MINISTERIO DE SANIDAD Y CONSUMO

Instituto de Salud Carlos III

VACCINATION AND DISEASE CONTROL

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Episouth 4Th June 2008

Outline

- Introduction
- Impact of vaccination programmes.
  - Pre implementation
    - Burden of disease
    - Decision about introduction
    - Strategy
  - Post implementation
    - Impact assesment
    - Vaccine efficacy
    - Quality indicators

Vaccination objectives

Containment

Risk group vaccination
To reduce mortality and severity

Elimination

Absence of indigenous transmission
If infection is introduced, transmission will not be sustained.
Mass vaccination programme
Vaccination cannot be stopped

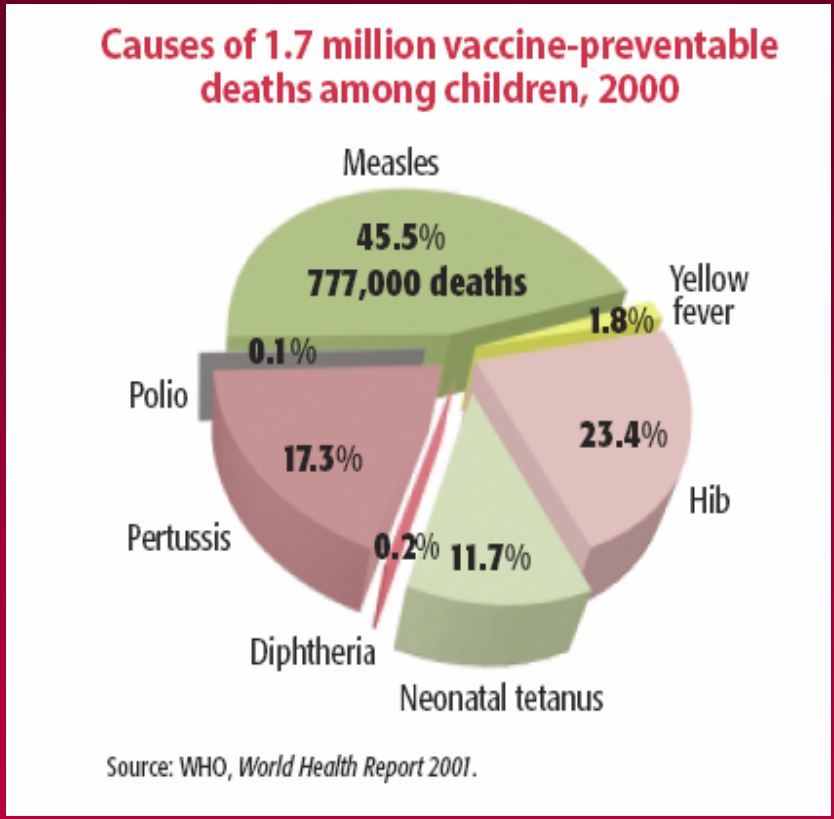
Eradication

Disease and its causal agent have been removed
Wordlwide strategy
Mass vaccination programme
Stop vaccination

Eradication / elimination

- No animal reservoir
- The virus cannot survive in the environment for a long time
- Diagnosis techniques are availble to detect infection
- An effective, inexpensive vaccine exists
- Immunity is life-long with natural and vaccine infection
- Eliminable diseases: polio, measles, rubella

Mortality attributed to VPV



Measles mortality vaccination impact

Regions	2000	2006	% change
AFR	396,000	36,000	**91%**
GLOBAL	757,000	242,000	**68%**

Source: WHO/UNICEF coverage estimates 1980-2006, August 2007

Vaccination impact

Vaccination programmes change the VPD epidemiology. This change depends on:

- the vaccine action
- the coverage reached
- presence of a non human host
- causal agent characteristics

PRE IMPLEMENTATION STEPS

A. Inform about vaccine development

B. Estimate burden

C. Decide about introduction

D. Decide strategy

B. Estimated burden VPD in Spain

- Mandatory notification of diseases and outbreaks (RENAVE).
  - Weekly total number of cases
  - Annual reporting of individualized data
  - Urgent outbreak notification and investigation
- Special Surveillance systems.
  - AFP surveillance
  - Measles
  - Rubella
- Special registries:

  Neonatal Tetanus and Congenital Rubella Syndrome (CRS)
- Sentinel physician reporting: Flu, varicella.
- Serological studies: expensives.
- Other sources
  - Hospital registries, Mortality registries
  - Special morbidity studies

C. Decide about introduction

1. Is the disease a Public health issue?
2. Vaccine is safe and effective?
3. What is the effect of this new vaccine on the vaccination schedule?
4. What will be the cost-effectiveness?

   Peña-Rey I et al. Estudio coste-efectividad de la vacunación contra la varicela en adolescentes en España. Gaceta Sanitaria 2004;18(4):287-294

5. Other aspects to be taken into consideration.

http://www.msc.es/ciudadanos/proteccionSalud/vacunaciones/docs/criteriosVacunas.pd

D. Decide immunisation strategy

- Selective immunisation
  - Individuals at risk of exposure
  - Individuals at increase risk from consequences of infections
  - Individuals at increased risk of exposing others (heath care workers)
- Mass immunisation
  - individual protection, herd immunity.

Infectious Disease dynamics

BASIC REPRODUTION NUMBER Ro

Number of secondary cases generated by one primary case, in a completely susceptible population

Ro = CxBxD

EFFECTIVE REPRODUCTION RATIO Re

Number of secondary cases generated from a primary case, in a population with immunes and susceptible people

Re = RoX

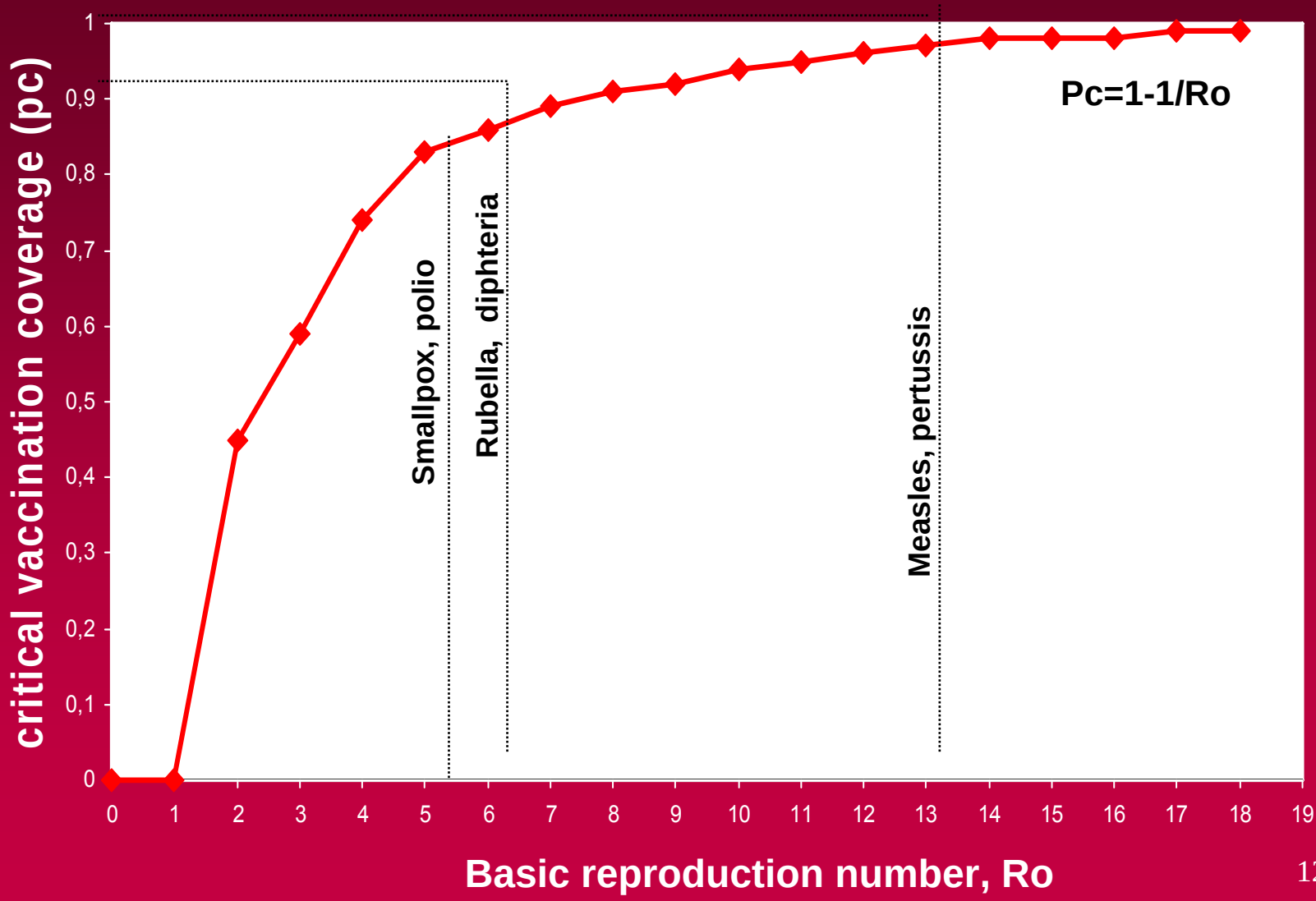
R= Ro (1-p) p >1-1/Ro elimination

pc = 1- 1/Ro Critical vaccination coverage: Herd immunity threshold

Proportion of population that needs to be immunized by vaccination in order to eliminate the infectious agent

R >1 Epidemic risk
R<1 Elimination

Critical vaccination coverage (Pc) and Ro



Vaccination programme history in Spain

Year	Schedule vaccine	New incorporations
1963	OPV (3)	IPV (2004)
1965	DPT (3) +OPV (3)+ Measles	DPaT
1979	Rubella	
1981	DPT (3) + VPO (3) + MMR (1)	MMR
1996	DPT (3) + OPV (3) + MMR (2) + Hep B (3)	HVB
1998	DPT (3)+OPV (3)+MMR (2)+HVB (3)+Hib (3)	*H. influenzae* type b
2000	DPT (3)+OPV (3)+MMR (2)+HVB (3)+Hib (3)+Men C (3)	Meningitis menigocócica C
2004	Varicella	

POST IMPLEMENTATION
Programme evaluation

A. Impact assesment: Direct and indirect effects

- Incidence
- Age distribution patterns
- Severity
- Causal agents variability
- Trends

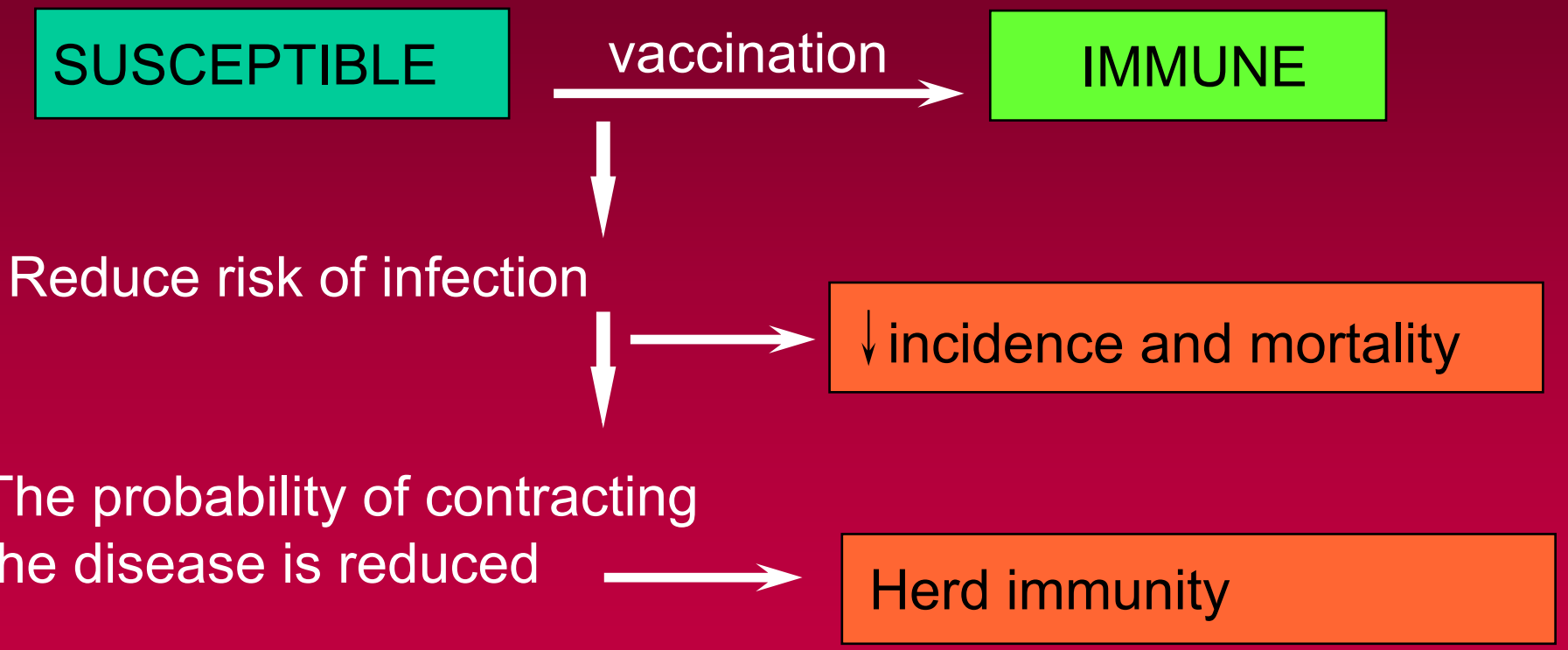
} Time series
Burden of disease
Mathematical models

B. Vaccine efficacy assessment:

- Vaccine coverage surveillance
- Studies on vaccine efficacy (outbreak investigation; surveillance data: screening method)

C. Surveillance system quality assesment: quality indicators

General effects of routine vaccination
Direct effects



A. Vaccination programme impact morbidity. Spain

Year of Highest incidence				Year 2007		
Disease		Cases	Rate/100.000	Cases	Rate/100.000	Change percent
Pertussis	1985	60564	157,41	548	1,28	-99,10
Tetanus	1983	90	0,24	11	0,06	-87,78
Diphteria	1940	27517	992,2	0	0	-100,00
Poliomyelitis	1959	2132	70,04	0	0	-100,00
Measles	1983	301319	781,2	266	0,59	-99,91
Rubella	1983	161772	423,9	69	0,27	-99,96
Mumps	1984	286887	748,51	10343	22,88	-96,39

Source: Nacional Centre for Epidemiology

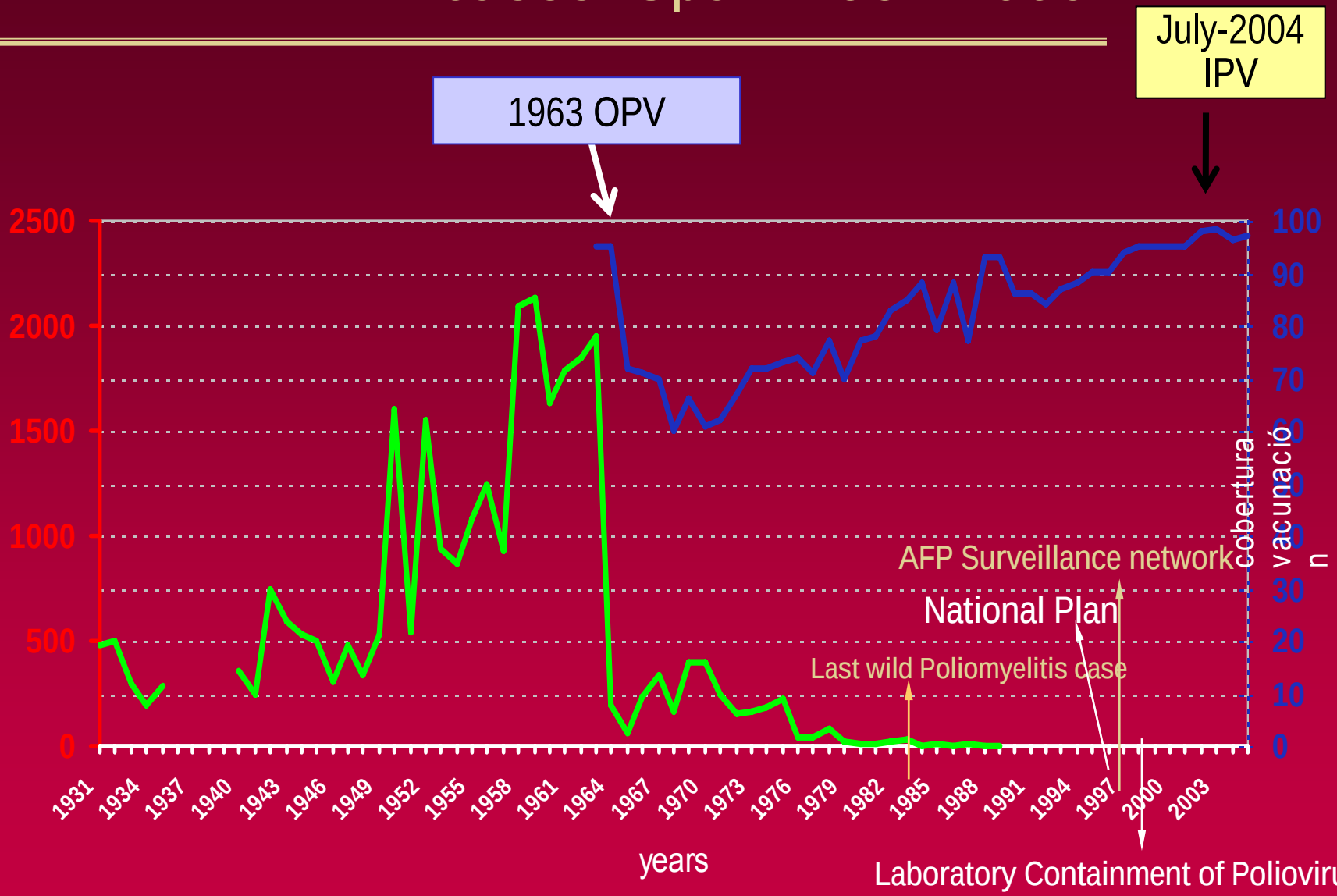
A. Vaccination programme impact mortality. Spain

Disease	Prevac year	Prevac mortality		mortality 2005	
		total	<15 years	total	<15 years
Pertussis	1960	133	133	1	1
Tetanus	1960	419	217	4	0
Diphteria	1960	139	136	0	0
Poliomyelitis	1960	208	196	0	0
Measles	1975-80	39	36	0	0
Rubella	1975-80	11	6	0	0
Mumps	1975-80	2	1	1	0

Tetanus mortality: in the elderly people, > 65 years old

Source: Nacional Centre for Epidemiology

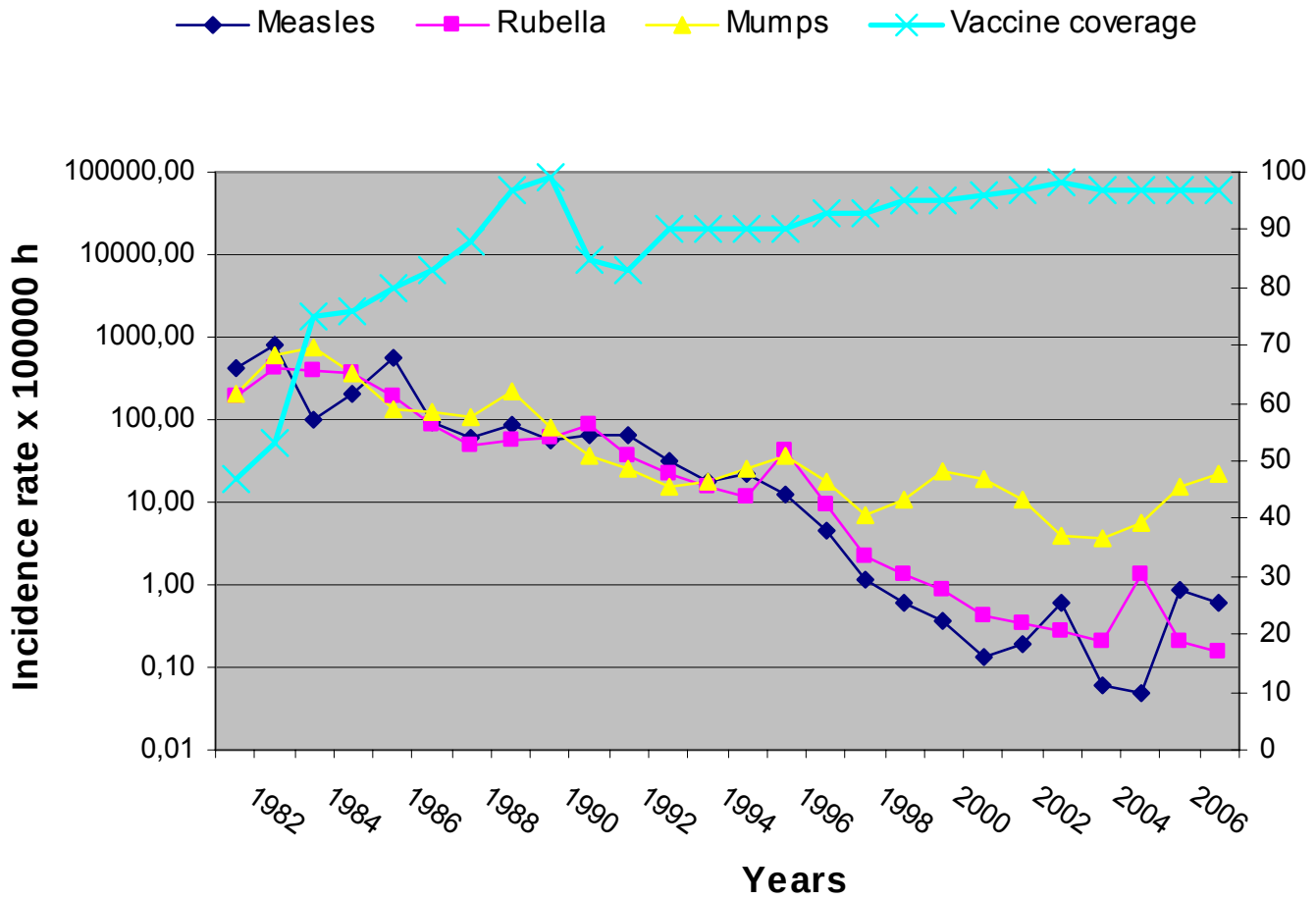
A. Direct effects: Immunization coverage & polio cases. Spain 1931-2005.



Source: Nacional Centre for Epidemiology

Directs effects:

Measles, rubella and mumps. Incidence and coverage. Spain 1982-2007



Source: National Centre for Epidemiology

http://www.isciii.es/htdocs/centros/epidemiologia/boletin_semanal/bes0719.pdf

Direct effects: Smallpox

- 1796 Jenner discovers vaccine.
- 1864: manufacturing and vaccination.
- 1958 WHO Eradication plan
- 1967: 10-15 million → mass vaccination campaign.

- Ring vaccination, isolation and contact follow-up. It was stopped transmission and the disease has been eradicated.
- Vaccinated people can trasnmit disease.
  - 1977: last case in Somalia.
  - 1978: Fatal case in a laboratory in United Kingdon.
  - 1979: WHO → Smallpox eradication Certificate
  - 1980: WHA decided STOP VACCINATION

Transmission of virus vaccinia

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May 4, 2007 / 56(17);417-419

Vulvar Vaccinia Infection After Sexual Contact with a Military Smallpox Vaccinee --- Alaska, 2006

On October 10, 2006, an otherwise healthy woman visited a public health clinic in Alaska after vaginal tears that she had first experienced 10 days before became increasingly painful. The patient reported having a new male sex partner during September 22--October 1, 2006. A viral swab specimen from a labial lesion of the woman was submitted to the Alaska State Virology Laboratory (ASVL) for viral culture. The viral isolate could not be identified initially and subsequently was sent to CDC on January 9, 2007, where the isolate was identified as a vaccine-strain vaccinia virus. After vaccinia was identified, investigators interviewed the woman more closely and learned that her new sex partner was a male U.S. military service member stationed at a local military base. Further investigation determined that the service member had been vaccinated for smallpox 3 days before beginning his relationship with the woman. This report describes the clinical evaluation of the woman

Indirect effects
General effects of routine vaccination

a) Lengthening of epidemic cycle

b) The population infected is older

c) Disease and complications are more severe

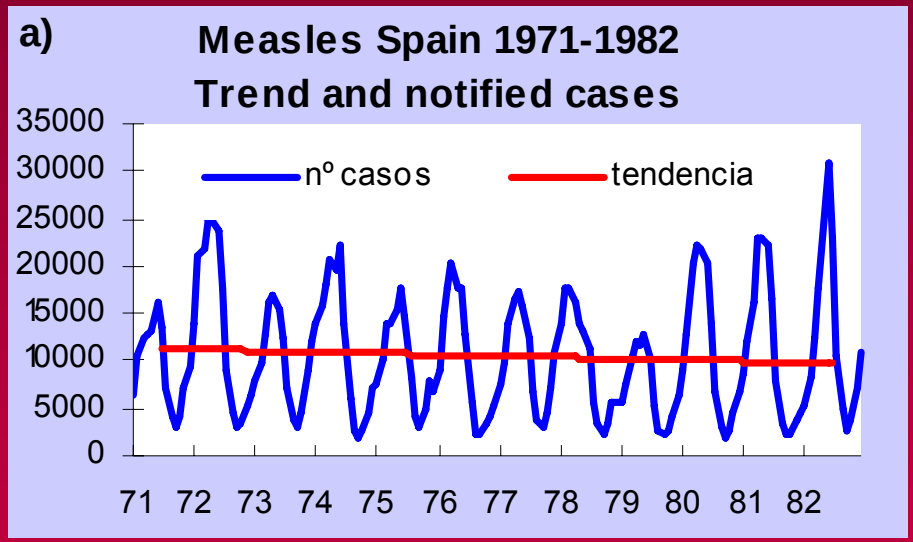
d) Seasonal pattern changes

e) Stops Transmission: no cases

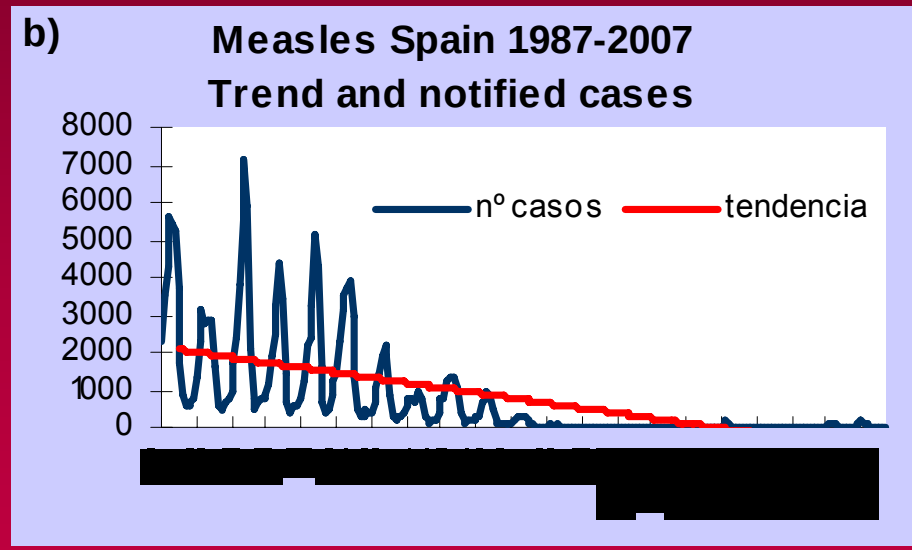
Indirects effects

a) Lengthening of epidemic cycle

pre-vaccine, 1971-1982



post-vaccine, 1987-2007

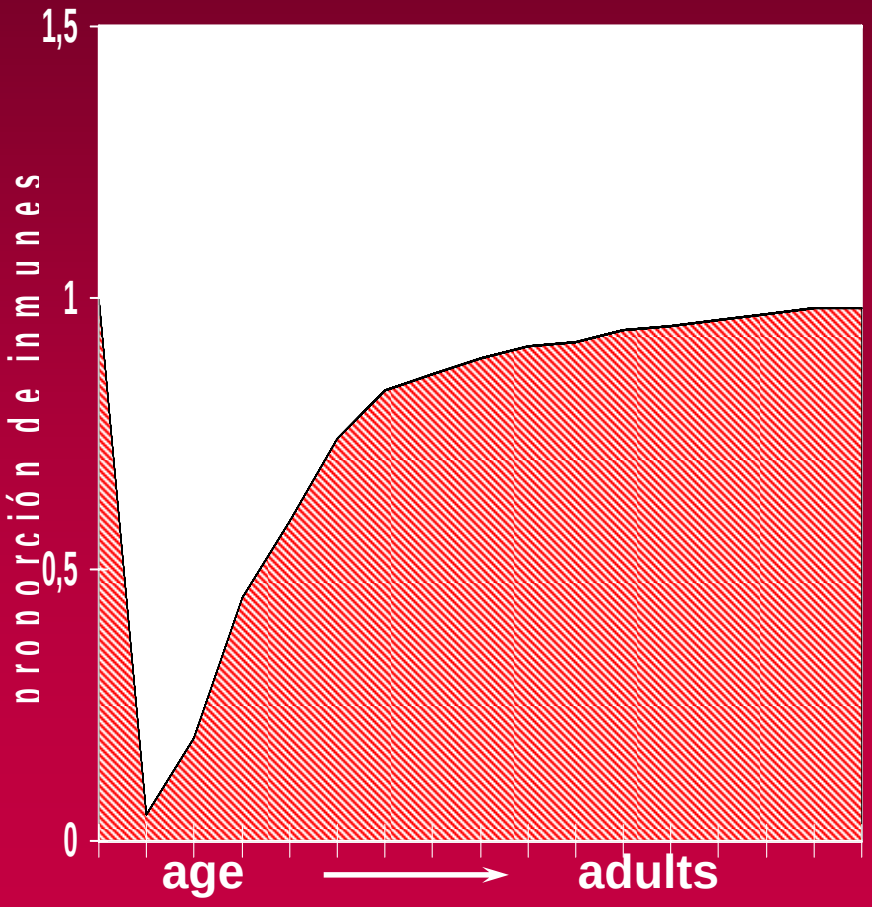


Peña-Rey I et al. Epidemiología del sarampión en España. 5º Monografía de la Sociedad Española de Epidemiología.

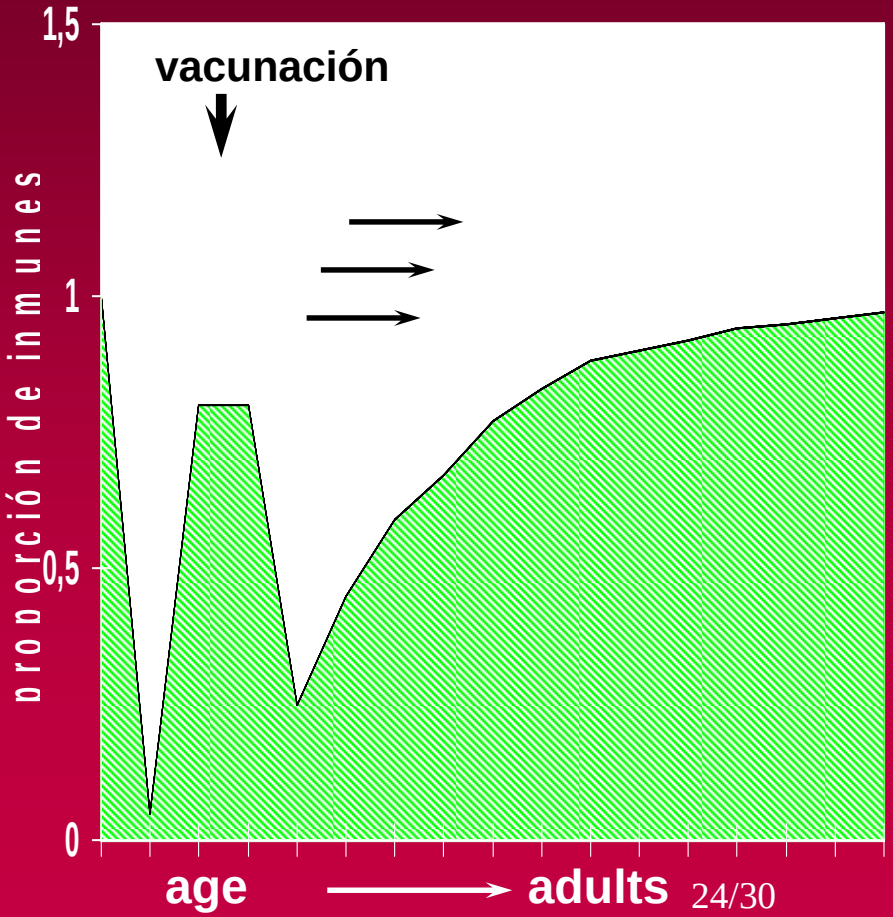
Indirects effects

b) Increasing susceptibles in older age groups

before vaccination

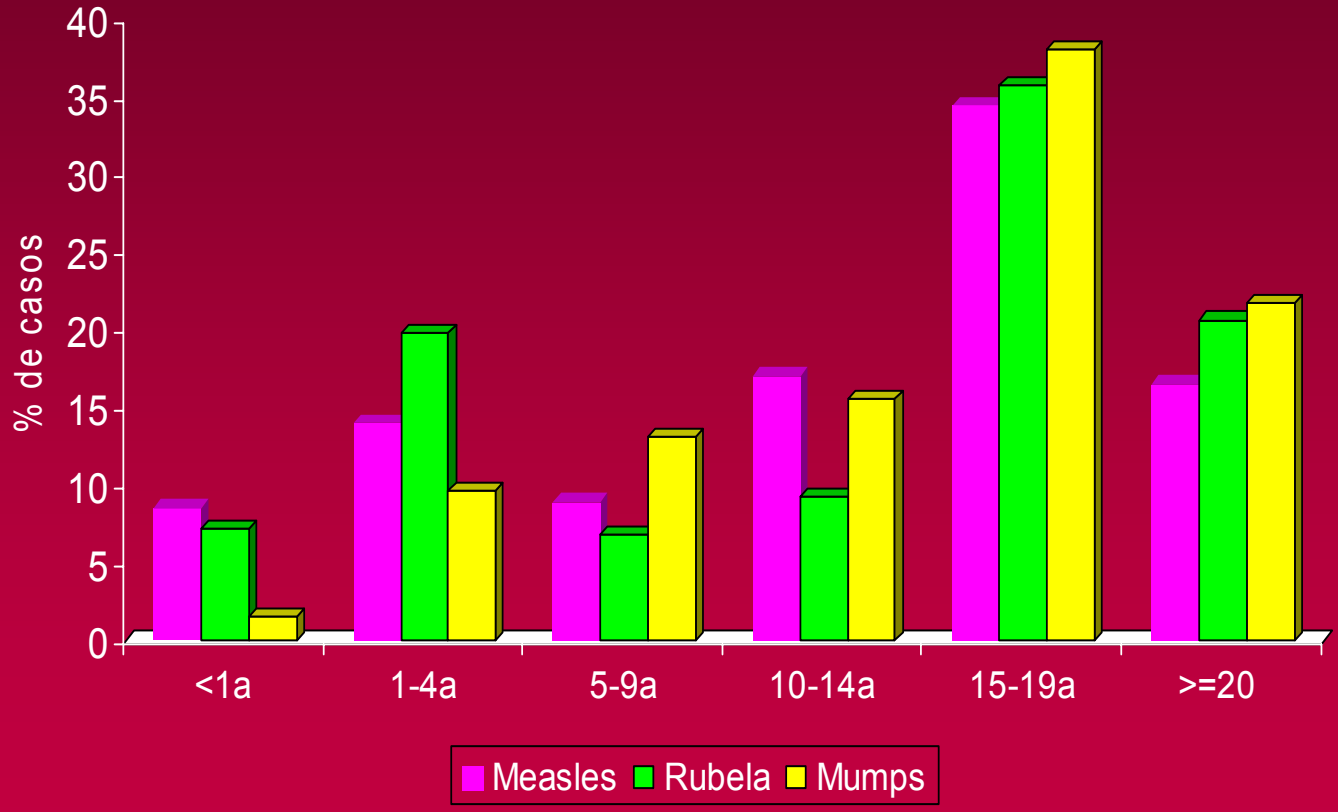


after vaccination



Indirects effects

b) Increasing susceptibles in older age groups

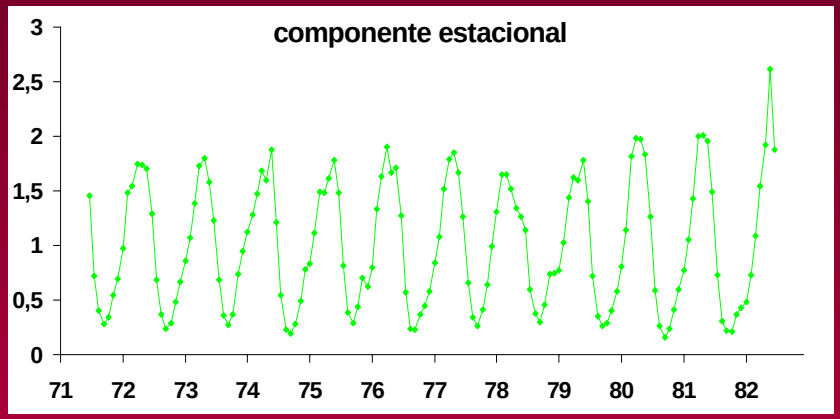


Source: Nacional Centre for Epidemiology

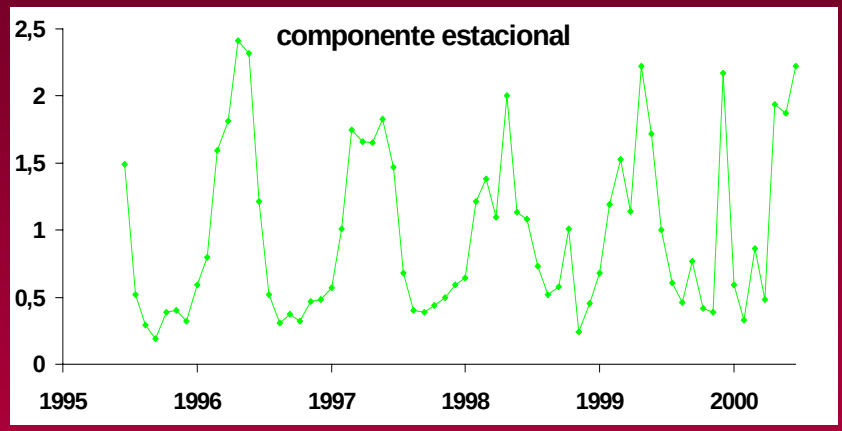
Indirects effects

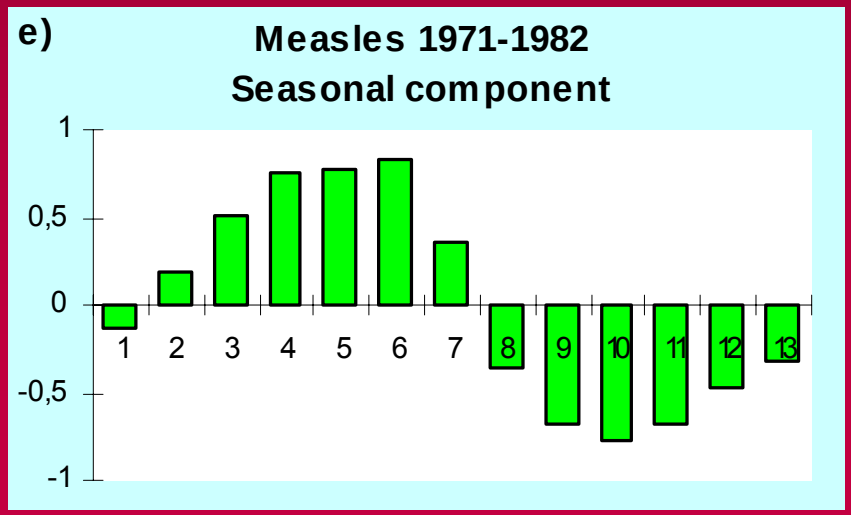
d) Seasonal pattern changes

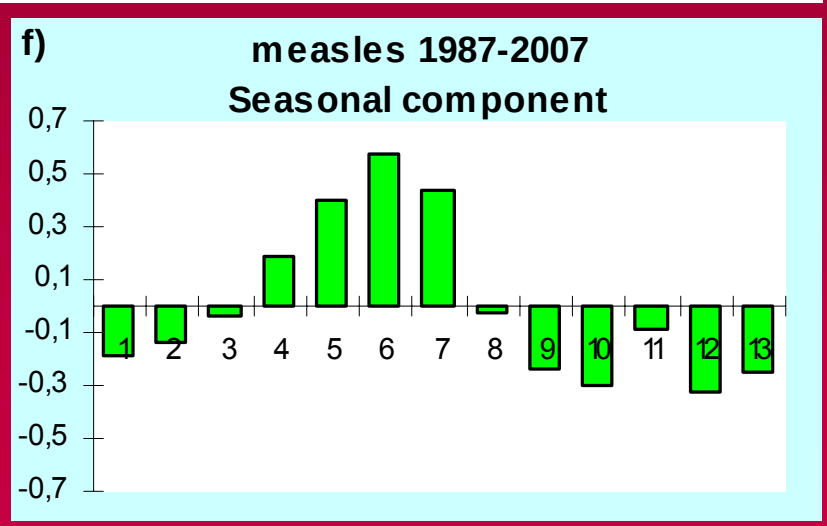
Prevac period, 1971-1982



Pos-vac period, 1982-2007







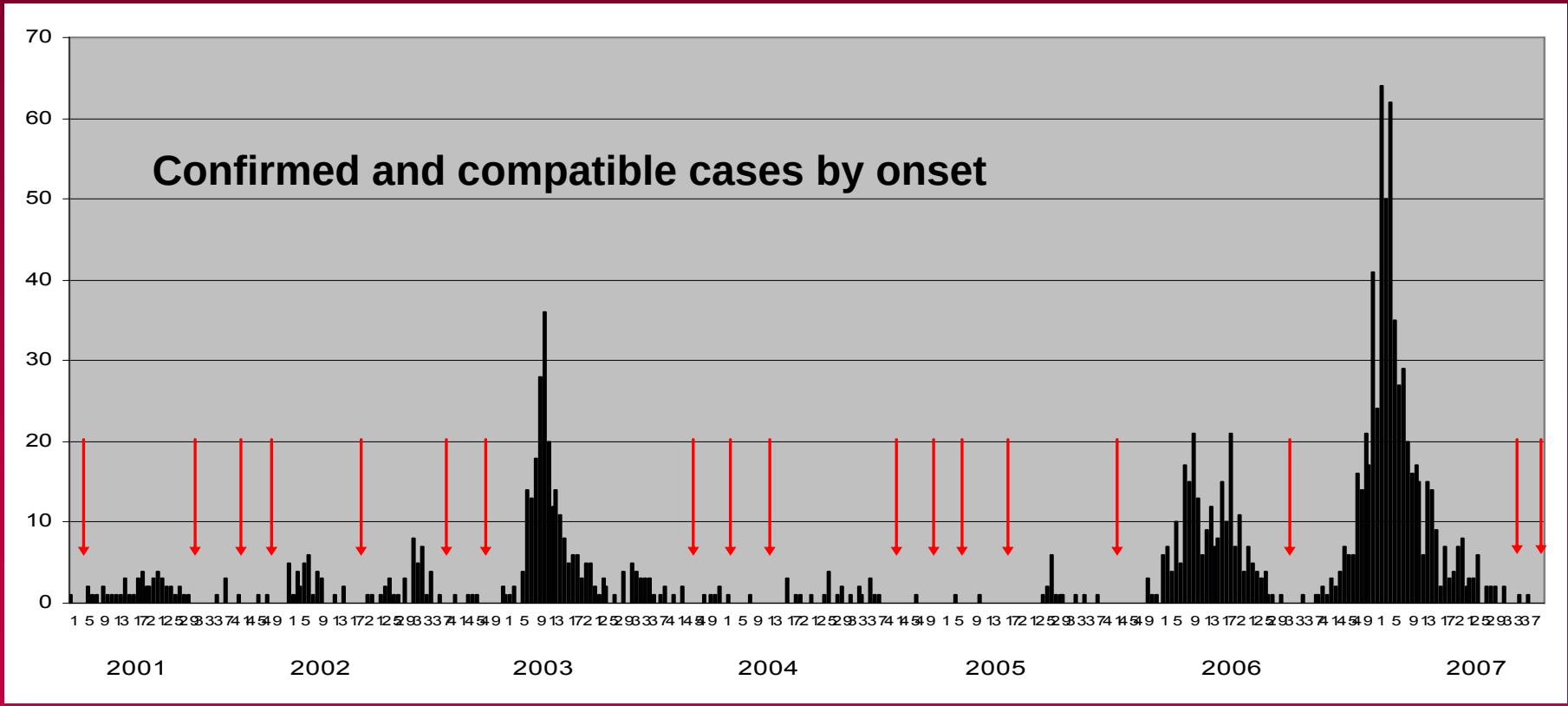
Peña-Rey I et al. Epidemiología del sarampión en España. 5º Monografía de la Sociedad Española de Epidemiología.

Indirects effects

Diapositiva 14

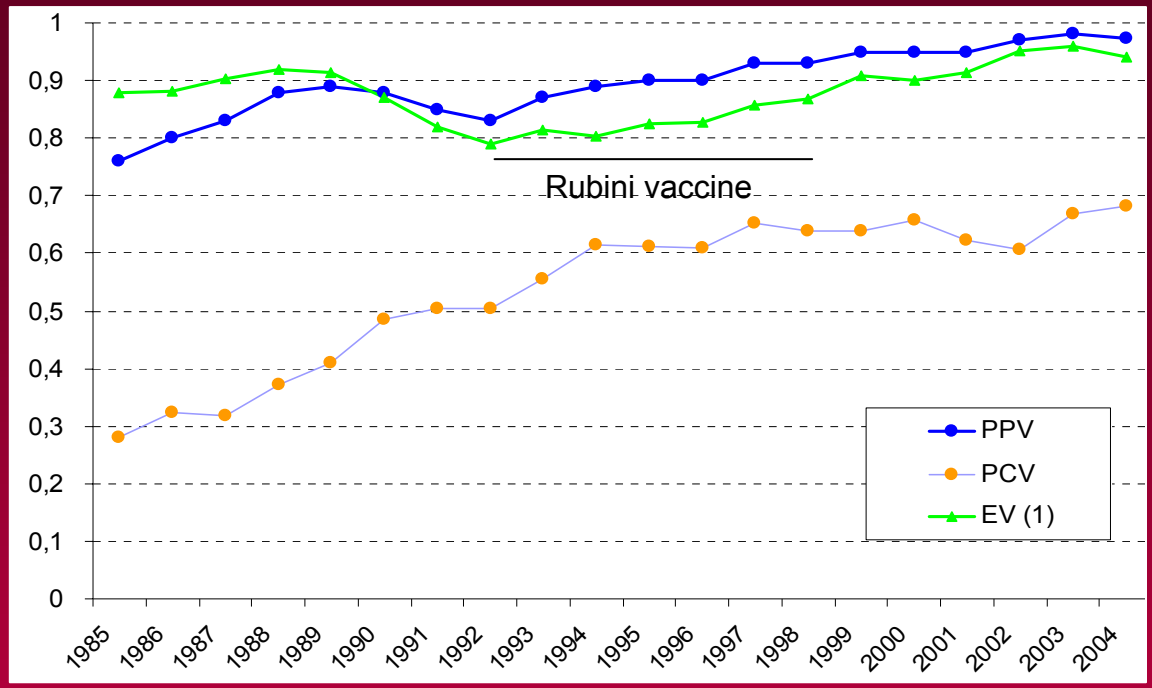
e) Stop transmission

Indigenous measles eliminated. Spain 2001-2007



Peña-Rey et al. Plan nacional de eliminación del sarampión. España. Año 2007. Bol Epidemiol Sem, 2008(16)

B. Screening method to estimate effectiveness of mumps vaccine by vaccination cohort. Spain 2005-2007



Screening method*: surveillance data

Farrington:

EV= 1-(pcv*(1-ppv)/(1-pcv)*ppv))

PCV = Proportion of vaccinated cases

PPV = Proporción of vaccinated population

Grupo edad	PPV	PCV	EV	I.C. 95%	
0-15m	-	-	-	-	-
16m-4a	0,97	0,64	0,947	0,92	0,97
5-9a	0,94	0,67	0,866	0,75	0,93
10-14a	0,89	0,76	**0,596**	0,31	0,76
15-19a	0,84	0,67	**0,598**	0,35	0,75
20-24a	0,61	0,33	**0,685**	0,49	0,80

Source: MV Martínez de Aragón. National Centre for Epidemiology. Not published data

C. Quality indicators for elimination

»For WHO European region

The number of countries with a measles incidence of <1/1000000

The number of countries with a rubella incidence of <1/1000000

The number of countries with a CRS incidence of <1/100000 live births

The number of countries with MCV1 coverage of >95% at national level and >90% in all districts

»For one country:

Quality indicators of Surveillance. Spain 2002-2007

	2002	2003	2004	2005	2006	2007
Percentage of sites reporting weekly ≥ 80%	84%	84%	79%	74%	89%	58%
Percentage of cases with adequate specimens and laboratory results ≥ 80%	91%	98%	97%	97%	88%	84%
Percentage of cases with laboratory results within 7 days of detection ≥ 80%	30%	91%	89%	86%	70%	70%
% outbreaks investigated	100%	100%	100%	100%	100%	100%

...

In Conclusion…

- Major impact on infectious disease control
- Elimination/eradication of diseases does not require complete vaccination coverage
- High coverage modifies infectious diseases epidemiology: increases epidemic periods
  increases age at infection
- Programmes evaluation

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