COMMUNITY DEVELOPMENT GROUP
AGENDA

Wednesday, 30th October 2019 at 7:15pm

Council Chamber, Braintree District Council, Causeway House, Bocking End, Braintree, CM7 9HB

THIS MEETING IS OPEN TO THE PUBLIC
(Please note this meeting will be audio recorded)
www.braintree.gov.uk

Members of the Community Development Group are requested to attend this meeting to transact the business set out in the Agenda.

Councillor Mrs C Dervish
Councillor Mrs D Garrod (Chairman)
Councillor A Hensman (Vice Chairman)
Councillor Mrs I Parker
Councillor Mrs J Pell
Councillor Mrs L Walters
Councillor Miss M Weeks
Councillor Mrs S Wilson
Councillor B Wright

Members unable to attend the meeting are requested to forward their apologies for absence to the Governance and Members Team on 01376 552525 or email governance@braintree.gov.uk by 3pm on the day of the meeting.

A WRIGHT
Chief Executive

INFORMATION FOR MEMBERS - DECLARATIONS OF INTERESTS

Declarations of Disclosable Pecuniary Interest, Other Pecuniary Interest or Non-Pecuniary Interest

Any member with a Disclosable Pecuniary Interest, other Pecuniary Interest or Non-Pecuniary Interest must declare the nature of their interest in accordance with the Code of Conduct. Members must not participate in any discussion of the matter in which they have declared a Disclosable Pecuniary Interest or other Pecuniary Interest or participate in any vote, or further vote, taken on the matter at the meeting. In addition, the Member must withdraw from the chamber where the meeting considering the business is being held unless the Member has received a dispensation from the Monitoring Officer.

Question Time
The Agenda allows for a period of up to 30 minutes when members of the public can speak. Members of the public wishing to speak are requested to register by contacting the Governance and Members Team on 01376 552525 or email governance@braintree.gov.uk by midday on the working day before the day of the Committee meeting. For example, if the Committee Meeting is due to be held on a Tuesday, the registration deadline is midday on Monday, (where there is a bank holiday Monday you will need to register by midday on the previous Friday).

The Council reserves the right to decline any requests to register to speak if they are received after this time. Members of the public can remain to observe the public session of the meeting.

Please note that there is public Wi-Fi in the Council Chamber, users are required to register in order to access this. There is limited availability of printed agendas.

Health and Safety
Any persons attending meetings in the Council offices are requested to take a few moments to familiarise themselves with the nearest available fire exit, indicated by the fire evacuation signs. In the event of an alarm you must evacuate the building immediately and follow all instructions provided by officers. You will be assisted to the nearest designated assembly point until it is safe to return to the building.

Mobile Phones
Please ensure that your mobile phone is switched to silent during the meeting in order to prevent disturbances.

Webcast and Audio Recording
Please note that this meeting will be audio recorded only.

Documents
Agendas, reports and minutes for all the Council's public meetings can be accessed via www.braintree.gov.uk

We welcome comments from members of the public to make our services as efficient and effective as possible. If you have any suggestions regarding the meeting you have attended, you can send these via governance@braintree.gov.uk

PUBLIC SESSION **Page**

1 Apologies for Absence

2 Member Declarations

1. To declare the existence and nature of any interests relating to items on the agenda having regard to the Code of Conduct for Members and having taken appropriate advice (where necessary) before the meeting.
2. To declare the existence and nature of any instruction given by or on behalf of a political group to any Councillor who is a member of that group as to how that Councillor shall speak or vote on any matter before the Committee or the application or threat to apply any sanction by the group in respect of that Councillor should he/she speak or vote on any particular matter.

3 Public Question Time

(See paragraph above)

4 Future Work Programme **5 - 7**

5 Scrutiny Review into Community Woodlands - 30th October 2019

Members to receive a presentation from Shaun Taylor, Team Supervisor in Landscape Services.

6 Scrutiny Review into Vaccinations - 30th October 2019 **8 - 158**

(Full report and appendices)

COMMUNITY DEVELOPMENT GROUP
30th October 2019

Future Work Programme	**Agenda No: 4**

Portfolio	**Overall Corporate Strategy and Direction**
Corporate Outcome:	**A high performing organisation that delivers excellent and value for money services**
Report presented by:	**Jessica Mann, Governance and Members Officer**
Report prepared by:	**Jessica Mann, Governance and Members Officer**

Background Papers:	**Public Report**
None.	**Key Decision: No**

Executive Summary:

This is a summary report intended to inform Members of the Community Development Group on the likely Work Programme for this Committee; this follows conversations with the Chairman of the Committee, as well as discussions with the Chairmen of the other Scrutiny Groups. For reference, the Terms of Reference for the Community Development Group have been included as well.

Terms of Reference:

- Community priorities and solutions
- Engaging and identifying needs of other Groups
- Building relationships to ensure policies are developed to empower and not constrain
- Reputation management through promotion, delivery and communication
- Town and Parish Council shared working (identifying opportunities whilst establishing priorities)

Upcoming Work:

Vaccination Uptake in the Braintree District:

Consider whether the District has any issues regarding the rate of vaccination uptake, and if any further work is needed by the District Council in order to help combat those issues. Key questions:

- Who is responsible for managing/overseeing the Vaccination Programme for the Braintree District?
- What vaccinations/diseases are covered by the “normal” Vaccination Programme e.g. through triggers such as age?
- Look at the District’s rates of Vaccination in comparison to the Essex and National averages and consider whether any rates give rise to public health

concerns, whether there are any trends we should be aware of (good or bad), and whether there are any hotspot concerns within the District (e.g. geographic/demographic groups)?
- What "optional" vaccinations are available and how, and what are the best or emerging practices e.g. triggers such as travel?

Second Phase of Review (if needed):

- Conduct focused work on specific issues highlighted as part of the initial fact find.
- Look at what is being done to address the issues identified.
- Identify what role Braintree District Council has, if any, in making improvements.
- Make any further recommendations.

Community Woodlands:

Look at conducting a cost-benefit review on community woodlands, including the community benefits and consider the influence on climate change.

- Look at what defines a Community Woodland (e.g. number of trees?), and what we have available in the Braintree District. Are they any past examples of woodlands?
- What is the impact on climate emission of woodlands? What are the ecological benefits?
- What, if any, strategies and/or policies are there in place?

Mobile Phone Coverage:

Conduct an initial data review of the information gathered e.g. Hot and Not mobile phone coverage spots, data from Ofcom, data from the LGA, any industry data available, and data available from Planning Policy or order to look at the levels of mobile phone coverage across the District.

- Levels of coverage e.g. signed +3G, 4G, inside and outside coverage, etc.
- What are the existing arrangements for improving mobile phone signal?
- Do we as a District Council have a role in supporting or enabling improvements, and what, if anything, can we effectively participate in?

Recommended Decision:

Members are asked to note the above and provide any additional feedback in respect of the future Work Programme for the Committee.

Purpose of Decision:

That Members are aware of the Future Work Programme for the Committee.

Any Corporate implications in relation to the following should be explained in detail.	
Financial:	There are no matters arising from the report. The work programme will be met from the Council's resources.
Legal:	The Work Programme will be managed to ensure that it remains within the Terms of Reference of the Committee and any legal implications will be dealt with within specific Work Programmes.
Safeguarding:	No matters arising out of this report.
Equalities/Diversity:	This report highlights prospective work for the committee, in itself it does not impact on the protected characteristics, however any work or recommendations may need to reflect the Council's obligations under the Equalities Act.
Customer Impact:	No matters arising out of this report.
Environment and Climate Change:	There are no matters arising directly from this report; however, the work of the Committee will need to be mindful of relevant future impacts.
Consultation/Community Engagement:	Whilst there is no direct community engagement in this report, appropriate engagement could be a part of future work.
Risks:	There are no matters arising from this report. Any future risk will be managed within the Work Programme.
Officer Contact:	Jessica Mann
Designation:	Governance and Members Officer
Ext. No:	2607
E-mail:	Jessica.mann@braintree.gov.uk

COMMUNITY DEVELOPMENT GROUP
30th October 2019

Braintree District Council

Scrutiny Review into Vaccinations	**Agenda No:** [for Governance use]

Portfolio	**Health and Communities**
Corporate Outcome:	**Residents live well in healthy and resilient communities where residents feel supported**
Report presented by:	**Jessica Mann, Governance and Members Officer**
Report prepared by:	**Jessica Mann, Governance and Members Officer**

Background Papers:	**Public Report**
Briefing Note on Immunisation Uptake in Braintree District (Report from NHS England and Appendices 1-5)	**Key Decision: No**

Executive Summary:

Members of the Community Development Group are invited to note the information contained within the attached report and accompanying papers provided by NHS England (East of England) in respect of vaccination uptake across the Braintree District.

Officers within the Governance and Members Team made enquiries with a number of different contacts, including Dr Mike Gogarty, Director of Wellbeing, Public Health and Communities at Essex County Council, in order to establish which body or organisation was responsible for the management/overseeing of the Vaccination Programme in the Braintree District. Dr Mike Gogarty was able to confirm that vaccination and immunisation were the responsibility of NHS England, and that the local lead consultant, Dr Pam Hall, would be able to provide us with the necessary data to help inform the Scrutiny Review.

As part of the enquiry directed to NHS England, information was sought on a number of key areas, as follows:-

- What Vaccinations/diseases are covered by the “normal” programme – what are the triggers to get Vaccinations? E.g. age/other

- What are Braintree District’s rates of vaccination in comparison to Essex / National averages, and would any rates give rise to public health concerns? Are there any trends (good or bad) we should be aware of? Are there any hotspot concerns within the District (e.g. geographics/demographic groups)?

- What “optional” vaccinations are available for people and how? E.g. Are there any best practices/emerging practices, travel vaccinations, etc?

For information, the vaccination and immunisation target set by the European Region of the World Health Organisation (WHO) is that at least 95% of children are immunised against diseases preventable by immunisation and targeted for elimination or control.

NHS England were subsequently able to provide key data on the rate of vaccination uptake within the District for children and adults to help give us a clearer indication as to the District's overall rate of vaccination uptake compared with the rest of the Mid-Essex area, Essex as a whole and the national average.

Dr Pam Hall, Senior Consultant and Mr Oliver Jackson, Screening and Immunisation Manager, were the primary contacts from NHS England, and they were invited to attend the meeting of the Community Development Group on 30th October 2019 to speak directly with Members and advise them on the data provided. Although no representatives were available to attend on the date of the meeting, staff at NHS England have stressed that they will happily assist the Group where possible in going forward with its Scrutiny Review, and that they would also like to be kept informed of the outcomes of the Review, as well as any documents produced as a result.

Members are asked to consider the information contained within the report and consider whether they would like to make further enquiries with NHS England to assist them with their Scrutiny Review.

Additional information relating to Vaccinations:

Childhood Vaccination Coverage Statistics – England 2018-19 (posted by NHS Digital on 26th September 2019)

https://digital.nhs.uk/data-and-information/publications/statistical/nhs-immunisation-statistics/england-2018-19

The Guardian – Drop in Vaccination Rates; Childhood Vaccines UK - Article

https://www.theguardian.com/society/2019/sep/26/drop-in-vaccination-rates-in-england-alarming-experts-warn

Daily Mail Online – Matt Hancock MP, Health Secretary – "Bold Action" regarding vaccines

https://www.dailymail.co.uk/health/article-7507111/Vaccine-coverage-falls-13-childhood-jabs-England-year.html

Recommended Decision:

That Members note the information provided by NHS England and highlight any issues arising from the report they would like to consider going forward as part of the Scrutiny Review.

Purpose of Decision:

To assist Members with forming the basis of the Scrutiny Review.

Any Corporate implications in relation to the following should be explained in detail.	
Financial:	No matters arising out of this report.
Legal:	No matters arising out of this report.
Safeguarding:	No matters arising out of this report.
Equalities/Diversity:	No matters arising out of this report.
Customer Impact:	No matters arising out of this report.
Environment and Climate Change:	No matters arising out of this report.
Consultation/Community Engagement:	Enquiries were made with Dr Mike Gogarty, Essex County Council, Health Watch Essex, the Mid-Essex Immunisation Team and a number of other organisations in order to determine which organisations could provide the necessary information to assist with the evidence gathering of the Community Development Group.
Risks:	No risks arising from the report; however, as a representative from NHS England was not available to attend the meeting, Members may want to consider how the Scrutiny Review into Vaccinations is taken forward, and if there are any key emerging issues from the data provided that they wish to scrutinise further.
Officer Contact:	Jessica Mann
Designation:	Governance and Members Officer
Ext. No:	2607
E-mail:	Jessica.mann@braintree.gov.uk

Briefing note on immunisation uptake in Braintree District

October 2019

This briefing note is provided to support the Scrutiny Review into Vaccinations in Braintree District, being conducted by the Community Development Group at Braintree District Council.

The Essex Screening and Immunisation Team (SIT) were asked to provide responses in key areas in order to provide details of vaccine uptake within the Braintree area, to identify any notable trends and provide information about how the immunisation programmes are managed and overseen within the Braintree District. These areas form the basis of this note.

Management / Oversight of the Vaccination Programme in the Braintree District

As commissioners of the national immunisation programmes, the Essex SIT chair a quarterly Essex Vaccination Oversight Committee (EVOC). Members of the EVOC committee include:-

- SIT team (Commissioners)
- service providers (e.g. Community and School Immunisation Service, Maternity Representatives from Essex trusts
- Child Health Information Services (CHIS) who schedule childhood immunisations and report uptake data
- Upper Tier Local Authority and CCG representatives
- Health Protection Team

The terms of reference are being reviewed at the next EVOC meeting as part of the scheduled update process but the draft is attached for information (see Appendix 1).

The routine immunisation schedule

A copy of the UK immunisation schedule is attached (see Appendix 2). This details all the immunisations offered universally through childhood and adulthood.

Immunisations offered up to the age of 5 are generally given at GP practices and the scheduling of these vaccinations is managed by the CHIS service. We also commission the Community and School Aged Immunisation Service (provided by Essex Partnership University NHS Foundation Trust, EPUT) to assist in the follow up children that are not up to date with their childhood immunisations.

Immunisations offered in adolescence are delivered in schools by the Community and School Aged Immunisation Service. Catch-up sessions are often offered in schools for children that have been absent, and vaccination can also take place in the community clinics offered by this service. This helps support reducing inequalities by providing additional access for home-educated children, Gypsy and Traveller communities and some faith groups. The community clinics also provide support for patients with needle-phobia. These clinics cover support for patients from birth to up to 19 years of age.

Vaccinations offered to older adults are generally delivered in GP practice, with the exception of the seasonal flu vaccine which is also offered through community pharmacy, and some maternity units for pregnant women only.

Selective immunisation programmes / Immunisations for patients with underlying medical conditions

The second page of the UK schedule attached above shows the currently recommended selective immunisation programmes and additional vaccines recommended for people with certain underlying medical conditions.

Selective immunisation programmes include vaccination of babies born to hepatitis B positive mothers, BCG vaccination for babies in areas of the UK with high TB incidence, or babies with parents or grandparents from countries with high TB incidence, flu vaccination for high risk children, and flu and pertussis vaccination for pregnant women.

- The selective hepatitis B programme is delivered in maternity (birth dose) and GP practice (subsequent doses).
- BCG vaccinations are delivered in hospital and community services.
- At risk children can be given flu vaccinations as part of the universal school programme or within GP practice.
- Pregnant women can be vaccinated in GP practice or in maternity units that offer the vaccine (currently all units except Mid Essex Hospital Services NHS Trust, MEHT).

Vaccines offered to those with the underlying medical conditions listed are expected to be vaccinated by the specialist teams that manage their conditions, although some are vaccinated in general practice.

Braintree District's Vaccination Rates

Immunisation uptake data is not routinely made available at lower tier local authority level however, using a list of Braintree located GP practices we have produced some local figures for your review (see Appendix 3.1 and 3.2).

Immunisation uptake for the following programmes for adults:

- Season flu (including the programme for two and three year olds)
- Shingles
- Pneumococcal
- Prenatal Pertussis

There are a number of indicators for the routine childhood immunisation up to 5 years of age. We have included uptake for the following:

- DTaP/IPV/Hib/HepB – Three doses at 12 months of age
- MMR dose 1 at 24 months of age
- Hib/MenC Booster at 24 months of age
- Pre-school booster (DTaP/IPV) at 5 years of age
- MMR dose 2 at 5 years of age

Vaccination uptake for immunisations within Mid Essex is generally amongst the highest in Essex, and Essex frequently demonstrates uptake levels slightly above the national average. The data shows that uptake for the Braintree GP practices is broadly similar to that of Mid Essex CCG.

The recommended uptake rates for the childhood vaccinations is 95%, which would provide 'herd immunity' (i.e. those that are contraindicated for vaccination would be protected because so much of the community is vaccinated that it prevents the circulation of disease). Uptake targets vary for the adult programmes. Both nationally and locally the uptake of key vaccinations is generally lower than the 95% level and has been dropping slightly year-on-year since around 2014. There is a national push to increase uptake in childhood vaccinations. For example, earlier this year a National Measles and Rubella Elimination Strategy was published (see attached). We also have a local strategy focussing on how we improve uptake across the East of England (see Appendix 4).

There is also NICE guidance aimed at reducing difference in uptake in all vaccinations for children (see Appendix 5).

We are currently undertaking a number of local projects and initiatives aimed at increasing uptake, such as focus groups to identify how the childhood immunisation invite letters can be improved, development of performance and benchmarking data to be shared with GP practices, the use of a software package that CHIS are using to extract more accurate vaccination information from GP practice systems that do not use the clinical system "SystmOne", and a pilot of paying GP practices to send shingles invitation letters to 70 years old patients not yet vaccinated.

Other Vaccinations

The only other vaccinations given regularly are for travel. We do not commission travel vaccines and therefore are unable to comment on delivery or uptake of these vaccinations.

A link to the NaTHNaC website, which provides more information about travel vaccinations, is shown below if you wish to explore this further.

https://nathnac.net/

Oliver Jackson
Screening and Immunisation Manager
NHS England and NHS Improvement

Nicola Taylor
Screening and Immunisation Coordinator
NHS England and NHS Improvement

October 2019.

Public Health England

NHS England

Terms of Reference for
Essex Vaccination Oversight Committee

Terms of Reference: The Essex Vaccination Oversight Committee (EVOC) will oversee effective commissioning and delivery of immunisation services that are high quality, safe and sustainable for the population of Essex. The strategic direction of the group will be the implementation of the national child and adult vaccination schedules as per the Section 7A agreement.

Constitution The Essex Vaccination Oversight Committee will be a strategic group to coordinate implementation of national child and adult vaccination schedules.

Membership The Essex Vaccination Oversight Committee will consist of commissioners and providers of adult and child vaccination services.

Quorum A representative from:

- NHS England Screening and Immunisation Team
- CHIS
- EPUT
- LA representative

Attendance
The following shall normally attend meetings:

- NHS England/PHE Screening and Immunisation Lead
- NHS England/PHE Screening and Immunisation Manager [chair]
- NHS England/PHE Screening and Immunisation Co-ordinator [deputy chair]
- CCDC, Essex Health Protection Team, PHE
- Child Health Information Service, PROVIDE
- Community Immunisation Team, EPUT
- Medicine management representative – EPUT
- Medicine management representative - ECC
- LA representative - Essex County Council
- LA representative - Southend Borough Council
- LA representative - Thurrock Council
- Representative from Health Visitor Services
- Representative from School Nursing services
- Representative from GP/Clinical Commissioning Groups
- Representative of Primary Care nurses
- Representative from Essex LMC
- Representative from maternity services, Essex

Frequency Meetings will be held quarterly, or more frequently if required

Reporting The Essex Vaccination Oversight Committee is authorised by NHS England and feedback and minutes will be sent to the Essex Screening and Immunisation Lead for NHS England – Midlands and East (East). The EVOC will report to the relevant providers contract meeting, if required.

Aim/Purpose The aim / purpose of the Essex Vaccination Oversight Committee is to ensure that the vaccination services commissioned are high quality, responsive, progressive and safe. The group will oversee the full implementation of national vaccination policies within the required timeframe and long term sustainability.

Objectives/duties The objectives of the Essex Vaccination Oversight Committee are as follows:

- Ensure the strategic direction of adult and child immunisation service development encompasses NHS England/Public Health England and the seven Essex CCGs' Strategic Plans.
- Inform and help coordinate the implementation of national policies in relation to immunisation services
- Ensure timescales and standards of implementing any national guidance/policies/protocols are achieved.
- Monitor population coverage and uptake of all childhood and adult immunisation programmes in Greater Essex, including identification of trends and variations by geography and patient sub-groups.
- Ensure strategic collaborative partnership working between commissioners and providers of adult and child health and social care services.
- Provide a forum for discussion on immunisation issues including serious incidents/learning opportunities.

Reporting The minutes of The Essex Vaccination Oversight Committee shall be formally recorded.

Date: October 2019
Date for Review of TOR: October 2021

Public Health England

NHS England

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- Community Immunisation Team, EPUT
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- Medicine management representative - ECC
- LA representative - Essex County Council
- LA representative - Southend Borough Council
- LA representative - Thurrock Council
- Representative from Health Visitor Services
- Representative from School Nursing services
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- Representative of Primary Care nurses
- Representative from Essex LMC
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Date: October 2019
Date for Review of TOR: October 2021

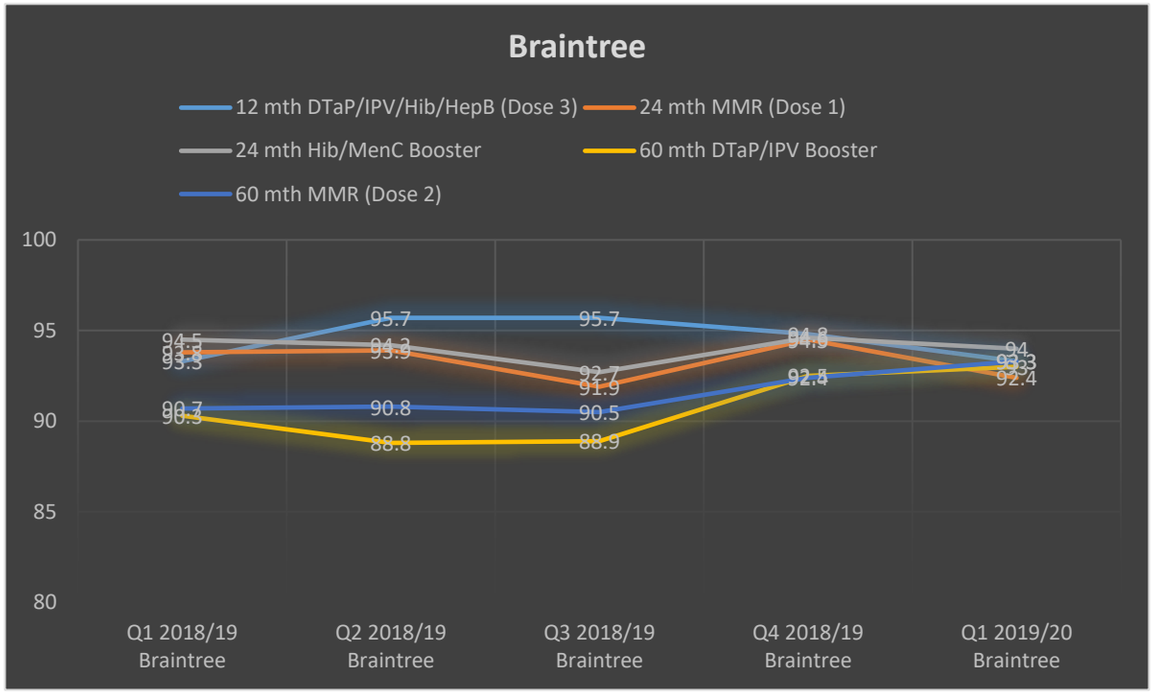
Area	Flu Vaccine Uptake 2018/19 - APPENDIX 3.1					Shingles 2018/19	PPV	Pertussis 2018/19
	65 and over	Under 65 (at-risk only)	All Pregnant Women	2 yr olds	3 yr olds	70yr olds	65+ Anytime	
Braintree Total	67.3	41.2	41.9	51.6	53	31.4	62	75.6
Mid Essex	68.5	41.8	40.6	51.5	53.2	34.5	63.3	78.3

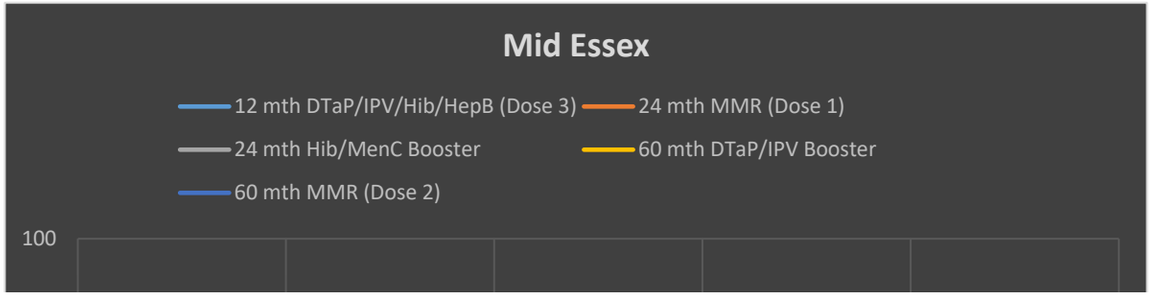
Source: ImmForm/PHE

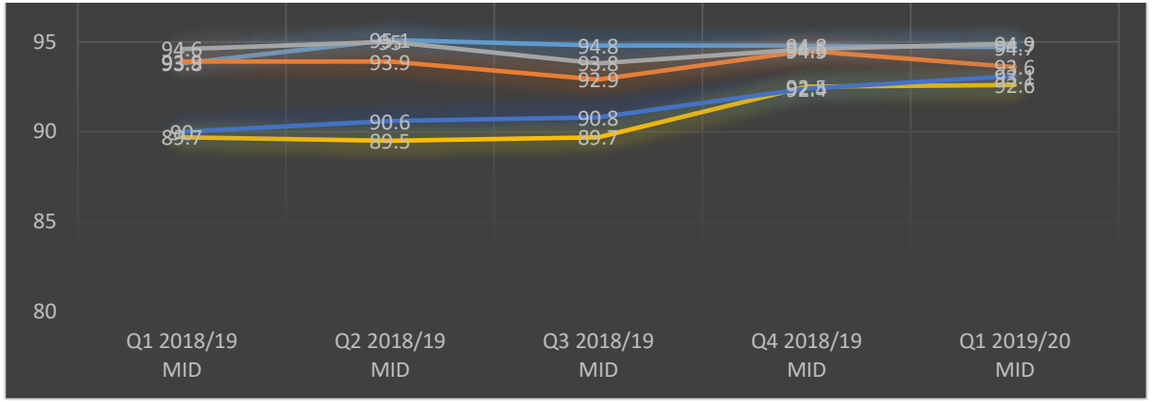
Notes: Data is based on GP registered population. Figures have been produced using the following GP Practices.

F81011	KELVEDON & FEERING HEALTH CENTRE,46 HIGH STREET,KELVEDON,CO5 9AG
F81014	CHURCH LANE SURGERY,BRAINTREE COLLEGE,CHURCH LANE,BRAINTREE,CM7 5SN
F81020	THE FRESHFORD PRACTICE,THE FRESHWELL HEALTH CTR.,WETHERSFIELD ROAD,FINCHINGFIELD,BRAINTREE,CM7 4BQ
F81030	FERN HOUSE SURGERY,FERN HOUSE SURGERY,129 NEWLAND STREET,WITHAM,CM8 1BH
F81068	THE ELIZABETH COURTAULD SURGERY,ELIZABETH COURTAULD SURG,FACTORY LANE WEST,HALSTEAD,CO9 1EX
F81087	MOUNT CHAMBERS MEDICAL PRACTICE,MOUNT CHAMBERS MED PRACT,92 COGGESHALL ROAD,BRAINTREE,CM7 9BY
F81105	LITTLE WALTHAM & GT NOTLEY SURGERY,LITTLE WALTHAM SURGERY,30 BROOK HILL,LITTLE WALTHAM,CM3 3LL
F81119	THE PUMP HOUSE SURGERY,NONANCOURT WAY,OFF MASSINGHAM DRIVE,EARLS COLNE,CO6 2SW
F81132	BLANDFORD MEDICAL CENTRE,MACE AVENUE,BRAINTREE,ESSEX,CM7 2AE
F81138	*DORMANT*HILTON HOUSE,HILTON HSE,77 SWAN STREET,SIBLE HEDINGHAM,HALSTEAD,CO9 3HT
F81173	DOUGLAS GROVE SURGERY,THE SURGERY,DOUGLAS GROVE,WITHAM,CM8 1TE
F81193	WITHAM HEALTH CENTRE,WITHAM HEALTH CENTRE,4 MAYLAND ROAD,WITHAM,CM8 2UX
F81635	COLLINGWOOD ROAD SURGERY,40 COLLINGWOOD ROAD,WITHAM,ESSEX,CM8 2DZ
F81683	BLYTH'S MEADOW SURGERY,BLYTH'S MEADOW SURGERY,TRINOVANTIAN WAY,BRAINTREE,CM7 3JN
F81730	THE COGGESHALL SURGERY,THE COGGESHALL SURGERY,STONEHAM ST, COGGESHALL,COLCHESTER,CO6 1UH
F81738	*DORMANT* BRIMPTON HOUSE,BRIMPTON HOUSE,59 HIGH STREET,KELVEDON,CO5 9AE
Y00293	HEDINGHAM MEDICAL CENTRE,10 FALCON SQUARE,CASTLE HEDINGHAM,HALSTEAD,CO9 3BY
Y05023	SILVER END SURGERY,THE SURGERY,BROADWAY,SILVER END,WITHAM,CM8 3RQ

Child Immunisations - APPENDIX 3.2	Q1 2018/19 MID	Q2 2018/19 MID	Q3 2018/19 MID	Q4 2018/19 MID	Q1 2019/20 MID	Q1 2018/19 Braintree	Q2 2018/19 Braintree	Q3 2018/19 Braintree	Q4 2018/19 Braintree	Q1 2019/20 Braintree
12 mth DTaP/IPV/Hib/HepB (Dose 3)	93.8	95.1	94.8	94.8	94.7	93.3	95.7	95.7	94.8	93.3
24 mth MMR (Dose 1)	93.9	93.9	92.9	94.5	93.6	93.8	93.9	91.9	94.5	92.4
24 mth Hib/MenC Booster	94.6	95	93.8	94.6	94.9	94.5	94.2	92.7	94.6	94
60 mth DTaP/IPV Booster	89.7	89.5	89.7	92.5	92.6	90.3	88.8	88.9	92.5	93
60 mth MMR (Dose 2)	90	90.6	90.8	92.4	93.1	90.7	90.8	90.5	92.4	93.3







Source: PHE

Notes: Data is based on GP registered population. Figures have been produced using the following GP Practices.

F81011	KELVEDON & FEERING HEALTH CENTRE,46 HIGH STREET,KELVEDON,CO5 9AG
F81014	CHURCH LANE SURGERY,BRAINTREE COLLEGE,CHURCH LANE,BRAINTREE,CM7 5SN
F81020	THE FRESHFORD PRACTICE,THE FRESHWELL HEALTH CTR.,WETHERSFIELD ROAD,FINCHINGFIELD,BRAINTREE,CM7 4BQ
F81030	FERN HOUSE SURGERY,FERN HOUSE SURGERY,129 NEWLAND STREET,WITHAM,CM8 1BH
F81068	THE ELIZABETH COURTAULD SURGERY,ELIZABETH COURTAULD SURG,FACTORY LANE WEST,HALSTEAD,CO9 1EX
F81087	MOUNT CHAMBERS MEDICAL PRACTICE,MOUNT CHAMBERS MED PRACT,92 COGGESHALL ROAD,BRAINTREE,CM7 9BY
F81105	LITTLE WALTHAM & GT NOTLEY SURGERY,LITTLE WALTHAM SURGERY,30 BROOK HILL,LITTLE WALTHAM,CM3 3LL
F81119	THE PUMP HOUSE SURGERY,NONANCOURT WAY,OFF MASSINGHAM DRIVE,EARLS COLNE,CO6 2SW
F81132	BLANDFORD MEDICAL CENTRE,MACE AVENUE,BRAINTREE,ESSEX,CM7 2AE
F81138	*DORMANT*HILTON HOUSE,HILTON HSE,77 SWAN STREET,SIBLE HEDINGHAM,HALSTEAD,CO9 3HT
F81173	DOUGLAS GROVE SURGERY,THE SURGERY,DOUGLAS GROVE,WITHAM,CM8 1TE
F81193	WITHAM HEALTH CENTRE,WITHAM HEALTH CENTRE,4 MAYLAND ROAD,WITHAM,CM8 2UX
F81635	COLLINGWOOD ROAD SURGERY,40 COLLINGWOOD ROAD,WITHAM,ESSEX,CM8 2DZ
F81683	BLYTH'S MEADOW SURGERY,BLYTH'S MEADOW SURGERY,TRINOVANTIAN WAY,BRAINTREE,CM7 3JN
F81730	THE COGGESHALL SURGERY,THE COGGESHALL SURGERY,STONEHAM ST, COGGESHALL,COLCHESTER,CO6 1UH
F81738	*DORMANT* BRIMPTON HOUSE,BRIMPTON HOUSE,59 HIGH STREET,KELVEDON,CO5 9AE
Y00293	HEDINGHAM MEDICAL CENTRE,10 FALCON SQUARE,CASTLE HEDINGHAM,HALSTEAD,CO9 3BY
Y05023	SILVER END SURGERY,THE SURGERY,BROADWAY,SILVER END,WITHAM,CM8 3RQ

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UK Measles and Rubella elimination strategy 2019

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1. WHO definitions

Clinically compatible measles case: a suspected case that has not been adequately tested by laboratory and has not been epidemiologically linked to a confirmed measles case.

Clinically compatible rubella case: a suspected case that has not been adequately tested by laboratory and has not been epidemiologically linked to a confirmed rubella case.

Discarded case: a suspected case that was investigated and discarded, either through negative results of adequate laboratory testing for measles and rubella or by an epidemiological link to a laboratory-confirmed case of another disease; or confirmation of vaccine-associated illness by detection of vaccine measles or rubella RNA. In addition, IgM-positive cases in recent vaccine recipients can be discarded if they meet all of the following criteria:

- history of vaccination with relevant vaccine 7 days to 6 weeks prior to specimen collection;
- onset of rash 7−14 days after vaccination;
- no evidence of virus transmission revealed by active search in community;
- no history of travel to areas in which the virus is known to be circulating.

Disease elimination: the absence of endemic measles or rubella cases in a defined geographical area for a period of at least 12 months, in the presence of a well-performing surveillance system. Regional elimination can be declared after 36 or more months of the absence of endemic measles or rubella in all Member States.

Disease eradication: worldwide interruption of measles or rubella transmission in the presence of a verified, well-performing surveillance system.

Endemic case: a laboratory-confirmed or epidemiologically linked case of measles or rubella resulting from endemic transmission of measles or rubella virus.

Endemic transmission: continuous transmission of indigenous or imported measles or rubella virus that persists for a period of 12 months or more in a defined geographical area.

Epidemiologically linked measles case: a suspected case that has not been adequately tested by laboratory and that was in contact with a laboratory-confirmed measles case 7–18 days before the onset of symptoms.

Epidemiologically linked rubella case: a suspected case that has not been adequately tested by laboratory and that was in contact with a laboratory-confirmed rubella case 12–23 days prior to onset of the disease.

Genotype: Operational taxonomic unit defined on the basis of nucleotide variation between viral sequences. Measles virus genotypes are defined on the genetic analysis of the N-450 sequence, which is the most variable coding region of the measles virus genome. Rubella virus genotypes are defined on genetic analysis of the E1-739 sequence.

Imported case: a case exposed outside the country during the 7-18 days (measles) or 12-23 days (rubella) prior to rash onset as supported by epidemiological and/or virological evidence.

Import-related case: a locally-acquired measles or rubella infection occurring as part of a chain of transmission originating in an imported case, as supported by epidemiological and/or virological evidence. (Note: if transmission of import-related cases persists for 12 months or more, cases are no longer considered as import-related but as endemic).

Laboratory-confirmed measles case: a suspected case that meets the laboratory criteria for measles case confirmation (i.e. measles IgM in blood or oral fluid (OF) in the absence of recent vaccination, or confirmed wild-type measles RNA in any clinical specimen).

Laboratory-confirmed rubella case: a suspected case that meets the laboratory criteria for rubella case confirmation (i.e. rubella IgM in OF, or rubella, IgM and low avidity rubella IgG in blood, in the absence of recent vaccination, or confirmed wild-type rubella RNA in any clinical specimen.

MeaNS WHO Measles Nucleotide Surveillance online database (www.who-measles.org*)*

Named strain (measles only): Measles virus variant specifically identified and named in MeaNS with a representative N-450 sequence (“distinct sequence ID”) due to its ongoing transmission in multiple countries. The distinct sequence is used to describe clusters. It allows us to describe viral diversity with finer resolution within a single genotype.

Re-establishment of endemic transmission: re-establishment of endemic measles or rubella transmission is a situation in which epidemiological and laboratory evidence indicate the presence of a chain of transmission of a virus variant that continues uninterrupted for a period of 12 months or more in a defined geographical area where disease was previously eliminated.

RubeNS: WHO Rubella Nucleotide Surveillance online database
www.who-rubella.org

Suspected measles case: a case with signs and symptoms consistent with measles clinical criteria: fever *and* maculopapular rash *and* cough or coryza (runny nose) or conjunctivitis (red eyes).

Suspected rubella case: a case with signs and symptoms consistent with rubella clinical criteria: maculopapular rash *and* cervical, suboccipital or post-auricular adenopathy, or arthralgia/arthritis.

2. Abbreviations

ADR	adverse drug reaction
BPSU	British Paediatric Surveillance Unit
CHIS	child health information systems
CHM	UK Commission on Human Medicines
CISID	Centralized Information System for Infectious Diseases
COVER	cover of vaccination evaluated rapidly
CRI	congenital rubella infection
CRPD	Clinical Practice Research Datalink
CRS	congenital rubella syndrome
CSF	cerebrospinal fluid
ECDC	European Centre for Disease Prevention and Control
FES	Field Epidemiology Services
GMS	general medical services contract
HCW	healthcare workers
HES	hospital episode statistics
HPT	health protection team
HPV	human papilloma virus
JCVI	Joint Committee on Vaccination and Immunisation
GUM	genitourinary medicine
LA	Local Authority
MCV	measles-containing vaccine
MHRA	Medicines and Healthcare Regulatory Agency
MMR	measles, mumps and rubella
MR	measles and rubella
NICE	National Institute for Health and Care Excellence
NIP	national immunisation programme
NIS	National Infection Service
NVC	national verification committee
OF	oral fluid
OFT	oral fluid test
ONS	Office of National Statistics
PCR	polymerase chain reaction
PCT	primary care trust
PHE	Public Health England
PMP	per million population
QOF	quality and outcomes framework
RCV	rubella containing vaccine
RIP	rubella infection in pregnancy
RVC	regional verification commission
SAGE	Strategic Advisory Group of Experts
SGSS	second generation surveillance system
SSPE	sub-acute sclerosing pan-encephalitis

TIP	tailoring immunisation programmes
VRD	Virus Reference Department
WHO	World Health Organisation

3. Executive summary

Building on the experience and success of fifty years of measles vaccination and thirty years of the Measles Mumps and Rubella (MMR) immunisation programme, this Strategy maps out how the UK can achieve a future that is free of measles, rubella and congenital rubella syndrome (CRS).

Since the introduction of the measles vaccine in 1968 it is estimated that 20 million cases and 4,500 deaths have been averted in the UK. From 1970 to 2017 it is estimated that rubella vaccination has averted 1,300 CRS births and 25,000 terminations. The childhood rubella vaccination programme alone has averted 1.4 million cases of rubella in the UK.

Eliminating measles and rubella is a core goal of the European Vaccine Action Plan 2015–2020 and an important part of global efforts to improve health and reduce inequalities. All Member States of the World Health Organization (WHO) European Region have a longstanding commitment to eliminating measles and rubella.

The WHO confirmed that the UK had eliminated rubella in 2015 and measles in 2016. This is a huge achievement and a testament to the hard work of health professionals in the NHS that led to uptake of the first dose of the MMR vaccine in 5 year olds reaching the 95% WHO target for the first time in 2016/17.

To achieve and maintain elimination, however, WHO recommends that we aim for 95% uptake with two doses of MMR by 5 years of age. Current UK performance for the second dose is sub-optimal at 88%. In addition, new PHE analyses suggest that population immunity levels are well below those required to interrupt measles transmission in many birth cohorts. Young people born between 1998/99 and 2003/04 (aged 15 to 20 years in 2018) are the most susceptible. London remains the most vulnerable region with immunity targets not achieved for many birth cohorts - including younger children of primary and secondary school age. There are also inequalities in vaccine uptake by ethnicity, deprivation and geography and the burden of measles and rubella falls disproportionately on certain communities.

Measles and rubella remain endemic in many other countries and, with current large measles outbreaks across Europe, imported infections pose a very real threat to the UK’s recent achievements. There is a risk that the UK will lose its elimination status for measles unless steps are taken to successfully address immunity gaps in the population

The Strategy focuses on four core components, all of which are required to maintain elimination going forward:

1. Achieve and sustain ≥ 95% coverage with two doses of MMR vaccine in the routine childhood programme (<5 years old)

2. Achieve ≥ 95% coverage with two doses of MMR vaccine in older age cohorts through opportunistic and targeted catch-up (>5 years old)

3. Strengthen measles and rubella surveillance through rigorous case investigation and testing ≥80% of all suspected cases with an Oral Fluid Test (OFT)

4. Ensure easy access to high-quality, evidence-based information for health professionals and the public

This Strategy has been independently assessed and endorsed by the UK National Verification Committee (NVC) and all of the UK nations have committed to taking the recommendations forward. In order to ensure successful implementation each of the countries must now draw up a national action plan with appropriate oversight from a multi-stakeholder group. Local teams will also need to take ownership of local plans to address the specific issues affecting their communities and services.

4. Background and rationale

Global measles eradication is considered feasible and cost-effective. In 2010, the WHO Strategic Advisory Group of Experts (SAGE) on Immunization conducted a comprehensive review of the evidence to establish the biological and technical feasibility of measles eradication and concluded that measles can and should be eradicated. They also concluded that, by using combined measles and rubella (MR) vaccines and conducting integrated surveillance for fever and rash, there is an opportunity to also eradicate rubella and to prevent congenital rubella syndrome.

Box 1. Criteria for disease eradication

Measles and rubella meet the necessary criteria for eradication:

- there is no animal or environmental reservoir and humans are critical to maintaining transmission
- accurate diagnostic tests are available
- vaccines and existing vaccination strategies for both diseases are highly effective and safe: the vaccine effectiveness of MMR is more than 90% for a single dose and more than 95% for two doses
- transmission has been interrupted in a large geographic area for a prolonged period of time

Eliminating measles and rubella is a core goal of the European Vaccine Action Plan 2015–2020 which all Member States have signed up to. Measles is highly infectious - the most infectious of all diseases transmitted through the respiratory route. As a result very high coverage (≥ 95%) with two doses of the MMR vaccine is necessary to interrupt virus transmission.

Measles (and rubella) elimination is defined by WHO as the absence of endemic transmission in a defined geographic area (e.g. UK) for a period of at least 12 months in the presence of a well-performing surveillance system. The elimination verification process is based on evidence documented by each Member State to show whether interruption of endemic transmission of measles and/or rubella at national level has been achieved and, if not, that a national plan has been developed to address this. PHE collates the required documentation on behalf of the devolved administrations for submission to the UK NVC and the WHO Regional Verification Commission for Measles and Rubella Elimination (RVC) for evaluation on an annual basis.

Before the introduction of measles vaccine in 1968 there were anywhere between 160,000 to 800,000 measles notifications and 100 deaths from acute measles in the UK each year. Similarly, more than 80% of adults had evidence of previous rubella

infection and before the introduction of a selective rubella vaccine programme in 1970; rubella infection in pregnancy (RIP) caused a significant burden in terms of terminations and babies born with Congenital Rubella Syndrome.

Thirty years on, the success of the MMR immunisation programme means that the UK has achieved both measles and rubella elimination. However more challenges lie ahead. We have yet to achieve the WHO target of 95% uptake with two doses of the MMR vaccine given by 5 years of age. We also know that population immunity levels are below those required to interrupt measles transmission in many birth cohorts with young people the most susceptible.

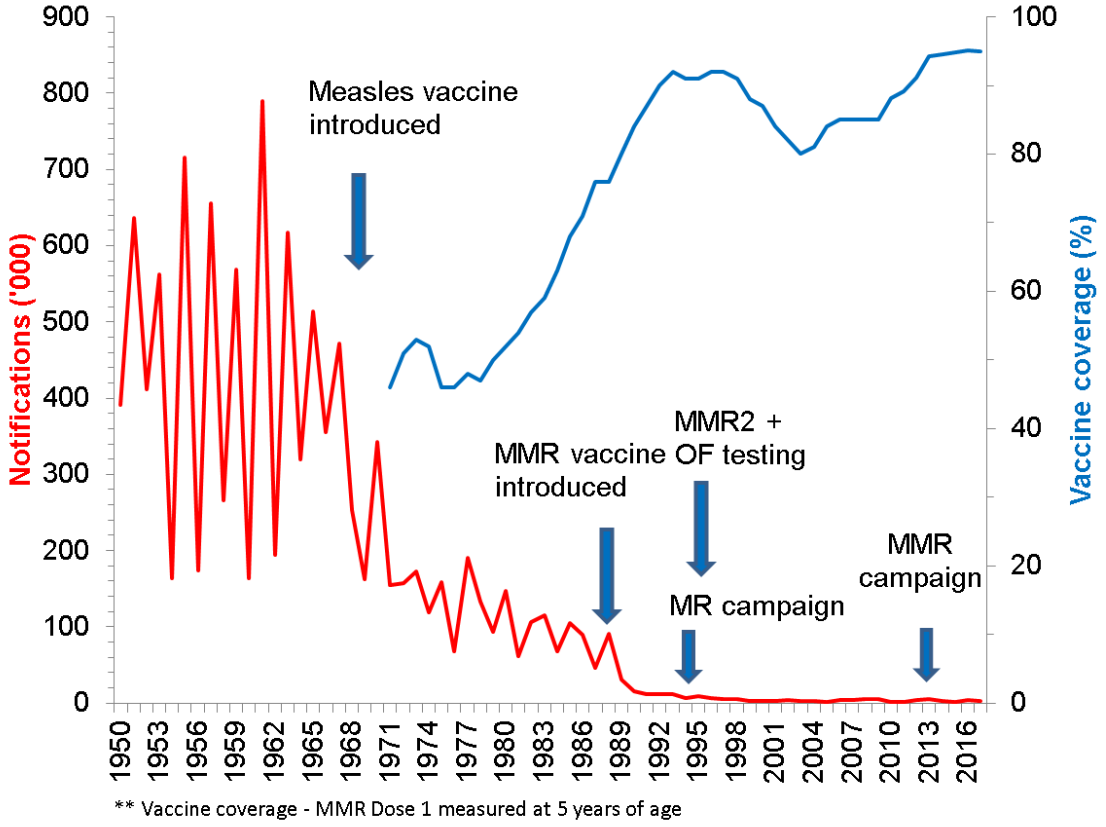
This document describes the evolution of the epidemiology of measles and rubella and associated burden of disease in the UK and captures fifty years of history of the national immunisation programme (NIP). It celebrates the successes that have been achieved in partnership with the NHS and highlights the gaps that still require our attention. In the final section we outline the steps needed to strengthen our immunisation programme and close the immunity gaps in the population to secure measles and rubella elimination for future generations.

Section 1. Situational analysis

1.1 History of measles epidemiology and immunisation in the UK

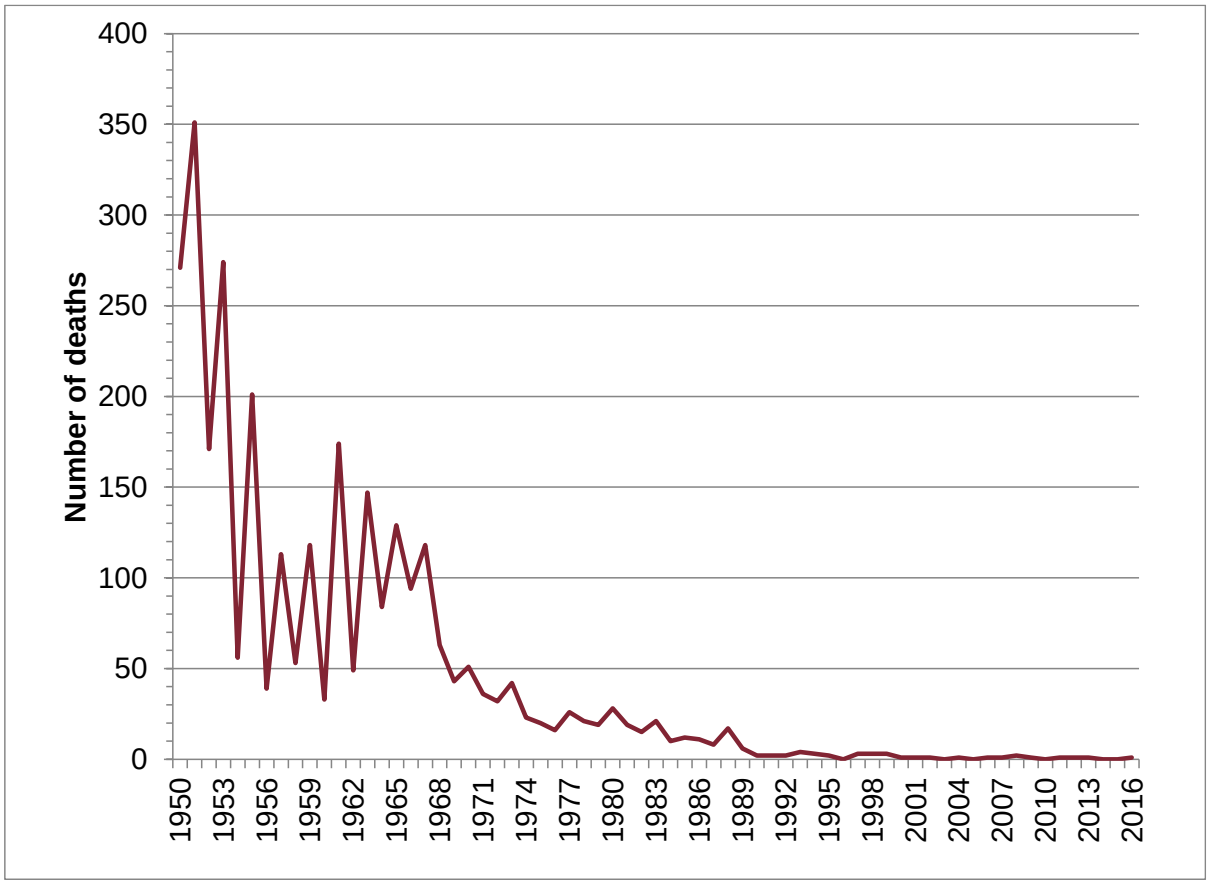
Notification of measles began in England and Wales in 1940. Before the introduction of measles vaccine in 1968, annual notifications ranged from 160,000 to 800,000, with peaks every two years (see Figure 1). More than 80% of adults had evidence of previous infection and around 100 deaths from acute measles were recorded each year. Vaccine coverage remained low until the late 1980s and was insufficient to interrupt measles transmission. Therefore, annual notifications only fell to between 50,000 and 100,000 and measles remained a major cause of morbidity and mortality.

Figure 1. UK coverage of measles vaccination and measles notifications from 1950 to 2016



Between 1970 and 1988, there continued to be an average of 13 acute measles deaths each year (Figure 2). Measles remained a major cause of mortality in children who could not be immunised because they were receiving immunosuppressive treatment. Between 1974 and 1984, of 51 children in remission from acute lymphatic leukaemia who died, 15 (29%) died from measles or its complications[1]. Between 1970 and 1983, more than half of acute measles deaths occurred in unimmunised children who were previously healthy[2].

Figure 2. Measles deaths, England and Wales, 1940 to 2016, Office for National Statistics



Following the introduction of measles, mumps and rubella (MMR) vaccine in October 1988 for children aged 13 to 15 months (with a catch up for children up to pre-school age), and the achievement of coverage levels in excess of 90%, measles transmission was substantially reduced and notifications of measles fell progressively to very low levels.

Because of the significant reduction in measles transmission in the UK, children were no longer exposed to measles infection and, if they had not been immunised, they remained susceptible to an older age. Seroprevalence studies confirmed that a higher proportion of school-age children were susceptible to measles in 1991 than in 1986/7[3]. A major resurgence of measles was predicted, mainly affecting the school-age population[3,4]. Small outbreaks of measles occurred in England and Wales in 1993, predominantly affecting secondary school children[5]. In 1993–94, a measles epidemic, affecting the west of Scotland, led to 138 teenagers being admitted to one hospital.

In order to prevent the predicted epidemic, a UK vaccination campaign was implemented in 1994. Over 8 million children aged between 5 and 16 years were immunised in school with MR vaccine. At that time, insufficient stocks of MMR were available to vaccinate all of these children against mumps. Susceptibility to measles

fell seven-fold in the target population and endemic transmission of measles was interrupted[6,7].

To maintain the control of measles established after the MR campaign, the second MMR dose was added in October 1996 to the existing routine pre-school booster immunisation programme. A one-off catch-up campaign was also implemented for those children who were too young to be immunised during the 1994 MR campaign but who were too old for the routine pre-school MMR second dose. A second dose of MMR helps to prevent an accumulation of susceptible individuals that could otherwise be sufficient to re-establish measles transmission. The efficacy of a single dose of measles-containing vaccine is around 90%[8,9]. A second dose of measles-containing vaccine protects those who do not respond to the first dose and boosts antibody levels in those who did respond. In order to eliminate measles, the WHO recommends two doses of a measles-containing vaccine.

By 1996 the UK appeared to have interrupted endemic transmission of measles and the two dose MMR schedule was well established with high coverage achieved for the routine childhood programme.

1.2 Review of measles epidemiology and immunisation programme from 2001 to 2017

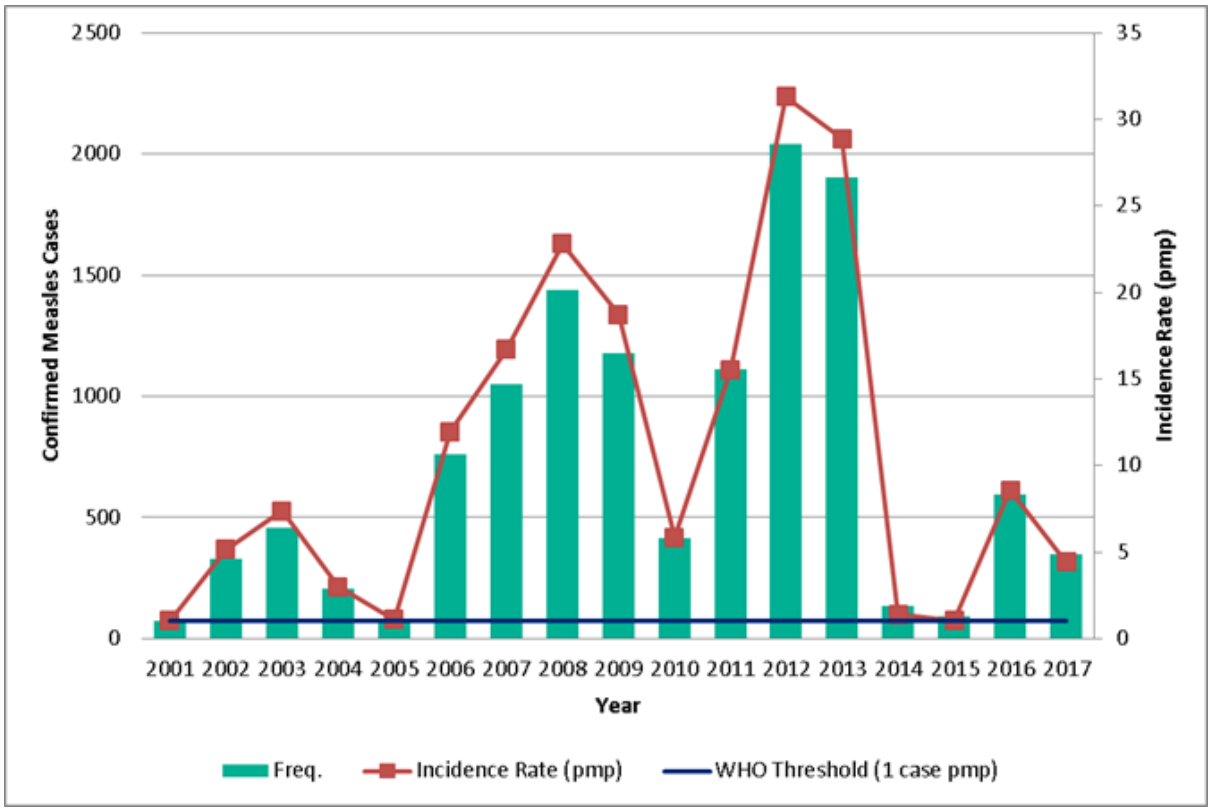
In 1998 Andrew Wakefield published his now infamous and discredited paper linking MMR to autism[10]. This resulted in intense media coverage in the UK and worldwide which peaked in 2002. It had an important impact on MMR coverage which dropped to about 80% nationally in the late nineties and early 2000s and took many years to recover.

During this period endemic transmission of measles remained interrupted and by 2004 it is likely that it was eliminated (this was not an official WHO status at that time). However the fall in MMR coverage led to a critical increase in the number of children susceptible to measles and it became clear that there was the potential for large outbreaks, particularly in cities, with London being the worst affected. In response, a London-wide ‘capital catch-up’ MMR vaccination campaign was launched targeting primary school-age children during the winter of 2004/05 during which it is estimated that about 40,000 children were immunised. Measles cases continued to rise and in 2006 endemic transmission became re-established in the UK with a disproportionate burden of cases in primary school children, the Irish traveller community, and the Orthodox Jewish community.

By 2007 the annual number of confirmed measles cases exceeded 1000 for the first time in a decade with the majority of cases in the 1 to 4 and 5 to 14 year old age groups (Figures 3 and 4). Modelling studies were conducted that predicted an epidemic of measles with the potential for 6,000 to 125,000 cases and the most

immediate risk of around 30,000 cases in London. In August 2008 the Chief Medical Officer called for a nationwide catch-up programme for MMR vaccination targeted at children of all ages from 13 months to 18 years in the main with individuals over 18 years leaving school to go to higher education or other further education establishments being included as a lower priority[11]. Primary Care Trusts (PCTs) were charged with implementing the campaign which was GP based and included the identification of eligible children, ensuring invitation for vaccination, and appropriate follow-up to encourage non-attenders to be vaccinated.

Figure 3. Annual number of laboratory confirmed measles cases and incidence* from 2001 to 2017 (n=12,201), UK.



* Incidence rate = confirmed measles cases / mid-year UK population. This excludes imported cases. Pmp = per million population.

A London evaluation estimated that the 2008 catch-up programme increased coverage with at least one dose of MMR in the under 5 year olds from 75% to 81%. However the impact on the 5 to 18 year olds was much more limited with less than a 1% increase in MMR coverage overall.

As a result there remained a significant proportion of susceptible children among the teenage cohorts who sustained another large outbreak in 2012 which started in Wales and spread to the rest of the UK. A national catch-up campaign was launched in April 2013 with the objective of ensuring that 95% of children aged 10 to 16 years received at least one dose of MMR. The campaign evaluation estimated that vaccine coverage (one dose of measles-containing vaccine) in England at

baseline was higher than routinely reported and was close to 95%[12]. Eleven per cent of the target population (previously unvaccinated children aged 10 to 16 years) were reached by the catch-up campaign at mid-point. Estimated coverage in London was 88%, significantly lower than in the rest of England. However it is believed that this is an underestimate due to less accurate data recording and higher mobility of the population when compared to the rest of the country. Nevertheless it was estimated that about 210,000 children aged 10 to 16 years remained unvaccinated nationally, with 80,000 (38%) of them in London.

By 2014 the UK had interrupted endemic transmission of measles (See Figure 4) and in 2017 the RVC for Measles and Rubella Elimination declared that the UK had eliminated measles[13]. In England, vaccine coverage of the first MMR dose evaluated in 5 year olds also reached the WHO 95% target for the first time in 2016/17. Annual vaccine coverage estimates for MMR1 at age two has never reached the WHO target of 95% in England and has been decreasing since 2013/14.

Figure 4. Imported, import-related and endemic measles cases in the UK from 2001 to 2017 (n=12,201)

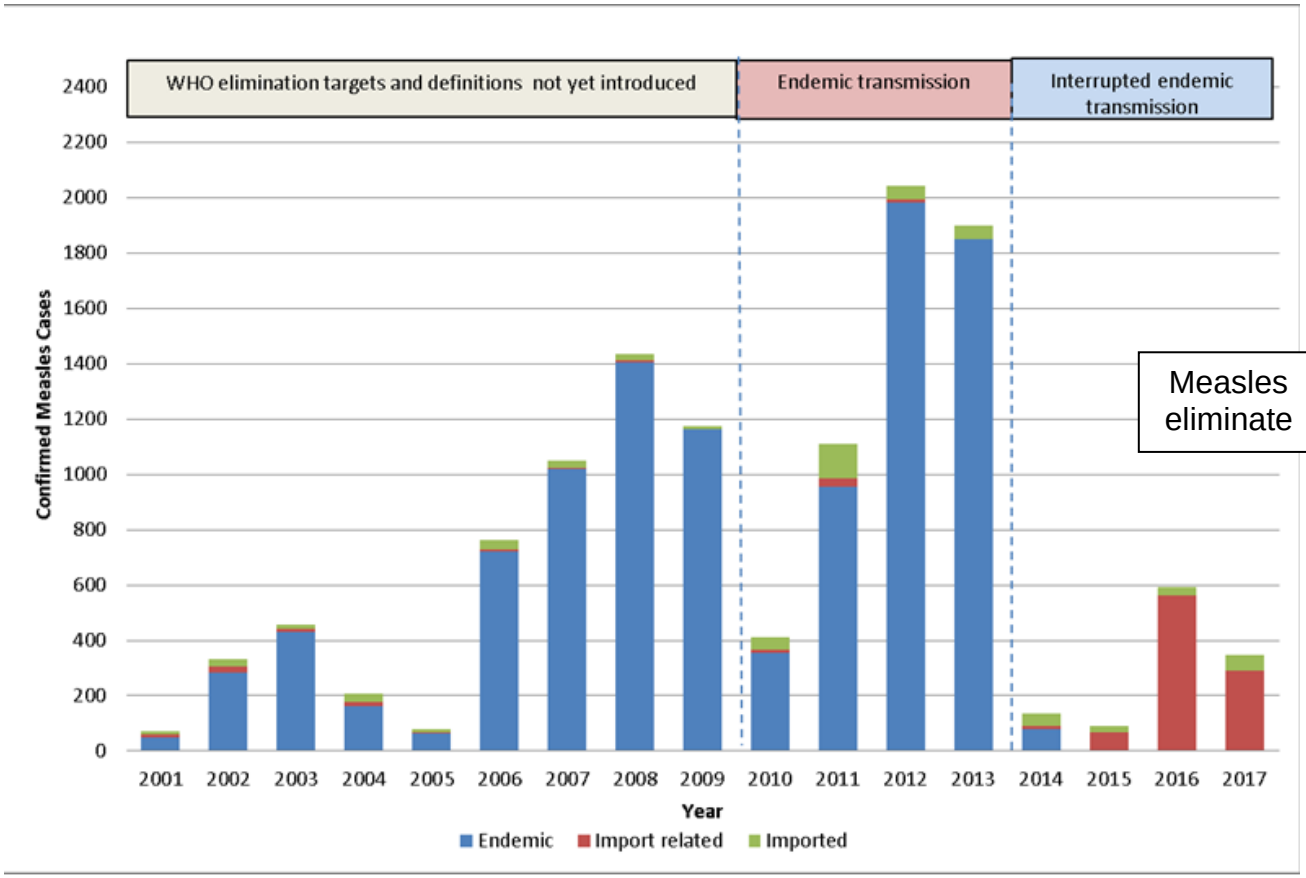


Figure 5 and Table 1 depict how the age profile of lab confirmed measles cases has changed over time. The burden of disease has moved from the younger age groups to those over 15 years of age in more recent years. However rates of disease remain highest in infants under the age of 1, reminding us of the importance of

achieving high coverage in the population in order to protect those who are not eligible for vaccination or cannot be immunised for other reasons.

Figure 5. Annual laboratory confirmed measles cases by age group from 2001 to 2017, UK (n=12,128 (Excl. age NK))

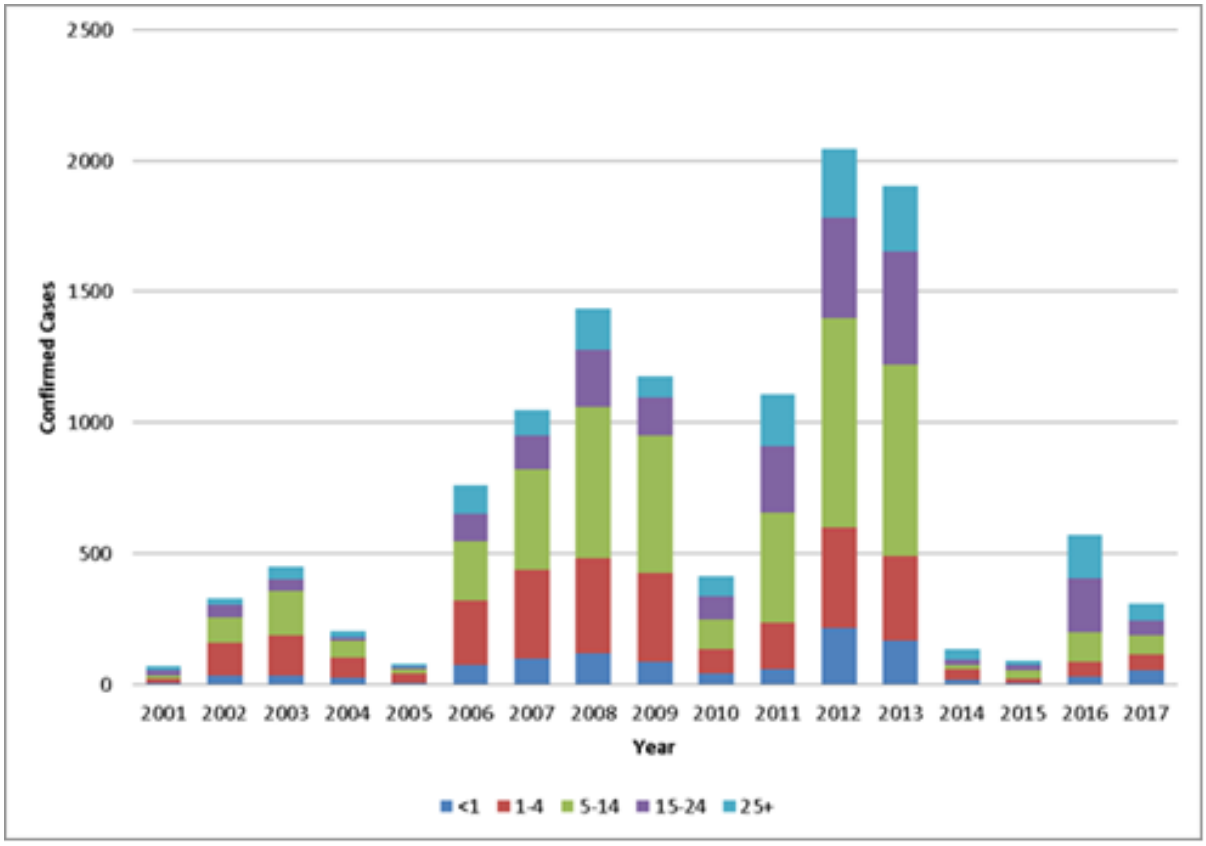


Table 1. Annual age specific rates of lab confirmed measles cases per 100,000 population, 2010 to 2017 in England and Wales.

Age group	2010	2011	2012	2013	2014	2015	2016	2017
under 1 year	4.51	8.06	29.37	22.93	2.58	1.15	3.84	5.41
1 to 4 years	2.96	6.14	13.57	10.79	1.24	0.51	1.90	2.07
5 to 9 years	1.38	5.63	11.17	7.05	0.23	0.25	1.22	0.91
10 to 14 years	1.86	7.39	13.59	15.17	0.22	0.63	2.19	1.05
15 to 24 years	1.16	3.31	5.16	5.74	0.33	0.32	2.66	0.64
over 25 years	0.19	0.50	0.67	0.60	0.10	0.04	0.38	0.15

Ninety three percent of the confirmed measles cases from 2001 to 2016 for whom vaccination status was known were unimmunised. Only 5% of cases had received one measles-containing vaccine and 2% had received two or more measles-containing vaccines.

Achieving measles elimination does not mean that measles has been wiped out. Measles remains endemic in many countries around the world and since 2016 there have been large measles outbreaks across Europe. Multiple importations to the UK

have led to a number of outbreaks in recent years, with some limited spread in the population, particularly young people and adults who missed out on MMR vaccine when they were younger and under vaccinated communities such as travellers, migrant populations and the Anthroposophic (Steiner) community[14].

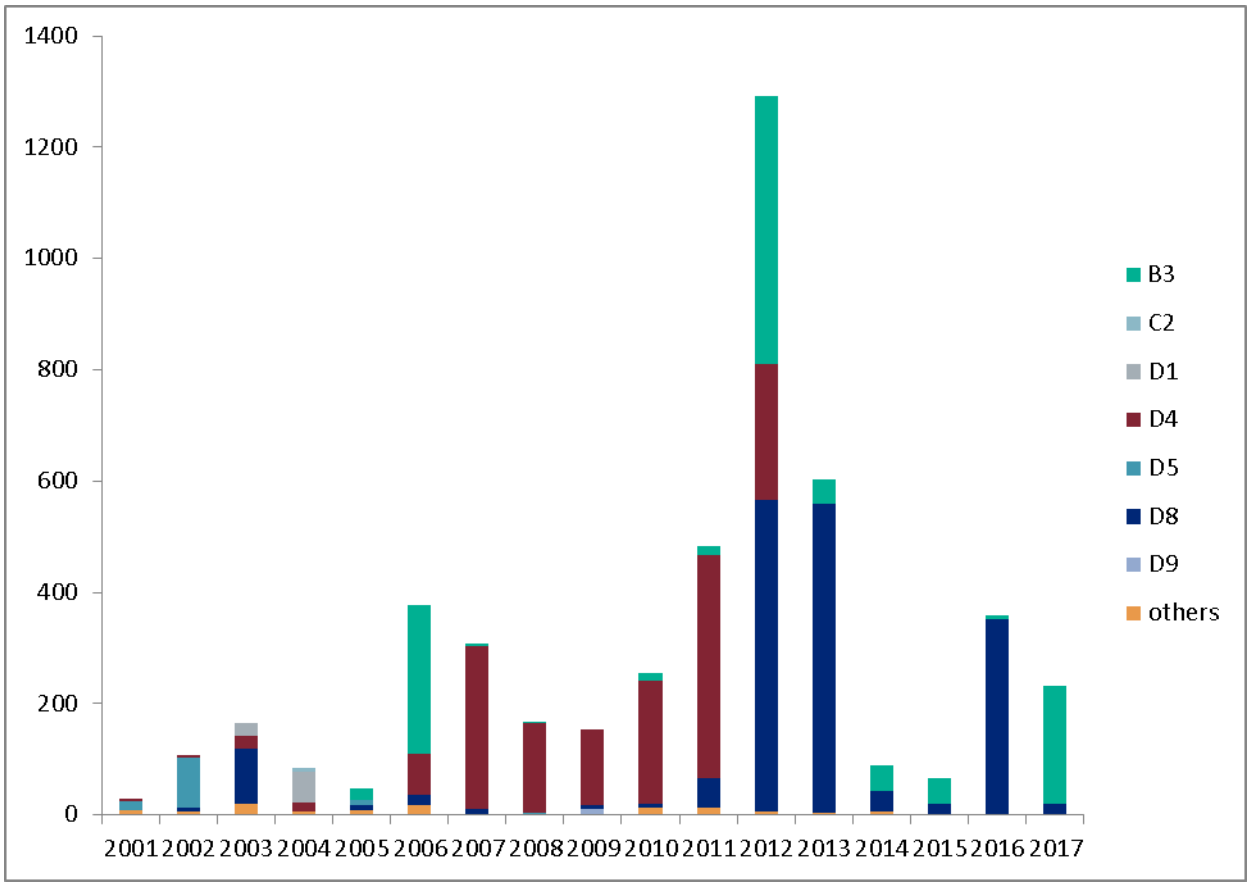
PHE National Measles Guidelines[15] outline how cases and contacts should be investigated and managed in order to achieve measles control.

1.2.1 Measles genotypes

Although 24 different genotypes have been described, with increased global control of measles infection the number of circulating genotypes has decreased. In the past, the requirement for sequence information was inversely proportional to the number of cases of measles described, in an outbreak situation only a representative sample of cases would have required sequencing. In general, countries without endemic measles will identify multiple genotypes among their cases reflecting importations from different parts of the world, whereas countries with endemic measles would normally only have one or two circulating genotypes.

In more recent years, as the number of global genotypes has decreased (only 5 circulating genotypes since 2016: B3, D4, D8, D9 and H1), even countries with sporadic cases only detect one or two genotypes. Distinction of importations is determined by strain information as well as by the genotype, and once elimination status is achieved sequence is required on more than 80% of clusters and sporadic cases.

Figure 6. Number of sequences and genotypes by year, UK, 2001-2017. Source: MeaNS database (n = 4,814)

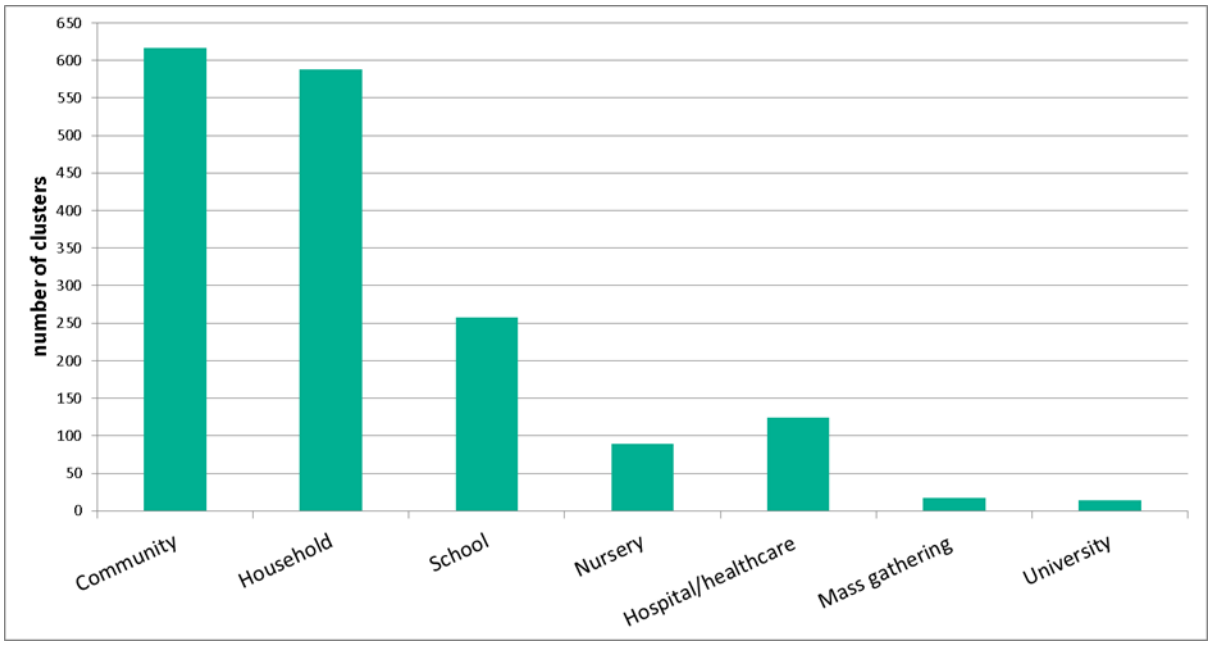


1.2.2 Clusters

An analysis of the clusters from 2010 to 2016 (Figure 7) reveals that most transmission occurs in the community or household setting. Traveller communities, the Orthodox Jewish community and Anthroposophic (Steiner) community suffer a disproportionate burden of disease due to lower vaccine uptake. Ethnicity and country of origin are not routinely captured in disease surveillance data and so identifying whether a case is a member of an under-vaccinated community requires the Health Protection Team (HPT) to flag them as such during the risk assessment.

Schools and nurseries are the main setting for the majority of outbreaks occurring outside of the household or community although there is also a significant burden associated with transmission in health care settings where the risk of exposing vulnerable individuals is greater.

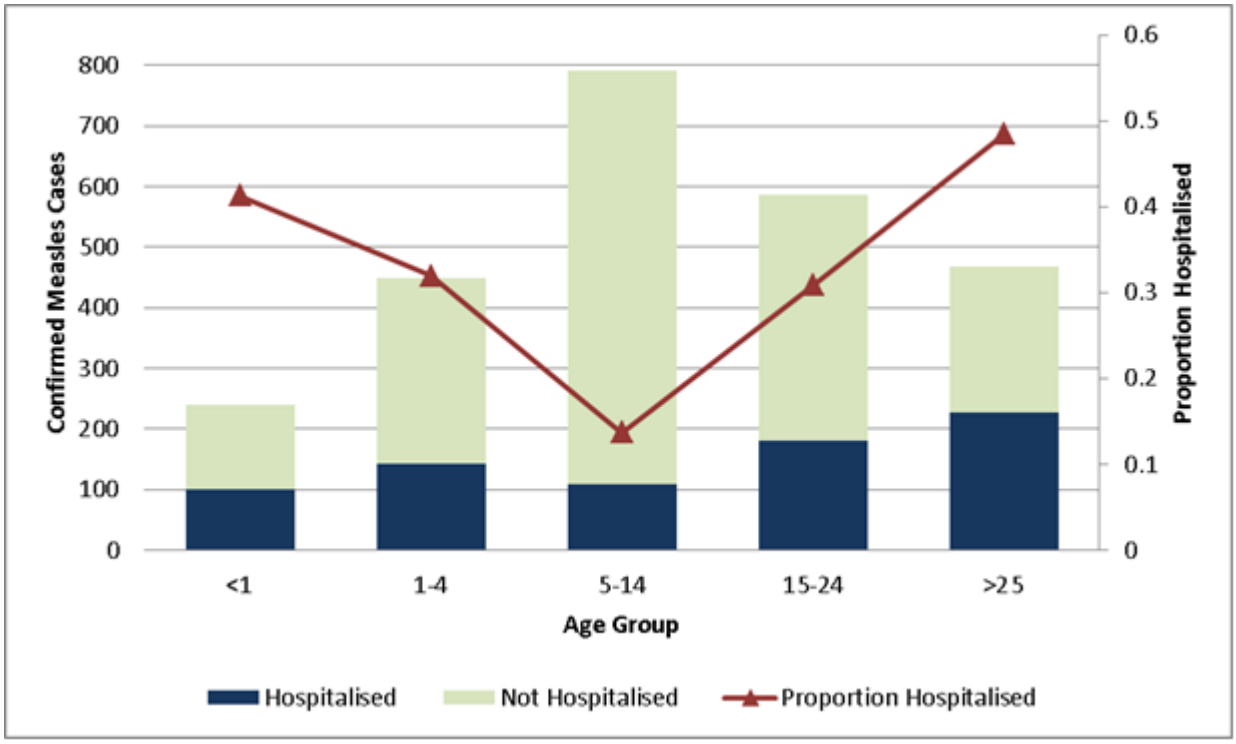
Figure 7. Measles cases in various communities across the England and Wales from 2001 to 2017 (n=1,707)



1.2.3 Hospitalisations

More than one in three (38%) of the measles cases in England and Wales confirmed between 2014 to 2016 were hospitalised, reflecting the age profile of the cases (Figure 8). As expected, the burden of hospitalisation is much higher in adults over 25 years (54.8%) who represent 27% of all cases confirmed during this time period. These data are based on reported hospitalisation on HPZone records and enhanced surveillance forms as Hospital Episode Statistics (HES) are not currently linked to routine surveillance data.

Figure 8. Hospitalisation rates in confirmed measles cases in the UK from 2013 to 2017 (n=2,553)



1.3 Sub-acute Sclerosing Pan-encephalitis

Sub-acute Sclerosing Pan-encephalitis (SSPE) is a rare, fatal neurological disease caused when measles virus establishes chronic infection in the brain. The UK SSPE registry, which is coordinated by PHE, was established in 1970, two years after the introduction of measles vaccine. SSPE cases were ascertained from a variety of sources in early years, including reports from paediatricians through the Surveillance Unit of the Royal College of Paediatrics and Child Health, reports from laboratories and reports from neurologists. In March 2002 a case finding exercise was undertaken, whereby virology and microbiology laboratories in England and Wales were contacted for reports of SSPE cases diagnosed since 1990, however no additional cases were identified. Death certificates for relevant categories from the Office for National Statistics (ONS) are routinely reviewed to identify any additional cases not reported to the registry. SSPE cases are formally reported to WHO.

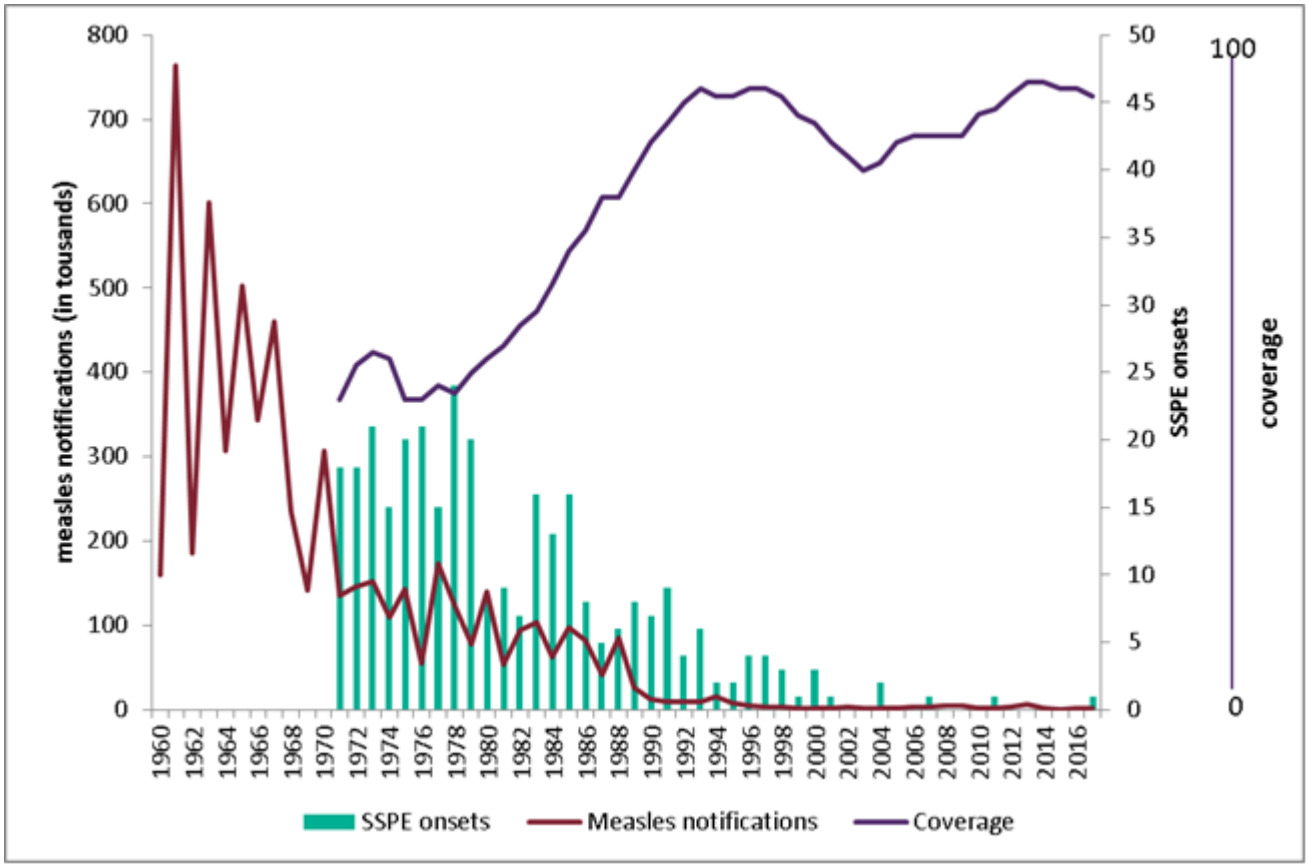
All the cases from 1990 onwards have been confirmed by the Virus Reference Department (VRD). The PHE VRD receives serum and cerebrospinal fluid (CSF) samples from laboratories for diagnostic confirmation and brain biopsy material where this is available. Diagnosis is based on finding a raised measles-specific IgG index, calculated using paired serum and CSF samples to compare the measles, rubella, Herpes Simplex Virus and Varicella Zoster Virus ratios (i.e. CSF measles antibody/ serum measles antibody) with the albumin ratio (CSF albumin/serum

albumin). Confirmation of the diagnosis can be achieved through detection of measles RNA or antigen in brain biopsy material.

The reduced incidence of measles, brought about by vaccination caused the almost total disappearance of SSPE in England and Wales. In the early 1970s, when the SSPE Register was put in place, around 20 cases were reported each year. By the early 1990s, the annual total had fallen to around six cases and this has fallen further to between one and none in recent years[16,17] despite testing an average of 20 clinically suspected cases each year.

In the twelve years between 2006 and 2017 only two cases of SSPE were identified with presumed UK measles acquisition. In addition there are currently six SSPE cases that are alive in the UK. Four of these cases were UK born with onset of symptoms between 1999 and 2010.

Figure 9. Measles notification, SSPE onsets and vaccine coverage in England and Wales 1960 to 2017



1.4 History of rubella epidemiology and immunisation in the United Kingdom

Before the introduction of rubella immunisation, rubella occurred commonly in children, and more than 80% of adults had evidence of previous rubella infection[18].

Rubella immunisation was introduced in the UK in 1970 for prepubertal girls and non-immune women of childbearing age to prevent RIP. Rather than interrupting the circulation of rubella, the aim of this strategy was to directly protect women of childbearing age by increasing the proportion with antibody to rubella; this increased from 85 to 90% before 1970 to 97 to 98% by 1987[6].

Surveillance for congenital rubella was established in 1971 to monitor the impact of the vaccination programme. During the period 1971–75 there were an average of 48 CRS births and 742 terminations annually in the UK[19].

Although the selective immunisation policy was effective in reducing the number of cases of CRS and terminations of pregnancy, cases of RIP continued to occur. This was mainly because the few women who remained susceptible to rubella could still acquire rubella infection from their own and/or their friends' children.

Universal immunisation against rubella, using the MMR vaccine, was introduced in October 1988. The aim of this policy was to interrupt circulation of rubella among young children, thereby protecting susceptible adult women from exposure. At the same time, rubella was made a notifiable disease. A considerable decline in rubella in young children followed the introduction of MMR, with a concomitant fall in rubella infections in pregnant women – from 167 in 1987 to one in 2003.

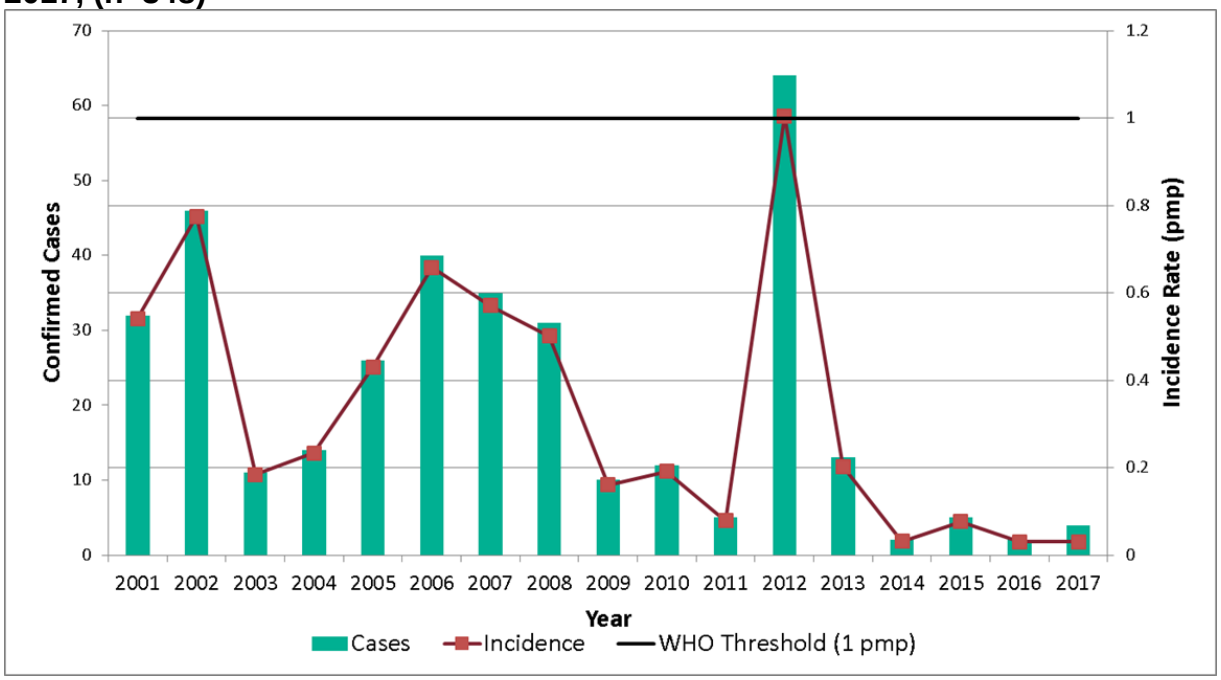
A seroprevalence study in 1989 showed a high rate of rubella susceptibility in school-age children, particularly in males[20]. In 1993, there was a large increase in both notifications and laboratory-confirmed cases of rubella. Many of the individuals affected would not have been eligible for MMR or for the rubella vaccine. For this reason, the combined MR vaccine was used for the schools campaign in November 1994. At that time, insufficient stocks of MMR were available to vaccinate all of these children against mumps. Over 8 million children aged between 5 and 16 years were immunised with the MR vaccine.

In October 1996, a two-dose MMR schedule was introduced and the selective vaccination policy of teenage girls ceased. A further resurgence of rubella was observed in the UK in 1996. Many of these cases occurred in colleges and universities in males who had already left school before the 1994 MR campaign[6].

1.5 Review of rubella epidemiology 2001 to 2016

The annual incidence of rubella in the UK has been well below the WHO threshold of 1 case per million population (pmp) over the last 15 years. (Figure 10) The peak in 2012 reflects an outbreak linked to importation from France that affected unvaccinated individuals attending a boarding school and a Steiner school.

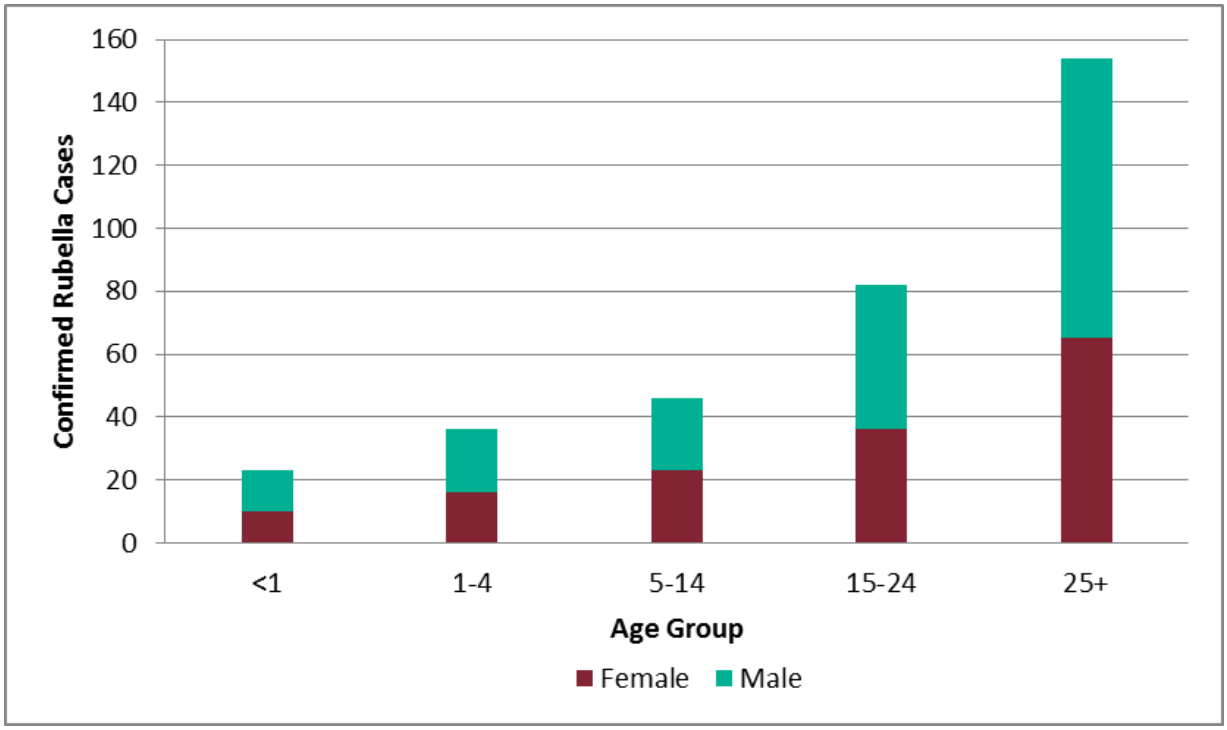
Figure 10. Confirmed rubella cases and incidence* in the UK from 2001 to 2017, (n=348)



* Incidence = confirmed rubella cases / mid-year UK population. This excludes imported cases. Pmp = per million population

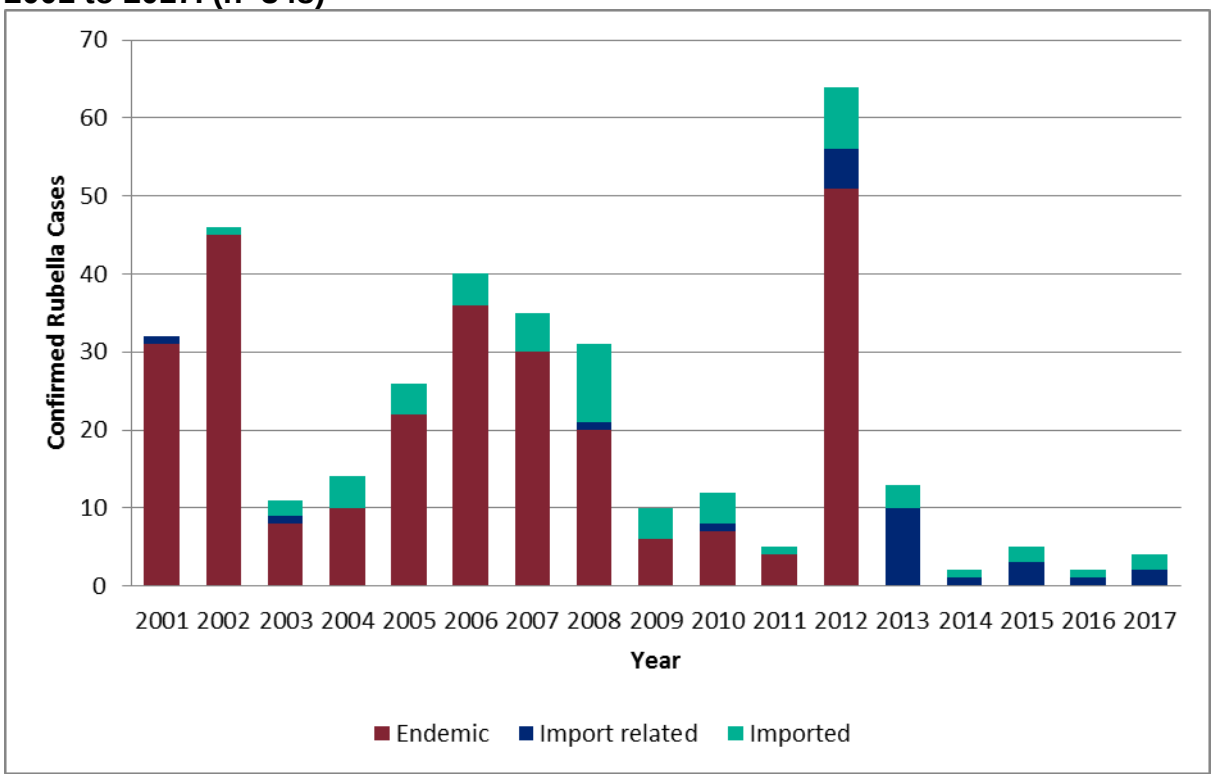
Most of the cases were reported in adults over the age of 25 (44% of cases), and men (58% of cases) are over-represented (Figure 11). London and the South East regions of England accounted for 67% of the cases confirmed during this time period.

Figure 11. Confirmed rubella cases by sex and age group in the UK from 2001 to 2017



In recent years cases have become sporadic with most classified as imported or import related and the RVC for Measles and Rubella Elimination declared that the UK eliminated endemic transmission of rubella in 2015.

Figure 12. Imported, import-related and endemic rubella cases in the UK from 2001 to 2017. (n=348)



1.6 Rubella infections in pregnancy (RIP) and congenital rubella infections (CRI)

The National Congenital Rubella Surveillance Programme, established in 1971 at the Institute of Child Health (London) captures reports of all suspected and confirmed cases of congenital rubella captured through the Royal College of Paediatrics and Child Health's British Paediatric Surveillance Unit (BPSU).

The PHE Guidance on Viral Rash in Pregnancy[21] outlines how every suspected case of RIP should be investigated. PHE conducts enhanced surveillance of reported RIP. Paired serum samples are requested from all suspected rubella cases in pregnant women in order to confirm the diagnosis and distinguish between primary infection and reinfection. Primary rubella infection is confirmed by a combination of rubella IgM plus either rubella IgG seroconversion, detection of rubella virus RNA and/or detection of low avidity rubella antibody. Rubella reinfection is distinguished by a significant increase in rubella IgG that has high avidity. The outcome of pregnancy and live birth (if relevant) is followed up and a

range of samples (cord blood, placenta, urine and OF) are collected from mother and baby for analysis.

Congenital rubella infection (CRI) is confirmed by detection of rubella IgM in serum or OF and/or detection of rubella RNA in body fluids. Infants with clinical features consistent with CRS are classified as CRS cases. Where possible retrospective laboratory investigations of maternal pregnancy samples are carried out for infants whose mothers were not previously diagnosed with infection in pregnancy.

Between 2010 and 2016, 13 RIP cases were diagnosed across the UK (0.19 infections per 100,000 pregnancies each year). This is a reduction from 18 infections in pregnant women that occurred in the previous seven years (0.27 rubella infections per 100,000 pregnancies each year, 2003-2009). Of the 31 infections identified in pregnancy over this fourteen year period, four were considered to have had a reinfection and 27 were primary infections. The risk to the fetus of subclinical maternal reinfection in the first 16 weeks gestation has not been precisely determined, but an overview would suggest the risk of congenital damage is less than 10%, and probably less than 5%. Maternal reinfection with a rash is very rare; it can be presumed to present a significant, but not quantified, risk to the fetus as viraemia will have occurred.

Almost all women diagnosed with a primary RIP between 2003 and 2016 were not born in the UK[22]. Country of origin was known for 21 out of the 27 women identified (78%) during this period and 20 (95%) of them were non-UK born. Origin of infection was known for 22 (81%) of the women, with 14 (64%) of them acquiring their rubella infection outside the UK. Only one of the mothers who had been infected in pregnancy had documentation of any prior immunisation with a rubella containing vaccine.

There were five CRS cases identified through the detection of RIP. Seven further cases were found through laboratory investigation of babies by the PHE VRD or the National Congenital Rubella Surveillance Programme. In these seven cases it was known that maternal infection was acquired abroad in rubella endemic countries. CRS rates fell from an average 0.17 per 100,000 live births annually between 2003 and 2009 to 0.05 per 100,000 between 2010 and 2016; a reduction of 71%. This fall was due to no babies being identified with CRS post-delivery in the most recent period.

1.7 UK population susceptibility to measles and rubella

In order to inform the development of recommendations and priority actions to be taken forward in the strategy up to date estimates of population susceptibility were

required. Population susceptibility can be measured either through seroprevalence surveys or through analyses of historical vaccine coverage data by birth cohort.

There is currently no established infrastructure to support a nationally representative UK sero-survey and resource would need to be identified and a case made for the added value such an exercise would bring. The residual blood sample scheme has been used in the past to estimate population susceptibility, however this has not been repeated because of concerns around the representativeness of the sample population. The scheme used excess diagnostic serology samples collected from NHS labs. The majority of samples from children were from a population undergoing chemotherapy or haematology investigations and the samples from young adults originated primarily from Genitourinary Medicine (GUM) clinics. Neither of these groups are thought to be representative of the general population and vaccination behaviour is likely to be significantly different to that of the general population, particularly for children with complex medical conditions and those who are immunosuppressed.

For this strategy PHE undertook new analyses of vaccine coverage data to generate population susceptibility estimates for measles and rubella by birth cohort for England.

1.7.1 Routine monitoring of MMR vaccine coverage

In England, MMR vaccine coverage has been estimated since its introduction in 1988 through the Cover of vaccination evaluated rapidly (COVER) programme using data from local Child Health Information Systems (CHISs)[23]. Prior to this, coverage estimates were generated for the routine single measles vaccine and the selective schoolgirl rubella vaccine programme.

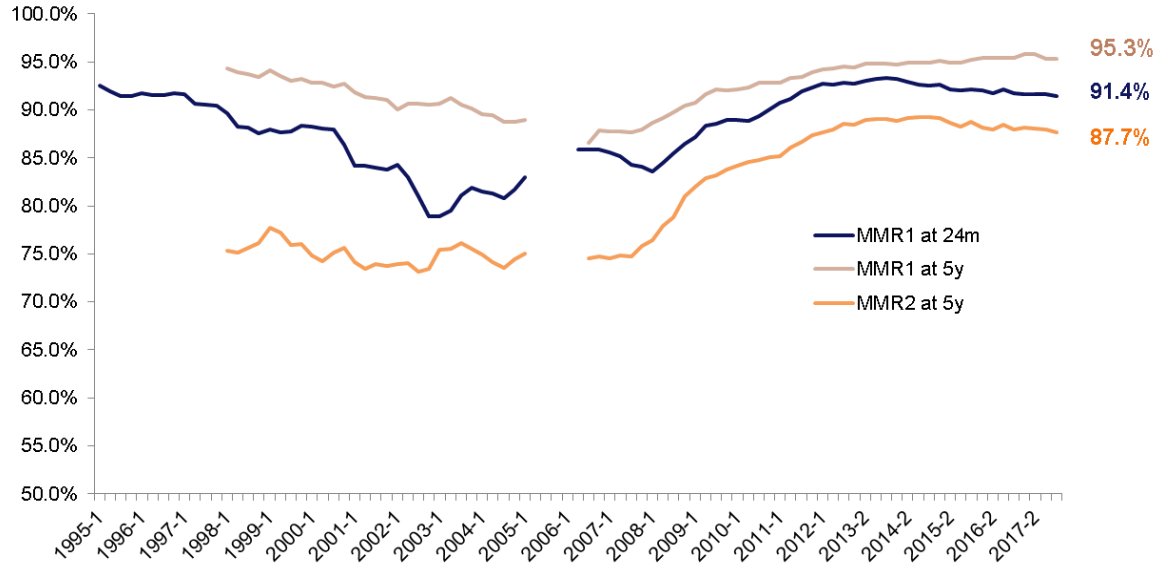
MMR vaccine coverage estimates are calculated as the proportion of individuals receiving MMR out of the total eligible responsible population in every local authority (LA) (i.e. those registered with a GP in the area and any additional unregistered individuals residing in that LA). Although the data extraction process varies from one CHIS to another, the specifications are standardised so that data is comparable across the country. Local and national MMR coverage estimates at 2 years (1 dose) and 5 years (1 dose and 2 doses since the introduction of the second dose in 1996) are published quarterly[24] and annually[25]. Vaccine coverage is one of the key elimination indicators that PHE reports on annually to the WHO RVC on behalf of the UK. However COVER data represent a snap shot in time for a particular birth cohort and are not updated as individuals get caught up with vaccination over time.

In 2012, an additional annual sentinel vaccine coverage collection was established using ImmForm, an online platform extracting immunisation data automatically from participating general practices in England (approximately 95% of GP practices in

England). This was used to generate baseline MMR vaccine coverage for 2 to 18 year olds in September 2012 ahead of NHS transition, and was used to monitor the impact of the 2013 MMR catch-up campaign.

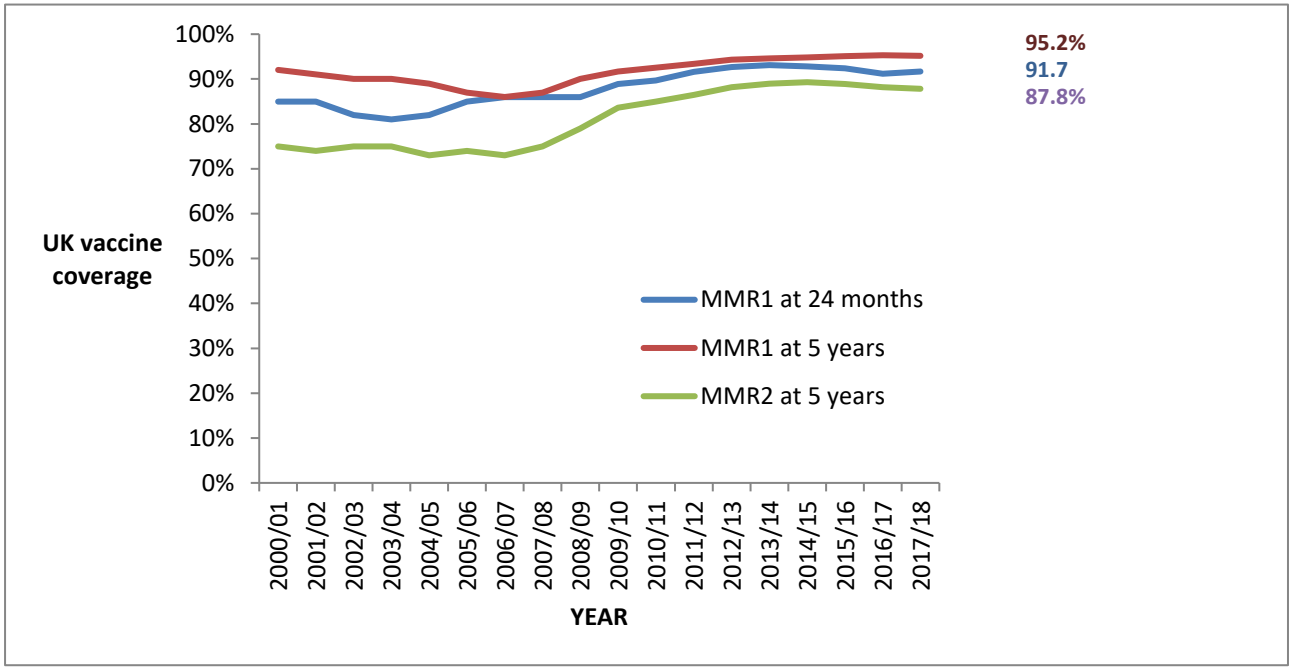
In 2015 this collection included MMR coverage for each birth cohort from 1985 onwards (individuals up to the age of 30) for approximately 45% of GP practices around the country. Unlike the COVER collection, this collection includes MMR vaccinations given at any age and includes anyone who arrived in England at any point in their lives, providing they are currently registered with a GP. Data quality is dependent on the completeness and accuracy of clinical coding at the practice level. Not all practices will retrospectively enter electronic vaccination records of vaccines given in previous practices or abroad, and those that do may not record these vaccinations using the correct clinical codes. As individuals get older and move practices data quality declines and vaccine coverage is underestimated. This means that vaccine coverage among adults born abroad before 2000 is not currently reliably captured. The evaluation of the 2013 MMR catch-up campaign showed that about 40-60% of individuals are incorrectly categorised as 'unvaccinated' in CHIS records and that this misclassification was more significant in older children and adults, and in London[26].

Figure 13. UK quarterly MMR coverage at 24 months and 5 years: April 1995 to March 2017.*



* N.B. Technical issues in 2005 and 2006 led to a temporary interruption of COVER data

Figure 14. UK annual MMR coverage at 24 months and 5 years: 2000/01* to 2017/18



*2001/01 to 2007/08: MMR1 and MMR2 at 5 years for England only

1.7.2 Birth cohort vaccine coverage and susceptibility estimates

In order to achieve a more accurate estimate of population susceptibility in England, MMR vaccine coverage estimates were calculated for each birth cohort from 1985-1986 to 2013-2014 using a combination of:

i) historical COVER (CHIS) data: Three vaccine coverage under-ascertainment scenarios were applied to annual vaccine coverage estimates, with assumptions made of a 10%, 25% or 50% misclassification of unvaccinated and under-vaccinated individuals within each cohort.

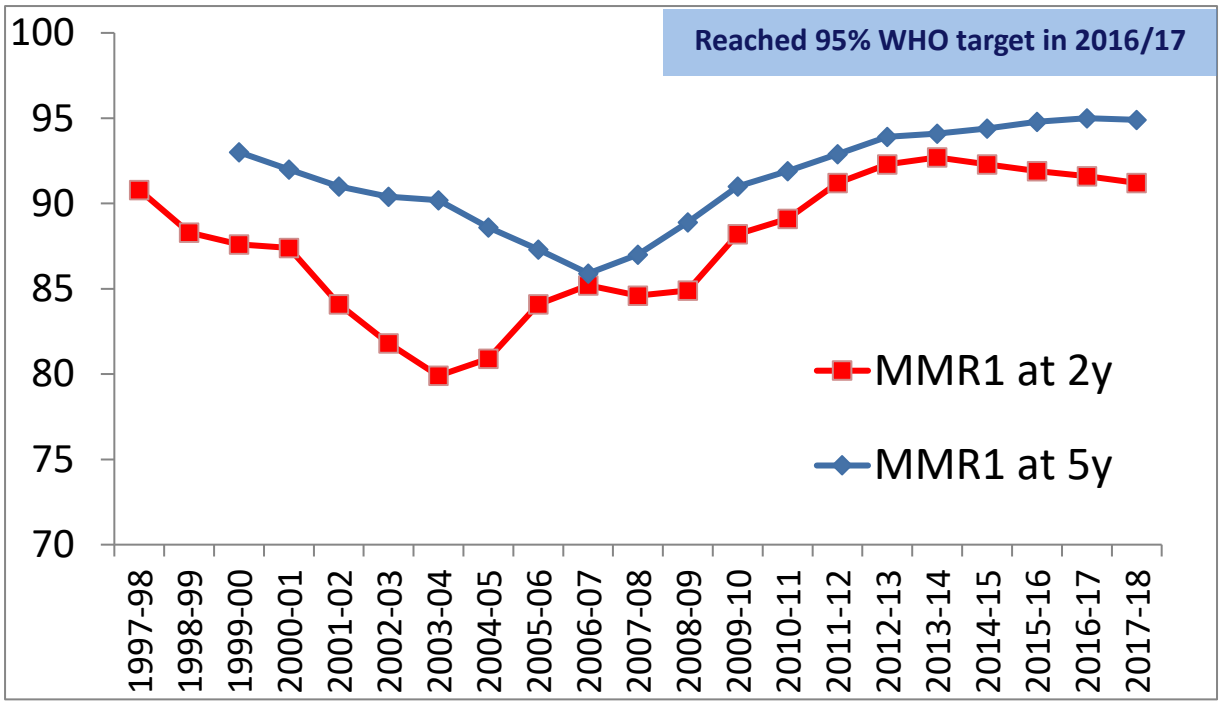
ii) ImmForm[27] (GP) data (extracted in 2016)

iii) coverage estimates for catch-up campaigns from 1985 to date (either using internal PHE data or published estimates[26,28] were applied to relevant cohorts:

a. MMR catch-up (2013)
b. MMR catch-up (2008)
c. MMR capital-catch up (London only, 2004)
d. MMR2 catch-up (1996)
e. Measles-Rubella (MR) catch-up (1994)
f. MMR catch-up (1988)

In England, MMR coverage is high, although the WHO targets of a 95% national coverage with one dose at two years and two doses at 5 years have never been achieved (See Figure 15). Nationally, MMR1 coverage at two years has been decreasing since 2013/14 (cohort born in 2011/12); this has been corroborated from coverage estimates extracted from both child health and GP IT systems, coverage at 2 years was 91.2% in 2017/18. MMR first dose as measured at five years reached 95% for the first time in 2016/17 and was 94.9% in 2017/18. Uptake of the second MMR dose by age five years was 87.2% in 2017/18[29].

Figure 15. MMR 1 coverage at two and five years of age, England 1997/8-2017/18



Vaccine effectiveness of 95% and 99.75% were assumed for one and two doses respectively, as well as no natural immunity. Susceptibility for each cohort was calculated nationally and for London as the proportion of individuals in the birth cohort likely not immune despite any routine or supplementary vaccination activities. (See Table 2)

A summary of overall population susceptibility for England and London is presented in Table 2 overleaf.

Table 2. Population susceptibility estimates for England and London

	National		London	
Under-ascertainment scenarios (%misclassification of unvaccinated and undervaccinated individuals)	Median susceptibility (%)	Range (%)	Median susceptibility (%)	Range (%)
10	8	2-12	11	2-16
25	7	2-11	9	2-13
50	5	1-9	6	1-9

The so called 'Wakefield cohorts' born in the late nineties and early 2000s (born between 1998 to 2004) have the highest proportion of susceptible individuals and this is even more pronounced in London.

In addition, when London is excluded from the analysis the cohorts born between 2008-2009 to 2010-2011 (aged 6 to 9 years in 2017) do meet the 95% MMR1target.

MMR1 coverage estimates were lower in primary care (ImmForm) data compared with child health (COVER) records (median 3.9%, range 1.5 - 5.3%) for the cohorts born from 2000-2001 to 2010-2011. In cohorts born prior to 2000-01, primary care data quality decreases and coverage is not interpretable.

The higher coverage in ImmForm compared with COVER in London for cohorts born 2000-2003 could result from the London specific capital catch up campaign increasing coverage in London, from a technical issue affecting London CHISs during this period causing a coverage underestimate[30], or a combination of both. Overall, the small difference between the two data sources suggests there are no large groups of unvaccinated foreign-born children in England and that little vaccination happens after 5 years of age. Low primary care data quality in older cohorts precludes estimating coverage or susceptibility in foreign-born adults- they remain a group with unknown coverage or susceptibility.

1.7.3 Target immunity levels and population immunity gaps

The herd immunity threshold for measles is often quoted at 90-95% for the whole population. In the 1990s the WHO European Region derived age-specific target immunity profiles, or the levels of immunity necessary in different age groups to achieve elimination[31]. Gaps in immunity can exist despite high routine MMR coverage if coverage targets were not met in the past, or because of population mixing patterns and migration. Funk and colleagues have recently updated these age-specific immunity targets taking into account the latest evidence around mixing

patterns in different age groups and settings[32]. The key message from this research is that 95% immunity needs to be achieved for each cohort at the time of school entry to guarantee elimination.

The England measles susceptibility estimates for each birth cohort were assessed against the age-specific immunity targets. (See Appendices 1 to 3). This analysis reveals that population immunity currently reaches sufficient levels in the youngest cohorts (born 2007-2008 to 2013-2014), in part because slightly lower levels of immunity are required to interrupt transmission in this age group than in the oldest cohorts (born 1985-1986 to 1988-1989). The immunity gap for England and London is most pronounced for the cohorts born between 1998-1999 and 2003-2004 (aged 14 to 19 years in 2017) who were negatively impacted by the fall in childhood vaccine coverage following the Wakefield scandal and have yet to be fully caught up despite several campaigns. Immunity levels in these cohorts are well below what is required to interrupt transmission of measles.

Compared with the rest of the England, London remains more vulnerable with immunity targets not achieved for the vast majority of the cohorts included in this analysis. The drivers for this are complex. London has a highly dynamic, mobile and diverse population with a significant proportion born abroad and therefore under-vaccinated communities are over-represented whilst data capture and quality remain a challenge.

Even in a scenario of high coverage under-ascertainment, measles susceptibility in England is likely to be sufficient to sustain disease transmission in particular age cohorts and in areas with lower coverage.

1.8 Under-vaccinated communities

There are inequalities in vaccine uptake by ethnicity, deprivation and geography and the burden of measles and rubella falls disproportionately on some communities. National Institute for Health and Care Excellence (NICE) guidance on Reducing differences in the uptake of immunisations[33] describes groups of children and young people who are at risk of not being fully immunised, for example, unregistered children, younger children from large families, children with learning disabilities and those from non-English speaking families. The main barrier to vaccination is access to immunisation services that meet the needs of the community. However there are also communities whose religious or cultural beliefs result in low or delayed vaccine uptake. Herd immunity extends the benefits of the national immunisation programme to unvaccinated individuals thus intrinsically reducing inequalities, however the extent of this effect will depend on overall vaccine coverage and population mixing patterns. When large numbers of unvaccinated individuals live in close proximity their communities become vulnerable to outbreaks.

Four case studies featured here highlight some of the issues and challenges faced by under-vaccinated communities.

Case study 1: Charedi Orthodox Jewish community in Hackney

The London borough of Hackney is home to one of the largest Charedi Orthodox Jewish communities, outside Israel and New York. The Charedi community was already established in Stamford Hill in the 1920s but the population increased significantly during the Second World War as new arrivals fled the Holocaust[34]. Membership of the community is not systematically recorded in medical records but is estimated at around 30,000. Immunisation uptake within the community is consistently lower than the rest of the borough and the rest of England. For example in the fourth quarter of 2014-15 General Practices serving the Charedi community achieved 78% uptake of MMR1 at 2 years of age compared to 86% in the rest of the borough[35]. Sub-optimal immunisation coverage has led to recurrent outbreaks of vaccine preventable diseases with measles outbreaks occurring in the borough of Hackney in 2007 and 2013. During these outbreaks the Charedi community suffered a higher burden of disease, with an estimated rate of measles five to tenfold higher than the rates observed in the rest of the population. The rate of measles for the Charedi community from 2006 to 2013 was 117 per 100,000 population compared to a rate of 29 per 100,000 for the rest of the Hackney population[35]. Due to close links with Charedi communities in other parts of the world, measles was exported from the UK to other countries including Israel[36] and Belgium[37].

Interventions such as: i) employing Charedi nurses to work with the community, ii) offering immunisation in community venues such as children's centres and iii) cultural awareness training for health professionals working with the community have been implemented with varying success. However a lack of rigorous evaluation and long-term recurrent funding within the context of an ever changing immunisation commissioning and provision landscape means that many interventions have been short lived.

More recently PHE and NHS England in collaboration with WHO Europe used the 'Tailoring Immunisation Programmes' (TIP) approach with the Charedi community. TIP was developed by WHO Europe to identify susceptible populations, determine barriers to vaccination and implement evidence-based interventions. The approach draws on health programme planning models, including the medical humanities, the social and behavioural sciences[38]. Community members and religious leaders were involved at all stages of the project and were key to its success. The chief Rabbi with responsibility for health who is very pro-vaccine and a representative from the Interlink foundation (an umbrella organisation for Orthodox Jewish charities) were keen supporters of the project and advocated for wider community engagement.

There was no evidence of religious or community-wide anti-vaccination beliefs. Due to larger than average families, there were significant issues with provision of and access to immunisation services within General Practice. Other issues identified included lack of up to date community specific communications, a need for improved recording of community membership and evaluation of any community specific interventions. The TIP report provided a series of recommendations for local commissioners and providers of immunisation services**Error! Bookmark not defined.**[35].

There are two smaller Orthodox Jewish communities in Greater Manchester (population, 11,000[39]) and Gateshead (population, 5,000) who also have lower than average immunisation uptake e.g. MMR1 coverage in Salford is around 60%. Some success in raising uptake has been achieved by implementing community specific interventions such as immunisation clinics in community settings, Sunday and domiciliary visits. Funding has also not been secure and often discontinued and rigorous evaluations of interventions are lacking.

Case study 2: Traveller communities

The majority of travellers in England are Irish Travellers, Gypsies or Roma. Irish travellers can be traced back to 12th Century Ireland, with migrations to Great Britain in the early 19th Century. The Irish Traveller community is categorised as an ethnic minority group under the Race Relations Act, 1976 (amended 2000); the Human Rights Act 1998; and the Equality Act 2010. Romani Gypsies have been in Britain since at least 1515 after migrating from continental Europe during the Roma migration from India. There are other smaller groups of Travellers who may travel through Britain, such as Scottish Travellers, Welsh Travellers and English Travellers.

Approximately half of all Travellers, Gypsies and Roma in the UK live in ‘bricks and mortar’ housing, many directly as a consequence of a shortage of Traveller sites. The majority (77%) of Travellers, Gypsies and Roma living in caravans live on either privately funded permanent authorised sites (46%) or on socially rented LA sites (31%). A minority of Travellers, Gypsies and Roma live on what are described as unauthorised sites (23%), of these approximately 10% own the land they are living on and 13% are camping on either private or LA land[40]. It is widely accepted that Travellers, Gypsies and Roma have some of the worst outcomes for a wide range of social indicators including health when compared to other communities.

In the 2011 census 58,000 people in England and Wales identified themselves as ‘Gypsy or Irish Traveller’ when the option was added to the ethnic classification for the first time[41]. This figure is thought to be conservative as it excludes non-white Gypsies and Travellers and non-Irish Travellers. Other estimates are based on

caravan counts or LA accommodation requirements. The traveller movement estimates that there around 120,000 travellers in England[42] and another survey carried out by the university of Salford estimated up to 500,000 indigenous and migrant Gypsies and Travellers[43].

Membership of traveller communities is not currently recorded or monitored by the NHS therefore assessing immunisation uptake and developing services to meet community needs can be challenging. A mapping exercise carried out in 2010 found that despite improvements in the provision of specialist services for the Gypsy, Traveller and Roma communities in England, only 16% o(PCTs were able to provide an estimate of vaccine coverage in Traveller communities. The majority of PCTs that could provide data estimated MMR1 uptake at less than 70%. The study concluded that there is an ongoing need to improve knowledge of population numbers and to provide accessible services that are culturally sensitive and responsive to the needs of Gypsy Traveller communities[44]. In 2015 an immunisation audit in a General Practice in the East of England serving a high proportion of Irish Travellers found that only 45% of Irish Traveller children had two MMR doses by 5 years of age compared to 90% of non-Traveller children. This General Practice had a good relationship with the local Traveller population and so coverage elsewhere could be even lower[45].

The low immunisation coverage rates are reflected in an increased disease burden and frequent outbreaks of vaccine preventable diseases in the Traveller communities[1],[2]. A retrospective analysis of 2006 to 2009 case management data estimated the excess risk of measles infection to be over one hundred fold[47].

The UNITING study[48] team carried out an interview study with Travellers and service providers followed by workshops to identify priorities. The study identified good examples of specialist immunisations services but these were not universally available. The researchers also highlighted that ‘recent cuts in funding and dispersal of public health expertise since the 2013 NHS reforms are hindering the co-ordinated and multi-agency approach advocated by those with the knowledge of the health needs of these communities’.

The study confirmed that the majority of Travellers are pro-vaccine and that most concerns and access issues were similar to those of the wider population. There were some community specific issues such as feeling judged unfavourably by some health professionals because of their lifestyle. Another qualitative study[49] also identified common barriers and facilitators to uptake of immunisations across all Traveller communities and confirmed that these were similar to those documented for the general population. All Roma communities experienced additional barriers of language and being in a new country. Men and women described similar barriers and facilitators although women spoke more of discrimination and low literacy. There was broad acceptance of childhood and adult immunisation across and within

communities, with current parents perceived as more positive than their elders. A minority of English-speaking Travellers worried about multiple/combined childhood vaccines, adult flu and whooping cough and described barriers to booking and attending immunisation. Language, literacy, discrimination, poor school attendance, poverty and housing were identified as barriers across different communities. Trustful relationships with health professionals were important and continuity of care valued.

The UNITING study participants identified and prioritised five interventions to improve immunisation uptake:

1. Cultural competence training for health professionals and frontline staff
2. Identification of Travellers in health records to tailor support and monitor uptake
3. Provision of a named frontline person in General Practices to provide a respectful and supportive service
4. Flexible and diverse systems for booking appointments, recall and reminders
5. Protected funding for health visitors specialising in Traveller health, including immunisation

Case study 3: Anthroposophic communities

Anthroposophy is a spiritual movement based on the teachings of Rudolf Steiner, an Austrian philosopher who suggested that febrile illnesses such as measles could benefit a child's spiritual development, and consequently parents may view immunisation negatively. It is generally accepted that the Steiner philosophy leads to a higher level of parents refusing or postponing vaccination until the child is older when compared to the wider population. It is not possible to estimate the numbers of people following the Steiner philosophy and their children's immunisation status as this information is not systematically recorded but there are a number of Steiner-Waldorf schools[50], early years providers and Camphill communities throughout England where under-vaccinated populations are vulnerable to vaccine preventable diseases.

The schools are a mixture of independent and state funded academies that have received Steiner accreditation or are affiliated. The Camphill communities provide care for people with special needs. Adults with learning disability live amongst co-worker families including their children, in active communities with a strong work ethic. There are 23 Camphill centres in England (schools, colleges for adolescents, training centres and working villages)[51]. Whilst there is no official Steiner-Waldorf position on immunisation, the schools do not generally promote immunisation or facilitate school based programmes.

Outbreaks of measles have occurred in Steiner schools and centres with spread to

other Anthroposophic communities. The vast majority of cases have been in unvaccinated members of the community[52,53,54] with some spread between communities[52] nationally and internationally and the wider population[53]. Interventions to improve uptake can be challenging due to the belief that the diseases bring spiritual development. Le Menach *et al*[53]. found that supplementary immunisation activity following an outbreak affecting the community was a successful strategy with a 114% increase in doses given the previous year. This was a more successful strategy in those whose children had a previous dose of MMR compared to those than those with no previous vaccinations[54]. Learning from local response to outbreaks in Steiner schools in England since continues to support this.

Case study 4: Migrants

A recent report from WHO Europe shows that migrants are more likely to be under-immunised—putting them at increased risk of vaccine-preventable diseases circulating in Europe—and may face greater disease, disability, and deaths from vaccine-preventable diseases than the host population.
The European Centre for Disease Prevention and Control (ECDC) noted that cross-border migration within the region has contributed to large measles outbreaks spreading to several countries with suboptimal vaccination coverage in Europe in 2017 and 2018.
Data show that newly arrived migrants to Europe have lower rates of vaccine coverage than the host population and might present with incomplete vaccination history or missing documentation of previous vaccinations. In the UK immunisation status should be checked at the GP practice on registration and new migrants should be brought up to date with the UK schedule for free. This can be a complex process if the patient's vaccination records are in a foreign language and the schedule of the country of origin differs from the UK. Health care workers (HCWs) may also mistakenly believe that European migrants will be up to date with their vaccinations, when in fact, many European countries have historically had low MMR uptake. It is also challenging to update these patients' vaccination record in the GP IT system and so even when vaccinated they may appear as 'unvaccinated' in the system.

Several measles outbreaks in the UK in 2017 and 2018 have been linked to importations from Europe, particularly Romania, with initial spread concentrated within the Romanian and other under vaccinated communities. Many of the cases were unregistered and did not speak English and so community engagement and outreach was a key component of outbreak response. Alternative service provision through domiciliary vaccination and community clinics were essential to ensure contacts were immunised.

European studies have highlighted that migrant women are less likely than native women to be immunised for rubella and the vast majority of RIP cases in the UK are in non-UK born women who were unvaccinated and also at greater risk of exposure to infection as they regularly travel to rubella endemic countries or have friends and

relatives who visit from those countries.

Compounding these issues are migrant's exposure to key social determinants including poor living conditions and disparities in access to health services on arrival due to language barriers, inability to pay, cultural beliefs, and fear of discrimination.

Consistently high levels of migration across Europe, coupled with low national MMR uptake in many countries, poses a challenge to achieving measles and rubella elimination in the Region.

1.9 High risk settings - healthcare related exposures

Although there is no evidence that HCWs have lower MMR uptake than the general population, the fact that they are in close contact with patients means that they are at increased risk of both catching measles and spreading it to patients and colleagues. A recent ECDC rapid risk assessment[55] on the measles situation in Europe highlighted HCWs as an important group to target as part of broader measles control plans. The cluster data presented in Figure 7 confirms that measles exposures in health care settings pose a significant burden in terms of transmission of infection. Due to the number of people HCWs are in contact with, the potential for onward spread of any infection is significant. This can result in amplification of measles transmission in health care settings but also in the community. Unvaccinated HCWs also pose a serious infection risk to vulnerable patients in whom measles infection can have very serious consequences.

In addition to the disease burden for individuals, outbreak management in health care settings is resource intensive. There are also implications for staff management as unvaccinated HCWs who are exposed to measles infection have to be excluded from the workplace to protect patients and colleagues placing an additional burden on other staff. An outbreak report from 2013 details an unvaccinated HCW who became infected with measles from an unvaccinated paediatric patient. Following infection the health protection team identified 110 contacts including patients, staff, and visitors. One 10 month old infant went on to develop measles[56].

In 2018 NHS Improvement issued a letter with recommended actions in response to an increase in healthcare-associated measles exposures and reminding trusts of their Occupational Health and Infection Control responsibilities.

1.10 National MMR programme delivery

The NHS public health functions agreement Service specification No.10[57] underpins national and local commissioning practices and service delivery of the MMR immunisation programme in England.

Immunisation against infectious disease[58] (known as 'The Green Book'), issued by PHE, provides guidance and the main evidence base for the programme. This should be read in conjunction with additional evidence, advice and recommendations issued by the Joint Committee on Vaccination and Immunisation[59] (JCVI) and the national guidance[15] on the public health management of cases, contacts and outbreaks.

PHE is responsible for the procurement and supply of the MMR vaccine (a combined live attenuated vaccine) for the national immunisation programme, working alongside the Department of Health and Social Care Commercial Directorate to deliver efficiencies and ensure continuity of supply to the NHS. GP surgeries and other providers such as school immunisers order vaccine direct from PHE using the 'ImmForm' website[60], volumes are determined locally to meet needs. GPs and other providers can order vaccine 24 hours a day and receive a delivery once a week, although this can be expedited for outbreak response purposes.

Nurses based in General Practices offer registered patients MMR vaccine according to the routine schedule, with first MMR dose offered at 1 year and the second MMR dose offered at 3 years and 4 months at the time of the pre-school booster. Individuals with uncertain or incomplete immunisation histories, including newly registered patients who have migrated to the UK should be brought up to date at the earliest opportunity as per national guidance[15].

The routine childhood immunisation programme is also supported by health visitors who at mandated baby visits at the ages of 10 to 14 days, 6 to 8 weeks and 1 year promote and discuss immunisations with parents[61].

Many countries around the world have not had a robust MMR programme and so patients without clear evidence of vaccination should be offered two doses of MMR – there are no negative effects from vaccinating people who are already immune. There is no upper age limit to offering MMR vaccine and GP practices and school immunisation services should maximise opportunities to ensure that patients are fully vaccinated. Other opportunities to offer catch up doses of MMR include entry into higher education, enlistment into the armed forces, prior to foreign travel and employment or study in the healthcare sector.

Catching up children aged 15 years or younger in primary care is covered under the global sum. An item of service fee can be claimed manually via the CQRS MMR

programme (aged 16 and over) for each dose of MMR administered to patients aged 16 years or over. This includes patients born before 1970 who have no history of measles or MMR. MMR is particularly important for women of child-bearing age, and should be assessed for example during consultation for contraceptive services, fertility problems, cervical screening, following miscarriage or termination of pregnancy and postnatally prior to hospital discharge and at the 6-8 week maternal check[61]. Post-natally, health visitors also have opportunities to assess mother's MMR immunisation status at the mandated new baby review (10 to 14 days) and 6 to 8 week assessment. It should be noted that central MMR vaccine stock can be used to catch-up anyone of any age.

The national S7A MMR service specification highlights key opportunities for school-based catch-up which has the potential of reaching unregistered children, unimmunised children who did not attend primary care for their immunisations and new-entrants to the UK. The evidence suggests that school-delivered immunisation programmes including catch-up are more equitable and can be more efficient in areas where MMR coverage at age 5 years is below the national average.

A high level of knowledge and a positive attitude to immunisation in healthcare practitioners are widely acknowledged as being important determinants in achieving and maintaining high vaccine uptake[62,63,64]. It is important that immunisers are confident, knowledgeable and up to date. PHE has published national training standards and core curriculum[65] for immunisers, which together with the Green Book, Vaccine Update[66], training slide sets and an e-learning module, support the delivery of a high quality programme. PHE also provide a suite of public facing online materials such as free to order leaflets, posters and social media banners that are available on the gov.uk website and the NHS website[67].

1.11 Monitoring vaccine safety and pharmacovigilance

The Medicines and Healthcare Regulatory Agency (MHRA) has a statutory responsibility across the UK to evaluate the safety, quality and efficacy of vaccines, medicines and medical devices. The UK Commission on Human Medicines (CHM) is the independent expert advisory body which advises the MHRA on the safety of vaccines and medicines.

Underpinning vaccine and medicines pharmacovigilance in the UK is the Yellow Card Scheme, which has been in operation since 1964. This is a voluntary reporting system through which any healthcare professional or member of the public can report a suspected adverse drug reaction (ADR) to any vaccine or medicine on the UK market. A Yellow Card report is not proof of a side effect occurring, but a suspicion by the reporter that the vaccine or medicine may have caused the side effect. Yellow Card reports may therefore relate to true side effects or they may be coincidental.

As well as using clinical judgement to detect new safety signals from the cumulative Yellow Card data, MHRA uses specialised IT software and statistical approaches, including disproportionality analyses, to systematically generate potential 'signals' from the Yellow Card data. MHRA also routinely evaluates all sources of safety data including clinical and epidemiological studies, published medical literature, and information from other regulatory authorities as well as pharmaceutical companies. MHRA also has access to electronic health record sources and record linkage databases such as the Clinical Practice Research Datalink (CRPD) and conducts ad hoc evaluation and research using such data, which may include near real-time 'observed vs expected' analysis, active safety surveillance of 'adverse events of interest', and formal epidemiological studies.

For any major new safety signals arising from its pharmacovigilance activities, MHRA has in place processes to obtain independent expert advice on the balance of risks and benefits from CHM and its sub-committees. Sharing international experience is also very important in vaccine pharmacovigilance, and MHRA works within a European regulatory framework in vaccine pharmacovigilance and also works closely with non-EU international counterparts.

The suggestion of a link between MMR vaccination and development of autism came to prominence following a paper by Andrew Wakefield *et al* published in *The Lancet* in 1998 which has since been withdrawn[10]. Around this time, the Committee on Safety Medicines established an independent MMR Working Party, which concluded that the available evidence did not support the alleged association or give cause for concern about the safety of MMR or MR vaccines. In 1999, *The Lancet* published a large epidemiological study[68] in North Thames region, which found no evidence of an association between MMR vaccine and autism. Over the next decade, several additional large epidemiological studies from a range of countries have consistently supported this conclusion. *The Lancet* subsequently retracted its 1998 paper after it emerged that conflicts of interest in the original study had not been disclosed, and the General Medical Council's findings regarding Andrew Wakefield's misconduct which led to him being struck off the General Medical Register in 2010. A 2014 meta-analysis of studies including over a million children confirmed that childhood vaccinations including MMR were not associated with the development of autism. There remains no credible scientific evidence that MMR vaccine or other vaccines cause autism[69].

1.12 Monitoring parental attitudes to vaccination

Parental attitudes, experiences and socio-economic background, influence whether a child receives a vaccine. Personal experience and knowledge of diseases influence perceptions about the seriousness of diseases and the likelihood of a child being affected[70]. In countries like the UK, where the national immunisation

programme is very well established, the challenge is maintaining high levels of vaccine coverage. In the absence of disease, the threat of that disease rapidly disappears and anxieties about the vaccine's safety may increase. A fall in vaccine coverage can lead to the return of disease as happened in the UK when rates of MMR immunisation fell from 1998 onwards as a consequence of loss of public confidence due to the negative publicity around the vaccine.

In 1991, the first of a series of surveys was undertaken in England to track parents' attitudes and experiences of immunisations and their recall of programme information materials. These surveys have improved understanding of parental views on: the seriousness of diseases that the vaccines prevent; concerns about vaccine safety; the type and amount of information they need; the service provided and what influences parental decisions to vaccinate. They provide a wealth of information on parents' perceptions and how they have changed over time and have been used to inform the planning and implementation of the national programme.

Interviews are carried out at the parents' home address with sampling undertaken to ensure a nationally representative sample. Prior to wave 24 (March 2003), interviews were carried out with mothers of children aged 0-2 years only. Wave 24 was the first wave in which men were eligible for the interview; provided they were the child's primary care giver (the person responsible for most of the decisions about the child's health care). In 2010 when the survey additionally included parents of children aged 3-4 years for the first time, the sample size was increased from 1000 parents overall to a minimum of 1,000 interviews among parents of 0-2 year olds and 1,000 interviews among parents of 3-4 year olds.

Prior to the 1998 survey the pertussis vaccine had caused parents the most concern due to a previous vaccine scare. Following the Wakefield paper and media hype around it, parental confidence in the MMR vaccine fell and despite a recovery in perception it wasn't until 2010 following the 2009 H1N1 flu pandemic that the 'swine flu' vaccine took over as being of most concern.

A paper published in 2007[71] detailed attitudes to the MMR over the first ten years of the surveys which tracked very clearly the impact of the vaccine controversy on parental confidence in the safety vaccine and the subsequent return to a more positive view of the vaccine (see Figures 16, 17, 18). In 2010 around eight in ten parents believed most vaccinations, including MMR, to be either completely safe or just a slight risk.

Figure16. Perceived safety of the MMR vaccine (1998-2006)

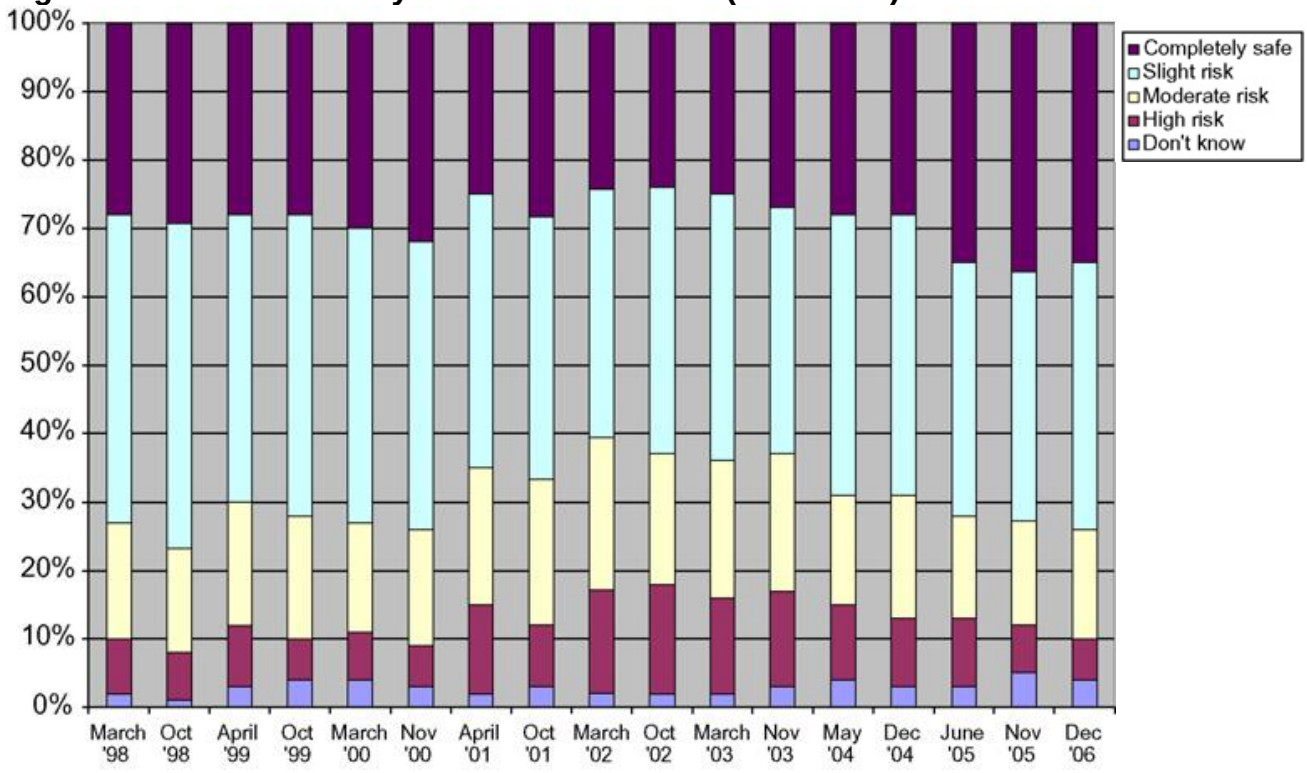
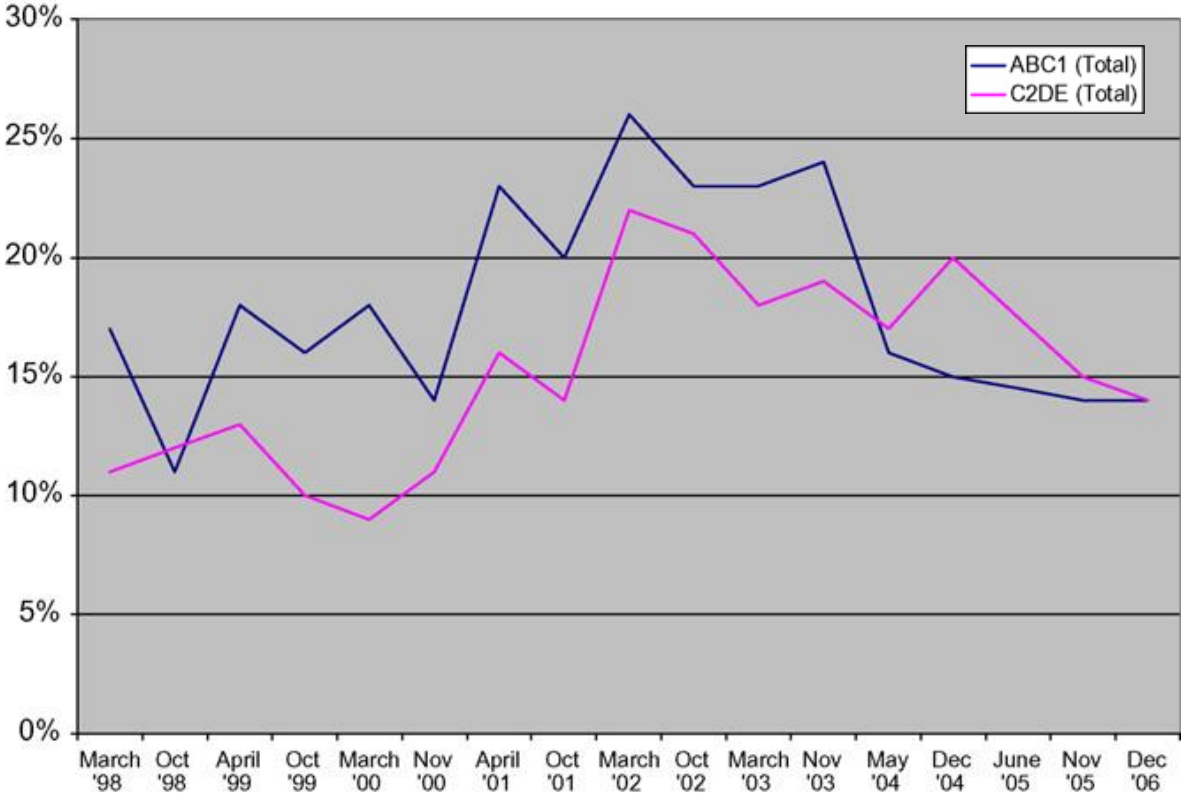
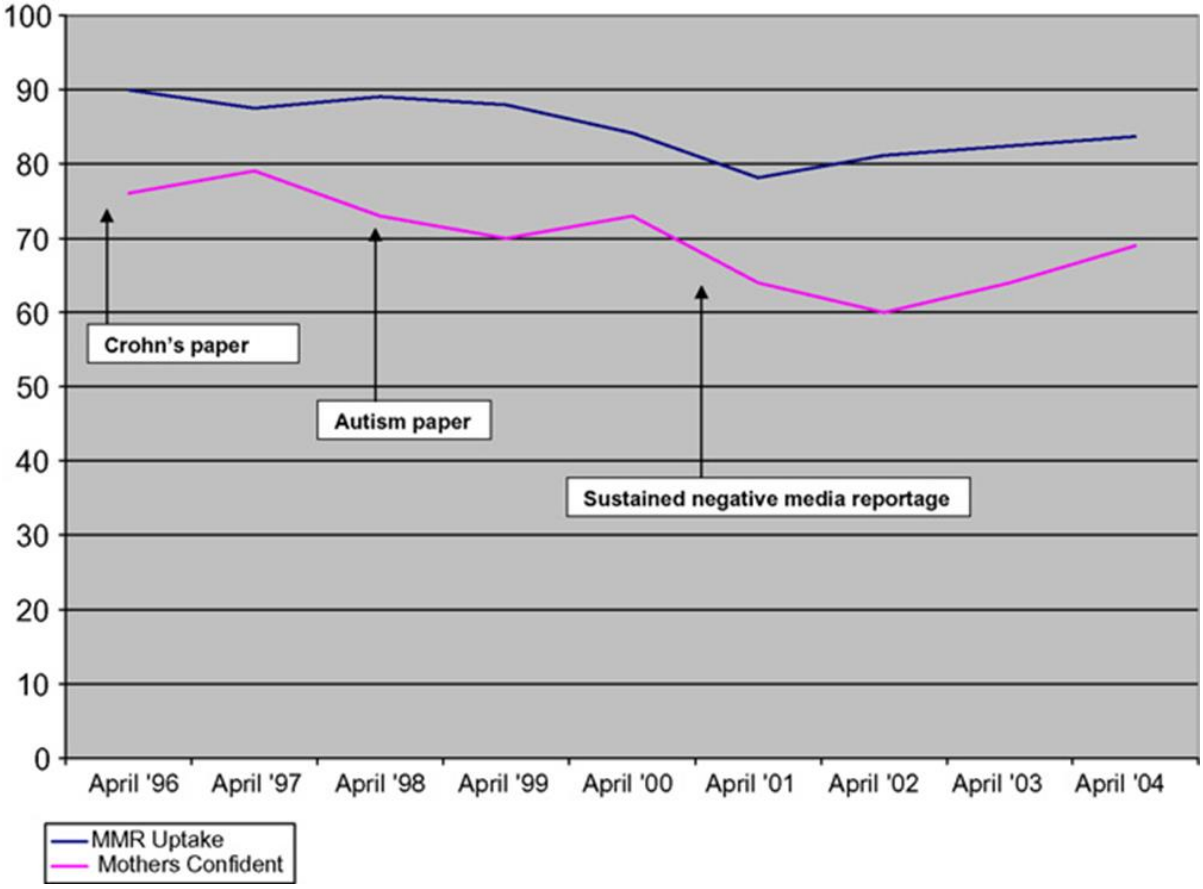


Figure 17: Proportion of parents who consider MMR a greater risk than the disease it protects against by social grade*



* Social grade is the socio-economic classification used by the Market Research and Marketing Industries based on the occupation of the main earner in the household. ABC1 refers to largely managerial and supervisory roles and C2DE refers to skilled, semi-skilled manual roles and the unemployed.

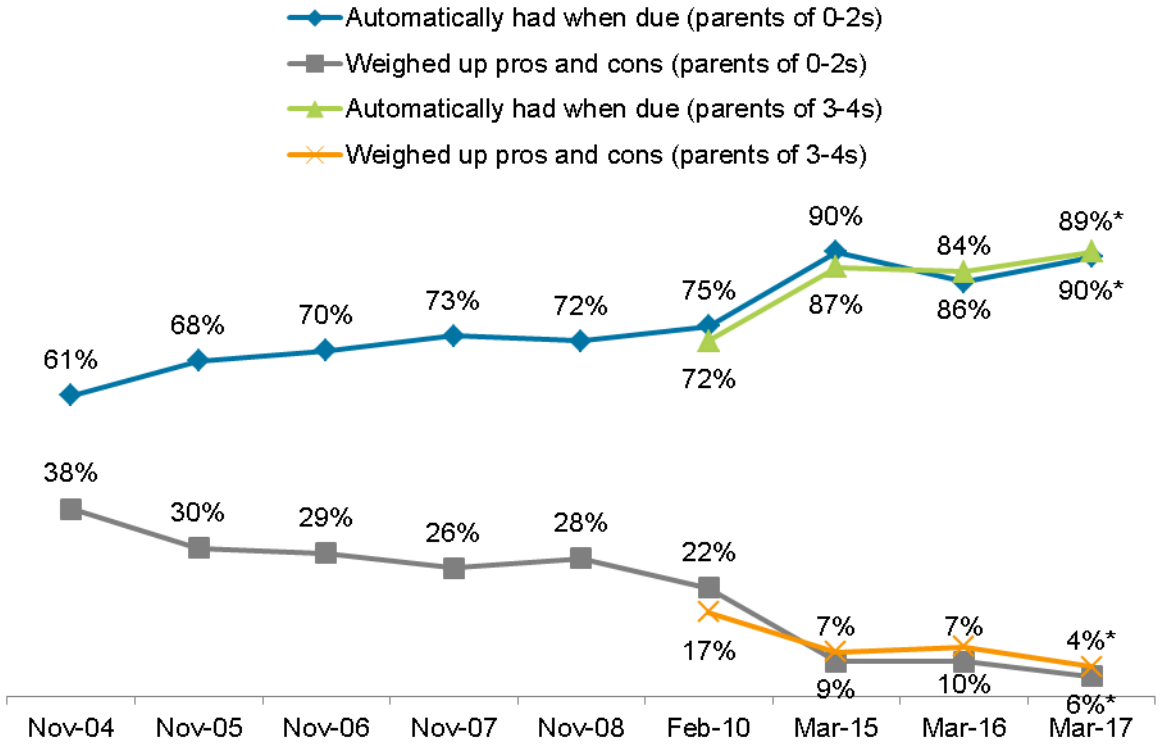
Figure 18: MMR vaccine coverage at 16 months (1996-2004) and proportion of mothers' confident in MMR vaccine (MMR completely safe or only poses a slight risk)



After a four year hiatus the surveys were started again in 2015. Ninety percent of parents reported having their child's immunisations done when they were due in 2015 compared to 72% reporting this in 2010. Only 2% of parents refused any vaccination and 7% delayed an immunisation (most of these went on to have it done later). MMR continued to be the most recalled vaccination with 84% of parents spontaneously naming it, down from 92% 2010. 80% of parents believed that the MMR vaccine was either completely safe or just a slight risk. There was also a significant increase in parents who believed that measles was a very serious disease up from 29% to 38%, perhaps reflecting the increased awareness of the disease due to a number of community outbreaks.

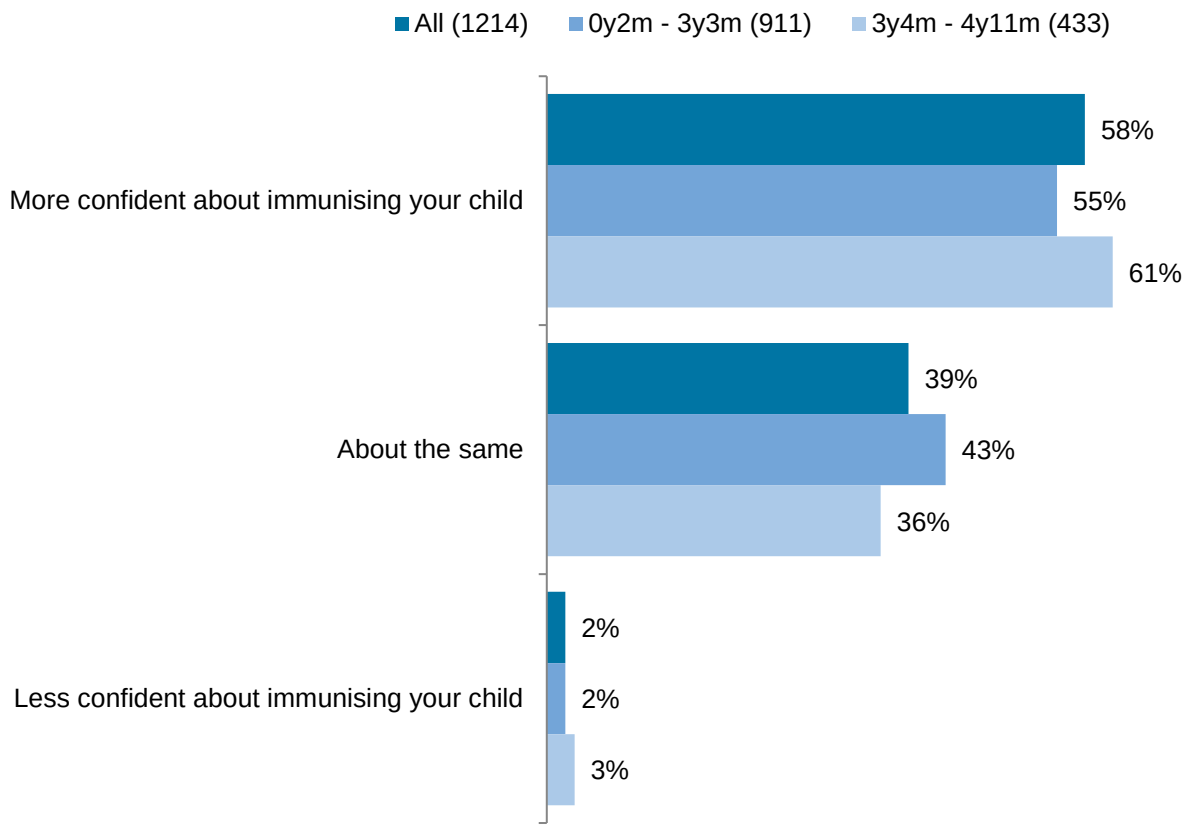
The most recent survey (2017) shows that the large majority of parents continue to be confident in the immunisation programme (93%), with 52% saying they were very confident. Around 90% of parents made the decision to immunise automatically. Only 23% of parents of 0-2 year olds who weighed up the pros and cons before deciding to vaccinate, mentioned MMR specifically in 2017 this is a steep decline from 88% of parents in 2008.

Figure 19: Proportion of parents (of 0-2 year olds and of 3-4 year olds) who automatically had child immunised or weighed up pros and cons (2003- 2017)



Health professionals are seen as the most trusted source of information (63% strongly agreed in 2017). Over 70% of parents had a discussion with a health professional before their child was immunised. Although prior to these discussions 86% of parents intended to fully immunise their child, 52% said they felt more confident following the discussion. Among parents of 0-2 year olds, 13% who had not intended to immunise changed their mind following discussion. The impact of discussions with a health professional was even greater in parents of 3-4 year olds with 22% changing their mind and deciding to go ahead and immunise, this proportion was even higher among parents from Black and Minority ethnic groups (29%) and among first time parents (38%).

Figure 20: Confidence in immunisation after discussion with health professional(s)



Only 7% (n=111) of all parents said they had seen or heard something that would make them doubt having their child(ren) immunised. Messages about side effects and MMR were the most likely to raise doubts. Although the overall numbers are small 34% of parents found these messages on the Internet, particularly social media sites such as Facebook and Twitter.

Section 2. Monitoring progress toward measles and rubella elimination

2.1 European Framework for measles and rubella elimination verification

The WHO European Region published a framework for the verification of measles and rubella elimination[72] in 2014 which describes the steps that need to be taken to document and verify that the elimination of measles and rubella has been achieved at the country and regional level.

The following **essential criteria** are required to verify elimination of measles and rubella in the UK:

- the absence of endemic measles and rubella cases for a period of at least 12 months from the last known case, due to complete interruption of endemic virus transmission;
- the presence of a high-quality surveillance system that is sensitive and specific enough to detect, confirm and classify all suspected cases; and
- genotype and sequencing evidence that supports the interruption of endemic transmission.

These essential criteria have to be supported by **evidence-based** information submitted to independent external panels of leading public health experts i.e. the NVC and the RVC on an annual basis to determine whether the UK has achieved and or sustained elimination. PHE takes on a coordination role on behalf of the UK to collate the annual report for submission to the NVC.

In addition a set of **measurable** surveillance performance indicators (see Table 3) and two markers (see Box 2) determine whether the national surveillance system provides timely and sufficient information based on pre-established quality criteria.

Table 3. Standard WHO indicators and targets for measuring performance of measles and rubella surveillance

Indicator	Description	Target
Timeliness of reporting (T)	Percentage of measles or rubella routine reports[a] submitted to national level by the deadline[b] *A:* number of reports submitted by the deadline *B:* number of expected reports *T* = (*A* * 100) / *B* (%)	≥80%
Completeness of reporting (C)	Percentage of measles or rubella routine reports[a] submitted to national level *E:* number of submitted reports *B*: number of expected reports *C* = (*E* * 100) / *B* (%)	-
Rate of laboratory investigations (L)	Percentage of cases suspected for measles or rubella with adequate specimens[c] collected and tested in a proficient laboratory[d] Note: Exclude from the denominator any suspected cases not tested by a laboratory and (a) confirmed by epidemiological linkage, or (b) discarded as non-measles/non-rubella by epidemiological linkage to a laboratory-confirmed case of another communicable disease or epidemiological linkage to a measles or rubella immunoglobulin M- (IgM) negative case. *F:* number of suspected measles or rubella cases with adequate specimens collected and tested in a proficient laboratory *G:* number of suspected cases *L* = (*F* * 100) / *G* (%)	≥80%
Rate of discarded cases (D)	The rate of suspected measles or rubella cases investigated and discarded as non-measles or non-rubella cases using laboratory testing in a proficient laboratory[d] and/or epidemiological linkage to another confirmed disease *H:* number of suspected measles or rubella cases investigated and discarded as non-measles or non-rubella cases *J:* population *D* = (*H* * 100 000) / *J*	**at least 2 discarded measles or rubella cases per 100 000**
Representativeness of reporting discarded cases (R)	Percentage of subnational administrative territories (e.g. at province level or its administrative equivalent) reporting the rate of discarded cases (*R*) at least 2 per 100 000 population per year *K:* number of subnational administrative territories reporting the rate of discarded cases (*R*) at least 2 per 100 000 population per year *M:* number of subnational administrative territories *R* = (*K* * 100) / *M* (%)	≥ 80%
Viral detection (V)	Percentage of laboratory-confirmed chains of transmission of measles or rubella with samples adequate for viral detection collected and tested in an accredited laboratory[e] *P:* number of chains of transmission of measles or rubella for which adequate samples have been submitted for viral detection/genotyping *Q:* number of chains of transmission identified *V* = (*P* * 100) / *Q* (%)	≥ 80%
Origin of infection identified (O)	Percentage of measles or rubella cases for which the origin of infection (e.g. imported, import-related or endemic) has been identified *W:* number of measles or rubella cases for which the origin of infection (e.g. imported, import-related or endemic) has been identified *X:* total number of measles or rubella cases *O* = (*W* * 100) / *X* (%)	≥ 80%
Timeliness of investigation (I)	Percentage of suspected measles or rubella cases with an adequate investigation[f] initiated within 48 hours of notification *Y:* number of measles or rubella cases with an adequate investigation *Z:* number of suspected measles or rubella cases, respectively *I* = (*Y* * 100) / *Z* (%)	≥ 80%

[a]Each surveillance reporting unit is to submit regular monthly or weekly reports, including "zero" reports.

[b] The deadline to submit data on the previous month or week is to be defined by the Member State.

[c] A single clinical sample obtained at the first contact with the health care system at any time within 28 days after rash onset is considered adequate for surveillance purposes (5)

[d]A proficient laboratory is WHO accredited and/or has an established quality assurance programme with oversight by a WHO accredited laboratory(6).

[e]Measles and rubella viruses can be detected in nasal secretions, urine, serum and whole blood, and dry blood spots up to seven days after onset of rash and in oral fluid for even longer (5).

[f] An adequate investigation includes the collection of at least the following essential data elements from each suspected measles/rubella case: case identifier, age (or date of birth), date of rash onset, date of specimen

Box 2. Measles and rubella eliminations markers

Vaccination coverage

The target for population immunity is the achievement and maintenance of **at least 95% coverage** annually with both first and second doses of measles and/or rubella vaccines in all districts (or their administrative equivalents) and at national level.

Incidence

The target for incidence is **< 1 measles or rubella case per million total population**. The numerator is the total number of measles cases, including laboratory-confirmed, epidemiologically linked and clinically compatible cases but excluding imported cases.

2.2 Measles and Rubella surveillance

2.2.1 Case-based surveillance

Measles (since 1940) and rubella (since 1988) are statutory notifiable infectious diseases. National enhanced surveillance of measles and rubella was introduced in November 1994 and laboratory notifications became statutory in October 2010. In line with WHO recommendations, countries with an elimination target are required to have intensive case-based surveillance to detect, investigate and confirm every suspected case. Notifications are made on suspicion or diagnosis of clinical disease without a case definition and clinicians are legally required to report any suspected cases to the appropriate officer of the local government authority. Notification of the local HPT fulfils the responsibility to notify the LA Proper Officer.

In England, Northern Ireland and Scotland local HPTs record clinical notifications of measles and rubella in real-time onto HPZone. Wales uses the Tarian case and incident management system with similar functionality. HPZone is a web based tool used for clinical and public health investigation and management of notified cases and outbreaks. HPZone data are accessible at the national level and used for surveillance purposes, although the level of national access varies by devolved administration. These systems ensure that we achieve WHO **targets for completeness (C) and timeliness (T) of reporting** of suspected cases to the national team.

Cases in HPZone are assessed for public health management by the health protection teams and then classified as confirmed, probable, possible or discarded. The public health assessment of measles and rubella cases is triggered on notification to the HPT ensuring **timeliness of investigation (I)**. Data from HPZone in England is extracted annually and reconciled with testing data from the National Reference Laboratory (WHO lab) and local and regional laboratories (WHO proficient). This step ensures that suspected cases that have been referred for measles and or rubella testing but not notified to the HPT are also captured. A similar process is undertaken in Wales and Northern Ireland, however Scotland do not currently have limited ability to link HPZone data to laboratory data.

The WHO classifies suspected measles cases on the basis of clinical symptoms (see Definitions section). However when measles is not endemic, the positive predictive value of a clinical diagnosis is generally poor and so to enhance the sensitivity of the surveillance system in the UK the suspected case definition is broader.

Box 3. Measles and rubella suspected case definition

Suspected case of measles[15]:

- any person in whom a clinician suspects measles infection, **OR**
- any person with fever **and** maculopapular rash (i.e. non-vesicular) **and** one of the following: cough or coryza (runny nose) or conjunctivitis (red eyes)

Suspected case of rubella:

- any person in whom a clinician suspects rubella infection, **OR**
- any person with fever **and** maculopapular rash (i.e. non-vesicular) **and** one of the following: arthralgia/arthritis or lymphadenopathy

In practice that means that in **England** 'suspected' measles/rubella cases include:

i) all possible, probable and confirmed cases on HPZone

ii) all clinically suspected cases that had a sample submitted for measles and or rubella testing to a PHE regional lab (positive and negative polymerase chain reaction (PCR) tests reported through DataMart) or national lab (MOLIS/LIMS) even if they were not notified to the local HPT

iii) all cases with an IgM positive serology test from regional and local labs (reported through PHE's Second Generation Surveillance System (SGSS) and Micropath)

iv) all cases that are measles RNA positive

2.2.2 Enhanced surveillance

All confirmed measles and rubella cases (regardless of where they were tested) are followed up by the national team with an enhanced surveillance form sent to their General Practitioner (GP) / requestor of testing. The information returned is entered onto a national database (Dataease). In England this is supplemented by information extracted from HPZone and laboratory records (SGSS, Datamart, MOLIS). (See Box 4).

Box 4. Measles and rubella enhanced surveillance form

Demographic details: name, sex, DOB, address, NHS number

Clinical features

- **Signs and symptoms** including onset dates of rash
- **Hospitalisation**

Individual epidemiological features

- **Travel:** any travel within and outside the UK during the incubation period, with an assessment of whether travel was in an area where measles is known to be circulating
- **Ethnic and cultural/religious background:** details on the patient's ethnicity, and whether the patient is a **member of an under-vaccinated population group** (e.g. Charedi Orthodox Jewish community)
- **Immunisation history:** any known vaccination history or history of measles
- **Epidemiological link:** assess if there has been a known epidemiological link with another laboratory or epidemiologically confirmed case

Pregnancy

2.2.3 Laboratory surveillance

The two key standard WHO indicators and targets for measuring the performance of national measles and rubella surveillance systems are the **rate of laboratory investigations (L)** (at least 80% of suspected cases) and the **rate of discarded cases (D)** (at least 2 per 100,000 population). In order to achieve these targets our focus is on ensuring that all suspected cases are appropriately tested.

IgM serology testing and OFT are the only two tests considered adequate by WHO for confirming and importantly discarding suspected measles and rubella cases. Measles PCR can be used for confirmed measles cases but NOT for discarding cases; rubella PCR is not considered sensitive enough for surveillance purposes. In order to facilitate universal testing of suspected cases for surveillance purposes OF testing was rolled out in 1994. Feedback from patients and parents suggests that, as a non-invasive test which is quick and easy to conduct, the OFT is highly acceptable. The National Infection Service (NIS) supplies each HPT with the OFT kits which are posted directly to the suspected cases for self-administration (or administration by the parent). The kit includes the swab, a request form and a sheet with instructions on how to take the sample and a package with pre-paid postage addressed to the VRD in Colindale which is a WHO Global Specialised Reference Laboratory for Measles and Rubella.

The OF samples are tested for virus-specific IgM, IgG measles RNA, and can therefore: i) reliably exclude measles and rubella diagnosis, as well as confirm it; ii) indicate whether the case is a primary or reinfection; and iii) genotype confirmed cases.

Return rates of the OFTs vary by area depending on how the service is organised locally. Paradoxically it is often challenging to get an OF sample on hospitalised patients who will have undergone multiple diagnostic investigations and so neither clinician nor the patient may understand the importance of submitting the OFT.

All positive diagnostic samples, such as serological samples, tested either through a regional PHE laboratory (entered on the DataMart database), a local NHS hospital laboratory (entered on the SGSS database) or private laboratory should be promptly forwarded to the VRD at Colindale for confirmatory testing which is conducted free of charge. In addition all regionally or locally confirmed cases should also get an OF sample taken.

Samples that have been confirmed positive for measles or rubella are further sequenced and entered on the WHO global Measles Nucleotide Surveillance (MeaNS) or the Rubella Nucleotide Surveillance (RubeNS) databases respectively which are hosted at the VRD, Colindale. Genotyping and further characterisation of measles and rubella is used to support investigation of transmission pathways and sources of infection. This system ensures we meet WHO targets for **Viral detection (V)** and **Origin of Infection identified (O)** and generates essential evidence to support confirmation of measles and rubella elimination status.

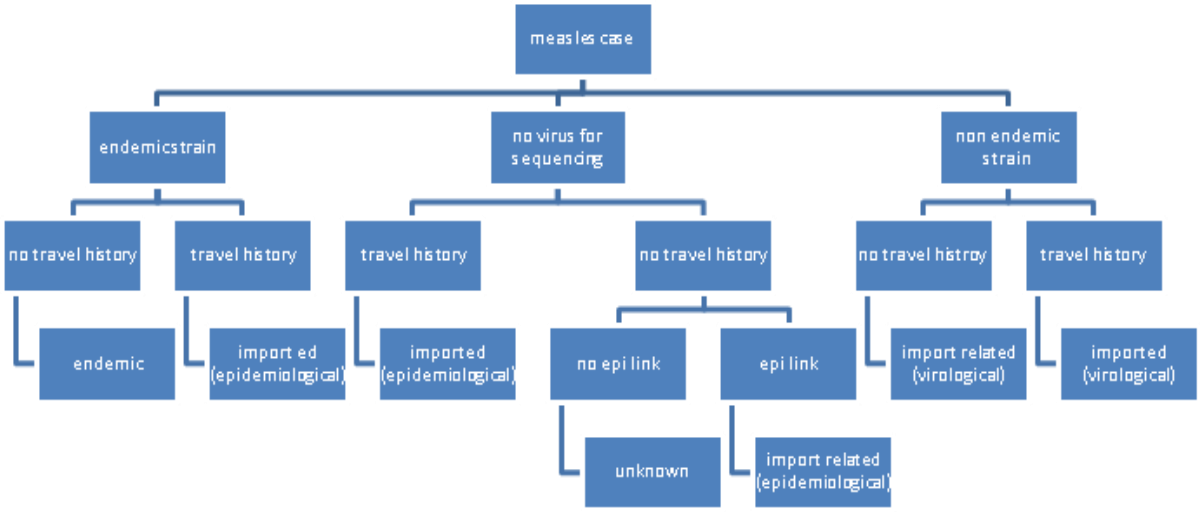
A subset of OFT samples that test negative for measles at VRD are subsequently tested for rubella and vice versa, if sufficient sample allows. This helps to increase the sensitivity of our surveillance system at a time when the positive predictive value of a clinical diagnosis for both of these infections is very low. It also ensures that we are meeting the required WHO discard rate of at least two discarded measles or rubella cases per 100,000 population which in practical terms requires a large throughput of samples to be maintained.

Results from all samples tested at Colindale are reported on the MOLIS/LIMS system and reported back to the patient's GP and local HPT. HPTs can also track samples and access the results which have been processed by the VRD in the previous 100 days through the MrEP site[73].

2.2.4 Case classification

For WHO reporting purposes cases are also classified as endemic, imported or import-related. Figure 21 depicts the decision tree used to classify cases using a combination of travel history, virological and epidemiological information.

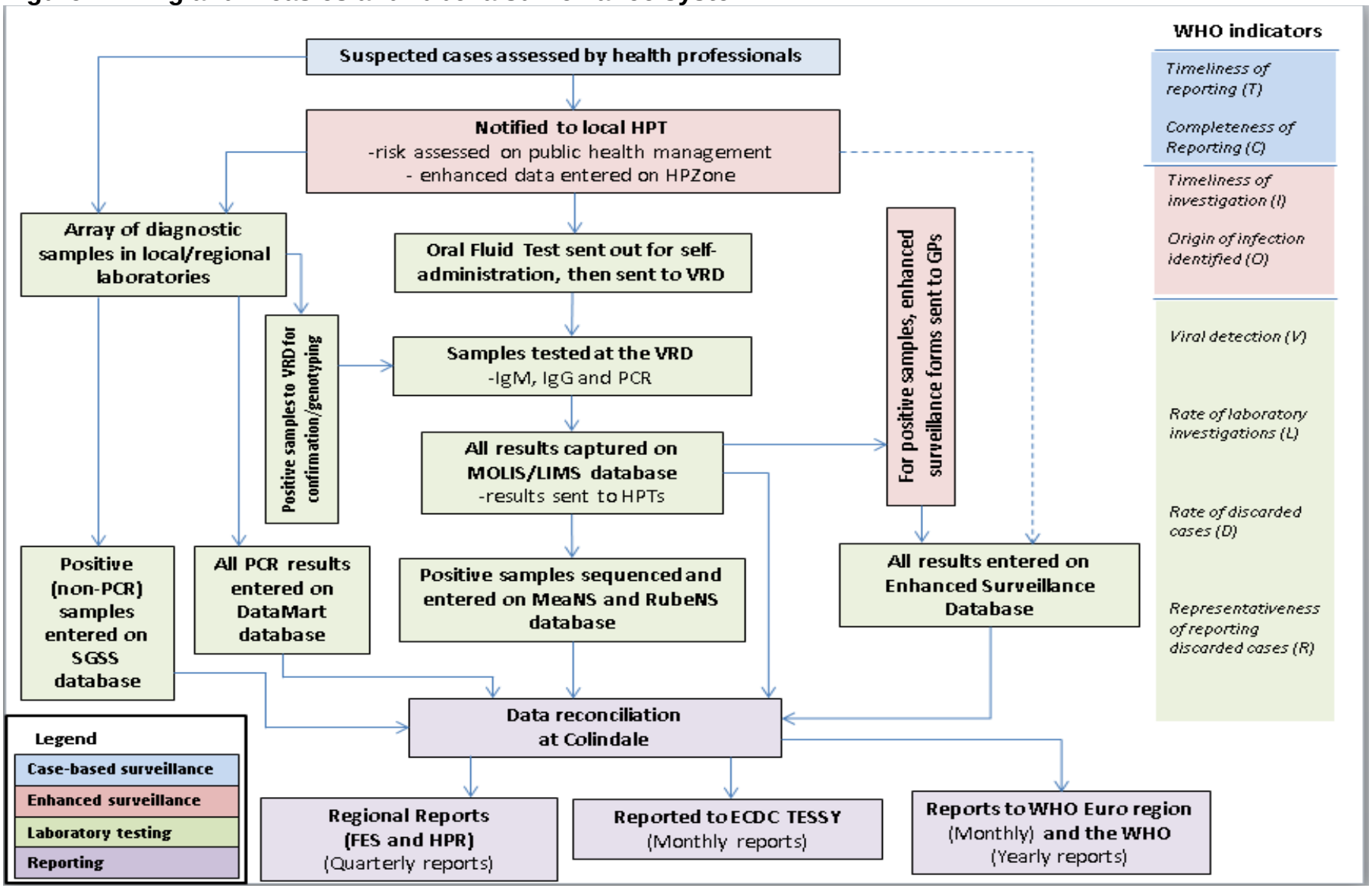
Figure 21. Classification of imported, import-related and endemic cases



2.2.5 Reporting

Data is extracted from the various databases (including MOLIS/LIMS, MeaNS, RubeNS, DataMart, SGSS, HPZone and the enhanced surveillance database Dataease) and reconciled by the national team. NIS is responsible for monthly reporting of epidemiologically and laboratory confirmed cases to the European Surveillance System, TESSy on behalf of the UK. This information is then forwarded to the WHO Region for Europe. VRD also report monthly data on the numbers of samples tested for measles to the WHO laboratory network via the Centralized Information System for Infectious Diseases (CISID). An annual report is compiled by PHE on behalf of the UK and is independently assessed by the NVC and submitted to the WHO Europe RVC.

Figure 22. England measles and rubella surveillance system



--------- Information only sought for positive cases through HPZone data.

Section 3. Achieving and maintaining elimination – how do we get there?

The evidence on how to achieve measles and rubella elimination is clear and the Region of the Americas demonstrated that it can be done at scale in 2016. In this section we capture the key recommendations for action for UK stakeholders to deliver on our commitment to maintain elimination. Recommendations are framed under four key building blocks in line with the strategy set out by WHO Europe:

1) Achieve and sustain ≥ 95% coverage with two doses of MMR vaccine in the routine childhood programme (<5 years old)

2) Achieve ≥ 95% coverage with two doses of MMR vaccine in older age cohorts through opportunistic and targeted catch-up (>5year olds)

3) Strengthen measles and rubella surveillance through rigorous case investigation and testing ≥80% of all suspected cases with an OFT

4) Ensure easy access to high-quality, evidence-based information for health professionals and the public

1. Achieve and sustain ≥ 95% coverage with two doses of MMR vaccine in the routine childhood programme (<5 years old)

95% immunity in the population needs to be achieved at the time of school entry in order to guarantee measles elimination. The WHO target of ≥ 95% uptake with the first dose of MMR (MMR1) at age 2 years and with two doses of MMR (MMR2) at age 5 years has never been achieved nationally. In addition MMR1 coverage at two years has been decreasing since 2013-14. Coverage for this vaccine is now at 91.2%, the lowest it has been since 2011-12. In England we achieved 95% uptake of MMR1 by age 5 years for the first time in 2016. London and the South East were the only two regions not to meet this target.

In order to achieve the 95% uptake with two doses of MMR by age 5 years the following actions need to be taken forward.

1.1 Strengthen routine national immunisation programme

Stakeholders to work collaboratively at the national and local level to address:

1.1.1 gaps in funding, commissioning, delivery and quality assurance of immunisation training

1.1.2 gaps in workforce planning and increasing pressure on the capacity of:

- primary care workforce, in particular practice nurses
- school immunisers
- health visitors

1.1.3 input into the implementation of NHS England's "Healthy Children: transforming child health information" strategy to ensure that it supports the elimination of Measles and Rubella

1.2 Investigate and address national decline in MMR1 coverage in cohorts born since 2011/12

1.2.1 local teams to develop an **MR elimination action plan** in partnership with local stakeholders which should include:

i) analysis of barriers to achieving the 95% target for MMR 1 and MMR 2 across the patch and a plan for how to address these. This should include an assessment of:

   - call recall practices (CHIS and GP)
   - immunisation clinic accessibility e.g. appointment times, locations, waiting lists

ii) opportunistic MMR check and offer at all contact points in primary care, health visiting, attendance at childcare centres and other community settings: 'making every contact count'

iii) how existing contract levers can be used and / or changed to improve uptake of routine programme

iv) assess opportunities to improve MMR uptake when reviewing broader plans for improved local service development and integration

1.2.2 national commissioning teams to identify additional support required for worst performing areas e.g. London

2. Achieve ≥ 95% coverage with two doses of MMR vaccine in older age cohorts through opportunistic and targeted catch-up (>5 year olds)

The immunity gap for England and London is most pronounced for the cohorts born between 1998/99 and 2003/04 (aged 15 to 20 years in 2018). Immunity levels in these cohorts are well below what is required to interrupt transmission of measles.

London remains the most vulnerable region with immunity targets not achieved for the vast majority of cohorts. In addition there are inequalities in vaccine uptake by ethnicity, deprivation and geography and the burden of measles and rubella falls disproportionately on some communities. Unless these immunity gaps are addressed through the strategies outlined below England will continue to remain vulnerable to measles outbreaks particularly in age cohorts with the highest susceptibility and areas and communities with the lowest coverage.

2.1 Address gaps in evidence on population MR susceptibility

2.1.1 generate susceptibility estimates for a wide range of age cohorts across the devolved administrations – including older ages (born before 1984)

2.1.2 estimate vaccine coverage in individuals born abroad before 2000

2.1.3 consider adding national routine coverage estimates at older ages (9, 14, 18) for MMR1 and MMR2

2.2 Build on legacy of 2013 MMR catch-up campaign

2.2.1 embed opportunities to check and where necessary offer individuals with unknown or incomplete history of MMR vaccination in all relevant national:

- commissioning documents
- contracts
- guidance

Particular areas of focus include:

Primary Care

Explore including additional MMR catch-up elements in the General Medical Services (GMS) contract and develop relevant indicators for quality and outcomes framework (QOF).

School immunisation providers

National team to engage with the Department for Education to strengthen commitment to support the roll-out of the NIP and school-based catch-up.

Local teams to:

i) review school based immunisation contracts and ensure:

- they include reference to routine immunisation checks at ages 4-5yrs, 10-11yrs and mid-teens.
- MMR check /offer is added on to human papilloma virus (HPV), teenage booster and MenACWY programme delivery.

LA public health teams and education departments should support school-based delivery of the immunisation programme including catch-up.

Maternity Services

Work with maternity services and primary care to ensure:

- 100% MMR check as routine part of antenatal care

- achieve 95% uptake of post-natal MMR for women without documentary evidence of two previous MMR doses.

Health visitors

Through the Best Start in Life programme, PHE has issued guidance for commissioners on the role of Health Visitors in the national immunisation programme. This includes utilising mandated contacts at the new baby review (10 to 14 days) and the 6 to 8 week review, to promote baby immunisations and assess maternal rubella status and follow up of two MMR vaccinations[61]. Health visitors have an important role to play in supporting the immunisation programme but can also be key to making

sure unregistered children or those who are unlikely to access primary care get immunised.

2.2.2 the MR local elimination action plan mentioned in 1.2.1 should also include:

i) a local population needs assessment

ii) an assessment of how existing contract levers can be used and / or changed to embed MMR check and offer for >5 year olds

iii) using the **NICE Quality Standard** (QS145)[74] on immunisation uptake in under 19 year olds to assess how the following key components of the programme are being implemented locally and identify areas for improvement:

- Recall invitations
- Offering outstanding invitations
- Recording vaccinations
- Checking immunisation status at specific educational stages
- Checking immunisation status of young offenders and offering outstanding vaccinations

iv) an assessment of any additional activity that is required to address the immunity gap:

v) whether there is a need for an additional catch-up campaign through schools or primary care

vi) whether alternative service provision is fit for purpose and how this can be strengthened to meet the needs of the population and reduce inequalities in uptake

2.3 Address the needs of under-vaccinated communities

2.3.1 local stakeholders to work together to:

i) use the WHO TIP tool to understand and address the specific needs of their under-vaccinated populations

ii) use NICE guidance on **Reducing differences in the uptake of immunisations**[75] to implement evidence based interventions locally

iii) evaluate local interventions and disseminate learning and examples of best practice

iv) strengthen plans for alternative provision of immunisation services for underserved / unregistered communities

v) address specific recommendations already identified through evidence collated to date:

1. improve recording of community membership on primary care medical records to enable accurate measurement of disease burden and planning of services

2. ensure community involvement and leadership in developing and implementing and evaluating community specific interventions

3. consider cultural awareness training for staff working directly with specific communities

2.4 Ensure health care settings are fully prepared for measles outbreaks

2.4.1 NHS Improvement/ regulators to remind health care employers of their public health, infection control and occupational health responsibilities through a national communication.

2.4.2 Local Clinical Commissioning Groups / equivalent to ensure MMR check and offer is conducted for all staff working in health care settings.

2.4.3 Acute and community NHS trusts to seek assurance that:

- Occupational Health provision is fit for purpose and that staff MR immune status can be accessed promptly in outbreak scenarios.
- Infection Control Teams are supported to implement national measles guidance.

3. Strengthen measles and rubella surveillance through rigorous case investigation and testing ≥80% of all suspected cases with an OFT

The quality of measles, rubella and CRS surveillance activities needs to be sufficient to ensure the detection of sporadic cases and provide adequate information on both the epidemiology and the virus genotype to allow case classification (endemic or

imported/import-related). This information needs to be collected, analysed and communicated effectively and in a timely manner to enable prompt and appropriate public health action and to ensure we provide the necessary evidence to the NVC and the RVC.

3.1 National Immunisation Team to:

3.1.1 publish updated Rash in Pregnancy guidelines and updated Green Book chapters for measles and rubella

3.1.2 review measles and rubella case management algorithms/guidance for the new CIMS (web-based case management tool) and enhanced surveillance data collection tools to improve routine collection of data on suspected cases e.g. ethnicity, member of under immunised communities etc.

3.1.3 link HES data to routine surveillance data to generate more accurate data on burden of disease

3.2 Field Epidemiology Services (FES) and Health Protection Teams to:

3.2.1 lead a national audit of OF testing for suspected measles and rubella cases with the aim of identifying interventions to achieve the following elimination indicators:

- at least 80% of suspected measles and rubella cases have an OFT
- a rate of discarded measles and rubella cases (those testing negative by OF testing / IgM serology) of ≥2 per 100,000 population.

3.3 The VRD to lead on implementing interventions to ensure measles and rubella cases are confirmed and excluded on the basis of an appropriate test (not PCR) at a WHO proficient lab. This work should include:

- ensuring that sufficient measles negative samples are dual tested for rubella to provide a discard rate above 2:100,000 population
- ensuring that suspected measles and rubella cases with an adequate specimen have an IgM result reported within 4 days of receipt at the lab
- ensuring that > 80% of confirmed sporadic cases of measles and >80% of chains of transmission are sequenced and genotyped
- an audit of the OFT kits arriving at the laboratory accessions service to inform improvements in design / packaging. The aim is to reduce the

proportion of samples received with inadequate information or incorrect packaging which can lead to samples not being processed
- collaborating with the Clinical Virology Network, Field Epidemiology FES, PHE Regional Microbiology Services and NHS Trusts to conduct a survey to assess the availability of measles testing (serology, PCR) in regional and local laboratories and if samples are being appropriately referred
- explore the possibility of obtaining negative measles and rubella tests from SGSS to capture additional testing done locally

3.4 Devolved Administrations to develop country-level action plans on how to achieve:

- at least 80% of suspected measles and rubella cases being investigated by an appropriate test (e.g. IgM serology)
- at least 80% of confirmed sporadic measles cases and 80% of chains of transmission are sequenced and genotyped
- a rate of discarded measles and rubella cases (those testing IgM negative by serology / OF testing) of ≥2 per 100,000 population. To achieve this target for rubella will invariably require that all measles negative samples are dual tested for rubella

4. Ensure easy access to high-quality, evidence-based information for health professionals and the public

A national communication strategy targeted at both health professionals and the public has to underpin the national MMR programme to increase and maintain the very high levels of vaccination coverage required to achieve measles and rubella elimination.

4.1 National Immunisation Team to continue to monitor changes in attitudes to MMR vaccine through annual survey with parents and monitoring of mainstream and social media.

4.2 National Immunisation Team to:

- develop MMR resources for schools and school immunisers to use at different educational stages
- develop an MMR marketing campaign targeted at 15 to 25 year olds, encouraging them to check their status and take up MMR through primary care

- collaborate with partners at the national and local level to raise awareness about MMR at summer festivals
- work with Universities UK to develop an MMR and MenACWY Universities toolkit to support MMR check and offer for students
- develop a measles resource for LAs

4.3 Local teams to:

- support and amplify national MMR messaging through mobilisation of local partners in the health and education sectors and beyond
- work with LA partners and community engagement groups to target messages at under-vaccinated communities as appropriate

Appendix 1. Reported Vaccine Coverage (COVER) and susceptibility by birth cohort, England, 1987-2016

Birth year	MMR1 coverage (%)	MMR2 coverage (%)	Catch-up campaign	Catch up Coverage (%)	Catch-up campaign	Catch up Coverage (%)	Under ascertainment scenario	Adjusted MMR1 coverage (%)	Adjusted MMR2 coverage (%)	% susceptible	Immunity target to keep R0<1?*
2013-2014	91.4						10%	92.2		12.4	YES
							25%	93.5		11.1	YES
							50%	95.7		9.1	YES
2012-2013	91.8						10%	92.7		12.0	YES
							25%	93.9		10.8	YES
							50%	95.9		8.9	YES
2011-2012	92.6						10%	93.3		11.4	YES
							25%	94.4		10.3	YES
							50%	96.3		8.5	YES
2010-2011	94.9	87.6					10%	95.4	88.9	5.2	YES
							25%	96.1	90.7	4.4	YES
							50%	97.4	93.8	3.0	YES
2009-2010	94.6	88.4					10%	95.1	89.5	5.4	NO
							25%	95.9	91.3	4.5	YES
							50%	97.3	94.2	3.1	YES
2008-2009	94.4	88.4					10%	95.0	89.6	5.5	NO
							25%	95.8	91.3	4.7	YES
							50%	97.2	94.2	3.2	YES
2007-2008	94.2	88.3			MMR Catch-up (2008)	n/a	10%	94.8	89.4	5.7	NO
							25%	95.7	91.2	4.8	YES
							50%	97.1	94.1	3.3	YES
2006-2007	93.5	87.0				n/a	10%	94.2	88.3	6.4	NO
							25%	95.1	90.2	5.3	NO
							50%	96.8	93.5	3.6	YES
2005-2006	92.4	84.6				n/a	10%	93.1	86.2	7.4	NO
							25%	94.3	88.5	6.2	NO
							50%	96.2	92.3	4.2	YES
2004-2005	91.5	83.0				n/a	10%	92.3	84.7	8.3	NO
							25%	93.6	87.2	6.9	NO
							50%	95.7	91.5	4.7	YES
2003-2004	89.9	80.1				n/a	10%	90.9	82.1	9.7	NO
							25%	92.4	85.1	8.2	NO
							50%	94.9	90.1	5.5	NO
2002-2003	87.3	74.7	MMR (2013)	10.8		n/a	10%	88.5	77.2	11.0	NO
							25%	90.4	81.0	9.2	NO
							50%	93.6	87.3	6.2	NO
2001-2002	86.8	73.2		10.8		n/a	10%	88.1	75.9	11.4	NO
							25%	90.1	79.9	9.5	NO
							50%	93.4	86.6	6.4	NO
2000-2001	86.0	73.0		10.8		n/a	10%	87.4	75.7	12.1	NO
							25%	89.5	79.8	10.1	NO
							50%	93.0	86.5	6.8	NO
1999-2000	88.6	74.0		10.8		n/a	10%	89.8	76.6	10.0	NO
							25%	91.5	80.5	8.4	NO

						50%	94.3	87.0	5.7	NO
1998-1999	89.6	74.6		10.8	n/a	10%	90.6	77.2	9.2	NO
						25%	92.2	81.0	7.7	NO
						50%	94.8	87.3	5.2	NO
1997-1998	90.5	74.6		10.8	n/a	10%	91.5	77.1	8.5	NO
						25%	92.9	81.0	7.1	NO
						50%	95.3	87.3	4.8	YES
996-1997	90.8	74.0		10.8	n/a	10%	91.7	76.6	8.3	NO
						25%	93.1	80.5	7.0	NO
						50%	95.4	87.0	4.7	YES
1995-1996	91.7	74.2			n/a	10%	92.6	76.8	8.4	NO
						25%	93.8	80.6	7.1	NO
						50%	95.9	87.1	4.8	YES
1994-1995	92.6	74.7			n/a	10%	93.4	77.2	7.6	NO
						25%	94.5	81.0	6.4	NO
						50%	96.3	87.3	4.3	YES
1993-1994	93.5	76.4			n/a	10%	94.2	78.8	6.8	NO
						25%	95.1	82.3	5.7	NO
						50%	96.8	88.2	3.9	YES
1992-1993	94.1	74.4			n/a	10%	94.7	76.9	6.4	NO
						25%	95.6	80.8	5.4	NO
						50%	97.0	87.2	3.7	YES
1991-1992	92.4		MMR2 catch up (1996)	60	n/a	10%	93.1		8.9	NO
						25%	94.3		7.8	NO
						50%	96.2		5.9	NO
1990-1991	92.7			60	n/a	10%	93.5		8.5	NO
						25%	94.6		7.5	NO
						50%	96.4		5.7	NO
1989-1990	92.0			60		10%	92.8		9.2	NO
						25%	94.0		8.0	NO
						50%	96.0		6.1	NO
1988-1989	89.8		Measles-Rubella (1994)	92		10%	90.8		1.7	YES
						25%	92.3		1.6	YES
						50%	94.9		1.2	YES
1987-1988	87.2			92		10%	88.5		2.0	YES
						25%	90.4		1.8	YES
						50%	93.6		1.4	YES
1986-1987	90.8			92		10%	91.7		1.6	YES
						25%	93.1		1.5	YES
						50%	95.4		1.2	YES
1985-1986	77.9			92		10%	80.1		3.0	YES
						25%	83.4		2.6	YES
						50%	88.9		2.0	YES

*Immunity above 85% for 0-4 years old and above 95% for 5+

Appendix 2. Reported Vaccine Coverage (COVER) and susceptibility by birth cohort, London, 1987-2016

Birth year	MMR1 coverage (%)	MMR2 coverage (%)	Catch-up campaign	Catch up Coverage (%)	Catch-up campaign	Catch up Coverage (%)	Catch-up campaign	Catch up Coverage (%)	Under ascertainment scenario	Adjusted MMR1 coverage (%)	Adjusted MMR2 coverage (%)	% susceptible	Immunity target to keep R0<1
2013-2014	84.9								10%	86.4		17.9	NO
									25%	88.7		15.7	NO
									50%	92.5		12.2	YES
2012-2013	86.3								10%	87.7		16.7	NO
									25%	89.7		14.8	YES
									50%	93.1		11.5	YES
2011-2012	86.9								10%	88.3		16.2	NO
									25%	90.2		14.3	YES
									50%	93.5		11.2	YES
2010-2011	90.9	79.3							10%	91.8	81.4	8.9	YES
									25%	93.2	84.5	7.5	YES
									50%	95.5	89.7	5.1	YES
2009-2010	91.1	80.5							10%	92.0	82.4	8.7	NO
									25%	93.3	85.4	7.3	NO
									50%	95.6	90.2	4.9	YES
2008-2009	90.9	80.2							10%	91.8	82.2	8.9	NO
									25%	93.2	85.1	7.5	NO
									50%	95.4	90.1	5.1	NO
2007-2008	91.3	80.6			MMR Catch-up (2008)	n/a			10%	92.1	82.6	8.5	NO
									25%	93.4	85.5	7.2	NO
									50%	95.6	90.3	4.9	YES
2006-2007	90.4	80.4				n/a			10%	91.4	82.4	9.3	NO
									25%	92.8	85.3	7.8	NO
									50%	95.2	90.2	5.3	NO
2005-2006	88.4	76.3				n/a			10%	89.6	78.7	11.2	NO
									25%	91.3	82.3	9.4	NO
									50%	94.2	88.2	6.3	NO
2004-2005	86.7	72.7				n/a			10%	88.0	75.5	12.8	NO
									25%	90.0	79.6	10.7	NO
									50%	93.3	86.4	7.2	NO

2003-2004	82.7	66.9				n/a			10%	84.4	70.2	12.7	NO
									25%	87.0	75.1	10.7	NO
								24	50%	91.3	83.4	7.2	NO
2002-2003	76.9	54.4	MMR (2013)	10.8		n/a			10%	79.2	59.0	15.3	NO
									25%	82.6	65.8	12.8	NO
								24	50%	88.4	77.2	8.6	NO
2001-2002	75.6	52.0		10.8		n/a			10%	78.1	56.8	16.1	NO
									25%	81.7	64.0	13.4	NO
								24	50%	87.8	76.0	9.0	NO
2000-2001	75.8	53.9		10.8		n/a			10%	78.3	58.6	15.9	NO
									25%	81.9	65.5	13.3	NO
								24	50%	87.9	77.0	8.9	NO
1999-2000	79.0	57.3		10.8		n/a			10%	81.1	61.5	14.0	NO
									25%	84.2	67.9	11.7	NO
								24	50%	89.5	78.6	7.9	NO
1998-1999	80.0	57.2		10.8		n/a			10%	82.0	61.5	13.3	NO
									25%	85.0	67.9	11.2	NO
								24	50%	90.0	78.6	7.5	NO
1997-1998	80.2	56.9		10.8		n/a			10%	82.2	61.2	13.2	NO
									25%	85.1	67.7	11.1	NO
								24	50%	90.1	78.5	7.5	NO
1996-1997	83.5	57.7		10.8		n/a			10%	85.2	61.9	11.2	NO
									25%	87.7	68.2	9.4	NO
								24	50%	91.8	78.8	6.3	NO
1995-1996	84.7	58.9				n/a	Capital catch-up (2004)		10%	86.2	63.0	11.7	NO
									25%	88.5	69.2	9.8	NO
								24	50%	92.3	79.5	6.6	NO
1994-1995	85.0	61.5				n/a			10%	86.5	65.4	11.4	NO
									25%	88.8	71.2	9.5	NO
								24	50%	92.5	80.8	6.4	NO
1993-1994	87.7	58.1				n/a			10%	88.9	62.3	9.7	NO
									25%	90.8	68.6	8.1	NO
								24	50%	93.9	79.0	5.5	NO
1992-1993	88.1	55.7				n/a			10%	89.3	60.1	9.5	NO
									25%	91.1	66.8	8.0	NO
								24	50%	94.1	77.9	5.4	NO
1991-1992	87.6		MMR2 catch up (1996)	60		n/a			10%	88.9		10.1	NO
									25%	90.7		8.7	NO
								24	50%	93.8		6.4	NO
1990-1991	87.7			60		n/a			10%	88.9		10.0	NO
									25%	90.8		8.7	NO
								24	50%	93.9		6.3	NO
1989-1990	86.8			60					10%	88.1		10.6	NO
								24	25%	90.1		9.2	NO

					50%	93.4	6.7	NO
1988-1989	81.1	Measles-Rubella (1994)	92	24	10%	83.0	2.1	YES
					25%	85.8	1.8	YES
					50%	90.5	1.4	YES
1987-1988	77.3		92	24	10%	79.6	2.4	YES
					25%	83.0	2.1	YES
					50%	88.7	1.6	YES
1986-1987	80.0		92	24	10%	82.0	2.2	YES
					25%	85.0	1.9	YES
					50%	90.0	1.5	YES
1985-1986	67.1		92	24	10%	70.4	3.3	YES
					25%	75.3	2.8	YES
					50%	83.6	2.0	YES

*Immunity above 85% for 0-4 years old and above 95% for 5+

Appendix 3. Reported Vaccine Coverage (COVER) and susceptibility by birth cohort, England (Excl. London), 1987-2016

Birth year	MMR1 coverage (%)	MMR2 coverage (%)	Catch-up campaign	Catch up Coverage (%)	Catch-up campaign	Catch up Coverage (%)	Under ascertainment scenario	Adjusted MMR1 coverage (%)	Adjusted MMR2 coverage (%)	% susceptible	Immunity target to keep R0<1?*
2013-2014	92.8						10%	92.2		11.1	YES
							25%	93.5		10.1	YES
							50%	95.7		8.4	YES
2012-2013	93.1						10%	92.7		10.9	YES
							25%	93.9		9.9	YES
							50%	95.9		8.3	YES
2011-2012	93.8						10%	93.3		10.3	YES
							25%	94.4		9.4	YES
							50%	96.3		7.9	YES
2010-2011	95.7	89.4					10%	95.4	88.9	4.4	YES
							25%	96.1	90.7	3.7	YES
							50%	97.4	93.8	2.5	YES
2009-2010	95.4	90.2					10%	95.1	89.5	4.6	YES
							25%	95.9	91.3	3.9	YES
							50%	97.3	94.2	2.7	YES
2008-2009	95.2	90.2					10%	95.0	89.6	4.8	YES
							25%	95.8	91.3	4.0	YES
							50%	97.2	94.2	2.8	YES
2007-2008	94.8	89.9			MMR Catch-up (2008)	n/a	10%	94.8	89.4	5.1	NO
							25%	95.7	91.2	4.3	YES
							50%	97.1	94.1	2.9	YES
2006-2007	94.2	88.4				n/a	10%	94.2	88.3	5.7	NO
							25%	95.1	90.2	4.8	YES
							50%	96.8	93.5	3.3	YES
2005-2006	93.2	86.4				n/a	10%	93.1	86.2	6.6	NO
							25%	94.3	88.5	5.5	NO
							50%	96.2	92.3	3.8	YES
2004-2005	92.5	85.2				n/a	10%	92.3	84.7	7.3	NO
							25%	93.6	87.2	6.1	NO
							50%	95.7	91.5	4.2	YES
2003-2004	91.4	82.9				n/a	10%	90.9	82.1	8.3	NO
							25%	92.4	85.1	7.0	NO
							50%	94.9	90.1	4.7	YES

2002-2003	89.2	78.5	MMR (2013)	10.8		n/a	10%	88.5	77.2	9.4	NO
							25%	90.4	81.0	7.9	NO
							50%	93.6	87.3	5.3	NO
2001-2002	88.8	76.9		10.8		n/a	10%	88.1	75.9	9.8	NO
							25%	90.1	79.9	8.2	NO
							50%	93.4	86.6	5.5	NO
2000-2001	87.4	75.8		10.8		n/a	10%	87.4	75.7	10.8	NO
							25%	89.5	79.8	9.1	NO
							50%	93.0	86.5	6.1	NO
1999-2000	90.3	76.8		10.8		n/a	10%	89.8	76.6	8.6	NO
							25%	91.5	80.5	7.2	NO
							50%	94.3	87.0	4.9	YES
1998-1999	91.4	77.9		10.8		n/a	10%	90.6	77.2	7.7	NO
							25%	92.2	81.0	6.5	NO
							50%	94.8	87.3	4.4	YES
1997-1998	91.9	78.2		10.8		n/a	10%	91.5	77.1	7.3	NO
							25%	92.9	81.0	6.1	NO
							50%	95.3	87.3	4.2	YES
1996-1997	91.7	76.0		10.8		n/a	10%	91.7	76.6	7.5	NO
							25%	93.1	80.5	6.3	NO
							50%	95.4	87.0	4.3	YES
1995-1996	92.9	76.7				n/a	10%	92.6	76.8	7.3	NO
							25%	93.8	80.6	6.1	NO
							50%	95.9	87.1	4.2	YES
1994-1995	93.9	76.9				n/a	10%	93.4	77.2	6.5	NO
							25%	94.5	81.0	5.4	NO
							50%	96.3	87.3	3.7	YES
1993-1994	94.4	79.5				n/a	10%	94.2	78.8	5.9	NO
							25%	95.1	82.3	4.9	YES
							50%	96.8	88.2	3.4	YES
1992-1993	95.3	78.9				n/a	10%	94.7	76.9	5.1	NO
							25%	95.6	80.8	4.3	YES
							50%	97.0	87.2	3.0	YES
1991-1992	93.2		MMR2 catch up (1996)	60		n/a	10%	93.1		8.1	NO
							25%	94.3		7.1	NO
							50%	96.2		5.5	NO
1990-1991	93.7			60		n/a	10%	93.5		7.7	NO
							25%	94.6		6.8	NO
							50%	96.4		5.2	NO
1989-	93.0			60			10%	92.8		8.3	NO

1990				25%	94.0	7.3	NO
				50%	96.0	5.6	NO
1988-1989	91.5	Measles-Rubella (1994)	92	10%	90.8	1.5	YES
				25%	92.3	1.4	YES
				50%	94.9	1.1	YES
1987-1988	89.4		92	10%	88.5	1.8	YES
				25%	90.4	1.6	YES
				50%	93.6	1.3	YES
1986-1987	93.2		92	10%	91.7	1.4	YES
				25%	93.1	1.2	YES
				50%	95.4	1.0	YES
1985-1986	80.8		92	10%	80.1	2.7	YES
				25%	83.4	2.4	YES
				50%	88.9	1.8	YES

*Immunity above 85% for 0-4 years old and above 95% for 5+

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NICE National Institute for Health and Care Excellence

NICE guideline

Immunisations: reducing differences in uptake in under 19s

Public health guideline

Published: 23 September 2009
nice.org.uk/guidance/ph21

Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

Contents

This guideline is the basis of QS65 and QS145.

Introduction

The Department of Health asked the National Institute for Health and Clinical Excellence (NICE) to produce public health guidance on reducing differences in the uptake of immunisations, including targeted vaccinations, among children and young people aged under 19 years.

The guidance focuses on increasing immunisation uptake among children and young people aged under 19 years in groups and settings where immunisation coverage is low. It also focuses on improving uptake of the hepatitis B immunisation for babies born to mothers infected with hepatitis B.

It is for NHS and other commissioners, managers and professionals who have a direct or indirect role in, and responsibility for, the immunisation of children and young people. This includes those working in: children's services, local authorities, education and the wider public, private, voluntary and community sectors. It may also be of interest to parents, others with parental responsibility, all those who look after the health and wellbeing of children and young people and members of the public.

This guidance supports national policy and guidance from the Department of Health as set out in the Green Book and on the NHS immunisation website.

The Public Health Interventions Advisory Committee (PHIAC) developed these recommendations on the basis of a review of the evidence, an economic analysis, expert advice, stakeholder comments and fieldwork.

Members of PHIAC are listed in appendix A. The methods used to develop the guidance are summarised in appendix B. Supporting documents used to prepare this document are listed in appendix E. Full details of the evidence collated, including fieldwork data and activities and stakeholder comments, are available, along with a list of the stakeholders involved and NICE's supporting process and methods manuals.

1 Recommendations

This is NICE's formal guidance on reducing differences in the uptake of immunisations, including targeted vaccinations, among children and young people aged under 19 years. When writing the recommendations, the Public Health Interventions Advisory Committee (PHIAC) (see appendix A) considered the evidence of effectiveness (including cost effectiveness, fieldwork data and comments from stakeholders).

The evidence statements underpinning the recommendations are listed in appendix C.

The evidence review, supporting evidence statements and economic analysis are available.

PHIAC considers that all the recommended measures are cost effective. For the research recommendations and gaps in research, see section 5 and appendix D respectively.

The guidance supports implementation of the vaccination courses as recommended by the Joint Committee on Vaccination and Immunisation and indicated in the Department of Health's Green Book[1]. It also supports timely vaccination according to the recommended schedule.

Focus of the recommendations

The guidance focuses on increasing immunisation uptake among groups and settings where coverage is low.

Recommendations 1 to 5 apply to all vaccinations for children from birth to 19 years.

Recommendation 6 focuses on the hepatitis B vaccination programme for infants, as an example of a programme targeted at particular groups. Specifically, it focuses on immunisation to prevent hepatitis B among babies and young children born to mothers who are chronically infected with the virus, or who have had acute hepatitis B infection during pregnancy. The hepatitis B programme for infants was chosen because some babies born to infected mothers (and their siblings) are not receiving the complete course at the right time. (For more details see sections 2 and 3)

Parental responsibility

A person with parental responsibility may be a parent, step-parent or the parent's civil partner. In the case of looked after children, this responsibility may have been acquired by another adult or the local authority under the Children Act.

Those with parental responsibility do not necessarily need to be present when a vaccination is given, provided they have received information about it and then arranged for another person (for example, a grandparent or childminder) to attend with the child. For further information see chapter 2 of the Green Book[1].

The term 'parent' is used throughout the recommendations to describe anyone with parental responsibility.

Recommendation 1: immunisation programmes

Who is the target population?

- Children and young people aged under 19 years, particularly those who may not have been immunised or may have only been partially immunised.
- Parents of children and young people aged under 19 years.

Who should take action?

- Commissioners, managers and coordinators in primary care, children's services, children's trusts, Sure Start children's centres and services for vulnerable groups (including those run by family nurse partnerships[2]).
- Health professionals responsible for children and young people's immunisation services including paediatricians, health visiting and school nursing teams, GPs and practice nurses.
- Directors of public health, immunisation coordinators, the Healthy Child Programme lead and others who provide or commission immunisation services in primary healthcare, including GP practices.
- Health protection specialists and immunisation leads in Local Public Health England teams.
- Children's service managers and nursing staff in hospital trusts, children's social care organisations and child and adolescent mental health services.

What action should they take?

- Ensure Department of Health guidance and updates on immunisations (including official letters from the Chief Medical Officer, Chief Nursing Officer and Chief Pharmaceutical Officer) are disseminated to relevant professionals and implemented.

- Adopt a multifaceted, coordinated programme across different settings to increase timely immunisation among groups with low or partial uptake. The programme should form part of the local child health strategy and should include the following actions:
    - Monitor vaccination status as part of a wider assessment of children and young people's health.
    - Ensure there is an identified healthcare professional in every GP practice who is responsible – and provides leadership – for the local childhood immunisation programme.
    - Ensure all staff involved in immunisation services have access to the Green Book[1]. Also ensure updates to the childhood immunisation programme and schedule are monitored and services adapted appropriately.
    - Improve access to immunisation services. This could be achieved by extending clinic times, ensuring children and young people are seen promptly and by making sure clinics are child- and family-friendly.
    - Ensure enough immunisation appointments are available so that all local children and young people can receive the recommended vaccinations on time.
    - Send tailored invitations for immunisation. When a child or young person does not attend appointments, send tailored reminders and recall invitations and follow them up by telephone or text message.
    - Provide parents and young people with tailored information, advice and support to ensure they know about the recommended routine childhood vaccinations and the benefits and risks. This should include details on the infections they prevent. Information should be provided in different formats, for example, for those whose first language is not English.
    - Ensure parents and young people have an opportunity to discuss any concerns they might have about immunisation. This could either be in person or by telephone and could involve a GP, community paediatrician, health visitor, school nurse or practice nurse.
    - Ensure young people fully understand what is involved in immunisation so that those who are aged under 16, but considered sufficiently capable, can give their consent to vaccinations, as advised in the Green Book.
    - Ensure young people and their parents know how to access immunisation services.

- Consider home visits to discuss immunisation with parents who have not responded to reminders, recall invitations or appointments. Offer to give their children vaccinations there and then (or arrange a convenient time in the future). Such visits could include groups that may not use primary care services, for example, travellers or asylum seekers.

- Check the immunisation status of children and young people at every appropriate opportunity. Checks should take place during appointments in primary care (for example, as part of a child health review), hospital in- or outpatient and accident and emergency departments, walk-in centres or minor injuries units. Use the personal child health record (PCHR, also known as the 'Red book') as appropriate. If any vaccinations are outstanding:

    - discuss them with the parent and, where appropriate, the young person. Where they have expressed concerns about immunisation and this is documented, these appointments should be used as an opportunity to have a further discussion

    - offer vaccinations by trained staff before they leave the premises, if appropriate. In such cases, notify the child or young person's GP, health visitor or local child health information department so that records can be updated

    - and, if immediate vaccination is not possible, refer them to services where they can receive any outstanding immunisations.

Recommendation 2: information systems

Who is the target population?

- Children and young people aged under 19 years, particularly those who may not have been immunised or may have only been partially immunised.

- Parents of children and young people aged under 19 years.

Who should take action?

- Those responsible for information services within the local healthcare commissioning organisation, acute trusts and GP practices.

- Local healthcare commissioning organisation coordinators, directors of public health and community paediatricians.

- Health protection specialists and immunisation leads in health protection units.

- GPs, practice nurses, health visiting teams and those who commission or provide immunisation services.
- Independent and private sector providers of immunisation services.

What action should they take?

- Ensure local healthcare commissioning organisations and GP practices have a structured, systematic method for recording, maintaining and transferring accurate information on the vaccination status of all children and young people. Vaccination information should be recorded in patient records, the personal child health record and the child health information system. The same data should be used when reporting vaccinations to the child health department and when submitting returns to the local healthcare commissioning organisation for GP and practice payments. This will ensure records in both systems are reconciled and consistent.
- Encourage and enable private providers to give the relevant GP practice or local healthcare commissioning organisation details of all vaccinations administered to children and young people, so they can be recorded in the appropriate information system.
- Record any factors which may make it less likely that a child or young person will be up-to-date with vaccinations in their patient records and the personal child health record. For example, note if children and young people are looked after, have special needs or have any contraindications to vaccination. Also note if the parents or young person have expressed concerns about vaccination.
- Regularly update and maintain the databases for recording children and young people's immunisation status. For example, ensure records are transferred when a child or young person moves out of the area, ensure information is not duplicated and follow up on any missing data.
- Ensure up-to-date information on vaccination coverage is available and disseminated to all those responsible for the immunisation of children and young people. This includes those who are delivering the vaccinations.
- Use recorded information on immunisation, together with surveillance data on the incidence of infection, to inform local and joint strategic needs assessments and health equity audits. These data should also be used to support delivery of an immunisation programme for children and young people.

- Monitor the age composition of the practice population so that there is enough capacity to provide timely immunisations. Waiting lists are unacceptable.

Recommendation 3: training

Who is the target population?

Those who advise on and provide immunisation services including:

- GPs, health visitors, practice nurses, community nurses (including school nurses), midwives and nurses working in neonatal care, nurseries, child and adolescent mental health services, young offender institutions and secure units.
- Immunisation coordinators and public health professionals.
- Hospital and community paediatricians, nursing staff in hospital trusts and walk-in centres and pharmacists.
- NHS health trainers.
- NHS support staff, including clinic clerks and receptionists.
- Managers of children's services and children's centres, social care workers (working with children) and those with parental responsibility for looked after children.

Who should take action?

- Professional bodies, skills councils and other organisations responsible for setting competencies and developing continuing professional development programmes for health professionals.
- Health protection units.
- Employers and managers in organisations advising on immunisation strategy or commissioning immunisation programmes, including general practices whose staff are involved in immunisation services.
- Private and independent sector providers of immunisation services for children and young people aged under 19 years.

What action should they take?

- Ensure all staff involved in immunisation services are appropriately trained. Training should be regularly updated. It should be tailored to individual needs to ensure staff have the necessary skills and knowledge, for example, communications skills and the ability to answer questions about different vaccinations.
- Ensure health professionals who deliver vaccinations have received training that complies with the Health Protection Agency's National minimum standard for immunisation training[3].
- Professional bodies should ensure health professionals working with children and young people have the appropriate knowledge and skills to give advice on the benefits and risks of immunisation. Specifically, they should be well-versed in the core topics defined in the Health Protection Agency's Core curriculum for immunisation training[4].
- Ensure staff are appropriately trained to document vaccinations accurately in the correct records.

Recommendation 4: contribution of nurseries, schools, colleges of further education

Who is the target population?

- Children and young people aged under 19 years attending nurseries, schools and colleges of further education, particularly those who may not have been immunised or may have only been partially immunised.
- Parents of children and young people aged under 19 years.

Who should take action?

- Directors of public health, immunisation coordinators and community paediatricians.
- Health visiting and school nursing teams, GPs and those involved in family nurse partnerships.[2]
- Head teachers, school governors and heads of further education colleges and pupil referral units.
- Nursery, pre-school and early years providers.

- Managers, nurses and early years support staff in Sure Start children's centres and children's services.

What action should they take?

- The Healthy Child team, led by a health visitor working with other practitioners, should check the immunisation record (including the personal child health record) of each child aged up to 5 years. They should carry out this check when the child joins a day nursery, nursery school, playgroup, Sure Start children's centre or when they start primary school. The check should be carried out in conjunction with childcare or education staff and the parents.
- School nursing teams, working with GP practices and schools, should check the vaccination status of children and young people when they transfer to a new school or college. They should also advise young people and their parents about the vaccinations recommended at secondary school age.
- If children and young people are not up-to-date with their vaccinations, school nursing teams, in conjunction with nurseries and schools, should explain to parents why immunisation is important. Information should be provided in an appropriate format (for example, as part of a question and answer session). School nursing teams should offer vaccinations to help them catch up, or refer them to other immunisation services.
- Head teachers, school governors, managers of children's services and immunisation coordinators should work with parents to encourage schools to become venues for vaccinating local children. This would form part of the extended school role.

Recommendation 5: targeting groups at risk of not being fully immunised

Who is the target population?

- Children and young people aged under 19 years at risk of not being immunised or only being partially immunised.
- Parents of these children and young people.

Who should take action?

- Commissioners, managers and coordinators of children's services, children's trusts, Sure Start children's centres and immigration services.

- Health professionals responsible for children's immunisation services including directors of public health, paediatricians, GPs, practice nurses, school nursing teams, health visiting teams and those involved in family nurse partnerships.[2]
- Nurses working in child and adolescent mental health services, young offender institutions and secure units.
- Other health professionals who have contact with children and young people aged under 19 years.
- Immunisation coordinators and others who work in immunisation services within local healthcare commissioning organisations and GP practices.
- Managers of children's services and children's centres.
- Social care workers responsible for children and those with parental responsibility for looked after children.

What action should they take?

- Improve access to immunisation services for those with transport, language or communication difficulties, and those with physical or learning disabilities. For example, provide longer appointment times, walk-in vaccination clinics, services offering extended hours and mobile or outreach services. The latter might include home visits or vaccinations at children's centres.
- Provide accurate, up-to-date information in a variety of formats on the benefits of immunisation against vaccine-preventable infections. This should be tailored for different communities and groups, according to local circumstances. For example, offer translation services and provide information in multiple languages.
- Consider using pharmacies, retail outlets, libraries and local community venues to promote and disseminate accurate, up-to-date information on childhood immunisation.
- Health professionals should check the immunisation history of new migrants, including asylum seekers, when they arrive in the country. They should discuss outstanding vaccinations with them and, if appropriate, their parents, and offer the necessary vaccinations administered by trained staff.
- Prison health services should check the immunisation history of young offenders. They should discuss any outstanding vaccinations with the young person and, if appropriate, their parents, and offer appropriate vaccines administered by trained staff.

- Check the immunisation status of looked after children during their initial health assessment, the annual review health assessment and statutory reviews. Ensure outstanding immunisations are addressed as part of the child's health plan. Offer opportunities to have any missed vaccinations, as appropriate, in discussion with the child or young person and those with parental responsibility for them.

Recommendation 6: hepatitis B immunisation for infants

Who is the target population?

- Children born to mothers who are hepatitis B-positive.
- Parents of children who are hepatitis B-positive.

Who should take action?

- GPs, health visitors, midwives, neonatal and community paediatricians, nursery and neonatal nurses, support workers and those involved in family nurse partnerships.[2]
- Directors of public health and immunisation coordinators.
- Managers and family health and support teams in children's services.
- Managers, health professionals and early years support staff in Sure Start children's centres.
- Commissioners and providers of immunisation services.

What action should they take?

- Babies born to hepatitis B-positive mothers should be given the first dose of the vaccine promptly, whether they are delivered in hospital or at home. They should then receive all other recommended doses, a blood test to check for infection and, where appropriate, hepatitis B immunoglobulin, in line with the Green Book[1].
- Health professionals should record the mother's hepatitis B status in the personal child health record as soon as possible after birth, before the midwife hands over care of the baby to the health visitor. The mother's hepatitis B status should also be entered on the child's record in the local Child Health Information System.
- Health professionals should provide parents with information, advice and support on how to prevent the transmission of hepatitis B. They should emphasise the importance of ensuring babies complete the recommended vaccination course at the right time. In addition, they

should assess whether or not the baby's siblings need to be immunised against hepatitis B or tested for infection and should offer them vaccinations and blood tests if necessary.

- All the above actions should be integrated into the local care pathway for infant hepatitis B. (See also NICE's guideline on antenatal care).

[1] First published in print in 2006 as 'Immunisation against infectious disease'.

[2] Under the family nurse partnership programme, specially trained nurses visit some of the most vulnerable young mothers and their families at home, working with them from early pregnancy until the child is aged 2 years.

[3] Health Protection Agency National minimum standard for immunisation training.

[4] Health Protection Agency Core curriculum for immunisation training.

2 Public health need and practice

The government is committed to an effective childhood immunisation programme to reduce the incidence of childhood infections such as meningitis C and measles. This commitment is emphasised in the government strategy for children and young people's health (DH 2009a) and the 'National service framework for children, young people and maternity services' (DH 2004). A priority is to increase the proportion of children who have received all their immunisations (DH 2008a; 2009b).

The national childhood immunisation programme is offered routinely through primary care and other health services. However, differences in uptake persist and are associated with a range of social, demographic, maternal- and infant-related factors (Peckham et al. 1989; Samad et al. 2006).

Immunisation coverage varies within and between regions. In most regions except London, overall uptake of diphtheria, tetanus, pertussis, polio, haemophilus influenzae type B, meningitis C and pneumococcal vaccines is above 90%. (These are due to be completed by the time a child is aged 13 months.) However, first doses of measles mumps and rubella (MMR) vaccination levels are below 86% in England. Even lower levels are reported for second doses. Even where coverage appears to be high, there may still be groups of children who are at risk of acquiring vaccine-preventable infections.

Groups at risk

Evidence has shown that the following groups of children and young people are at risk of not being fully immunised:

- those who have missed previous vaccinations (whether as a result of parental choice or otherwise)
- looked after children
- those with physical or learning disabilities
- children of teenage or lone parents
- those not registered with a GP
- younger children from large families
- children who are hospitalised or have a chronic illness

- those from some minority ethnic groups
- those from non-English speaking families
- vulnerable children, such as those whose families are travellers, asylum seekers or are homeless.

(DH 2005; Hill et al. 2003; Peckham et al. 1989; Samad et al. 2006.)

In addition, some groups are less likely to have received certain vaccines. There is some evidence that uptake of MMR has declined at a greater rate among children of more highly educated parents and among those living in more affluent areas (Wright and Polack 2005). Pearce et al. (2008) found that maternal education to degree level was a risk factor for not receiving the MMR triple vaccine. A study of over a million children born in Scotland between 1987 and 2004 found that children of more affluent parents were generally either vaccinated with MMR on time or not at all. In contrast, late MMR vaccination was associated with socioeconomic disadvantage (Friederichs et al. 2006).

An estimated 3 million children aged 18 months to 18 years may have missed either their first or their second MMR vaccination (DH 2008b). The potential exposure of so many children and young people to the measles virus means that there is a risk of a large outbreak. As measles can lead to serious complications – and can even be fatal – local healthcare commissioning organisations have been supported and funded to help these children have the MMR vaccination during 2008/09 (DH 2008b).

Infant hepatitis B vaccination

Hepatitis B infection can be transmitted at birth to babies whose mothers are infected with the hepatitis B virus, so all pregnant women should be offered screening for hepatitis B during pregnancy (DH 2006).

If a pregnant woman has chronic hepatitis B infection, the baby should receive an initial dose of the vaccine within 24 hours of birth, with further doses at 1, 2 and 12 months. Some babies, who are particularly at risk, may also need hepatitis B immunoglobulin at birth (DH 2006).

Hepatitis B infection is relatively uncommon in the UK. The rates of chronic infection are higher among groups that have their origins in endemic countries. The incidence of infection is also higher among South Asian and African residents in England and Wales, particularly children (Giraudon et al. 2009; Hahné et al. 2004). Infection in children rarely leads to acute hepatitis; chronic infection is

more common and, if untreated, it may result in cirrhosis or liver cancer, leading to liver failure and death.

3 Considerations

The Public Health Interventions Advisory Committee (PHIAC) took account of a number of factors and issues when developing the recommendations.

3.1 Childhood immunisation is an important part of the Healthy Child programme, formerly known as the Child Health Promotion programme. Children who are not up-to-date with vaccinations may also be behind on other Healthy Child programme activities – or may have other health needs. The parents (including those with parental responsibility) of these children and young people may need additional support, information and encouragement to ensure their children complete the vaccination programme.

3.2 The UK childhood immunisation schedule is timed to take into account when children are likely to come into contact with vaccine-preventable infections and when, physiologically, they can produce a protective immune response. It is still important to give vaccinations, even when there has been a delay. But the focus of this guidance is on ensuring children and young people receive them in line with the national recommended schedule.

3.3 There was little published evidence on information recording and monitoring systems. However, PHIAC considered that evidence from practice was a valid and appropriate basis for a recommendation. It also recognised the fundamental role that accurate records and effective information systems play in enabling services to identify and contact children and young people who may not be fully immunised.

3.4 Most published research on interventions to increase immunisation uptake is non-UK based. Nevertheless, PHIAC judged that some of the evidence was applicable to the UK.

3.5 Evidence from other countries suggests that legislation or a proof-of-immunisation requirement for entry to nursery or school does increase vaccine coverage. PHIAC noted that school entry offers an opportunity for checking immunisation status and to provide relevant advice and information. It believes this may be acceptable to parents, those with parental responsibility and schools. However, PHIAC considered that an over-reliance on school entry as a

checkpoint for immunisation status could have an adverse impact on timely vaccination in the pre-school years.

3.6 PHIAC noted that research carried out around the time of the controversy over MMR may have been influenced by that controversy – and may become less relevant in the future. Research published in 1998 raised concerns about the safety of the MMR vaccine, suggesting a link with autism and certain bowel problems. As a result, some parents chose not to immunise their children, delayed the immunisation or only allowed their children to receive 1 of the 2 doses of the vaccine. Further extensive studies have found no evidence to link the vaccine to autism or chronic bowel conditions. However, despite advice from professionals and the Department of Health, some parents remain concerned. The subsequent reduction in vaccination coverage in England has led to outbreaks of measles. More recently, MMR vaccination coverage has slowly begun to increase.

3.7 PHIAC acknowledged that there may be various reasons why children and young people might not be up-to-date with their vaccinations. Logistical difficulties associated with large families have been identified as 1 factor. Other children and young people may be at risk of missing vaccinations because they are not in contact with primary care services. These include those who are homeless, asylum seekers and drug users (or whose parents are drug users). Children from minority ethnic groups and those whose first language is not English may also be more vulnerable, because services are not flexible enough and information is not provided in a language they understand. Some children from at-risk groups may be in contact with children's services and other health services – but not necessarily immunisation services. This includes young offenders, those in the care of child and adolescent mental health services and looked after children.

3.8 Vaccination against some infections can provide indirect benefits to people who are not immunised – so-called 'herd immunity'. The higher the proportion of the population who are vaccinated against an infection, the lower the proportion at risk of becoming infected (and the lower the chance of infection spreading within the population). People who have not been immunised (by choice or for medical reasons) and those in whom immunisation did not produce a protective immune response also benefit from this reduced transmission. Once the proportion of people vaccinated reaches a certain level, there may still be some

onward transmission but no epidemics. This level varies for different infections, but it is over 95% coverage for measles. Even if vaccine coverage levels reach the level needed to prevent an epidemic, it is important to maintain these levels unless the infection has been eradicated globally. This is because an infected person may enter the country and could transmit the infection to susceptible people.

3.9 The human papillomavirus (HPV) immunisation programme for girls aged 12–13, and a catch-up programme for older girls and young women, was introduced in September 2008. PHIAC was unable to make specific recommendations related to HPV vaccination, as the UK programme was in its infancy.

3.10 Young people aged 16 and 17 years can be assumed to have the same capacity as an adult to consent to immunisations and do not need parental consent, unless there is reason to believe that they do not have that capacity. Young people under the age of 16 can also give consent to immunisation if they fully understand what is proposed. PHIAC recognised that some practitioners, including teachers and social care workers, may not be aware of this. More detailed information about consent is available from the Department of Health's Green Book and the DH website.

3.11 PHIAC recognised the importance of leadership from GPs and health visitors, working with a wide range of professionals and staff from different sectors, to provide effective immunisation services for all children and young people. GPs and health visitors can also provide important additional support to those working with children who are at increased risk of not being immunised and their families.

3.12 PHIAC noted that health visitors have the lead role in the delivery of the Healthy Child programme. The health visiting team is responsible for working with parents and families to ensure children aged under 5 years are offered – and are able to receive – all vaccinations, as specified in the immunisation schedule.

3.13 PHIAC recognised the importance of information sharing and communication between health and social care services to ensure looked after children's records are passed on if they move.

3.14 PHIAC focused on the infant hepatitis B vaccination programme because the earlier a child is infected the more likely they are to become a chronic carrier and develop cirrhosis and liver cancer. In addition, this programme is not well understood nor widely implemented. PHIAC did not consider the hepatitis B vaccination programme for any other age group.

3.15 Economic modelling was carried out for measles vaccination, as an important example of a universal vaccination in the UK. It was also carried out for hepatitis B vaccination among at-risk neonates, as an important example of a targeted vaccination in the UK.

3.16 Economic modelling showed that, at current levels of immunisation, efforts to increase uptake of the measles vaccine were highly cost effective in groups with both high and low immunisation coverage. Increasing uptake among low-coverage groups was shown to be marginally more efficient than increasing uptake among high-coverage groups. (This is true if the cost per child were the same in each group.) It would also do more to reduce health inequalities. The modelling suggested that home visits (likely to be the most expensive means of increasing coverage by 1 percentage point) would be a cost effective use of NHS resources. The implication is that almost any method of increasing coverage would be cost effective. The model underestimated the cost effectiveness of the MMR vaccine because it did not ascribe any benefits to the concurrent prevention of mumps and rubella infection. (The vaccine offers simultaneous protection against 3 different infections.)

3.17 Economic modelling demonstrates that the current UK infant hepatitis B vaccination programme, whereby immunisation is targeted at babies of mothers who are hepatitis B-positive, is cost saving. The analysis suggests that considerable additional resources could be invested to improve timely uptake, and the programme would still be cost effective.

4 Implementation

NICE guidance can help:

- NHS organisations, social care and children's services meet the requirements of the Department of Health's 'Operating framework for 2008/09' and 'Operational plans 2008/09–2010/11'.
- NHS organisations, social care and children's services meet the requirements of the Department of Communities and Local Government's 'The new performance framework for local authorities and local authority partnerships'.
- National and local organisations within the public sector meet government indicators and targets to improve health and reduce health inequalities.
- Local authorities fulfil their remit to promote the economic, social and environmental wellbeing of communities.
- Local NHS organisations, local authorities and other local public sector partners benefit from any identified cost savings, disinvestment opportunities or opportunities for re-directing resources.
- Provide a focus for multi-sector partnerships for health, such as local strategic partnerships.

NICE has developed tools to help organisations put this guidance into practice.

5 Recommendations for research

PHIAC recommends that the following research questions should be addressed. It notes that 'effectiveness' in this context relates not only to the size of the effect, but also to cost effectiveness and duration of effect. It also takes into account any harmful or negative side effects.

1. What are the most effective and cost effective ways of increasing immunisation uptake among looked after children and young people and other population groups at risk of being only partially immunised or not immunised at all?

2. What are the most effective and cost effective ways of modifying services to increase vaccine uptake among children and young people, particularly those at risk of not being immunised, or of being only partially immunised? Does this vary by population subgroups? Examples might include home visits, changes in information provision and the introduction of opportunities to discuss immunisation before vaccines are given.

3. What are the most effective and cost effective ways of providing parents of children and young people with information to encourage timely immunisation? Specifically, what are the most effective and cost effective ways of providing information to reach those who are particularly at risk of not being immunised or only partially immunised?

4. How effective – and how acceptable to the public – are quasi-mandatory and incentive schemes for immunisation? (Examples of the former are schemes linked to nursery or school entry.) What impact do such schemes have on the timely uptake of vaccinations?

5. Does giving incentives to immunisation providers increase immunisation rates in the UK? For example, how does community target setting, or changes in targets or payment systems, affect immunisation coverage?

More detail on the gaps in the evidence identified during development of this guidance is provided in appendix D.

6 Related NICE guidance

Tuberculosis (2016) NICE guideline NG33

Meningitis (bacterial) and meningococcal septicaemia in under 16s: recognition, diagnosis and management (2010) NICE guideline CG102

Looked-after children and young people (2010) NICE guideline PH28

Antenatal care for uncomplicated pregnancies (2008) NICE guideline CG62

Behaviour change: general approaches (2007) NICE guideline PH6

Sexually transmitted infections and under-18 conceptions: prevention (2007) NICE guideline PH3

Postnatal care up to 8 weeks after birth (2006) NICE guideline CG37

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Appendix A: Membership of the Public Health Interventions Advisory Committee (PHIAC), the NICE project team and external contractors

Public Health Interventions Advisory Committee

NICE has set up a standing committee, the Public Health Interventions Advisory Committee (PHIAC), which reviews the evidence and develops recommendations on public health interventions. Membership of PHIAC is multidisciplinary, comprising public health practitioners, clinicians (both specialists and generalists), local authority officers, teachers, social care professionals, representatives of the public, patients and/or carers, academics and technical experts as follows.

Professor Sue Atkinson CBE Independent Consultant and Visiting Professor, Department of Epidemiology and Public Health, University College London

Mr John F Barker Associate Foundation Stage Regional Adviser for the Parents as Partners in Early Learning Project, DfES National Strategies

Professor Michael Bury Emeritus Professor of Sociology, University of London. Honorary Professor of Sociology, University of Kent

Professor K K Cheng Professor of Epidemiology, University of Birmingham

Ms Joanne Cooke Programme Manager, Collaboration and Leadership in Applied Health Research and Care for South Yorkshire

Dr Richard Cookson Senior Lecturer, Department of Social Policy and Social Work, University of York

Mr Philip Cutler Forums Support Manager, Bradford Alliance on Community Care

Ms Lesley Michele de Meza Personal, Social, Health and Economic (PSHE) Education Consultant, Trainer and Writer

Professor Ruth Hall Regional Director, Health Protection Agency, South West

Ms Amanda Hoey Director, Consumer Health Consulting Limited

Mr Alasdair J Hogarth Head Teacher, Archbishops School, Canterbury

Mr Andrew Hopkin Assistant Director, Local Environment, Derby City Council

Dr Ann Hoskins Director, Children, Young People and Maternity, NHS North West

Ms Muriel James Secretary, Northampton Healthy Communities Collaborative and the King Edward Road Surgery Patient Participation Group

Dr Matt Kearney General Practitioner, Castlefields, Runcorn. GP Public Health Practitioner, Knowsley PCT

Ms Valerie King Designated Nurse for Looked After Children, Northampton PCT, Daventry and South Northants PCT and Northampton General Hospital. Public Health Skills Development Nurse, Northampton PCT

CHAIRProfessor Catherine Law Professor of Public Health and Epidemiology, UCL Institute of Child Health

Mr David McDaid Research Fellow, Department of Health and Social Care, London School of Economics and Political Science

Mr Bren McInerney Community Member

Professor Susan Michie Professor of Health Psychology, BPS Centre for Outcomes Research and Effectiveness, University College London

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Dr Mike Owen General Practitioner, William Budd Health Centre, Bristol

Dr Toby Prevost Reader in Medical Statistics, Department of Public Health Sciences, King's College London

Ms Jane Putsey Lay Representative, Chair of Trustees of the Breastfeeding Network

Dr Mike Rayner Director, British Heart Foundation Health Promotion Research Group, Department of Public Health, University of Oxford

Mr Dale Robinson Chief Environmental Health Officer, South Cambridgeshire District Council

Ms Joyce Rothschild Children's Services Improvement Adviser, Solihull Metropolitan Borough Council

Dr Tracey Sach Senior Lecturer in Health Economics, University of East Anglia

Professor Mark Sculpher Professor of Health Economics, Centre for Health Economics, University of York

Dr David Sloan Retired Director of Public Health

Dr Stephanie Taylor Reader, Applied Research, Centre for Health Sciences, Barts and The London School of Medicine and Dentistry

Dr Stephen Walters Reader, Medical Statistics, University of Sheffield

Dr Dagmar Zeuner Joint Director of Public Health, Hammersmith and Fulham PCT

Expert co-optees to PHIAC:

Dr Helen Bedford Senior Lecturer in Children's Health, UCL Institute of Child Health, London

Dr David Elliman Consultant Community Paediatrician, Great Ormond Street Hospital NHS Trust and Haringey Teaching PCT

Professor Andrew Hall Chairman, Joint Committee on Vaccination and Immunisation

Dr Anthony Harnden Lecturer in General Practice, Department of Primary Care, University of Oxford

Dr Mary Ramsay Consultant Epidemiologist, Health Protection Agency Centre for Infections

Expert testimony to PHIAC:

Professor John Edmunds Infectious Disease Epidemiology Unit, London School of Hygiene and Tropical Medicine

Professor David Salisbury Head of Immunisation, Department of Health

NICE project team

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External contractors

Reviewers: effectiveness review

Review 1: 'Review of the evidence of the effectiveness and cost effectiveness of interventions to address differences in the uptake of immunisations (including targeted vaccines) in people younger than 19 years' was carried out by the National Collaborating Centre for Women's and Children's

Health. The principal authors were: Jane Tuckerman, Nina Balachander, Sharangini Rajesh, Ceri Oeppen, Anna Bancsi, Paul Jacklin, Jay Banerjee and Andrew Clegg.

Reviewers: economic analysis

Analysis 1: 'The impact of increasing vaccine coverage on the distribution of disease: measles in the UK' was carried out by the London School of Hygiene and Tropical Medicine. The principal authors were: John Edmunds and Albert Jan Van Hoek (Health Protection Agency).

Analysis 2: 'An exploration of the cost-effectiveness of interventions to reduce the difference in uptake of childhood immunisations in the UK using threshold analysis' was carried out by the National Collaborating Centre for Women's and Children's Health. The principal author was Paul Jacklin.

Analysis 3: 'The estimated cost-effectiveness of vaccination in infants born to hepatitis B virus positive mothers' was carried out by the London School of Hygiene and Tropical Medicine. The principal authors were: John Edmunds and Mary Ramsay.

Fieldwork

The fieldwork report, 'Reducing differences in the uptake of immunisations (including targeted vaccines) in children and young people aged under 19 years' was carried out by Greenstreet Berman Ltd.

Appendix B: Summary of the methods used to develop this guidance

Introduction

The review and economic analysis include full details of the methods used to select the evidence (including search strategies), assess its quality and summarise it.

The minutes of the PHIAC meetings provide further detail about the Committee's interpretation of the evidence and development of the recommendations.

All supporting documents are listed in appendix E and are available online.

Guidance development

The stages involved in developing public health intervention guidance are outlined in the box below.

1. Draft scope released for consultation
2. Stakeholder meeting about the draft scope
3. Stakeholder comments used to revise the scope
4. Final scope and responses to comments published on website
5. Evidence review(s) and economic analysis undertaken
6. Evidence and economic analysis released for consultation
7. Comments and additional material submitted by stakeholders
8. Review of additional material submitted by stakeholders (screened against inclusion criteria used in review/s)
9. Evidence and economic analysis submitted to PHIAC
10. PHIAC produces draft recommendations
11. Draft guidance released for consultation and for field testing
12. PHIAC amends recommendations
13. Final guidance published on website
14. Responses to comments published on website

Key questions

The key questions were established as part of the scope. They formed the starting point for the reviews of evidence and were used by PHIAC to help develop the recommendations. The overarching questions were:

- What interventions are effective and cost effective at reducing differences in immunisation uptake in children and young people 19 years or younger?
- What are the views and experiences of parents and carers, those receiving and those delivering either immunisations themselves or interventions to increase uptake of immunisations in the UK to children and young people 19 years or younger?

Reviewing the evidence of effectiveness

A review of effectiveness was conducted for each intervention that reduces differences in immunisation uptake.

Identifying the evidence

The following databases were searched for published literature (1 January 1988 to 31 March 2008):

- ASSIA
- Campbell Collaboration
- CINAHL
- Cochrane Library (Cochrane Database of Systematic Reviews and Database of Abstracts of Reviews of Effectiveness [DARE])
- Embase
- Eppi-centre databases
- ERIC
- Medline
- PsycINFO

- Sociological Abstracts

The review team contacted relevant external people for additional information and also searched the following websites for relevant studies:

- CDC
- American Academy of Pediatrics
- Canadian Coalition for Immunization awareness and Promotion
- Canadian Pediatric Society
- Department of Health
- DIPEX: personal experiences of health and illness
- European Centre for Disease Prevention and Control
- Eurosurveillance
- Evidence for Social Policy and Practice Co-ordinating Centre
- Health Evidence Bulletins Wales
- Health Protection Agency
- Health Protection Scotland
- Immunisation advisory centre
- Immunise Australia
- Intute (previously OMNI)
- National Centre for Immunisation Research and Surveillance
- NHS Quality Improvement Scotland
- NHS Wales
- Public Health Organization of Canada
- Scottish Intercollegiate Guidelines Network (SIGN)

- US Centers for Disease Control and Prevention
- Vaccine Education Center, Philadelphia Children's Hospital
- World Health Organization

Further details of the databases, search terms and strategies are included in the review reports.

Selection criteria

Qualitative studies were included in the effectiveness review if:

- they took place in the UK
- they reported on the knowledge, attitudes, values and beliefs relating to immunisations for children and young people under 19 years
- they reported on immunisation uptake rates in people under 19.

Quantitative and economic studies were included in the effectiveness review if they reported on interventions that seek to reduce differences in the uptake of universal or targeted vaccination programmes for children and young people under 19 years.

Studies were excluded if they:

- were published in a language other than English
- were conducted in developing countries
- reported interventions that sought to reduce differences in the uptake of immunisations in people aged 19 or older
- explored the setting of national immunisation strategies, policies, priorities and targets
- targeted vaccination of young people at occupational risk of infection (for example, vaccination of healthcare workers for hepatitis B and varicella)
- targeted vaccination of children and young people travelling to countries with increased prevalence of infectious agents (for example, vaccination for typhoid, rabies or tick-borne encephalitis)

- targeted vaccination of children and young people who were clinically at risk of infection with a vaccine-preventable disease as a result of an underlying condition (for example, vaccination of asplenic or immunocompromised people for pneumococcal or Haemophilus influenzae type b infections)
- aimed to increase uptake of single vaccines for measles, mumps and rubella
- did not report findings from primary research (for example, were secondary reviews of the literature)
- were published before 1988
- were published as abstracts only or were not held by the British Library.

The evidence in this review was subject to further analysis and revision. This revision was carried out by NICE.

The revised analysis excluded studies if they were not transferrable to the UK context. It also excluded studies if they:

- involved the provision of free vaccines either alone or as part of a health insurance package
- involved immunisation-linked, provider payments on a capitation or fee-for-service basis
- reported baseline coverage levels of less than 70% (with the exception of MMR coverage)
- presented post-intervention and control (no-intervention) levels less than 70% (however, if multiple vaccines or age groups were considered and at least 1 baseline level was greater than 70%, then the study was included)
- aimed to increase uptake of human papillomavirus vaccine.

Quality appraisal

Included papers were assessed for methodological rigour and quality using the NICE methodology checklist, as set out in the NICE technical manual 'Methods for the development of NICE public health guidance' (see appendix E). Each study was graded (++, +, −) to reflect the risk of potential bias arising from its design and execution.

Study quality

++ All or most of the methodology checklist criteria have been fulfilled. Where they have not been fulfilled, the conclusions are thought very unlikely to alter.

+ Some of the methodology checklist criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.

− Few or no methodology checklist criteria have been fulfilled. The conclusions of the study are thought likely or very likely to alter.

Summarising the evidence and making evidence statements

The review data was summarised in the revised analysis and in evidence tables.

The findings from the revised analysis were synthesised and used as the basis for a number of evidence statements relating to each key question. The evidence statements were prepared by NICE. The statements reflect their judgement of the strength (quantity, type and quality) of evidence and its applicability to the populations and settings in the scope.

Economic analysis

The economic analysis consisted of a review of economic evaluations and a cost-effectiveness analysis which consisted of 3 economic models.

Review of economic evaluations

The following databases were searched for the period from 1 January 1988 to 31 March 2008:

- Health Economics Evaluation Database(HEED)
- Econlit (1969–March 2008)
- Health Technology Assessment
- NHS Economic Evaluation Database (NHS EED).

Cost-effectiveness analysis

An economic model for measles was constructed 'The impact of increasing vaccine coverage on the distribution of disease: measles in the UK'. Further results are reported in: 'An exploration of the cost-effectiveness of interventions to reduce the difference in uptake of childhood immunisations in the UK using threshold analysis'.

Additional economic modelling was undertaken to produce: 'The estimated cost-effectiveness of vaccination in infants born to hepatitis-B-virus-positive mothers'. The 3 economic modelling reports are available.

Fieldwork

Fieldwork was carried out to evaluate how relevant and useful NICE's recommendations are for practitioners and how feasible it would be to put them into practice. It was conducted with practitioners and commissioners who are involved in immunisation within primary care, public health and children's services in the NHS.

The fieldwork comprised 2 studies commissioned to ensure ample geographical coverage:

- Seven workshops carried out in Birmingham, Brighton, London and Manchester with a range of practitioners including immunisation coordinators, nurses, paediatricians, GPs and directors of public health.
- Thirty telephone interviews with a range of professionals including practice nurses and managers, community and neonatal paediatricians and those involved in PCT information services.

The main issues arising from the 2 studies are set out in appendix C under 'Fieldwork findings'. The full fieldwork report is Reducing differences in the uptake of immunisations (including targeted vaccines) in children and young people aged under 19 years.

How PHIAC formulated the recommendations

At its meetings in October 2008, January, March and June 2009, PHIAC considered the evidence of effectiveness and the revised analysis, plus the cost effectiveness to determine:

- whether there was sufficient evidence (in terms of quantity, quality and applicability) to form a judgement

- whether, on balance, the evidence demonstrates that the intervention is effective, ineffective or equivocal
- where there is an effect, the typical size of effect.

PHIAC developed draft recommendations through informal consensus, based on the following criteria.

- Strength (quality and quantity) of evidence of effectiveness and its applicability to the populations/settings referred to in the scope.
- Effect size and potential impact on the target population's health.
- Impact on inequalities in health between different groups of the population.
- Cost effectiveness (for the NHS and other public sector organisations).
- Balance of risks and benefits.
- Ease of implementation and any anticipated changes in practice.

Where possible, recommendations were linked to an evidence statement(s) (see appendix C for details). Where a recommendation was inferred from the evidence, this was indicated by the reference 'IDE' (inference derived from the evidence).

The draft guidance, including the recommendations, was released for consultation in May 2009. At its meeting in June 2009, PHIAC amended the guidance in light of comments from stakeholders, experts and the fieldwork. The guidance was signed off by the NICE Guidance Executive in August 2009.

Appendix C: The evidence

This appendix lists evidence statements from the revised analysis of the review of effectiveness (see appendix A and B) and links them to the relevant recommendations. The evidence statements are presented here without references – these can be found in the full review (see appendix E for details). It also sets out a brief summary of findings from the economic analysis and the fieldwork

Evidence statement 7 indicates that the linked statement is numbered 7 in the revised review of effectiveness.

The review, economic analysis and fieldwork report are available online. Where a recommendation is not directly taken from the evidence statements, but is inferred from the evidence, this is indicated by **IDE** (inference derived from the evidence) below.

Recommendation 1: evidence statements 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 38, 39, 40, 41, 47, 48, 49, 51, 52, 55, 61; IDE

Recommendation 2: IDE

Recommendation 3: evidence statements 25, 26, 27, 28; IDE

Recommendation 4: evidence statements 20, 41; IDE

Recommendation 5: evidence statements 16, 43, 48, 49, 51

Recommendation 6: 66; IDE

Evidence statements

Evidence Statement 5

There is mixed evidence from 3 RCT's, all from the USA, as to the effectiveness at increasing immunisation uptake of reminder/recall interventions targeting families of low socioeconomic status. One RCT ([++] n=601 [n is the number of participants]) found that reminder postcards in advance of appointments with follow-up postcards and phone calls if the appointment is missed significantly increased the number of infants up-to-date with immunisations compared with families that only received a single reminder postcard if they failed to keep the appointment. The second RCT ([+] n=1273) found that although postcard and telephone reminders in advance of an

appointment significantly increased vaccination coverage in infants who were not up-to-date at baseline compared with families who didn't receive a reminder, there was no significant difference in overall vaccination coverage rates between reminder and control groups. Finally, 1 RCT ([−] n=222) found that although more children of families who received a computer-generated phone message in advance of an appointment were vaccinated within 1 month of being due compared with families who didn't receive a reminder, the difference was not significant.

Evidence Statement 6

There is mixed evidence from 3 studies from the USA: 2 RCTs (both −) and 1 non-randomised controlled trial (nRCT) (+) as to the effectiveness of universal reminder/recall interventions for children aged under 2 years. Two studies found that compared with children who received no contact, reminders comprising either mailed postcards or computer-generated telephone messages in advance of appointments increased uptake of DTP (RCT [−] n=1138) and DTP, OPV, Hib, and MMR (n-RCT[+] n=213). Conversely, 1 RCT found that letters comprising either a health message or a message reminding parents that vaccination is compulsory under state law had no significant impact on vaccine coverage at 7 months compared with a control group that received no reminder/recall letters ([−] n=1351).

Evidence statement 7

There is evidence from 1 RCT ([++] n=169) from Australia that a home vaccination service for children who were behind on the recommended immunisation schedule (DTP/OPV/Hib or MMR) significantly improved vaccination coverage compared with children who did not receive a home-based vaccination service.

Evidence statement 8

There is evidence from 1 BA study ([+] n=1075) from the USA that a community-based outreach programme comprising home visits to a large public housing development to identify children and pregnant women significantly improved children's vaccination coverage in this population.

There is evidence from 1 RCT ([+] n=220) from the USA that a community-based outreach programme comprising 7 home visits during the baby's first 15 months of life together with advice and support for mothers is as effective at ensuring age-appropriate immunisations regardless of whether it is delivered on a one-to-one basis or a group basis.(See also evidence statement 45.)

Evidence statement 10

There is evidence from 1 RCT from the USA reported in 2 articles ([+] and [−] n=102) to suggest that an intervention targeting pregnant adolescents which incorporated intensive home visits (approximately 17 antenatal and postnatal visits) extended from pregnancy to 1 year postpartum significantly improved vaccination uptake at age 12 months compared with a control group that received 1 or 2 visits. Evaluation of the programme at 24 months postpartum found that the intervention group was less likely than the control group to be up-to-date with immunisations, although more than 40% of participants had been lost to follow-up by 24 months, limiting the reliability of this finding.

Evidence statement 11

There is evidence from 1 RCT ([++] n=152) from Australia to suggest that regular home visits up to 6 months postpartum by midwives to new mothers who were illicit drug users did not significantly increase age-appropriate vaccination rates of newborns at 2, 4 or 6 months compared with a control group who received telephone contact at 2 months and a home visit at 6 months. Vaccination rates at 2 and 4 months were higher (although not significantly) in the intervention group compared with control.

Evidence statement 12

Conceptions of the severity of vaccine-preventable diseases: There is evidence from a focus group study with 66 parents (+) and an interview study with 22 parents (++) that many parents lacked knowledge about immunisations and vaccine-preventable diseases, their incidence in the UK and their severity.

There is evidence from 20 surveys of mothers of children aged under 3 years (n=15,000) carried out over a 10-year period from 1991 to 2001 (+) that the perceived severity of vaccine-preventable diseases has changed over time, with the perceived severity of some diseases having decreased (diphtheria, pertussis and polio), increased (meningitis C), remained stable (tetanus and mumps), or varied (Hib, measles and rubella).

There is conflicting evidence as to the relationship between how severe vaccine-preventable diseases are perceived to be by parents and the likelihood of their children having completed their immunisations. A postal survey of 44 parents (−) suggested that parents of children with incomplete immunisations were less likely to see childhood diseases as being severe. Conversely, an interview study with 759 parents (−) found that there were few differences between the beliefs of

parents who had and had not had their children immunised regarding incidence and severity of vaccine-preventable diseases.

There was evidence from 2 qualitative studies with parents living in inner-city settings to suggest that vaccine-preventable childhood diseases were perceived to be severe or serious. One interview and focus group study with 21 Somali, Pakistani and African-Caribbean mothers (+) found that the severity and incidence of childhood diseases was perceived as high. Likewise, a survey of orthodox Jewish parents (n=67) in London found that most parents perceived vaccine-preventable diseases such as measles as being very serious or serious (+).

However, 3 studies found that there were mixed views on how serious different vaccine-preventable diseases were perceived to be. One recent interview study undertaken in October and November 2006 with mothers of children aged under 3 years (n=1016) found that meningitis was perceived as being the most severe disease, while measles, mumps and rubella were seen as being the least severe (++). One questionnaire study with 68 parents in an inner-city setting (+) found that meningitis was perceived to be the most serious disease, with pertussis, diphtheria and measles being perceived as serious or very serious and rubella being perceived as mild. One interview study with 13 parents in an inner-city setting (−) found that diphtheria, tetanus and polio were perceived as serious, whilst measles, mumps and rubella were perceived as mild.

There is evidence from 1 focus group study (++) with 25 orthodox Jewish mothers and 10 local healthcare workers from an orthodox Jewish community in North East London found that the separation of the community from outside influence led to feelings of safety and a lack of need for the BCG vaccination, a situation that local healthcare providers occasionally supported, although this was not done consistently.

Evidence statement 13

Misconceptions about the safety of vaccines: There is evidence from 1 study comprising 20 surveys of mothers of children aged under 3 years carried out over 10 years ([+] n=15,000) that most mothers (more than 90%) trust the safety of immunisations. However, there is evidence from 5 studies that some mothers and parents consider the risks of vaccines to be greater than the risks of acquiring vaccine-preventable diseases ([++] n=18,488; [−] n=87; [+] n=68; [−] n=29; [−] n=13).

There is evidence to suggest that a range of perceived risks of immunisation may influence some parental decisions to delay or avoid immunisations for their children, as suggested by a postal questionnaire with 87 parents (−), a nationally representative interview survey with 18,488 mothers (++), and a postal survey of 44 parents (−). A fear of vaccines being contraindicated for

existing medical conditions such as eczema was indicated by some parents (proportion not stated) in an interview study with 759 parents (−). Concerns about combined antigens putting too much stress on a baby's immune system were identified by 3 studies ([+] n=72; [++] n=22; [−] n=44).

There is evidence from 1 survey (n=NR) that reported that 1 in 3 parents of children aged 0–2 years worry about the effect of multiple vaccines and too many vaccinations on the child. One in 3 parents had some concern over the immunisation process, with the principle concerns being around a lack of information and worries about the effect on the child, but also concern about the way health professionals carry out immunisation appointments (a perceived lack of empathy, concern and time, in particular [−]).

There is evidence from an interview study with 10 orthodox Jewish mothers (−) that mothers' fears of adverse reactions to vaccines were a reason for low uptake. A multi-method study with 21 Somali, Pakistani and African-Caribbean mothers (+) indicated that none of the mothers knew anyone who had suffered an adverse reaction to immunisation and all were positive about immunisation.

A study which included focus groups with health professionals (−) found that health professionals thought that parents' fears of side effects were a reason for low uptake and that in close-knit communities negative reports about immunisation were perpetuated.

Some studies indicated that parents making the decision to immunise their children weighed up the risks and benefits of immunisation as they perceived them, as illustrated in a postal questionnaire with 87 parents (−), an interview study with 13 parents in an inner-city setting (−), a questionnaire study with 68 parents in an inner-city setting (+) and an interview study with 19 mothers and 10 health professionals (−). However, the decision-making process is complicated and different parents in different studies raised differing perceptions of risks and benefits.

Evidence statement 14

Information sources: Evidence from 20 surveys carried out over 10 years involving 15,000 mothers (+) suggests that the majority of parents discuss immunisation with a health professional before uptake. However, the same study and an interview study with 759 parents (−) found that a substantial minority did not. There is also evidence from 2 studies to suggest that some health professionals would like more time to discuss immunisation with parents and that some health professionals worried about 'overloading' parents with information particularly if it might cause otherwise compliant parents not to immunise their children ([+] n=22 health visitors; [+] n=58 primary healthcare professionals).

There is evidence from 5 studies which suggest that parents find health professionals, NHS literature, friends and the media (including television and the Internet) to be important sources of information on immunisation ([+] n=859 parents; [+] n=278 parents and n=322 health professionals; [−] n=44 parents; [−] n=NR; [−] n=759).

Evidence statement 15

Satisfaction with information sources: There is evidence from 2 UK postal surveys that found that although the majority of parents (70%) were satisfied with information on immunisation, parents of fully immunised children were more likely to be satisfied with available information than parents whose children were unimmunised or only partially immunised ([+] n=859 parents of children aged 18–24 months; [−] n=20 parents). However, there is also evidence from 1 study from Scotland that found that an investigation of parents' beliefs indicated dissatisfaction with the information provided by NHS leaflets and professionals ([+] n=278 parents).

There is evidence from an interview study with 13 parents in an inner-city setting who had chosen not to immunise their children (−), and a questionnaire study with 68 parents in an inner-city setting with children with incomplete immunisation (+) to suggest that some parents mistrusted the information provided (proportion not reported in the first study, 28% in the second study), because they perceived that the information exaggerated the efficacy of vaccines and did not adequately acknowledge the potential side effects of vaccines.

A postal questionnaire including 278 parents in Scotland (+) found that parents of children with incomplete immunisations were more likely to rely on information from the media (including the Internet) and friends and were less likely to have discussed immunisation with a health professional, compared with parents with completely immunised children. Similar results were found by a postal survey of 44 parents (24 of whom had completely immunised children and 20 of whom had partially or unimmunised children [−]).

A postal questionnaire study of 859 parents reported that there were mixed views on the preferred timing of information (for example, either before the baby's birth, at the first health visitor's visit or at the 6–8 week postnatal check[+]).

Evidence statement 16

Tailoring information to population subgroups: Three studies (2 [+] and 1 [−]) indicated a need to tailor immunisation information to particular groups. There is evidence from a multi-method study with 21 Somali, Pakistani and African-Caribbean mothers (+) and an interview study with 22 health visitors (+) that there are concerns about the accessibility of immunisation literature (whether

translated or not), particularly for migrants with low levels of literacy. Concerns were also raised by African-Caribbean mothers in 1 study (+) who were dissatisfied with the lack of ethnic minority representations in literature on immunisation. Two studies, 1 interview study with orthodox-Jewish mothers (n=10) in London (−) and another focus group study with 25 orthodox Jewish mothers and 10 local healthcare workers from an orthodox Jewish community in North East London (++) found that the research participants felt 'cut off' from the media as a source of information and instead relied on sources of information within their social networks.

Evidence statement 20

There is evidence from an interview study with head teachers (n=31), school nurses (n=12) and parents (of n=1411 children) in inner-city London (+) that the majority of head teachers would be in favour of asking about immunisation status on school entry, and would be prepared to recommend that parents had their children fully immunised before school entry.

Evidence statement 25

Poor knowledge of the benefits and risks of vaccines: There is evidence from 1 questionnaire study with 174 health professionals in Liverpool (−) and 1 postal questionnaire including 116 health visitors and practice nurses in Scotland (+) to suggest that there are mixed views from health professionals about what constitutes a contraindication to some vaccines.

There is evidence from 1 questionnaire study (−) of health professionals (n=120; midwives, nurses, allied professionals and doctors) from an acute hospital in England that found that less than 50% could accurately identify which babies should receive a neonatal BCG vaccine.

There is evidence from 1 recent survey (n=NR) of GPs (31% response rate), health visitors (63%) and practice nurses (63%) that found one-third of health professionals who stated concerns about immunisation reported their main concern as being that babies were given too many immunisations (−). Similar concerns were reported in a postal questionnaire of 116 health visitors and practice nurses in Scotland (+) that found that several health professionals (n=NR) were concerned about the ability of babies' immune systems to cope with vaccines. Other concerns raised by health professionals included difficulties with the practicalities of administering the number of vaccinations in the current schedule, the complexity of and changes to the schedule, and difficulties with keeping up-to-date (−).

There is evidence from 1 questionnaire study (−) that found that health professionals (health visitors, school nurses and clinical medical officers) judged that different vaccines offered different levels of protection with pertussis and measles vaccines being given lower scores than others. The

study also found that more health professionals thought it very important to prevent diphtheria, tetanus, pertussis and polio, but fewer thought measles prevention to be very important.

Evidence statement 26

Health professionals views on immunisation education and training: There is evidence from 2 surveys from the UK that found that most health professionals (including health visitors and practice nurses) surveyed would like further education or training on immunisation ([−] n=174; [+] n=116). Recent evidence from 1 survey (n=NR) of GPs (31% response rate), health visitors (63%) and practice nurses (63%) found that compared with GPs, health visitors and practice nurses were more likely to be aware of immunisation training (89% of health visitors versus 94% of practice nurses versus 49% of GPs) and their local immunisation coordinator (89% of health visitors versus 94% of practice nurses versus 49% of GPs). The study also found that health visitors and practice nurses were more likely to have attended 1–2 sessions of immunisation training in the preceding 2 years than were GPs (69% of health visitors versus 72% of practice nurses versus 64% of GPs; p value not reported; [−]).

Evidence statement 27

Information sources for health professionals: There is evidence from 2 surveys that found that Department of Health publications (including the Green Book and Chief Medical Officer letters or updates) and NHS information and publications are important and frequently used sources of information for GPs, health visitors and practice nurses (1 [−] and 1 [+]). One study reported that in addition to being the most frequently used source of information, Department of Health/NHS information and publications were the most useful source of information. The Department of Health's website was mentioned most frequently (21% of GPs versus 46% of health visitors versus 36% of practice nurses). The NHS Immunisation Information website was the second most commonly mentioned Internet site (6% of GPs versus 23% of health visitors versus 18% of practice nurses). GPs continued to be least likely to use the Green Book often (39%) with greater use among health visitors (of whom 46% used it often) and practice nurses (with 71% using it often and 25% using it very often).

There is evidence from 1 recent survey that found that health professionals' (including GPs, health visitors and practice nurses) preferred format for the Green Book was hard copy (around 30% in each group), with very few preferring an Internet-only version (−).

There is evidence from 1 recent survey that found that other sources of information on immunisation used by health professionals included medical and nursing journals, the media (for example, television, radio and newspapers), trust and professional body guidelines and the Internet.

Among health visitors and practice nurses there appeared to be widespread use of a large variety of information sources, with GPs generally using a more restricted range of materials (−).

Evidence statement 28

There is evidence from 4 UK studies (1 ITS [+] and 3 BA [−]) that education and training for health professionals (including midwives, health visitors, GPs and paediatricians) in the implementation of targeted neonatal BCG vaccination policies (comprising identification and referral of at-risk neonates; administration of the BCG vaccine, identification of contraindications etc) was effective at increasing the proportion of at-risk neonates that received timely vaccination (Gill and Scott, 1998; 1 ITS [+] and 3 BA [−]).

Evidence statement 38

There is evidence from a focus group study of 48 parents which found that some (not further quantified) parents felt that opportunistic immunisation of children in accident and emergency departments, or during a hospital admission, was both inappropriate and distressing (+).

Evidence statement 39

There is strong evidence from 7 studies from the UK (1 BA [−] and 1 BA [+]), USA (1 RCT [+]; 1 BA [++]; 1 BA [+]; 1 cohort [−]), and Australia (1 BA [+]), that hospital-based opportunistic immunisation strategies are effective for increasing uptake of recommended vaccinations in children admitted to hospital. One RCT ([+] n=1835) from the USA found that fewer children remained under-immunised after discharge if the hospital had either sent a letter to primary care providers notifying them of under-immunisation status or had vaccinated before discharge compared with no intervention, although the difference was not significant. Two BA studies from the USA found that hospital-based vaccination of children (aged 0–2 years) who were either under-immunised or from predominantly low-income families significantly increased the proportion of children who were age-appropriately immunised (BA [++] n=2006) and reduced the number of missed opportunities for vaccination (BA [−] n=1163).

One BA ([+] n=866) from Australia found that after introduction of an opportunistic vaccination strategy that comprised training of health professionals and vaccination of under-immunised children, the number of vaccinations provided significantly increased in paediatric wards, but not emergency departments. Two studies from the UK found that some children were successfully brought up-to-date with the recommended vaccination schedule after hospital-based immunisation (BA [+] n=56; and BA [−] n=1000). Although 1 study found that some carers refused, preferring to have vaccinations administered by their primary care provider. Finally, 1 cohort study

([−] n=1301) from the USA found that the proportion of pre-school children not up-to-date with the recommended immunisation schedule on admission to the emergency department significantly decreased on discharge after hospital-based vaccination. However, by 6 months, there was no significant difference in the proportion of children up-to-date on discharge compared with that on hospital admission.

Evidence statement 40

There is evidence from 2 studies from Australia and Switzerland (1 NRCT [−] and 1 NRCT [+]) that delivery of a verbal reminder to parents of children identified on admission to hospital as being not up-to-date with the recommended immunisation schedule with or without a follow-up letter sent to the child's primary care provider, was effective at encouraging vaccination within 30 days compared with children whose parents were not given a reminder (NRCT [+] n=430; NRCT [−] n=54).

Evidence statement 41

There is evidence from an interview study with head teachers (n=31), school nurses (n= 12) and parents (of 1411 children) in inner-city London (+) that although most parents (69%) whose children were not fully immunised were in favour of opportunistic school-based immunisations (for example, at the school health interview), there were mixed views among school nurses and head teachers. Findings from a postal survey of 24 school nurses in Oxfordshire found that where school-based immunisations had taken place they had greatly increased school nurses' workload (−).

There is evidence from a questionnaire that sought to identify lessons for future practice, training needs, operational planning and resource management of school nurses (throughout England; response rate 57.6%) after undertaking a nationwide rubella and measles immunisation programme for children aged 5–16 years ([−] n=288). The study found that: the timing of the campaign was not ideal for school nurses with the dates coinciding with the beginning of school holidays, a time when most school nurses do not work; 75% felt confident in undertaking immunisations but a few nurses who did not have access to training admitted to lacking confidence; the majority (95%) found the campaign tiring and many put in extra time that was not remunerated; 92% of nurses had found the campaign a challenge and stimulating and most (96%) enjoyed working in a team (those that worked within a team structure felt more confident and enjoyed the camaraderie).

There is evidence from a semi-structured focus group study involving parents (n= 39) and pupils (n=50) in Glasgow (++) that explored immunisation in general and universal hepatitis B vaccination.

It found that most parents agreed with vaccinations being delivered at school, and felt that their children thought likewise. A minority of pupils and parents perceived a lack of privacy and embarrassment to be barriers to vaccination in school. Pupils liked receiving vaccine at school because they felt supported by their peers.

Evidence statement 43

There is evidence from 1 ITS (+) from the UK that offering hepatitis B vaccination to all injecting drug users (aged 16–20 years) who were inmates of youth offender institutions and prisons, significantly increased uptake.

Evidence statement 47

There is strong evidence from 10 studies to suggest that targeted multicomponent community-based interventions are effective at increasing uptake of childhood immunisations.

Four RCTs (3 [+] and 1 [−]) and 4 BA studies (1 [+] and 3 [−]) found that multicomponent community-based interventions targeting children at risk of low immunisation uptake (for example, already behind in their vaccinations or from low-income or black and minority ethnic group families) increased the number of children who were up-to-date with the recommended vaccination series or who received vaccinations, at least in the short term (6 months to 1 year) compared with children who did not receive community-based outreach. Although intervention components varied between studies they generally comprised: home visits; advice and support for parents;, local media campaigns and networking with local organisations; vaccination-specific components such as referral and reminders of upcoming vaccinations; working with parents to ensure they understood the immunisation schedule, reduced their misconceptions about vaccinations or encouraging them to be proactive and request immunisations from their providers; direct contact with the family's immunisation providers; immunising in other settings such as hospitals and immunisation-linked incentives.

One cluster RCT ([+] n=286) found that a multicomponent community-based intervention comprising home visits, parent-baby developmental play groups, parent support groups and monthly support calls, targeting children from black, low-income families, significantly improved uptake of immunisations to age 9 months compared with children receiving standard social services. Although there was no significant difference in completion of primary immunisation series at 12 months, drop out was greater than 50%, limiting reliability of this finding.

One NRCT ([+] n=1,508) compared a media-based education and outreach campaign to encourage Vietnamese American parents to have their children vaccinated with hepatitis B vaccine with a

community mobilisation strategy undertaken by a Vietnamese American community-based organisation that developed an action plan of activities and timeline with the goal of improving vaccination rates. It found that both strategies significantly increased uptake of hepatitis B vaccine compared with a control group that did not receive any intervention.

However, there is mixed evidence on the long-term effectiveness of community-based outreach interventions at increasing immunisation uptake. One RCT ([+] n=232) followed up children for 7 years and found there was no significant difference between intervention and control groups in the proportion of children that had received MMR or the school booster, although subsequent children of mothers in the intervention group were significantly more likely to have completed polio and Hib immunisations compared with subsequent children of mothers in the control group.

Two RCTs (1 [+] and 1 [−]) found that universal multicomponent community-based interventions which comprised postnatal home visits in addition to parental advice and support (RCT [+] n=439) or postcard or telephone reminders for parents to attend for vaccinations and a number of provider-based interventions (RCT [−] n=3015) significantly improved up-to-date vaccination coverage rates compared with no intervention.

Evidence statement 48

Barriers to immunisation uptake: A nationally representative interview survey with 18,488 mothers found that parents of partially immunised children were likely to refer to practical or logistical problems with getting to immunisation clinics as reasons for incomplete immunisation (++).

An interview study with parents of 1411 children in inner-city London found that recent immigration was a practical barrier to immunisation, although the study did not elaborate on the types of barriers caused by immigration (+).

Evidence statement 49

Parental and health professional views on interventions to reduce barriers to immunisation uptake: There was evidence from 2 studies, 1 postal survey of health professionals (including school nurses, clinical medical officers and health visitors) and 1 focus group study (involving health visitors and parents), that identified a number of practical suggestions for improving immunisation uptake. These included: mobile or home-based immunisation; incentives for parents to bring their children for immunisation; special clinics solely for immunisation; general improvements to the immunisation service ([−] n=174 health professionals), and varying clinic timing ([−] n=15 health visitors and parents). Only 6–9% of professionals supported compulsory immunisation.

An interview study with 759 parents found that 25% of them would prefer immunisation in the home by a health visitor (−). Another interview study of 22 parents indicated that parents had a preference for a flexible system for immunisation appointments (++).

There is evidence from an interview study with 10 orthodox Jewish mothers (−) and a questionnaire study with 67 orthodox Jewish parents (+) that identified a number of interventions such as reducing clinic waiting times, improving play facilities in clinics and reducing overcrowding in waiting rooms that may help to improve immunisation uptake, many of which sought to address practical barriers such as having to care for large families and multiple competing demands on time.

Evidence statement 51

There is evidence from 2 studies (1 cluster RCT [+] and 1 ITS [−]) that targeted multicomponent programmes based on enhancing access to vaccination services in combination with reminder/recall interventions is effective at increasing uptake of immunisations. The first study (cluster RCT [−] n=2665) found that an intervention based on reminder/recall in addition to home visits and transportation to the clinic for children of low-income families in need of vaccinations was effective at increasing the proportion of babies up-to-date with immunisations compared with children receiving no contact ([+] n=2665). The second study (ITS [−] n=3184) found that a programme comprising a community-wide reminder/recall and outreach system in which children behind in their immunisations received reminder/recall (telephone, postcard, or letter) with increasing intensity for children who were further behind in immunisations, and home visits for those where all previous strategies had failed, significantly increased immunisation rates in city and suburban settings from baseline after 3 years. After 6 years the increase was no longer statistically significant.

Evidence statement 52

There is evidence from 1 BA study ([++] n=464) from Ireland that a targeted multicomponent provider-based intervention comprising: checking of practice immunisation records and implementation of opportunistic immunisations; sending postal reminders to non-vaccinated children and providing monthly written feedback of uptake figures to all practice staff, significantly increased uptake after the postal reminders were sent of DTP and Hib among children aged more than 6 months living in a deprived area.

Evidence statement 55

Differences in knowledge and beliefs across different ethnic groups: There is evidence from a study that used mixed methods (quantitative analysis and focus groups with 37 mothers) in Brent, North

West London and found a significant relationship between uptake of the first dose of MMR vaccine and ethnicity. Uptake of the first dose of MMR vaccine was highest among children from Indian backgrounds followed by African-Caribbean children and lastly white children (++).

Among people of Asian origin, immunisation was seen as beneficial, possibly influencing their uptake; these people followed their cultural tradition of consulting their elders, especially their mothers-in-law, for advice about immunisation. Asian mothers were also more likely to consult their GPs for advice and were most trusting of such advice. Conversely, African-Caribbean and white mothers were more likely to question pro-MMR vaccination advice given by healthcare professionals (++).

Differences in knowledge and beliefs across different socio-economic groups: There is evidence from a recent interview study undertaken in October and November 2006 with mothers of children aged under 3 years (n=1016) that found that mothers from lower socioeconomic groups were significantly more likely to consider the MMR vaccine as being completely safe compared with mothers from higher socioeconomic groups. Furthermore, the study found that before 2002, a greater proportion of mothers from higher socioeconomic groups considered the MMR vaccine to pose a greater risk than diseases it protected against than did mothers from lower socioeconomic groups, although the gap had narrowed in subsequent years and by 2006 the proportion was 14% in both groups (++).

Evidence statement 61

There is evidence from 1 recent cluster RCT ([+] n=142) from the UK that found that children were significantly more likely to have been vaccinated with MMR if their parents had received the NHS Health Scotland information leaflet 'MMR – your questions answered' and were also invited to attend a parent-led intervention, a one-off, 2-hour parent meeting (consisting of information giving and a question and answer session), a support network and enablement, compared with parents that received only standard information.

Evidence statement 66

There is mixed evidence from 2 cohort studies (1 [+] and 1 [−]) and 2 ITS studies (both [−]) to suggest that neonatal hepatitis B immunisation strategies centred around early identification of hepatitis B positive mothers and initiation of the vaccination schedule in hospital can increase neonatal hepatitis B vaccination coverage. The first cohort study ([+] n=265) from the UK found that a hospital-based service in which an immunisation clinic was held in the hospital at the same time as the neonatal follow-up clinic led to higher levels of vaccination compared with a neighbouring area with no hospital intervention. The second cohort study ([−] n=832), in which

HBsAg-positive mothers were contacted by phone, letter or home visit and counselled about the risks of transmission and importance of screening household contacts found that babies were significantly more likely to complete the hepatitis B vaccination series if the first dose was given in hospital. However, 1 poor-quality study (ITS [−] n=323) found that a comprehensive immunisation strategy where the first dose of hepatitis B vaccine was given in hospital and a GP was nominated to continue the vaccination schedule did not increase the proportion of eligible babies receiving the recommended 3 doses of the vaccine.

One study from Italy (ITS [−] n=NR) reported that over a 4-year period the proportion of eligible babies immunised against hepatitis B increased significantly following introduction of a policy to administer intramuscular hepatitis B immunoglobulin within 24 hours of birth and the first dose of hepatitis B vaccine within 7 days of birth.

Finally, 1 cohort study in Australia ([−] n=658) found that extension of an existing neonatal hepatitis B vaccination policy (covering neonates born to mothers who carried HBV) to include neonates born to mothers from high-risk countries (including Vietnam), irrespective of the mother's hepatitis B status significantly increased hepatitis B vaccine coverage rates, although the applicability of this study to the UK context may be limited.

Cost-effectiveness evidence

At current levels of coverage, immunisation against measles is estimated to save the NHS money (that is, the money saved as a result of not having to treat a case of measles more than pays for the immunisation). This is likely to be true even when taking into account the cost of home visits targeting children who have not been immunised. (It would only cost money if the refusal rates were very high.) The level of vaccine coverage required against measles is higher than for other universal vaccinations, such as mumps and rubella. It follows that immunisation against these infections would be cost saving in almost all circumstances, as it is given as a combined vaccine.

Currently, the targeted immunisation programme to reduce the incidence of infant hepatitis B is estimated to be cost saving, where it costs less than about £30 per injection. It would still be cost effective (but not cost saving) if the administration costs were up to several hundred pounds.

Fieldwork findings

Fieldwork aimed to test the relevance, usefulness and the feasibility of putting the recommendations into practice. PHIAC considered the findings when developing the final recommendations. For details, go to the fieldwork section in appendix B and Reducing differences

in the uptake of immunisations (including targeted vaccines) in children and young people aged under 19 years.

Fieldwork participants who have a direct or indirect role in the delivery of immunisation programmes for children and young people were very positive about the recommendations. If implemented, they felt that they could help reduce differences in the uptake of immunisations.

Many participants felt that the recommendations would raise the profile of immunisation, particularly in primary care settings and, potentially, could be effective in areas where immunisation uptake is low. Information systems were thought to be integral to implementing the guidance successfully.

The recommendations were seen to reinforce government policy on immunisation, particularly in relation to:

- completion of the appropriate immunisation schedule
- timely vaccination
- the lead role of health visitors, working with other frontline practitioners and with parents and families to improve the health and development of children under the age of 5 years
- the role of children's centres and family nurse partnerships in promoting the health of children from the most disadvantaged families.

Although neither practitioners nor commissioners felt the recommendations offered a new approach, they agreed that the measures had not been implemented universally. They believed this could be achieved if there was:

- a robust information system on immunisation, based on good quality data
- collaborative working between professional groups and services that have a role in the immunisation of children and young people
- greater access to good quality training for all those working to improve the uptake of immunisations, so that they can confidently communicate the benefits (and how safe the vaccines are) to parents and young people.

Appendix D: Gaps in the evidence

PHIAC identified a number of gaps in the evidence relating to the interventions under examination, based on an assessment of the evidence, stakeholder and expert comments and fieldwork. These gaps are set out below.

1. There is a lack of UK evidence on the effectiveness and cost-effectiveness of different interventions aimed at increasing immunisation uptake among children and young people aged under 19 years, particularly among those who may not have been immunised or only partially immunised.

2. There is a lack of UK evidence on the differential effect of universal interventions to increase immunisation uptake across different groups.

3. There is a lack of UK evidence on the effectiveness and cost-effectiveness of interventions aimed at increasing uptake of the school leavers' booster vaccination.

4. There is a lack of UK evidence to determine whether removal of the barriers to accessing immunisation services increases immunisation uptake among children and young people aged under 19 years. Information is particularly lacking in relation to population subgroups at increased risk of not being immunised or only being partially immunised.

5. There is a lack of UK evidence to judge whether or not interventions to increase uptake of immunisations in children and young people aged under 19 have any unintended or negative effects. For example, on how repeat reminders to those who do not want their child immunised may affect their relationship with the GP.

6. There is a lack of evidence on the differential effect of using different professionals (such as nurses, GPs and other practitioners) to increase immunisation uptake among children and young people aged under 19 years. In particular, there is a lack of evidence on how this affects subgroups at increased risk of not being immunised or only being partially immunised.

The Committee made 5 recommendations for research. These are listed in section 5.

Appendix E: Supporting documents

Supporting documents are available online. These include the following.

- Reviews of effectiveness:
  - 'Review of the evidence of the effectiveness and cost effectiveness of interventions to address differences in the uptake of immunisations (including targeted vaccines) in people younger than 19 years'
  - 'Revised analysis of the evidence of interventions to reduce differences in immunisation uptake (including targeted vaccines) in people younger than 19 years'.
- Economic analysis:
  - Analysis 1: 'The impact of increasing vaccine coverage on the distribution of disease: measles in the UK'
  - Analysis 2: 'An exploration of the cost effectiveness of interventions to reduce the difference in uptake of childhood immunisations in the UK using threshold analysis'
  - Analysis 3: 'The estimated cost effectiveness of vaccination in infants born to hepatitis B virus positive mothers'.
- Fieldwork report: 'Reducing differences in the uptake of immunisations (including targeted vaccines) in children and young people aged under 19 years'.

Update information

September 2017: Links to the online version of the Green Book were added. Parts of recommendation 6 were removed to bring it in line with the incorporation of hepatitis B vaccination into the standard routine vaccinations for babies. Terminology throughout was updated to reflect current public sector structures for commissioning and delivery of immunisation services where these had changed since original publication.

August 2010: The immunisations website which is referred to in this guidance has been closed. Resources for professionals are now available from Department of Health pages and for parents, carers and patients at NHS Choices.

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