Smallpox

Poliomyelitis
Rationale for eliminating measles

- Measles is a major cause of vaccine-preventable morbidity and mortality worldwide

Elimination: The interruption of indigenous transmission. There may still be imported cases but circulation of the virus following importation ends naturally without intervention, usually after a limited number of generations of disease transmission.
Reported measles cases in the United States, 1944-2009

Data source: MMWR, CDC
Estimated number of measles deaths worldwide during 2000-08

Source: WHO, CDC

Challenges in Eliminating Measles and Rubella in Europe

6th October 2012
Measles and rubella are targeted for elimination in the European region

WHO European Region:
53 Member States

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>900,000,000</td>
</tr>
<tr>
<td>Infants</td>
<td>11,000,000</td>
</tr>
<tr>
<td>&lt; 5yr</td>
<td>55,000,000</td>
</tr>
<tr>
<td>&lt;15yr</td>
<td>157,000,000</td>
</tr>
</tbody>
</table>

New goal: 2015
Measles and rubella elimination strategies

1. Achieve and sustain very high coverage (≥ 95%) with two doses of measles and at least one dose of rubella vaccine through high-quality routine immunization services.

2. Provide a second opportunity for measles immunization through supplementary immunization activities to populations susceptible to measles.

3. Provide rubella vaccination opportunities, including supplementary immunization activities, to all rubella-susceptible children, adolescents and women of childbearing age.

4. Strengthen surveillance systems

5. Improve the availability of high-quality information for health professions and the public
Confirmed that measles was infectious

Defined the 14-day interval between exposure and appearance of rash

Recognized the higher case-fatality at the extremes of age

Infection provided life-long immunity

“Observations made during the epidemic of measles on the Faroe Islands in the year 1846”

Peter Ludwig Panum (1820-1885)
Measles

- Highly contagious viral disease
- Fever, conjunctivitis, cough, coryza, rash
- Complications:
  - *Otitis media*
  - *Pneumonia*
  - *Diarrhoea*
  - *Encephalitis*
  - *Subacute-sclerosing panencephalitis*
- More severe in:
  - *infants and adults*
- High case fatality in developing countries
Rubella

- Viral disease caused by rubella virus
- Low-grade fever, headache, malaise, mild coryza and conjunctivitis, lymphadenopathy (post-auricular, occipital, posterior cervical), rash
- Rash indistinguishable from:
  - Measles
  - Parvovirus B19
  - Coxsackie virus
  - Adenovirus
  - Scarlet fever
- Complications:
  - Arthralgia
  - Arthritis
  - Encephalitis (1:6000 cases)
- Congenital rubella syndrome occurs in 90% of women infected in the first 10 weeks of pregnancy
Objectives

- To describe the epidemiology of measles and rubella in relation to the goal of elimination by 2015.

- To describe individuals susceptible to measles and to provide an overview of affected groups, and the public settings in which measles transmission occurred in Europe in 2005–09.

- To demonstrate the role of importations of measles and rubella virus
Objectives

- To describe the epidemiology of measles and rubella in relation to the goal of elimination by 2015.
- To describe individuals susceptible to measles and to provide an overview of affected groups, and the public settings in which measles transmission occurred in Europe in 2005–09.
- To demonstrate the role of importations of measles and rubella virus
Objectives

- To describe the epidemiology of measles and rubella in relation to the goal of elimination by 2015.

- To describe individuals susceptible to measles and to provide an overview of affected groups, and the public settings in which measles transmission occurred in Europe in 2005–09.

- To demonstrate the role of importations of measles and rubella virus
Objective 1

The statistics

To assess the epidemiology of measles and rubella in relation to the goal of elimination by 2015.
Incidence of measles per 100,000 inhabitants, 2012*

- No data
- 0 per million
- <1 per million
- 1 - 10 per million
- >10 per million

*Jan-Jul 2012
Update Date: 30-Aug-2012

Challenges in Eliminating Measles and Rubella in Europe

6th October 2012
Number of reported measles cases, WHO European Region, 2005-2012*

Data Source: Monthly MR reporting to WHO European Region
Data as of 13 Sep 2012
Proportion of measles cases by age groups, WHO European Region 2009-12* \( (n=18,825) \)

Age group known in 96% of cases

Data Source: Monthly MR reporting to WHO European Region
*Data as of 13 Sep 2012
Proportion of measles cases by age groups, 11 countries and the WHO European Region, 2009-12*

Known age group  96%
Measles cases by immunization status, WHO European Region 2009-12*

Known immunization status 60%

Data Source: Monthly MR reporting to WHO European Region
Data as of 13 Sep 2012
Measles case fatality rate, 2005-12*

Number of deaths = 70

Main causes of death: Acute pneumonia and acute encephalitis

<table>
<thead>
<tr>
<th>Country</th>
<th>2005-2012*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>3</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>24</td>
</tr>
<tr>
<td>France</td>
<td>10</td>
</tr>
<tr>
<td>Germany</td>
<td>4</td>
</tr>
<tr>
<td>Italy</td>
<td>1</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>1</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1</td>
</tr>
<tr>
<td>Romania</td>
<td>16</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>3</td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
</tr>
<tr>
<td>Turkey</td>
<td>1</td>
</tr>
<tr>
<td>Ukraine</td>
<td>3</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2</td>
</tr>
</tbody>
</table>
Measles outbreak in France:

Number of measles cases per month – Mandatory notification, France, January 2008 – August 2011*

Data source: InVs

*Provisional data for August
First dose measles vaccination coverage at 24 months of age

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage « 1 dose »</td>
<td>87.5%</td>
<td>87.2%</td>
<td>89.4%</td>
<td>90.1%</td>
<td>89.1%</td>
<td>89.0%*</td>
</tr>
</tbody>
</table>

First and second dose measles vaccination coverage in 6 to 15 years old children based on school surveys

<table>
<thead>
<tr>
<th>Date of survey</th>
<th>School grade</th>
<th>Birth cohorts</th>
<th>Coverage « 1 dose »</th>
<th>Coverage « 2 doses »</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-2004</td>
<td>9th grade (15 yr)</td>
<td>1988-1989</td>
<td>93.9%</td>
<td>65.7%</td>
</tr>
<tr>
<td>2004-2005</td>
<td>5th grade (11 yr)</td>
<td>1993-1994</td>
<td>95.7%</td>
<td>74.2%</td>
</tr>
<tr>
<td>2005-2006</td>
<td>Preschool (6 yr)</td>
<td>1999-2000</td>
<td>93.3%</td>
<td>44.3%</td>
</tr>
</tbody>
</table>

Data sources: InVS-Drees-DESCO

* Provisional data for 2009

Measles outbreak in France:
Measles outbreak in France:

Measles immunization coverage at 24 months of age by district (département), France, 2003-08

Geographical distribution of notified measles cases, France (October 2010 to September 2011)

Data source: InVS, Drees
Age-distribution of reported rubella cases, WHO European Region, January-July 2012 (n=18,055)

Age group known in 89% of cases
Incidence of rubella per 100,000 inhabitants, 2012*

- No data
- < 1 per million
- 1-9.99 per million
- 10-99.99 per million
- >100 per million

Update Date: 30-Aug-2012
The most challenged countries in the Region - Poland and Romania

Rubella cases in Poland, Romania and rest of WHO European Region by month, 2009 - July 2012

- Poland
- Romania
- WHO Europe (51 MS)
Rubella and measles by age of onset, Romania, 2011 - 2012
Objective 2

Who Gets Measles in Europe?

To describe individuals susceptible to measles and to provide an overview of affected groups, and the public settings in which measles transmission occurred in Europe in 2005–09.
Susceptibility chart

Susceptible individuals

Non-vaccination
- Eligible individuals
- Ineligible individuals
  - Inappropriate age
  - Contraindications

Vaccine failure
- Primary
- Secondary
Reasons for not vaccinating against measles

- Lack of information
- Misconceptions
  - Child benefited from the illness
  - Mild inter-current diseases
  - Incorrect information on the contraindications
- Concerns about safety
- Philosophical beliefs
- Doctors against vaccines
- Religious community lifestyle
Measles outbreaks in under-vaccinated groups, Europe, 2005-10

- Roma and Sinti communities
- Followers of Anthroposophy
- Traveller communities
- Ultra-Orthodox Jewish communities
Increased measles transmission is facilitated by social factors

- Large families
- Large social gatherings
- Attending same schools
Distinct groups that suffered measles outbreaks

- Roma

Roma population around Europe, estimates

Source: Council of Europe Roma and Travellers Division, July 2008
Distinct groups that suffered measles outbreaks

- Traveller communities
Distinct groups that suffered measles outbreaks

- Anthroposophic communities

Rapid communications

An ongoing multi-state outbreak of measles linked to non-immune anthroposophic communities in Austria, Germany, and Norway, March-April 2008

Rapid communications


E van Velzen (e.v.h.vanvelzen@ocw.denhag, nl), E de Coster, R van Binnendijk, S Hahn

Challenges in Eliminating Measles and Rubella in Europe

6th October 2012
Distinct groups that suffered measles outbreaks

- Ultra-orthodox Jewish communities

**Surveillance and outbreak reports**

**AN OUTBREAK OF MEASLES IN ORTHODOX JEWISH COMMUNITIES IN ANTWERP, BELGIUM, 2007-2008: DIFFERENT REASONS FOR ACCUMULATION OF SUSCEPTIBLES**

T Lernout [tine.lernout@sante.fgov.be], E Kislitinger, V Hutse, K De Schrijver, G Top

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

C Stein-Zamir [chol@hjor.health.gov.il], N Abrams, R Shoch, G Zentner

1. Jerusalem District Health Office, Ministry of Health, Israel
Main public settings for measles outbreaks in Europe, 2005-09

- Schools
- Kindergartens and day-care centres
- University
- Hospitals and healthcare facilities
Transmission patterns during nosocomial measles outbreaks

1. Patient to patient
2. Patient to HCW
3. HCW to patient
4. HCW to HCW

Risk of acquiring measles is estimated to be 13-19 times higher for susceptible HCWs than for the general public.
Objective 3

Importations

To demonstrate the role of importations of measles and rubella virus
Examples of measles outbreaks following importation, 2006-10

- India/Nepal
- Pakistan
- Thailand
- East Africa
- India

Challenges in Eliminating Measles and Rubella in Europe

6th October 2012
Source of measles importation, 2010 \((n=217)\)

3\% of those cases with known importation status

Top exporters:

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>44</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>27</td>
</tr>
<tr>
<td>Italy</td>
<td>20</td>
</tr>
<tr>
<td>Spain</td>
<td>16</td>
</tr>
<tr>
<td>UK</td>
<td>15</td>
</tr>
<tr>
<td>India</td>
<td>13</td>
</tr>
<tr>
<td>South Africa</td>
<td>12</td>
</tr>
<tr>
<td>Ireland</td>
<td>7</td>
</tr>
<tr>
<td>Morocco</td>
<td>7</td>
</tr>
<tr>
<td>China</td>
<td>4</td>
</tr>
</tbody>
</table>

Data source: EUVAC.NET
Reported measles cases by week of onset, Denmark, 2006 \((n=27)\)

- **Copenhagen clusters**
  - B3
  - D5
  - D4 v1*

- **Odense cluster**
  - D4 v1*

- **Sporadic cases**
  - D4 v2**
  - D9

- **Epidemiologically linked cases**
  - Linked to D5
  - Linked to D4 v1*

**Imported from:**
- Thailand
- Pakistan
- Lebanon
- Indonesia

**Week of rash onset**

<table>
<thead>
<tr>
<th>No. of measles cases</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-4</td>
</tr>
<tr>
<td>2</td>
<td>5-7</td>
</tr>
<tr>
<td>3</td>
<td>9-11</td>
</tr>
<tr>
<td>4</td>
<td>12-14</td>
</tr>
<tr>
<td>5</td>
<td>16-18</td>
</tr>
<tr>
<td>6</td>
<td>20-22</td>
</tr>
</tbody>
</table>

- i = imported, E = Epidemiologically linked cases, * D4 variant 1, ** D4 variant 2
- (1) = Case linked to Copenhagen airport
- (2) = Connected with the Middle East

Challenges in Eliminating Measles and Rubella in Europe

6th October 2012
Reported measles cases by week of onset, Denmark, 2006 (n=27) – without genotyping

Week of rash onset

Imported from: Thailand Pakistan Lebanon Pakistan Indonesia

No. of measles cases

1 2 3 4 5 6

i = imported, E = Epidemio logically linked cases,

Data source: Department of Epidemiology, SSI
Rubella outbreak in Sweden

Number of laboratory confirmed rubella cases by age-group in Sweden, April-August 2012* (n=35)

Total cases 47

![Pie chart showing distribution of rubella cases by age-group in Sweden, April-August 2012.](chart.png)

- **5-9 years**: 55%
- **10-14 years**: 13%
- **20-29 years**: 4%
- **30-39 years**: 2%
- **40-49 years**: 13%
- **1-4 years**: 13%
- **>50 years**: 0%
- **<1 years**: 0%
Conclusions

- Outbreaks of measles and rubella continue to occur in countries with suboptimum vaccination coverage.

- Achieving and maintaining high vaccination coverage with MMR presents numerous challenges and issues that need to be addressed.
Challenges in eliminating measles in Europe

- Socio-economic and political diversity
Challenges in eliminating measles in Europe

- Multi-ethnic society often with large cultural, lifestyle, philosophical, religious and linguistic diversity

Outbreaks among Christian Reformed Church communities in the Netherlands:
- Polio 1992-93: 71 cases
- Measles 1999-00: 3292 cases
- Rubella 2004-05: 387 cases
- Mumps 2007-08: 87 cases
Challenges in eliminating measles in Europe

- Vociferous anti-vaccination lobbying groups, vaccine sceptics, alternative medicine, vaccine opponents
Challenges in eliminating measles in Europe

- “Doctors without borders”

EDITORIALS

Do European doctors support measles, mumps, rubella vaccination programmes enough?

P L Lopalco (Pierluigi.lopalco@ecdc.europa.eu), M Sprenger

1. European Centre for Disease Prevention and Control, Stockholm, Sweden
Challenges in eliminating measles in Europe

- Different healthcare delivery systems
Challenges in eliminating measles in Europe

- The frequency of international travel and migrations
Challenges in eliminating measles in Europe

- Greater importance to individual rights over public health concerns

"... other anti-vaccination parents believe that it is unreasonable to expect parents to risk their children's lives for the sake of public health ...."

"... contemporary advocates for mandatory vaccinations contend that immunizations are necessary to maintain public health."
What do we need to do to attain measles elimination in Europe?

- Continued efforts to identify barriers for vaccine uptake
  - Steady commitment
  - Reminders and recall systems

- To focus on under-vaccinated groups
  - Understanding attitudes
  - Better communication strategies
  - Improve integration with health-care systems
What do we need to do to attain measles elimination in Europe?

- Enhance surveillance
  - Rapid investigation of suspected cases with laboratory tests
  - Seroprevalence studies

- Policies to improve prevention and control
  - Hospitals and healthcare settings
  - School entry requirement
  - Adult vaccination:
    - pre-travel vaccination
    - “infant-parents” vaccination
What do we need to do to attain measles elimination in Europe?

- Improve availability of high-quality information
  - Websites
  - Medical and nursing curricula
Changing perception about infectious diseases

New York, 1939 - Queing for the smallpox vaccine

England, 2010 - Mega Monday: bargain-hunters join half-mile queue

Copenhagen, 1943 - Queing for the diphtheria vaccine
Thank you
Supplementary slides
MEASLES MORTALITY: A RETROSPECTIVE LOOK AT THE VACCINE ERA

ROGER M. BARKIN


**Figure 3.** Measles age-specific rates, United States, 1958–1970.
### Challenges in Eliminating Measles and Rubella in Europe

**6th October 2012**

#### Table 1: Mortality in Aarensen 1835-45

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 1 Aar</td>
<td>50</td>
<td>10 1/11</td>
<td>1-10 Aar</td>
<td>6</td>
<td>1 1/1</td>
<td>1-20 Aar</td>
<td>5</td>
<td>1/1</td>
</tr>
<tr>
<td>10-20 Aar</td>
<td>8</td>
<td>1/1</td>
<td>20-30 Aar</td>
<td>8</td>
<td>1/1</td>
<td>30-40 Aar</td>
<td>13</td>
<td>1 1/1</td>
</tr>
<tr>
<td>30-40 Aar</td>
<td>16</td>
<td>1/1</td>
<td>40-50 Aar</td>
<td>18</td>
<td>1 1/1</td>
<td>50-60 Aar</td>
<td>28</td>
<td>1 1/1</td>
</tr>
<tr>
<td>60-70 Aar</td>
<td>31</td>
<td>2</td>
<td>70-80 Aar</td>
<td>30</td>
<td>6 1/1</td>
<td>80-100 Aar</td>
<td>26</td>
<td>16 1/1</td>
</tr>
<tr>
<td>80-100 Aar</td>
<td>215</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Table 2: Mortality Rates

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
<th>Age Group</th>
<th>Deaths</th>
<th>Per Cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 1 year</td>
<td>18 1/11</td>
<td>10 9/11</td>
<td>1-10 years</td>
<td>7 3/11</td>
<td>6 1/1</td>
<td>1-20 years</td>
<td>5 5/11</td>
<td>5 1/1</td>
</tr>
<tr>
<td>Between 1 and 10</td>
<td>6</td>
<td>6/11</td>
<td>Between 20 and 30</td>
<td>8</td>
<td>11/22</td>
<td>Between 30 and 40</td>
<td>13</td>
<td>17/22</td>
</tr>
<tr>
<td>Between 10 and 20</td>
<td>5</td>
<td>5/11</td>
<td></td>
<td></td>
<td></td>
<td>Between 40 and 50</td>
<td>18</td>
<td>1 1/1</td>
</tr>
<tr>
<td>Between 20 and 30</td>
<td>6</td>
<td>1/11</td>
<td></td>
<td></td>
<td></td>
<td>Between 50 and 60</td>
<td>28</td>
<td>10/11</td>
</tr>
<tr>
<td>Between 30 and 40</td>
<td>7 4/11</td>
<td>10/11</td>
<td></td>
<td></td>
<td></td>
<td>Between 60 and 70</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Between 40 and 50</td>
<td>5 5/11</td>
<td>4 4/9</td>
<td></td>
<td></td>
<td></td>
<td>Between 70 and 80</td>
<td>30</td>
<td>6 5/10</td>
</tr>
<tr>
<td>Between 50 and 60</td>
<td>14 10/11</td>
<td>13 1/11</td>
<td></td>
<td></td>
<td></td>
<td>Between 80 and 100</td>
<td>16 9/11</td>
<td>16 9/11</td>
</tr>
<tr>
<td>Total</td>
<td>96 3/11</td>
<td>215</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“The impact of vaccination on the health of the world’s peoples is hard to exaggerate. With the exception of safe water, no other modality has had such a major effect on mortality reduction and population growth.”

Percentage MMR uptake and number of measles cases, UK 1996/97-2008/09

Data source: Health Protection Agency, UK
Risk assessment shift with time

Adapted from: Chen RT et al. Vaccine 1994;12:542-50
Incidence of rubella per 100,000 inhabitants, 2010 and 2011