Can universal immunization of children induce herd immunity ?

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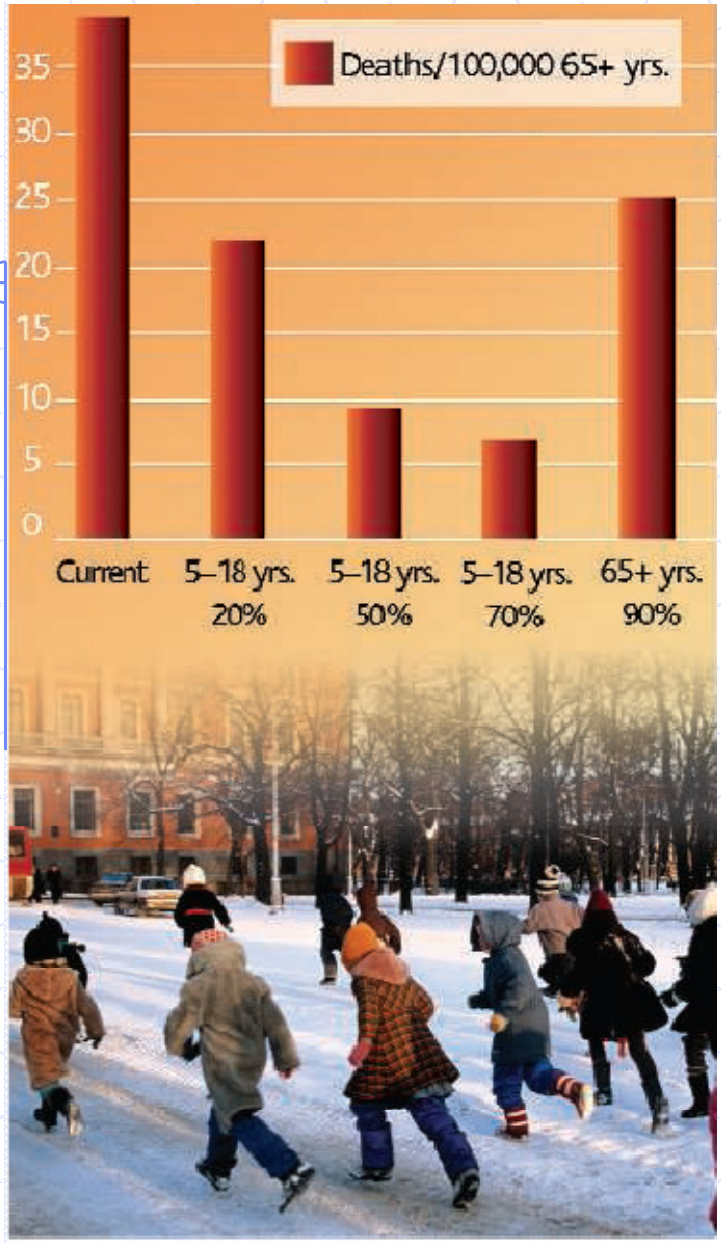
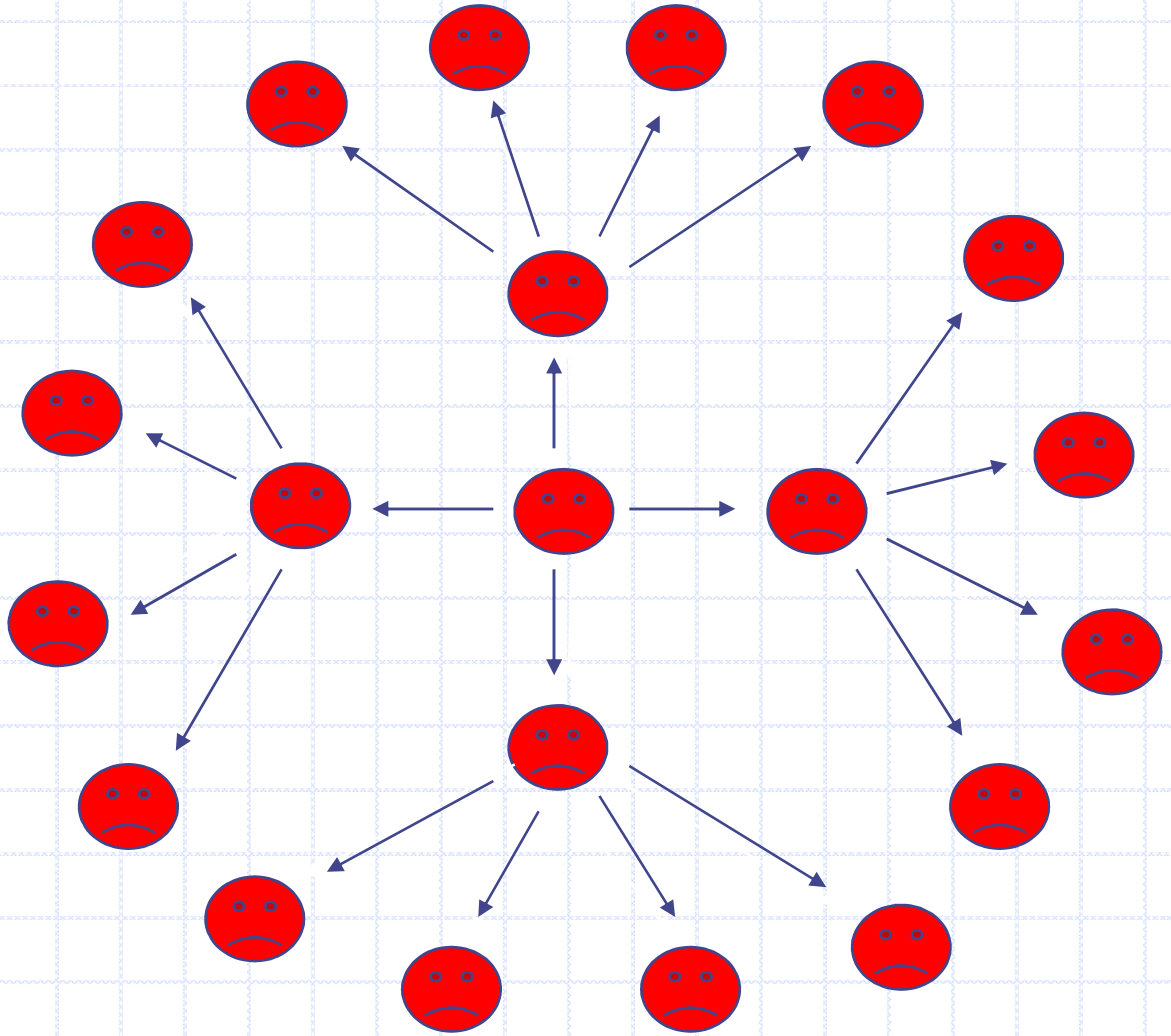


Kid you not. Vaccinating even 20% of school-age children may prevent elderly deaths from flu more effectively than increasing elderly vaccination rates.

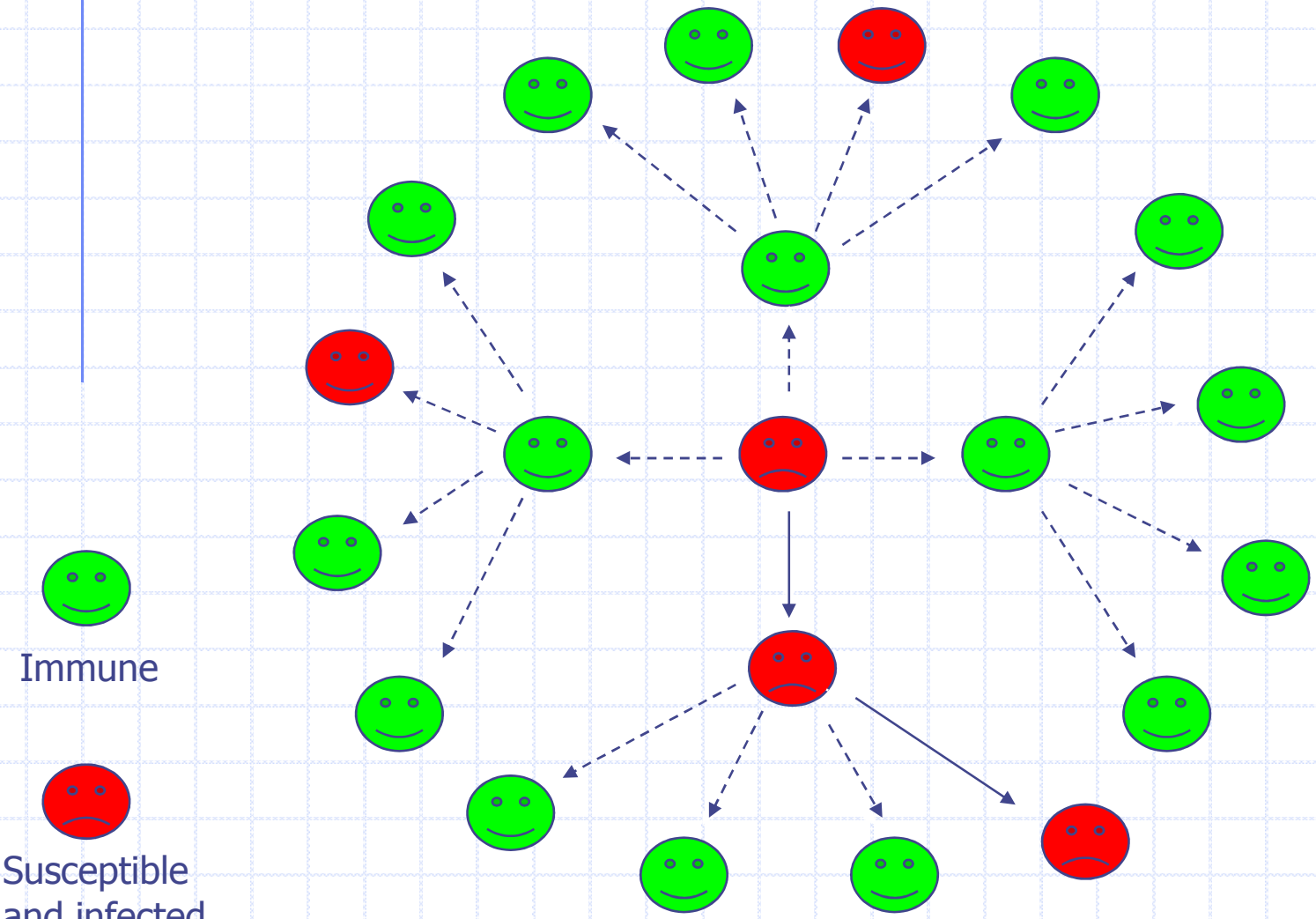
The immunization of 20% of school children may prevent more deaths in the elderly than vaccinating 90% of persons ≥ 65

Person to person transmission



Susceptible
and infected

Herd immunity effect

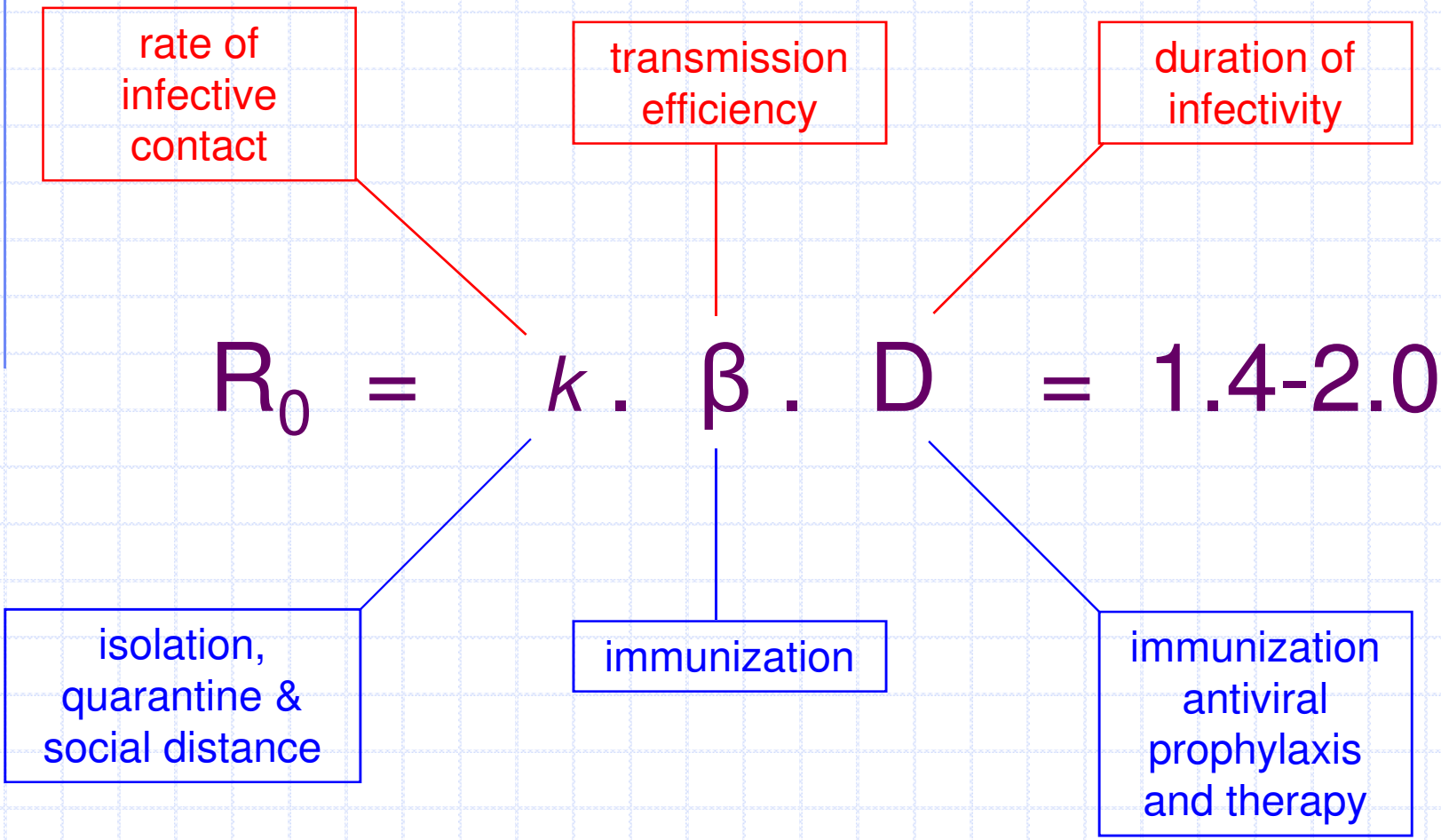


Immune

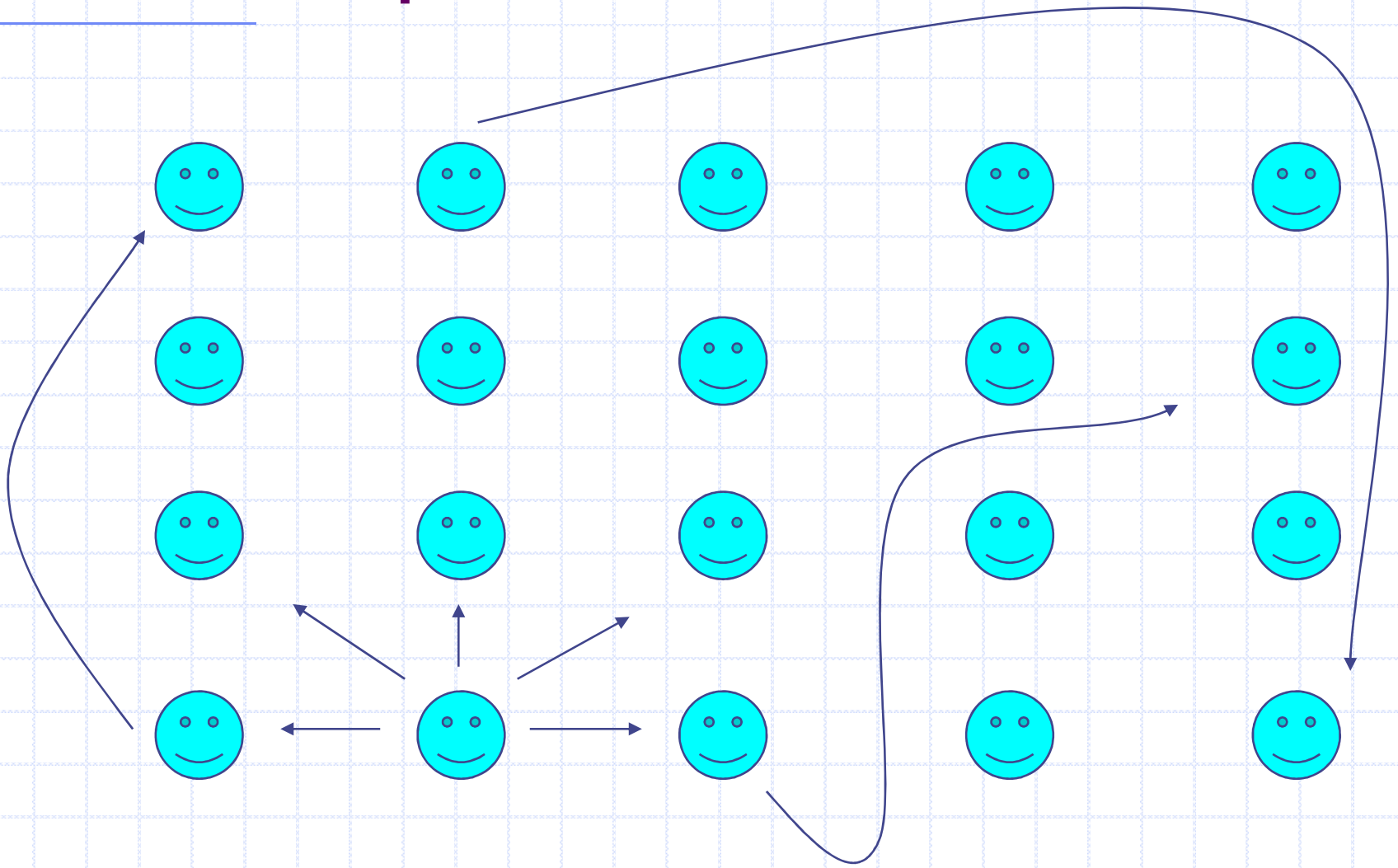
Susceptible
and infected

Susceptible
but not infected

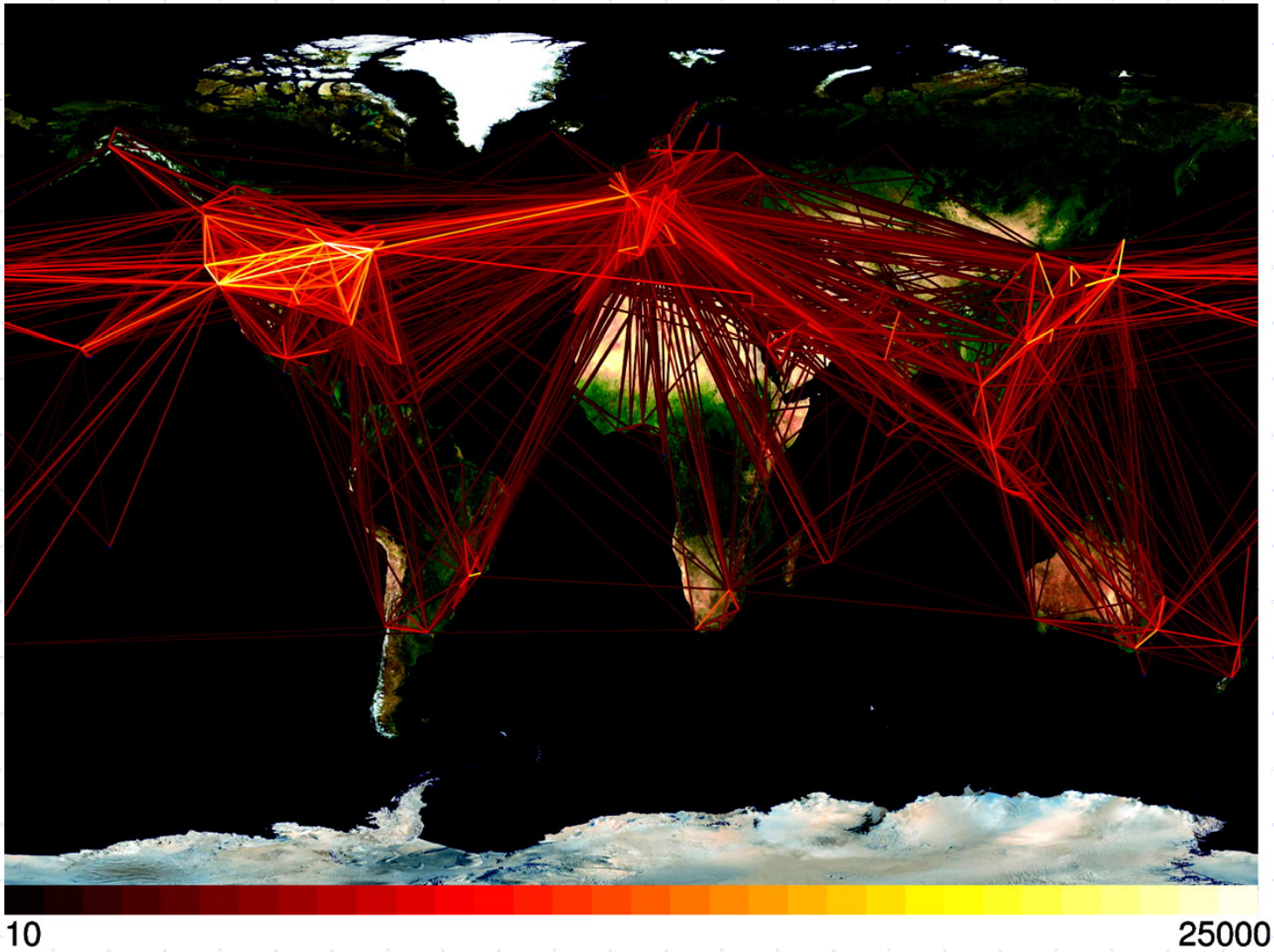
Basic reproductive rate



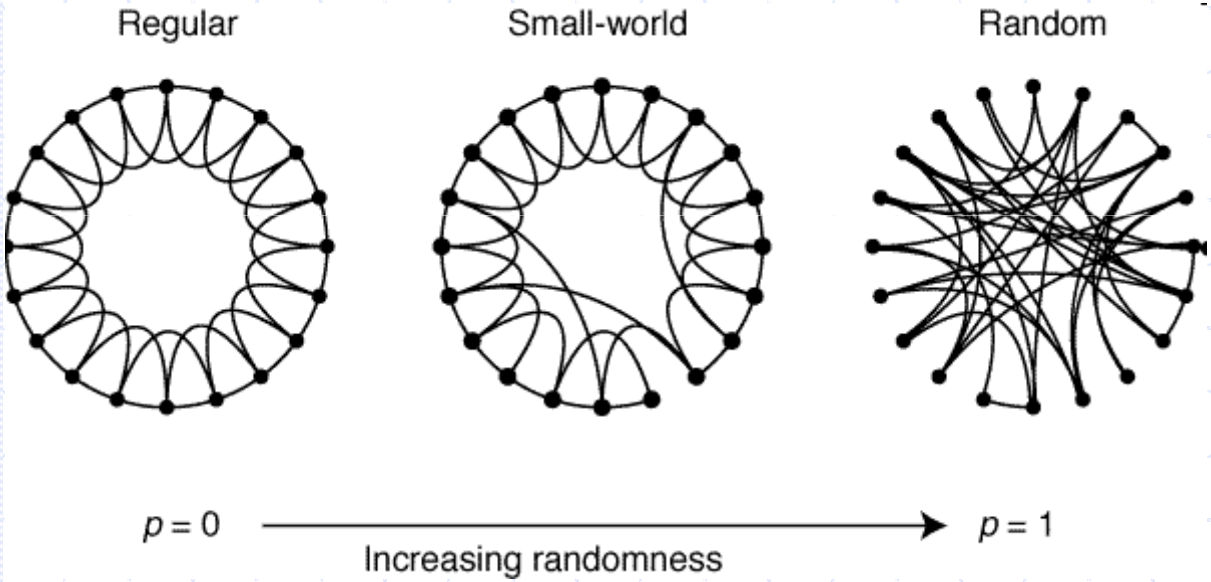
Contacts patterns ?



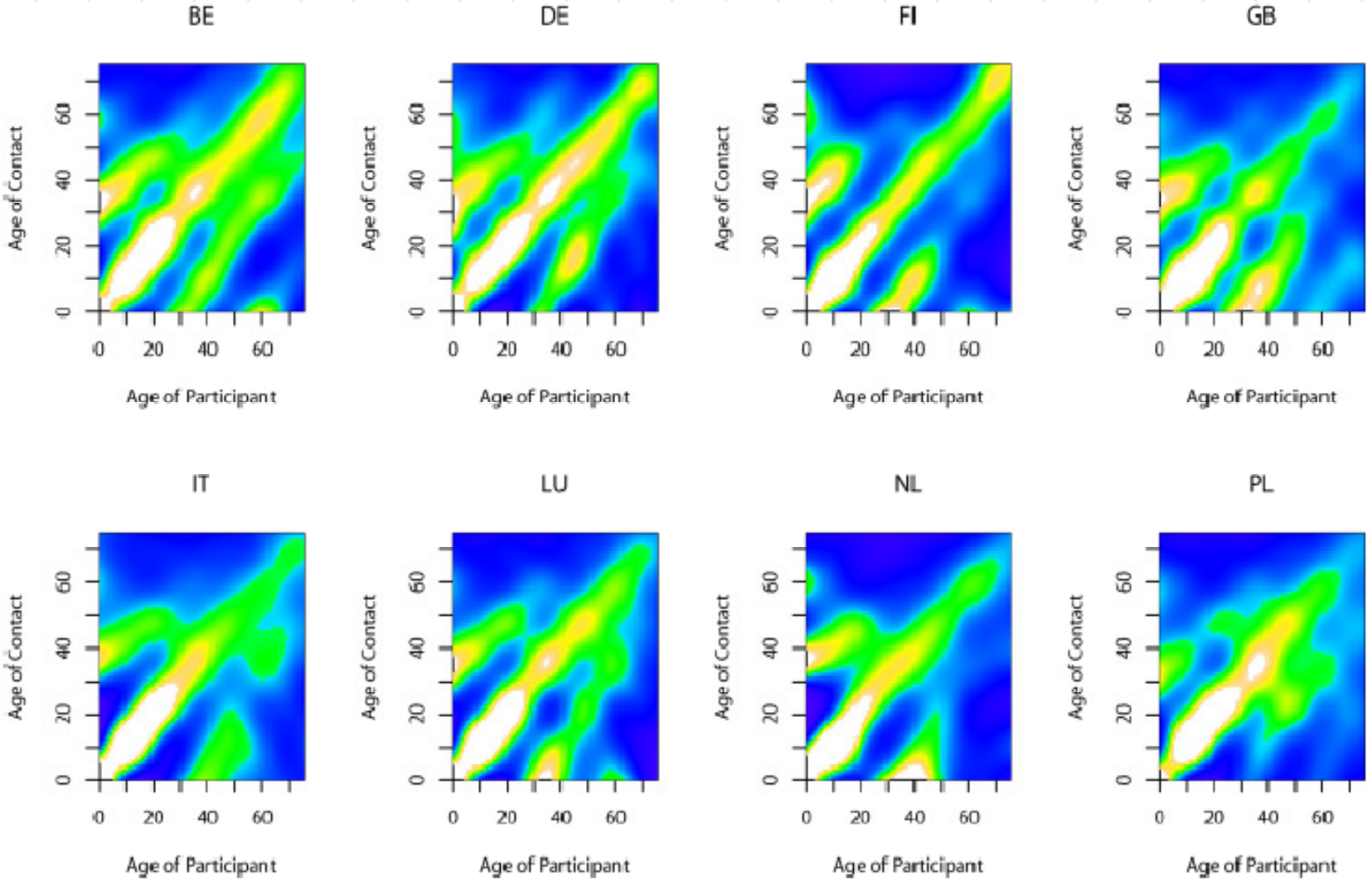
Civil airlines traffic



It’s a small world…

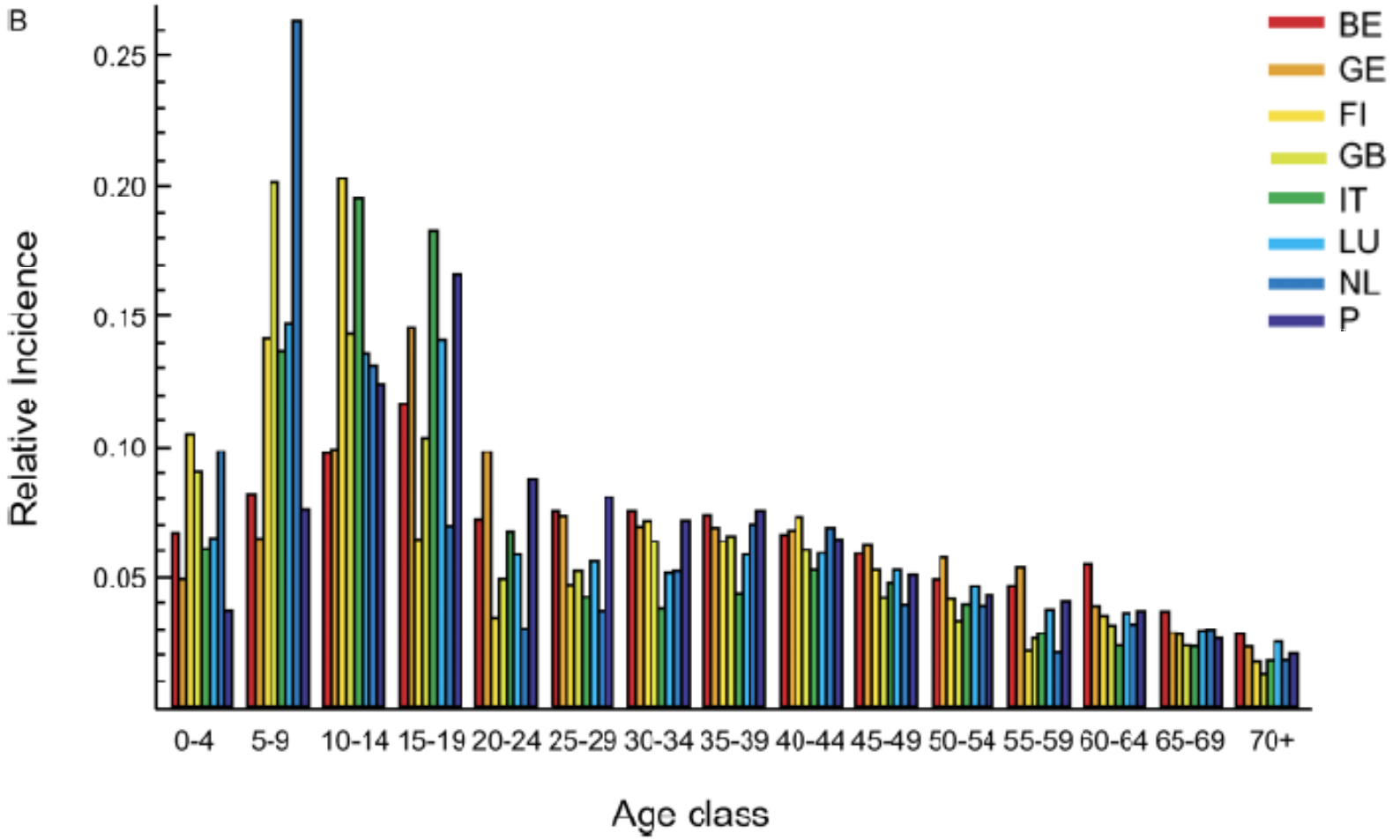


Contact patterns !



Mossong. PLOS Medicine 2008;5:e74

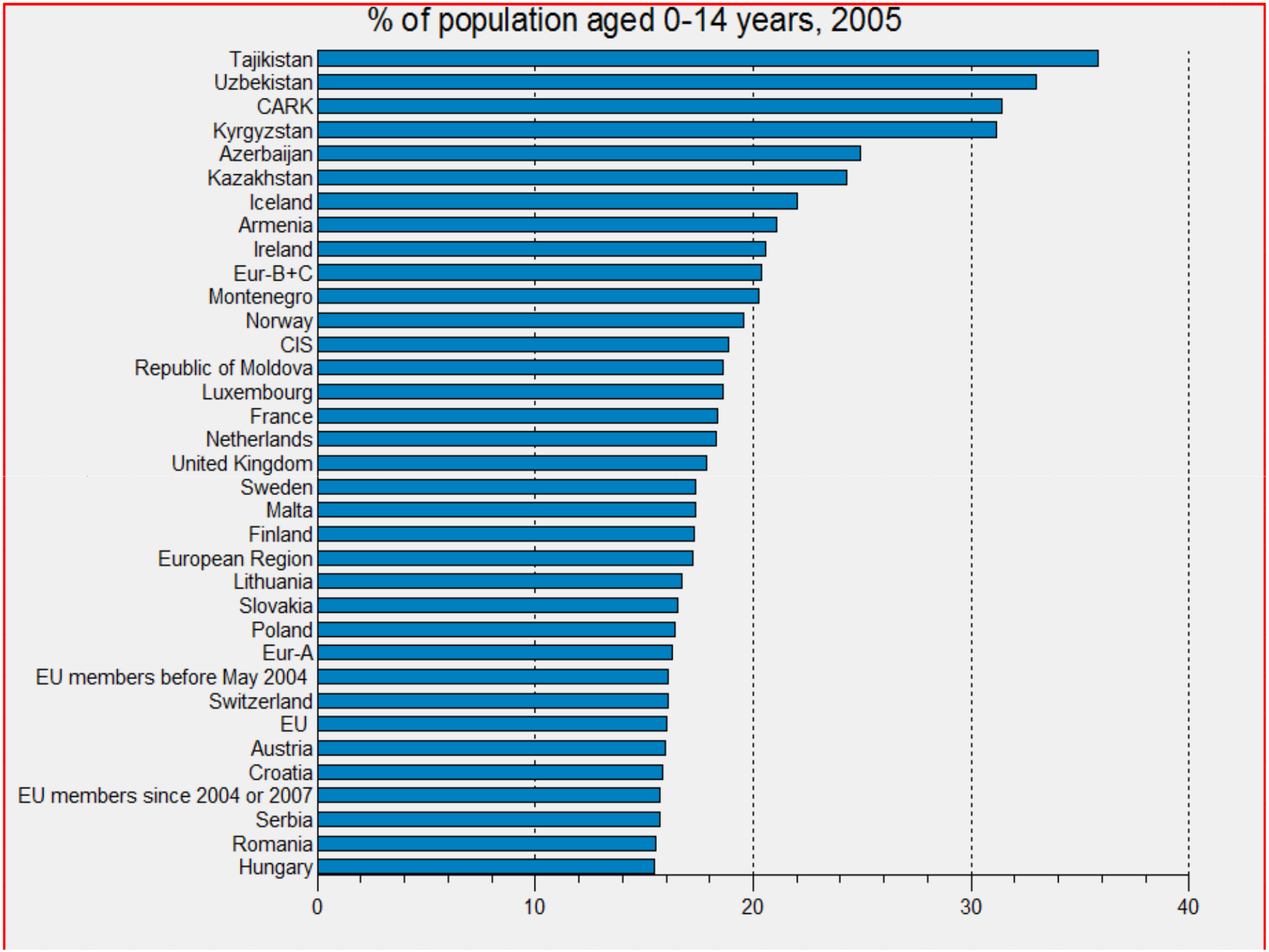
Relative incidence of an emerging infection in a susceptible population

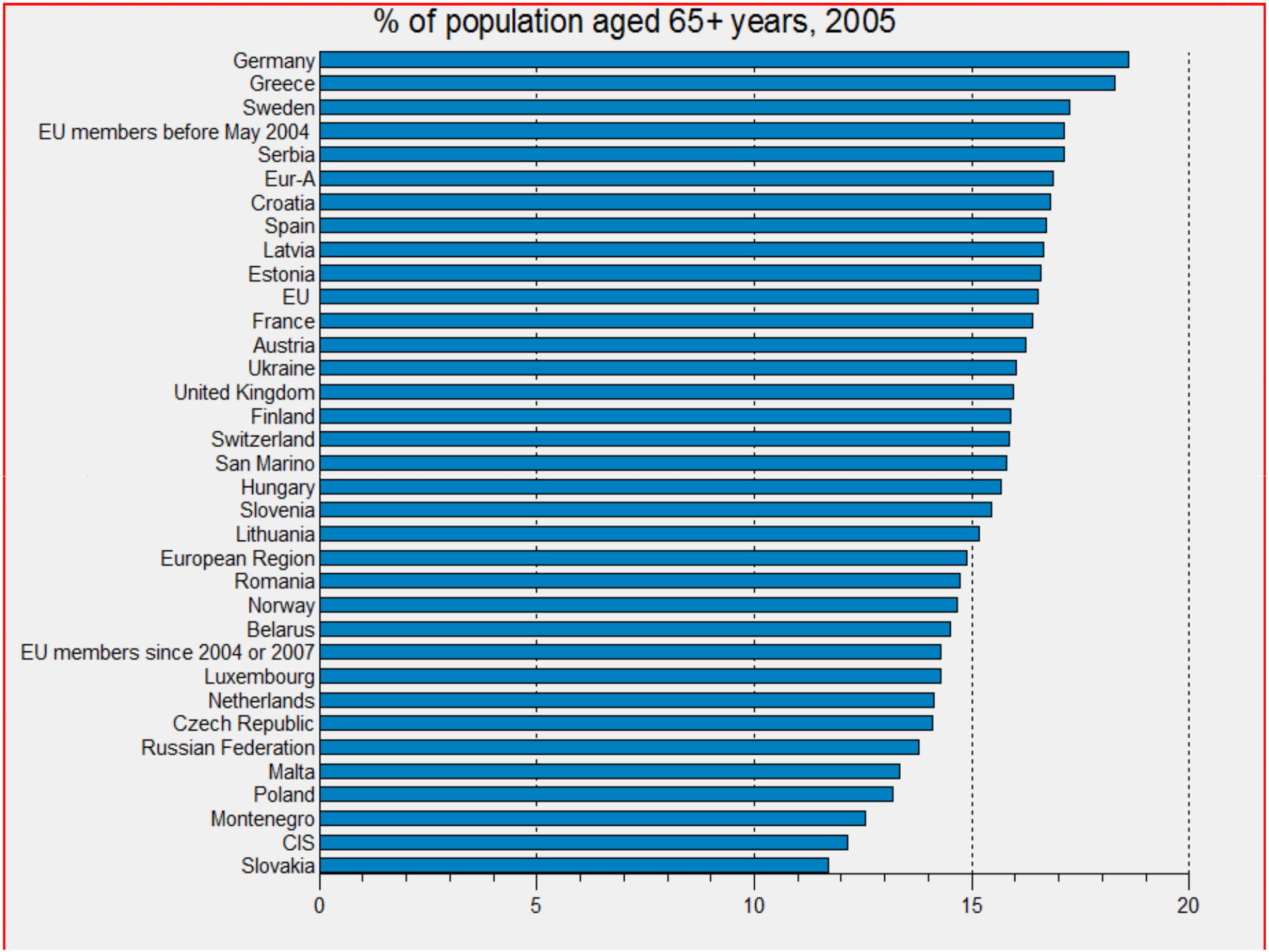


Mossong. PLOS Medicine 2008;5:e74

School children come first

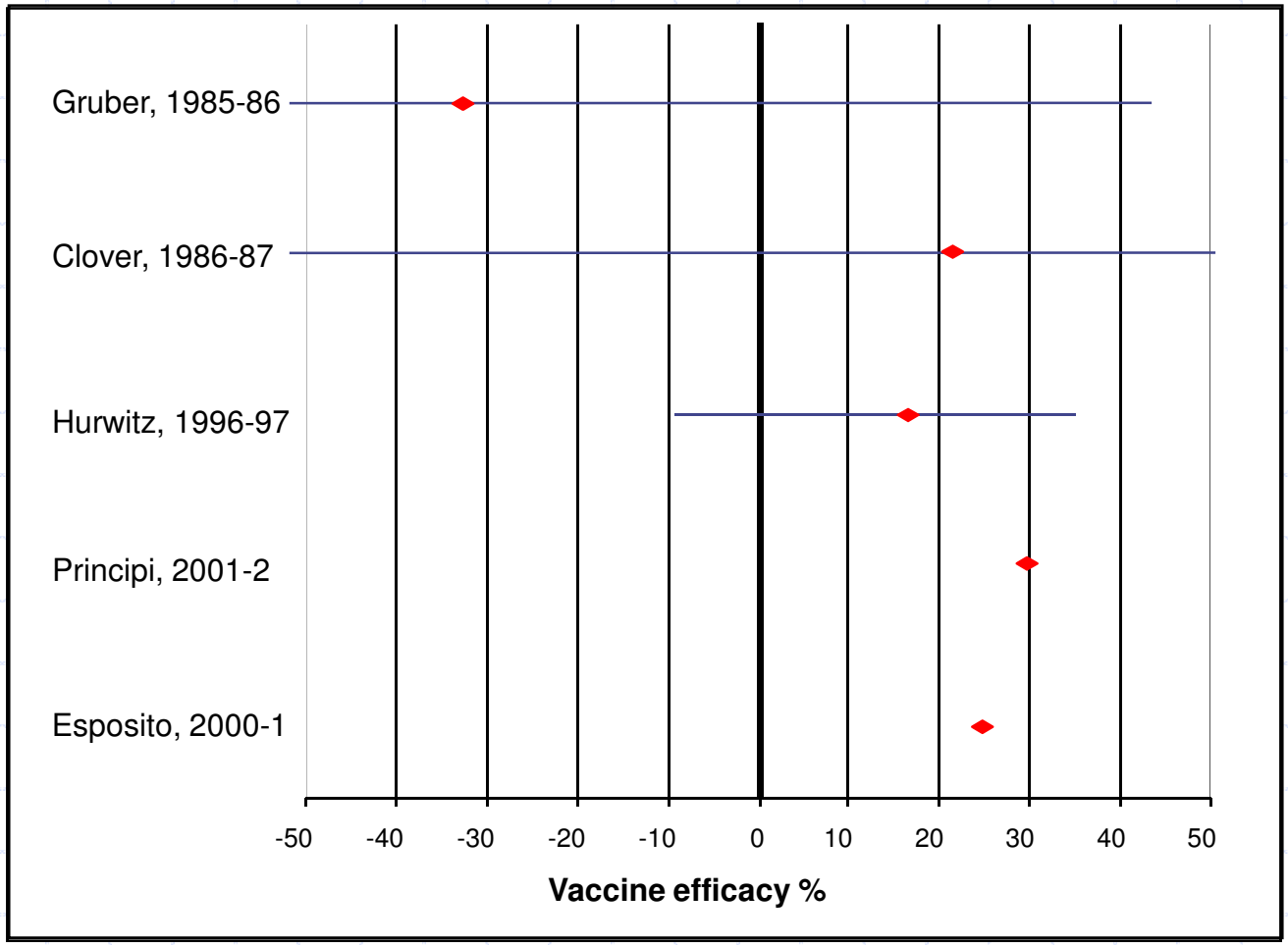
Age (yr)	Epidemic stage		
	Early (%)	Peak (%)	Late (%)
< 5	236(18.4)	489(24.3)	248(24.5)
5-19	687(53.6)	741(36.8)	356(35.2)
≥ 20	359(28.0)	785(39.0)	407(40.3)
Total	1,282	2,015	1,011


% of population aged 0-14 years, 2005
Tajikistan
Uzbekistan
CARK
Kyrgyzstan
Azerbaijan
Kazakhstan
Iceland
Armenia
Ireland
Eur-B+C
Montenegro
Norway
CIS
Republic of Moldova
Luxembourg
France
Netherlands
United Kingdom
Sweden
Malta
Finland
European Region
Lithuania
Slovakia
Poland
Eur-A
EU members before May 2004
Switzerland
EU
Austria
Croatia
EU members since 2004 or 2007
Serbia
Romania
Hungary
0
10
20
30
40


% of population aged 65+ years, 2005
Germany
Greece
Sweden
EU members before May 2004
Serbia
Eur-A
Croatia
Spain
Latvia
Estonia
EU
France
Austria
Ukraine
United Kingdom
Finland
Switzerland
San Marino
Hungary
Slovenia
Lithuania
European Region
Romania
Norway
Belarus
EU members since 2004 or 2007
Luxembourg
Netherlands
Czech Republic
Russian Federation
Malta
Poland
Montenegro
CIS
Slovakia
0
5
10
15
20


EU
22
21
20
19
18
17
16
15
14
13
12
1980
1990
2000
2010
2020
≤ 14 yrs
≥ 65 yrs

Efficacy of inactivated influenza vaccines in contacts of vaccinees



Efficacy of inactivated influenza vaccines in the community at large

Author	Vaccine target population	Population considered in the outcome	Results
Monto, 1968-69	Children 5-19 years	Whole population	67% efficacy
Reichert, 1949-99	School children	Mainly the elderly	Vaccination of 420 children prevented 1 death
Ghendon, 2006	Children 3-17 years	Persons >60 years	3.4 times less ILI and 1.7-2.6 times less complications

Japan vs USA

THE JAPANESE EXPERIENCE WITH VACCINATING SCHOOLCHILDREN AGAINST INFLUENZA

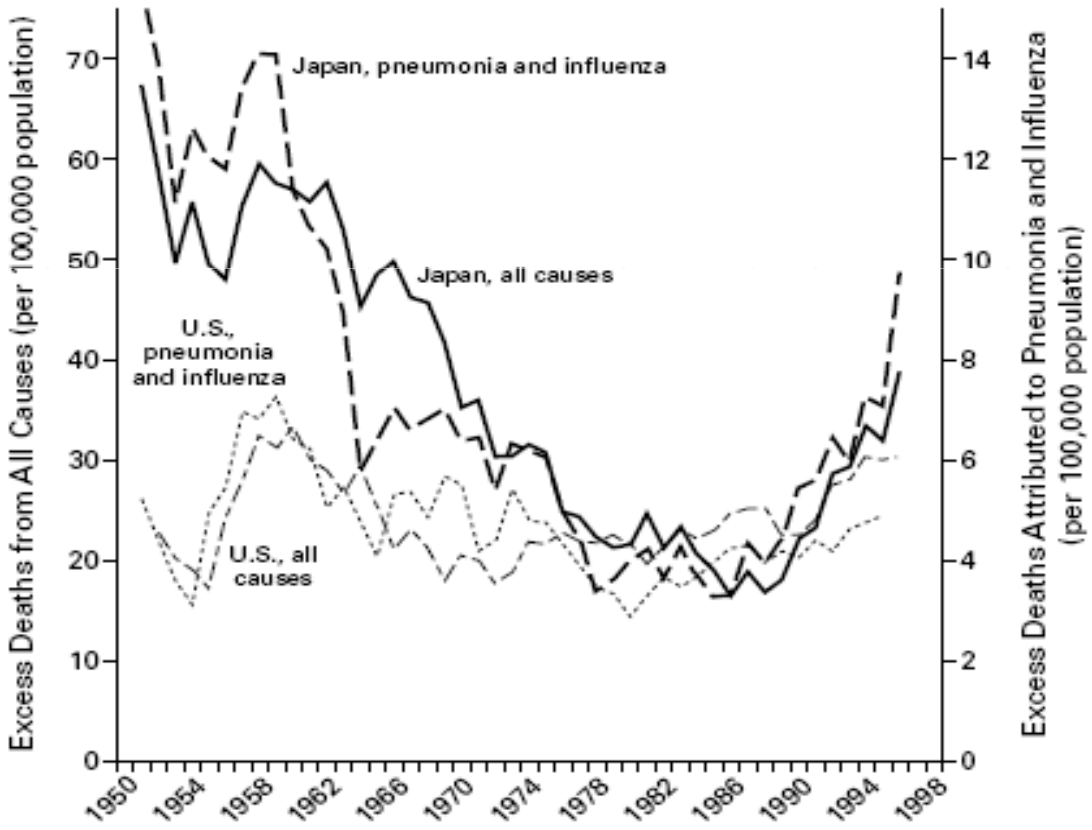


Figure 3. The Five-Year Moving Average of Excess Deaths Attributed to Both Pneumonia and Influenza and All Causes, for Japan and the United States.

Tick marks represent the beginning of the years indicated.

Japan vs USA

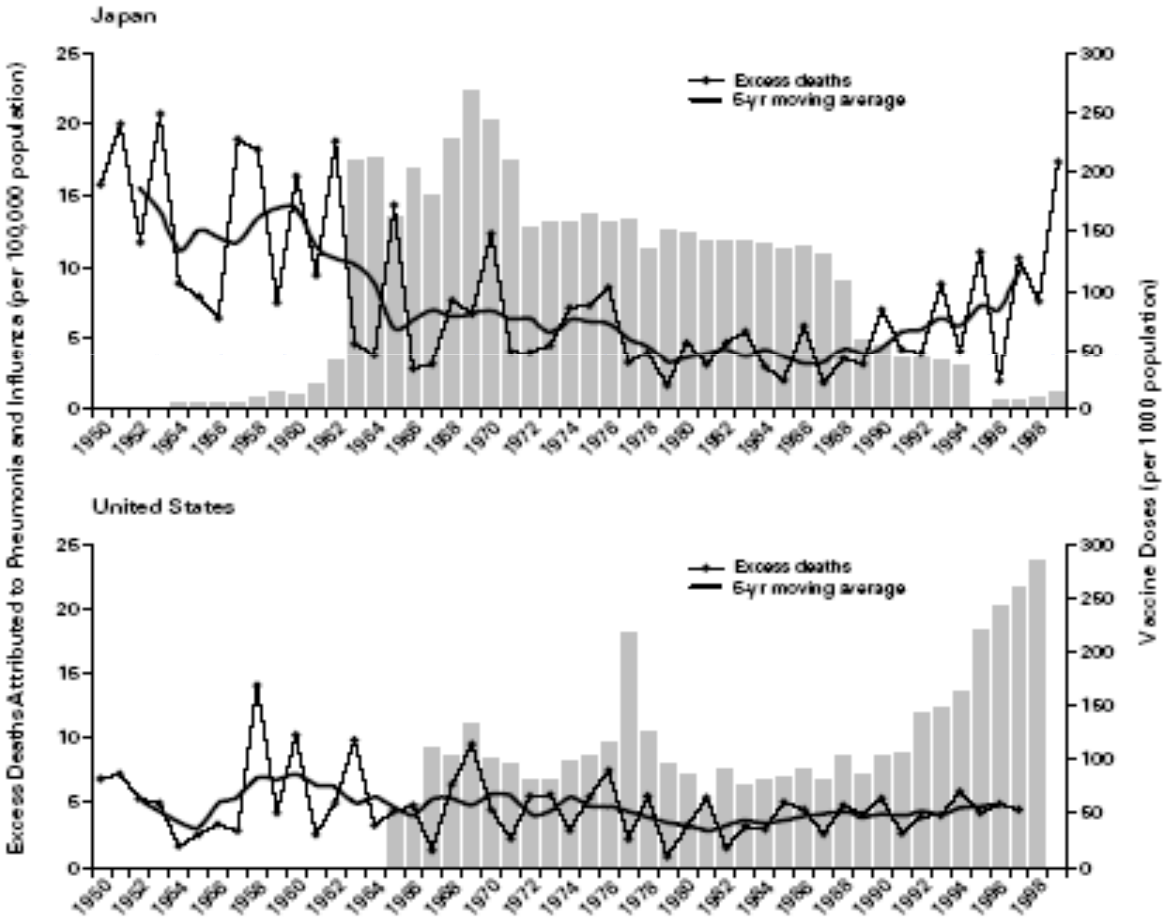


Figure 4. Excess Deaths Attributed to Pneumonia and Influenza over a 50-Year Period in Japan and the United States. The five-year moving average is also shown. The history of the rates of use of vaccine in each country is superimposed (shaded bars). Tick marks represent the beginning of the years indicated.

Efficacy of live attenuated influenza vaccines

Author	Vaccine target population	Population considered in the outcome	Results (ARR)
Rudenko, 1990-91	Children 7-14 years	Teachers	Reduction of illness rate
Clover, 1986-87	Children 3-18 years	Family contacts	5% (-87;51)
Piedra, 1998-2001	Children 18 months-18 years	General population	8-18% in adults ≥ 35
Piedra, 2003-2004	Children 5-18 years	General population	13% in 5-11 years old; 9% in 35-44 years old
King, 2005	Children > 5 years	Adult households	10.8%

Problems in efficacy studies

- ✓ Outcome case definition
  - Culture confirmed
  - ILI
  - Deaths
  - …
- ✓ Vaccination status of contacts
- ✓ Selection bias/randomization
- ✓ Sample size
- ✓ Vaccine match with circulating virus
- ✓ Most studies conducted in a single season

Conclusions/1

- ✓ Herd immunity may play a central role in controlling influenza in certain conditions
- ✓ There is still uncertainty on the effect of immunization of children in inducing herd immunity in other age groups although the available evidence is suggestive
- ✓ Universal vaccination of children may be hardly justified if the aim is only to protect the elderly
- ✓ Immunization of the elderly (and risk groups) and of households remains central

Conclusions/2

- ✓ Optimal immunization strategy is country-specific
- ✓ Data should be continuously monitored and analyzed to fit the best predictions and implement the most efficacious immunization strategy
- ✓ We need to perform more (large) experimental studies to definitely demonstrate and measure the induction of herd immunity from universal immunization of children

Can universal immunization of children induce herd immunity ?

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