Understanding vaccine hesitancy and other impediments to measles elimination in Europe

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Outline

(1) Measles disease, outbreaks and transmission dynamics
(2) Hesitancy
(3) Conclusion
Measles

Complications:
• Dehydration (diarrhea, vomiting)
• Middle ear infection
• Eye infection
• Bronchopneumonia

• Meningitis
• Encephalitis
• Hepatitis
• Fatal brain complication (SSPE)

Measles case distribution by month and WHO Region (2015-2019)

Notes: Based on data received 2019-11

Data Source: IVB Database

This is surveillance data, hence for the last month(s), the data may be incomplete.

WHO, 2019
# Measles Incidence Rate per Million (1 year up to nov 2019)

## Top 10**

<table>
<thead>
<tr>
<th>Country</th>
<th>Cases</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madagascar</td>
<td>151032</td>
<td>6066.87</td>
</tr>
<tr>
<td>Ukraine</td>
<td>78708</td>
<td>1771.16</td>
</tr>
<tr>
<td>India****</td>
<td>69218</td>
<td>52.27</td>
</tr>
<tr>
<td>Philippines</td>
<td>49419</td>
<td>478.31</td>
</tr>
<tr>
<td>Nigeria</td>
<td>27954</td>
<td>150.3</td>
</tr>
<tr>
<td>Brazil</td>
<td>18927</td>
<td>91.15</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>10696</td>
<td>594.63</td>
</tr>
<tr>
<td>DR Congo</td>
<td>9245</td>
<td>117.42</td>
</tr>
<tr>
<td>Yemen</td>
<td>9156</td>
<td>331.93</td>
</tr>
<tr>
<td>Thailand</td>
<td>7738</td>
<td>112.37</td>
</tr>
</tbody>
</table>

Notes: Based on data received 2019-11 and covering the period between 2018-10 and 2019-09. Incidence: Number of cases / population* * 1,000,000. * World population prospects, 2019 revision. ** Countries with the highest number of cases for the period. **** Countries with the highest incidence rates (excluding those already listed in the table above). WHO** classifies all suspected measles cases reported from India as measles clinically compatible if a specimen was not collected as per the algorithm for classification of suspected measles in the WHO VPD surveillance standards. Thus numbers might be different between what WHO reports and what India reports.
Measles case distribution (EUR), 2015-2019

WHO, 2019
Critical proportion of immune individuals needed to interrupt transmission (herd-immunity threshold)

\[ P = \left(1 - \frac{1}{R_0}\right) \]

Guerra et al, Lancet ID 2017
Seroconversion measles component MMR: 96.3%  
Schenk J, et al, meta analysis, 2019
Non-vaccination is the main reason why outbreaks occur in Europe.
We expect to detect cases in vaccinated persons in sporadic outbreaks, especially if coverage is high.

\[
VE = 1 - \frac{PCV \times (1-PPV)}{(1-PCV) \times PPV}
\]
FIGURE 2
Historical non-vaccination

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

Campaigns avoided larger outbreaks

Public Health England, 2017
MCV1 coverage in EU countries

WHO, WHO-UNICEF coverage estimates, 2017
Outbreaks occur because susceptibles build up over time...

Susceptibility to measles infection depends on:

1. Previous exposure to natural measles infection
2. Previous vaccination coverage: whether or not susceptibles received measles containing vaccine (MCV)
3. Effectiveness over time of MCV
Occurrence and persistence of measles outbreaks depends on

Level of susceptibility and whether susceptibles cluster in physical locations, like schools, religious communities, households, etc.
Well-documented: religious belief clustering

Mazelen 1 mei 2013 tot 7 augustus 2013
per gemeente, N = 921*

Periode
- 31 juli 2013 tot 7 augustus 2013
- 1 mei 2013 tot 31 juli 2013

BMR vaccinatiegraad
- < 80
- 80 - 90
- 90 - 95
- ≥ 95

SGP: Staatkundig Gereformeerde Partij

RIVM, 2013-2014
Clustering of measles susceptibility within households (Kuylen E, et al, 2019)

Effective R → impact at start of outbreak!

Percentage of persistent outbreaks
Conceptual model for vaccination

Vaccine refusal & hesitancy: Measles as an example

RETRACTED: Intestinal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

Dr AJ Wakefield, FRCS • SH Murch, MB • A Anthony, MB • J Linnell, PhD • DM Casson, MRCP • M Malik, MRCP et al.  Show all authors

Published: February 28, 1998  •  DOI: https://doi.org/10.1016/S0140-6736(97)11096-0

Donald J. Trump
@realDonaldTrump

Healthy young child goes to doctor, gets pumped with massive shot of many vaccines, doesn’t feel good and changes - AUTISM. Many such cases!
Definition: Vaccine Hesitancy

Vaccine hesitancy refers to delay in acceptance or refusal of vaccines despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence.
“Belgium has the lowest percentage of respondents agreeing that the MMR vaccine is safe and important for children: 64.7% believe it is important for children and 64.9% that it is safe.” Larson et al, EC report 2018
Within-country-determinants of stating:

The MMR vaccine is safe

Larson et al, EC report 2018
GPs are more supportive of vaccination than the general population (generally more so for flu)

Larson et al, EC report 2018
Behavior & Infectious diseases

Verelst et al. 2016, J R Soc Interface
Quantifying decisions

Information

Disease
Prevention

Coverage attributes
• Free-riding
• Peer influence?
• Social norms?

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Attribute levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine effectiveness</td>
<td>50% 90%</td>
</tr>
<tr>
<td>Burden of disease</td>
<td>Rare &amp; Mild  \nRare &amp; Severe  \nCommon &amp; Mild  \nCommon &amp; Severe</td>
</tr>
<tr>
<td>Mild VRSE</td>
<td>Common  \nRare</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Free &amp; Available  \nCo-payment &amp; prescription</td>
</tr>
<tr>
<td>Local coverage</td>
<td>30% 60% 90%</td>
</tr>
<tr>
<td>Global coverage</td>
<td>30% 60% 90%</td>
</tr>
</tbody>
</table>

Verelst F, et al, 2019
Individual decisions to vaccinate one's child or oneself: A discrete choice experiment rejecting free-riding motives

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Social norms

> Free-riding!
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Frederik Verelst