



Why still Polio

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ECDC polio consultant
14 April 2016

A medical student
with the last textbook
on

Communicable
diseases !

Where there is no
chapter on

Poliomyelitis !!!



What can I say

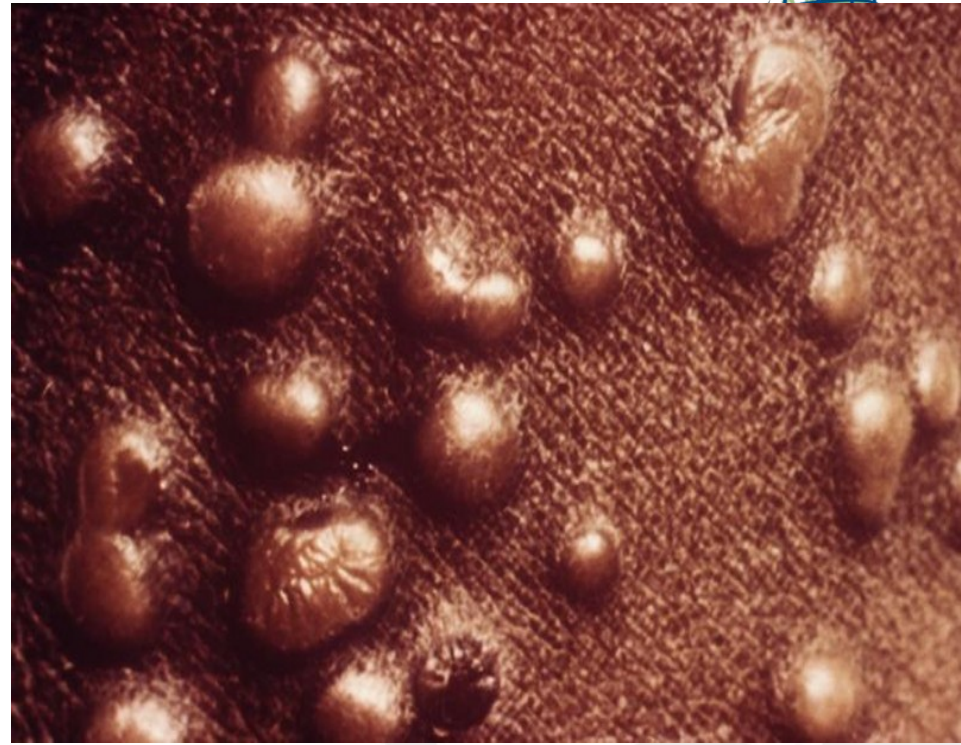
- Background
- Polio Still present
- The disease
- The eradication plan
- A fragile genoma
- The Vaccine derived poliovirus
- The ECDC Action plan on polio



SMALLPOX



Last endemic case 1977
Eradication certified 1979



We are so close !!

- Type 2 eradicated , Last type 3 seen in 2012
 - 4 of the 6 WHO region polio free (EU in 2002)
 - Bivalent OPV switched on trivalent
 - All countries with at least one IPV dose
- BUT
- Still cases from Afghanistan and Pakistan (73 in 2015, but cases continue to occur)
 - Emerging cVDPV (28 cases in 7 Countries in 2015)
 - Containment plan quite late (still incomplete phase 1)

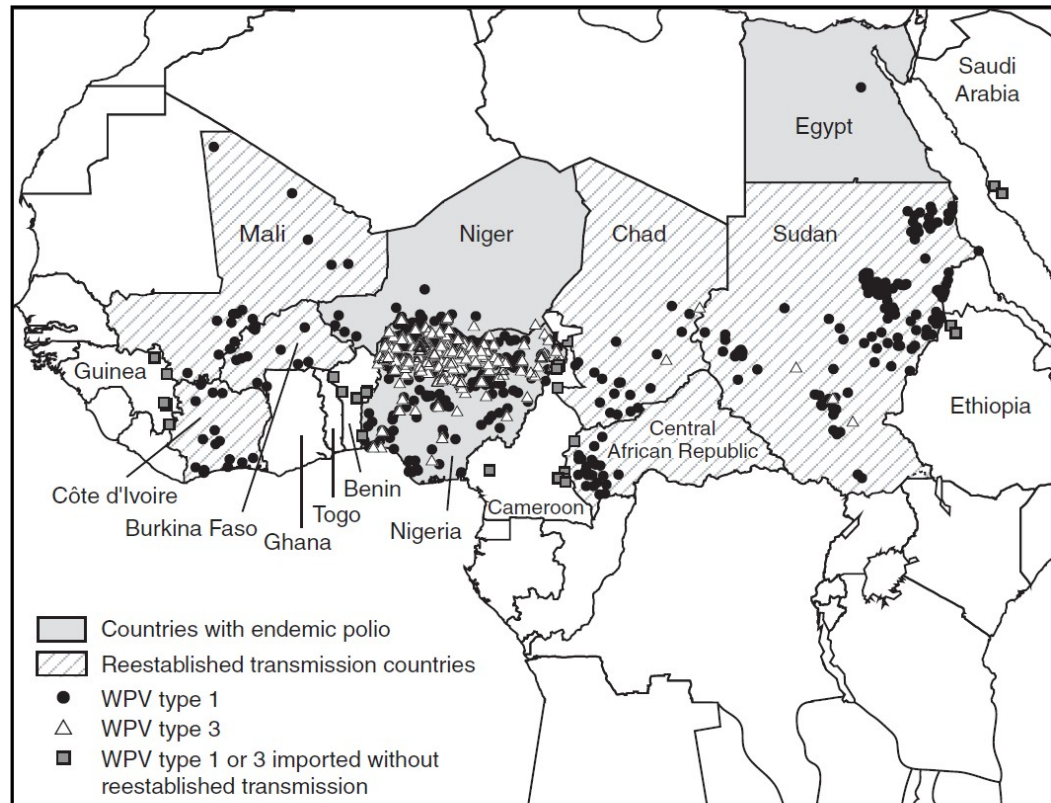
Polio action possible scenario

- Last case seen in 2016
 - One IPV introduced in all countries 2016
 - Polio eradication certified in 2019
 - Wild poliovirus contained by 2019
 - OPV withdrawal by 2020
 - Sabin polio virus contained by 2022
 - Polio vaccination interrupted by 2025
 - Polio surveillance stopped by 2030
- 15 years of polio activity !!!



Failure Is Not An Option

Global Re-emergence After Temporary Boycott of Polio Vaccination in Nigeria, 2003



- By end of 2003, spread to 8 previously polio-free countries
- By end of 2004, 14 countries infected, with re-established transmission in 6
- By end of 2006, 20 countries infected





Mountains
cows
cotton and
nice
people



600 paralyzed children !





*governo did not purchase polio
vaccine for two years*

*In some Districts polio coverage
less than 50%*

In war areas vaccination stopped



SIRIA RECENT EPIDEMIC



LIBIA : WHO IS VACCINATING ??

Lebanon : 2 million refugees ??

ISRAELE !!!

More than 100 WP!
Isolates from sewage in all
the country in the last 2
years !!



Polio virus leaks in to river



🕒 Sun 07/09/2014 - 12:42 👤 MB

The River Laan/Lasne that flows through Flemish and Walloon Brabant became infected

An ancient disease



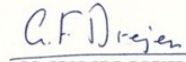
CERTIFICATE

WORLD HEALTH ORGANIZATION
EUROPEAN REGION

REGIONAL COMMISSION FOR THE CERTIFICATION
OF POLIOMYELITIS ERADICATION

THE COMMISSION CONCLUDES,
FROM EVIDENCE PROVIDED
BY THE NATIONAL
CERTIFICATION COMMITTEES
OF THE 51 MEMBER STATES,
THAT THE TRANSMISSION
OF INDIGENOUS WILD POLIOVIRUS
HAS BEEN INTERRUPTED
IN ALL COUNTRIES OF THE REGION.
THE COMMISSION ON THIS DAY
DECLARES THE EUROPEAN REGION
POLIOMYELITIS-FREE.


SIR JOSEPH SMITH, CHAIRMAN


DR GEORGE F. DREJER


PROFESSOR MARGARETA BÖTTIGER


PROFESSOR SERGEY G. DROZDOV


PROFESSOR ISTVÁN DOMOK


DR DONATO GRECO

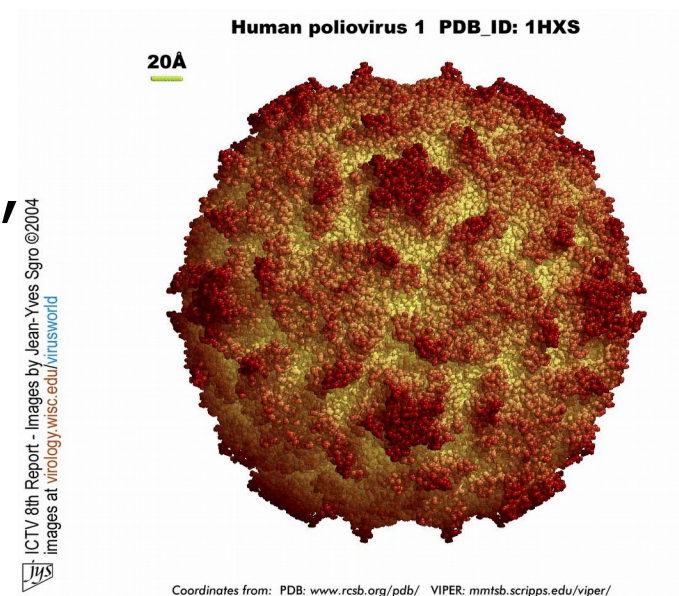

DR WALTER DOWDLE


PROFESSOR BURGHARD STÜCK

COPENHAGEN, 21 JUNE 2002

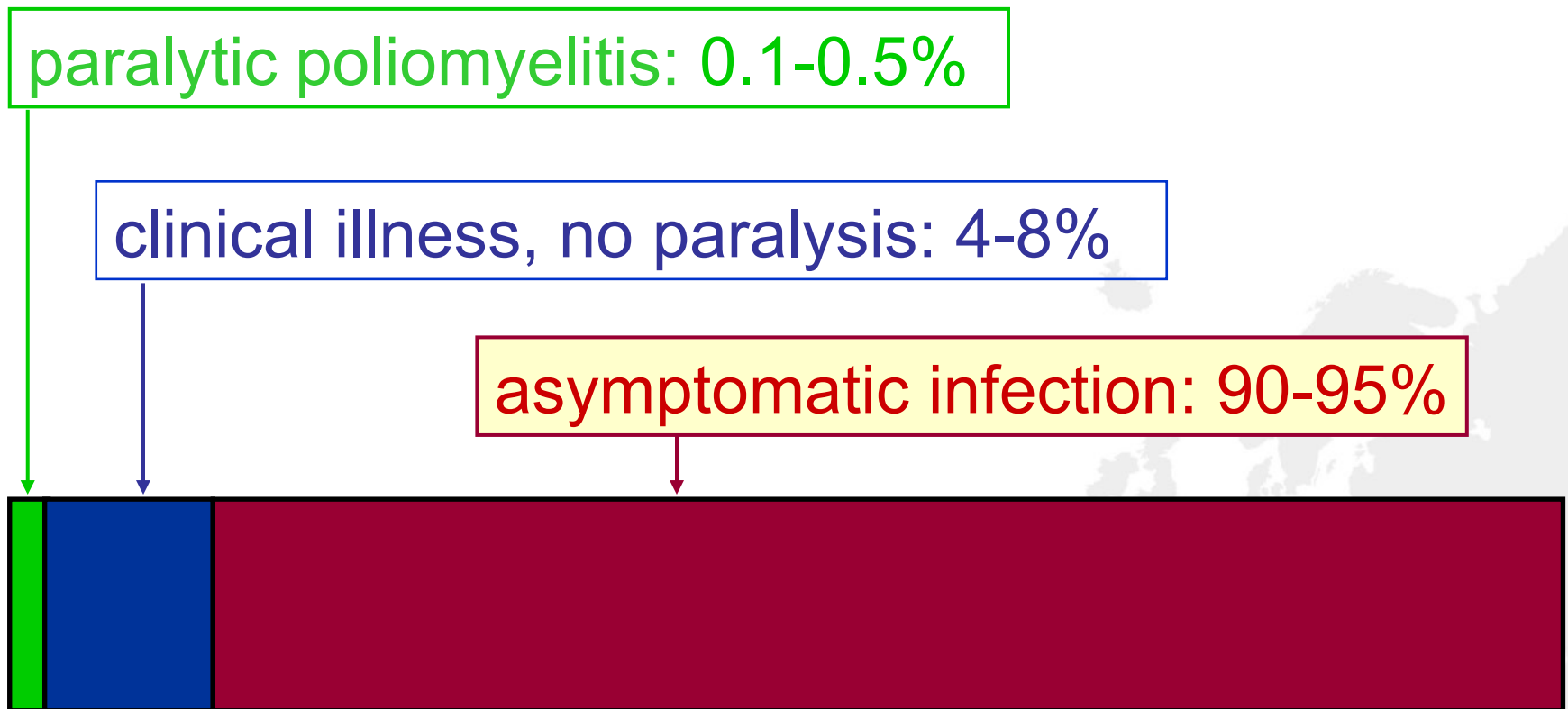
Polio – The Viruses and the Disease

- Human infection by one of 3 poliovirus serotypes (RNA viruses - *Enterovirus* genus)
- Transmitted person-to-person, by fecal-oral route and respiratory route
- Highly infectious, ubiquitous infection in absence of immunization
- Paralysis is a rare outcome (<1%)





Range of Symptoms with Infection



The Global Polio Eradication Initiative (GPEI)



- **1988 World Health Assembly Resolution**
- **Headed by national governments with five leading partners**
 - World Health Organization (WHO)
 - Rotary International
 - Centers for Disease Control and Prevention
 - United Nations Children's Fund (UNICEF)

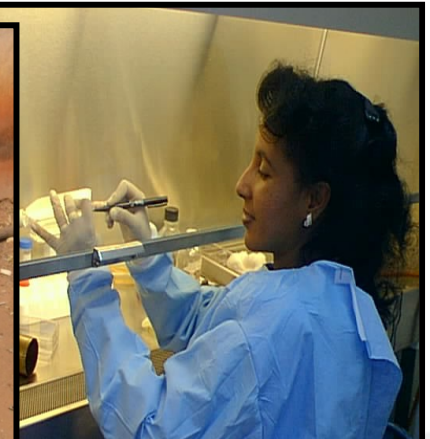


BILL & MELINDA
GATES foundation

The Global Polio Eradication Initiative: *The 4 Key Strategies*



1. Routine Immunization



4. Surveillance



**2. Supplemental
Immunization
Activities (SIAs):
National / subnational**



3. SIAs: Mop-ups

Progress: Four WHO Regions Certified Polio-Free



1991: Luis Fermín
Tenorio Cortez, last
case in the
Americas (Peru)



1997: Mum
Chanty, last
case in the
**Western Pacific
Region**
(Cambodia)

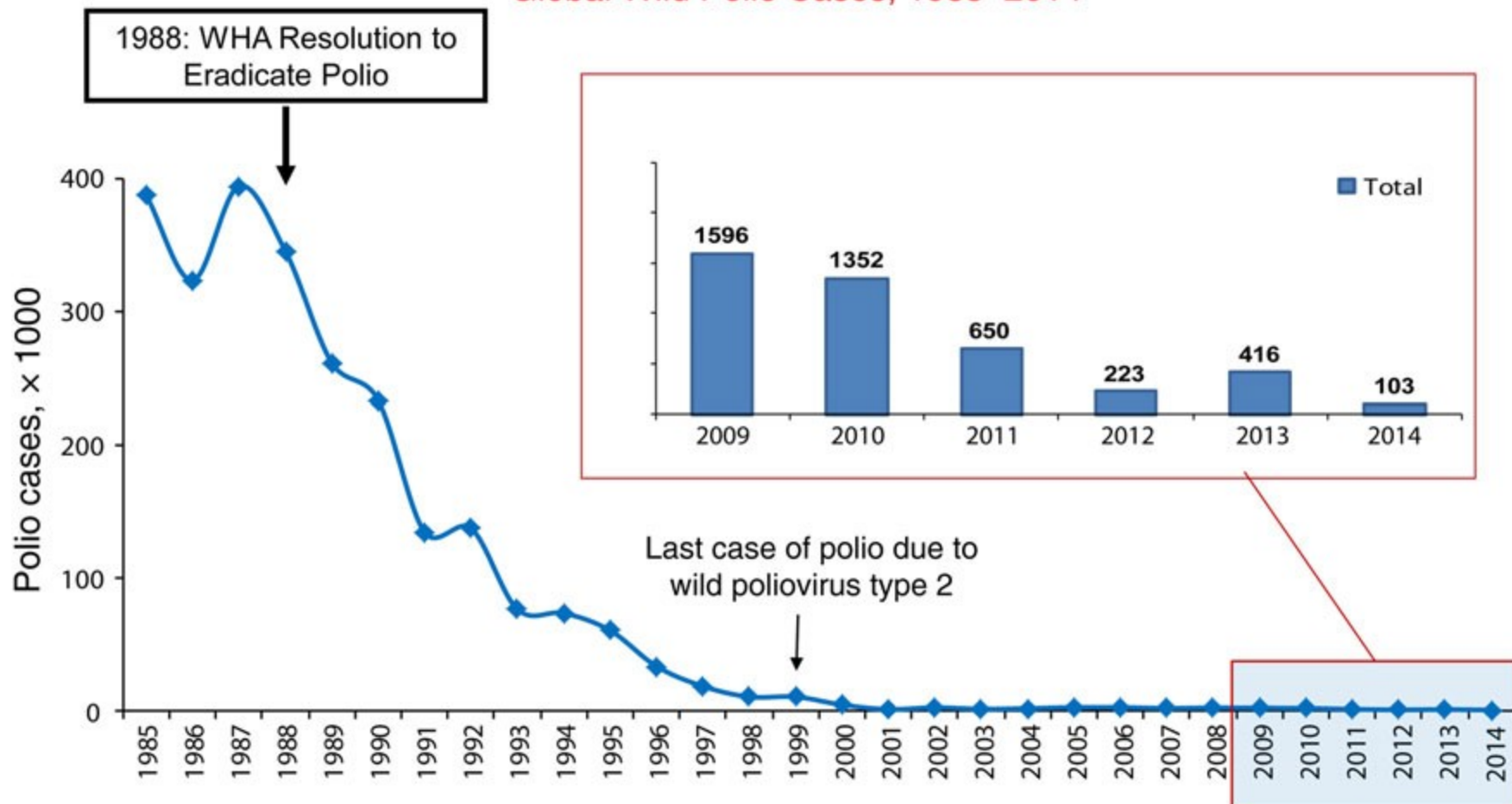


1998: Melik
Minas, last
case in
Europe
(Turkey)



2011: Rukhsar
Khatoon, last case
in **Southeastern
Asia Region**
(India)

Global Wild Polio Cases, 1985–2014



Polio training Yemen 2012



The Legacy: Remember.....

- **>13 million cases of polio prevented (since 1988)**
- **>650,000 deaths from polio prevented**
- **>1.5 million deaths prevented by vitamin A use**
- **By 2035, \$US 40-50 billion saved***

*Duintjer Tebbens et al: *Vaccine 2010*, "Economic Analysis of the Global Polio Eradication Initiative,"

Poliovirus Strains

- **Sabin strains contained in OPV are derived from wild poliovirus (WPV)**
 - **Attenuation: Mutations in genome induced by lab manipulation**
- **Attenuation results in:**
 - **Reduced ability to cause paralysis (neurovirulence)**
 - **Reduced capacity to pass from person to person (transmissibility)**
 - **Similar induction of antibodies (serum, pharynx, intestine)**



Poliovirus Strains

- **However, attenuation makes Sabin strains genetically unstable**
 - Tend to revert to strains similar to WPV, more fit to survive
 - Some of these “revertant” strains are called “Vaccine-Derived Poliovirus”



Vaccine-Derived Poliovirus (VDPV)

- **Definition: Poliovirus with high divergence from Sabin virus**
 - Divergence results from prolonged replication in one or multiple individuals
 - Identification only through genetic sequencing in the laboratory
- **By consensus, virus are considered VDPVs if they have the following degrees of divergence from Sabin strains:**
 - Types 1 and 3: ≥ 10 nucleotide changes from Sabin ($>1\%$ difference)
 - Type 2: ≥ 6 nucleotide changes from the Sabin strain
- **Viruses with less divergence from Sabin strains may be called pre-VDPVs or vaccine-related poliovirus (VRPVs).**
 - No need to worry about these in the field

How Do Sabin Polioviruses Revert?

- **Replication of Sabin strains in the intestine (and shedding in stools):**
 - Necessary to induce immunity against polio
 - Stops when local antibodies appear
 - Duration:
 - zero to few days in immune individuals
 - several weeks in susceptible individuals
- **During replication Sabin viruses mutate into different variants**
 - Variants that regain characteristics of wild are more fit to survive
- **Prolonged replication facilitates emergence of variants with characteristics of wild poliovirus**

Conditions that Favor Reversion of Sabin Strains

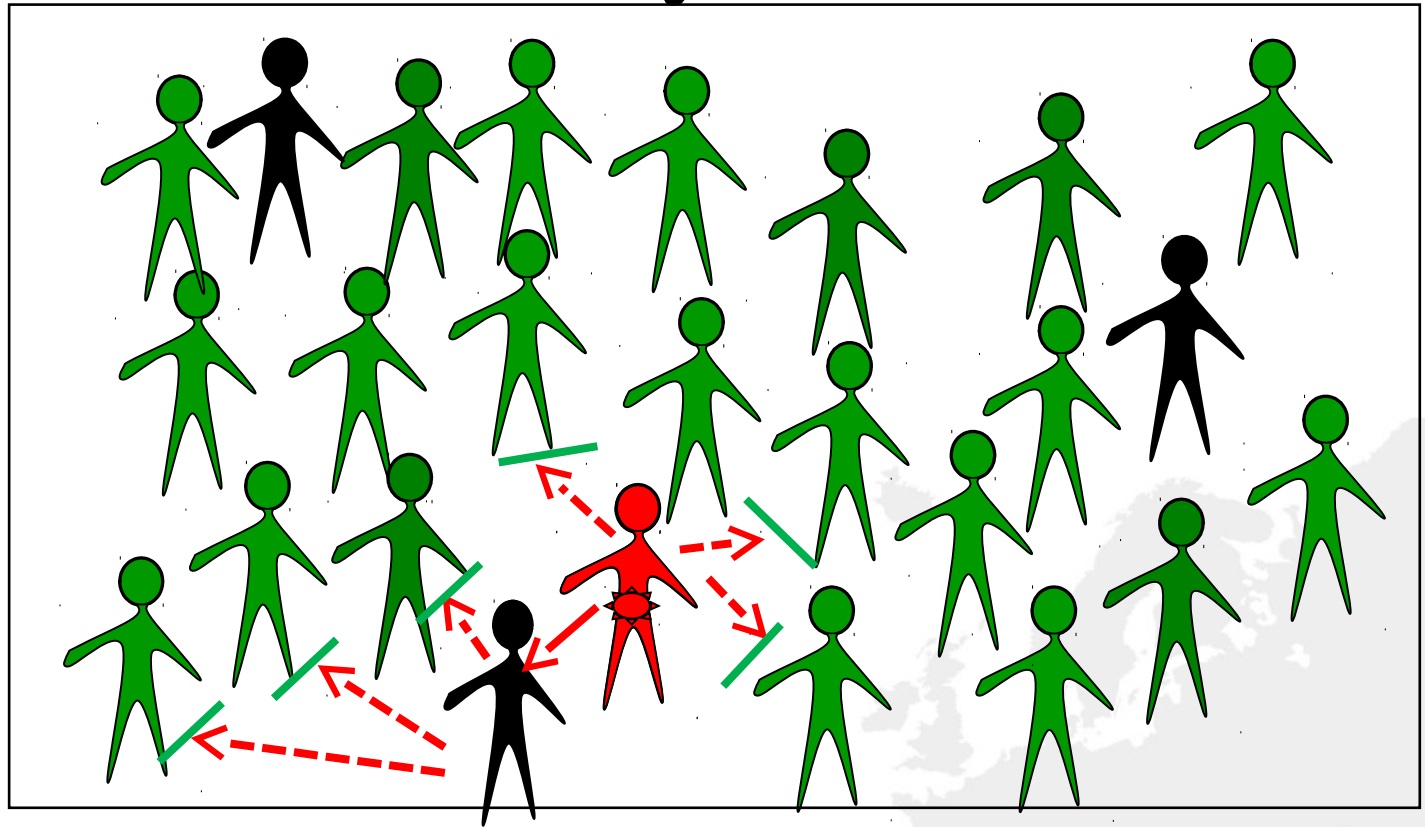
- **Prolonged replication in the same individual**
 - **Individuals with severe immunodeficiencies do not develop antibodies in serum or intestine**
 - **Replication and shedding in stools may last months or years**
 - **Over the years some children develop iVDPV**
 - Some shed iVDPVs without suffering paralysis**
 - Some develop AFP**
- **Prolonged replication and transmission within a population**
 - **Populations with high number of susceptible individuals allow person-to-person transmission of Sabin strains for a long time**

Unlikely Emergence of Revertant Strains if High Population Immunity

Immune

Susceptible

Just vaccinated



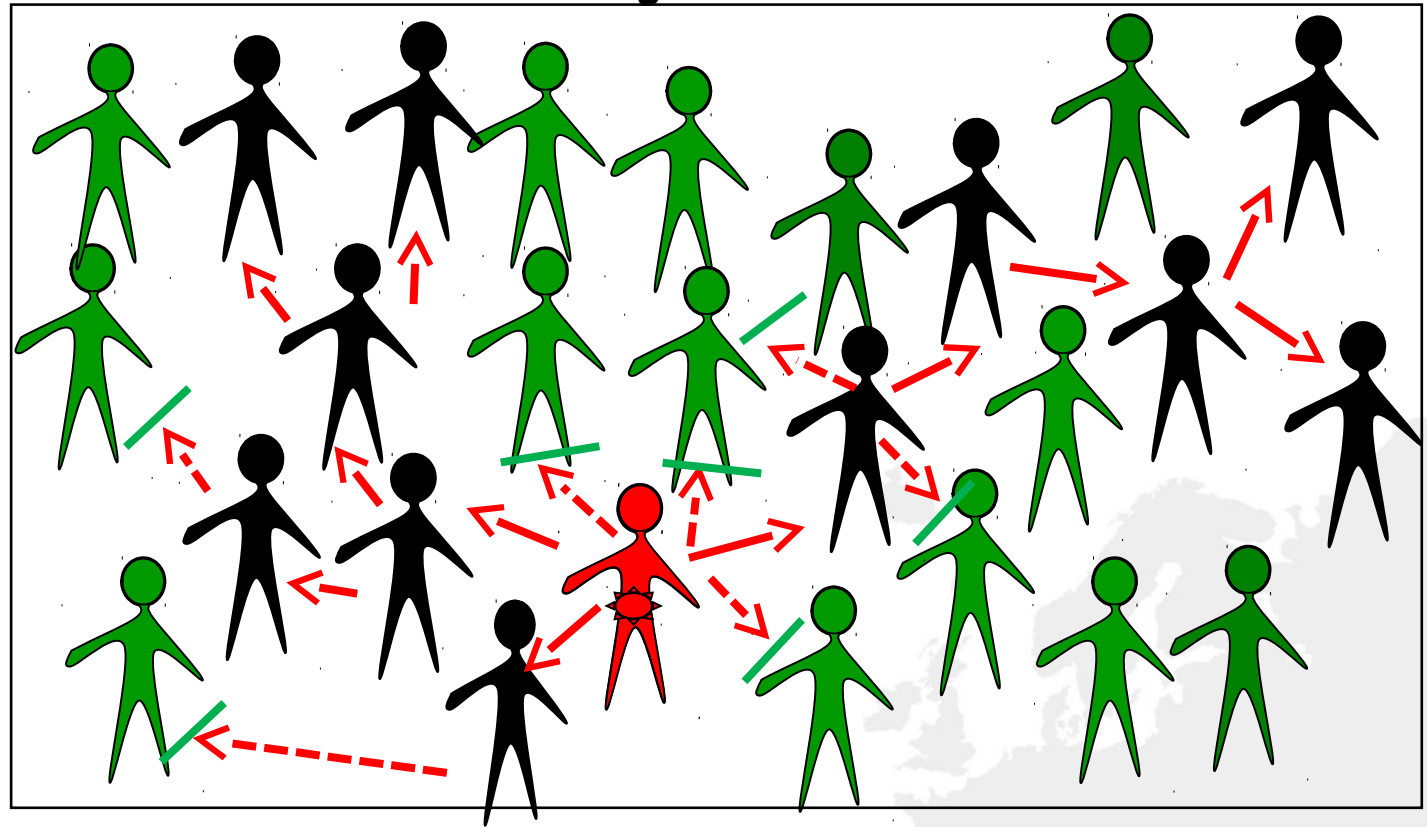
Vaccine poliovirus (Sabin) transmitted to close contacts – if most of them are immune, transmission of Sabin virus stops within a few weeks.

Likely Emergence of Revertant Strains if Low Population Immunity

Immune

Susceptible

Just vaccinated



Vaccine poliovirus (Sabin) is transmitted to close susceptible contacts – replication continues as Sabin virus passes through new contacts – circulating vaccine-derived polioviruses emerge

Circulating VDPVs (cVDPVs)

- **Detected in**
 - **Stools of AFP cases**
 - **Stools of healthy contacts**
 - **Environmental surveillance**
- **cVDPVs behave like WPV biologically**
 - **Similar neurovirulence to the same serotype**
 - **Potential for sustained circulation and for causing outbreaks**
- **Type 2 cVDPVs have been the most frequently identified in AFP cases and in environmental surveillance**

Risk Factors for cVDPVs

1. Low population immunity

No wild poliovirus circulation for several years

Low routine immunization coverage, pockets of unimmunized individuals

2. Factors that facilitate poliovirus transmission

Crowding

Poor sanitation

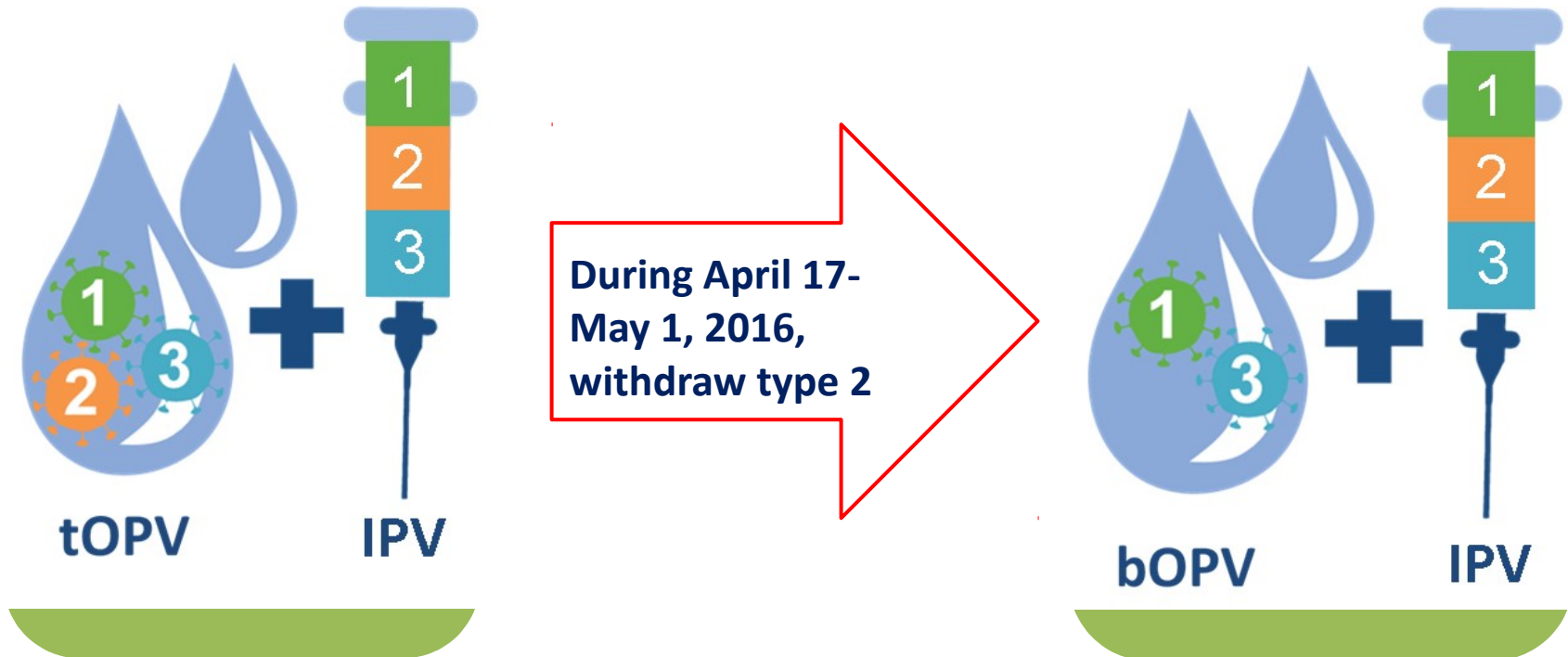


Time to detect

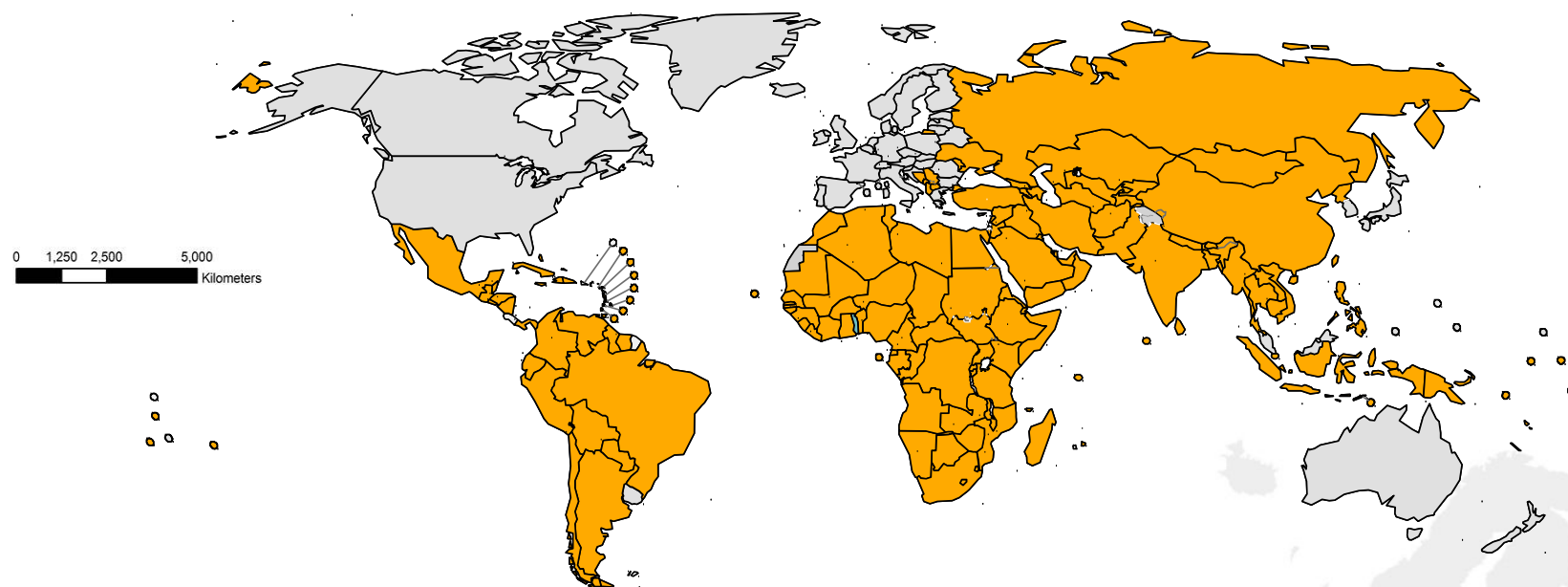
- In High IPV coverage Countries
- Assuming borderline transmission ($R = 1$ to 1)
- Before a case of AFP is detected :
- From a minimum of 300 up to 500 days of poliovirus silent transmission should occur
- And infect from 300 to 1500 individuals asymptotically
- **The only way to capture the virus before is Environmental surveillance**

Bencsko et Ferency
Epidemiol Infect 2016

tOPV to bOPV Switch



Countries Participating in the Switch



- Countries switching from trivalent to bivalent OPV (144 countries)
- Not available/ non switch countries (46 countries) + 4 countries switching from tOPV to IPV
- Not applicable (switch area territories)

Data source: WHO/IVB Database, as of 01 March 2016
based on 148 OPV user countries and 7 Territories
Map production Immunization Vaccines and Biologicals (IVB),
World Health Organization