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Eradication and Control Programs: A Look at Polio

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Overview of Presentation

1. Background on Disease Eradication
2. Background on Polio
3. Background on Polio Vaccines
4. Background on Global Polio Eradication Initiative
5. Examining Polio Eradication Strategies through a Case Study of India – 2 Main Strategies:
    A. Immunizations (routine, mass campaigns, mop-up)
    B. Surveillance
6. Cultural Considerations

Background on Disease Eradication

Disease Eradication vs. Elimination vs. Control

- **Eradication:** Reduction of the worldwide incidence of a disease to zero as a result of deliberate efforts. Once eradication occurs, intervention measures are no longer needed. True eradication usually eliminates the microorganism itself completely from nature
- **Elimination:** Refers to cessation of transmission of a disease in a single country, continent, or other limited geographic area, rather than global eradication. Continued measures to prevent reestablishment of transmission are required because the disease can be imported and re-introduced from other parts of the world
- **Control:** Reduced incidence or prevalence of a disease or condition; control measures are continually required

Source: www.cartercenter.org/health/itfde/program_definition.html

Three Types of Criteria for Eradication

1. Biological and technical feasibility
2. Economic costs and benefits
3. Societal and political considerations

Source: www.pubmedcentral.nih.gov/picrender.fcgi?artid=1446384&blobtype=pdf

Biologic and Technical Feasibility

- **Epidemiologic vulnerability** (e.g., no nonhuman reservoir; ease of transmission; naturally induced immunity; ease of diagnosis; and relapse potential)
- **Effective, practical intervention available** (e.g., vaccine or other means of eliminating vector). Intervention should be effective, safe, inexpensive, long-lasting, and easily administered
- **Demonstrated feasibility** (e.g., documented elimination from a geographic area)

Source: www.cdc.gov/mmwr/PDF/rr/rr4216.pdf

Economic Costs and Benefits

- **Expected cost of eradication** (especially in relation to perceived burden from the disease)
- **Potential for added benefits or savings** (i.e. improved immunization, improved surveillance, better sanitation, improved health education, etc)
- **Necessity for eradication rather than control**: (Are costs of long term control efforts very high? Is it more cost-effective to eradicate and no longer have to continue interventions?)

Source: www.cdc.gov/mmwr/PDF/rr/rr4216.pdf

Societal and political considerations

- **Public health importance** and perceived burden of the disease
- **Perceived benefits** expected from eradication
- **Broad international appeal** (perceived relevance to rich and poor countries)
- **Political commitment** (must be gained at the highest levels, along with buy-in at regional and local levels)
- **Resources** (a clear commitment of resources from international sources. Eradication efforts should not detract resources from or undermine the general health infrastructure of a country)
- **Cultural barriers** (cultural issues should be evaluated)

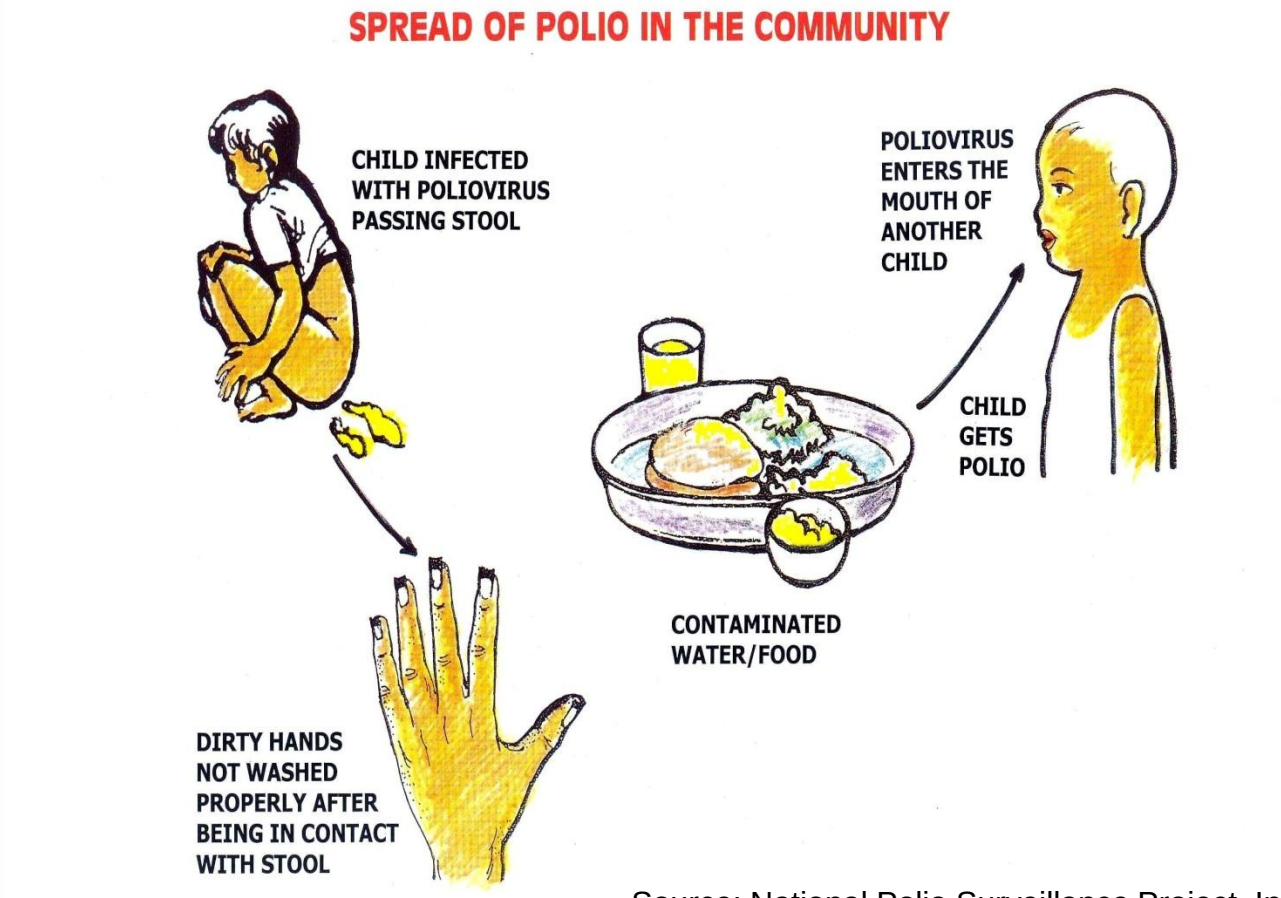
Source: www.cdc.gov/mmwr/preview/mmwrhtml/su48a7.htm

Background on Polio

About Polio

- Poliomyelitis (polio) is caused by an enterovirus
- It has no nonhuman reservoir
- It invades the nervous system, and can cause total paralysis
- It can strike at any age, but affects mainly children under 5
- There is no cure for polio; it can only be prevented through immunization, hygiene, and sanitation

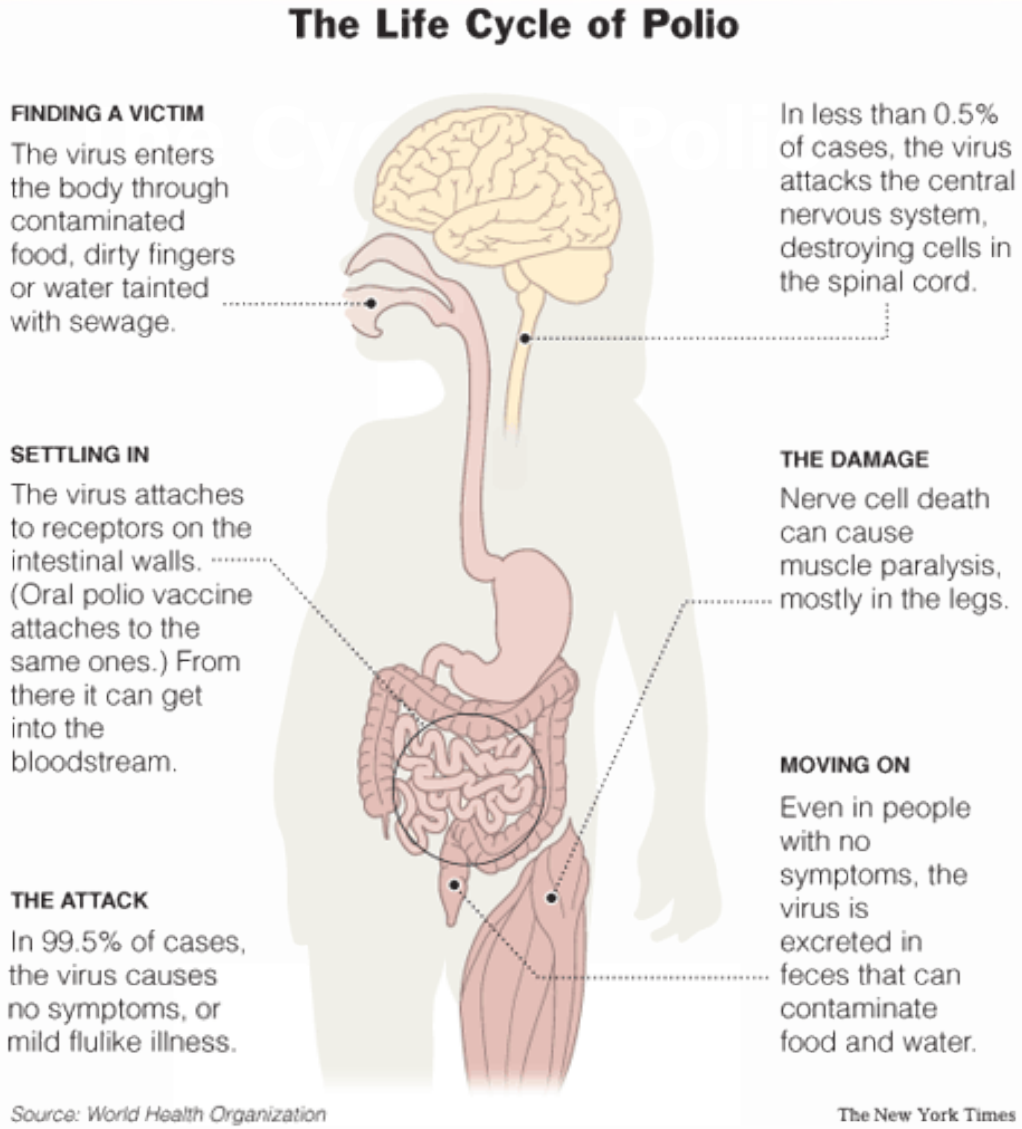
Polio spreads through fecal-oral route



Source: National Polio Surveillance Project, India www.npspindia.org

Polio Infections

- Polio is highly infectious
- 90-95% of those infected with the virus remain asymptomatic
- Because so many people are asymptomatic, they can go around spreading polio to others without even realizing it



Source: www.nytimes.com/imagepages/2006/03/19/international/20060320_POLIO_GRAPHIC_2.html

Pathophysiology

- The virus enters the body through the mouth and multiplies in the intestine
- Once established in the intestines, poliovirus can enter the blood stream and invade the central nervous system, destroying motor neurons. This only occurs in a small percentage of cases

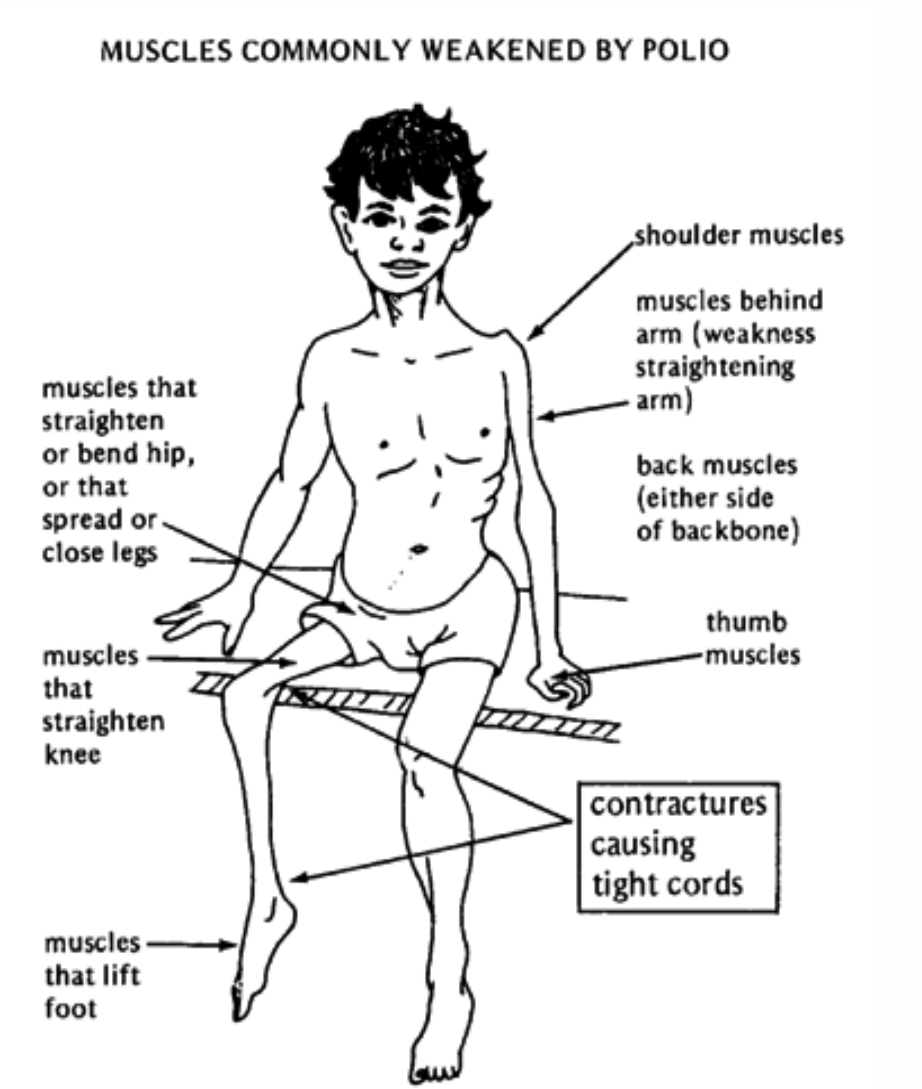
Symptoms of Polio

- In the 4-5% of cases which are symptomatic, the illness appears in three forms:

1. **Abortive polio**: mild form; upper respiratory infection, vomiting, diarrhea, fever malaise
2. **Non-paralytic polio**: aseptic meningitis (1% to 5% exhibit photophobia and neck stiffness)
3. **Paralytic polio**: severe, debilitating form (0.1% to 2% of cases). The virus destroys motor neurons, leading to acute flaccid paralysis (AFP).

Paralytic Polio

- There are 3 serotypes of poliovirus (types 1, 2, and 3). In countries where poliovirus is still endemic, paralytic disease is most often caused by type 1, less frequently by type 3, and least frequently by type 2
- Usually paralysis occurs in the legs; in more severe cases muscles of abdomen, thorax, or even brainstem (bulbar polio) can be affected



Source: www.dinf.ne.jp/doc/english/global/david/dwe002/dwe002g/dwe00209g01.gif

History of Polio in the United States

- Large outbreaks in first half of 20th century
- In 1916, New York City alone had 9,000 cases and 2,343 deaths due to polio
- In early 1920's, future President Franklin D. Roosevelt contracts paralytic polio
- In late 1920's, "iron lung" was developed to help people breathe if they developed paralysis of chest muscles
- 1950's – polio vaccine developed, and cases begin to drop as population vaccinated. Now U.S. is no longer a polio-endemic country.

Background on Polio Vaccines

Polio Vaccines

- **Polio cannot be cured; only prevented through vaccines. 2 types of vaccines:**
  - **Oral Polio Vaccine** (OPV) – live, attenuated virus; orally administered; also called Sabin vaccine
  - **Inactivated Polio Vaccine** (IPV) - killed virus; injection instead of oral; also called Salk vaccine

Oral Polio Vaccine (OPV)

- **Advantages:** antibodies produced in blood **and** in intestinal mucous membranes (decreases person-to-person transmission); does not need health professional or injection equipment to administer; inexpensive
- **Disadvantages:** Vaccine-associated polio paralysis (VAPP) - In extremely rare cases (approx. 1 in every 2.5 million doses of the vaccine) the live attenuated vaccine virus in OPV can cause paralysis

Inactivated Polio Vaccine (IPV)

- **Advantages:** dead virus, so no risk of vaccine-associated polio paralysis
- **Disadvantages:** Does not confer intestinal immunity (only produces antibodies in blood). Helps with individual immunity but virus can still multiply inside the intestines and be shed in stools, risking continued circulation in the population. Also, it requires healthcare professionals and injection equipment to administer

Choice of Vaccine

- In the U.S, where polio is no longer endemic, IPV is used (because the risk of VAPP may outweigh the risk of acquiring wild polio)
- In most endemic countries, OPV is used because it is easier and cheaper to administer, and the risk of VAPP is small compared to the risk of acquiring wild polio)

Cold Chain

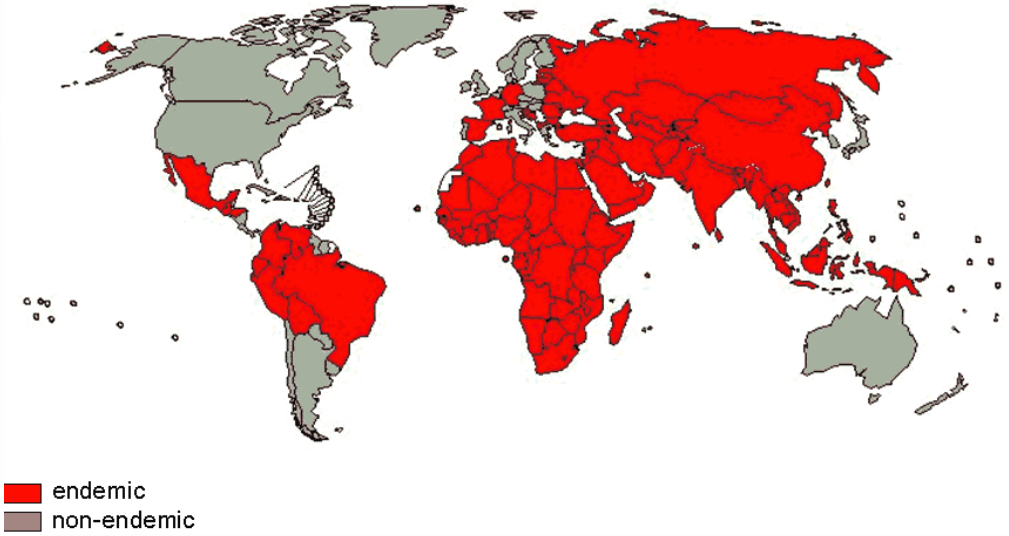
- A series of points that keep the vaccine cold and viable as it travels from manufacturer to child
- Each link in the chain, from warehouse to clinic, is equipped with freezers and, if possible, emergency electrical generators
- In polio-endemic countries, resources and infrastructure are often lacking, and maintaining the cold chain can be difficult. In the field, vaccine vial monitors (VVM) are now often used to indicate vaccine damage

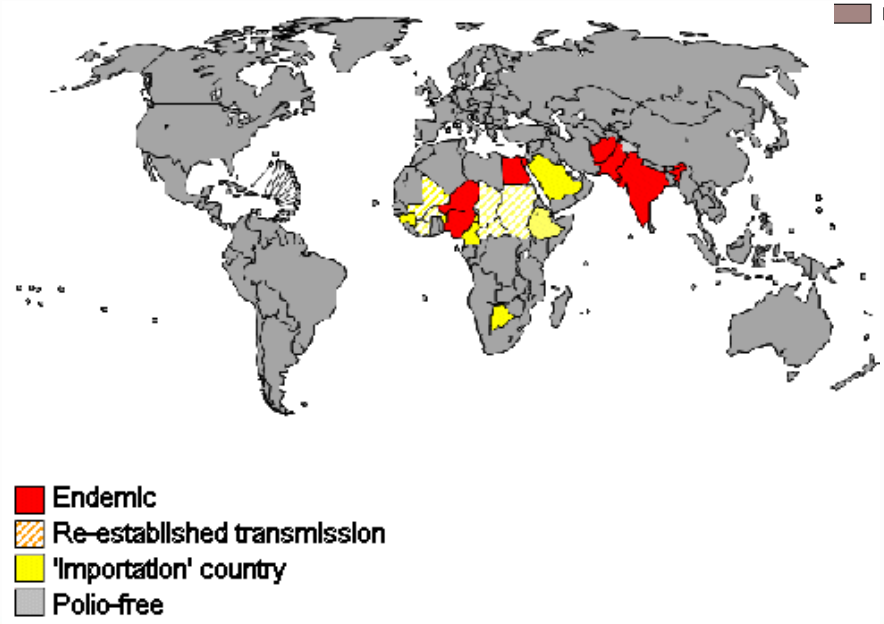
Background on Global Polio Eradication Initiative

Global Polio Eradication Initiative

- **1988**: World Health Assembly voted to launch Global Polio Eradication Initiative. At the time, 125 countries on five continents were polio-endemic, leading to paralysis in more than 1000 children every day.
- **Late 2003**: Polio eradicated from all but 6 countries (Nigeria, India, Pakistan, Niger, Afghanistan, Egypt)
- **2004-2006**: Egypt and Niger removed from list of endemic countries, but some other African countries re-infected

Global Polio Status in 1998





Global Polio Status in 2004

Source: www.polioeradication.org/progress.asp

Countries with highest polio case counts, 2008

Country	2008 case count
Nigeria	801
India	559
Pakistan	118
Chad	37
Afghanistan	31
Angola	29
Sudan	26
Niger	12

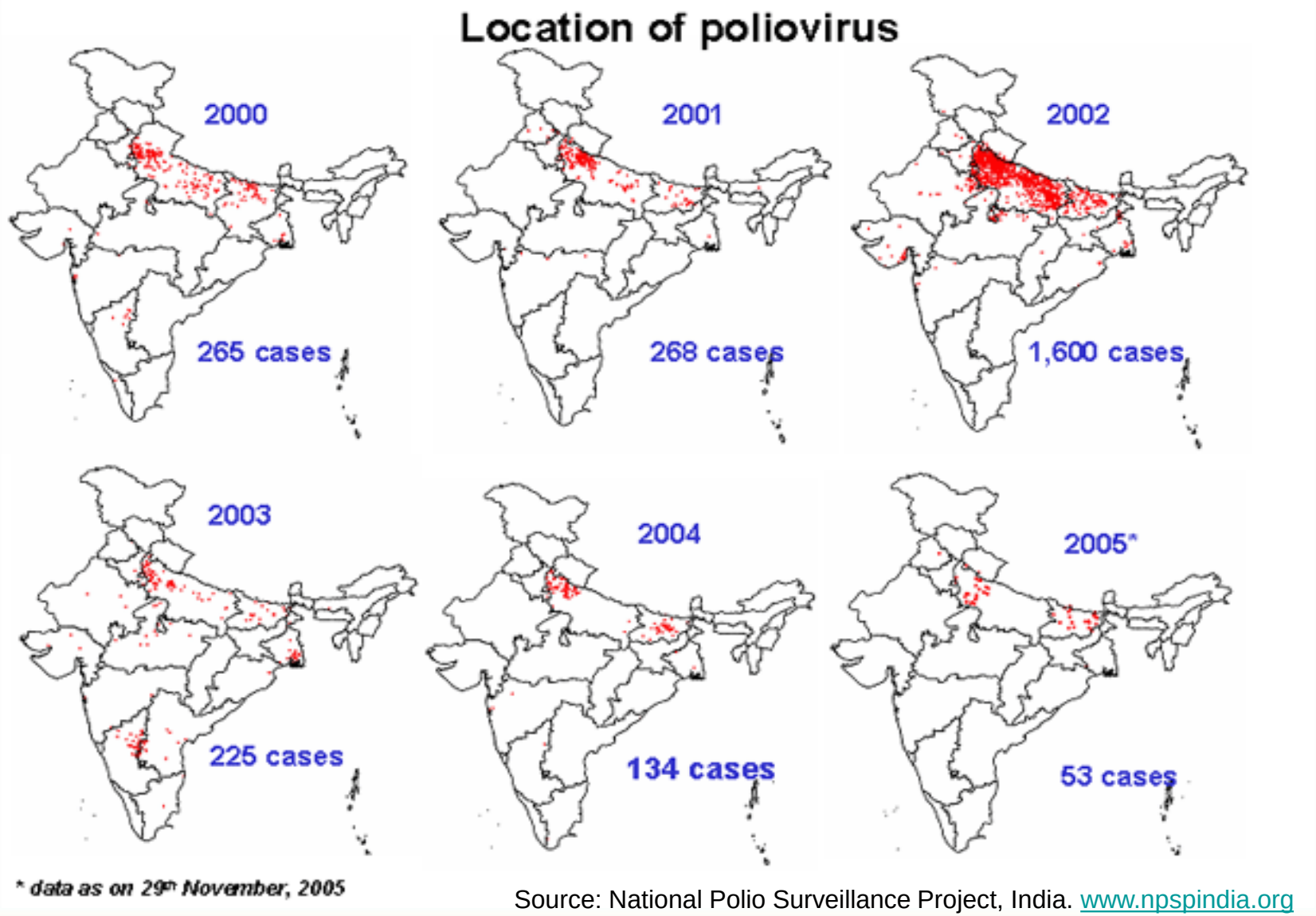
Source: www.polioeradication.org/casecount.asp

Examining Polio Eradication Strategies

A look at India as a case study

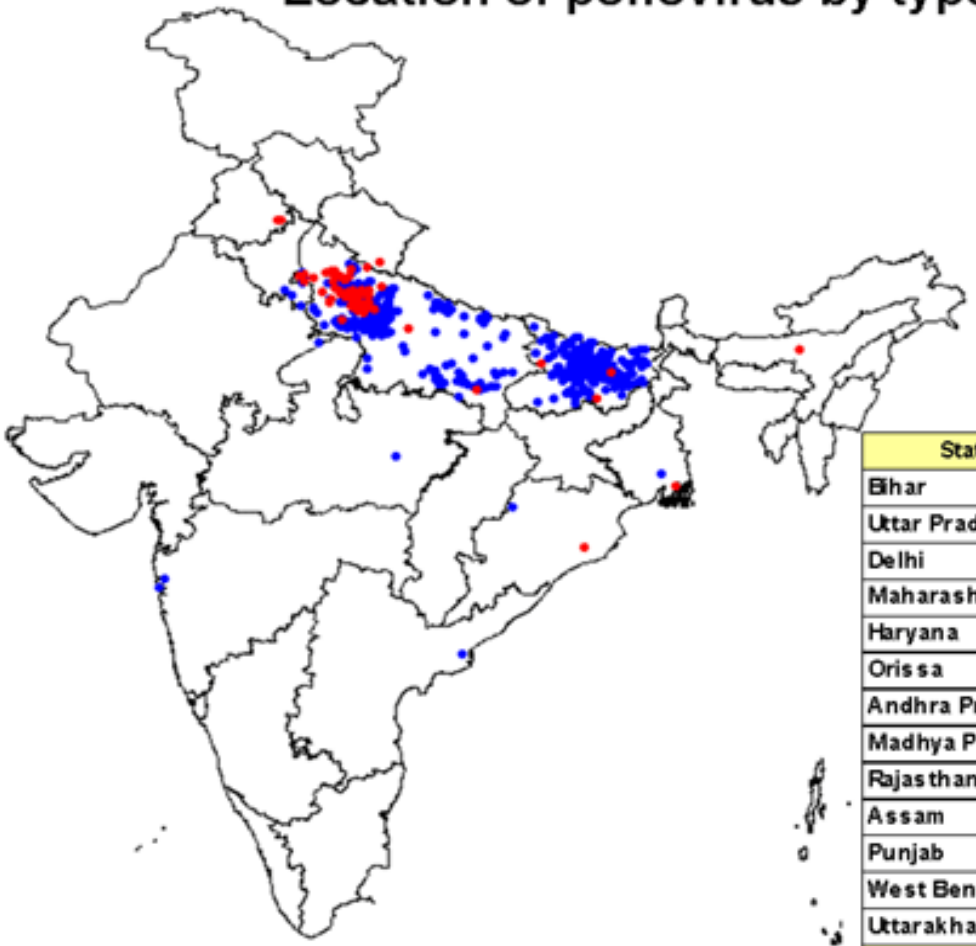
Polio in India

- Decreasing steadily since 1998, due to vaccination campaigns (National Immunization Days)
- Resurgence of polio in 2002, as number of vaccination campaigns were reduced.
- Since 2002, vaccination efforts have been intensified, and polio cases are again declining
- In 2005, only 2 states in Northern India (Uttar Pradesh and Bihar) were still reporting polio. The other states claimed to be polio-free.
- In 2006-2008, polio cases reported from other several other states that were previously polio-free



Source: National Polio Surveillance Project, India. www.npspindia.org

Location of poliovirus by type, 2008*



State	P1	P3	Total
Bihar	3	230	233
Uttar Pradesh	62	243	305
Delhi	4	1	5
Maharashtra	0	2	2
Haryana	0	2	2
Orissa	1	1	2
Andhra Pradesh	0	1	1
Madhya Pradesh	0	1	1
Rajasthan	0	2	2
Assam	1	0	1
Punjab	2	0	2
West Bengal	1	1	2
Uttarakhand	1	0	1
Total	75	484	559

** data as on 6th March 2009*

Source: National Polio Surveillance Project, India. www.npspindia.org

Eradicating Polio

Main activities for eradicating polio:

1. Immunizations
2. Surveillance

Polio Eradication Strategy 1: *Immunization*

3 types of immunization activities used:

- Routine Immunization
- Mass immunization campaigns
- “Mop-up” Immunization

Routine Immunizations

- Goal is to achieve high infant immunization coverage, throughout the population, with four doses of OPV in the first year of life`

Mass Immunization Campaigns:

- Conduct “National Immunization Days” to provide extra doses of vaccine to every child <5 years, often through a house-to-house, “find and vaccinate” approach
- Goal is to catch children who are either not immunized or to boost immunity in those who have been immunized. Also, to flood the community with vaccine and interrupt virus transmission

"Mop-up" Immunization

- Implemented when the final geographic pockets of poliovirus transmission have been identified
- The campaigns involve door-to-door immunization in high-risk areas

A health worker gives supplementary OPV doses to children in rural India

Photo credit: Tista Ghosh

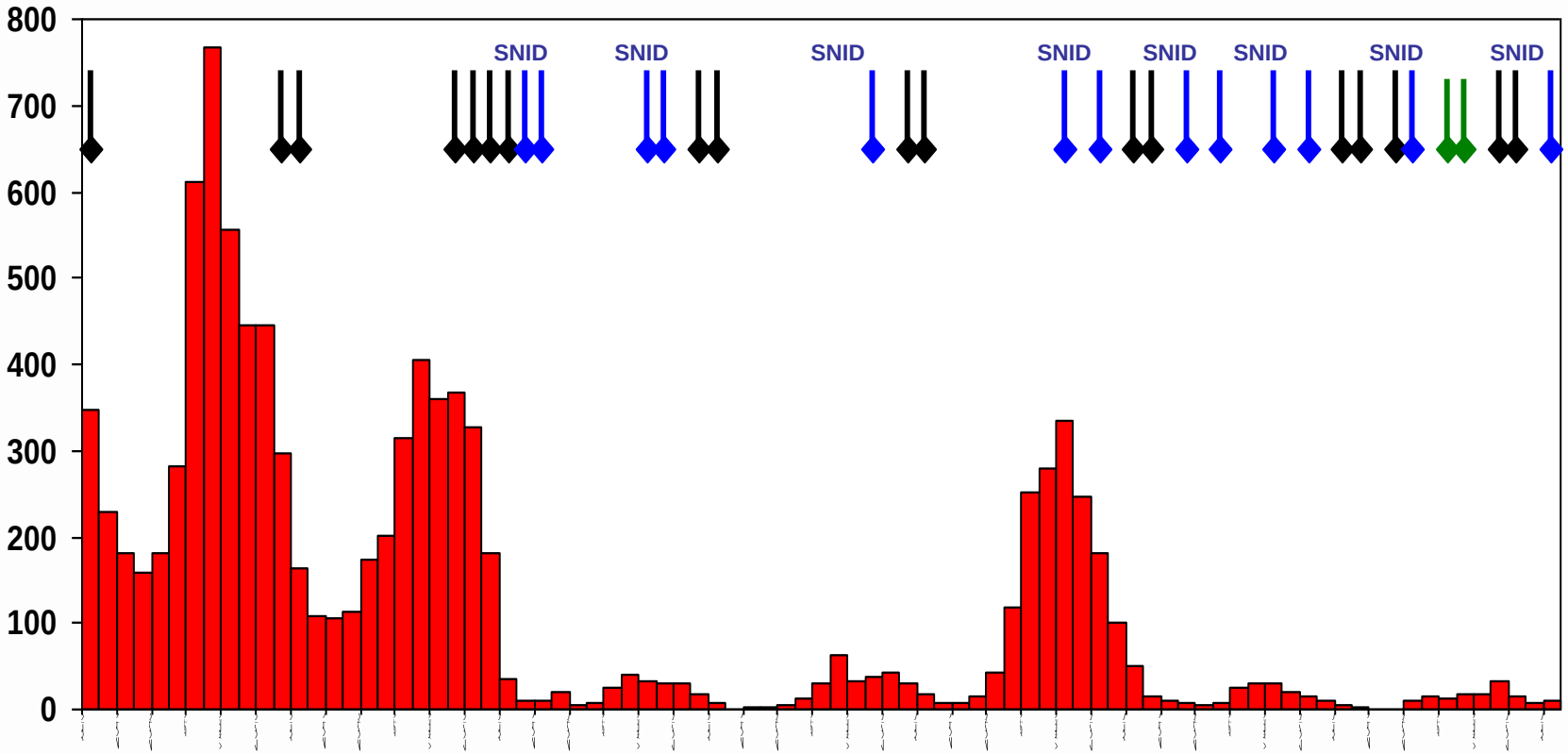
Immunization activities in India

- In India, “National Immunization Days” (NID) were implemented in the 1990’s. These campaigns attempted to seek out every child <5 across the country, in both rural and urban areas, to give supplementary OPV doses
- Additional “Sub-National Immunization Days” (SNID) were later added. These campaigns were conducted only in those states where case counts remained high

Immunization activities in India

- By 2000-2001, the strategies appeared to be working. Case counts were dropping. So the numbers of NIDs and SNIDs were reduced
- In 2002, a resurgence in polio cases were seen. The number of NIDs and SNIDs were increased once more, and the number of cases dropped in the following years

Cases of polio in India 1998 –2005



Source: National Polio Surveillance Project, India. www.npspindia.org

Polio Eradication Strategy 2: *Surveillance*

- Surveillance is the ongoing systematic collection and analysis of data on a certain disease and the use of this information to prevent and control the disease
- Intelligence network used to detect and track certain illness; often used to monitor infectious diseases

Surveillance

- Can be used to detect cases that are:
  - Infected with a lab-confirmed organism (i.e., polio virus, *E. coli* O157:H7)
  - OR showing signs of a clinical syndrome (i.e., acute flaccid paralysis, hemolytic-uremic syndrome). This is known as syndromic surveillance.

Surveillance

- In countries with good laboratories, surveillance of laboratory-confirmed organisms is used. But in many polio-endemic countries, laboratory resources are poor, so syndromic surveillance is often used.
- Once a clinical syndrome is reported, specimens are often sent to national or international laboratories for confirmation.

Acute Flaccid Paralysis (AFP) Surveillance

- World Health Organization (WHO) uses AFP surveillance to look for cases of polio in endemic countries
- Syndromic surveillance for any case of sudden flaccid (floppy) paralysis
- Goal is to cast a wide net (increase sensitivity) and capture as many polio cases as possible by keeping definition broad

Acute Flaccid Paralysis

- **Acute:** rapid progression of paralysis from onset to maximum paralysis
- **Flaccid:** loss of muscle tone, “floppy” – as opposed to spastic or rigid
- **Paralysis:** weakness, loss of voluntary movement

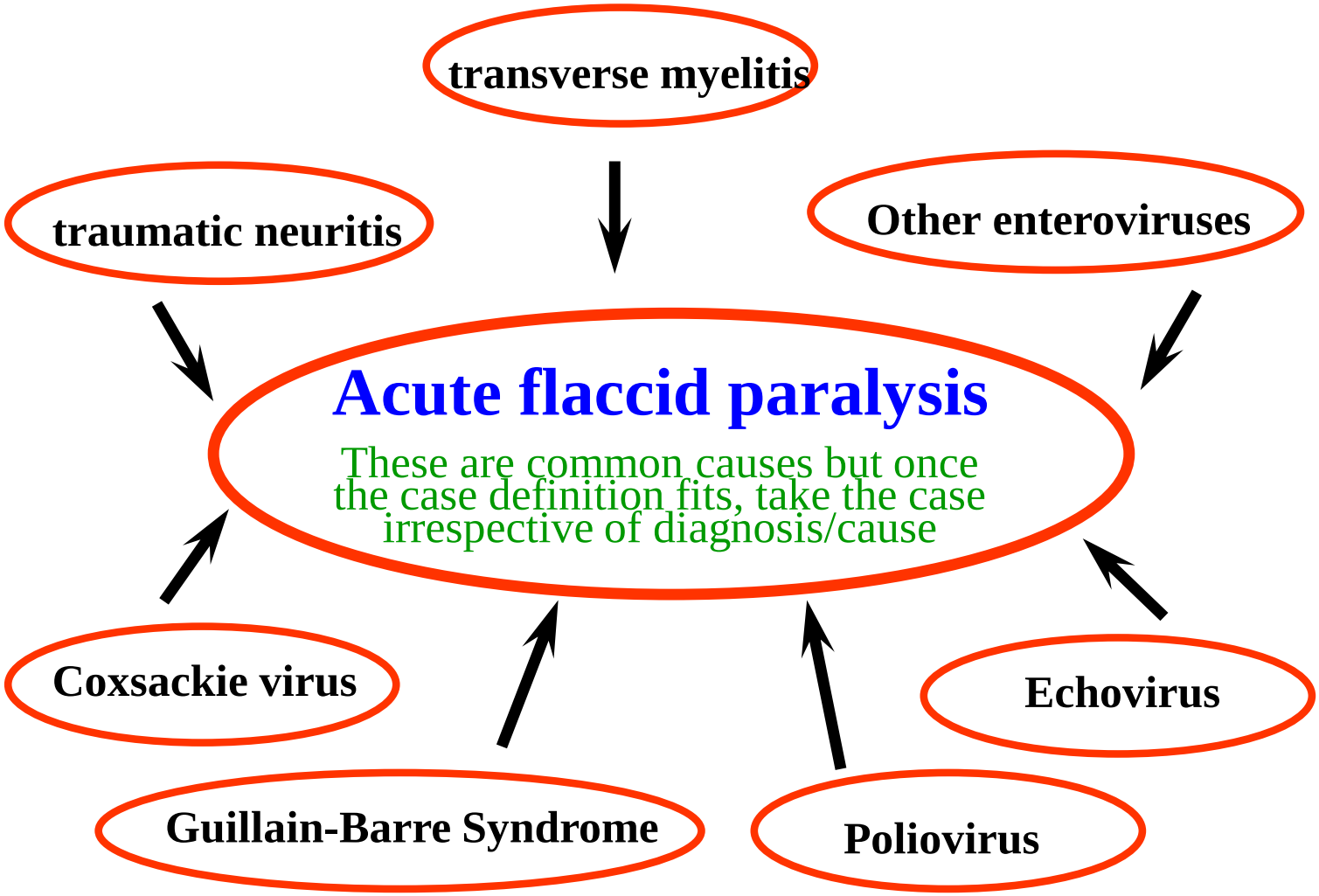
Source: National Polio Surveillance Project, India. www.npspindia.org

What is a case of AFP?

- Any child <15 years who has sudden onset of flaccid paralysis

or

- paralytic illness in a person of any age in which polio is suspected



Source: National Polio Surveillance Project, India. www.npspindia.org

AFP Surveillance

- Any case of AFP needs to be reported to WHO
- For example: If Clinician A has a pediatric patient with acute flaccid paralysis that she believes is due to traumatic neuritis, she **still** needs to report the case
- WHO then arranges to collect specimens from the patient and test for polio in their international laboratories
- Most of the AFP cases reported probably won't be polio. But WHO's goal is to cast a wide net so no polio cases missed

Examining a child with AFP in rural India

Photo credit: Tista Ghosh

AFP Surveillance Network in India

- **The following groups are asked to report AFP cases to WHO to try and capture the number of polio cases:**
  - Hospitals and other organized health clinics
  - Community-based physicians
  - Traditional healers (practicing alternative forms of medicine such as Ayurveda, homeopathy)

Surveillance Activities in India

- WHO has Surveillance Medical Officers stationed throughout India to follow-up on AFP reporting
- Additionally, outside consultants are often brought in to check up on the strength of the surveillance system and assess whether:
  - AFP cases are truly being reported
  - If health care providers truly understand AFP surveillance

India's Surveillance System - Gaps

In certain Indian states, problems with the surveillance system have been noted. These include:

- Reporting network inadequate, with few reporting units located in geographic areas with difficult access
- Traditional healers often not included in network. Yet these types of healers are often utilized heavily by the population
- Health care provider confusion on definition of AFP
- Missed cases of AFP, which may mean missed cases of polio`

The Importance of Surveillance

Gaps in surveillance lead to questions about:

- Increases or decreases in reported polio case numbers - are they true changes? Or do they simply reflect the strength or weakness of the surveillance system in a certain region?
- Are the eradication efforts truly working? Without accurate case reports, it may be difficult to say

Cultural Considerations

- Approximately 13% of India's population is Muslim
- A myth is being spread by a small group of Muslim clerics that the polio vaccination effort is part of a plot to sterilize Muslim children and lower the Muslim birth rate
- This myth is particularly rampant in Uttar Pradesh, one of the Indian states with the highest polio case counts
- Similar issues have been seen in some Muslim groups in Nigeria, Somalia, and other countries
- International Muslim leaders are working to dispel the myth

Take Away Lessons

- Polio eradication strategies rely on immunization efforts to increase a population's immunity and break transmission of the virus
- However, polio eradication strategies also rely on the strength of surveillance efforts to indicate whether the virus is still circulating in different regions of a country
- Cultural issues can affect eradication efforts. Recognizing and dealing with these issues are essential to the success of eradication campaigns

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