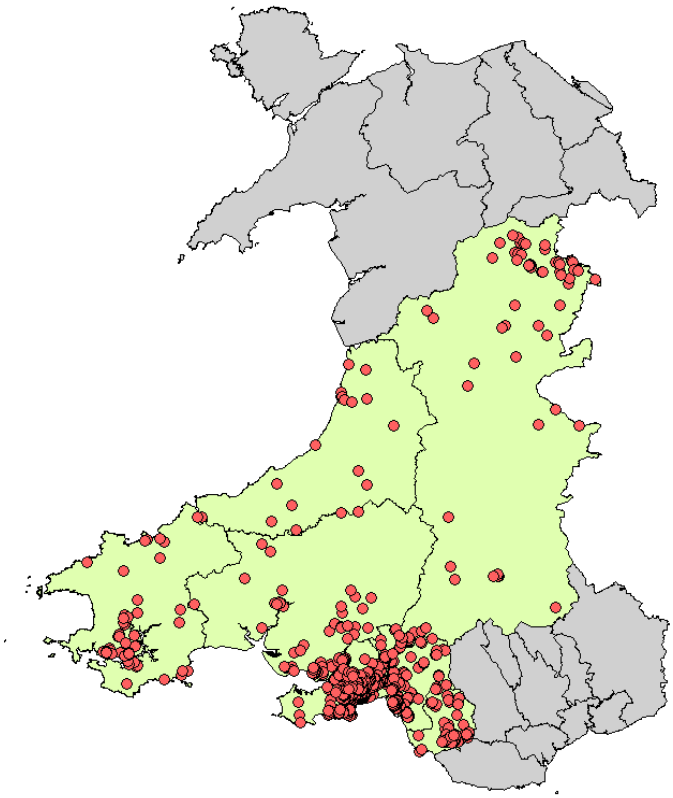
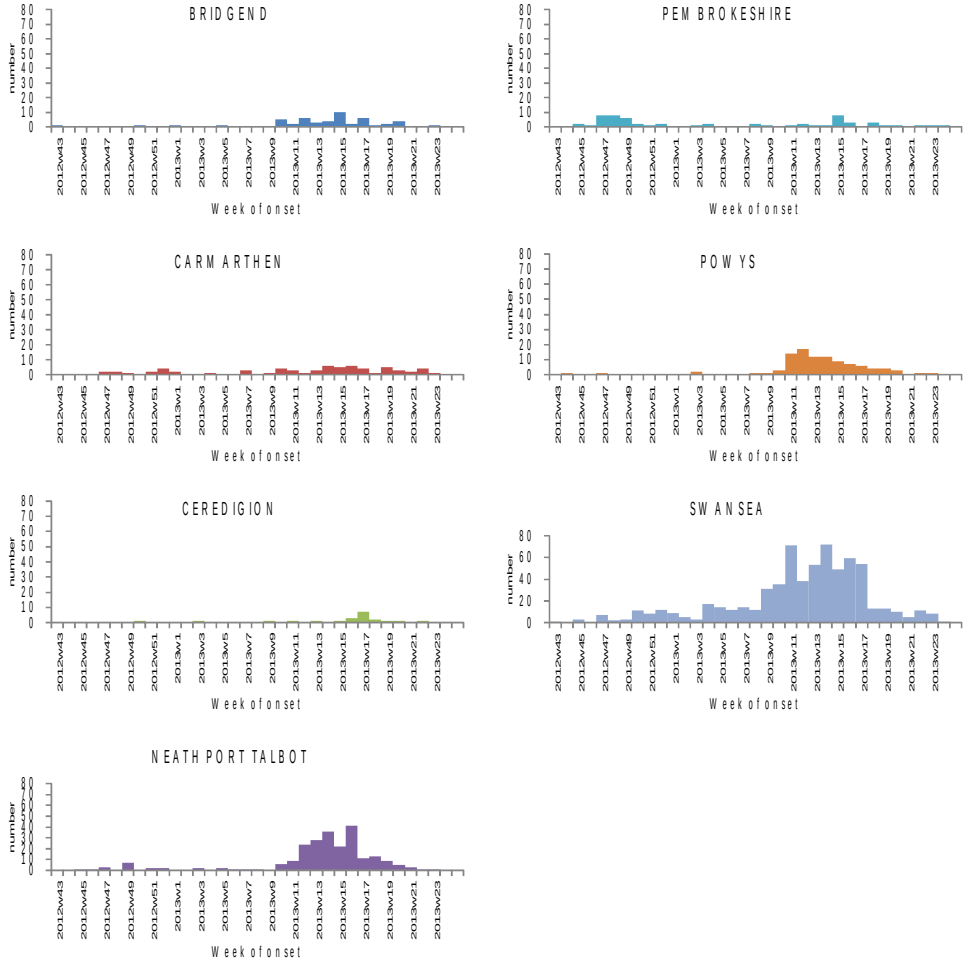


Figure 8. Epidemic curve for each local authority of residence: notified cases (01/11/2012 to 16/6/2013).



Based on analysis of information collected on immunisation status for confirmed measles cases: of the 432 cases confirmed with onset dates between 1 November 2012 and 16 June 2013, 20 had received a single dose of MMR greater than 10 days before onset of illness and 31 had received a full two dose course of MMR more than 10 days before onset of illness. For younger children, self/ parental-reported vaccine status could be verified using the Child Health System. However for older confirmed cases the reliability of self-reported vaccine status is unknown. Of the 313 confirmed cases aged 2 to 20 years, eight had received a single dose of MMR more than 10 days before onset of illness and 23 had received a full two dose course of MMR more than 10 days before onset of illness. In the outbreak children who were unvaccinated had a chance of catching measles of around 1 in 18 (6,812/371), children who were partly vaccinated had a chance of catching measles of around 1 in 750 (14,219/19) and children who were fully vaccinated had a chance of catching measles of around 1 in 2,200 (68,825/31). This shows that 2 doses of MMR were over 99% effective in protecting against measles and 1 dose of MMR was over 97% effective in protecting against measles.

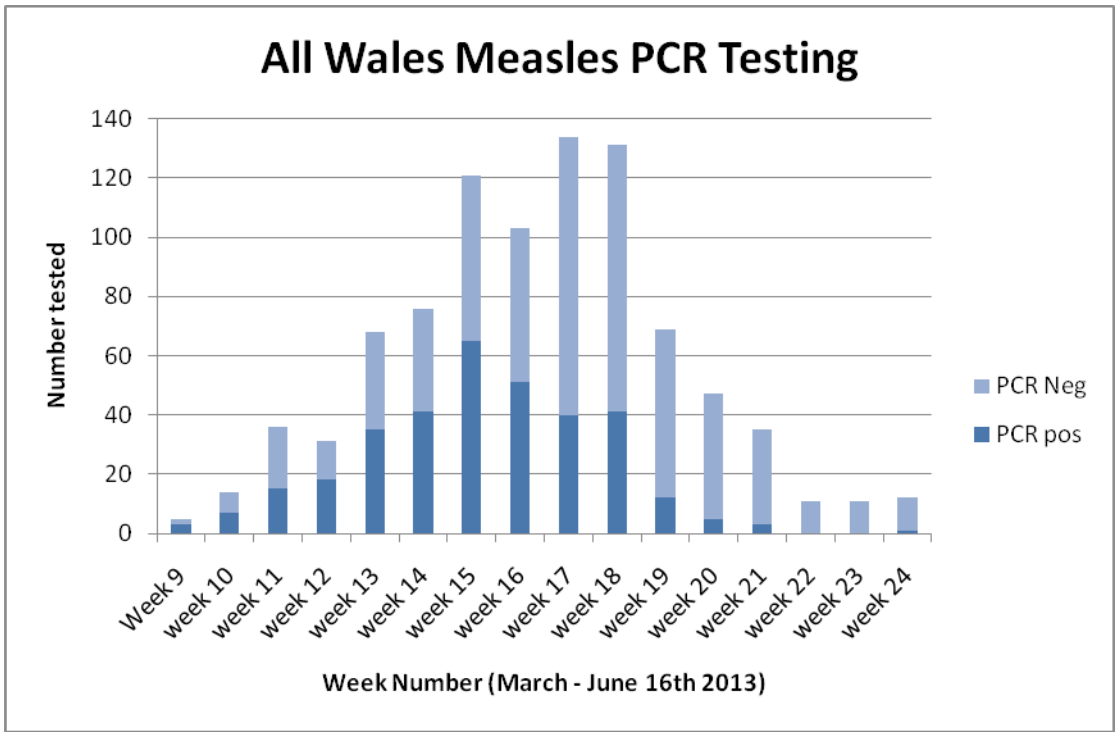
Hübschen J, Kremer J, De Landtsheer S and Muller C (2008) A Multiplex Taqman PCR Assay for the Detection of Measles and Rubella Virus. Journal of Virological Methods 149 (2) 246-250

6.2 Microbiology findings

6.2.1 Measles PCR testing

Between 9 November 2012 and 28 February 2013 95 cases tested positive for measles virus in the WHO laboratory in London. From 28 February 2013 until 16 June 2013 (week 24 of 2013), the Cardiff laboratory received and processed samples from 904 notified cases predominantly but not exclusively from the outbreak area. Of these, 337 tested positive for measles virus (figure 7). In total, 432 cases were confirmed by laboratory testing between 1 November 2012 (date of onset of first confirmed case) and 22 May 2013 (date of onset of last confirmed case).

Figure 7. Measles PCR testing figures by week of sample receipt in the Cardiff laboratory



During the peak week of the outbreak (week 15) 53% of all samples processed by PCR were positive for measles virus, with some of the daily runs at that time having 100% of the samples from the outbreak area testing positive.

During April 2013, the Cardiff assay was used to rapidly confirm the presence of measles virus in throat and blood samples from the fatal measles case prior to the post mortem. These preliminary results were confirmed by secondary testing in London and by subsequent sampling and testing of samples collected during the post mortem examination itself.

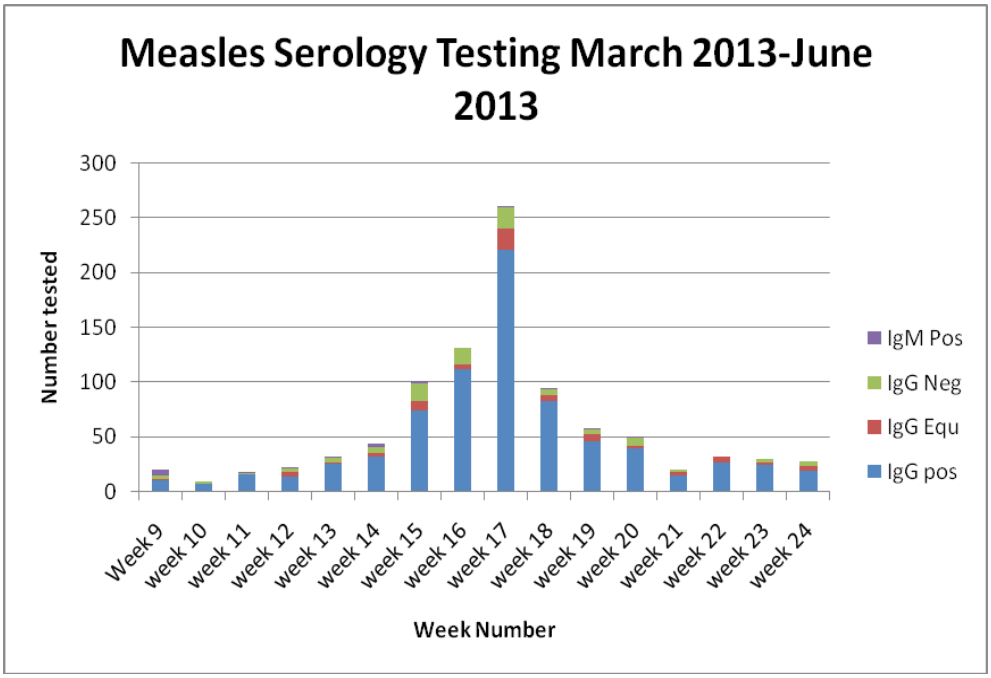
The last laboratory confirmed case from the outbreak was detected during week 24 with an onset date of 22 May 2013. The outbreak was declared over on 3 July 2013 when there were no further laboratory confirmed cases from the outbreak area within two incubation periods of the onset date of the last laboratory confirmed case.

6.2.2 Measles serological testing

In addition to the PCR testing to confirm acute cases, serological testing of suspected contacts, including pregnant women and healthcare workers who were not certain of their vaccine status, were also performed to confirm the presence or not of measles specific Immunoglobulin G (IgG) antibody. All contacts who were IgG negative were either followed up to receive HNIG if at risk from infection and in a vulnerable group or were excluded from work and later offered vaccination if they remained asymptomatic.

This put additional, unexpected pressure on the laboratory as frontline healthcare workers who did not have a documented MMR vaccine were supposed to be excluded from work. As measles has an incubation period of 10 days this would mean an extensive period of time away from work for frontline healthcare workers. But testing for IgG, staff could be back at work quickly with evidence of prior immunity. Over the time period of the outbreak, 893 serological tests were performed to confirm immunity with 261 tests being performed in week 17 alone (Figure 8). Most of the cases tested demonstrated previous immunity probably through vaccination, which suggests that vaccination records particularly for healthcare workers, were incomplete prior to the measles outbreak.

Figure 8. Measles serology testing March 2013-June 2013



6.2.3 Measles virus genotyping

As part of the WHO global monitoring of measles virus transmission a 450 nucleotide hypervariable (HVR) region of the measles virus nucleoprotein should be sequenced to track and monitor outbreaks and new introductions. This is particularly important when the region has been already been declared free of indigenous measles transmission.

Initial genotyping results returned from London suggested that the outbreak was caused by a measles genotype D8 virus. What was not clear from this information was where the virus was introduced and whether there was a single outbreak affecting both South Wales and Powys or whether there were several introductions of different viruses. To clarify this further, 50 positive samples collected throughout the outbreak from different parts of Wales and at different times were selected and sent to the National Virus Reference Laboratory (NVRL) in Dublin for sequence analysis.

The genotyping results (Figure 9) demonstrated the circulation of three distinct strains of measles virus in Wales during the outbreak period, all within genotype D8. MVs/Taunton.GBR/27.12[D8] (D8-Taunton) was introduced in November 2012 seeded from an ongoing outbreak in the South West of England and was the strain of all measles cases in the outbreak area until January 2013. In week 4 2013 of the outbreak, a second D8 strain was identified MVs/Swansea.GBR/4.13[D8] (D8-Swansea) that differed by a single nucleotide base from D8-Taunton. This strain was the only one identified in the outbreak area until the outbreak was declared over on 3 July 2013.

In addition, a separate introduction was found to have caused the outbreak in Powys - MVs/FrankfurtMain.DEU/17.11[D8] (D8-FrankfurtMain). This virus originated from an outbreak occurring on the European mainland which had in turn seeded into England near to the Welsh border with North Powys, from where it was highly likely to have seeded into Powys.

This continued introduction of the measles virus into Wales was confirmed by a third cluster of cases in Gwent being caused by the introduction of a genotype B3 virus (MVs/Newport.GBR/18.13 [B3]).

Further work is ongoing to determine whether D8-Swansea represents a new introduction into the region or whether there was a natural mutation of D8-Taunton causing the single base change.

Figure 9. South-West Wales measles outbreak: Temporal distribution of measles D8 strains

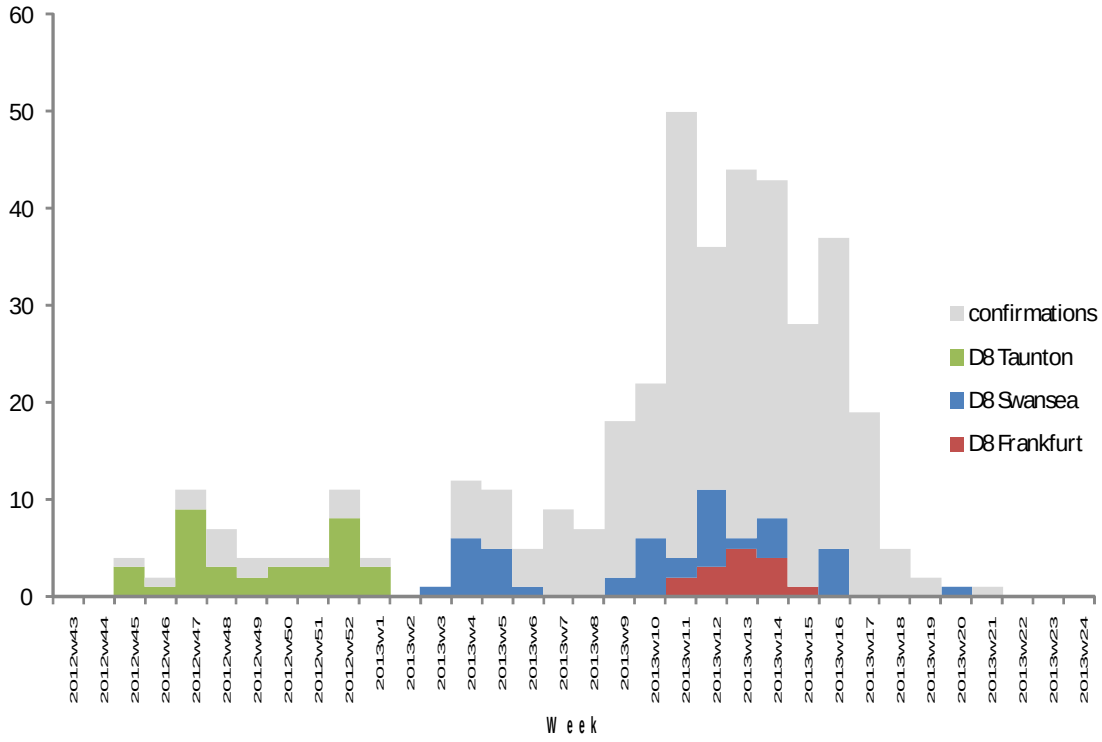


Figure 10: Molecular characterisation of measles viruses in Wales during 2013 Outbreak.

All the viruses from the outbreak and surrounding areas were sequenced across a 450 nucleotide fragment of the nucleoprotein gene. By comparing the sequence obtained from the Welsh viruses against reference measles strains specific software (PAUP) can be used to calculate the number of nucleotide differences and where they are in relation to each other. The software then constructs the family tree based on these (sometimes subtle) genetic differences and importantly for molecular epidemiology of outbreaks the similarities.

7. Outbreak control measures

7.1 Management of cases

The following describes case assessment and management prior to and in the first two months of the outbreak

Measles is notifiable by law. Cases are notified typically by General Practitioners (GPs) after a suspected diagnosis is made, most often by telephone. All other forms of notifications, such as fax or letter etc are accepted readily by the health protection teams as well.

After a notification is received the administrative team routinely adds Exeter System or Welsh Health data about the case to the information received from the GP. Cases, or parents of cases, are contacted and interviewed about clinical history including onset dates of different signs and symptoms. A verbal history of previous MMR vaccination is established and categorised into fully, partially or unimmunised.

Possible epidemiological links to probable or confirmed cases are ascertained and a travel history is taken. Links to the travelling community are confirmed or discounted. Educational establishments and places of employment are asked about and documented.

Actions taken by the health protection team typically consists of:

- Case interview aided by a checklist
- Contact tracing
- Immunisation advice for contacts and case
- Checking immunisation history with Child Health in health board
- Exclusion advice for case (and possibly contacts)
- Sending of sample kit(s) to case

Contact tracing typically consists of documenting names, addresses, dates of birth, and MMR status of close contacts, and a risk assessment of establishments and or events attended during the infectious period.

The case is then categorised as confirmed, probable or possible, depending on the case definition and the information ascertained in the case interview. If cases or parents are uncertain of their vaccination history or symptomatology, GPs who assessed the case are often interviewed to aid the classification.

The categorisation of cases is important as some actions undertaken with vulnerable contacts or in institutional settings will depend on which category the case falls into. These include, for example, whether to recommend that a vulnerable contact should receive HNIG, or whether a small child might receive MMR vaccine ahead of schedule. There might also be implications for action taken in schools depending on whether cases are classed as possible or probable.

Changes to case management during the outbreak:

When notification numbers increased, and were often also dealt with out of hours, the need arose to stream line some of the practices, provide extra support to the local health protection team and ensure all individuals who could be protected by MMR were offered this opportunity. As a result the following were implemented:

1. All measles notifications were forwarded to a central measles response centre in Cardiff where eight specialists were available from 8am to 8pm seven days a week.
2. The following modifications were added to the case list:
    - Relevant vulnerable contact groups were agreed, i.e. babies aged less than 9 months, pregnant contacts and immune suppressed individuals.
    - The travel history of the case whilst infectious, to enable fast responses in containing secondary cases outside the outbreak area.
    - Contacts from outside the outbreak area who may have visited the case in the infectious period were also ascertained.
3. When measles was circulating widely in the community in Swansea, Neath Port Talbot and Llanelli this area was declared an outbreak area. All GPs in Wales received a letter recommending that MMR be given to any baby aged between six months and a year living in or travelling to the outbreak area.

It was agreed that for notifications received from the outbreak area the case classification was not necessarily time efficient, as the majority of notifications in that period from here were testing positive for measles. The emphasis was placed on identifying vulnerable contacts as above and taking appropriate health protection action, e.g. HNIG facilitation etc. This change reduced the time needed for interviewing cases without vulnerable contacts to a minimum without the loss of protection of such contacts. This was never applied to notifications from outside the defined outbreak area. When measles notifications declined the measles response centre was stood down and the health protection team reverted to the previous system as described above.

Human Normal Immunoglobulin (HNIG):

Indication for prescription of HNIG was determined for vulnerable contacts throughout the outbreak. Twenty-seven doses were prescribed to patients on the recommendations of the health protection team. Difficulties with storing and dispensing of HNIG were identified and addressed during the outbreak by Public Health Wales and partner agencies in a number of ways.

Access to Child Health Data:

To facilitate ascertainment of documented MMR status during the outbreak the health protection team was given access to that part of the child health system which enabled the team to check and document individual immunisation records. This helped with case classification and decision

making for vulnerable contacts and decisions regarding interventions in schools and exclusion from institutions.

Exclusion of unvaccinated contacts of probable and confirmed cases:

Exclusion of unvaccinated household contacts of probable and confirmed cases was recommended to cases and parents of cases throughout the outbreak. However, it was deemed non enforceable and also often observed as not being adhered to.

7.2 Management of the outbreak

In addition to exclusion the primary response to the outbreak was vaccination of susceptible individuals – those not vaccinated or partially vaccinated. There were three principal models of delivery of catch-up vaccinations: by general practitioners in the primary care setting, in school immunisation sessions and in weekend/ evening drop-in clinics arranged by Health Boards. There were also campaigns targeting NHS staff and prisoners. The following sections describe the response in Mid and West Wales and across Wales.

7.2.1 Abertawe Bro Morgannwg University and Powys Health Boards

An Outbreak Control Team (OCT) meeting was convened on 28 November 2012 in response to evidence of transmission in a school setting in Swansea (membership of OCT Appendix 1). On Public Health Wales advice ABMU Health Board agreed to provide a vaccination session for all susceptible pupils in the affected school as analysis of vaccination uptake rates in the pupils suggested a large number were susceptible. This vaccination session was run the following week using staff drawn from the community, primary and secondary care. Public Health Wales health professionals were present to provide advice and support.

Other measures agreed were advice letters to primary care, letters to all schools and tailored letters to schools in which measles cases had been notified. A pro-active press release was issued to inform the public of the outbreak and to promote the Measles Mumps and Rubella (MMR) vaccination. Postings were placed on the Public Health Wales Twitter and Facebook pages. The Welsh Government was informed.

The outbreak meeting also agreed that outbreak management would consist of identifying vulnerable contacts, exclusion advice and further special vaccination sessions in schools where there was evidence of measles transmission. Unvaccinated or under-vaccinated members of the public were encouraged to catch up with MMR vaccination through their primary care practitioners. In the first eight weeks of 2013 10 to 20 notifications for suspected measles were received per week, with around half of them subsequently laboratory confirmed.

Discussions over the next few weeks covered communications with professionals and the public, advice over exclusions and the arrangements for testing and for offering immunoglobulin to vulnerable contacts. The Consultant in Communicable Disease Control (CCDC) and Director of Public Health (DPH) liaised closely throughout this period and ABMU Health Board ran vaccination sessions in a further two schools in February 2013 and one in March 2013. A weekly newsletter for health professionals was started in the first week of March 2013, carrying updates and advice as the outbreak progressed. GPs were encouraged to vaccinate susceptible children who had missed their MMR in the routine schedule.

The following schools were offered vaccination sessions from Dec 2012 to March 2013 of the outbreak:

Pentrehafod Secondary School, Swansea	5 to 6 December 2012
Parklands Primary School, Sketty, Swansea	6 February 2013
Olchfa Comprehensive School, Mumbles, Swansea	21 to 22 February 2013
Ysgol Gyfun Ystalyfera, Pontardawe	4 March 2013

Planning for the vaccination sessions in the four ABMU Health Board schools had demonstrated there was missing data on the Child Health System and it was agreed that GPs in the ABMU Health Board area would be asked to review their records and update the Child Health System. The Consultant in Communicable Disease Control and Director of Public Health met the Local Medical Committee (LMC) to agree these arrangements. They also agreed to circulate a letter to parents of all children identified as susceptible to advise them to be vaccinated as quickly as possible. The outbreak Local Enhanced Service (LES) agreement was also amended to remove the restriction to vaccinate only those who were aged under 40.

By 7 February 2013 the Public Health Wales health protection team based in Swansea had received a total of 168 notifications of measles. A decision was taken to establish a Public Health Wales Senior Response Team (SRT) chaired by the Executive Director of Public Health Services at Public Health Wales. The SRT assumed the remit of oversight of the public health response and co-ordination of an MMR catch-up campaign. It ensured consistent advice to professionals and the public. It also ensured that the health protection team was adequately resourced to deliver against an increasing workload. The SRT met 17 times over the course of the outbreak. Membership of the SRT is set out in Appendix 2.

In parallel, ABMU Health Board, which was at the epicentre of the outbreak, set up Silver and Bronze Command groups to organise the complicated logistics around vaccinating very large numbers of people. It managed issues such as transporting large numbers of vaccine into the community at the correct temperature; and ensuring there were adequate numbers of

vaccinators available for both the drop-in MMR clinics and school vaccination sessions. The command groups included local authority membership, who were key to helping set up the urgent school vaccination sessions, minimising unnecessary delays. There was also a sharp focus on local communication, and delivering the most effective ways to inform and communicate with the local population to maximise the uptake of vaccinations.

Partnership working was key to the success of the vaccination campaign and the dissemination of clear advice. Key partners included local GPs and other primary care providers, local education authorities, the Wales Ambulance Service Trust (WAST), the NHS Wales Informatics Service (NWIS), NHS Direct Wales (WAST), colleges and universities, prisons and the voluntary sector. All these partners were invited to local Health Board planning meetings allowing for consistent advice and information to be developed and opportunities to engage with the public identified. All the local authorities contributed to the planning and implementation of the school vaccination campaign to encourage multi collaborative community working. NHS Direct Wales (WAST) provided clear advice for use on its website and for its advisors when dealing with individual enquiries from members of the public. The Director of Public Health for ABMU met with the Local Medical Committee to update it on the situation and to gain their support in encouraging and enabling local GPs to vaccinate those that required the MMR.

ABMU Health Board also worked with neighbouring Health Boards. Hywel Dda offered mutual aid in support of vaccination efforts and the details of non-residents vaccinated at drop in sessions were passed to their ‘home’ Health Boards.

Public Health Wales advised ABMU Health Board to encourage MMR vaccination through primary care and MMR sessions in schools where measles transmission was identified. However, as the Easter school holidays approached, the ABMU Silver Command Group decided to launch open access drop-in clinics as well, to avoid any delay before the schools re-opened after the Easter break. As the scale of the outbreak increased, the response expanded to include:

- Hospital drop-in sessions, run by staff drawn from primary and community care as well as hospital staff, delivered in out-patient clinics. The first drop-in clinic was held at Morriston Hospital, Neath Port Talbot, Singleton Hospital and the Princess of Wales Hospital on Saturday, 6 April 2013, and over 1,700 MMR vaccinations were given.
- Unscheduled GP vaccinations with payment covered by an updated outbreak MMR Local Enhanced Service Agreement (referred to above).
- A school vaccination programme where MMR sessions were led by school nurses. Sessions were offered in all comprehensive schools, special schools and colleges. Primary school age children were advised to attend their general practitioner or drop-in clinics. The local Healthy Schools Co-ordinators supported the communications with schools and parents and in addition helped tailor the clinics. Head teachers played a vital role in contacting parents who had not returned

consent forms urging them to do so. School web pages were established, school texting services were supported and the Facebook page was promoted.

- Open access occupational health vaccinations for health staff.
- Vaccine provision to local prisons for prisoners and staff.
- Health visitors contacting parents of under-vaccinated children on their case loads and encouraging vaccination.
- Midwives advising pregnant mothers-to-be of the risks to themselves and their unborn babies and encouraging vaccination of under-vaccinated children in their households.
- Vaccination of under-vaccinated care staff, clients and patients born from 1970 onwards in long-stay residential and nursing home facilities, psychiatric and learning disability units.
- Working with local universities to promote MMR for students through their GPs or drop-in sessions.

This local response resulted in the delivery of more than 30,000 unscheduled MMR vaccinations in the ABMU Health Board area, of which 14,152 were delivered in primary care.

The outbreak in Powys came to light in the week beginning 18 March 2013, when 16 cases were reported to Public Health Wales. Six of the cases were from Llanfyllin High School, Montgomeryshire.

A local Outbreak Control Team (OCT) was established to co-ordinate the response in Powys (see Powys Outbreak Control Team Membership in Appendix 3). This group had representation from local stakeholders and met regularly until August 2013. MMR vaccinations were made available through GP practices (via a Locally Enhanced Service), through a comprehensive school based vaccination programme in spring 2013 and through two community drop-in clinics held at the weekend. The aim of the community drop-in clinics was to enable primary school aged children and older teenagers attending Coleg Powys to be able to easily access the MMR vaccine. The clinics were held in Brecon War Memorial Hospital and Montgomery County Infirmary, Newtown on Saturday 25 May 2013. To promote attendance, there were national and local press releases, advertisements in local newspapers, social media stories (the Facebook story had over 2,500 viewings) and all parents of pupils at nearby schools received a letter informing them of the drop in sessions. In addition, letters were sent to pupils attending nearby Coleg Powys sites.

The response in Powys was undertaken in partnership with the education department at Powys County Council ensuring that timely messages were sent to schools, pupils and parents to help raise awareness of the outbreak, organise MMR vaccination sessions and promote MMR uptake. The local authority ensured that home educated children and those at Pupil Referral

Units (PRUs) were provided with advice and support in obtaining MMR vaccination.

Schools proactively raised awareness of measles and MMR vaccination opportunities by writing letters, promoting Powys Teaching Health Board's Facebook page on their website (resulting in over 8,000 views in 24 hours), and e-mailing and texting parents.

Information was also disseminated to parents, children and young people through Powys County Council Leisure Services, Youth Information Service, Children and Young People's Partnerships and the council's website. Information was circulated through various community groups, for example, Young Farmers and Girl Guides. Powys Association of Voluntary Organisations also helped to raise awareness of measles and promote MMR vaccination opportunities. Community Health Councils in Powys helped to disseminate key messages amongst their networks.

Presentations were made to councillors to promote community leadership. The Health Board also managed communications with other community leaders including local Assembly Members and Members of Parliament to enable consistent widespread messaging to promote MMR vaccination uptake.

Public health officials at the time suspected that this outbreak was an introduction from an outbreak in the neighbouring English county of Shropshire. This required close working with Public Health England, as well as the local public health team in Shropshire, to ensure a co-ordinated response. As described under 6.2.3; evidence from virus genotyping now confirms this introduction.

Between 18 March 2013 and 1 July 2013, GP practices administered 2,580 vaccines, 330 vaccines were given at Comprehensive School vaccination sessions and 29 vaccines were given at the community drop-in clinics.

7.2.2 All Wales Response

At a national level, Public Health Wales supported the response through its Senior Response Team (SRT). The SRT met weekly after the first meeting on 18 February 2013. The team provided advice to Health Boards, including primary care and the Welsh Government on the response required to deal with the outbreak and minimise opportunities for further cases of measles to arise across Wales. It oversaw consistent advice to professionals and the public. As the Directors of Public Health from all the health boards were invited members of the SRT it allowed for the sharing of good practice between Health Boards. It was also a forum for discussion and resolution of issues as they arose.

The formal outbreak area was defined by Public Health Wales as being Swansea, Neath Port Talbot and Llanelli as there was definitive evidence that measles was being transmitted in community settings. In response to this, all

GPs in Wales were advised by Public Health Wales that it would be reasonable to offer one dose of MMR to all children aged between six months and one year of age living in or travelling to the outbreak area.

On 27 March 2013 the Chief Executive of Public Health Wales wrote to Chief Executives and Directors of Public Health in all Health Boards advising them of the interventions necessary to halt the measles outbreak and further spread across Wales. The Chief Executive of Public Health Wales, together with the Executive Director of Public Health Services and Director of Health Protection, met with the Chief Executives of ABMU Health Board and Swansea and Neath Port Talbot local authorities to discuss and agree the response to the outbreak.

On 11 April 2013, in anticipation of a Wales-wide schools MMR campaign, Public Health Wales provided all directors of public health and Health Board vaccination and immunisation co-ordinators with school vaccination statistics to support local planning.

On 17 April 2013 the Chief Medical Officer (CMO) for Wales sent a letter to all Health Boards directing them to undertake a Wales-wide schools catch-up MMR vaccination campaign to be completed by 24 May 2013. Public Health Wales supported Health Boards by reviewing local implementation plans, co-ordinating action between Health Boards, facilitating the exchange of learning and experience and measuring impact.

On 24 May 2013, the Executive Director of Public Health Services, Public Health Wales wrote to Chief Executives of all the Health Boards asking for their co-operation in a data reconciliation exercise to ensure that all unscheduled MMR vaccines given were recorded in the Child Health System. The Director of Health Protection wrote to all GPs requesting the same.

7.2.3 Measuring the impact of the response

Surveillance of MMR immunisation coverage in the areas affected by the outbreak was carried out using the National Community Child Health Database (NCCHD) and methods routinely used in the Public Health Wales COVER scheme (see Glossary). The COVER scheme has provided vaccine coverage statistics in Wales for more than 25 years, making it ideal for monitoring of long term trends.

In addition to assessing existing coverage of MMR in the outbreak area, it was important to monitor the number of vulnerable patients who were being vaccinated as part of the outbreak catch-up campaigns. As the NCCHD contains data limited to those under the age of 19 years and is refreshed on a quarterly basis, new surveillances were set up to provide timely uptake statistics including the wider population.

Reports on improvements in MMR vaccine coverage in the outbreak area, the wider Mid and West Wales area and other areas of Wales were prepared each Monday, Wednesday and Friday. These reports were distributed to the

measles SRT, with headline figures provided to the Welsh Government. They were used as the basis for pro-active press releases every Tuesday and Thursday. The latest data on numbers of vaccinations given and susceptible populations remaining, broken down by age-group and area, were released to the general public every Tuesday and Thursday on an internet web-page to coincide with the press releases.

Estimation of the susceptible population

Historical COVER data were evaluated to identify which age-groups were most likely to have missed out on scheduled MMR vaccination and to highlight gaps in coverage of MMR vaccine.

The most recent refresh of the NCCHD was used to calculate numbers of unvaccinated (0 doses) or under-vaccinated (only one dose) children and teenagers. During the course of the outbreak it became apparent that, although NCCHD immunisation data for those receiving their MMR vaccinations on time, recorded and returned on scheduled lists, were largely accurate, there were higher numbers of older children who had received opportunistic MMR vaccines which were not recorded on the NCCHD. This meant that estimates for vaccine coverage in older children calculated at the start of the outbreak were likely to have been underestimates. At the end of the outbreak a large data reconciliation exercise was conducted across Wales, with GPs and child health offices liaising to ensure accuracy of local data. Although participation in this data reconciliation was variable across Wales, there was a noticeable improvement in the quality of NCCHD data by July 2013.

Data from the NCCHD were also used to provide Health Boards with estimates of the percentages of children in each school who required one or more doses of MMR vaccine.

Monitoring of vaccinations given in primary care

In order to track progress in the GP delivered element of the catch-up campaign, specific read code based MMR searches were written and deployed using the Audit+ primary care data reporting tool, routinely used for GP surveillance by the Communicable Disease Surveillance Centre in Public Health Wales. Almost all General Practices in Wales have Audit+ software installed on their system and approximately 80% to 90% submit data automatically on a daily basis. The MMR searches identified total numbers of patients receiving the first or second dose of MMR on the preceding day, the preceding seven days and the preceding Monday to Sunday standard week, in each general practice. It reported figures broken down by single year age bands on a daily basis.

Totals for first doses of MMR vaccine given to all, apart from those aged one year, were calculated as a proxy for ‘non-routine first doses’. This included vaccinations given early to babies of less than one year of age. Totals for second doses of MMR given to all, apart from those aged three years were calculated as a proxy for ‘non-routine second doses’. Figures were reported

back to Health Boards and the SRT each Monday, Wednesday and Friday for non-routine MMR vaccinations given in the preceding seven days. An age group breakdown was also provided to identify whether the target age group was being reached.

Monitoring of vaccinations given in school immunisation sessions and drop-in clinics

As there was no routine surveillance mechanism in place to provide timely feedback of school immunisation session data, an internet based data submission form was set up. On a weekly basis Health Boards throughout Wales manually entered data to facilitate central monitoring of the progress in the school campaigns and the success of drop-in clinics. This data was then collated, analysed and reported back to the SRT and Health Boards each week. Headline figures were also used in proactive press releases and were made available to the public through the Public Health Wales internet site.

Closing the gap

It was not possible to use any one surveillance system to monitor progress in reducing the gap in population coverage of MMR on a real-time basis. This was due to timeliness of data entry on some systems and limits on the refresh frequency of the NCCHD. In order to provide timely feedback which could be used operationally for planning and also to inform the public, the remaining numbers of children in the target age-group requiring one or two MMR doses were estimated on a weekly basis, factoring uptake data from primary care, from school immunisation sessions and drop-in clinics. These estimates were reported back to the SRT and Health Boards weekly to enable them to monitor progress in closing the MMR coverage gap.

Surveillance results

Historic trends in MMR coverage from the annual COVER reports identified that the largest proportion of those susceptible to measles were likely to be those who had missed out on scheduled MMR vaccination during the height of the autism scare during the late 1990s and early 2000s (Figure 11).

Further examination of the most recent NCCHD immunisation data (November 2012 refresh) at the start of the outbreak, confirmed that it was older children and teenagers who were most at risk, and that the largest gaps in MMR coverage were seen in children resident in Swansea (Figure 12).

Using data from the NCCHD, it was estimated that, in November 2012, there were 77,957 children resident in Wales aged 2 to 18 years who were partially immunised or unimmunised, requiring one or two catch-up doses. Almost 20% of these children were resident in the ABMU Health Board area.

Of the highest risk target age-group of 10 to 18 year olds, there were an estimated 50,887 requiring one or two catch-up MMR doses: 9,187 (18%) of these children lived in the ABMU Health Board area.

Figure 11. Annual percentage uptake of the first dose of MMR in children aged two years, resident in the Abertawe Bro Morgannwg UHB area (dotted line represents all Wales uptake). Data source: Public Health Wales Annual COVER statistics.

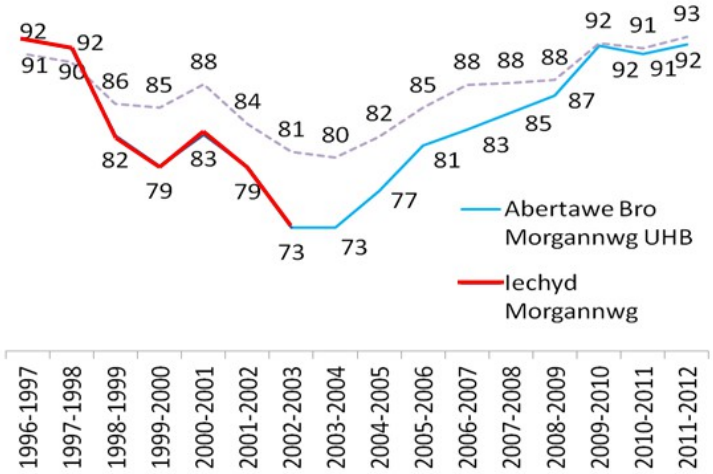
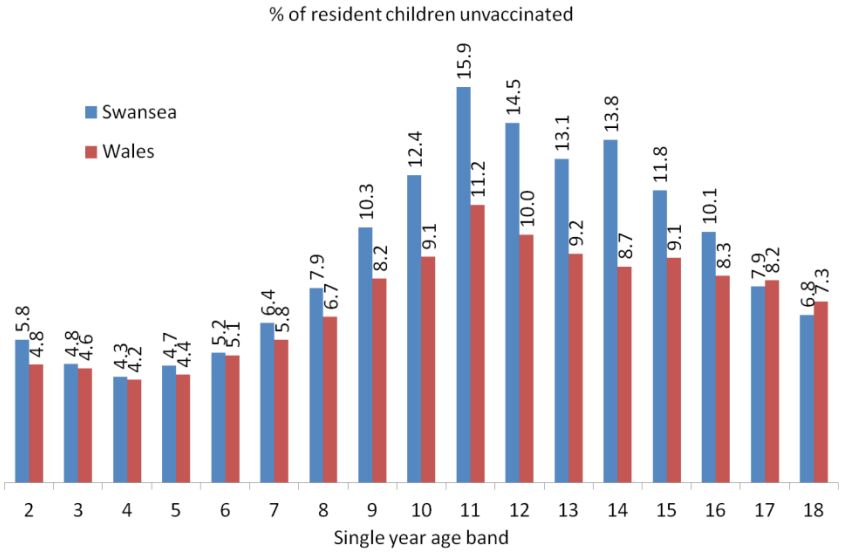


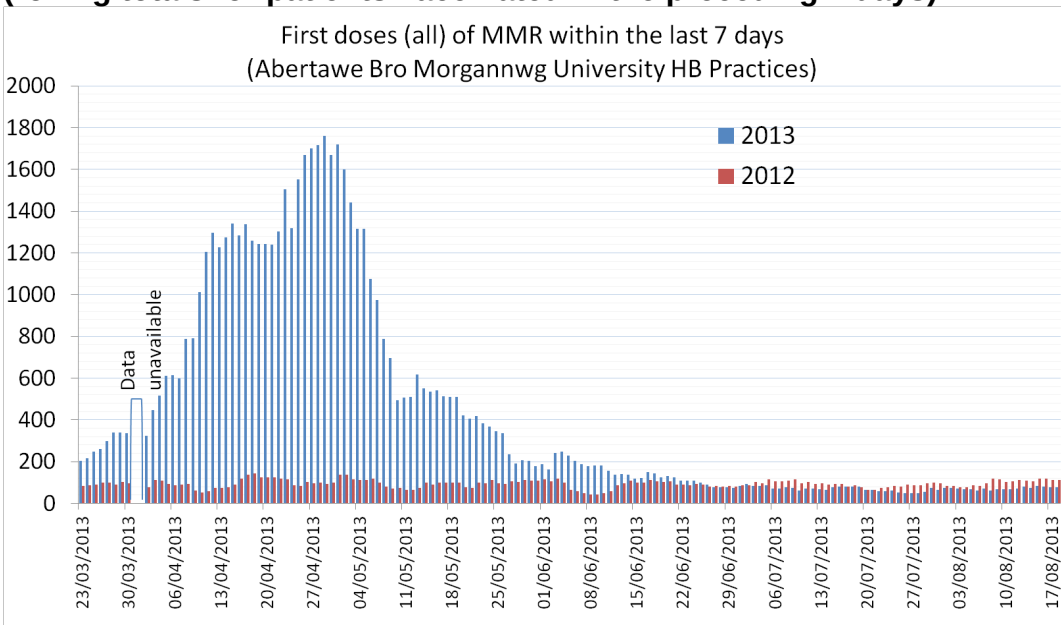
Figure 12. Percentages of children, by single year age band, who were resident in Swansea LA and had not received MMR (as at 1 November 2012), compared to all Wales figures. Data source: NCCHD November 2012 refresh.



Closing the MMR coverage gap through primary care

During the peak week (seven day period ending 29 April 2013) of the primary care catch up campaign in ABMU Health Board, 1,762 first MMR doses were given and 92% of these were non-routine (unscheduled) immunisations given to patients at ages other than one year. This compares to 94 first MMR doses given in the corresponding period during 2012 (Figure 13).

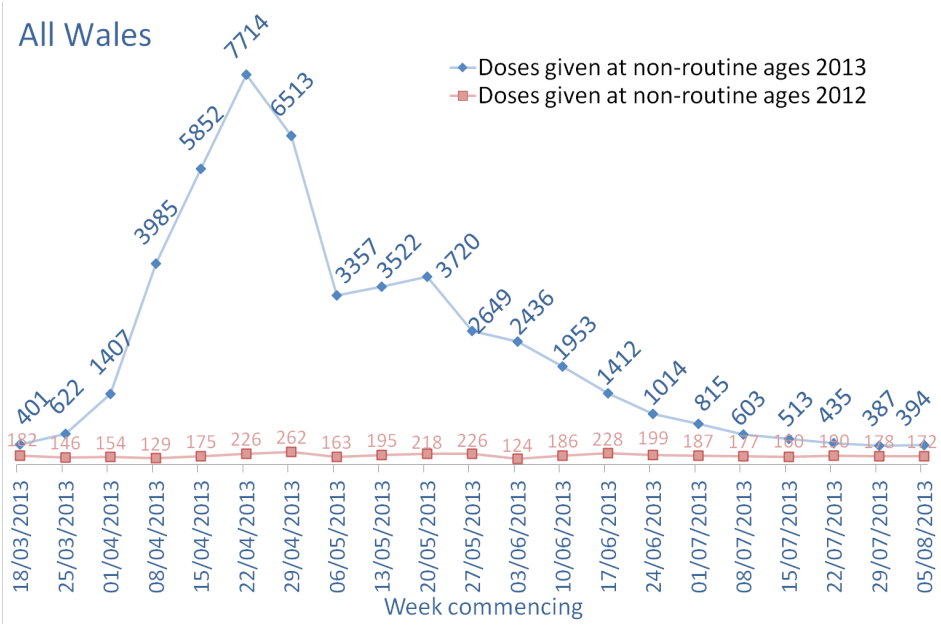
Figure 13. First doses of MMR vaccination given to patients by Abertawe Bro Morgannwg University Health Board GPs during 2012 and 2013 (rolling totals for patients vaccinated in the preceding 7 days).



During the peak week of the primary care catch-up campaign across all of Wales (seven day period ending 29 April 2013), the number of non-routine (unscheduled) first and second doses of MMR vaccine given was 7,714. This is more than 40 times higher than the number of non-routine doses delivered by GPs during the corresponding week in 2012 (Figure 14).

By 20 August 2013, Welsh GPs had delivered more than 47,988 catch-up MMR doses. Almost a quarter (23%) of these were given to children and teenagers aged 10 to 18 years. Of the total vaccinations given 37% were delivered in the ABMU Health Board area.

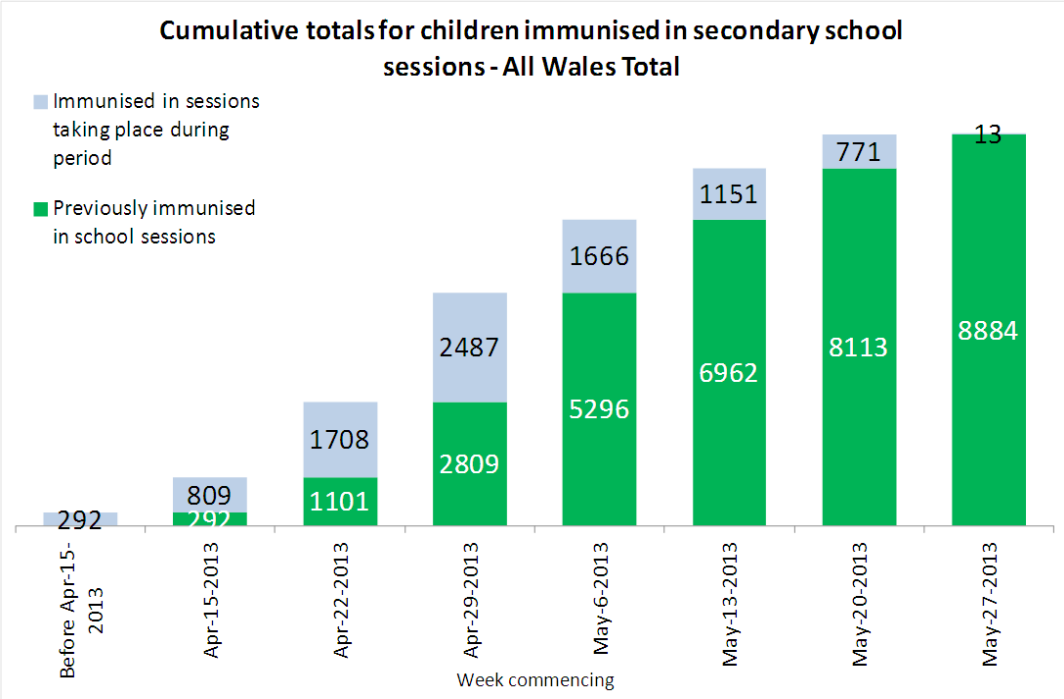
Figure 14. Weekly non-routine doses of MMR vaccination given to patients by GPs in Wales during 2012 and 2013.



Closing the MMR coverage gap through school immunisation sessions

In total, 9,644 children were immunised in school vaccination sessions, 1,749 of whom were pupils of schools in the ABMU Health Board area.

Figure 15. Summary of MMR immunisations (combined doses 1, 2 and unknown) given in secondary schools sessions – All Wales data.



Collating the surveillance data and measuring the effectiveness of interventions

Up to 20 August 2013, at least 77,805 catch-up doses of MMR had been delivered in response to the outbreak. The true total is likely to be higher than this as data was not received from every general practice in Wales.

Table 1. Breakdown of numbers of immunisations given (first and second doses combined), by health board and setting for all aged and the 10 to 18 year olds target population.

All ages					
	GP*	Drop in	School	Occupational Health	Total
Abertawe Bro Morgannwg UHB	17605	8674	1749	2600	30628
Aneurin Bevan HB	9966	2940	2094	472	15472
Betsi Cadwaladr UHB	3482	0	1344	1026	5852
Cardiff and Vale UHB	4799	214	1283	1108	7404
Cwm Taf HB	3585	0	1640	466	5691
Hywel Dda HB	5894	570	1204	386	8054
Powys Teaching HB	2657	29	330	59	3075
Wales	**47988**	**12427**	**9644**	**6117**	**76176**

10 to 18 year olds				
	GP*	Drop in	School	Total
Abertawe Bro Morgannwg UHB**	2954	1017	1749	5720
Aneurin Bevan HB***	2643	374	2094	5111
Betsi Cadwaladr UHB	972	0	869	1841
Cardiff and Vale UHB***	1524	24	1277	2825
Cwm Taf HB	1162	0	1374	2536
Hywel Dda HB***	1122	68	1204	2394
Powys Teaching HB	725	11	330	1066
Wales	**11102**	**1494**	**8897**	**21493**

Total given in prisons	**1629**
Grand total	**77805**

* Based on data submitted each week by approximately 90% of practices (does not include MMR given at routine ages)
** Drop-in clinic data for 10 - 17 year olds
*** Drop in clinic data estimated for 10 - 18 year olds based on 12% of total for all ages

8. Communications

Public Health Wales provided regular verbal updates to the Welsh Government and daily reports of notifications of measles and hospitalised cases.

8.1 Direct communication with parents

Since the start of the outbreak, ABMU Health Board proactively communicated with the parents of under vaccinated children. Initially this was by sending letters through schools encouraging all parents to check the immunisation status of their children and to get them vaccinated if needed. In addition to this, child health records were used to identify under vaccinated children so their parents were written to directly by the Health Board, again encouraging them to get their children vaccinated.

The communications team in the Health Board provided vital support to this process, with pro-active press/media coverage and publicity urging parents and young people who had not had MMR to get vaccinated. The team also used social media, particularly Facebook, to engage with parents and young people.

In support of the school vaccination programme the ABMU Health Board wrote to the parents of under vaccinated children with consent forms that were required for the child to get vaccinated in the school. This happened in two stages: initially from the end of 2012 at schools where measles transmission occurred and then, from April 2013, as part of the programme to provide sessions in every secondary school, special school and college. This was combined with an individual school text messaging system, alerting parents to the MMR sessions, with a URL link to the schools' own information web pages which had been developed on the ABMU website.

8.2 Communication with professionals

GPs in Mid and West Wales were informed about the outbreak from the outset. From 3 March 2013 a joint ABMU Health Board / Public Health Wales weekly update was sent to all GPs, other primary care providers, clinical partners, NHS Direct Wales (WAST) and local authorities within the ABMU Health Board area. The update contained information and advice from both agencies, vaccination advice, the number of cases reported during the previous week and the total number of those hospitalised to date.

8.3 Communication with the media

The media response was led by Public Health Wales but closely co-ordinated with Health Boards, local authorities and the Welsh Government. Public Health Wales issued press releases on 29 November 2012 and on 31 January 2013 to raise the profile of measles and to promote MMR vaccination. Since late February 2013, a further 32 press releases were issued. Published twice weekly these included updates on the number of cases and progress with vaccination.

Public Health Wales managed local, national and international media interest in the outbreak, responding to more than 460 enquires from reporters. A core team of spokespeople, in both English and Welsh, were briefed and more than 100 broadcast interviews were given.

In addition to the public health media work, ABMU Health Board responded to many enquiries daily, and managed the huge interest of media at the drop-in MMR clinics, where 30 sets of local, national and international TV, radio, press and photographers attended, and from which there were regular live broadcasts and interviews.

From the onset of the MMR drop-in clinics, the Health Board recognised the importance of encouraging attendance of press and media, so that the ensuing coverage would help to normalise vaccination behaviour for parents who were still unsure. Powerful images of children and young people receiving their MMR jabs were printed and broadcast locally, nationally and internationally. In addition, journalists had access to parents and young people for interviews. The media visits needed careful management to ensure families gave consent and confidentiality was not breached. However, the wide access given to press and media at the drop-in clinics was a major factor in keeping the issues at the top of the news agenda for some weeks, encouraging further take up.

The Health Board also issued 19 press releases to promote community and school vaccination clinics. Several of the press releases were 'human interest' ones which highlighted the stories of people who had been left with long term damage as a result of measles, and who urged uptake of the MMR jab.
Media interviews with the ABMU Director of Public Health and local GPs and other clinical staff were also managed by the Health Board. Other Health Boards were also proactive with the media.
Media coverage reached an audience of many millions of people nationally and globally with coverage concentrated in Wales and in Swansea in particular.

8.4 Web

The Public Health Wales website was updated on a regular basis and the measles content promoted via the web links www.publichealthwales.org/measles and www.iechydcyhoedduscymru.org/y-frech-goch. Links across other NHS, local government and relevant websites were made. The total number of page views of all web pages specific to the measles outbreak was 80,489. This accounted for 31% of the total number of page views for the whole Public Health Wales site during this time period (from 28 February 2013 to 3 July 2013 when the outbreak (and public/media interest) was at its height).

In order to support the schools vaccination programme, ABMU Health Board also created individual web pages for 41 schools and colleges containing tailored information and supporting statements from the respective Head

teacher. Information on how to access the sites was included in the consent letters sent to parents and via school texting systems. These pages were visited nearly 9,000 times during April and May 2013. A general MMR/measles information webpage was also set up on the ABMU Health Board website, which received nearly 16,000 visits.

8.5 Social media

The social media focus was led by ABMU Health Board where the audience was more targeted to the outbreak. ABMU Health Board actively used social media to encourage MMR vaccination and provide clear and consistent advice to the public. Over a three month period, 109 measles related posts on the Health Board's two Facebook pages reached over 540,000 users in total, and generated over 1,000 comments and queries, which the Health Board responded to in 'real time' as much as possible and well into the late evening if necessary.

A single ABMU Facebook post reached nearly 133,000 views, and gave details of the first MMR drop-in sessions and was the first indication of how busy the clinics would be. Paid-for targeted posts were also used. One, aimed specifically at 13 to 18 year olds, targeted a geographical area at the centre of the outbreak and directly reached over 13,000 teenagers. The Health Board also sent out 85 tweets on Twitter and answered questions on newspaper online websites on stories linked to measles/MMR.

The Public Health Wales Twitter and Facebook pages were updated on a near daily basis from mid March 2013. The number of Twitter followers and Facebook 'likes' increased substantially as a result of the outbreak. Both sites have been used by the public to make points and ask questions and the communication team were active in responding. The sharing of public health content by others meant that Facebook reached up to 10,000 people at a time and Twitter up to 20,000 at a time.

8.6 Events

Public Health Wales liaised with organisers of events to ensure that public health advice was given to people organising and attending events.

8.7 Visual communication

Centrally designed posters and leaflets were distributed across Wales. Infographics were designed for use on the web and in social media.

8.8 Partners

The communication teams of Public Health Wales and the Health Boards worked with organisations in the private, public and voluntary sectors to promote MMR uptake. These included community groups, football and rugby clubs and youth clubs.

9. Discussion and lessons learnt

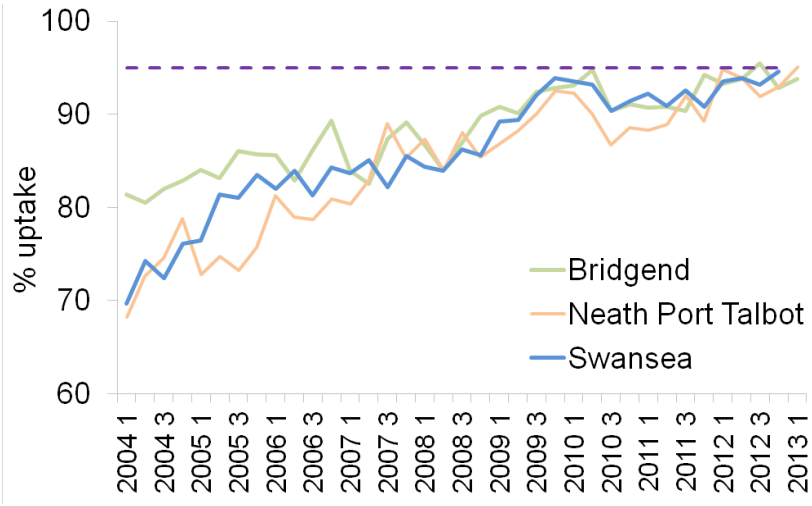
Measles is a notifiable disease in the UK (Health Protection (Notification) Regulations 2010, Schedule 1). Any doctor who suspects that a patient has measles is required by law to report it.

The target uptake for MMR is to immunise 95% of all children with two doses of MMR. MMR is routinely scheduled at 12-13 months and 3 years 4 months of age. This target level of uptake is sufficient to interrupt the transmission of measles virus when it is introduced into a community, ensuring the disease cannot spread and protecting those unable to be vaccinated because they are too young or have a weakened immune system, so called 'herd immunity'. Measles transmission in Wales and the UK was interrupted for several years in the mid 1990s due to high levels of uptake of MMR vaccine. The WHO European Region has set a goal to eliminate measles transmission in the region by 2015.

However, due to falling uptake, measles re-established as an endemic disease in the UK. In the late 1990s, in response to extensive media coverage of a paper published in The Lancet in 1998 and the claims of a few researchers that MMR, autism and bowel disease were linked, uptake of MMR vaccine fell in the UK. Between 1997 and 2002, national annual uptake of one dose of MMR in two year olds fell 11% (from 91% to 80%). In the Abertawe Bro Morgannwg University Health Board area the decrease was 19% (from 92% to 73%). This was even lower in those areas for local reasons most affected by the controversy, such as Swansea and Neath Port Talbot. The Lancet paper has since been formally withdrawn, and the research thoroughly discredited. Independent research overwhelmingly supports the safety of MMR.

Although the decline in MMR uptake, during the late 1990s and early 2000s in Wales, was most pronounced in Swansea and the wider ABMU Health Board area (Figure 11), the subsequent recovery in routine uptake of MMR in children by their second birthday has been notable (Figure 17).

Figure 17. Quarterly trends in the uptake of MMR vaccine in children reaching two years of age (data from Public Health Wales Quarterly COVER reports 2004 – 2013).



Despite the recovery in uptake of MMR routine vaccination at appropriate ages, a large number of children accumulated who had missed out on MMR vaccination at routine ages. The National Public Health Service for Wales (2005 – 2009) and subsequently Public Health Wales have published frequent warnings regarding the accumulation of children susceptible to Measles, Mumps and Rubella, through the quarterly COVER reports since the decline in MMR uptake.

(Appendix 4 outlines all the action undertaken in Wales to address the poor uptake of MMR in older children).

Based on information from the NCCHD, (correct as at February 2013), Public Health Wales estimated that in November 2012 there were 41,129 children in Wales from 2 to 18 years of age who had not received any MMR vaccination) and a further 35,926 from 4 to 18 years of age who had only received an incomplete course of MMR vaccination. Further analysis by single year age band revealed that the highest proportion of children who were at risk were approximately 10 to 18 years of age. There were 50,887 children and teenagers aged 10 to 18 years in Wales who had not received a full course of MMR as at November 2012 and of these. Of these 26,611 had not received any doses of MMR.

An outbreak was inevitable when measles, one of the most contagious of infections, was introduced to such a large susceptible population.

Diagnosing measles clinically is problematic when measles is not circulating widely in the community. The diagnostic test used at the beginning of this outbreak (salivary samples sent by post to the WHO measles reference laboratory in London) incurs a two week delay before a case of measles is confirmed. (A PCR test was not available at the beginning of the outbreak.) Although close family contacts are identified and MMR vaccine offered if appropriate when a single case is notified, wider public health action is only commenced when a case is confirmed. This involves providing MMR vaccine to those susceptible contacts that are not close family contacts. With a two week delay spread will have inevitably occurred in this wider group.

Curtailing spread further requires vaccination of susceptible individuals as quickly as possible. However, the response to the initial call for children to be vaccinated either in school settings/or in primary care was poor from both parents and services. Resources to provide vaccination sessions in schools were scarce and there was delay of one to two weeks between identification of school children at risk from circulating measles and delivering the vaccination session. The uptake of MMR by those requiring it was 30% in the schools where it was offered.

The SRT met for the first time on the 18 February 2013 following discussion between the Director of Public Health Services, the Director of Health Protection and the Consultant in Communicable Disease Control for ABMU Health Board Area. Usually the SRT is a mechanism internal to Public Health Wales for ensuring that senior members of the organisation lead and co-ordinate the organisations own response to a public health emergency and that it is adequately resourced to do so. However, in this outbreak it took on a wider remit. In addition to advising Health Boards on public health action required to halt the outbreak, it mentored and monitored: supporting Health Boards by reviewing local implementation plans for school based MMR catch up campaign, co-ordinating action between Health Boards, facilitating the exchange of learning and experience and measuring impact.

The SRT considered whether or not susceptible children from schools where measles was circulating should be excluded for the incubation period of measles (up to 21 days). This policy was not adopted as at this stage as measles was circulating in over 100 child settings and it could only be effective if followed by vaccination of all those susceptible. If this policy had been adopted when the first cases were identified it may have proven effective and as Wales moves towards eliminating measles worth further debate.

As anticipated, the numbers of measles notifications began to rise in early March 2013 above the 20 (approximately) reported weekly from November 2012 to February 2013. This was despite a very proactive local and national media campaign encouraging parents to take incompletely immunised children to their general practice for MMR. Across Wales, notifications of measles were reported which had epidemiological links to the outbreak area. Numbers attending primary care for vaccination had increased only slightly above figures for the same period in 2012 and it was evident that a more active approach was required.

The SRT agreed that dialogue and engagement was required at the highest level if resources to control the outbreak were to be made available against competing priorities. The Chief Executive, Public Health Wales wrote, on 27 March 2013, to Chief Executives, Directors of Public Health and Medical Directors at all Health Boards outlining the interventions that were necessary to halt the measles outbreak and further spread across Wales.

This direction to Health Boards was followed by a letter from the Chief Medical Officer for Wales, (CMO) requesting all Health Boards to undertake a school based immunisation programme.

Services responded, resources were made available across Wales to deliver the school-based catch-up campaign, which was co-ordinated by the SRT led by Public Health Wales. Almost 9000 children were vaccinated in schools by 24 May 2013.

Primary care proactively encouraged parents to take incompletely immunised children to their local GP surgeries, the numbers attending rose dramatically with 7714 non-routine doses of MMR administered by GPs in the week ending 15 April 2013.

The response from the media was very positive and meant that measles was frequently leading the news. This provided health professionals with the opportunity to reiterate the message that MMR is safe and effective and measles a serious illness. The Saturday drop-in sessions held in the outbreak area were also effective in both the numbers vaccinated and in portraying through the media a very positive message of parents and young people actively seeking the vaccination.

Audience research undertaken by Public Health Wales during the outbreak showed that parents and young people had few concerns about the safety of the vaccine. The surveys found that an extremely small proportion of these parents whose child's records were incomplete for MMR, 20 of 320 questioned, reported continuing safety concerns about the MMR vaccine as a reason for not consenting to immunisation. It would be reasonable to conclude based on these surveys that residual concerns about the safety of MMR vaccine in Wales have been allayed for the vast majority of parents. Parents' views of MMR now reflect the overwhelming scientific evidence and expert opinion that MMR is a safe and effective vaccine that saves lives. Further work is required to truly understand why over 30,000 of those aged ten to 18 still remain at risk of Measles Mumps and Rubella.

The combined efforts of primary care, Health Boards, local authorities and public health were effective in halting the outbreak which was declared over on 3 July 2013. The effectiveness of efforts was demonstrated by Professor Keeling, at the University of Warwick Mathematics Department, who modelled the impact of interventions used in the measles outbreak at the request of Public Health Wales.

Provisional output enabled Public Health Wales to suggest that the immunisation effort from late March 2013 had brought the peak of the outbreak forward from late June 2013 with a peak of approximately 200 new cases weekly, to early April 2013, with a peak in the greater Swansea area of about 120 cases per week. The study therefore suggested that the public health response by the NHS in Wales had effectively reduced the outbreak by a factor of 20 and in duration by 10 weeks. To consolidate these

improvements the efforts must be maintained until no further susceptible individuals remain.

Wales now has the highest uptake of MMR ever reported with 95.9% of two year olds vaccinated with first dose and 92.8% for two doses at five years of age. However, there are 30,000 school children in Wales today who are either not vaccinated or only partially vaccinated with MMR and another outbreak could occur if this pool of susceptible is not reduced considerably.

9.1 Response of the Health and Social Care Committee, National Assembly for Wales

On 10 July 2013 the Health and Social Care Committee conducted a short inquiry into the measles outbreak to examine:

- The factors that led to the outbreak;
- The actions taken by public health professionals, in partnership with other agencies, in response to the outbreak;
- The lessons that could be learned in order to prevent future outbreaks.

The committee commented that effective and decisive action was taken by all relevant partners once the 2013 outbreak had been confirmed and commended efforts to encourage partnership working across organisations and jurisdictions. However, having reviewed the evidence and considered the responses of all those who gave oral evidence, in addition to written evidence submitted, the committee identified a series of key issues for further consideration or monitoring. The key issues identified are:

1. Awareness of the need to receive MMR
2. Increasing opportunities to receive the MMR vaccine
3. Uptake of the MMR vaccination among frontline health staff
4. Staff training
5. Data sharing and IT systems
6. Communication

The multiagency response team which has prepared this report has considered the above before making its recommendations.

10. Conclusions and Recommendations

10.1 Conclusions

Between November 2012 and July 2013 Wales experienced its largest ever measles outbreak since the introduction of the MMR vaccine. In Mid and West Wales there were 1,202 measles notifications, 88 hospitalisations and one death. It can no longer be accepted that measles is an endemic infection in Wales. Agencies and the public must strive to eliminate it.

The multiagency response was effective in controlling the outbreak as evidenced by mathematical modelling. During the outbreak period 77,805 vaccines were administered, 21,493 of these to those aged between 10 to 18 years.

The discredited research that was published in 1998 had a negative impact on MMR immunisation in Wales and this impact was greater in the outbreak area than elsewhere. However, research conducted during the outbreak indicates that the vast majority of parents are no longer concerned about the safety of the MMR vaccine.

The outbreak has demonstrated that two doses of MMR are over 99% effective in protecting against measles and one dose of MMR is over 97% effective.

This outbreak has demonstrated the strength of timely diagnostics and the value of real time surveillance at both a national level for strategic planning and a local level for service delivery.

This outbreak has also demonstrated the importance of the media in raising awareness of the risks of measles and the safety of the MMR vaccine.

The local response benefited from practical local authority support for the school campaign. For example, local authorities assisted with the production and distribution of the letters to parents and head teachers prompted parents to return their consent forms.

The response delivered across Wales demonstrates that the emergency plans for mass vaccination can be translated into reality using existing plans and structures.

10.2 Recommendations

All Agencies – Welsh Government, Health Boards, Trusts, Local Authorities and Public Health Wales

1. All public agencies in Wales should strongly support the elimination of measles, including through a policy of aggressive control of measles cases imported into or transmitted within Wales. The following measures should be implemented for routine use in dealing with cases of probable or confirmed measles in Wales.
    - The exclusion of unimmunised close contacts of probable cases of measles from school, child care and other child centred social settings until the infectious period is over. Where necessary this should be backed by a formal request to co-operate under public health law if necessary.
    - The implementation of prompt school based immunisation sessions is recommended within two working days in all schools where vaccination rates are low and a single case of measles has occurred. It is recommended that such sessions should take place within two working days of notification of probable case.
1. An all Wales protocol for the sourcing and clinical administration of immunoglobulin to vulnerable close contacts of measles cases should be developed and implemented, led by Public Health Wales. All relevant health agencies should participate in this work.
2. In outbreaks where interventions are targeted at teenagers, assertive efforts should be made to target this age group directly, maximising opportunities afforded by social media and other channels of communication. However, targeted communication should be backed up by easy access to MMR jabs; likely to involve outreach clinics where young people congregate.
3. The Communicable Disease Outbreak Plan for Wales should continue to be used as the model for outbreak control in Wales. The following two additions to the plan are recommended:
    - The Outbreak Control Team (OCT) should alert hospital pharmacists urgently about any outbreaks where mass immunisation sessions are a possibility. In some cases it might be advisable to co-opt hospital pharmacy representation onto the OCT.
    - In future outbreaks in Wales involving viruses, the OCT should ensure that the Public Health Wales Virology service is promptly and formally briefed even if the outbreak is being supported directly by local microbiology services.

10.2.1 Health Boards

4. As a priority, Health Boards should continue to develop and implement plans to improve MMR coverage rates in children and young adults. This planning should include looking at novel settings (such as sexual health clinics) for delivering MMR to older teenagers/young adults.
5. Health Boards should take action to ensure that all health care workers are protected against Measles, Mumps and Rubella as specified in Immunisation against Infectious Disease (the "Green Book"). As part of this work robust occupational health systems should be developed and implemented to systematically check and update health care worker vaccination status.

Article I. Health Boards should ensure that the guidelines within the **Child Health Immunisation Process Standards** (CHIPS) are met and maintained. This includes data-sharing guidelines for maintaining accurate records on children who are living in, but treated outside, the Health Board area (and vice-versa).

6. Health Boards should ensure that Child Health System output includes uptake by school at agreed intervals, for example at the start of each academic year.

7. Health Boards should work with the NHS Wales Informatics Services to support electronic linkage of GP vaccination records to the Child Health System and to allow GPs and Public Health Wales health protection team's access to Child Health Records.

10.2.2 Welsh Government

8. The Welsh Government should commission a review looking at the issue of teenagers not being immunised with MMR and support a Wales-wide campaign targeting this group. The review should:
   - Summarise the current evidence base around the issue
   - Include a critical appraisal of interventions tried to increase uptake
   - Identify what further research is needed
   - Make recommendations for future action to be incorporated into Health Board action plans.

10.2.3 NHS Wales Informatics Service (NWIS)

9. NWIS should prioritise current work to link up electronic data systems to support the Child Health System. The following actions are specifically recommended:
   - Electronic linkage to the Child Health System of records of vaccines given by GPs.

- Providing GP practices and Public Health Wales health protection teams with read-only access to child health records held by the Health Boards.

10.2.4 Local Authorities

10. Local authorities should make school roll lists available to their local Health Boards in an electronic format in June each year to allow rapid and efficient updating of child health system records on immunisation before the new academic year.
11. Local authorities should encourage schools to discuss with parents the immunisation status of their child and encourage MMR immunisation if unimmunised prior to starting school.

10.2.5 Public Health Wales

Article II. Public Health Wales should set up a working group to consider future strategy and protocols for measles case management in Wales. This group should specifically consider:

Article III. A measles diagnostic strategy for Wales

- Appropriate public health actions to control and eliminate measles

Article IV. Public Health Wales should review its process for developing databases in outbreaks and develop a generic template for recording case information in outbreaks.

12. Public Health Wales should work with other healthcare organisations to raise awareness that routine screening for immunity before immunisation with MMR is not required.

11. Appendices

11.1 Appendix 1– ABMU Outbreak Control Team Membership

CHAIR: Dr Jörg Hoffman, (Public Health Wales)
Andrea Evens (ABMU)
Brendan Mason, (Public Health Wales)
Denise Western (Public Health Wales)
Giuseppe Pichierri (Public Health Wales)
Heather Lewis (Public Health Wales)
Jo Black (Public Health Wales)
June Wheel (ABMU)
Liz Jones (ABMU)
Mac Walapu (Public Health Wales)
Polly Leett (Hywel Dda)
Sara Hayes (ABMU)
Sion Lingard (Public Health Wales)
Sue Morgan (Public Health Wales)
Teresa Owen (Hywel Dda Health Board)
Vicky Bailey (ABMU)

11.2 Appendix 2– SRT Membership

CHAIR: Quentin Sandifer (Public Health Wales)
Andrea Evans (ABM ULHB);
Andrew Jones (BCUHB);
Anna Humphries (Public Health Wales)
Anne Hinchliffe (Public Health Wales)
Anne McGowan (Public Health Wales)
Anne Thomas (Public Health Wales);
Ann-Marie Pearce (Cardiff and Vale UHB)
Ashley Gould (Public Health Wales);
Bethan Owen (BCUHB - Public Health)
Beverley Gregory (Public Health Wales)
Brendan Mason (Public Health Wales)
Catherine Moore (Public Health Wales)
Catherine Woodward (Powys Teaching Health Board)
Chris Lines (Public Health Wales)
Chris Whiteside (Public Health Wales)
Derian Roberts (Public Health Wales;
Elaine Gilbert (Powys Teaching Health Board)
Gail Roberts (Public Health Wales)
Gill Richardson (Public Health Wales)
Heather Lewis (Public Health Wales);
Jane G. Davies (Powys Teaching Health Board)
Janet Barlow (Cwm Taf HB)
Jenny Sanders (ABM ULHB)
Jo Black (Public Health Wales)
Jorg Hoffmann (Public Health Wales)
Judith Tomlinson (Public Health Wales)
Judy Hart (Public Health Wales)
June Wheel (ABM ULHB)
Karen Fitzgerald (Public Health Wales)
Karen Jones (ABM ULHB - Planning Directorate)
Lee Morgan (ABM ULHB - Information)
Lika Nehaul (Public Health Wales)
Lindsey Baber (Public Health Wales)
Lisa Verallo (Public Health Wales)
Lyn Harris (Public Health Wales)
Lyn Westacott (ABM ULHB)
Mac Walapu (Public Health Wales)
Marion Lyons (Public Health Wales)
Mark Dickinson (Public Health Wales)
Meirion Evans (Public Health Wales)
Mererid Bowley (Public Health Wales)
Michele Lewis-Marden (Public Health Wales)
Nicola John (Cwm Taf LHB - Director of Public Health)
Nicola Miller (Public Health Wales)
Nina Williams (Public Health Wales)
Rachel Jones (Public Health Wales - Microbiology)

Rhiannon Beaumont-Wood (Public Health Wales)
Richard Roberts (Public Health Wales - Health Protection)
Roland Salmon (Public Health Wales - Health Protection)
Sally Pearson (Public Health Wales)
Samantha Matthews (Aneurin Bevan Health Board - Excecutive Directors)
Sara Hayes (ABM ULHB)
Sharon Hopkins (Cardiff and Vale UHB)
Simon Cottrell (Public Health Wales)
Sion Lingard (Public Health Wales)
Sumina Azam; (Powys Health Board)
Susan Anne Jones (ABM ULHB - Primary Care)
Susan Belfourd (Public Health Wales)
Teresa Owen (Hywel Dda Health Board)
Tom Porter (Public Health Wales)
Nathan Jones (Public Health Wales)
Siobhan Jones (Public Health Wales)

11.3 Appendix 3– Powys Outbreak Control Team Membership

CHAIR: Dr Mac Walapu (Public Health Wales)
Andrea Normington, (West Midland North Protection, England)
Bernette Venables, (Lead School Nurse)
Beverley Gregory, (Public Health Wales)

Carole Stanley (Powys Teaching Health Board)

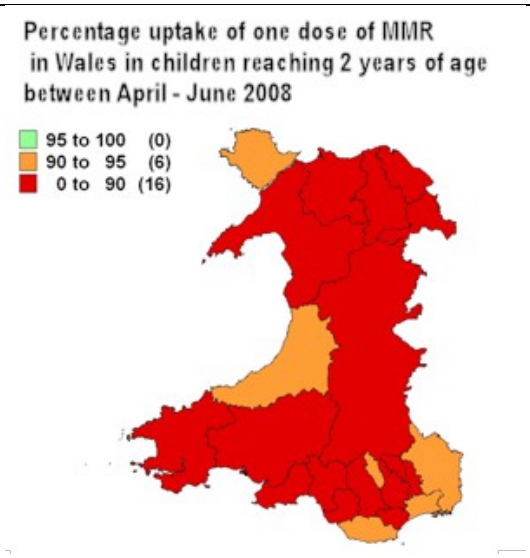
Chris Roberts (Practice Manager, Llanfair Caereinion)
Chris Roberts (Practice Manager, Llanfair Caereinion)
Denise Western, (Public Health Wales) (minute taker)
Jane Davies (Powys Teaching Health Board)
Jane Price (Powys Teaching Health Board)
Jayne Ingram-Jones, (Powys PHT) (Note taker)
Kate Heneghan (Public Health Wales)
Margot Jones, (Practice Manager, Llanidloes)
Musarrat Afza, (West Midland North Protection, England)
Moira Bell, (Public Health Wales)
Ruth Marks-Twelvetrees, (Head of Children's PH Nursing)
Sue Morgan, (Public Health Wales)
Sumina Azam (Public Health Wales – Powys)
Susan Lewis, (Practice Manager, Llanfyllin)
Tin Wheeler, (Communications Officer, Powys Health Board)
Tina James, Health Visitor, Machynlleth

11.4 Appendix 4 - Actions Supporting MMR Vaccine Uptake in Children in Wales

Date	Action
1968	**Single measles vaccine introduced.**
1988	**Measles mumps rubella (MMR) vaccine introduced for infants around 13 months of age.**
1994	**MR (measles and rubella) campaign**
1996	**Second dose of MMR added for pre-school children.**
Mid 1990's	**Transmission of measles in the UK had been interrupted, with very low levels of cases.**
Late 1990's	**In response to extensive media coverage of a paper published in the Lancet in 1998 and the claims of a few researchers that MMR, autism and bowel disease were linked, uptake of MMR vaccine fell in the UK.** Between 1997 and 2002, national annual uptake of one dose of MMR in two year olds fell 11% (from 91% to 80%). In the Abertawe Bro Morgannwg University Health Board area the decrease was 19% (from 92% to 73%). **Even lower in those areas for local reasons most affected by the controversy, such as Swansea and Neath Port Talbot. (The Lancet paper has since been formally withdrawn, and the research thoroughly discredited, with independent research overwhelmingly supporting the safety of MMR.)**
1999	The 'MMR Mythbuster' was developed by a group of health protection professionals who later formed the core of the Vaccine Preventable Disease Programme (VPDP). This was designed for use by primary care professionals with parents The VPDP was an informal professional grouping before 2003. In 2003 the NPHS was formed, and the VPDP became a formal national programme, funded by WG from 2005 on.
2000	**The 'MMR Mythbuster' was published and distributed to all practices in Wales by the Welsh Assembly Government**
	The National Public Health Service was formed and began to informally

2003	**coordinate national efforts to improve vaccination uptake by supporting the Welsh Assembly Government, Local Health Boards and practitioners**	
2004	**The Welsh Assembly Government convened an MMR Task Group, to examine and report on all modifiable factors which may lead to improved control of measles, mumps and rubella in Wales.**	
2005	January: The MMR Task Group report identified the steps necessary to prevent illness and its consequences, making recommendations for action. As a result of the recommendations of the report, the Welsh Assembly Government issued policy WHC(2005)081. It required Local Health Boards to participate in a coordinated national MMR catch up campaign for those 11-25 years of age, with the immediate purpose of bringing a national outbreak of mumps under control, but the longer term goal of eliminating measles and rubella. The Assembly Government supported the campaign through provision of vaccine, advertising and promotional materials, and the VPDP supported local implementation.	
October 2005 to May 2006	MMR catch up campaign was undertaken in secondary schools, colleges, and universities in Wales. Those not in education were offered MMR through their local Practice. A total of 126,657 secondary school pupils in 293 schools were identified who had missed either one or both doses of MMR. Of these 53,708 received one or more doses of MMR, an uptake in the target group of 42.4%. Uptake by LHB in the target group in secondary schools ranged from 21.5% to 75.0%. In addition a total of 7,112 students in colleges and universities were also given MMR. Overall, during the campaign a total of 60,820 children and students were immunised with one or more doses of MMR.	
2006 onwards	The identification of children who had missed MMR and the offer of vaccination became a routine activity. MMR status checks were made at entry to primary and secondary school, and when the teenage booster vaccine was offered at 13-15 years of age.	
2000-2007	Only 78 confirmed cases of measles in Wales. **In 2006 a quarter of children entered primary school without a full course of MMR, and 1 in 8 had received no MMR at all. It was estimated that there**	

	were over 35,000 children in primary school in Wales who had not had MMR vaccine.

2006-2008	The NPHS supported vigorous use of government targets, national publications, awareness raising, supporting materials, local initiatives, audit and surveillance information management action to improve MMR uptake. **By 2008, uptake of two doses of MMR by 5 years of age was higher than ever before. However, 1 in 10 school pupils in Wales under 14 years of age were still vulnerable to measles, mumps and rubella infection because they had missed one or both doses of MMR.**	
2008	**The Welsh Assembly Government reminded the NHS of the importance of implementing occupation health recommendations on MMR and the control of measles in health care settings [CEM/CMO/2008/07].**	
June 2008	**Audit of implementation of recommendations to improve MMR uptake was carried out by the NPHS.**	
July 2008	The Health Protection Agency (HPA) announced that endemic circulation of the D4 measles strain in the UK had been re-established following a 14 year period during which sustained person to person transmission of measles had been successfully interrupted due to high levels of immunisation. Measles incidence remained lower in Wales than in England. That may have been due to a number of factors: 1. Routine MMR uptake in Wales has been higher for a number of years; 2. The successful Wales MMR catch-up campaign in 2005 would have reduced the number of susceptible individuals in the older cohorts; the policy of routine follow up of defaulters and at primary and secondary school entry introduced in 2005 should have minimised the accumulation of younger susceptible cohorts in those settings	
August 2008	**A briefing paper on 'Control of measles in Wales' was written by the NPHS for the Welsh Assembly Government, describing measles uptake rates by school year, and assessing the threat from measles. It made a number of recommendations**	
2009	GIG CYMRU NHS WALES **ment wrote to health boards individually to WHC(2005)081.**	
2009		

2010 Onwards	**The Public Health Wales VPDP has held routine monthly teleconferences with health board Immunisation Coordinators, with vaccine uptake a standing item on the agenda.**	
2010 Onwards	**The Public Health Wales VPDP developed and maintained a large number of resources to support action to improve MMR uptake**	
2013	**Uptake of immunisation by school has been published to support new work to improve uptake in Wales in response to the measles outbreak in the Swansea area**	