

# Preparedness, research and response when epidemics and news go viral



Gagandeep Kang

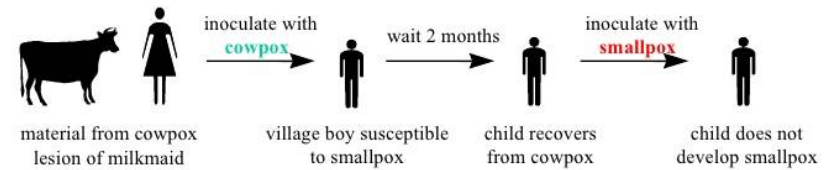


# We know the value of prevention



- In the 1700s, in Europe alone 400,000 people died every year of small pox

## Edward Jenner's experiment (1796)



By 1800, vaccines administered across Europe and North America

By 1900: smallpox eliminated from much of industrialized world

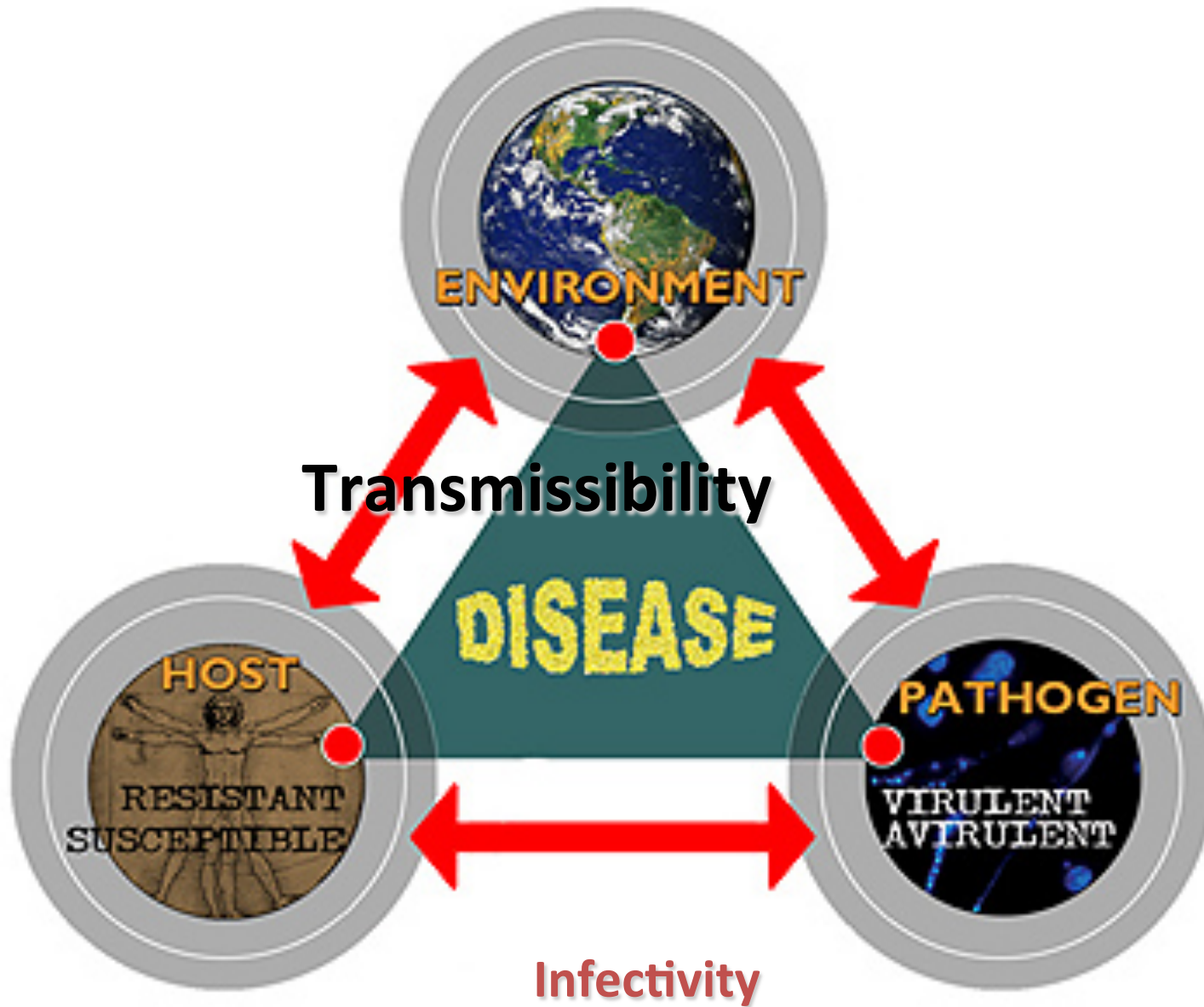
1950: Pan Am Health Org - eradication program throughout Americas

1959: Beginning of global smallpox eradication program

1975: Rahima Banu, one of the last people naturally infected by smallpox

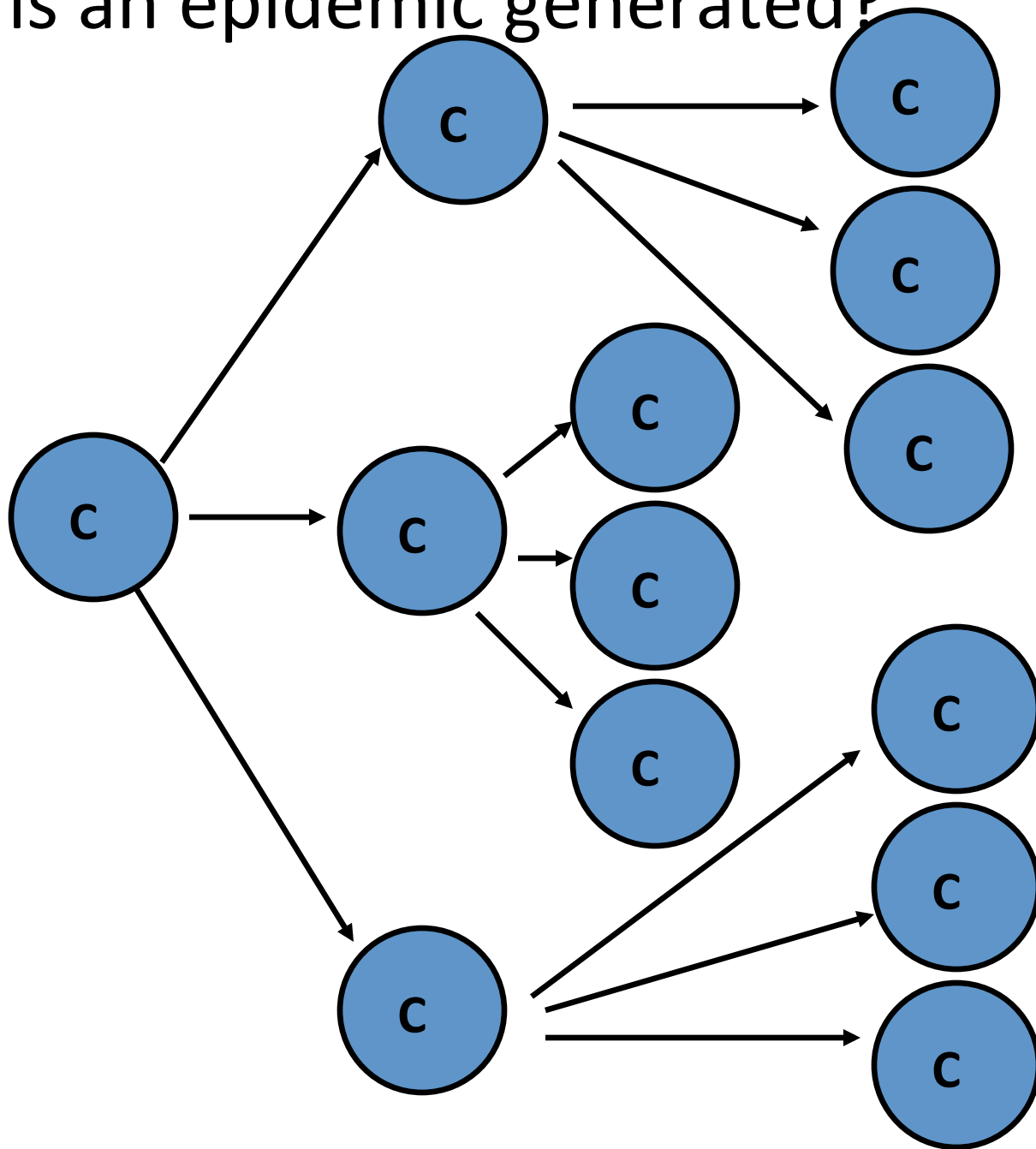


12/9/1979: WHO declared smallpox eradicated



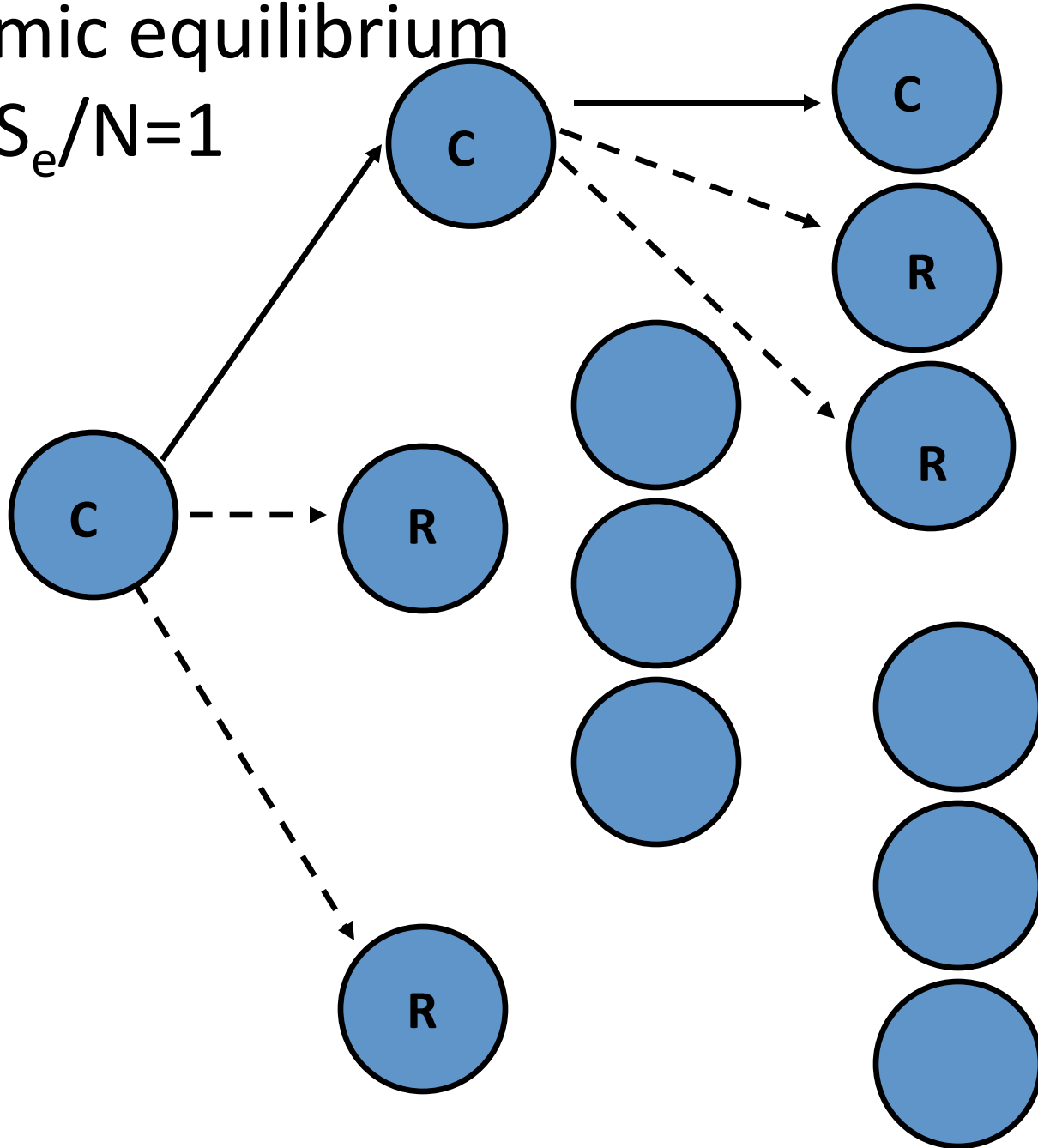
# How is an epidemic generated?

$R_0=3$



Endemic equilibrium

$$R_0 \times S_e / N = 1$$

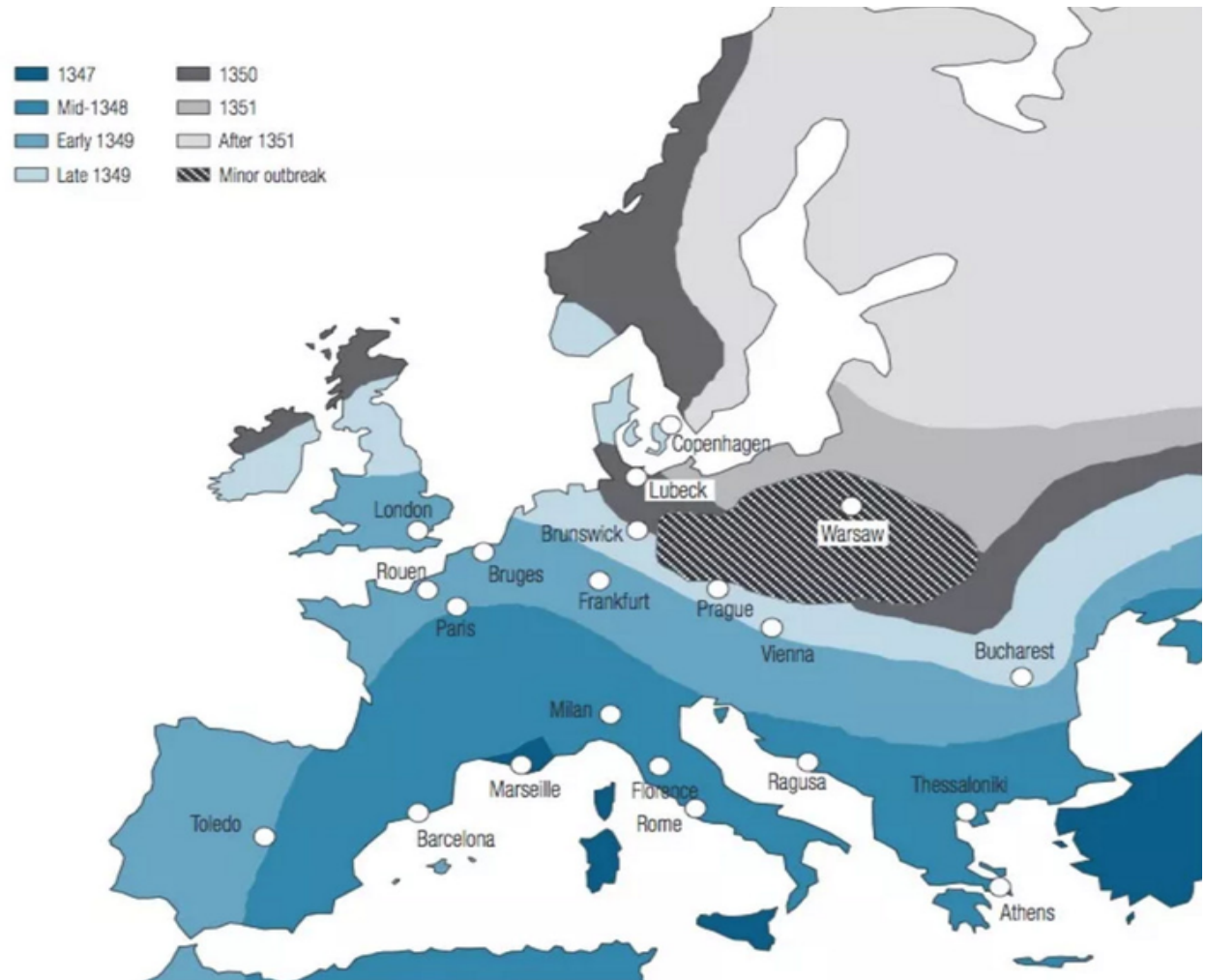


# Factors affecting transmission and natural history of disease

- Who gets infected?
- Who develops immunity? How broad is immunity?
- What processes generate direct or indirect contacts that can transmit infection?
- What factors affect transmission given a contact?
- What environments allow survival and growth of an agent?
- What is the pattern of disease in infected individuals?

# We have understood and had the ability to track diseases for a long time

Bubonic plague in Europe from 1340 to 1350





But today's world is very different and the timelines for spread have changed

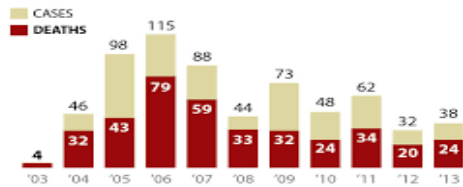


# The challenge of epidemics



## H5N1 AVIAN FLU CASES

Annual confirmed human cases for avian influenza A(H5N1) and deaths reported to the World Health Organization as of Dec. 10, 2013:



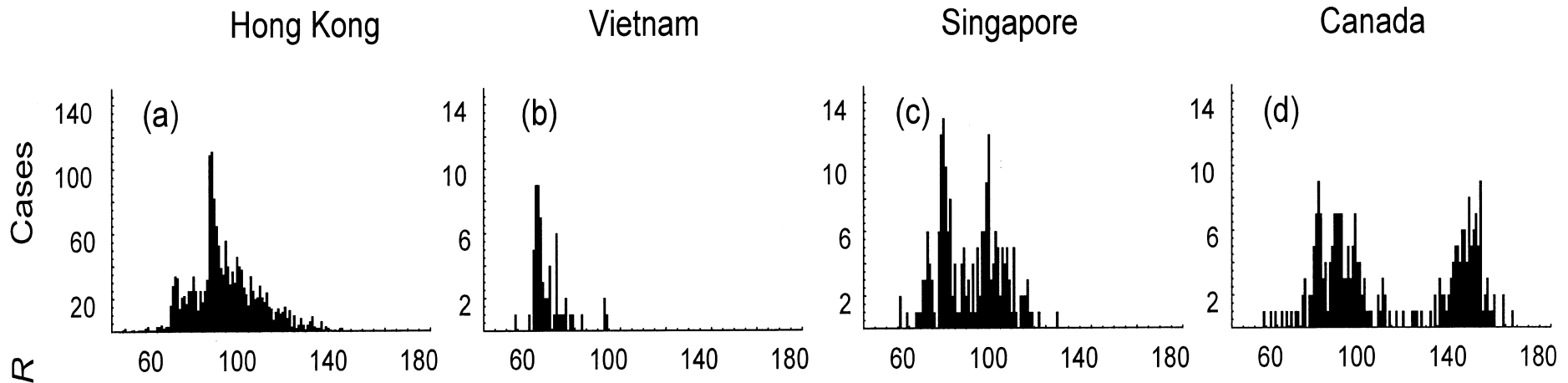
SOURCE: WORLD HEALTH ORGANIZATION

THE CANADIAN PRESS



# Approaches to control of epidemics

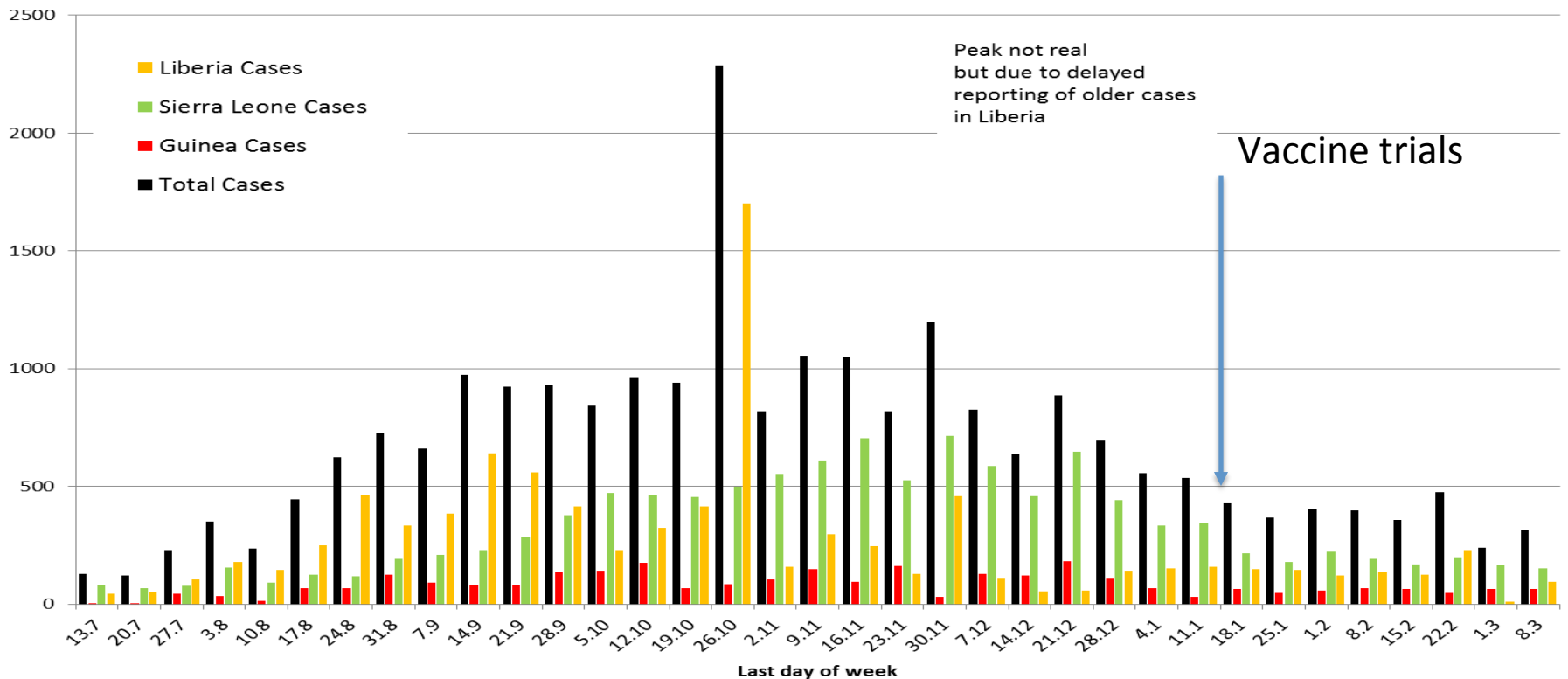
- SARS epidemic curves
  - Screening and quarantine
  - Barrier nursing



# Ebola in West Africa 2014/2015

## 2014/2015 West Africa Ebola epidemic

Reported Cases per Week

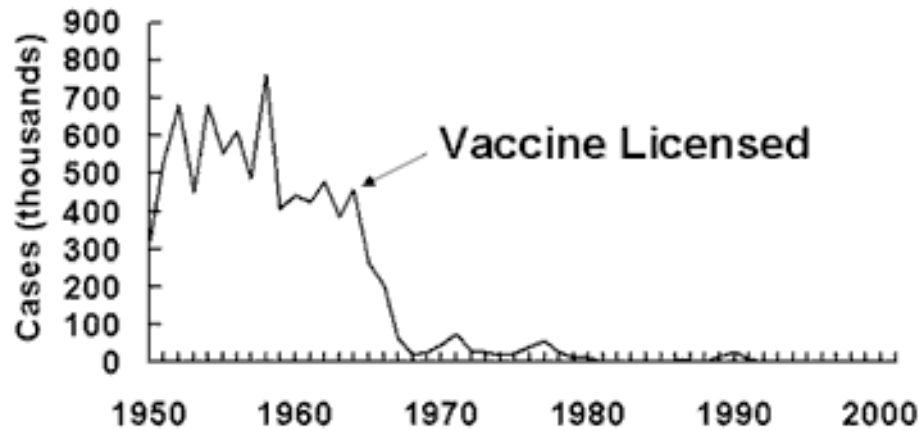


# Why think of vaccines when other approaches work?

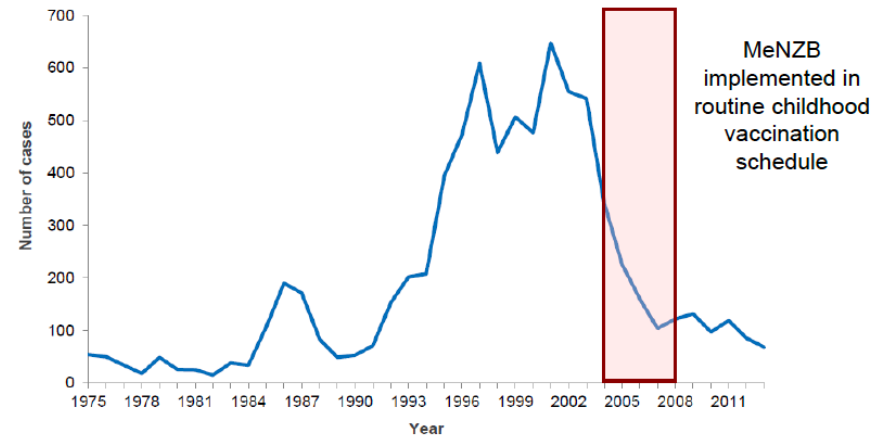
- Prevention is better than cure
- Preparation compared to uncertain scale of response
- Challenges in epidemics
  - Screening needs
  - Trained staff
  - Surge capacity in hospitals, people/resources
  - Impact on other programs

# What can vaccines do to disease?

Measles—United States, 1950-2001



Notified cases of meningococcal disease, NZ 1975-2013



Lopez, I. and Sherwood, J. The Epidemiology of Meningococcal Disease in New Zealand in 2013-2014, Institute of Environmental Science and Research Ltd (ESR) Wellington New Zealand

Vaccines prevent 2-3 million deaths a year

7000 deaths a day

300 deaths an hour

5 deaths every minute

And this is only counting deaths, not all sickness prevented

A pandemic could cost up to 570 Billion US\$ in a year



#### Indirect costs

- Death of healthcare professionals
- Quarantine necessitates expensive, rigorous screening and closure of borders
- Reduces trade and travel
- Affects food supply (<30,000 cases but >1000,000s affected)

The World Bank estimates that Ebola cost 4 billion US dollars in direct costs. **54 billion US dollars total costs**

Rebuilding is expensive.

# Calls for global action

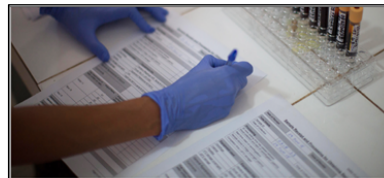
ADVANCE UNEDITED COPY

## Protecting Humanity from Future Health Crises

Report of the  
High-level Panel on the Global Response to Health Crises

25 January 2016

## Report of the Ebola Interim Assessment Panel



## AN R&D BLUEPRINT FOR ACTION TO PREVENT EPIDEMICS PLAN OF ACTION MAY 2016



Outcome document  
Financing of R&D Preparedness and Response to Epidemic  
Emergencies  
October 29-30, 2015  
Oslo, Norway

### Background

This Outcome document summarizes discussions that took place during the Oslo consultation on *Financing of R&D Preparedness and Response to Epidemic Emergencies* (October 29-30, 2015). It reflects views expressed and the discussion that took place, but does not necessarily reflect all interventions. Names of representatives of countries and organizations participating in the Oslo consultation on Financing can be found on the webpage of the Norwegian Institute of Public Health. Stakeholders represented included government, industry, NGOs and academia as well as charitable foundations and other relevant actors. The consultation was jointly organized by WHO and the Norwegian Institute of Public Health and hosted by the Norwegian Institute of Public Health.

## THE LANCET

Online First Current Issue All Issues Special Issues Multimedia Information for Authors

All Content Search Advanced Search

Access provided by The Wellcome Trust

< Previous Article Volume 386, No. 10009, p2204-2221, 28 November 2015 Next Article >

Health Policy

### Will Ebola change the game? Ten essential reforms before the next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola

Dr Suerie Moon, PhD, DPhil, Sophie Delaunay, MDPHil, Prof Eric Goosby, MD, Prof Leung, MD, J Stephen Morris, Benjamin Hawkins, PhD, LSHTM  
Published Online: 22 November 2015

## NATIONAL ACADEMY OF MEDICINE

ABOUT THE NAM PROGRAMS INITIATIVES PERSPECTIVES NEWS SUPPORT MEMBER RESOURCES

## Global Health Risk Framework

*The Neglected Dimension of Global Security: A Framework to Counter Infectious Disease Crises*

Download the Report



## The NEW ENGLAND JOURNAL of MEDICINE

HOME ARTICLES & MULTIMEDIA ISSUES SPECIALTIES & TOPICS FOR AUTHORS CME



### Perspective

## Establishing a Global Vaccine-Development Fund

Stanley A. Plotkin, M.D., Adel A.F. Mahmoud, M.D., Ph.D., and Jeremy Farrar, M.D., Ph.D.  
N Engl J Med 2015; 373:297-300 | July 23, 2015 | DOI: 10.1056/NEJAp1506820

Comments open through July 29, 2015

Share Facebook Twitter LinkedIn YouTube

Article References Citing Articles (8) Comments (2) Metrics

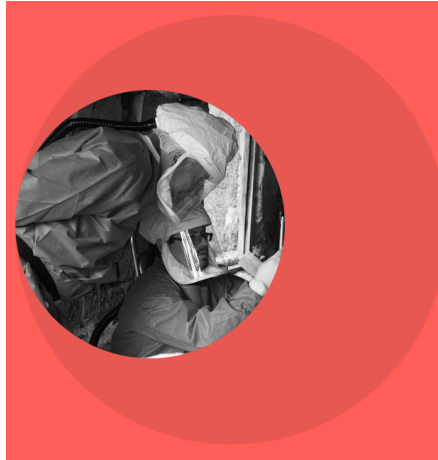


# In response to Ebola-a new initiative



## **Preparedness**

Advance access to safe and effective vaccines against emerging infectious diseases



## **Response**

Accelerate the research, development and use of vaccines during outbreaks



## **Sustainability**

Create durable and equitable solutions for outbreak response capacity

## Coalition for Epidemic Preparedness Innovations

# The CEPI response

**Rationalize &  
accelerate**

**Rationalize** and **accelerate** research and development responses to new outbreaks



**Coordinate**

**Coordinate** resources of industry, academia, governments, philanthropies, and NGOs



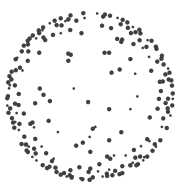
**Prioritize &  
facilitate**

**Prioritize** platform technology and vaccine targets and **facilitate** the advanced development of vaccines for emerging infectious diseases

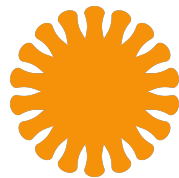
# Rationalize and accelerate

- WHO R and D Blueprint
- Updated for top ten threats every year
  
- And disease X

# CEPI's strategic portfolio targets



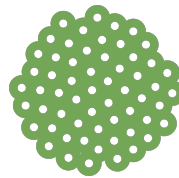
Lassa



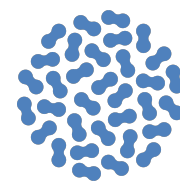
MERS-CoV



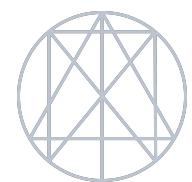
Nipah



Rift Valley  
Fever



Chikungunya



Disease X

Advance at least one vaccine for each pathogen through phase IIa and stockpile within five years of funding

Support activities enabling late stage development, prequalification and access

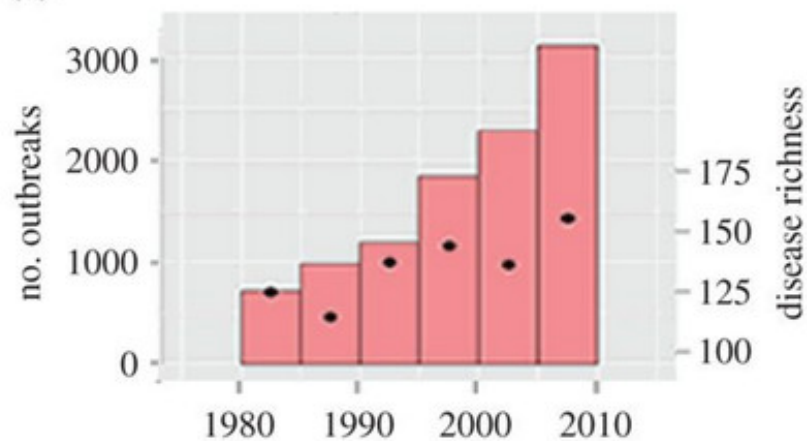
Advance through phase I multiple rapid response platforms with potential to significantly improve speed of vaccine development against multiple pathogens

# Dec 2019-Jan 2020 Pathogen X

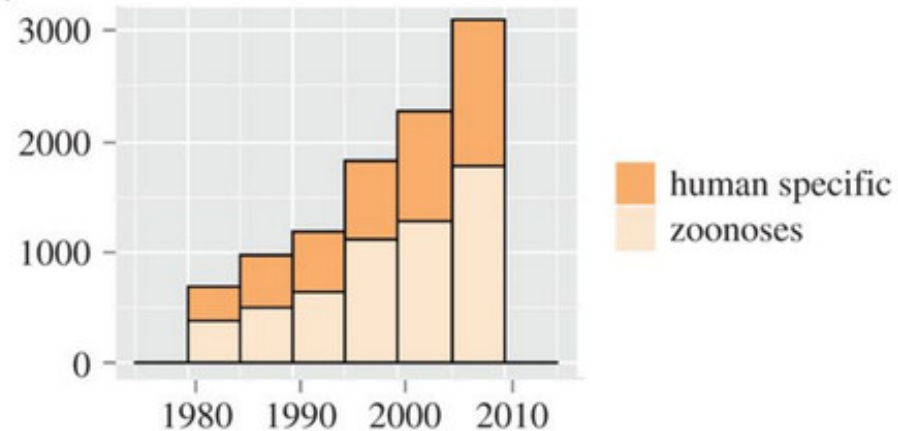


# Not unexpected, zoonotic diseases from AIDS to Zika

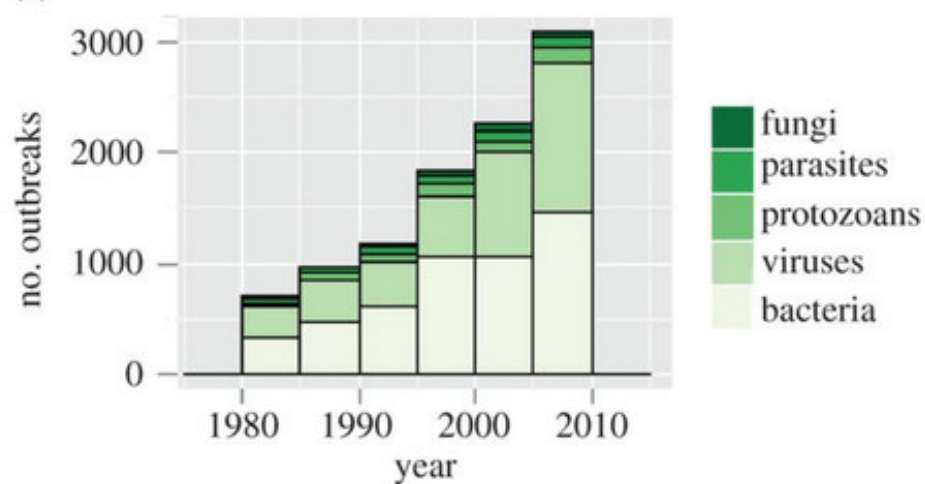
(a)



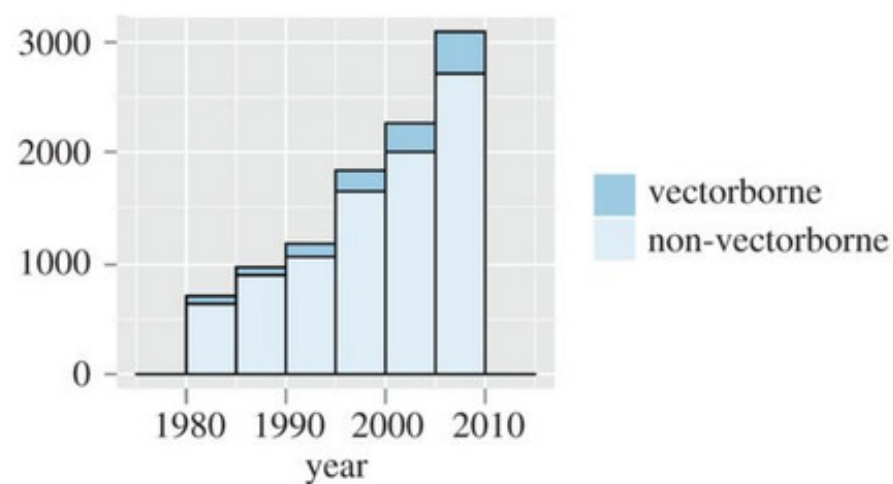
(b)



(c)



(d)



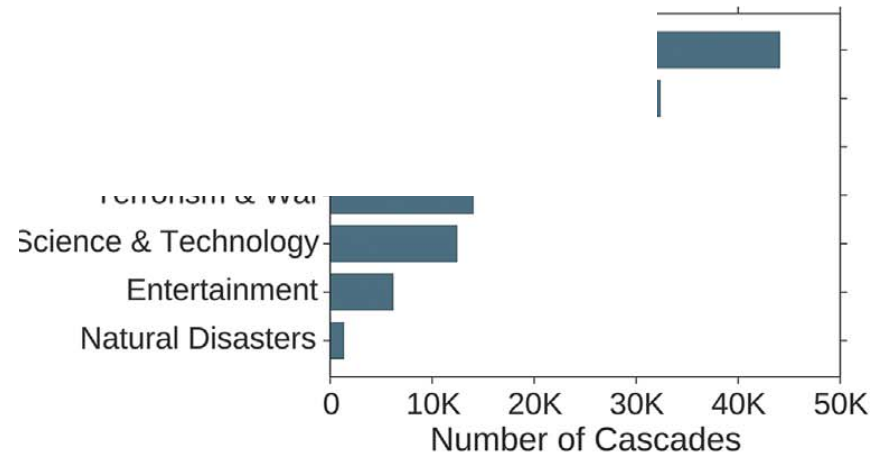
# Coronavirus has sparked an infodemic

- Manmade bioweapon
- No evidence based on sequencing data
- More than 100,000 have died
- Just over 2800 as of yesterday

SOCIAL SCIENCE

# The spread of true and false news online

Soroush Vosoughi,<sup>1</sup> Deb Roy,<sup>1</sup> Sinan Aral<sup>2\*</sup>



- Falsehood diffused significantly farther, faster, deeper, and more broadly than the truth in all categories of information
- False stories inspired fear, disgust, and surprise
- False news spreads more than the truth because humans, not robots, are more likely to spread it



# In today's world we access information easily

## COVID-19

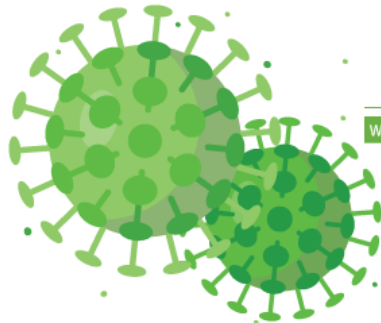
Disease caused by the SARS-CoV-2 virus



### Novel coronavirus

Coronaviruses are viruses that **circulate among animals** but some of them are also known to affect humans.

The 2019 novel coronavirus was identified in China at the end of 2019 and is a new strain that has not previously been **seen in humans**.



### Symptoms

FEVER

COUGH

DIFFICULTY BREATHING

MUSCLE PAIN

TIREDNESS

### Prevention

When visiting affected areas

Avoid contact with sick people



Wash your hands with soap and water



If you develop cough, use a medical face mask



Wherever you travel apply general hygiene rules



### Transmission

VIA RESPIRATORY DROPLETS

2-14 days

estimated incubation period



# Too easily.....and inaccurately

Ugly battles erupt as residents fight housing coronavirus patients in their cities



Los Angeles Times

LOG IN



Have we not learned lessons from

PANDEMIC IN OCT

IFRC

unicef for every child

World Health Organization

Costa Mesa and the state of Cal. refuse to be a petri dish

Expose the hidden... to bring Corona Virus into our city!

Life will end as we know it!

Social Stigma associated with COVID-19

A guide to preventing and addressing social stigma<sup>1</sup>

Target audience: Government, media and local organisations working on the new coronavirus disease (COVID-19).





Coordination for public protection

# Internal preparedness

- Who responds?
  - Disaster/Emergency/Outbreak



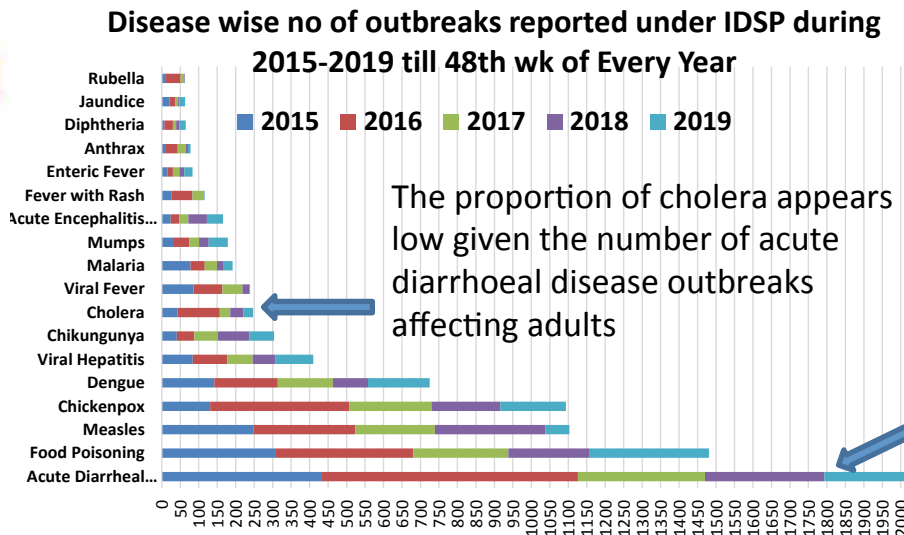
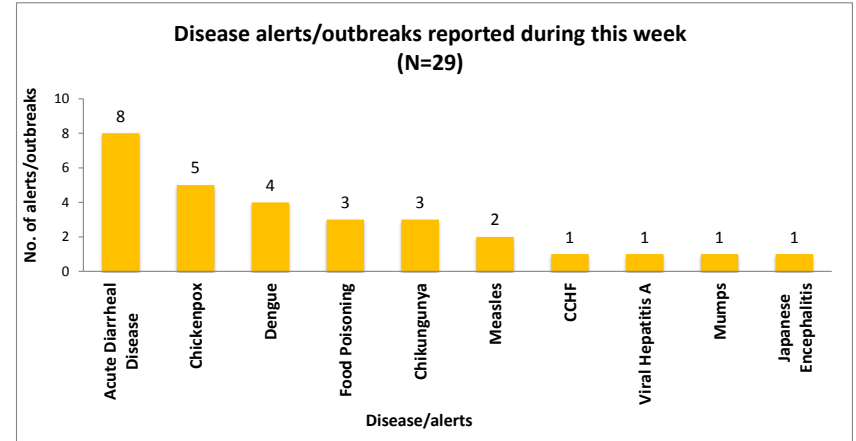
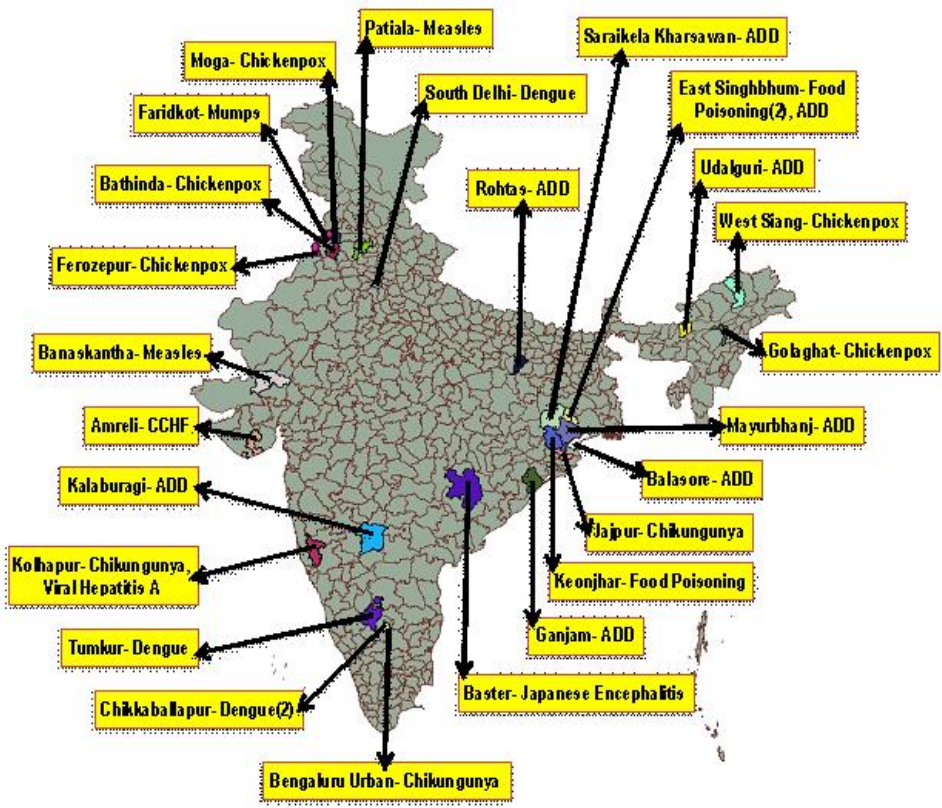
48<sup>th</sup> Week

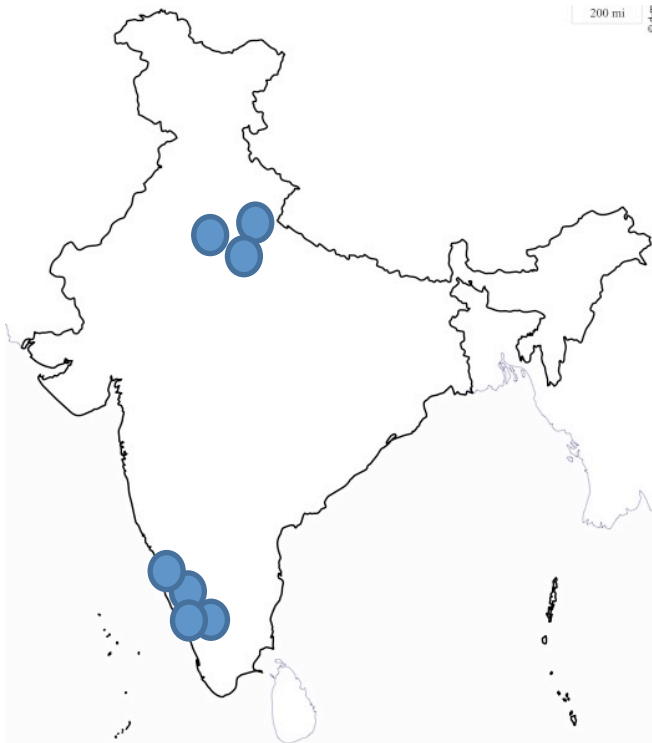
# WEEKLY OUTBREAK REPORT

Disease Alerts/Outbreaks reported and responded to by States/UTs through Integrated Disease Surveillance Program (IDSP)  
(25<sup>th</sup> November to 1<sup>st</sup> December 2019)

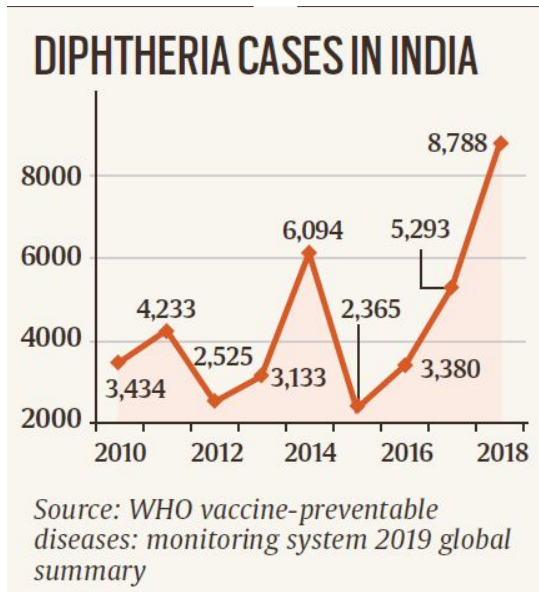
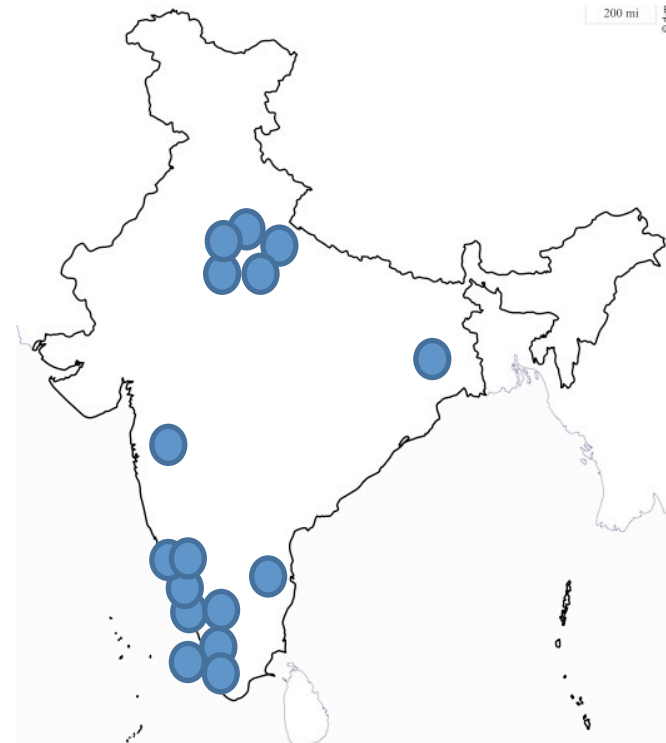


District wise disease alerts/outbreaks reported in the 48<sup>th</sup> week 2019  
48<sup>th</sup> Week Map





Two sets of investigations into diphtheria outbreaks in India in 2014



# Preparedness for research

- Ability to diagnose
- Ability to treat
- Ability to measure
- Ability to prevent

# CDC distributes tests 3 weeks after sequence



A traveler wearing a protective facemask at Changi Airport in Singapore. The city has not seen COVID-19 cases exploding yet. ROSLAN RAHMAN/AFP VIA GETTY IMAGES

## Singapore claims first use of antibody test to track coronavirus infections

By [Dennis Normile](#) | Feb. 27, 2020 , 4:30 PM



# Surge capacity in hospitals

- Pre-hospital
- Outpatients
- Healthcare facilities
- Public health
- Mental health
- Mortuary



# Ability to measure

## Coronavirus disease 2019 (COVID-19) Situation Report – 37

Data as reported by 10AM CET 25 February 2020\*

### HIGHLIGHTS

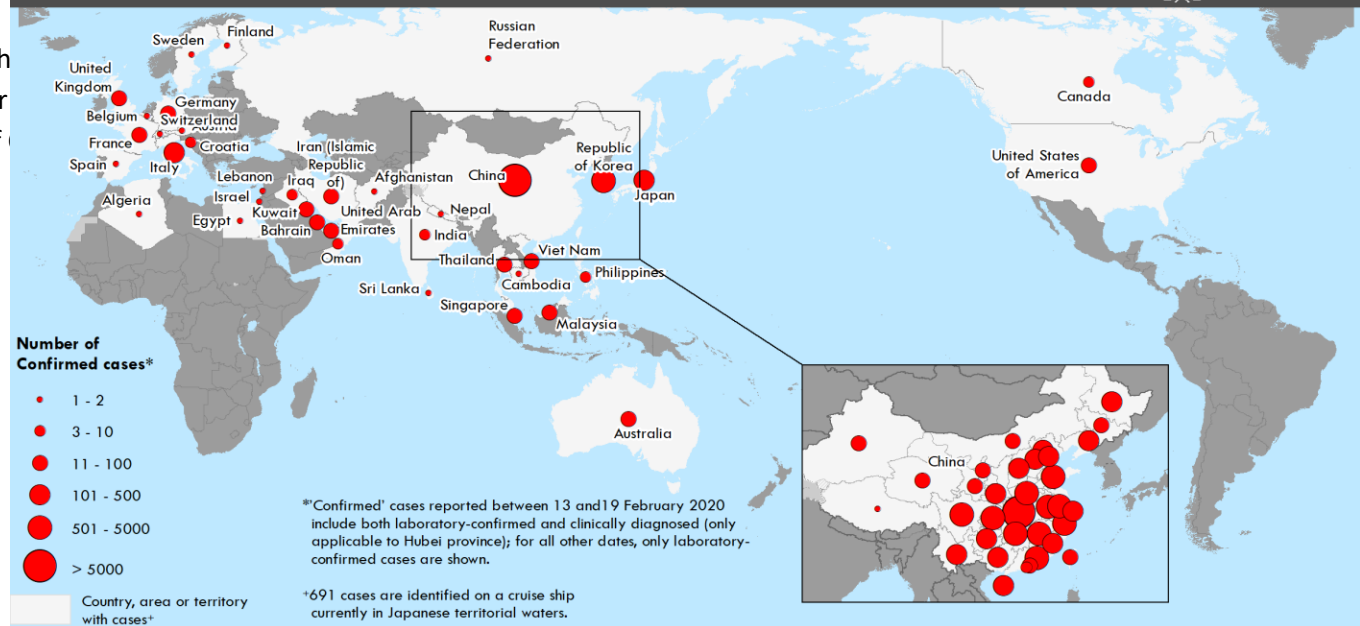
- Four new Member States (Algeria, Austria, Croatia, and Switzerland) reported cases of COVID-19 in the past 24 hours. Algeria is the first Member State of the AFRO Region to report COVID-19 cases.
- For the first time, since the start of the COVID-19 outbreak on 8 December 2019, cases were reported from countries outside of the WHO Region of the Americas.

### SITUATION IN NUMBERS total and new cases in last 24 hours

Globally

81 400 cases confirmed (674 new)

### Distribution of COVID-19 cases as of 26 February 2020



# Ability to do research

**How many? The coronavirus is prompting a burst of clinical trials in search of a treatment**

By [Ed Silverman](#)<sup>3</sup> [@Pharmalot](#)<sup>4</sup>

February 19, 2020



Medical staff members work at an exhibition centre converted into a hospital in Wuhan. *STR/AFP via Getty Images*

# What can we do and what does it take?

- Diagnostics
- Repurposing drugs
- New antivirals
- Monoclonal antibodies
- Vaccines
- Personal protective equipment
- Linking all stakeholders-national and international
- Sharing
  - Data
  - Reagents
  - Protocols
  - Patients
- Supporting
  - Preparedness planning
  - Research in peace time and in war



# The example of CEPI

CEPI accelerates development of vaccines against emerging infectious diseases and enables equitable access to these vaccines for affected populations during outbreaks

New vaccines for a safer world

# From Jenner to Pasteur to Hilleman

- Isolate
- Inactivate/Attenuate
- Inject

Upto the 1950s

## Bacterial vaccines

Diphtheria

Tetanus

Pertussis

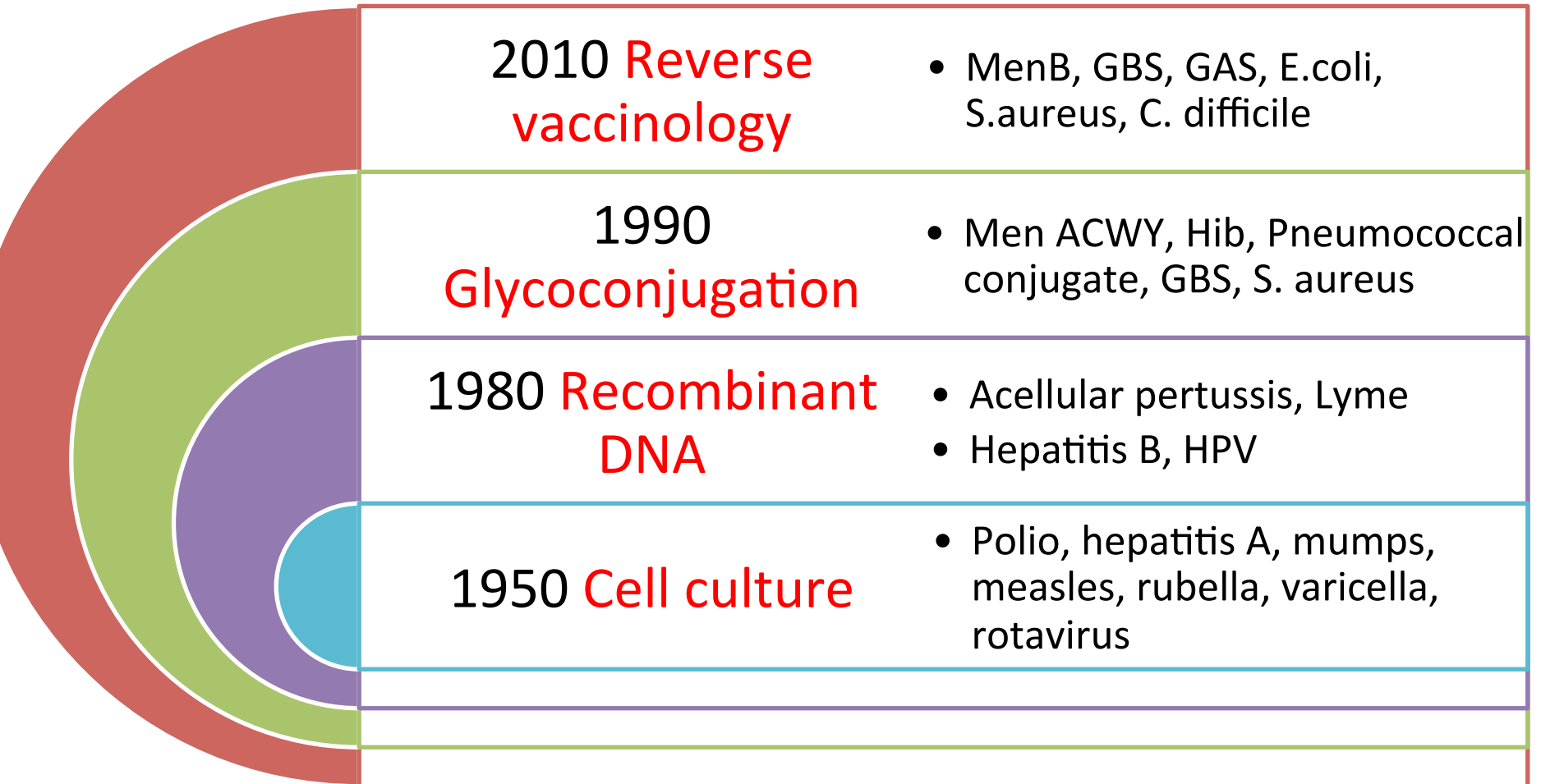
BCG

## Viral vaccines

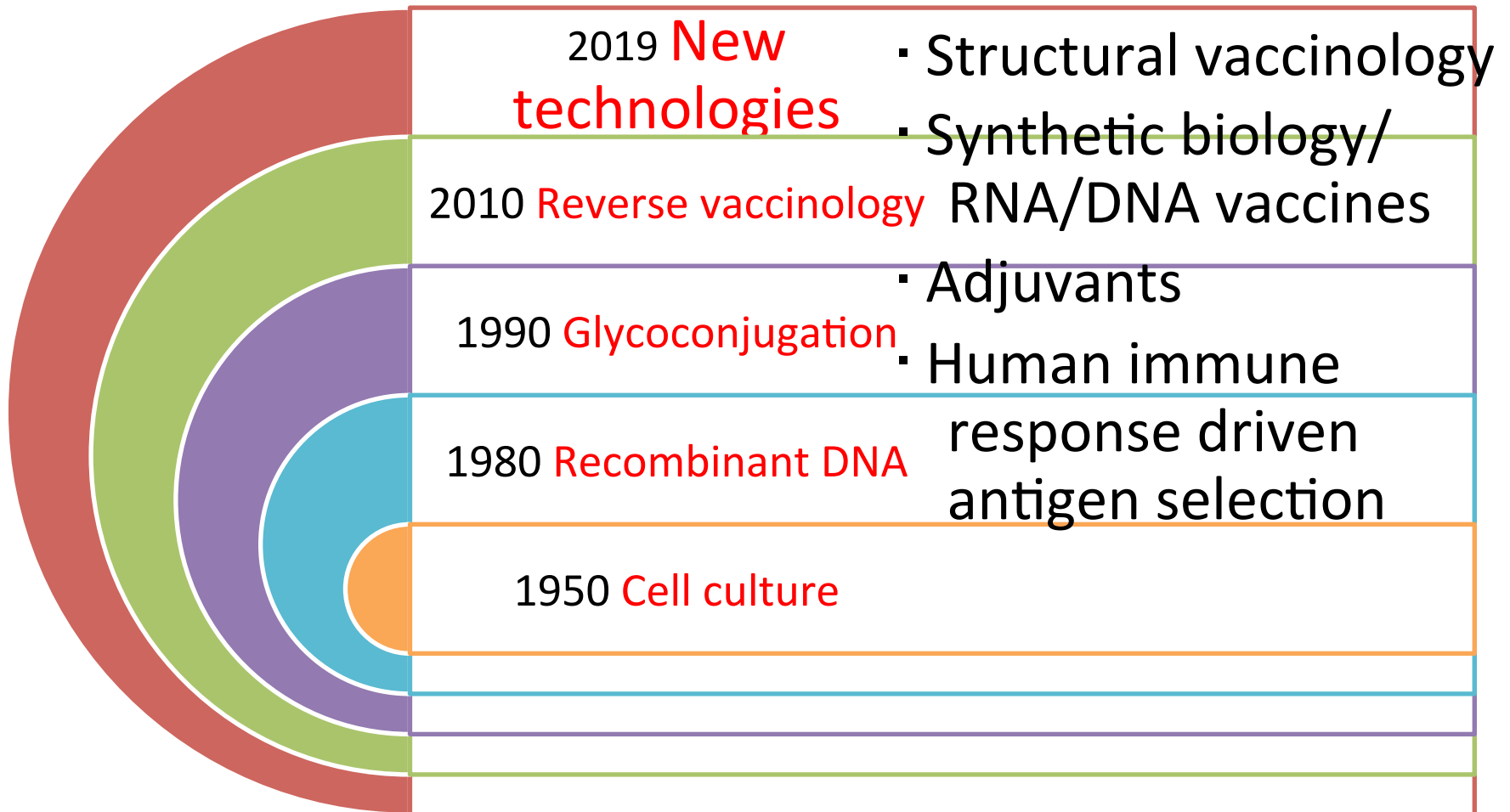
Smallpox

Rabies

After 1950, new technologies have advanced vaccines beyond the older empirical approaches

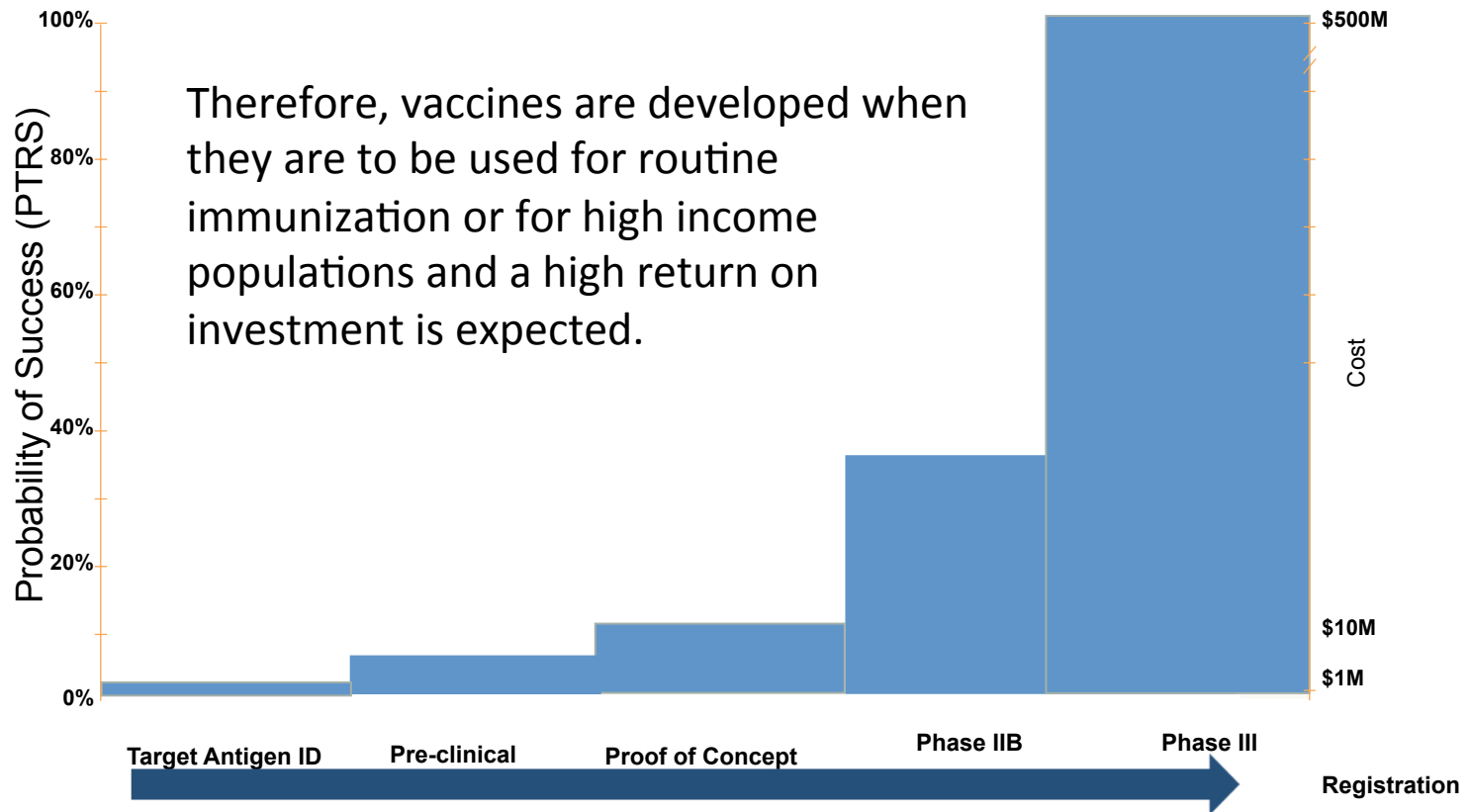


# During the past 20 years, new technologies have exploded vaccine design

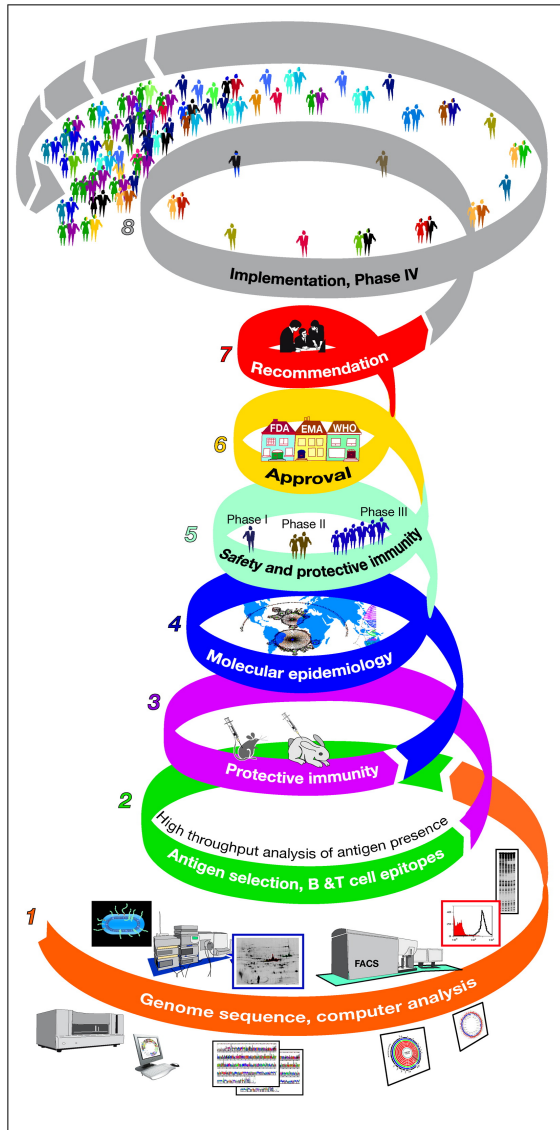
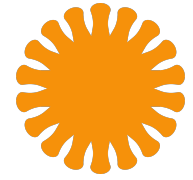




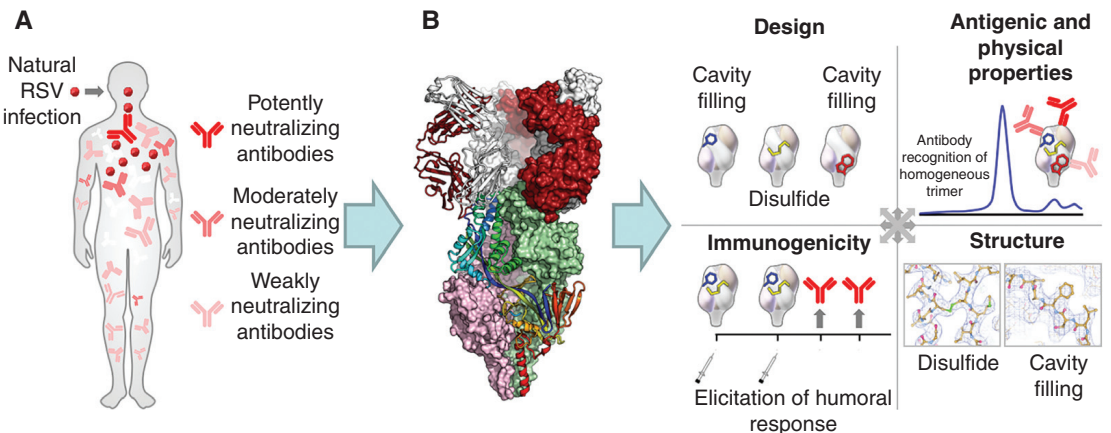
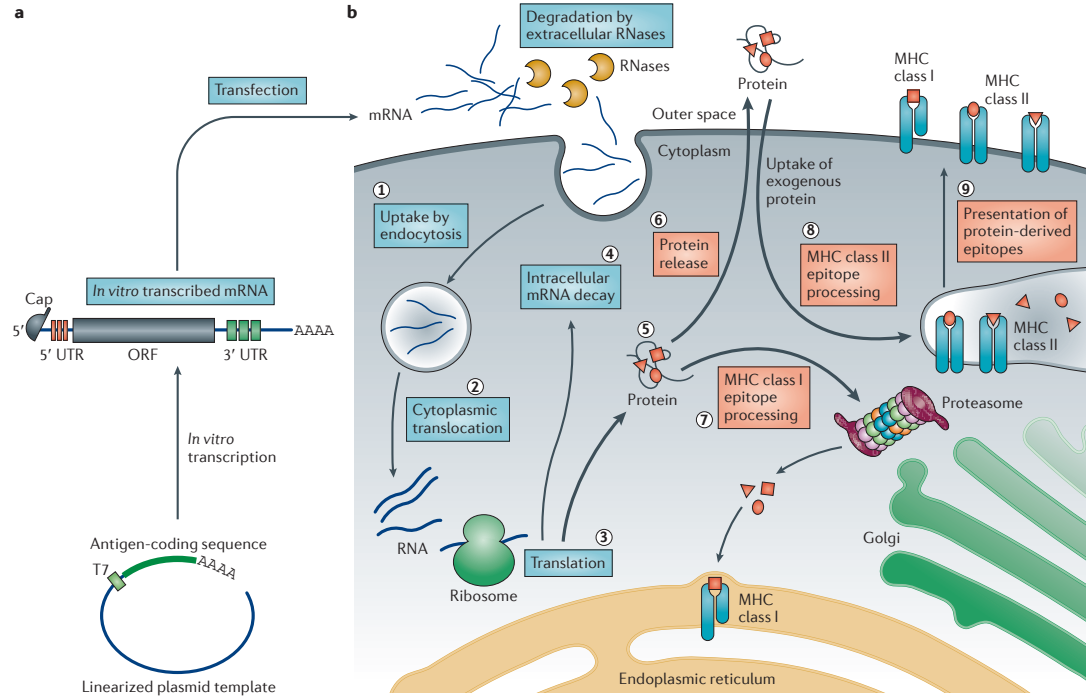
# The cost of making vaccines



# CEPI SARS-CoV2 platform technologies



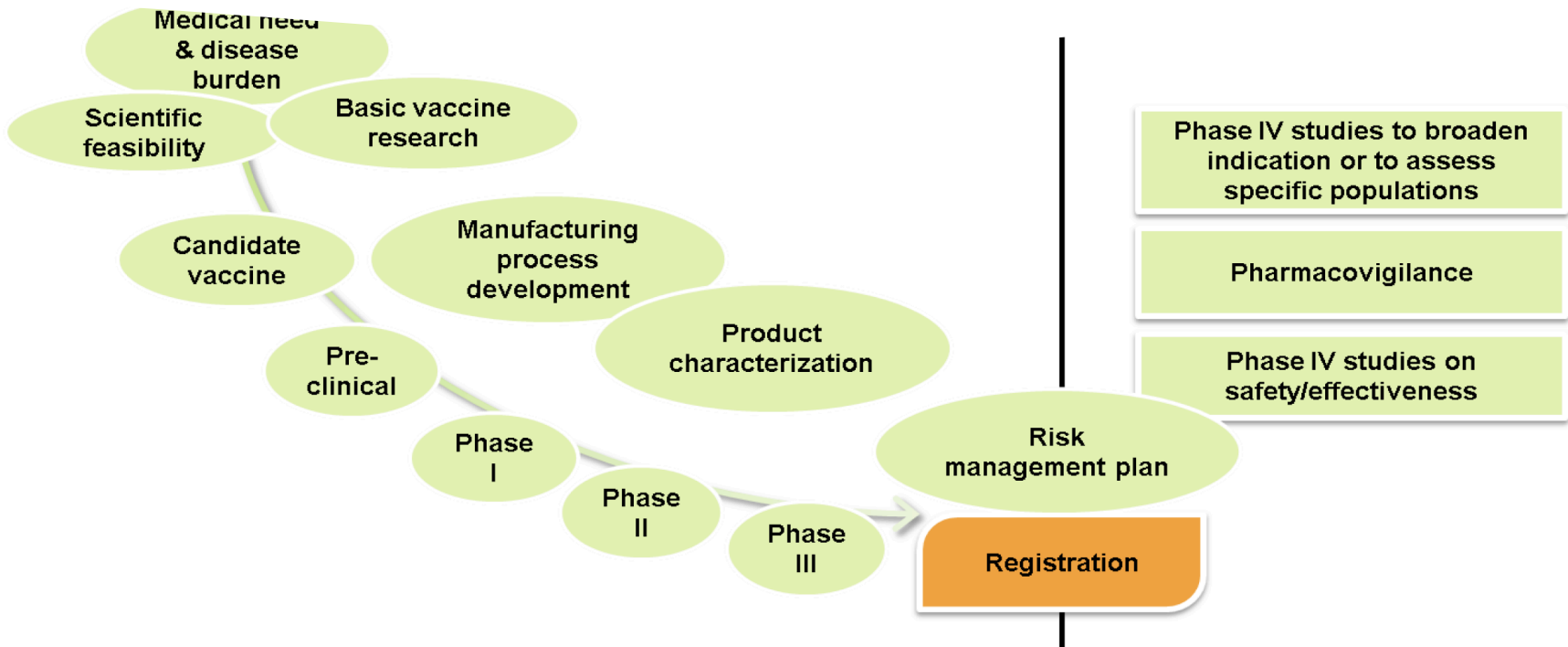
CEPI



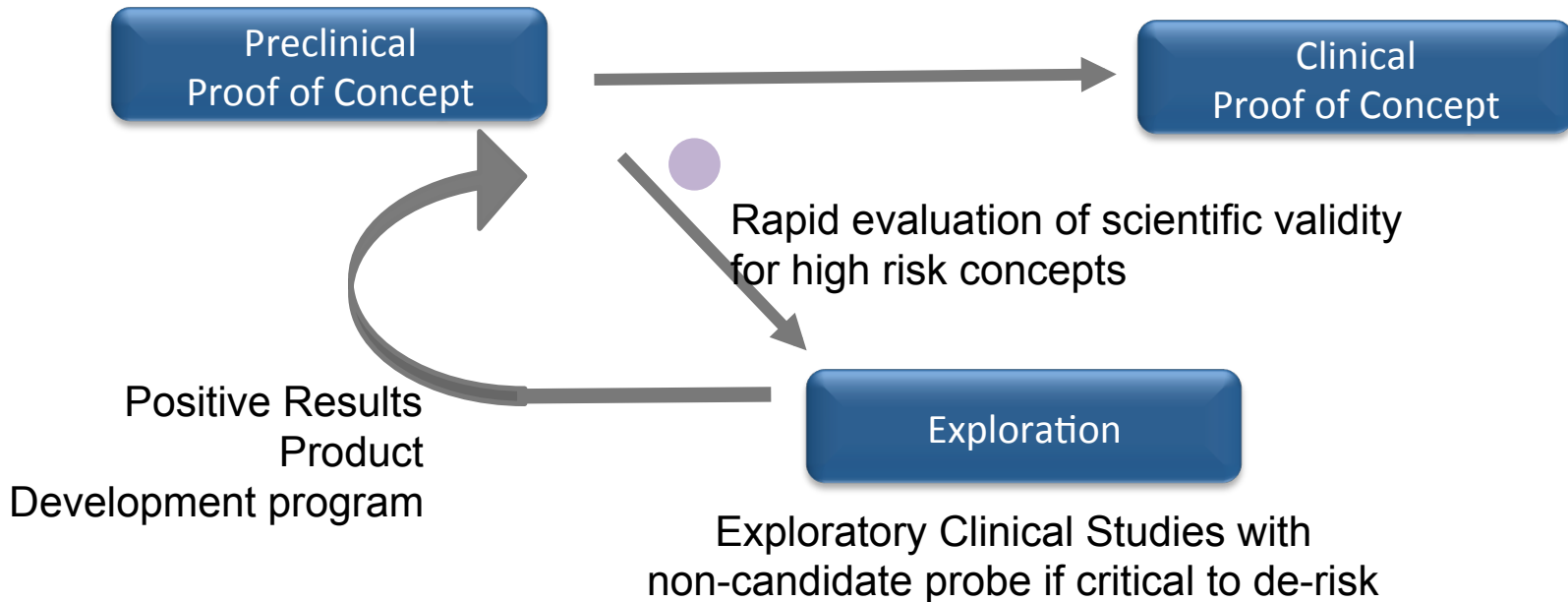
# Vaccine development in the 21<sup>st</sup> Century

- Time it takes to develop and deliver a new vaccine to market remains too slow.
- A number of issues contribute to the delay:
  - Limitation of animal models to predict and mimic vaccine-induced immunity
  - Limited ability to generate novel, but physiologically relevant and testable hypotheses about the mechanisms of vaccine-induced protection
  - Difficulties in defining correlates of protection
  - Poor strategies to rationally up and down select different vaccine candidates in an affordable and timely manner
- **Exploratory clinical studies could circumvent many of these problems BUT there are major logistical barriers to this approach**

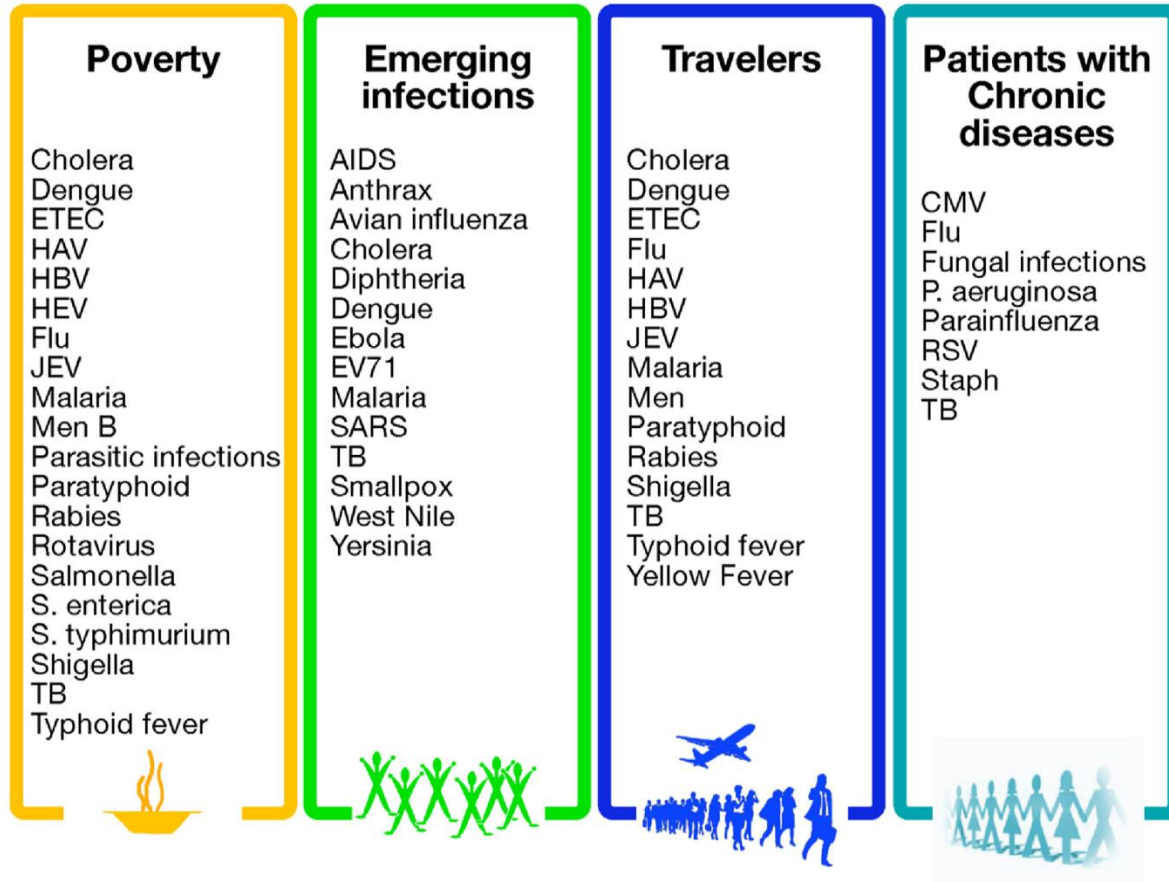
# Current pathways



# Product development through experimental medicine approaches



# Vaccines have potential for prevention beyond epidemics-for all of society



## Immunotherapy/therapeutic vaccines?

- Cancer**
- Autoimmune diseases**
- Alzheimer**
- Chronic infections**  
(HCV, HBV, HPV, HIV, ...)
- Metabolic diseases**
- Allergy**
- Drug addiction**

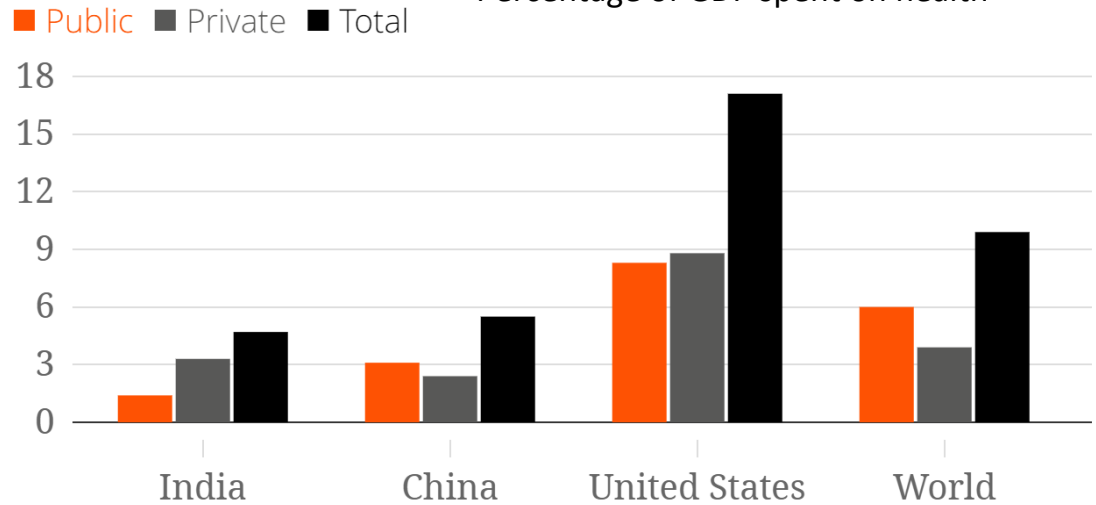


# Vaccines are one tool of public health always useful in peace time, and sometimes in war

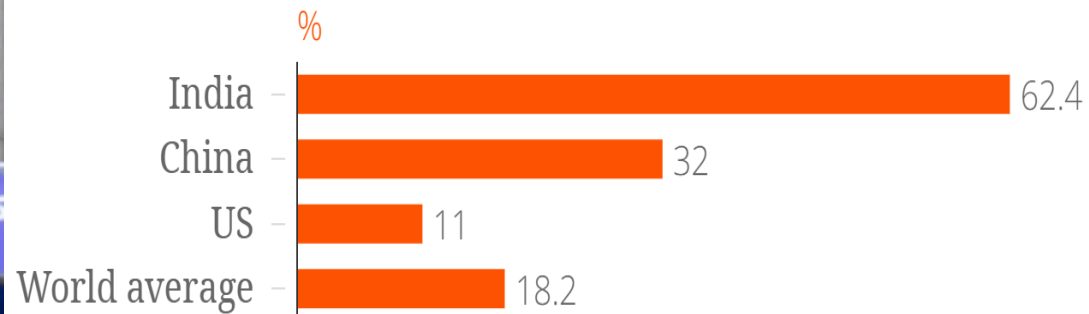
Protection, planning and  
policy

63 million have catastrophic  
health spending annually!  
Without outbreaks

Percentage of GDP spent on health



Out of pocket expenditure as % of total health expenditure



Vaccines transformed public health in the 20<sup>th</sup> century and in the 21<sup>st</sup> century we will see them not just for prevention of infectious diseases and outbreaks but in the prevention and treatment of non-communicable disease

60% of vaccines used in public immunization programs for children use a vaccine made in India

But we can do more



# The MenAfriVac story



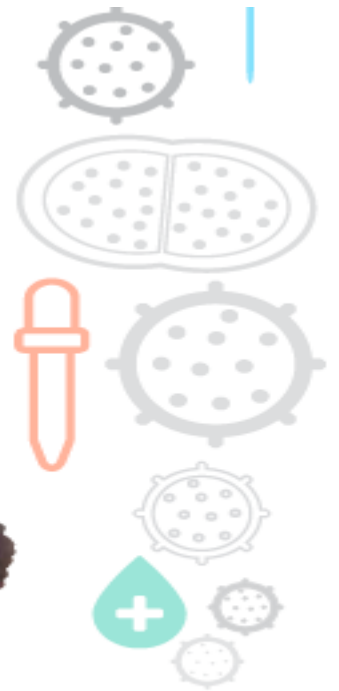
- Meningitis Vaccine Project (PATH, Synco Biopartners, CBER and Serum Institute)
- <10 years, 70 million US\$
- Freeze-dried polysaccharide of *Neisseria meningitidis* group A conjugated to tetanus toxoid at a price of 0.50 US\$ (other vaccines 50-80 US\$)

103 million people immunised

## Impact:

Number of MenA cases:

	2009	2012
Niger	1,460	0
Burkina Faso	36	0
Mali	16	0



# EMA approval for Ebola vaccine-first rVSV vaccine licensed for human use

## EBOLA Fighting the outbreaks

EMA has worked together with regulatory authorities around the world to support WHO in combating outbreaks

### Outbreaks

The first Ebola disease outbreaks were reported back in 1976. Since then more than 30 outbreaks have occurred in Africa (mostly in Sudan, Uganda, the Democratic Republic of Congo, and Gabon).

Currently, the Democratic Republic of Congo (DRC) is grappling with the world's second largest Ebola epidemic on record.

**August** — WHO declared Ebola outbreak in West Africa a public health emergency

### First vaccine

Ervebo is a genetically engineered, replication-competent, viral vectored vaccine. Data from clinical trials and compassionate use programs have shown that Ervebo protects against Ebola virus disease in humans, following a single dose.

**June** — Ebola outbreak in West Africa ended

**May** — DRC Ebola outbreak started  
**July** — DRC Ebola outbreak ended

**May** — DRC Ebola outbreak started  
**July** — DRC Ebola outbreak ended  
**August** — A second Ebola outbreak started in DRC

**July** — WHO declared Ebola outbreak in DRC a public health emergency

### What is next?

The opinion adopted by EMA's committee for human medicines is an important step on Ervebo's path to patient access.

The opinion for conditional marketing authorisation will be sent to the European Commission (EC) for the adoption of a decision on an EU-wide marketing authorisation.

### Our role

Ebola virus disease is a rare but severe illness caused by the Ebola virus. Death rates in infected patients have ranged from 25% to 90% in past outbreaks.

Since 2014, EMA has provided advice on the development, evaluation and approval of medicines to fight Ebola virus disease.

2014

- EMA ad-hoc expert group established
- Review of experimental Ebola treatments started
- Interim report on experimental treatments review

2015

- Clinical trials of **1st investigational vaccine** started

2016

- Final report on experimental treatments review
- Application for accelerated assessment of **1st investigational vaccine**
- PRIME eligibility for **1st investigational vaccine**

2017

2018

- EMA contributed to WHO consultations on monitored emergency use of unregistered and investigational interventions for Ebola virus disease
- EMA contributed to a WHO ad-hoc expert consultation on clinical trials for Ebola therapeutics

2019

- EMA contributed to WHO Ebola vaccine evaluation and therapeutics consultations
- Marketing authorisation application for **1st vaccine against Ebola**
- Approval for accelerated assessment of **2nd investigational vaccine**
- Positive opinion for granting a conditional marketing authorisation for **1st vaccine against Ebola**
- EMA supported the EC's Health Security Committee to promote availability of investigational therapeutics and vaccines in Member States