

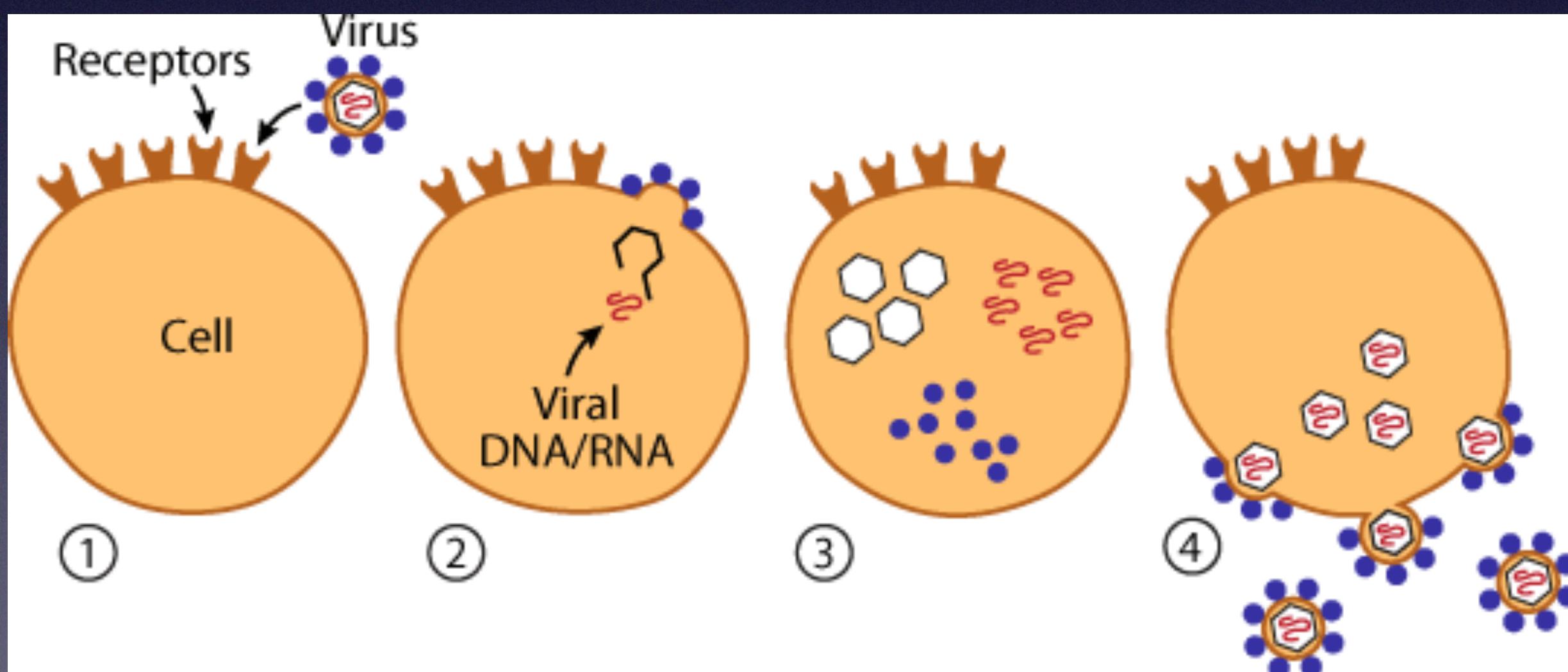
# Vaccines

# Vaccine Topics

- How can we develop vaccines ethically?
- Do we have a moral responsibility to get vaccinated?
- Is it morally permissible, or even morally obligatory, for states and institutions to mandate vaccines?

# What is a Virus?

- A virus is an infectious particle with a protein coat or “envelope” containing genetic material
- Viruses cannot replicate independently and must infect a host cell to survive

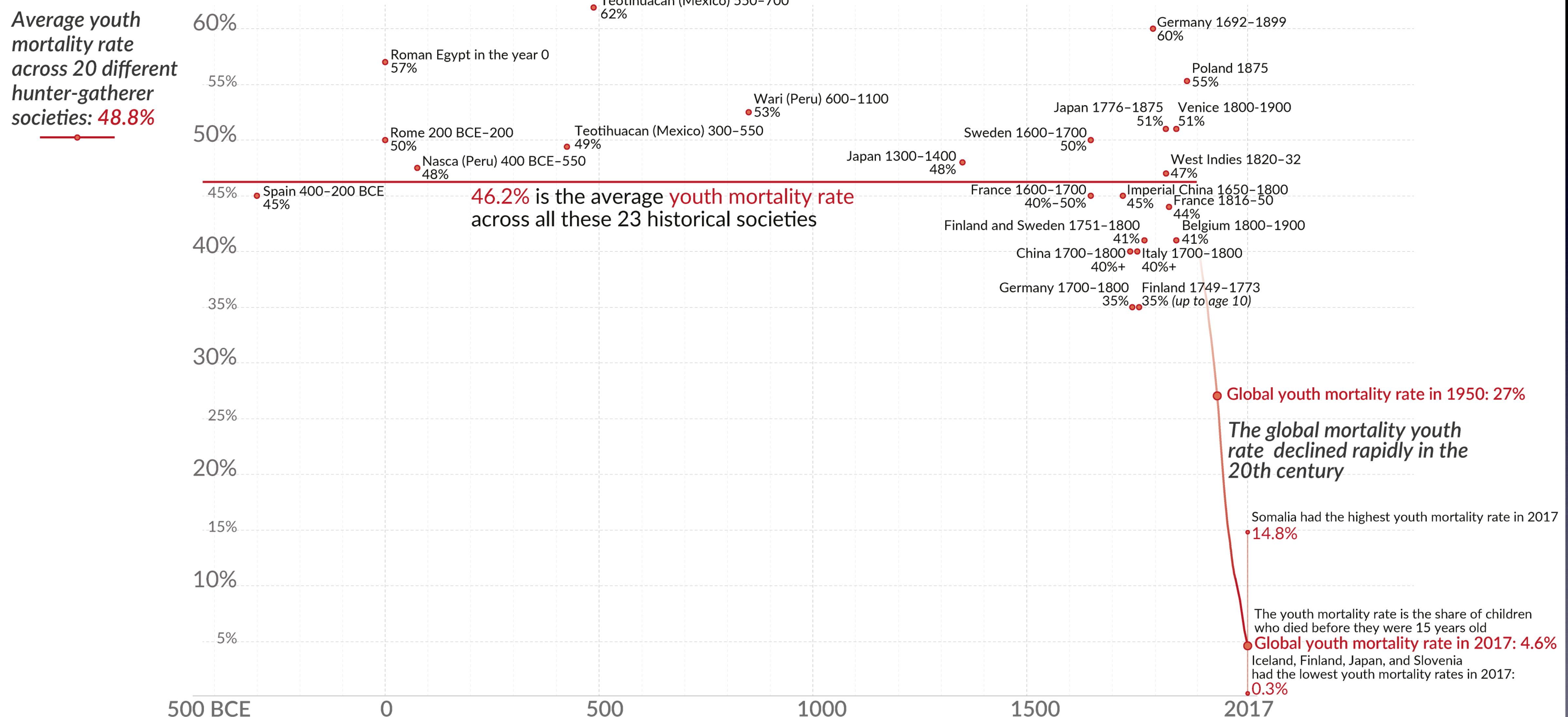


# How does the immune system work?

- PBS & Crash Course on Vaccines

# Youth mortality over the last 2400 years

Shown is the share who died as infants or children before reaching the end of puberty (younger than 15)



Data sources: the mortality estimates for historical societies are from a large number of independent studies collected in Volk and Atkinson (2013) – *Infant and child death in the human environment of evolutionary adaptation*.

Data for 2017 is from the United Nations Inter-agency group for child mortality estimation [IGME]. Global estimates for the 20th century are based on under five mortality from Our World in Data.

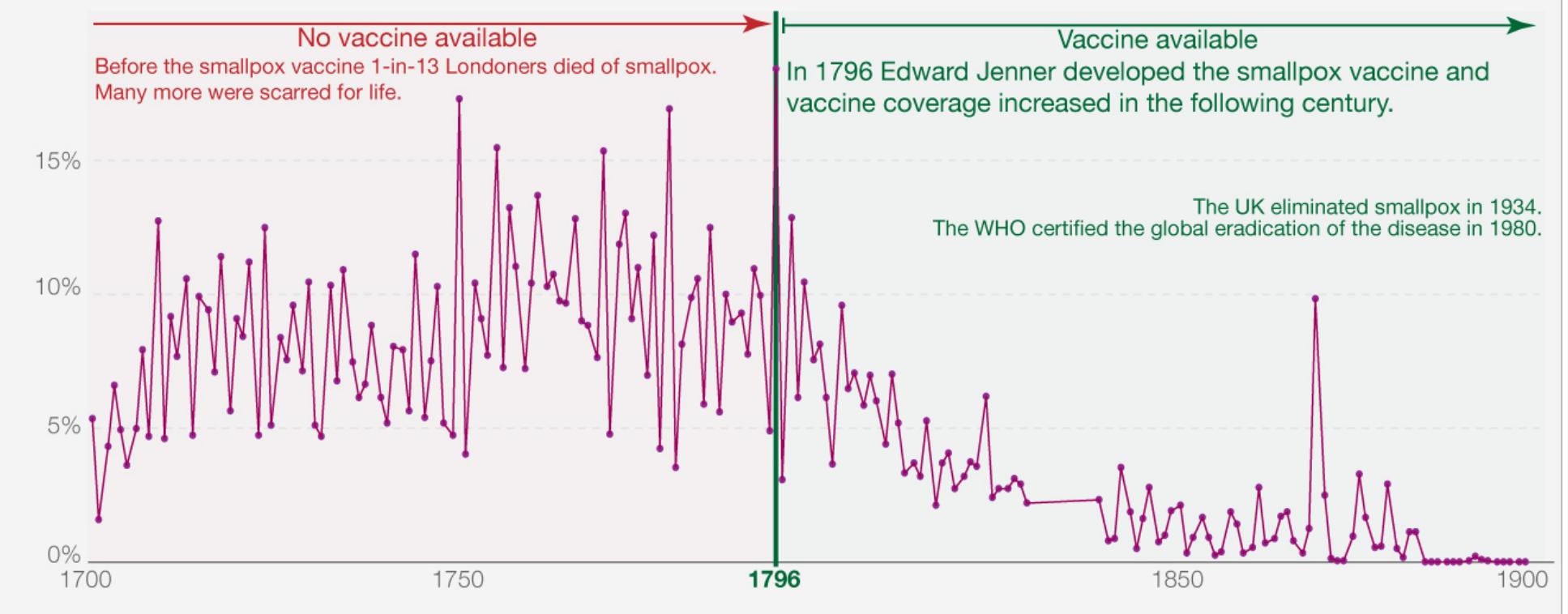
This is a visualization from [OurWorldInData.org](http://OurWorldInData.org), the online publication for research and data to make progress against the world's largest problems

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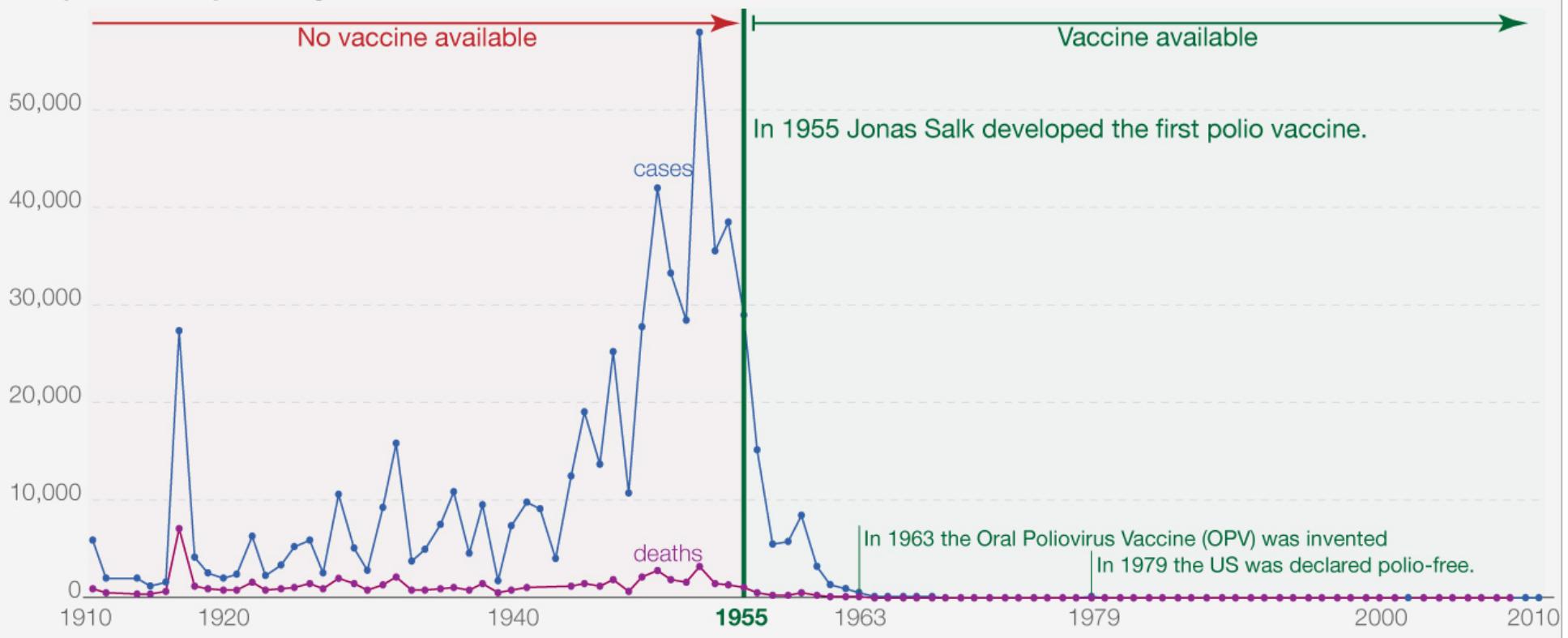
# Infectious diseases before and after a vaccine became available

Our World  
in Data

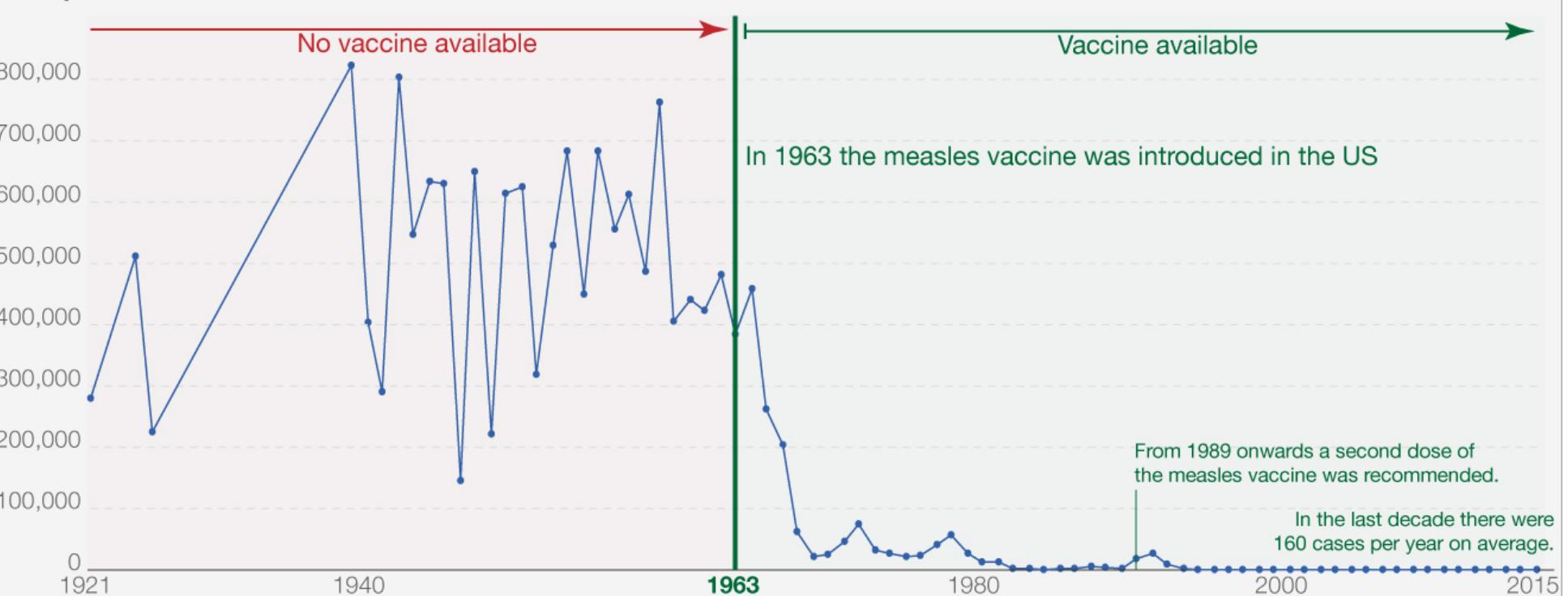
## Deaths caused by smallpox as a share of all deaths in London



## Reported paralytic polio cases and deaths in the United States



## Reported cases of measles in the United States



Data sources: Smallpox: Our World in Data based on Guy (1882) and several publications of the Registrar General between 1886 and 1903

Polio: Our World in Data based on US Public Health Service (1910-1951) and US Center for Disease Control (1960-2010)

Measles: Our World in Data based on several publications from the Public Health Reports, the US Public Health Service's Morbidity and Mortality Weekly Report Annual Supplements, and the US Census's Annual Statistical Abstracts

OurWorldinData.org – Research and data to make progress against the world's largest problems.

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# Vaccine Development

- Edward Jenner in 1796 started giving people cowpox intentionally. He gave cowpox to eight-year-old James Phipps, the son of his gardener. He then exposed little James to smallpox several times. But James never caught it. Thanks to cowpox, James was immune.





# Human Challenge Trials



# Polio & The Cutter Incident

- Polio (poliomyelitis) mainly affects children under 5 years of age.
- 1 in 200 infections leads to irreversible paralysis.
- Among those paralyzed, 5% to 10% die when their breathing muscles become immobilized.





# How do Vaccines Work?

<https://youtu.be/GuYsVg20fwM>

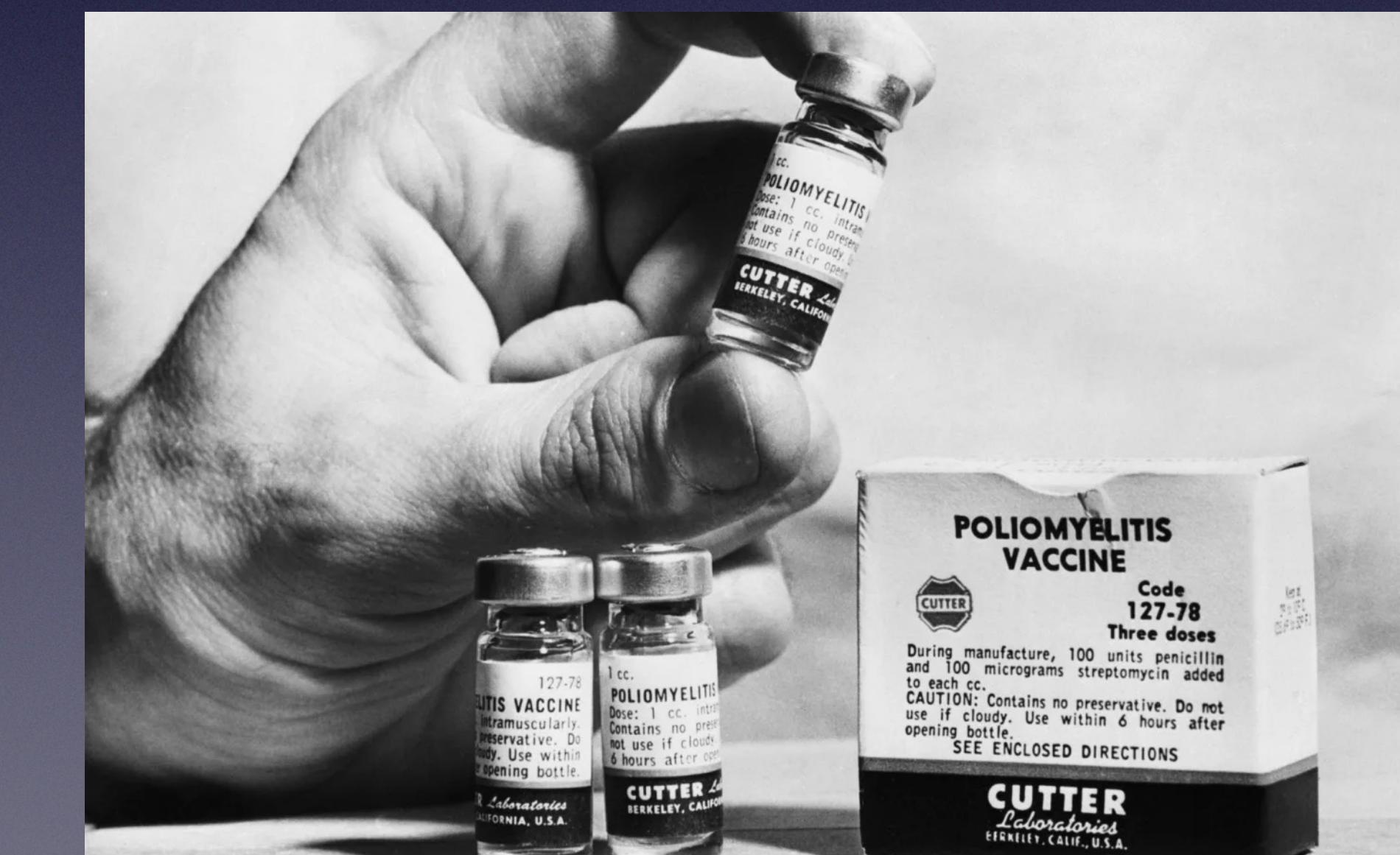
# Six Youngsters Stricken After Receiving Shots

Government Orders

Cutter Product Halted

By United Press

WASHINGTON, April 27.—



# Cutter Incident

- Six pharmaceutical companies were licensed in 1955 to produce the Salk vaccine.
- The virus in the Salk vaccine was killed by exposure to formaldehyde. But on April 24, 1955, just weeks after the first children were vaccinated, a doctor in Pocatello, Idaho, reported that a 7-year-old patient named Susan Pierce was suffering from fever and paralysis in her left arm, the same arm that was injected with the Salk vaccine. Three days later, little Susan was dead.
- After hundreds more cases of vaccine-related infections were reported nationwide, the surgeon general halted all vaccinations on May 8, 1955 until a cause could be determined. An emergency investigation traced all of the infections to one batch of Salk vaccine manufactured by Cutter Laboratories in California. Proteins in the vaccine had clumped together, preventing the formaldehyde from fully killing the virus.
- Two hundred sixty people contracted polio directly or indirectly from Cutter's vaccine and 11 people died.
- After manufacturing guidelines were tightened, vaccines resumed. By 1961, the total number of polio cases nationwide had declined by 97 percent below the pre-vaccine years. Six years following the introduction of the Salk vaccine, polio was almost eradicated as a major public health problem in the United States.

# The Vaccine Life Cycle

safety at every phase

## GUIDE

### ACIP

ADVISORY  
COMMITTEE ON  
IMMUNIZATION  
PRACTICES

### BLA

BIOLOGICS LICENSE  
APPLICATION

### CDC

CENTERS FOR  
DISEASE CONTROL  
AND PREVENTION

### FDA

FOOD AND DRUG  
ADMINISTRATION

### IND

INVESTIGATIONAL  
NEW DRUG  
APPLICATION

**safety**  
is a priority  
during vaccine  
development  
+ approval

BASIC  
RESEARCH

DISCOVERY  
PRE-  
CLINICAL  
STUDIES

IND SUBMITTED

CLINICAL STUDIES / TRIALS

PHASE 1  
safety

PHASE 2  
effectiveness

PHASE 3  
safety +  
effectiveness

BLA SUBMITTED

FDA  
REVIEW

FDA APPROVAL OF 1 NEW VACCINE

ACIP  
REVIEW

ACIP RECOMMENDATION

PHASE 4  
safety monitoring for  
serious, unexpected  
adverse events

POST-APPROVAL  
MONITORING +  
RESEARCH

**safety**  
continues with  
CDC + FDA  
safety  
monitoring

# COVID-19 vaccine development timeline



## Typical vaccine development timeline



**The F.D.A. tells Johnson & Johnson  
that about 60 million doses made at  
a troubled plant cannot be used.**



Preparing Johnson & Johnson coronavirus vaccine in Staten Island in April. Mary Altaffer/Associated Press



Is there an obligation to get vaccinated?

# Free Riders

- A free rider is someone who receives a benefit without contributing towards the cost of its production.
- The free rider problem is that the efficient production of important collective goods by free agents is jeopardized by the incentive each agent has not to pay for it:
  - if the supply of the good is inadequate, one's own action of paying will not make it adequate;
  - if the supply is adequate, one can receive it without paying.

# Climate Change Example

- “If all individuals refrained from doing A, every individual as a member of the community would derive a certain advantage. But now if all individuals less one continue refraining from doing A, the community loss is very slight, whereas the one individual doing A makes a personal gain far greater than the loss that he incurs as a member of the community.” (Pareto 1935, vol. 3, sect. 1496, pp. 946–7)
- A = emitting carbon pollution
- Other examples: voting, skipping the draft, non-compliance with Covid restrictions, etc.



# But what if everyone did it?

- We intuitively think that if a group should behave or refrain from behaving a certain way, then each member in the group should behave or refrain from behaving in a certain way. This is a fallacy.
- Fallacy of composition: The fact a whole,  $w$ , has a property  $F$ , does not entail that any part has that property  $P$ .
- The fact that it would be in the collective interest of some group to have a particular result, even counting the costs of providing the result, does not entail that it would be in the interest of each individual in the group to bear the individual costs of contributing to the group's collective provision.

# The Prisoner's Dilemma

		Your accomplice
		Keeps shtoom
You		Spills the beans
Keep shtoom	You both get 2 years	You get 5 years; he goes free
Spill the beans	He gets 5 years; you go free	You both get 4 years

# Vaccine Benefits

- If herd immunity is provided to anyone, it is de facto provided for everyone in the relevant area or group.
- If herd immunity is achieved, it is impossible to exclude anyone from benefitting from it.
- Not everyone needs to be vaccinated to achieve herd immunity.
- (This also applies to group compliance with Covid restrictions, the volunteering to test vaccines, etc. In each case, the benefits provided to the group are benefits provided to each member in the group and some members could free-ride without undermining those benefits.)

# Immorality of Free Riding

- There is an obligation of fairness to contribute towards the cost of producing a collective good. You might not have any interest in doing so. It might even harm you. But there's some sense of fairness that requires you share the burden of the cost. L.A. Hart's principle of "mutuality of restrictions" puts this as follows:
- "when a number of persons conduct any joint enterprise according to rules and thus restrict their liberty, those who have submitted to these restrictions when required have a right to a similar submission from those who have benefited by their submission." (Hart 1955, 185)
- If a group collectively sacrifices in a way that benefits members of the group, whether they wanted those benefits or not, the group has a right to each beneficiary sharing the burden. Consider those who do get vaccinated, those who volunteered for vaccine trials, etc.