Measles and rubella elimination: communicating the importance of vaccination
ECDC TECHNICAL REPORT

Measles and rubella elimination: communicating the importance of vaccination
This report was commissioned by the European Centre for Disease Prevention and Control (ECDC), coordinated by Svetla Tsolova, and produced by Cornelia Betsch.

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## Abbreviations

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>CRS</td>
<td>Congenital rubella syndrome</td>
</tr>
<tr>
<td>EEA</td>
<td>European Economic Area</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>MMR</td>
<td>Measles, mumps and rubella</td>
</tr>
<tr>
<td>MMRV</td>
<td>Measles, mumps, rubella and varicella</td>
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<tr>
<td>Q&amp;As</td>
<td>Questions and answers</td>
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Goals of the project

The goal of this project is to support EU Member States in their fight against measles and rubella. More specifically, this project aims to:

- dispel the myths about measles vaccination;
- offer scientific, evidence-based corrections of misperceptions on measles;
- inform about rubella infections in pregnancy; and
- discuss the risks and benefits of vaccination against rubella for women of childbearing age.

This report should enable Member States to engage in effective, evidence-based risk communication. Information on measles and rubella is presented in a modular fashion, so it can be easily used in customised leaflets, flyers, or web pages. The facts presented in this report are intended to lower the barriers to measles and rubella vaccination and raise awareness for congenital rubella syndrome (CRS), including awareness for ante-natal screenings and post-partum vaccination.

Methodology

We reviewed recent scientific literature on measles and rubella vaccination. We also conducted a global search of internet sites on measles and rubella published in English, German, Dutch, or Spanish.

Specific internet searches (internet discussion forums, websites of anti-vaccination activists, anti-vaccine websites, and social media) were conducted to find:

- flyers which could serve as examples on how to inform the public or health professionals on measles, measles vaccination, or debunking vaccination myths;
- information on common ‘measles myths’;
- information on EU vaccine policies (rubella) with respect to women of childbearing age; and
- information about recent rubella outbreaks, with a focus on CRS.

Scientific literature was analysed in order to obtain information:

- on recent rubella outbreaks, with a focus on CRS;
- on the risks of rubella infection and the benefits of vaccination with regard to pregnancy and protection of the foetus/newborn;
- on common myths about measles and measles vaccination; and
- on evidence-based corrections in order to reduce misperceptions on measles and measles vaccination.

There is increasing awareness that communicated facts should be evidence-based and that it is necessary to employ evidence-based communication to make health communication effective [3]. Especially when myths are debunked, certain techniques should be applied [4] to ensure effective correction of misperceptions [5].

Review of online flyers

We conducted a global online search in four languages (German, English, Spanish, and Dutch). As search terms we used ‘leaflet’, ‘brochure’, ‘flyer’, ‘measles’, ‘vaccine/vaccination’, ‘herd immunity’ combined with country names (Great Britain, Switzerland/Schweiz, Netherlands/Nederland, Österreich, United States, Canada, South Africa) and/or with names of public health authorities both at the national and county level (NHS, CDC, Bundeszentrale für gesundheitliche Aufklärung, Bundesamt für Gesundheit, Eidgenössisches Departement des Innern, Health Service Executive Public Health Division, Rijksinstituut voor Volksgezondheid en Milieu, Department of Health of the Republic of South Africa).

A detailed list of obtained flyers along with an evaluation grid can be found in Annex A.

The first flyer we analysed (filename: PL-dis-measles-color-office.pdf) was produced at the US CDC and directed at parents. It meets most of the criteria for comprehensive information. It is well structured; text is presented in short paragraphs. Core information can be easily extracted. Furthermore, the use of tables and natural numbers helps understanding.

The second flyer (filename: Measles_infographic.pdf) by Public Health Wales uses a visual approach. Literature has repeatedly shown that health literacy strongly depends on literacy as well as numeracy [8]. The Public Health Wales infographic should be understandable to a much wider audience, although there are no empirical data available; as an added benefit, healthcare workers can use the illustrations when talking to their patients.

A review of all leaflets showed that none of them discloses any conflicts of interest or makes mention of scientific or medical uncertainties, i.e. points to issues where science may lack evidence or where studies contradict each
other. The leaflets only occasionally use graphs and figures, and only few leaflets point out that there is no effective alternative to vaccination. These shortcomings are addressed in the fact sheets/key messages presented later in this report.

We also conducted an online search for flyers on rubella, albeit in a less systematic fashion. Two commendable examples were developed the US CDC: one on rubella (PL-dis-rubella-color-office.pdf) and one on ‘Immunization and pregnancy’ (CDC, f_preg.pdf).

Common myths and evidence-based counterarguments

We collected common myths on measles and measles vaccination by searching internet forums, websites of anti-vaccination activists, vaccine-sceptic websites and social media. In a more specific search, we selected websites where common myths were collected and partially refuted (Table 1a) as well as websites from anti-vaccination movements (Table 1b).

In an unspesific search, Google and Google Scholar were used to identify the most common myths as mentioned in scientific papers [16-18] and newspaper/magazine articles [19]. Facebook and Twitter were searched to assess the popularity of these myths in social media. The number of followers of the websites was used as a proxy for popularity (see Table 1c for most popular sites).

Table 1a. Public health websites

<table>
<thead>
<tr>
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<th>Source</th>
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<tr>
<td>Some common misconceptions about vaccination and how to respond to them</td>
<td><a href="http://www.cdc.gov/vaccines/vac-gen/6mishome.htm">http://www.cdc.gov/vaccines/vac-gen/6mishome.htm</a></td>
</tr>
<tr>
<td>Top 20 questions about vaccination</td>
<td><a href="http://www.historyofvaccines.org/content/articles/top-20-questions-about-vaccination">http://www.historyofvaccines.org/content/articles/top-20-questions-about-vaccination</a></td>
</tr>
<tr>
<td>What are some of the myths – and facts – about vaccination?</td>
<td><a href="http://www.who.int/features/qa/84/en/">http://www.who.int/features/qa/84/en/</a></td>
</tr>
</tbody>
</table>

Table 1b. Anti-vaccination websites

<table>
<thead>
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<th>Title</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Vaccination causes autism – Here’s what they know…</td>
<td><a href="http://vactruth.com/2013/07/04/vaccination-causes-autism/">http://vactruth.com/2013/07/04/vaccination-causes-autism/</a></td>
</tr>
<tr>
<td>Case reports to NVIC of diabetes following MMR shots</td>
<td><a href="http://www.nvic.org/vaccines-and-diseases/Diabetes/diabetesmmrsots.aspx">http://www.nvic.org/vaccines-and-diseases/Diabetes/diabetesmmrsots.aspx</a></td>
</tr>
<tr>
<td>The great thimerosal cover-up: Mercury, vaccines, autism and your child’s health</td>
<td><a href="http://www.naturalnews.com/011764_thimerosal_mercury.html">http://www.naturalnews.com/011764_thimerosal_mercury.html</a></td>
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<tr>
<td>Datenbank Impfschadensmeldungen</td>
<td><a href="http://www.impfschaden.info/impfsch%C3%A4den/impfschadensdatenbank.html">http://www.impfschaden.info/impfsch%C3%A4den/impfschadensdatenbank.html</a></td>
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Table 1c. Facebook accounts

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<td>Vaccine resistance movement</td>
<td>601</td>
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<td>Dr. Tenpenny on vaccines</td>
<td>73 279</td>
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<tr>
<td>Impfen ... Nein danke!</td>
<td>245</td>
</tr>
<tr>
<td>Vaccine Information Network (VINE)</td>
<td>96 512</td>
</tr>
<tr>
<td>Gegen Zwangsimpfung und Impfhyysterie</td>
<td>37</td>
</tr>
</tbody>
</table>

We selected the following six myths to be debunked:

- Measles is a harmless disease. The healthcare system in developed countries provides enough resources when someone has measles.
- It is better to get immunity through disease exposure than through the vaccine.
- Homeopathy can be used as an alternative to protect children against measles.
- Giving a child the MMR vaccine increases the risk of harmful side effects and can overload the immune system.
- MMR vaccination may cause autism.
- Measles is eliminated in Europe, so there is no reason to get vaccinated.
Literature searches were conducted to collect information regarding the myths to be refuted. The actual debunking process followed rules proposed in the literature [4,5,9].

Defining ‘myth’

Myths and misperceptions about vaccination are as old as vaccination itself. Research has identified common myths [10-12], and the literature on the topic discusses potential reasons of how these vaccination myths developed [13]. In general, risks are less tolerated and perceived as higher when they result from human actions, are hidden, cause irreversible damage, or are poorly understood by science [13,14]. Myths often link diseases or chronic conditions to vaccination. It was found that the diseases or chronic conditions linked to vaccination are usually of idiopathic origin; that they are characterised by an apparent rise in incidence; that there is face-value biological plausibility of a link to vaccines; that the outcomes are dreaded, and that disease onset is in close proximity to immunisation [13]. We consider misinformation as a myth when sufficient scientific evidence refutes the claim.

Defining ‘evidence-based’

According to Sackett et al., ‘evidence-based’ is defined as follows: ‘Evidence-based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research’ [15].

Fact sheets and key messages: design and concept

Criteria and definitions

We used a standard set of criteria elaborated by Bodemer et al. as criteria to evaluate flyers and develop our own fact sheets and key messages [7]. These criteria include: explaining the goal, defining the target population, explaining aetiology, providing epidemiological data, comparing figures, elaborating on cost estimates, communicating treatment effects (including visual references), explaining alternative treatments and their limitations, and disclosing conflicts of interest.

Criteria for collecting facts, based on Bodemer et al. [7]:

- How is the disease transmitted?
- What are the consequences of the infection?
- How prevalent is the disease?
- Is there any specific treatment?
- What is the aim of the vaccination?
- For whom is the vaccine recommended?
- How long does vaccine protection last?
- Are there other preventive methods?
- What is the vaccine’s effectiveness?
- What are the side effects of the vaccines?

Communicating vaccination information

Ever since vaccination has been practiced, myths and misinformation about vaccination abound. Psychological research has shown that debunking myths is difficult: the mere reading about a myth, even about a myth’s refutation, can strengthen the myth – rather than weaken its influence [35]. Likewise, an explicit and strong negation of a risk can paradoxically increase the perception of risk in the reader [5].
Building blocks for debunking vaccination myths

- Core facts. A refutation should emphasise the facts, not the myth. The introduction should start with the facts to aid retention. Present only key facts. Avoid that complicated debunking is harder to process than a simple myth.
- Explicit warnings. Before any mention of a myth, text or visual cues should warn that the upcoming information is false.
- Alternative explanation. Any gaps in the mental model left by the debunking need to be filled. This may be achieved by providing an alternative causal explanation for why the myth is wrong and, optionally, why the misinformers promoted the myth in the first place.
- Graphics. Core facts should be displayed graphically if possible.
- Language. Avoid strong language when you say that there is no risk. Making strong claims denying the possibility of risk associated with vaccinations may backfire.

Adapted from [4,5,9]

Fact sheets and questions and answers (Q&As)

We identified a total of six key messages for measles and another five for rubella and expanded them into full-fledged fact sheets, offering detailed and evidence-based corrections of measles myths [6].

Preceding the fact sheets and their key messages are two short sections with questions and answers ('Q&A: measles', 'Q&A: rubella') which address basic questions on transmission, prevalence and prevention.

The fact sheets aim at providing Member States with the necessary building blocks to design their own evidence-based information materials or campaigns. Information is presented in a modular way, which lets public health official use either a complete or partial set of modules when designing information campaigns.

Target groups

The fact sheets/key messages presented in this report are directed at health professionals and communication experts who are in charge of communication and information activities. Consequently, the level of scientific explanations is geared toward supplying public health personnel with arguments designed to effectively communicate with the general public.

As the fact sheets on measles intend to support health professionals in communicating with un- or undervaccinated adults and parents of unvaccinated children, their language is less complex than in scientific literature.

The fact sheets/key messages on rubella are targeted at women of childbearing age, women planning to become pregnant, and parents of unvaccinated children. Therefore, this information is especially suitable for designing catch-up campaigns.

Structure of the fact sheets

All fact sheets on measles first introduce a key message, which is followed by a brief introductory paragraph. We then present a misperception (‘a myth’), immediately followed by its scientific correction and the corresponding scientific evidence. For the presentation and correction of the myth we follow techniques proposed by Lewandowsky et al. [4]. For details, please refer to the text box above.

At the end of each fact sheet, a conclusion repeats the key message to make it more memorable [8].

It is important to note that our key messages do not directly reiterate a myth because research has shown that referring to misinformation in headlines and key messages can actually reinforce misperceptions [4].

With regard to rubella, we also summarised vaccination policies in Member States and included information on recent outbreaks and CRS cases in order to raise awareness and provide convincing examples of the seriousness of the disease (Annex B).

A separate Q&A (questions and answers) section for both measles and rubella provides the basic scientific facts on immunisation and serves as a general introduction into the topic.

Note: In the Q&A sections, references to the literature are in parentheses/round brackets and listed as endnotes immediately following the text. All other references appear in square brackets, with a full list of references at the end of this report.
Q&A – measles

How are measles transmitted?
Measles is transmitted from person-to-person via droplets. Measles can be transmitted in closed areas (e.g., office, examination room) for up to two hours after a person with measles left the area.

Measles is highly communicable. The probability of infection when a susceptible person had contact with an infected person or source is 90% (1).

Measles is a human disease; there is no known animal reservoir.

What are the consequences of the infection?
Symptoms usually appear after 10 to 12 days of infection, initially resembling a cold with a runny nose, cough and a slight fever. The eyes become red and sensitive to light. As the illness progresses, and usually on the third to seventh day, the temperature may reach up to 39–41 °C, and a red rash lasting four to seven days appears. The rash begins on the face and then spreads over the entire body. Small white spots (Koplik’s spots) may also appear on the gums and inside of the cheeks (2).

Approximately 30% of reported measles cases have one or more complications (1), with more complications among children younger than five years of age and adults 20 years of age and older. The following complications can be expected (1, 3-5):

- Diarrhoea: 80 in 1000 measles cases
- Otitis media: 70 to 90 in 1000 measles cases
- Pneumonia: 10 to 60 in 1000 measles cases
- Encephalitis: 1 in 1000 measles cases
- Convulsions: 5 in 1000 measles cases
- Death: 0.7 to 2 in 1000 measles cases
- SSPE: 1 in 1700 to 1 in 3300 measles cases

SSPE (subacute sclerosing panencephalitis) is a degenerative central nervous system disease which starts usually between 4 and 10 years after the measles infection. A recent German study (4) suggests that the risk for SSPE in children infected with measles below five years of age is 1:1 700 to 1:3 300.

In Europe, 38 cases were complicated by acute measles encephalitis between 2007 and 2011 (6-10). Between 2005 and 2013 there were 24 deaths from measles in Bulgaria; 17 in Romania; 10 in France; 3 in Albania, the United Kingdom and Germany; 2 in Georgia and the Netherlands; and one in Spain.

After the disease, a person has life-long immunity against measles.

How prevalent is measles?

2013/2014 data

<table>
<thead>
<tr>
<th>Country</th>
<th>2013</th>
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<th>2013</th>
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<th>Total cases</th>
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Monthly updates can be found in ECDC’s publication ‘Measles and rubella monitoring’ (12).
Measles and rubella elimination: communicating the importance of vaccination

<table>
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<th>Question</th>
<th>Answer</th>
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<td><strong>Is there any specific treatment for measles?</strong></td>
<td>There is no specific treatment for measles. Only symptoms can be treated. The symptoms usually disappear within 7 to 10 days if no complications occur (13). Supportive care that ensures good nutrition, adequate fluid intake, and treatment of dehydration may prevent severe complications. Antibiotics should be used to treat eye and ear infections, and pneumonia (14).</td>
</tr>
<tr>
<td><strong>What is the aim of the vaccination?</strong></td>
<td>Vaccination against measles – usually combined with vaccines against mumps and rubella (MMR) – elicits specific responses in the immune system, similar to infection with an actual pathogen. This way, the immune system produces antibodies against the disease. The vaccinated individual is protected against the disease and will not develop severe symptoms, complications or sequelae. If 95% of the population were vaccinated, elimination of the measles would be possible; this had been achieved in the Americas. Thus, vaccination against measles has a direct effect by providing protection for the vaccinated individual and an indirect effect by stopping transmission, which helps to control morbidity and mortality on a societal level.</td>
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<tr>
<td><strong>For whom is the vaccine recommended?</strong></td>
<td>All Member States of the European Union embark on a two-dose measles vaccination strategy (15). The specific schedules differ between countries. In general, the first dose is given around the first 12 months of life. The online ECDC immunisation scheduler offers access to the immunisation schedules of all EU/EEA countries (15).</td>
</tr>
<tr>
<td><strong>How long does the vaccine last?</strong></td>
<td>One dose of MMR vaccine delivers lifelong immunity to most people (1, 16). A second dose protects those who did not respond to the first dose and increases the immune response in those whose response was low from the first dose. Thus, a second dose leads to a protective level of antibodies and is therefore necessary to ensure protection (17).</td>
</tr>
<tr>
<td><strong>Are there other preventive methods?</strong></td>
<td>Immunisation is the only effective preventive measure against measles (18).</td>
</tr>
<tr>
<td><strong>What is the vaccine’s effectiveness?</strong></td>
<td>The measles vaccine is usually combined with rubella and mumps vaccines in one product (MMR vaccine). It is equally effective in the single or combined form (14). Measles vaccine is at least 95% (range 90%-98%) effective. Vaccine failure of the first dose at 12 months of age or older occurs in up to 5% of people who receive vaccination, but a second vaccine dose gives immunity to 95% of first-dose failures (18). In Europe in 2012/2013, 3.5% of the measles cases occurred in individuals who were vaccinated with two doses (19). Eliminating measles is a cost-effective strategy. This was examined by comparing elimination against the status quo in 2010 (20). Elimination can only be achieved by increasing coverage in Europe to 95%, with two doses of measles-containing vaccine.</td>
</tr>
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</table>
| **What are the side effects of the vaccine?**                          | A vaccine, like any pharmaceutical substance, is capable of causing adverse events. MMR vaccine has been used since 1963 and has an excellent safety record. As MMR vaccine is a live-attenuated vaccine it can cause mild and non-communicable symptoms of measles (rash, fever) in three to five of 100 vaccinated individuals. It commonly causes minor reactions and rarely more serious reactions (21, 22): Common adverse events (1 in 10 to 1 in 100 vaccinated individuals):  
  • Fever (usually day 5–12 post-vaccination)  
  • Local swelling at injection site  
  • Rash commonly between day 5–12 post-vaccination  
  • Irritability  
  • Arthralgia (transient; mainly in adults, e.g. post-partum vaccination)  
  Less common adverse events (1 in 1000 to 1 in 10 000 vaccinated individuals)  
  • Lymphadenopathy  
  • Swelling of parotid gland  
  • Diarrhoea  
  • Vomiting  
  • Febrile convulsions  
  Rare adverse events (< 1 in 10 000 vaccinated individuals)  
  • Urticaria  
  • Thrombocytopenia (transient; up to 1 per 30 000)  
  • Meningitis/encephalitis (up to 1 per 100 000)  
  • Deafness  
  • Anaphylaxis, anaphylactoid reactions (1.5 per 1 000 000)  

• Rare adverse events (< 1 in 10 000 vaccinated individuals):  
  • Anaphylaxis, anaphylactoid reactions (1.5 per 1 000 000)
Q&A measles: references


Communicating the importance of measles immunisation – key messages

Key message: Measles is a serious disease

Introduction

In 1980, before measles vaccination became widely available, 2.6 million deaths worldwide were caused by measles [1]. In 2012, this number has been reduced to 122 000 people, mostly children.

Myth

It is a common misperception that measles is a harmless disease. Some people also believe that the healthcare system in developed countries has sufficient resources for good care when someone is infected with measles.

Correction of the myth

This misperception probably occurs due to the vaccination’s success: many people have never seen a person with measles infection and consider measles a relatively harmless disease. In fact, measles can be a very severe infection, which cannot be directly treated with antivirals. Once infected, only the symptoms (e.g. high fever) can be mitigated.

Complications occur in about 30% of all measles cases and affect almost every organ [2]. Complications range from ear infections, diarrhoea and related dehydration, to severe respiratory infections such as pneumonia and involve sequelae such as blindness or encephalitis [1,2].

Most measles-related deaths occur due to the complications associated with measles. Supportive care may only lower the probability of severe complications [2]. Globally, more than 95% of measles deaths occur in low-income countries with weak health infrastructures. However, measles-related deaths also occur in developed and industrialised European countries: between 2005 and 2013, there were 24 deaths in Bulgaria, 17 in Romania, 10 in France, four in Italy, and three each in the United Kingdom and Germany [3].

The number of hospitalisations due to measles is considerable: between 2005 and 2013, there were around 20 000 hospitalisations in Ukraine, Romania and Bulgaria, 5 239 hospitalisations in France, 1 607 in the United Kingdom, and 1 216 in Spain [3].

Conclusion

Although good healthcare can lower the probability of severe complications, measles-related deaths and hospitalisations due to complications occur even in developed and industrialised European countries. Vaccination is the only effective way to protect against it.

1 All key messages have a dedicated reference section (see p. 10).
**Figure 1.** Incidence of measles in the EU, 2013 (cases per 1 000 000 population)

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**References:** Measles is a serious disease


Key message: Vaccination is the best way to get immunity against measles

Introduction

The MMR vaccine provides protection against measles, mumps and rubella without causing severe symptoms, complications, or sequelae that are associated with the diseases. Mild symptoms such as rash or fever may occur after vaccination in three to five of 100 individuals, as MMR is a live-attenuated vaccine.

Measles is a severe infection, which cannot be treated with antivirals. Once infected, only the symptoms can be treated. Complications of measles occur in 30% of the infections, can affect almost every organ [1], and involve sequelae such as blindness, encephalitis, severe diarrhoea and related dehydration, ear infections, or severe respiratory infections such as pneumonia [1,2]. Most measles-related deaths occur following complications.

Myth

It is a common myth that it is better to get immunity from the disease than from the vaccine.

Correction of the myth

This misperception seems to be based on the false assumption that vaccination does not give life-long immunity [3]. It is a fact, however, that a second dose of the vaccine leads to a protective level of antibodies and thus to the same degree of immunity one would acquire through natural infection.

Vaccinations elicit specific immune responses from the immune system (i.e. the production of specific antibodies against the disease), similar to the way an infection would. Vaccination protects against the disease with minimal consequences, as opposed to measles infection and its potentially severe symptoms, complications, and sequelae.

Further, immunity through vaccination will protect others. Vaccination immunises the individual so he or she cannot transmit the virus. Acquiring immunity through the disease, on the other hand, exposes others to the risk of infection. Measles is communicable four days before the first symptoms appear. During this time, non-immune individuals may be infected and measles can spread.

Another factor may be the fear of potential side effects from vaccination. A vaccine, like any pharmaceutical substance, entails a certain probability of side effects [4], for example fever in 5–15 of 100 first doses or seizures in 1 of 3 000 first doses [5]. More severe reactions occur only rarely, with incidences below 1 in 10 000. MMR vaccination thus has an excellent safety record and is recommended in all EU countries.

The way humans perceive risk may also contribute to a preference for natural infection. A study showed that parents rated the symptoms following vaccination as more severe than the same symptoms during an actual infection [6] (see Figure below). This bias occurs because humans tend to regret negative outcomes that result from their own actions more than identical outcomes caused by others or inaction: while own actions and their negative outcomes lead to guilt, the outcomes caused by outside factors are considered as ‘unavoidable fate’. Understanding this bias can help to take a more rational decision [7].

Conclusion

The MMR vaccine provides protection against measles while avoiding potentially severe symptoms, complications or sequelae. Severe adverse events following MMR vaccination are very rare. It is therefore safer to vaccinate than to contract the disease. Further, immunity through vaccination will protect others while immunity through the disease exposes others to the risk of the disease, both before and during the time of infection. Thus, vaccination offers better and safer protection against measles.
Figure 2. Biased perception of side effects

Percentage (modal response) of parents considering...

- seizure a severe symptom
- fever above 38.5 °C a moderate symptom
- fever below 38.5 °C a mild symptom

Source: Brown et al. [6]
All differences are statistically significant (p<0.05)

References: Vaccination is the best way to get immunity against measles

Key message: Vaccination is the only effective way to protect against measles

Introduction

MMR vaccination elicits specific responses in the immune system, similar to the way an infection would, leading to the production of antibodies against measles, mumps and rubella, but without causing severe symptoms, complications, and sequelae.

Myth

It is a myth that homeopathy can be used as a vaccination alternative to protect children against measles. Despite the lack of evidence for alternative methods, a number of medical professionals are hesitant in recommending vaccination against measles and other childhood vaccinations [1] and offer, for example, homeopathic remedies as alternatives to vaccination.

Correction of the myth

A vaccine, like any pharmaceutical substance, entails a certain probability of side effects [2]. Even though the side effects are usually mild, and more severe adverse events are very rare, this may lead to the desire of avoiding these side effects by using seemingly harmless homeopathic products instead. Homeopathic products promise to strengthen the immune system and thereby protect against disease without side effects. However, homeopathy is not entirely devoid of risk [3]. Research has also shown that the proposed mechanisms of homeopathy are implausible [4] and that homeopathic substances are ineffective [3, 5, 6]. Ostensible effects of homeopathic substances are equal to placebo effects: effects occur because of mere expectations and not because of the substances themselves [7].

But even people with a strong immune system are susceptible to measles: individuals exposed to the virus will contract measles with a probability of 90%, regardless of the state of their immune system. Only vaccination can protect against measles.

Conclusion

Homeopathy has been shown to be ineffective; it is based on implausible mechanisms. Substances that claim to strengthen the immune system in general will not prevent a susceptible individual from contracting measles. Vaccination is the only effective way to protect against measles.

References: Vaccination is the only effective way to protect against measles

Key message: The MMR vaccine combines three vaccinations in one and has an excellent safety record

Introduction

Some combination vaccines contain multiple vaccines against different diseases, such as MMR vaccine, which contains vaccines against measles, mumps and rubella. This way, the organism is protected against different diseases with only one shot.

Myth

It is a common myth that giving a child the MMR combination vaccine increases the risk of harmful side effects and can overload the immune system.

Correction of the myth

This misperception is based on the idea that the more foreign substances enter the body, the more the immune system is stressed. However, the myth that combination vaccines overload the immune system underestimates the power of the human immune system [1], and overestimates the number of foreign substances in multivalent vaccines [2]. The neonatal immune system develops even before birth [2]. The immune system is capable of dealing with a very large number of antigens at the same time. In fact, foreign substances, e.g. in dust and dirt, continuously trigger a child's immune responses. A sore throat or a cold exposes a child to more antigens than a vaccine. Studies have shown that vaccines do not weaken the immune system because recently vaccinated children were equally likely to become infected by other pathogens as unvaccinated children [3–5].

Sometimes two or more injections with multivalent vaccines are administered during one visit (e.g. MMR and varicella, or MMR and diphtheria-tetanus-pertussis (DTP)). Several studies have shown that both MMR alone and MMR combined with certain other vaccines have an excellent safety record [2, 6–7]. If multiple vaccines would weaken the immune system, one would expect lower immune responses than with individual applications of the vaccines [8, 9]. However, similar immune responses have been found when MMR vaccine was combined on the same day with vaccination against a) varicella [10, 11], or b) DTP and oral poliovirus [12], or c) DTP-Hib (Haemophilus influenzae type b and varicella [13], or d) with Hib [14].

Conclusion

The myth that combination vaccines overload the immune system underestimates the power of the human immune system and overestimates the number of foreign substances in combination vaccines [1]. In sum, the MMR vaccine, either applied alone or simultaneously with certain other vaccines, provides protection against many diseases while reducing the number of injections. The combination formula has an excellent safety record.

References: The MMR vaccine combines three vaccinations in one and has an excellent safety record


Key message: MMR vaccination does not increase the risk of getting autism

Introduction

Since its introduction, around 575 million doses of MMR vaccine have been administered worldwide. It has an excellent safety record [1].

Myth

A common myth states that MMR vaccination may cause autism.

Correction of the myth

This myth was born in England in 1998. A journal article suggested a link between the MMR vaccine and autism and gastrointestinal disease. The author’s call to stop distributing the MMR vaccine received considerable media attention. In 2004, it was revealed that the author had a pecuniary interest in linking the MMR vaccine to autism [2]. A lawyer who intended to sue vaccine manufacturers had hired him and also recruited the children for the study. Moreover, data were falsified: contrary to what was stated in the article, some of the children already showed signs of autism before they were even vaccinated. The original article was retracted by the journal [3].

The fears caused by this article and the media attention it received led to years of lowered vaccine uptake, especially in the United Kingdom, which in turn led to several severe measles outbreaks.

Several independent studies were conducted in many parts of the world to test the correlation between MMR vaccine and autism. All concluded that there is no such correlation [4-9].

One reason why this myth is so persistent is that autism is often diagnosed at a time in the life of a child when most countries administer MMR vaccination [10]; this might have given rise to a false sense of causality. Moreover, from 1976 to 1997 diagnoses of autism increased by a factor of almost 10 in the United States [11] – the same period when the MMR vaccine was introduced. This increase, however, does not mean autism is occurring more often; more likely, the increase may be related to ‘the introduction of broader, more precise diagnostic criteria, increased availability of services, and increased awareness of autism’ [11]. When two rare events become very noticeable (e.g. due to novelty or an increase in frequency), humans tend to perceive causality between the two events [12]. This so-called illusory correlation is a typical cognitive bias [12] and may have contributed to the persistence of the myth.

Conclusion

A flawed journal article caused fears that the MMR vaccine may lead to autism. Numerous scientific articles showing no such correlation have since refuted this claim. A general cognitive bias to perceive causality when two rare events randomly co-occur contributed to the stability of the myth. It can be concluded that MMR vaccination does not increase the risk of developing autism.

References: MMR vaccination does not increase the risk of getting autism

2. Deer B. Secrets of the MMR scare: How the vaccine crisis was meant to make money. BMJ. 2011; 342:c5258.


Key message: Measles is a serious threat to health; elimination of measles in Europe is endangered by non-vaccinated individuals

Introduction
In some regions of the world, for example the Americas, measles has been eliminated [1].

Myth
It is a misconception that measles has also been eliminated in Europe. There is still a need to get vaccinated.

Correction of the myth
Overall, measles is rare in Europe, and many people may have never seen a person infected with measles. This may explain the myth.

European countries have pledged to eliminate measles by 2015. Since 2005, outbreaks have occurred in Austria, Belgium, Bulgaria, Denmark, France, Italy, Spain, Romania, the United Kingdom and Switzerland [2-9, 10]. Outbreaks lead to hospitalisations and measles-related deaths. Between 2005 and 2013, measles caused 24 deaths in Bulgaria; 17 in Romania; 10 in France; three each in Albania, the United Kingdom, and Germany; two each in Georgia and the Netherlands; and one in Spain [11]. Outbreaks occur due to pockets of susceptible individuals who are not immune, either because they did not get vaccinated, their immune systems failed to respond to the vaccine (this is rare), or because they were too young or too ill to get vaccinated [1].

Measles occurs with even higher incidence rates in other parts of the world, e.g. Africa and Asia [10,12]. Global interconnectivity can distribute diseases across huge distances [13], and only high vaccination rates can mitigate the consistent introduction and reintroduction of measles. If at least 95% of the population are vaccinated with two doses of measles-containing vaccine, measles can be eliminated [14].

Stopping measles vaccination in a population can lead to dramatic increases in measles infections. This was seen, for example, in the United Kingdom following an unsubstantiated vaccine scare, which caused vaccine rates to drop and led to thousands of measles cases [15].

Vaccination against measles helps to protect the individual and at the same time protects others who may be not immune but benefit from so-called herd immunity: when a significant number of people are vaccinated, chains of infections are stopped sooner, which indirectly protects non-immune individuals. For measles, 95% vaccine coverage is needed for herd immunity to work. To quote Bauch et al.: ‘Vaccine-generated herd immunity can reduce disease incidence to such low levels that real or imagined vaccine risks appear large in comparison, causing individuals to cease vaccinating. This implies a feedback loop between disease prevalence and strategic individual vaccinating behaviour.’ [16].

Experts emphasise the importance of individual contributions to both health programmes and society at large: ‘Successful vaccination programmes, like successful societies, depend on the cooperation of every individual to ensure the good of all’ [17]. It is each individual's responsibility to contribute to a safe and healthy environment for everyone.

Conclusion
The planned elimination of measles in Europe is endangered by non-vaccinated individuals and high global mobility. Elimination can only be reached if 95% percent of Europe’s population are vaccinated with two doses of measles-containing vaccine. Until then, measles remains a serious threat to health in Europe.

References: Measles is a serious threat to health; elimination of measles in Europe is endangered by non-vaccinated individuals


Q&A – rubella

How is rubella transmitted?
Rubella is transmitted via droplets from person to person. It may be transmitted by persons with subclinical or asymptomatic infection, which occurs in up to 50% of all rubella infections (1).

What are the consequences of the infection?
Rubella is usually a mild disease (2).
Children usually have few or no constitutional symptoms but adults may experience 1–5 days of fever, malaise, headache and arthralgia.

The typical presentation of rubella is a red rash and swollen lymph glands around the ears and the back of the head and – occasionally in adults – pain and inflammation of the joints.

Complications of acute rubella are rare (with the exception of rubella infection during pregnancy, which is discussed below):
- Encephalitis: 1 out of 5000–6000 cases
- Thrombocytopenia: 1 out of 3000 cases
- Transient polyarthritis and polyarthralgia are common complications in adolescents and adults, but rare in children.

What are the consequences of rubella in a pregnant woman?
85 out of 100 babies born to mothers who had rubella before conception or in the first three months of pregnancy will have a birth defect, so-called congenital rubella syndrome (CRS) (3). This syndrome manifests itself in a number of ways: deafness, cataracts, heart defects, microcephaly, mental retardation, bone alterations, liver and spleen damage.

Symptoms appear after birth up to when the infected child is two to four years old. Other late-onset manifestations are diabetes mellitus, thyroid dysfunction, visual or neurological abnormalities.

In 20% of the cases, rubella infections can result in spontaneous abortion and stillbirth/foetal death (1,4,5).

How prevalent is rubella in the EU? 2013/14 data
Reported rates of rubella in EU/EEA countries, June 2013 to May 2014 (6)

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NR=not reporting

Monthly updates can be found in ECDC’s publication ‘Measles and rubella monitoring’ (7).
## How prevalent is CRS?
Between 2008 and 2012, there were at least 77 CRS cases in Europe (8): two cases each occurred in the Czech Republic, Poland, and Portugal; four cases each were reported from Germany and Spain; Italy reported six cases; and 57 cases were reported by Romania.

## Is there any specific treatment for rubella?
There is no specific treatment for rubella. Symptoms will normally pass within 7 to 10 days (9). Up to 50% of infections may be subclinical or unapparent (1).

## What is the aim of the vaccination?
The aim of the vaccination is to reduce and eliminate rubella and congenital rubella syndrome (1). It is usually given as MMR vaccine, which is a combination vaccine against measles, mumps and rubella. MMR vaccination elicits specific responses in the immune system, similar to infection with an actual pathogen. This way, the immune system produces antibodies against measles, mumps and rubella without developing severe symptoms, complications and sequelae. The vaccinated individual is protected against the diseases.

Elimination of rubella is possible and cost-effective (10), but it can only be achieved by increasing coverage in Europe to more than 80%, with at least one dose of rubella-containing vaccine. Since rubella vaccine is usually combined with vaccination against measles, elimination of rubella will benefit from the goal of 95% coverage for the MMR vaccine. As measles is more contagious than rubella, higher coverage is needed to reach elimination.

Vaccination against rubella has a direct effect by providing protection for the vaccinated individual, especially during pregnancy, and an indirect effect by stopping transmission, which helps to control morbidity and mortality on a societal level.

## For whom is the vaccine recommended?
As of December 2009, all European countries have introduced rubella-containing vaccine to their routine schedules (11). According to national schedules, every child should receive immunisation against rubella by means of the MMR vaccine.

WHO recommends that in order to eliminate rubella within 10 years, high vaccination coverage must be achieved in young children, adolescents and adults (1–39 years) (11), which means that some countries must run catch-up campaigns for those who have not yet been vaccinated.

Women who wish to be pregnant should be advised to check their immunity status. Women with unknown immunisation status or no specific IgG antibodies must be considered susceptible and should get vaccinated before pregnancy (12). After vaccination with MMR vaccine women should avoid getting pregnant for at least 28 days (11).

## How long does the vaccine last?
One dose of MMR vaccine delivers lifelong immunity to most people (1,13,14,15). After two doses, between 91% and 100% of the vaccinees had detectable antibodies 12 to 15 years after receiving the second dose (14,15). A recent study shows that natural infections lead to higher levels of antibodies. However, after two rather than one dose of MMR vaccine, the concentration of rubella-specific antibodies was above the protective level and declined slower (16).

## Are there other preventive methods?
Only rubella vaccine (usually included in MMR vaccine) can prevent rubella and CRS.

## What is the vaccine’s effectiveness?
All licensed rubella vaccines induce seroconversion rates of approximately 95% or higher after a single dose.

The high response rate to a single dose of rubella vaccine and the long-term persistence of protection in vaccinees do not support a routine requirement for a second dose of rubella vaccine, even though immunity wanes more slowly after two doses (16). However, as the combined MMR vaccine is 98% effective, a second dose of MMR is recommended to produce immunity to measles and mumps in those who failed to respond to the first dose. Data indicate that almost all persons who do not respond to the measles component of the first dose will respond to a second dose of MMR (1).
What are the side effects of the vaccines?

The live-attenuated measles, mumps and rubella combination vaccine has been used since 1963 and has an excellent safety record. However, some adverse events may be possible, as with any medicinal product.

MMR vaccine commonly causes minor reactions, and rarely more serious reactions (17,18):

Common adverse events (1 in 10 to 1 in 100 vaccinated individuals)
- Fever commonly day 5–12 post-vaccination
- Local swelling at injection site
- Rash commonly between day 5–12 post-vaccination
- Irritability
- Arthralgia, transient (mainly in adults, e.g. post-partum vaccination)

Less common adverse events (1 in 1000 to 1 in 10 000 vaccinated individuals)
- Lymphadenopathy
- Swelling of parotid gland
- Diarrhoea
- Vomiting
- Febrile convulsions

Rare adverse events (< 1 in 10 000 vaccinated individuals)
- Urticaria
- Thrombocytopenia, transient (up to 1 per 30 000)
- Meningitis/encephalitis (up to 1 per 100 000)
- Deafness
- Anaphylaxis, anaphylactoid reactions (1.5 per 1.000 000) (19)

Q&A: rubella


Communicating the importance of rubella immunisation – key messages

Key message: Rubella infection during early pregnancy carries a high risk of harm to the foetus

Evidence

The symptoms of rubella are often mild, and up to 50% of infections may be subclinical or inapparent [1]. However, 85 out of 100 babies born to mothers who had rubella shortly before or during the first three months of pregnancy will have a birth defect, so-called congenital rubella syndrome (CRS) [2]. These include deafness, cataracts, heart defects, microcephaly, mental retardation, bone alterations, liver and spleen damage. Symptoms occur after birth up to when the infected child is two to four years old. Other late-onset manifestations are diabetes mellitus, thyroid dysfunction, and visual or neurological abnormalities. In 20% of the cases, rubella infections can result in spontaneous abortion and stillbirth/foetal death [1, 3, 4].

Worldwide, an estimated 110 000 babies are born with CRS every year [3]. EU countries reported 77 cases between 2008 and 2012 [5].

Pockets of unvaccinated individuals were repeatedly involved in large outbreaks of rubella, for example in Poland in 2013, with more than 30 000 cases of rubella infections. In the Netherlands in 2004/2005, 29 women were reported to have been infected with rubella virus during their pregnancy, none of whom had been vaccinated. The infections in the Netherlands, as known so far, resulted in two foetal deaths and 14 infants with congenital infection. Eleven children had clinical defects including deafness in all cases [6].

Conclusion

Rubella infections in healthy individuals usually have mild symptoms. However, rubella infection occurring just before conception and during early pregnancy is very likely to result in miscarriage, foetal death, or congenital defects known as congenital rubella syndrome (CRS). Vaccination well before getting pregnant protects from rubella and CRS.

References: Rubella infection during early pregnancy carries a high risk of harm to the foetus

Key message: Check your immunity against rubella before getting pregnant

Evidence

Before planning to get pregnant, women should confirm their rubella vaccination status [1]. Vaccination at least one month before pregnancy is the only way to effectively prevent congenital rubella syndrome (CRS). When a pregnant woman is infected with rubella shortly before or during the first trimester of her pregnancy, the virus is capable of infecting the foetus. It then stops cells from developing, or destroys them [2], which results in an 85–90% probability of the child being born with CRS [2].

In cases where it is not possible to verify the immunisation status (verification is usually done by checking vaccination cards or by testing for specific IgG antibodies), a woman must be considered susceptible. Screening is not a necessary condition for vaccination [3]. Vaccination against rubella and varicella should be offered to all women of childbearing age who do not have acceptable evidence of immunity [4].

Conclusion

If a woman wishes to be pregnant and is rubella antibody negative or of unknown immune status, she should receive at least one dose of MMR or MMRV vaccine. She should avoid becoming pregnant for 28 days after receipt of MMR vaccine because MMR is a live-attenuated vaccine [3].

References: Check your immunity against rubella before getting pregnant


Key message: Susceptible pregnant women should receive immunisation against rubella immediately after delivery

Evidence

In most EU countries, rubella screening is offered during regular antenatal care. Screening does not detect rubella infection in pregnancy but it identifies susceptible women, who can then get vaccinated in the post-partum period, which reduces the risk of infection in future pregnancies [1].

Susceptibility to rubella during pregnancy has several consequences. For example, pregnant women who were screened as non-immune should avoid contact with potentially infected individuals.

Rubella is contagious about one week before the individual develops the characteristic rash and about one week thereafter [2]. Up to 50% of all infections disappear without any symptoms. Thus, pregnant women may encounter individuals with rubella who may not know (yet) that they are infected.

Any woman presenting with a rash or who is exposed to others with a rash should be investigated.

Conclusion

Women who are found to be susceptible for rubella during their pregnancy should avoid contact with potentially infected individuals. Infections during early pregnancy can lead to severe consequences for the unborn child [3]. In order to protect the foetus in any subsequent pregnancies, susceptible women should receive at least one dose of rubella-containing vaccine immediately after delivery [4]. The same strategy applies to women after abortions [3].

References: Susceptible pregnant women should receive immunisation against rubella immediately after delivery


Key message: Unvaccinated males and females should get rubella vaccination to protect unborn life

Evidence

In order to protect the foetus from congenital rubella syndrome (CRS) it is essential for women of childbearing age to be immunised against rubella before pregnancy. In the past, only certain segments of the population, for example school-age girls, were targeted by vaccination schedules [1]. This caused immunity gaps, i.e. unprotected cohorts and population subgroups (e.g. males), which can lead to large outbreaks such as the one in Poland with more than 30,000 cases [2]. Recent outbreaks affected more men than women, but the proportion of infected women of childbearing age and of CRS cases can nevertheless be high, as was seen in outbreaks in Poland, Romania and Spain [2, 3, 4].

In order to eliminate rubella, high vaccination coverage must therefore be achieved in young children, adolescents and adults of both genders (1–39 years [5]), which means that some countries must run catch-up campaigns for those who have not yet been vaccinated.

Conclusion

All susceptible women who wish to be pregnant should be vaccinated. In addition, every person between 1 and 39 years of age with unknown immunisation status or no specific IgG antibodies must be considered susceptible and should be vaccinated. It is important to also vaccinate men and young children to eliminate rubella by stopping its transmission. Only if transmission of rubella is terminated, CRS can be stopped.

References: Unvaccinated males and females should get rubella vaccination to protect unborn life

Key message: Stopping rubella also means stopping congenital rubella syndrome

Evidence

Despite the pledge to eliminate congenital rubella syndrome (CRS) by 2015, many European countries reported outbreaks in unvaccinated population groups over the last few years. Between 2004 and 2013, Poland [1], Sweden [2], Romania [3], Italy [4], Austria [5, 6], Spain [7] and the Netherlands [8] all reported major outbreaks. It is now highly unlikely that rubella will be eradicated within the original time frame.

In Europe, only girls were initially targeted by national vaccination schedules [9]. This led to unprotected cohorts and population subgroups, particularly men, which in turn led to large outbreaks like the one in Poland with more than 30 000 cases [1]. In order to eliminate rubella within 10 years, high vaccination coverage must be achieved in young children, adolescents and adults (1–39 years [9]), which means that some countries must run catch-up campaigns for those who have not yet been vaccinated.

Rubella occurs with even higher incidence rates in other parts of the world, e.g. Africa and south-east Asia, where vaccination rates are lowest [10]. Global interconnectivity can distribute diseases across huge distances [11], and only high vaccination rates can mitigate the consistent introduction and reintroduction of rubella. If at least 80% of the population are vaccinated with at least one dose of rubella-containing vaccine [9], rubella can be eliminated.

Stopping rubella vaccination in a population can lead to dramatic increases in infection numbers. This was seen, for example, in the Netherlands in 2004/2005, where 29 women of an anthroposophic community contracted rubella during their pregnancy; none of them had been vaccinated. The infections resulted in two foetal deaths and 14 infants with congenital infection. Eleven children had clinical defects including deafness in all cases [8].

Vaccination against rubella helps to protect the individual and at the same time protects others who may be not immune but benefit from so-called herd immunity: when a significant number of people are vaccinated, chains of infections are stopped sooner, which indirectly protects non-immune individuals.

Conclusion

Elimination of rubella in Europe aims at preventing rubella infection and CRS. The goal of elimination is endangered by pockets of non-vaccinated individuals and by high global mobility. Only if at least 80% percent of Europe's population are vaccinated with at least one dose of rubella-containing vaccine, elimination of rubella can be reached and CRS be prevented.

References: Stopping rubella also means stopping congenital rubella syndrome


## Annex A. Leaflets on measles immunisation

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<th>Provide epidemiological data</th>
<th>Communicate treatment effects in absolute numbers</th>
<th>Include visualisations to illustrate treatment effects to address a wide range of people</th>
<th>Communicate cost estimates to convey an idea of individual and public health investments</th>
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Note: + indicates a strong strength in the respective area, - indicates a weak strength in the respective area.
### Standards for media coverage of health issues

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<th>Filename</th>
<th>Explain goal of medical treatment or prevention</th>
<th>Define target population</th>
<th>Explain aetiology</th>
<th>Provide epidemiological data</th>
<th>Communicate treatment effects in absolute numbers</th>
<th>Include visualizations to illustrate treatment effects to address a wide range of people</th>
<th>Communicate cost estimates to convey an idea of individual and public health investments</th>
<th>Mention alternatives to treatment</th>
<th>Use comparative figures</th>
<th>Disclose uncertainties and what is not (yet) known</th>
<th>Disclose conflicts of interests</th>
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31
Annex B. Summary of EU vaccination policies on rubella for adolescent females or women of childbearing age

ECDC provides an online overview of the rubella vaccination policies in EU countries at [http://vaccine-schedule.ecdc.europa.eu](http://vaccine-schedule.ecdc.europa.eu). The overview shows that seven countries explicitly recommend catch-up vaccinations for women between 15 and 45 (Austria, Belgium, France, Germany, Italy, Poland and the United Kingdom). Latvia, Lithuania and Sweden recommend catch-up strategies for 12-year-olds. All other countries recommend vaccination against rubella between birth and nine years of age. Eight countries (Belgium, Bulgaria, Estonia, Hungary, Iceland, Norway, Poland, and Romania) recommend that the second dose of rubella should be administered as late as between 10 and 13 years of age. Greece explicitly recommends that women who are seronegative at the birth of their first child should get two doses of rubella in the postpartum period for protection during further pregnancies.

Recent outbreaks of rubella

Several outbreaks of rubella have been reported in the literature over the last years. Below we have listed major outbreaks in EU/EEA Member States since 2005. All outbreaks are characterised by a high number of cases and demonstrate the ubiquity of the rubella and CRS threat. The description of the outbreaks is based on published scientific reports. As these reports frequently refer to ongoing outbreaks, we complemented the summaries with data reported to WHO via the global monitoring system [20].

Table A-2 summarises the percentage of women of childbearing age affected by rubella and the number of cases of CRS reported in the outbreaks (WHO data). The displayed male-to-female ratio shows that rubella is a major problem in male populations. This can probably be explained by older vaccination policies which initially only covered women.

### Table A-2. Rubella outbreaks in Europe (2004–2013)

<table>
<thead>
<tr>
<th>Country</th>
<th>Time period</th>
<th>Male-to-female ratio</th>
<th>Percentage of infected women 15–49 years of age</th>
<th>Number of cases of rubella in pregnancy (confirmed cases)</th>
<th>Number of CRS cases/year (WHO data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>2013–ongoing</td>
<td>10:1</td>
<td>No data</td>
<td>2</td>
<td>2 in 2013[21]</td>
</tr>
<tr>
<td>Sweden</td>
<td>2012</td>
<td>1.38:1</td>
<td>6%</td>
<td>no data</td>
<td>0 in 2012</td>
</tr>
<tr>
<td>Romania</td>
<td>2011–2012</td>
<td>1.4:1</td>
<td>40.9%</td>
<td>2</td>
<td>55 in 2012</td>
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<tr>
<td>Italy</td>
<td>2008</td>
<td>2.82:1</td>
<td>no data</td>
<td>3</td>
<td>6 in 2009</td>
</tr>
<tr>
<td>Austria</td>
<td>2008–2009</td>
<td>1:1:43</td>
<td>41%</td>
<td>1</td>
<td>no data</td>
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<tr>
<td>Spain</td>
<td>2005</td>
<td>1.33:1</td>
<td>39%</td>
<td>no data</td>
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<tr>
<td>Netherlands</td>
<td>2004–2005</td>
<td>No data</td>
<td>No data</td>
<td>29</td>
<td>4 in 2005</td>
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</table>

**Poland.** From January to April 2013, Poland experienced a 10-fold increase of rubella cases. According to the ECDC Monthly Measles and Rubella Monitoring report (June 2013; [31]), the outbreak in Poland accounted for 29 741 cases from 1 January to 31 May 2013. The incidence varied strongly between provinces ranging from 7.4–151.1 per 100 000 inhabitants. 81% of the cases were aged 15–29-year-olds. The outbreak also reflects the history of immunisation policies in Poland, namely selective vaccination of adolescent girls from 1989 to 2003, then universal two-dose measles-mumps-rubella vaccination since 2004. Of the 72% cases for which vaccination status was known, 10% were vaccinated with one dose of rubella-containing vaccine; 2% received two doses of rubella-containing vaccine. Up to April 2013, two CRS cases have been reported [21].

**Romania.** Romania faced a large outbreak of rubella in 2012. 20 812 cases were reported to WHO in 2012, 3 494 in 2011, leading to 55 cases of CRS in 2012 [20]. Janta et al. cover a smaller outbreak, which took place from September 2011 to January 2012 in Salaj in north-western Romania (1 873 cases, 40.9% in women of childbearing age) [23]. A total of 2.1% of the cases reported in Romania were vaccinated with one dose of rubella-containing vaccine [23].

**Sweden.** The outbreak in Järna (near Stockholm) originated in an anthroposophic community. The index case contracted rubella during a trip to central Europe. Forty-one children (aged 1–13 years, ten of whom were aged 5–9) and nine adults were infected. 48 people were unvaccinated. Two adults were reported to have been vaccinated against rubella [22, 32, 33, 34].

**Italy.** Italy reported an outbreak of rubella from January to June 2008 in two residential homes for mentally and physically disabled young adults [24]. The epidemic subsequently spread to the general population. In total, 4 847 cases of rubella were reported to WHO in 2008 [20], followed by six CRS cases in 2009. According to
D’Agaro et al., the outbreak affected mostly young adult cohorts. The majority of cases were male (73.8%), with a mean age of 26.6 years in males and 27.4 in females. 133 cases (111 laboratory confirmed) were observed [24]. Although the proportion of infected women of childbearing age was low, three pregnant women were infected. Two pregnancies were terminated, and one fetus was tested positive for rubella virus. As of June 2009, no increase in CRS cases was observed. The proportion of susceptible women of childbearing age in north-east Italy was estimated at 5.5%.

**Austria.** The rubella outbreak in 2008/09 affected two provinces, Styria and Burgenland. Of 355 cases (146 of whom were female), the 15–19-years-olds (44.4%) and the 20–24-year-olds (32.4%) were most affected [25]. Of the 230 cases for whom vaccination status was available, 10% had received one dose of MMR vaccine; no case had received two doses. One laboratory-confirmed rubella infection in a pregnant 18-year-old woman resulted in elective abortion. The woman ‘had not been vaccinated in childbirth after her first delivery a year earlier although she had been identified as non-immune to rubella infection’ [26].

**Spain.** Between January and May 2005, the region of Madrid reported a rubella outbreak with a total of 431 cases, most patients were between 20 and 29 years old [27]. The majority of the patients (58%) were of foreign, mainly Latin American, origin. Thirty-three percent of cases were in immigrant women of childbearing age, compared with 6% in Spanish women of childbearing age; 360 of 431 cases were confirmed [27]. In total, 185 (43%) patients were female, with 170 (92%) of childbearing age. This resulted in three voluntary abortions because of the risk of CRS.

**Netherlands.** A rubella outbreak in an unvaccinated orthodox religious subpopulation in 2004/05 spread to a Canadian community which shares historical, religious and social links with the affected Dutch community [28, 29]. In the Netherlands, a total of 410 cases of rubella were reported to WHO [20] (2004 and 2005). In Canada, 320 rubella cases and two CRS cases were reported between 2004 and 2005. In the Netherlands, 29 women were infected with rubella virus during their pregnancy, none of whom was vaccinated. The outbreak resulted in two foetal deaths and 14 infants with congenital infection. Eleven children had clinical defects, including deafness in all cases [29]. The estimated vaccine effectiveness was 99.3% [29].

**Summary.** During the latest reported outbreaks, rubella infection affected more men than women (due to older vaccination policies targeting predominantly women). Nevertheless, there is still a sizeable proportion of infected women of childbearing age. Public health efforts need to be directed at both women of childbearing age and unvaccinated men.

**CRS due to recent outbreaks**

As summarised in Table A-2, Romania had a high incidence of CRS; Poland may see similar numbers because of recent large-scale outbreaks. Six terminated pregnancies due to rubella infections and CRS risk were reported, but the actual number is probably much higher. There is no recent literature which covers abortions conducted because of CRS risk.
Policies and recommendations in Europe: recommendations on rubella vaccination, rubella screening, and post-partum vaccination

Rubella vaccination in Europe

Vaccination against rubella was introduced in the 1970s [38]. As of December 2009, all European countries have introduced rubella-containing vaccine in the routine schedule [39]: all children should receive immunisation against rubella by means of the MMR vaccine, which is a combination vaccine against measles, mumps and rubella.

European vaccination strategies are directed at two goals: the first goal is the protection of pregnant women and their unborn children, as rubella infection shortly before or during early pregnancy entails a high risk of miscarriage, foetal death, or congenital defects (congenital rubella syndrome, CRS). Vaccinating young children ensures sustained reduction in the incidence of rubella and CRS [40]. The second goal is to interrupt the transmission of rubella and eventually eliminate rubella and prevent CRS by achieving 80% vaccine coverage with at least one dose of rubella-containing vaccine [40]. Since rubella vaccine is usually combined with vaccination against measles, elimination of rubella will benefit from the goal of 95% coverage for the MMR vaccine. As measles is more contagious than rubella, higher coverage is needed to reach elimination.

Vaccination against rubella was introduced later than vaccination against measles. In the past, many European countries only targeted girls in their vaccination schedules [40]. This led to unprotected cohorts and population subgroups, particularly males, which in turn led to large outbreaks like the one in Poland with more than 30 000 cases in 2013 [21]. WHO recommends that in order to eliminate rubella within 10 years, high vaccination coverage must be achieved in young children, adolescents and adults (1–39 years), which means that some countries must run catch-up campaigns for those who have not yet been vaccinated [39,41].

Screening before and during pregnancy

Women who wish to be pregnant should be advised to check their immunity status by a blood screening. Women with unknown immunisation status or no specific IgG antibodies must be considered susceptible [41]. In most European countries, routine rubella screening by means of a blood test is offered as part of the usual antenatal care [42].

Rubella antibody negative before pregnancy

If a woman of childbearing age is rubella antibody negative she should receive at least one dose of MMR or MMRV vaccine. She should avoid becoming pregnant for 28 days after receipt of MMR vaccine because MMR is a live-attenuated vaccine [40].

Rubella antibody negative during pregnancy

If pregnant women are rubella antibody negative, they should avoid contact with potentially infected individuals if possible. They should be followed until the end of pregnancy and immunised with at least one dose of MMR immediately after delivery [43,44,45].

Inadvertent vaccination against rubella during or shortly before pregnancy

For pregnant women, MMR vaccination is contraindicated because it is a live-attenuated vaccine. Termination of pregnancy is, however, not recommended after inadvertent vaccination during or shortly before pregnancy [40].

Vaccination of susceptible women immediately after delivery

If a woman was susceptible for rubella during her pregnancy, she should receive MMR vaccine immediately after delivery for protection during future pregnancies [41]. The same strategy applies for women after abortions.
References
