Understanding vaccine hesitancy and other impediments to measles elimination in Europe

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Opening new horizons

Outline

(1) Measles disease, outbreaks and transmission dynamics

(2) Hesitancy

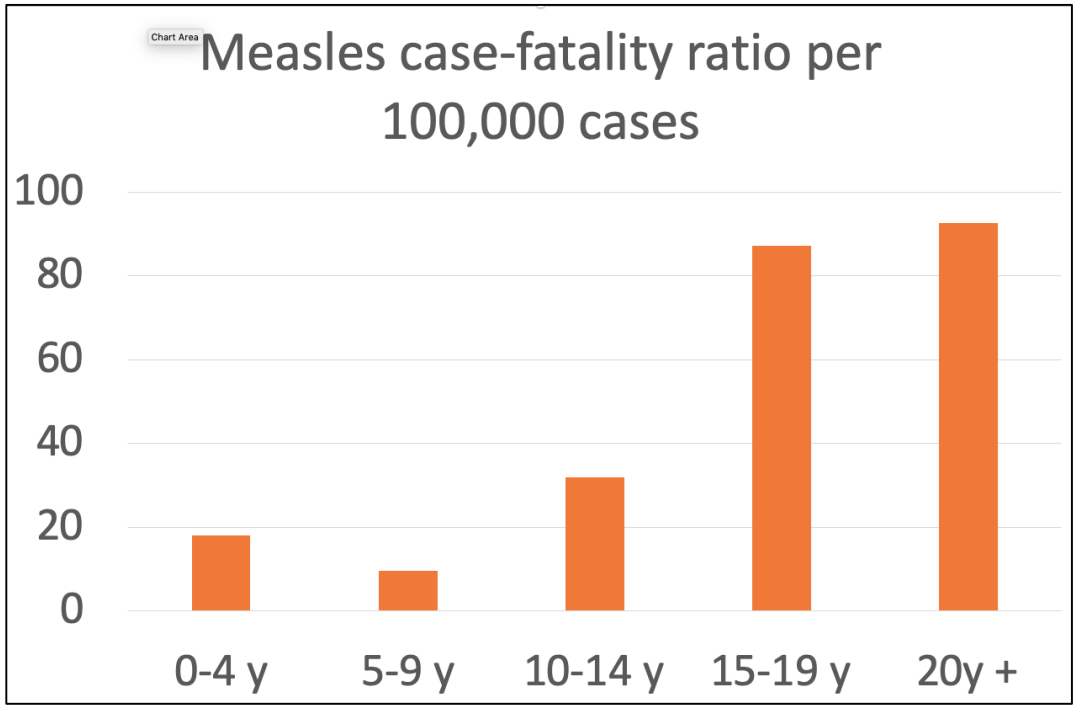
(3) Conclusion

Measles

Complications:

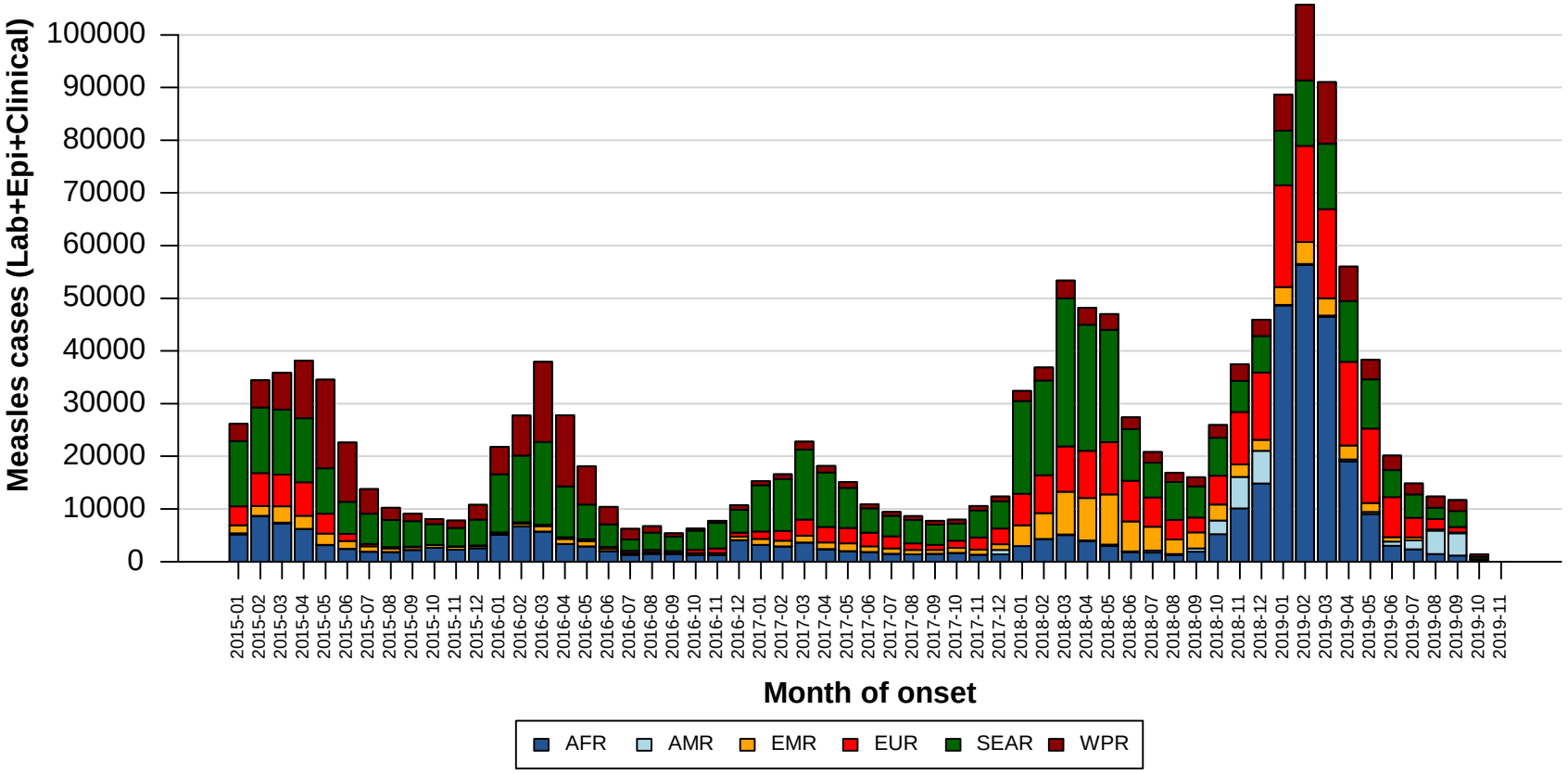
- Dehydration (diarrhea, vomiting)
- Middle ear infection
- Eye infection
- Bronchopneumonia

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



Ramsay M, et al. Communicable Disease Rev 1994 ; 4 : R141–6.

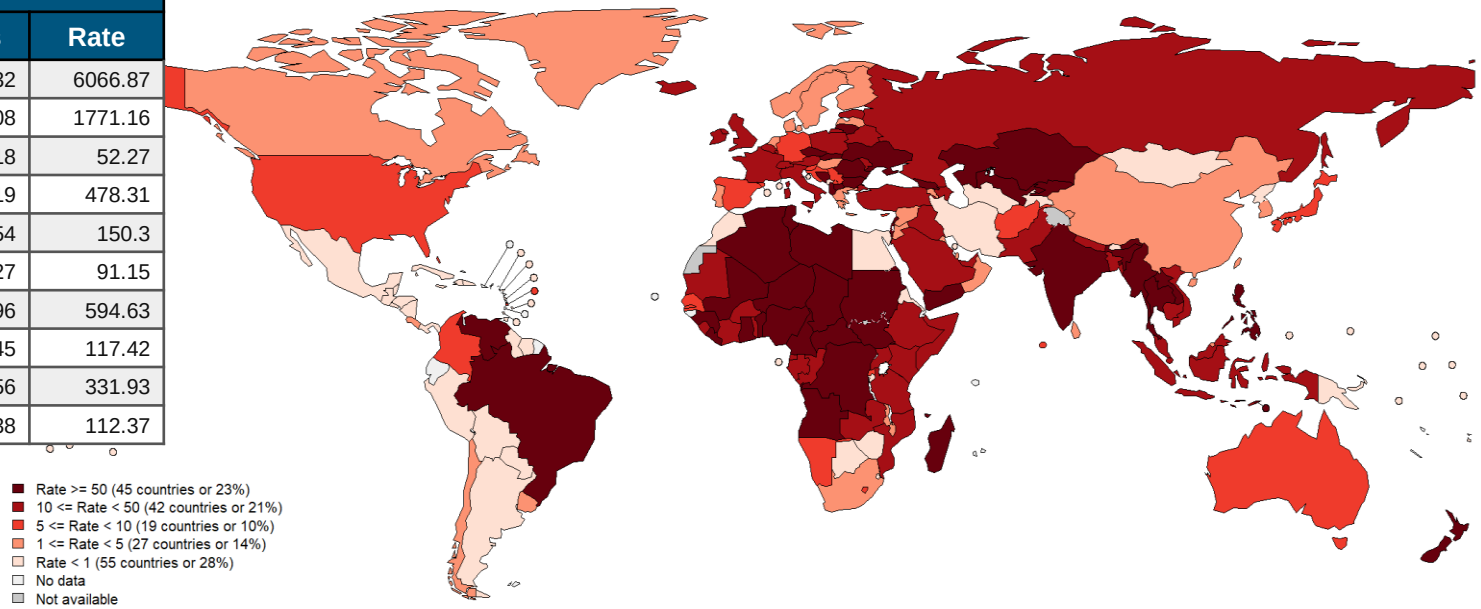
Measles case distribution by month and WHO Region (2015-2019)



WHO, 2019

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

Top 10**		
Country	**Cases**	**Rate**
Madagascar	151032	6066.87
Ukraine	78708	1771.16
India****	69218	52.27
Philippines	49419	478.31
Nigeria	27954	150.3
Brazil	18927	91.15
Kazakhstan	10696	594.63
DR Congo	9245	117.42
Yemen	9156	331.93
Thailand	7738	112.37



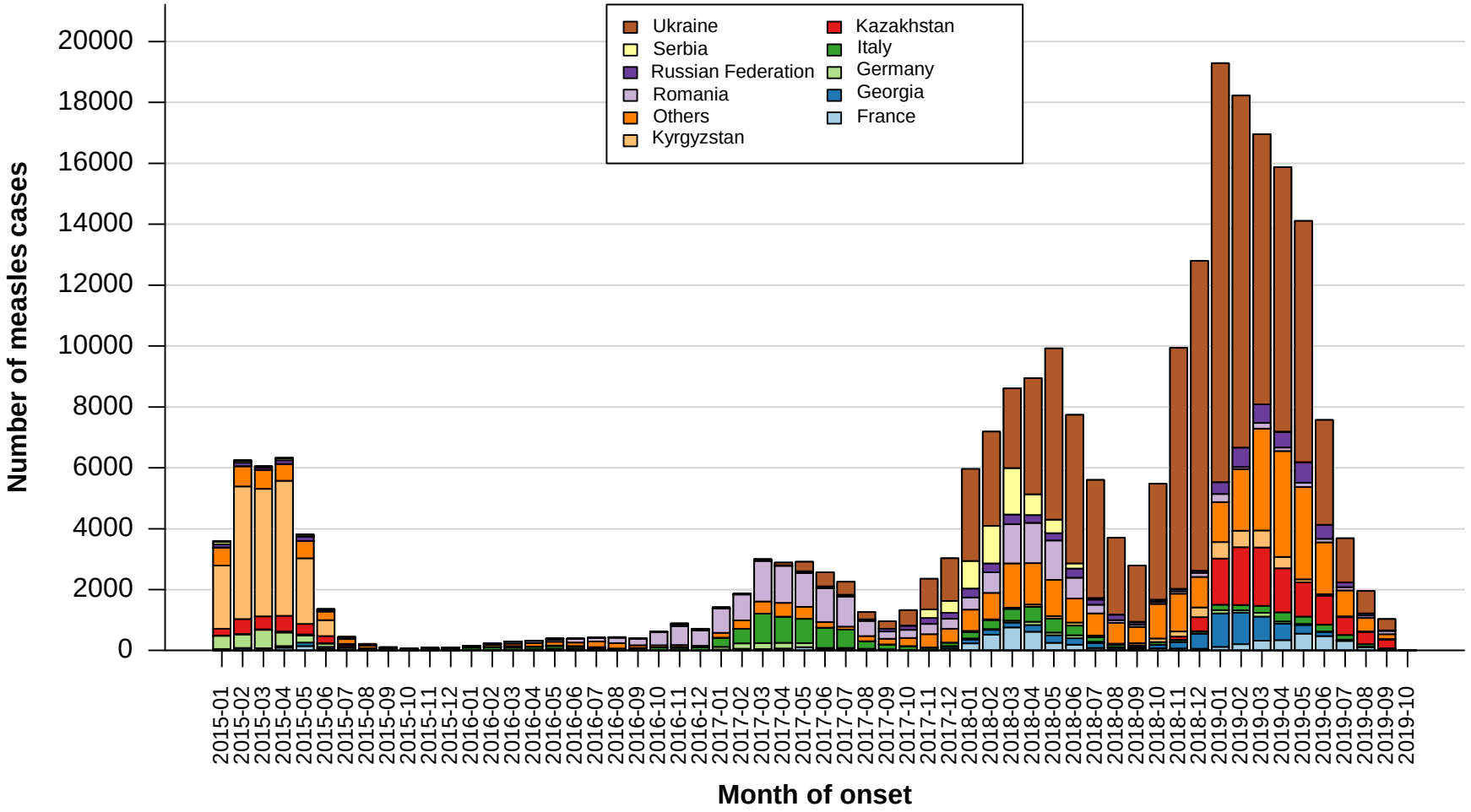
World Health Organization

Map production: World Health Organization, WHO, 2019. All rights reserved
Data source: IVB Database

Disclaimer:
The boundaries and names shown and the designations used on this map do notimply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

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.

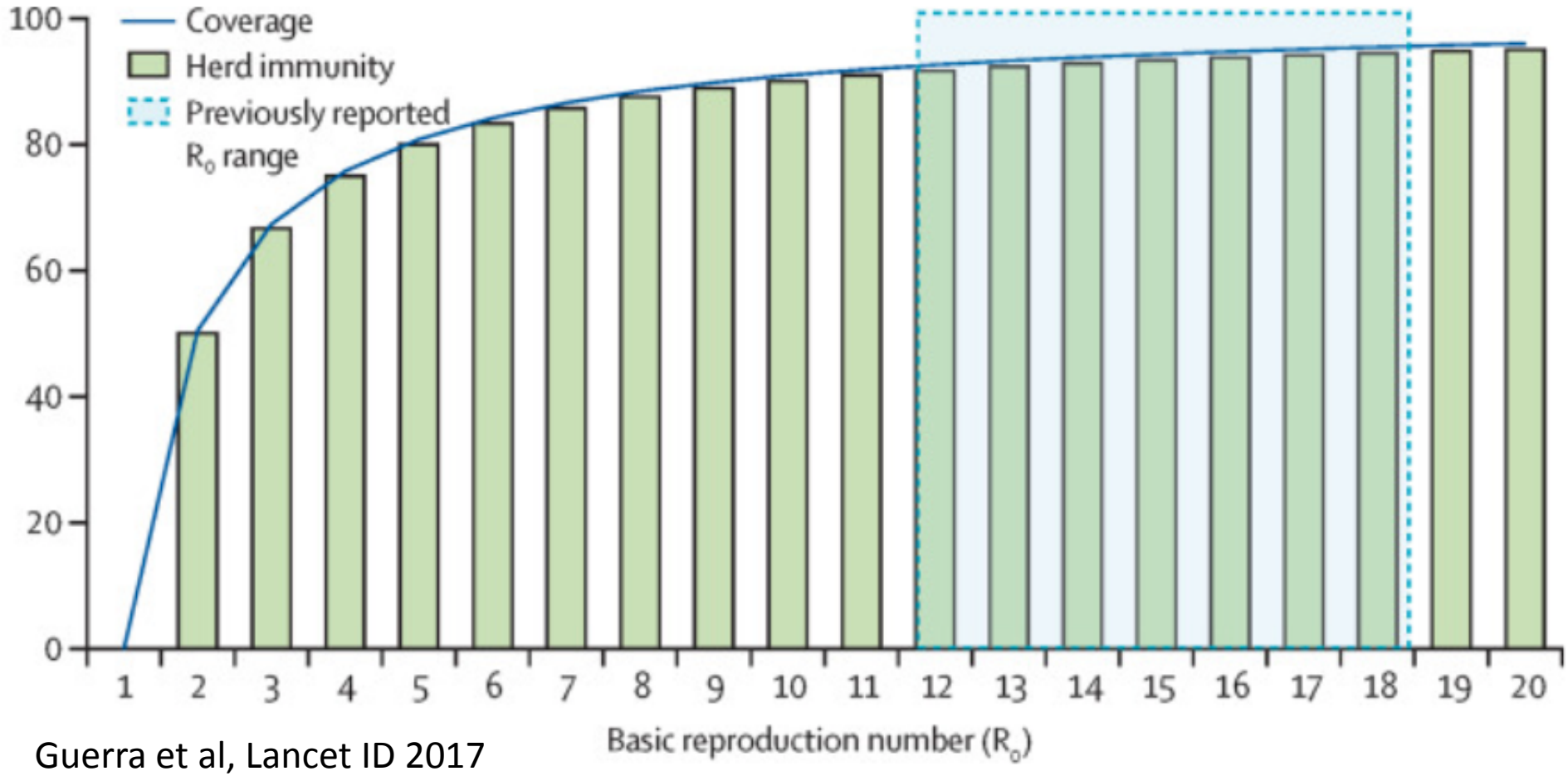
Measles case distribution (EUR), 2015-2019



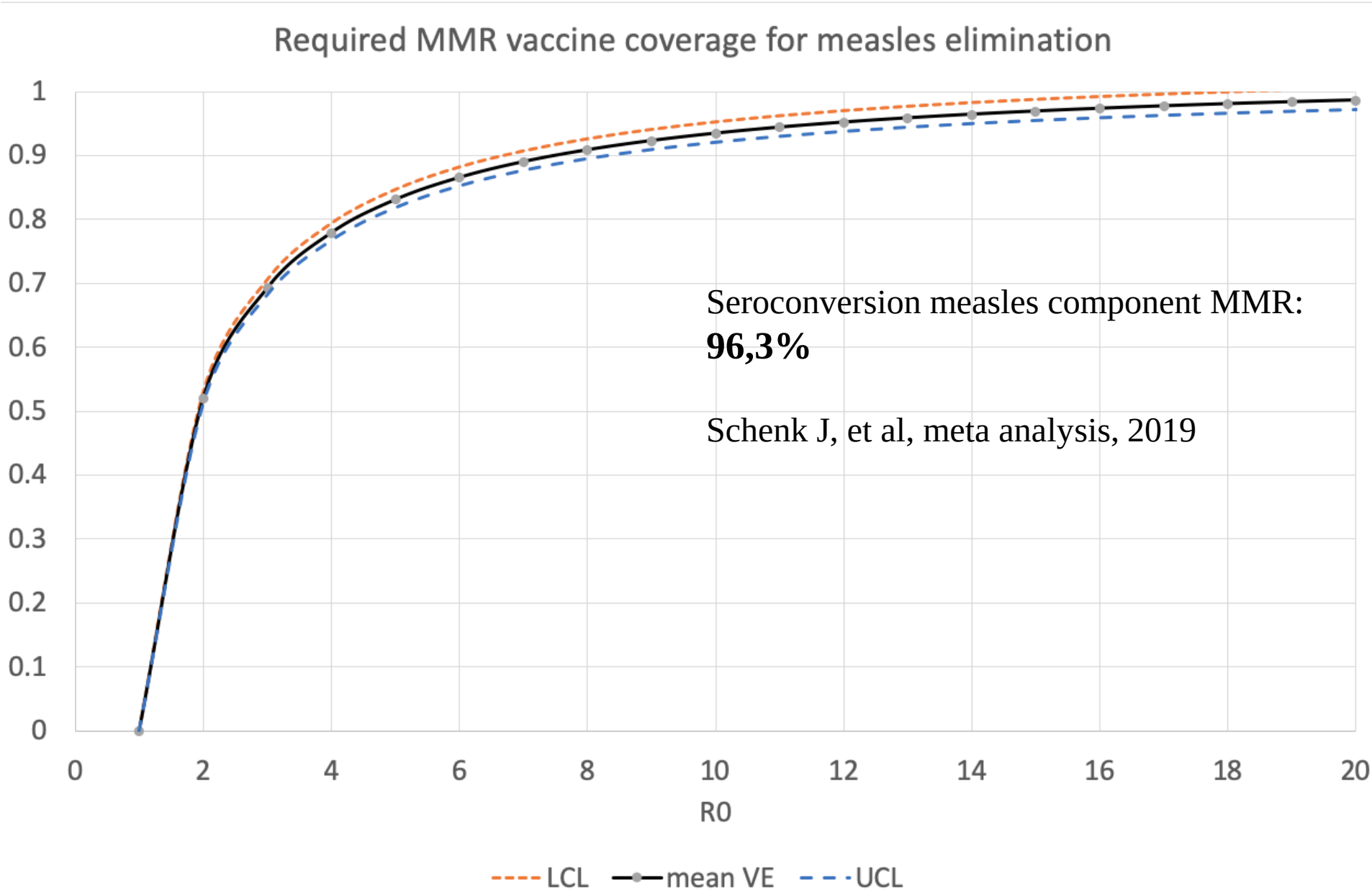
WHO, 2019

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

$$P = (1 - 1/R_0)$$



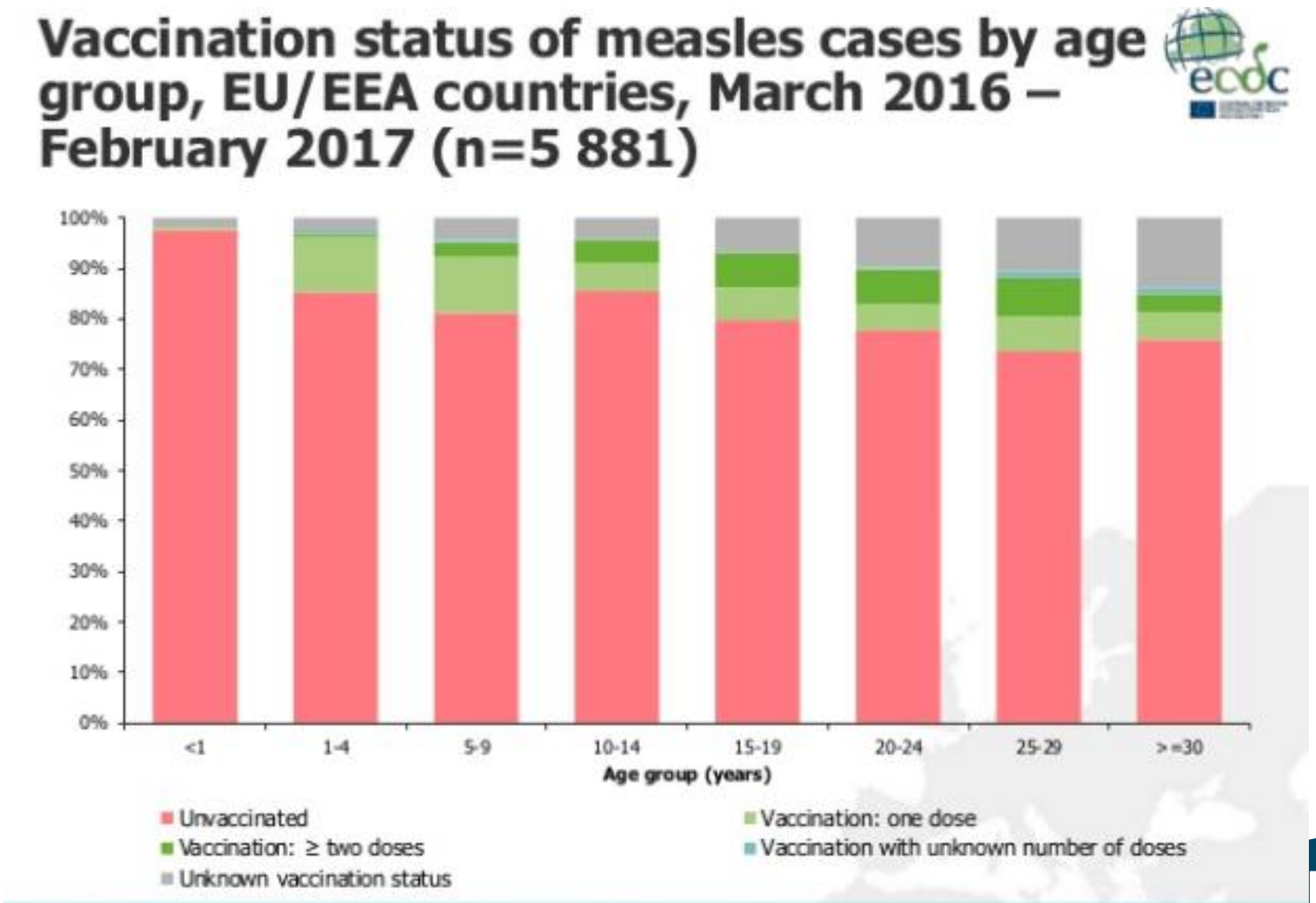
Guerra et al, Lancet ID 2017



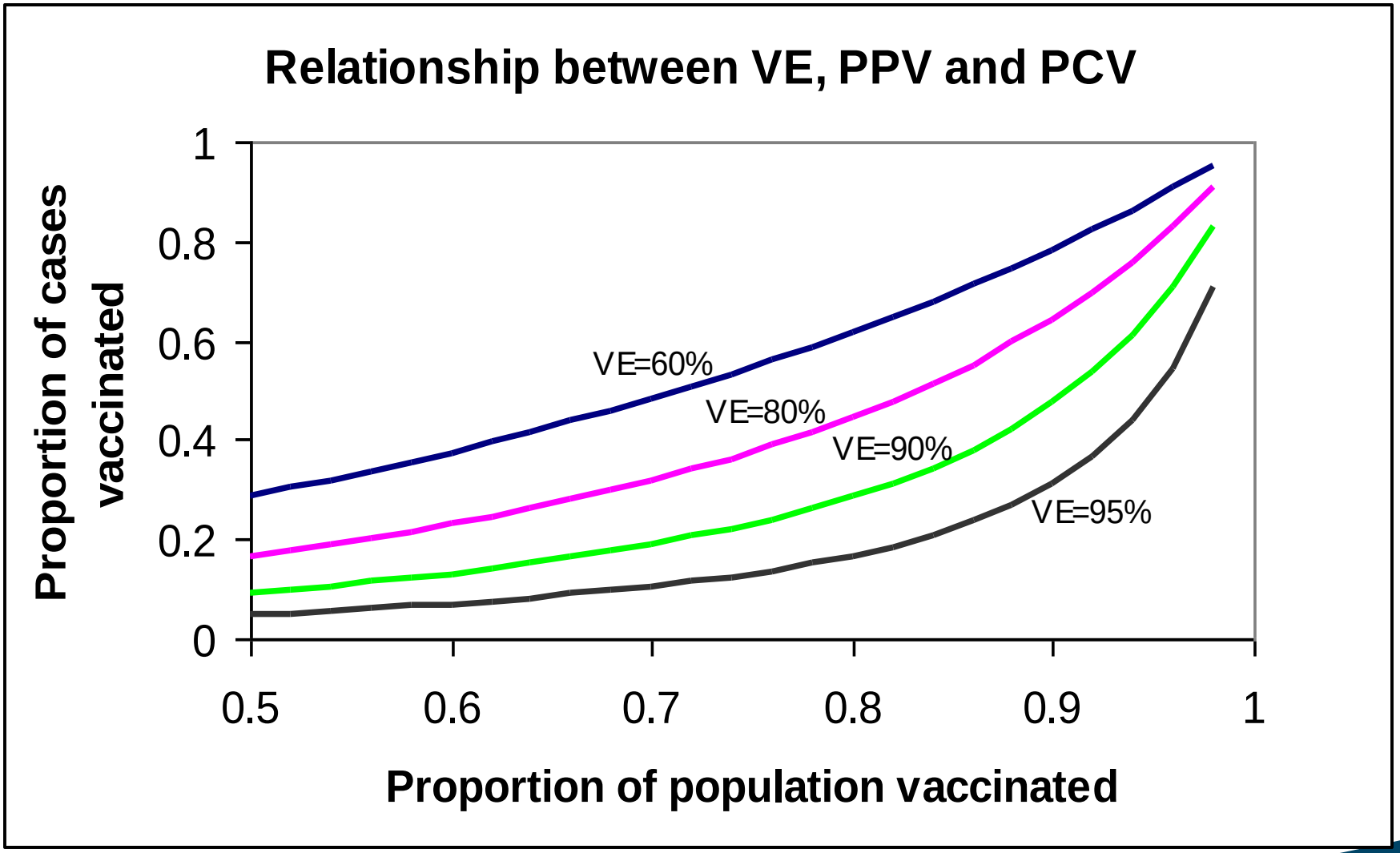
Seroconversion measles component MMR:
96,3%

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



$$VE = 1 - \frac{PCV \times (1-PPV)}{(1-PCV) \times PPV}$$

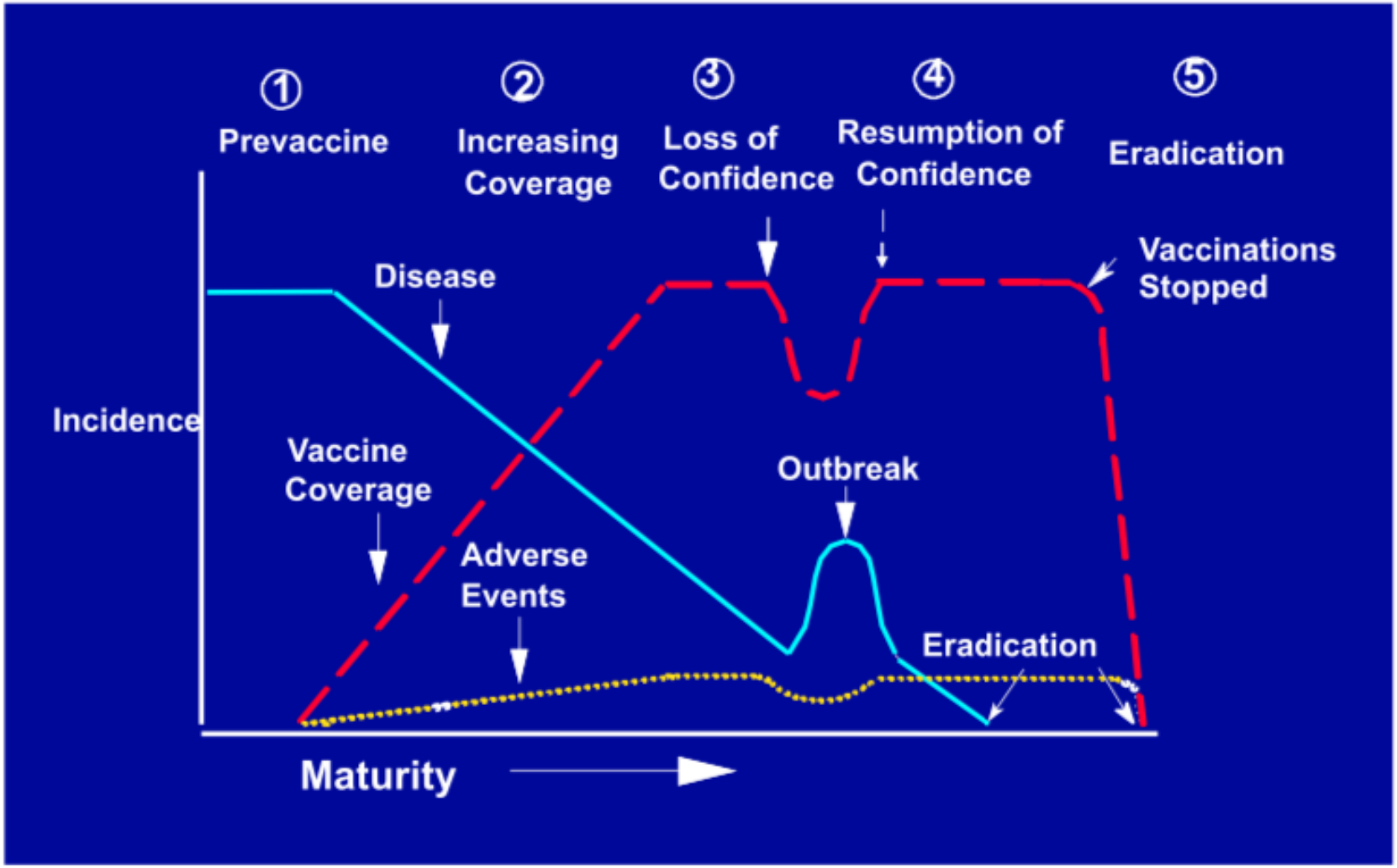
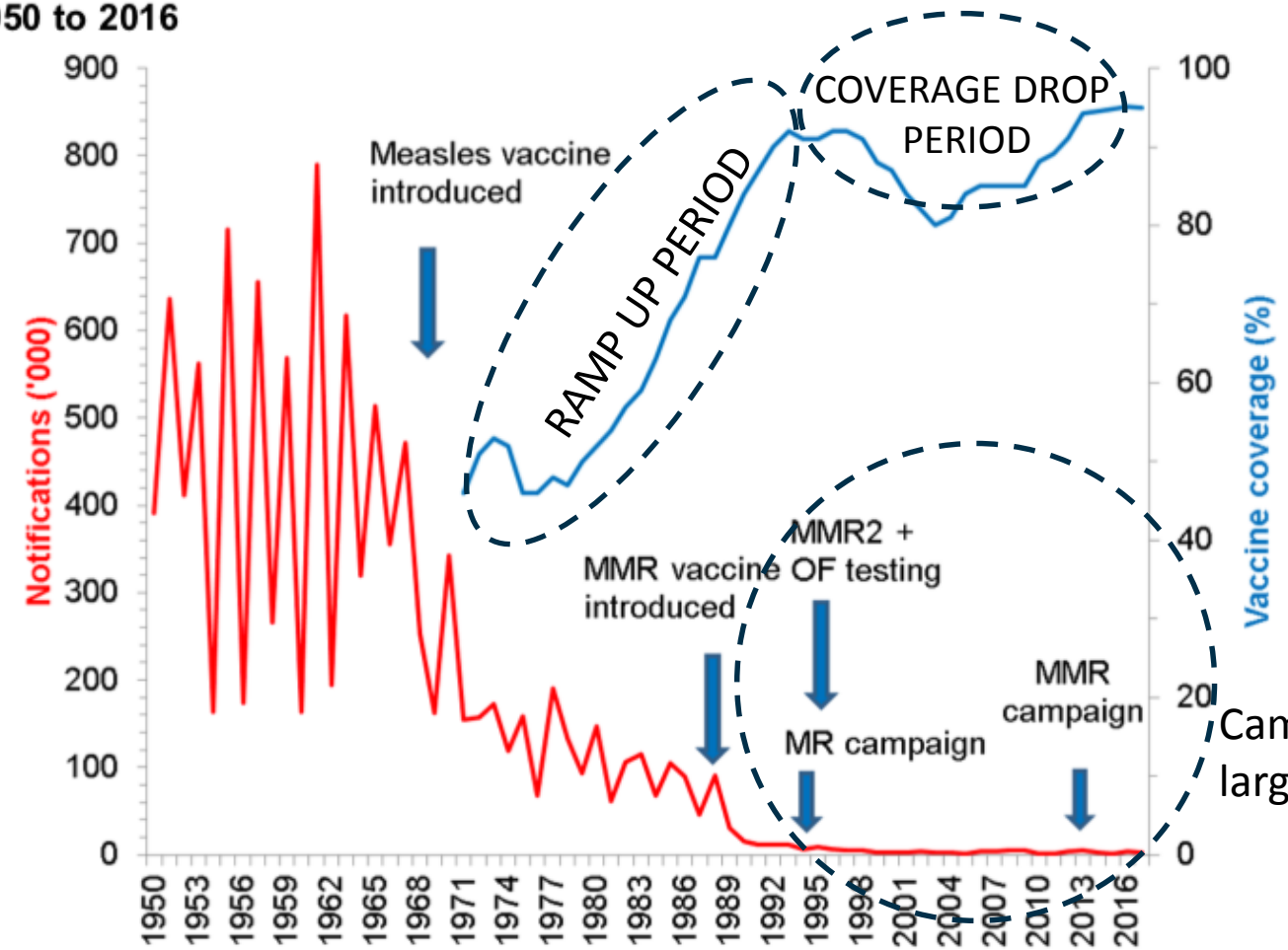


FIGURE 2

Evolution of a vaccine program. Reproduced with permission. Chen RT, Orenstein WA. Epidemiologic methods in immunization programs. *Epidemiol Rev.* 1996;18(2):102. Copyright © 1996 by the Oxford University Press.

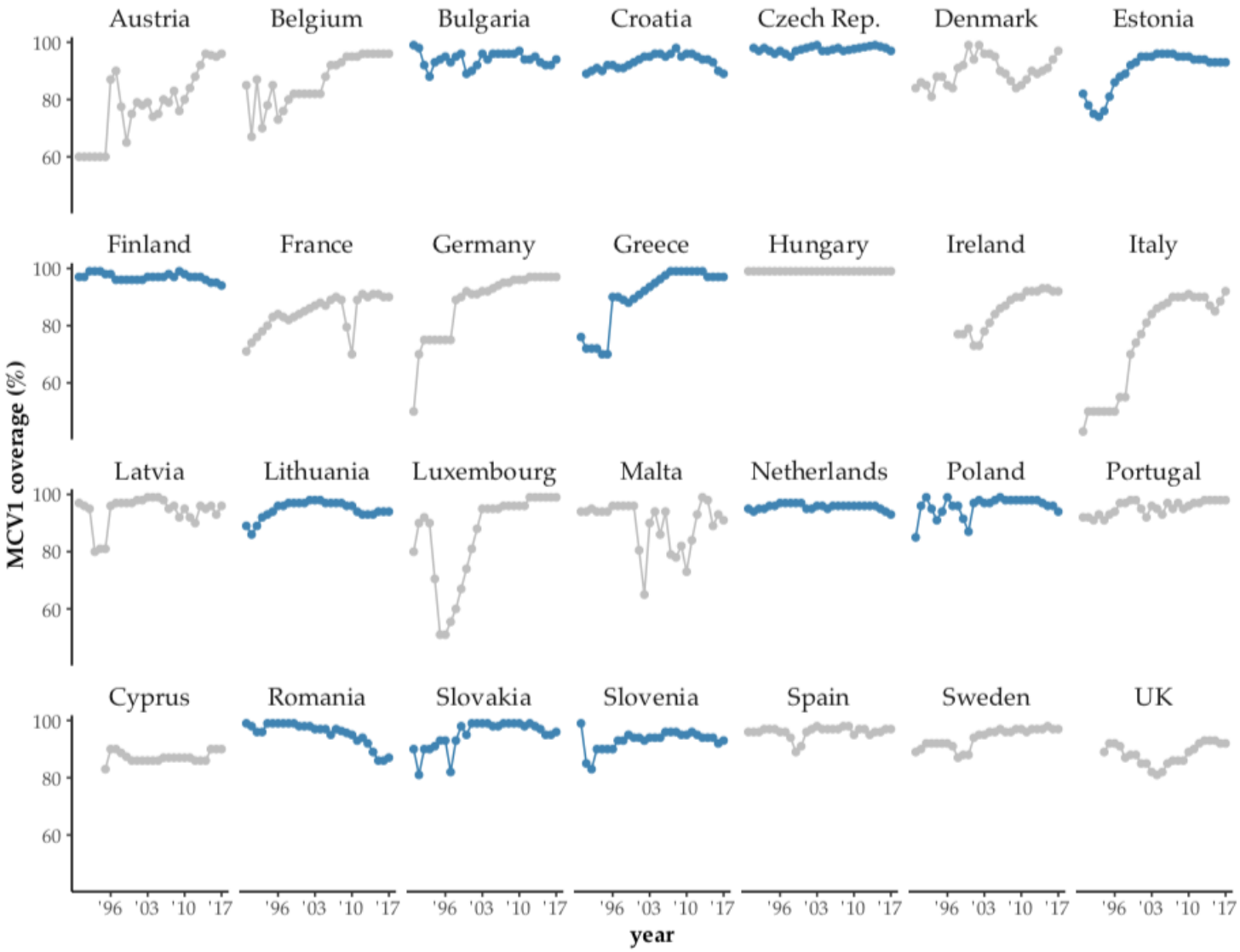
Historical non-vaccination

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



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

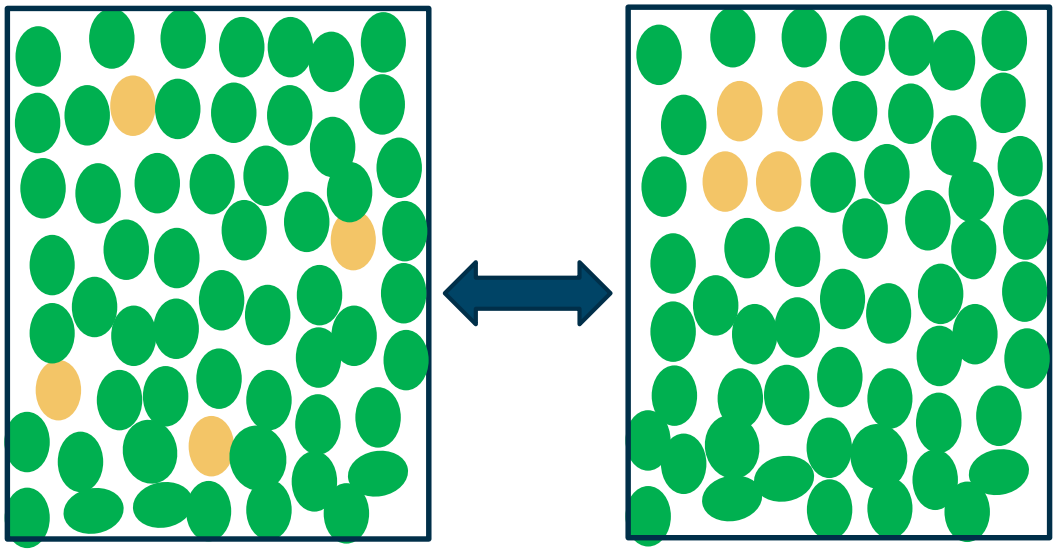
Occurrence and persistence of measles outbreaks depends on

Level of susceptibility and

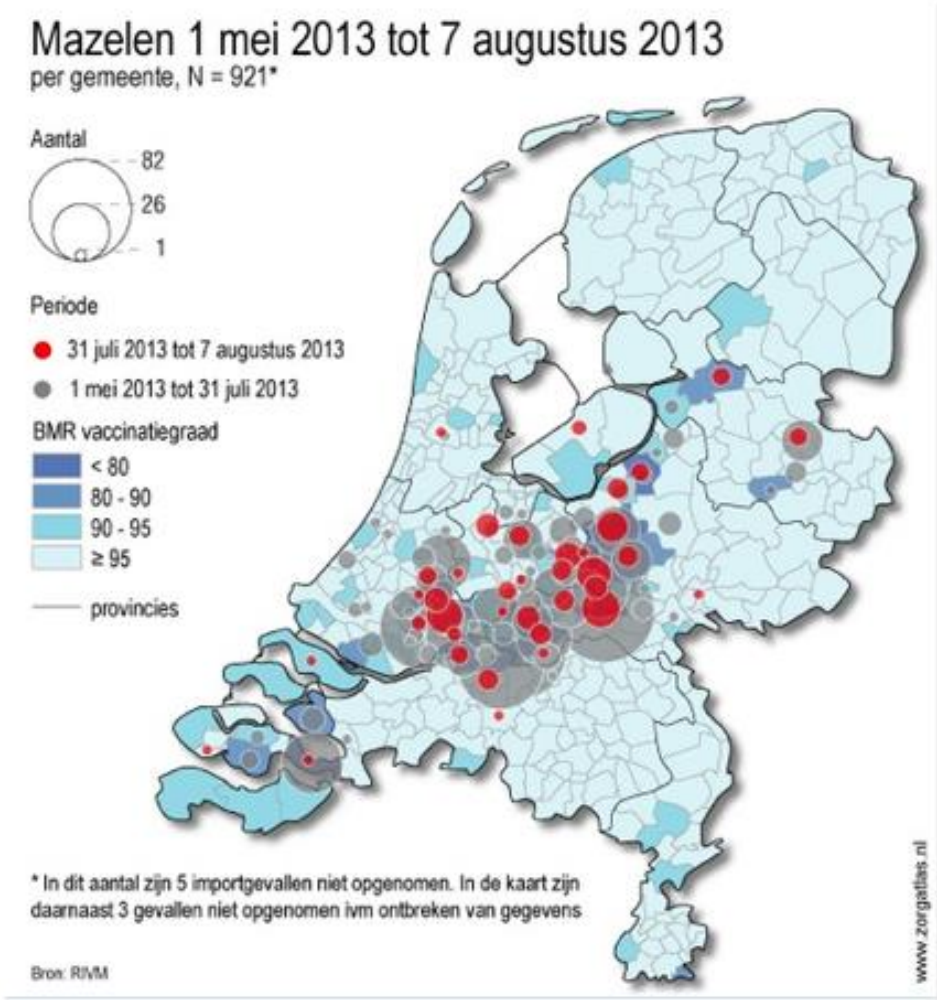
whether susceptibles cluster in physical locations, like schools, religious communities, households, etc

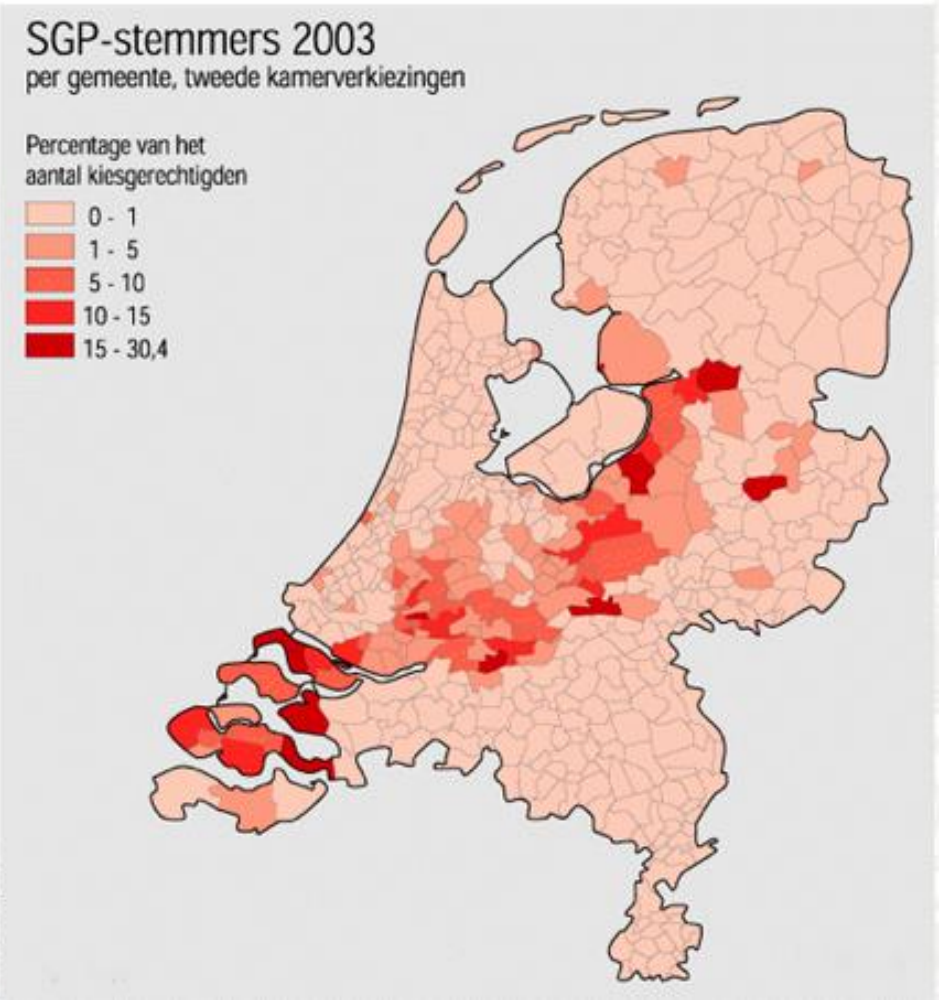
susceptible

immune



Well-documented: religious belief clustering



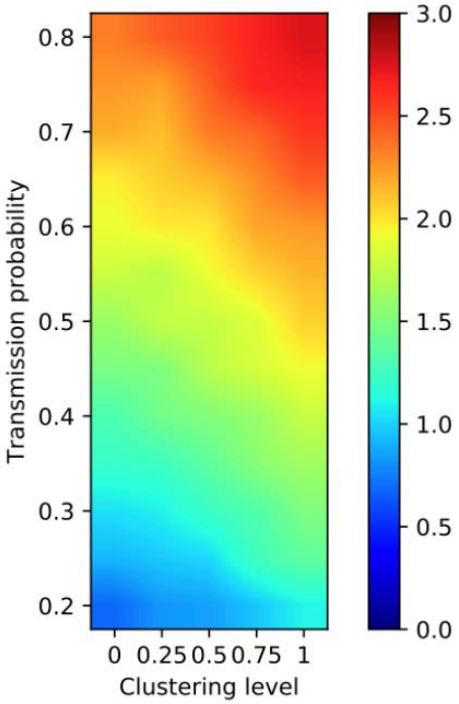


SGP: Staatkundig Gereformeerde Partij

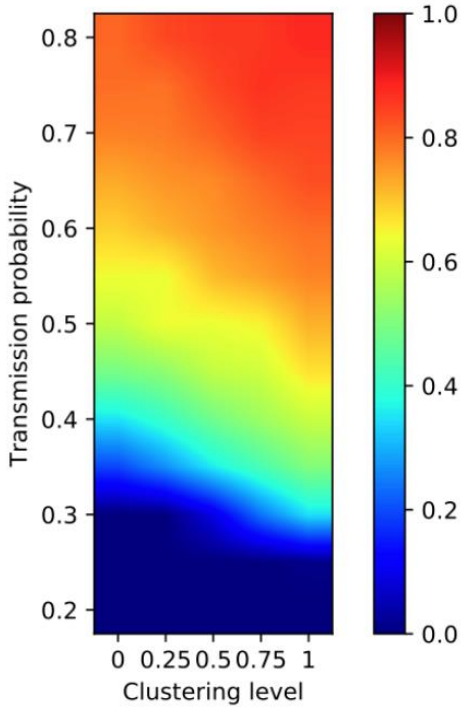
RIVM, 2013-2014

Clustering of measles susceptibility within households (Kuylen E, et al, 2019)

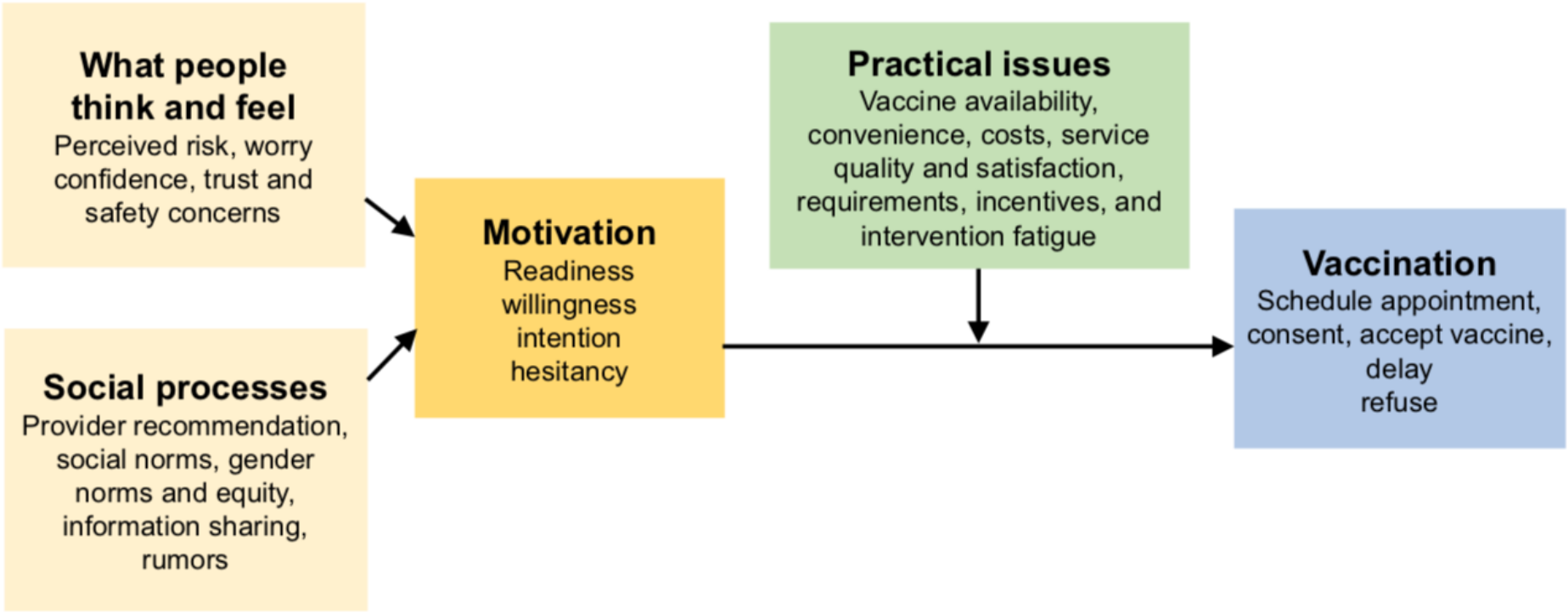
Effective R
→ impact at start of outbreak!



Percentage of persistent outbreaks

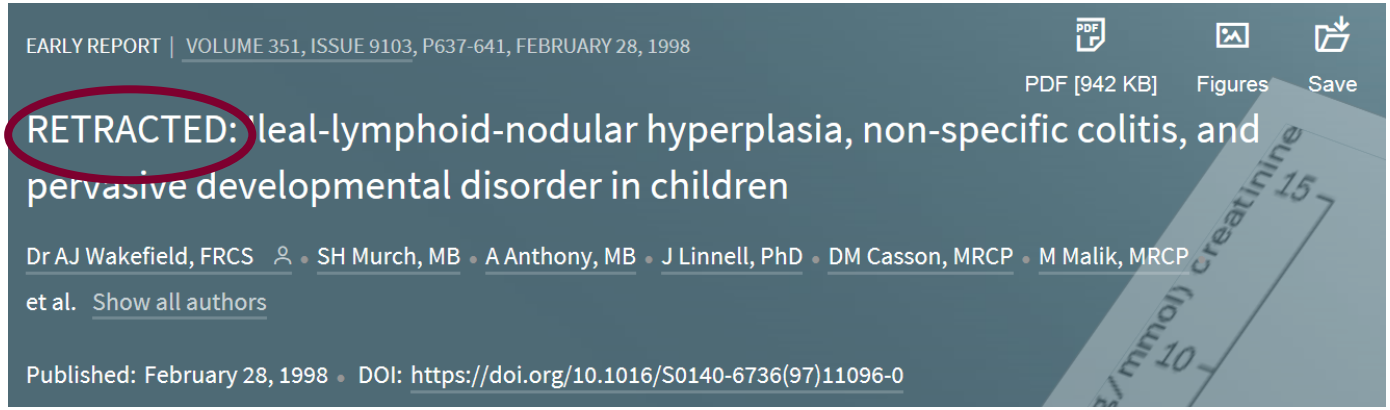


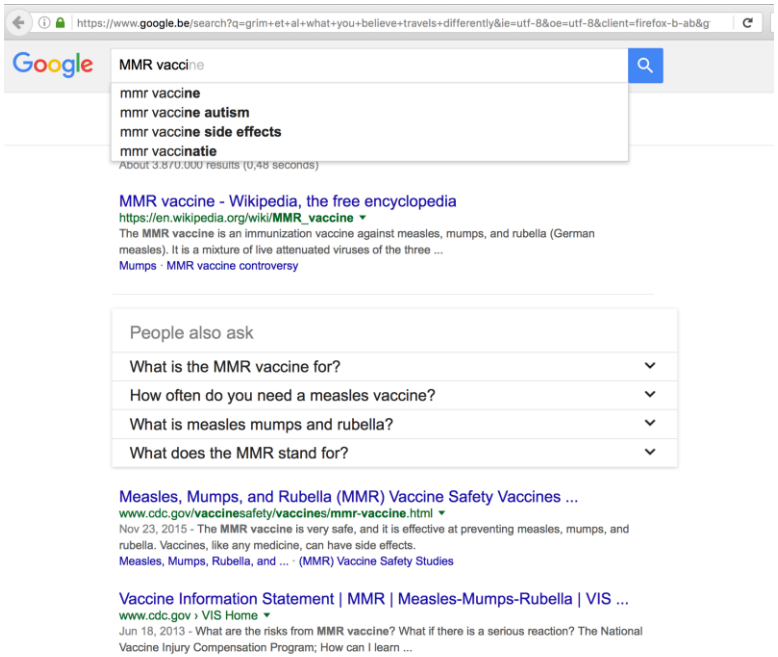
Conceptual model for vaccination

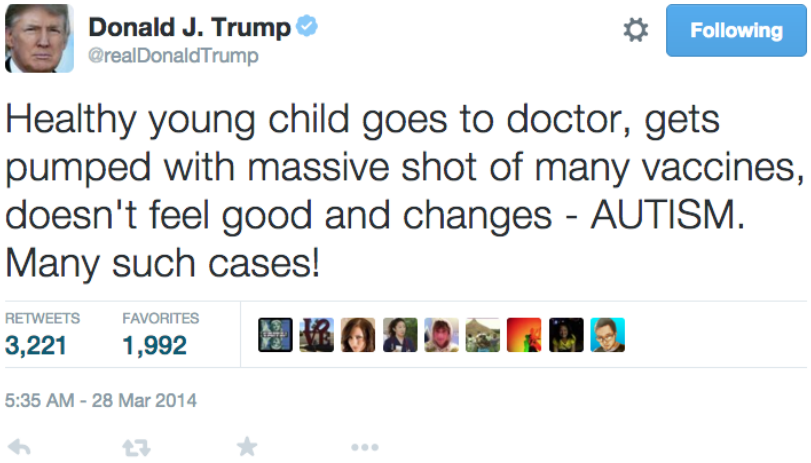


Source: The BeSD expert working group. Based on: Brewer NT, Chapman GB, Rothman AJ, Leask J, and Kempe A (2017). Increasing vaccination: Putting psychological science into action. *Psychological Science for the Public Interest.* 18(3): 149-207

Vaccine refusal & hesitancy: Measles as an example





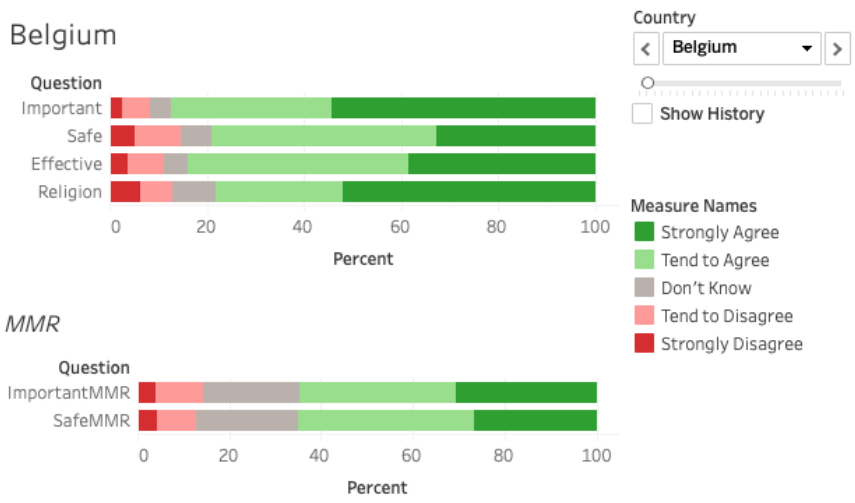


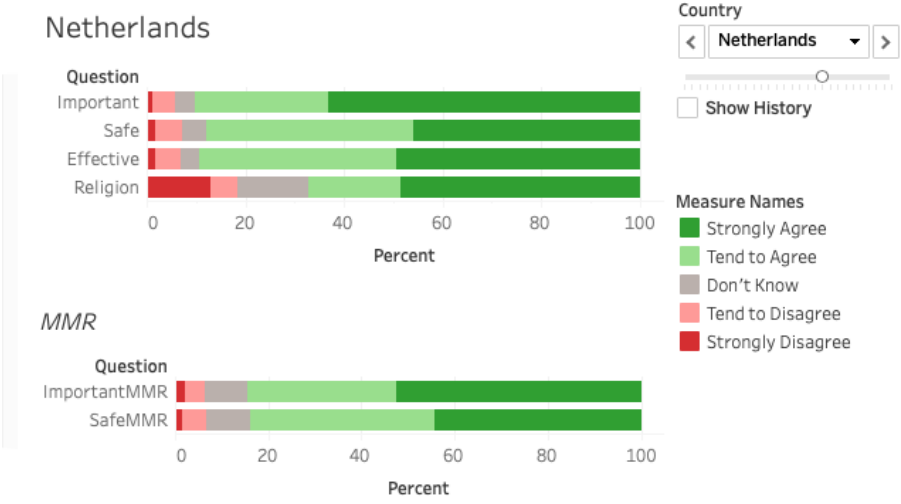
WHO SAGE definition

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.

Vaccine confidence project (LSHTM): “vaccines are…”



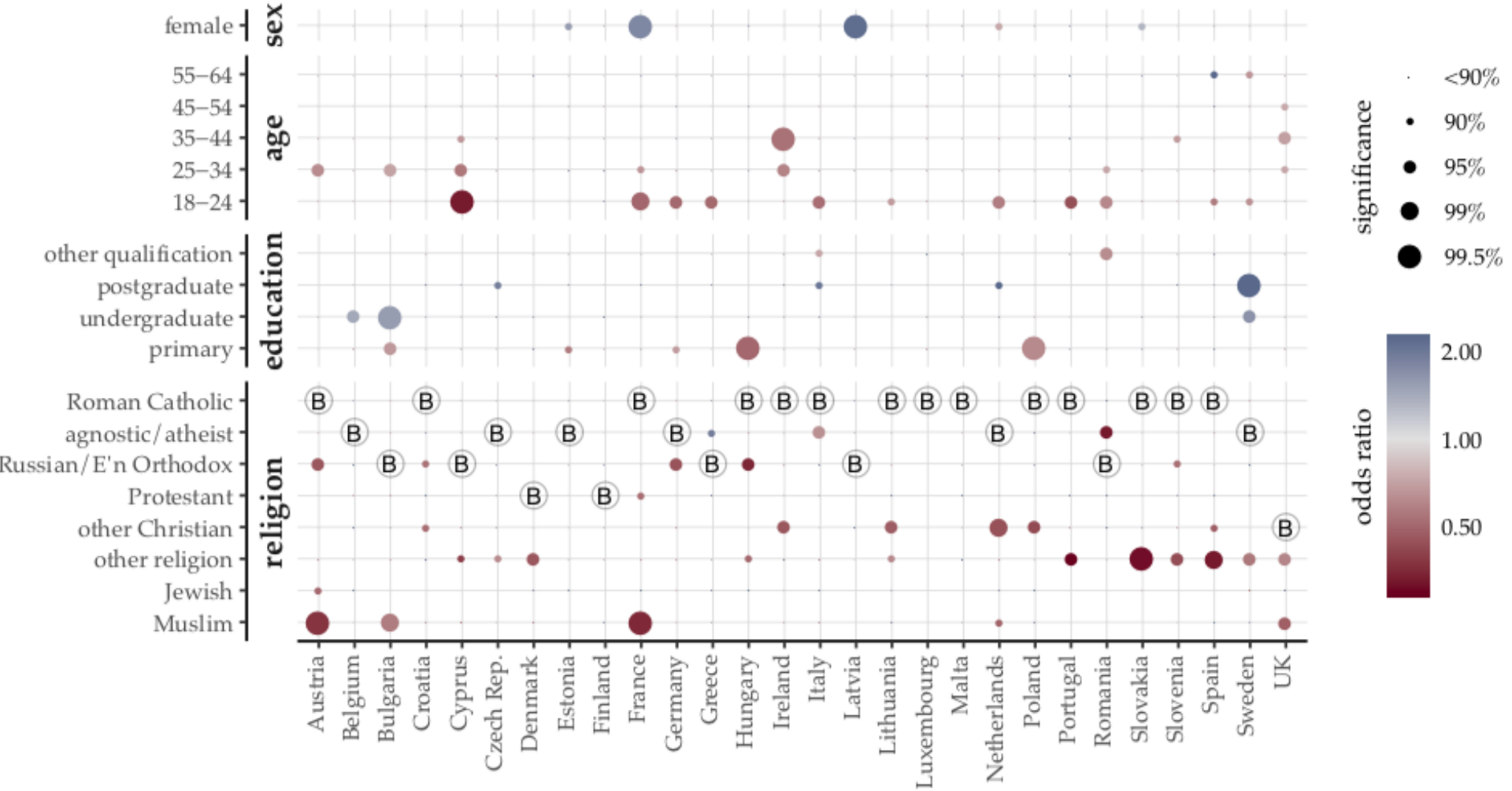


*“**Belgium** has the lowest percentage of respondents agreeing that the MMR vaccine is safe and important for children: 64.7% believe it is important for children and 64.9% that it is safe.”* Larson et al, EC report 2018

vaccineconfidence.org

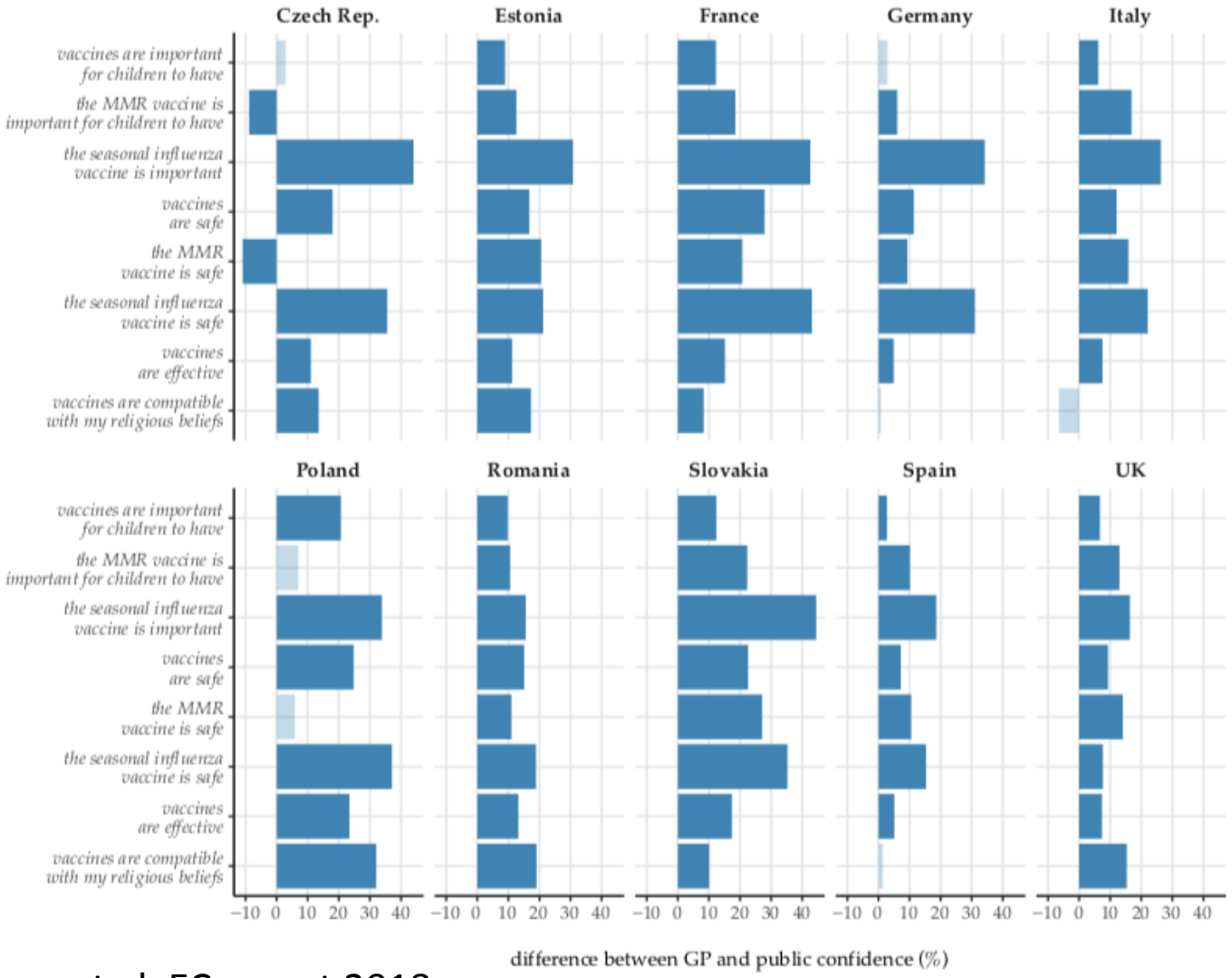
Within-country-determinants of stating:

The MMR vaccine is safe



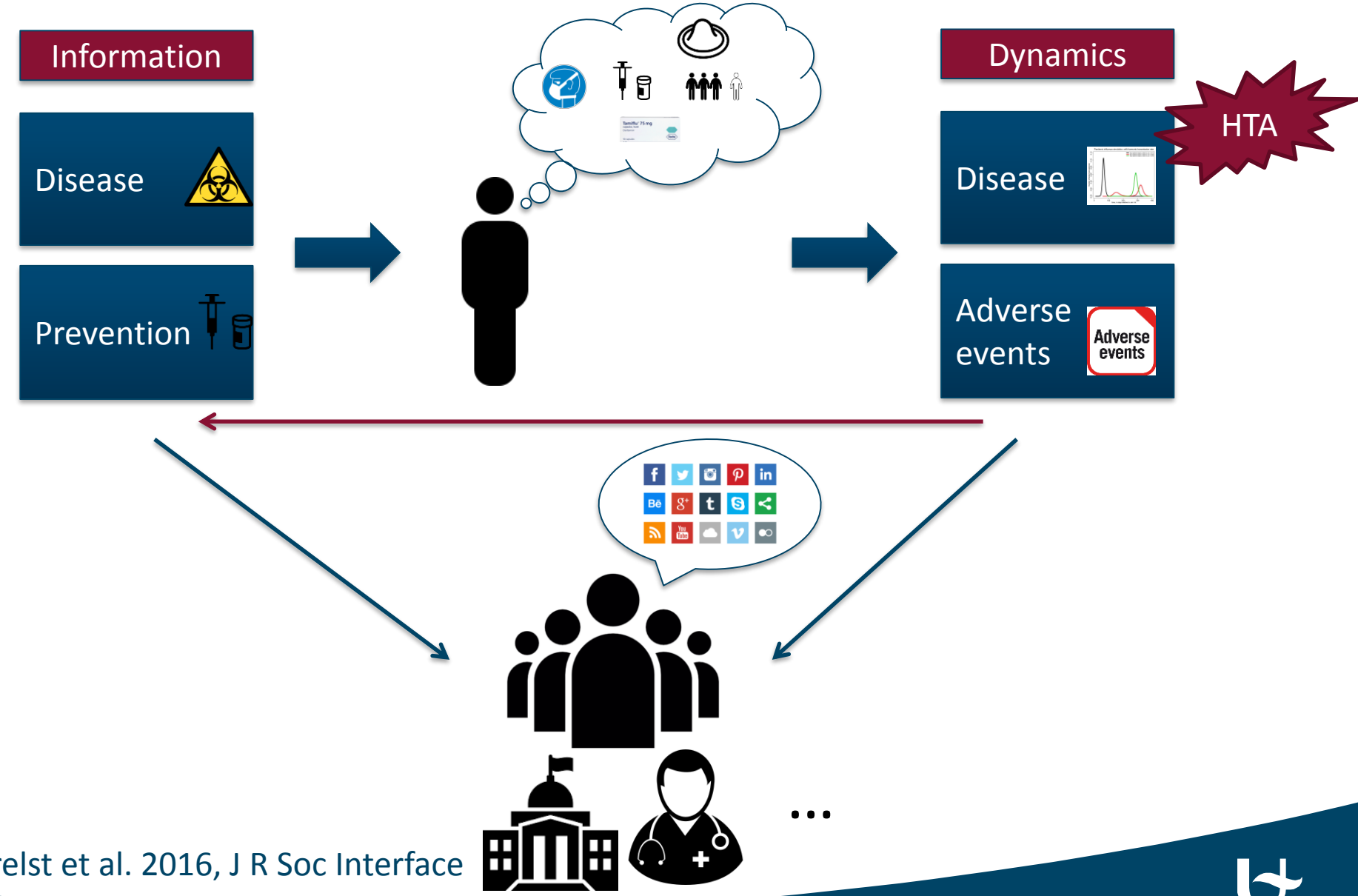
Larson et al, EC report 2018

GPs are more supportive of vaccination than the general population (generally more so for flu)



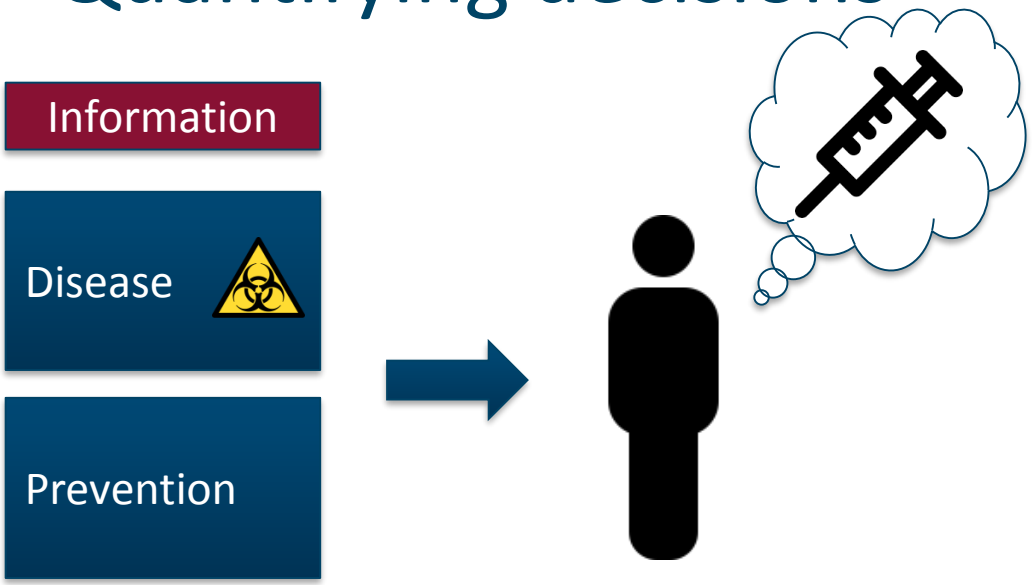
Larson et al, EC report 2018

Behavior & Infectious diseases



Verelst et al. 2016, J R Soc Interface

Quantifying decisions



Attribute	Attribute levels
Vaccine effectiveness	50% 90%
Burden of disease	Rare & Mild Rare & Severe Common & Mild Common & Severe
Mild VRSE	Common Rare
Accessibility	Free & Available Co-payment & prescription
Local coverage	30% 60% 90%
Global coverage	30% 60% 90%

Coverage attributes

- Free-riding
- Peer influence?
- Social norms?

Verelst F, et al, 2019

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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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