Polio Eradication

a reconsideration of strategy

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Expenditures – to date and projected

(from WHO web site)

- Global polio eradication is 19 years old
- Expenditures to date
  - International assistance $5,200,000,000
  - National budget costs $5,200,000,000+
  - >50 times the total cost of smallpox eradication
- Needed through 2009 (if all goes well)
  - At least $1,500,000,000 in international assistance plus equivalent or more in national expenditures
- Needed for 2009-2012 (confirmation phase) ?

Global Eradication Campaigns

***Hookworm**	Sanitary, treatment	1909-22	13
***Yellow Fever**	Vector control	1915-32	17
***Yaws**	Penicillin	1948-66	18
***Malaria**	DDT, treatment	1955-73	18
Smallpox	**Vaccine**	**1967-80**	**13**
Guinea Worm	Water: Rx	1986-	21+
Poliomyelitis	Vaccine	1988-	19+

***Failed**

Landmarks in polio eradication

- Program began in the Americas --1985
- Global program launched -- 1988
- Last cases
  - 1991 Americas
  - 1995 Europe
  - 1998 Western Pacific
- Expected occurrence of last case - 2009
- Certification of eradication - 2012

Polio, the disease – a perspective

- Clinical cases
  - Late 19th C. – a few scattered outbreaks described
  - 1941-51 (U.S.) -- 5000-15,000 paralytic cases/yr.
  - 1952 (peak, U.S.) -- 21,269 paralytic cases
- Developing countries
  - 1970 Not seen as a major problem*
  - 1988 350,000 cases (estimated)

*Compared to such as AIDs, measles, malaria, tuberculosis, diarrheal and respiratory problems

Why the special status of polio?

- From the 1930s, a special program in the U.S.
  - President Roosevelt, the March of Dimes, NFIP
  - Polio, of increasing relevance as other infectious diseases declined
- A dream of global eradication
  - Roles of Albert Sabin, Rotary, CDC, WHO
  - Principle: Industrialized countries to pay:

    developing countries benefit by strengthened EPI

Development of Polio Vaccines

- 1948 Tissue cell culture of poliovirus
- 1955 Inactivated poliovaccine – IPV (Salk)
- 1962 Live oral poliovaccine -- OPV (Sabin)

Characteristics – IPV and OPV

	IPV	OPV
Admin.	Needle	Oral
Cost	$ 3.30	~15 cents
95% protection	2 (3+)	3 (4-6)
Oral immunity	++++	++++
Intest. immunity	+	++++
Household spread	0	++++
Use in epidemic	No	Yes

- Smallpox was eradicated in 1980

- So why not polio? After all, there is a preventive vaccine for both and neither has an animal reservoir

Smallpox—much easier to eradicate

Smallpox

- Surveillance-Containment
  - Visible rash – all cases
  - Readily diagnosed
  - Minimal demand for lab
  - Targeted containment
- Epidemiology
  - Transmission only by cases
  - Moderately contagious

Polio

- 1/200 with paralysis
- Flaccid paralysis problem
- Heavy lab demand
- Area-wide campaigns

- Primarily by asymptomatic
- Very contagious

Smallpox and Polio Vaccines compared

Smallpox	Polio
– Heat stable	▪ Labile
– Production in endemic countries	▪ No
– One dose	▪ 4+ OPV: 3+ IPV
– One antigenic strain	▪ 3 virus strains
– Storage -at least 45 years	▪ c. 5 years

Polio eradication strategy

- Defined as “0” cases or isolates of wild poliovirus*
- An addition to the EPI
  - Industrialized countries to bear increment costs
- National immunization days -- 0 to 4 years
- Surveillance for acute flaccid paralysis
  - Isolation of virus from stool specimen
- Vaccination in area of a case
- “Mop-up” vaccination in high-risk areas

**Later redefined to include all vaccine-derived polioviruses*

Countries with polio – 2006

- No. confirmed cases (virus isolation) 2,000

  No. of infections ~400,000

- Land area (population) of polio endemic countries

  Seven countries* 3,814,000 mi² (1,443,831,000)

  USA 48 states 3,718,000 " (300,000,000)

  * India, Pakistan, Afghanistan, Nigeria, Somalia, Angola, Dem Rep of Congo

Countries with polio –2007

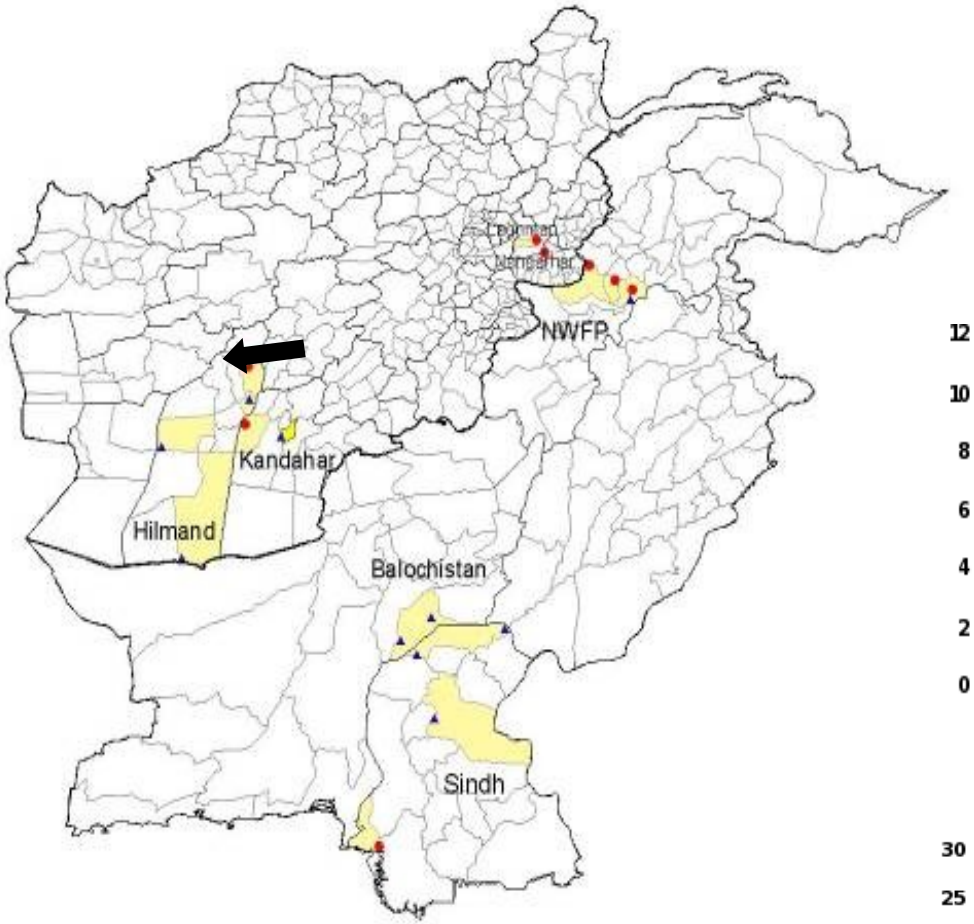
(notifications to WHO – 5 September)

Country	2007	2006 (YTD)
– India	185	258
– Nigeria	175	784
– Pakistan	12*	16
– Afghanistan	9*	26
– *Dem Rep Congo*	*26**	*8*
– *Angola*	*10**	*1*
– *Somalia*	*8**	*30*
– Other countries	19	59
– Total	444	1182

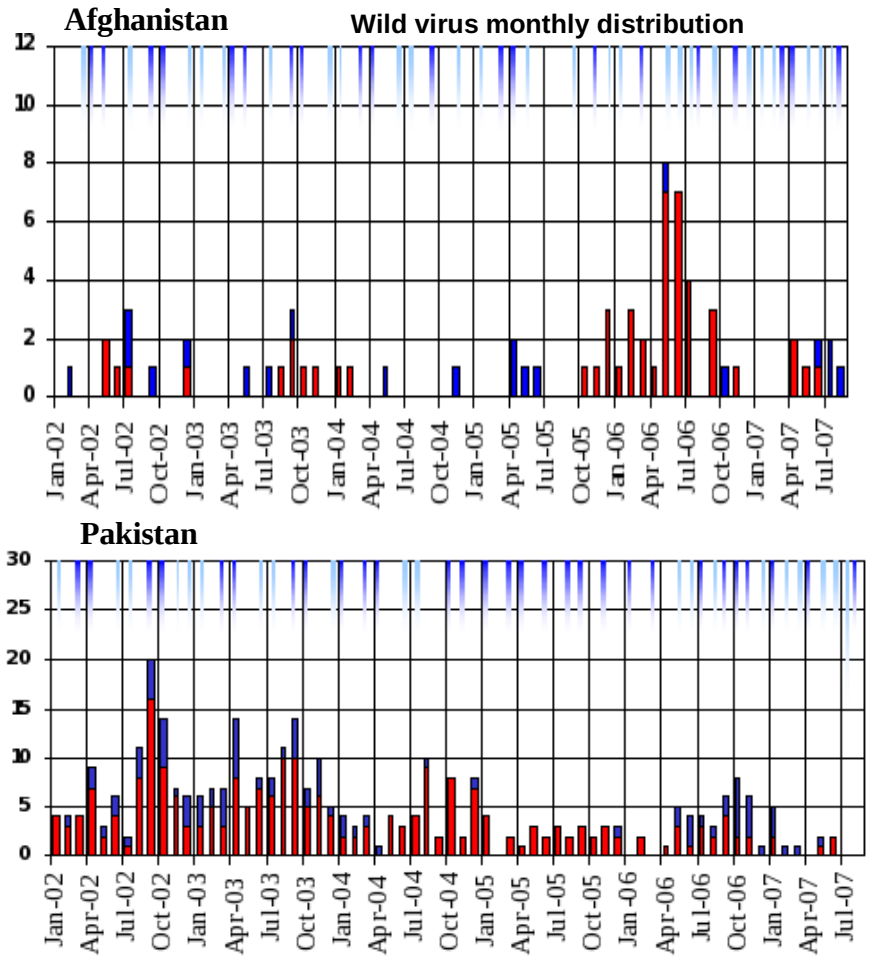
*Significant areas with limited surveillance

Afghanistan & Pakistan

Wild Poliovirus, 2007

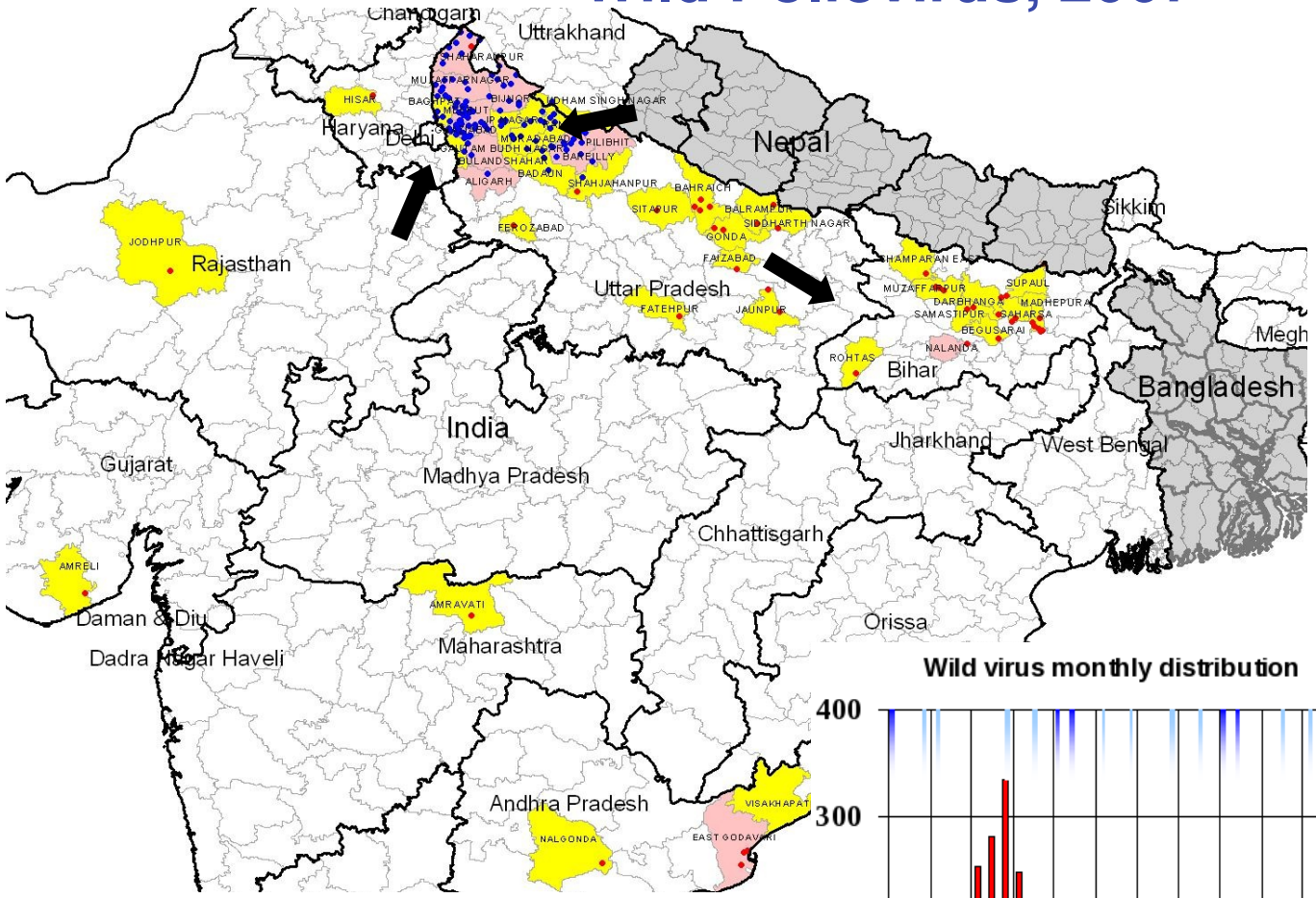


New district with wild virus



India

Wild Poliovirus, 2007

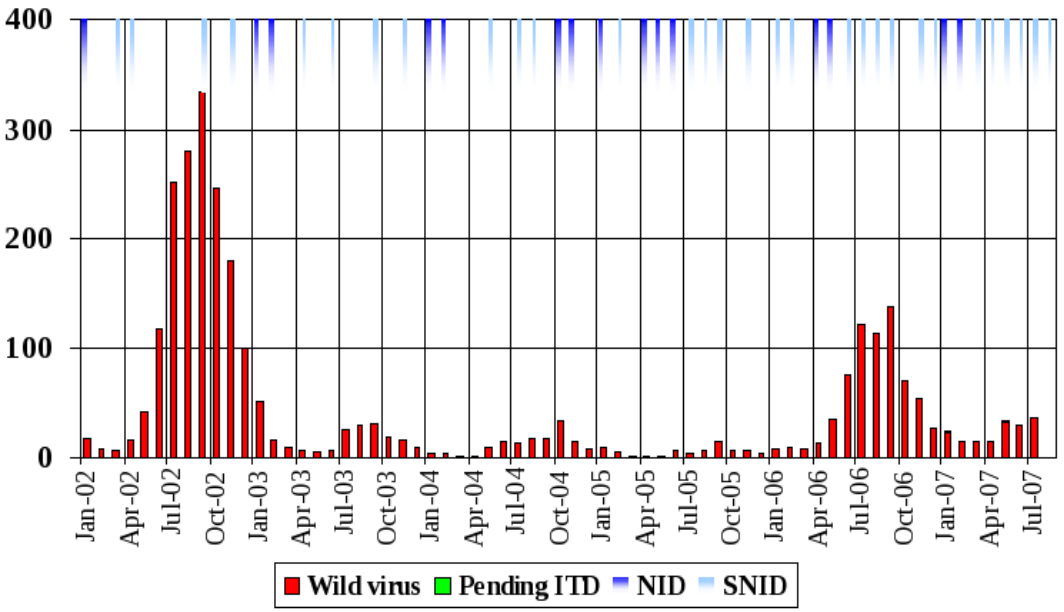


Districts with wild poliovirus in 2007

Districts with wild poliovirus in current week

New district with wild virus

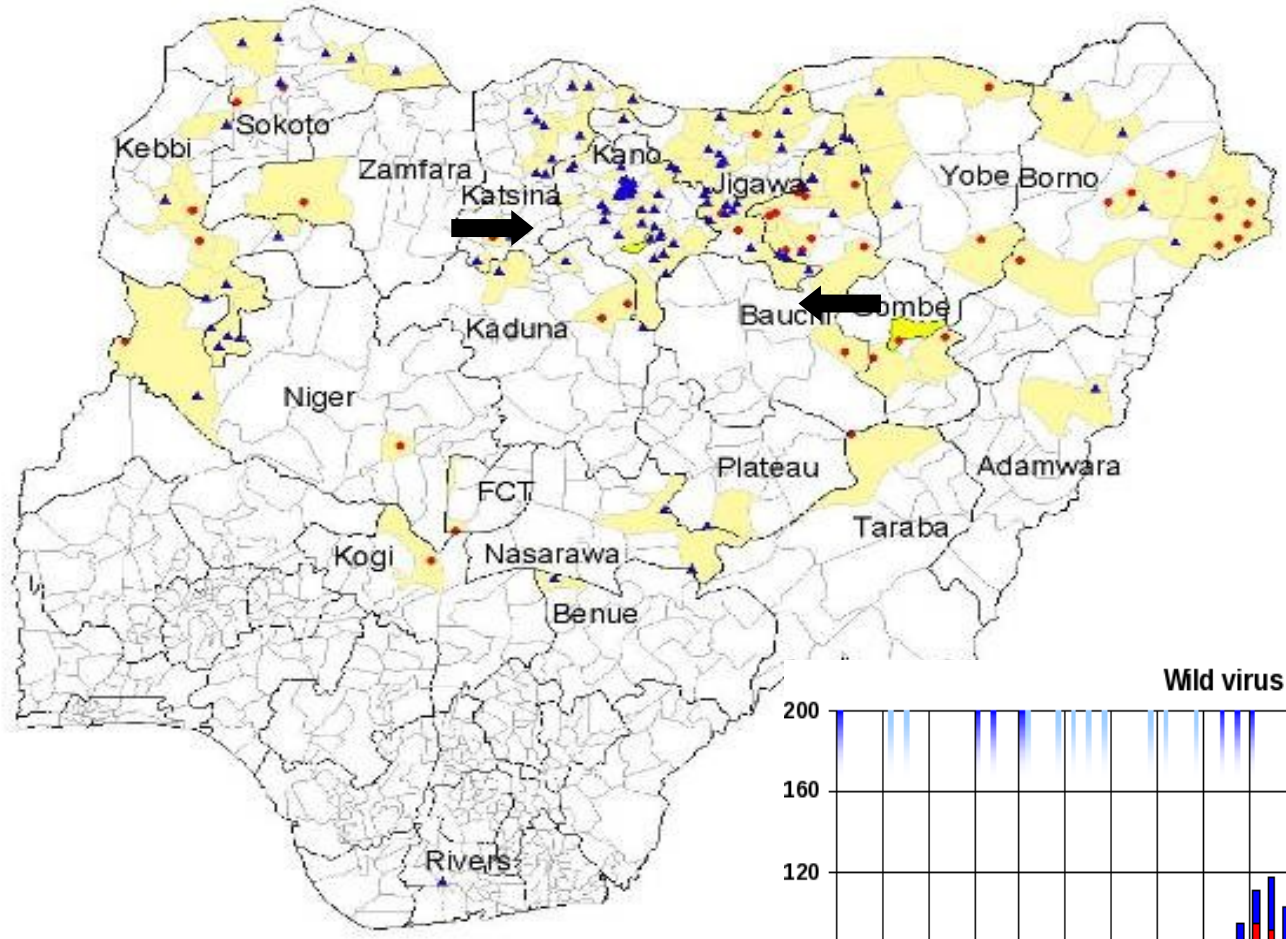
Wild virus monthly distribution

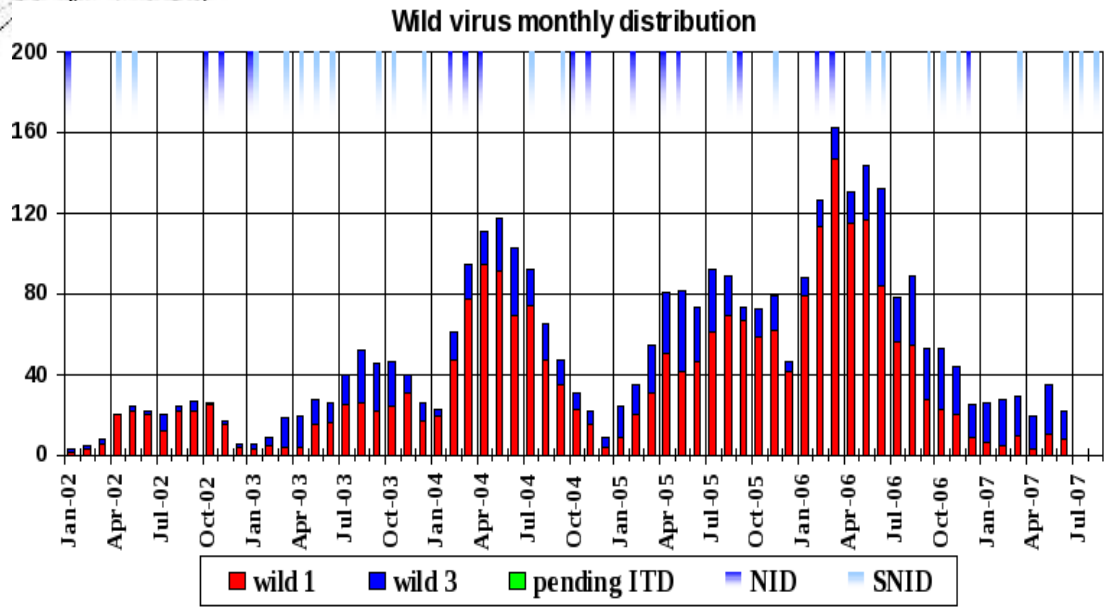


Data in WHO HQ as of 21 Aug 2007

Nigeria

Wild Poliovirus, 2007





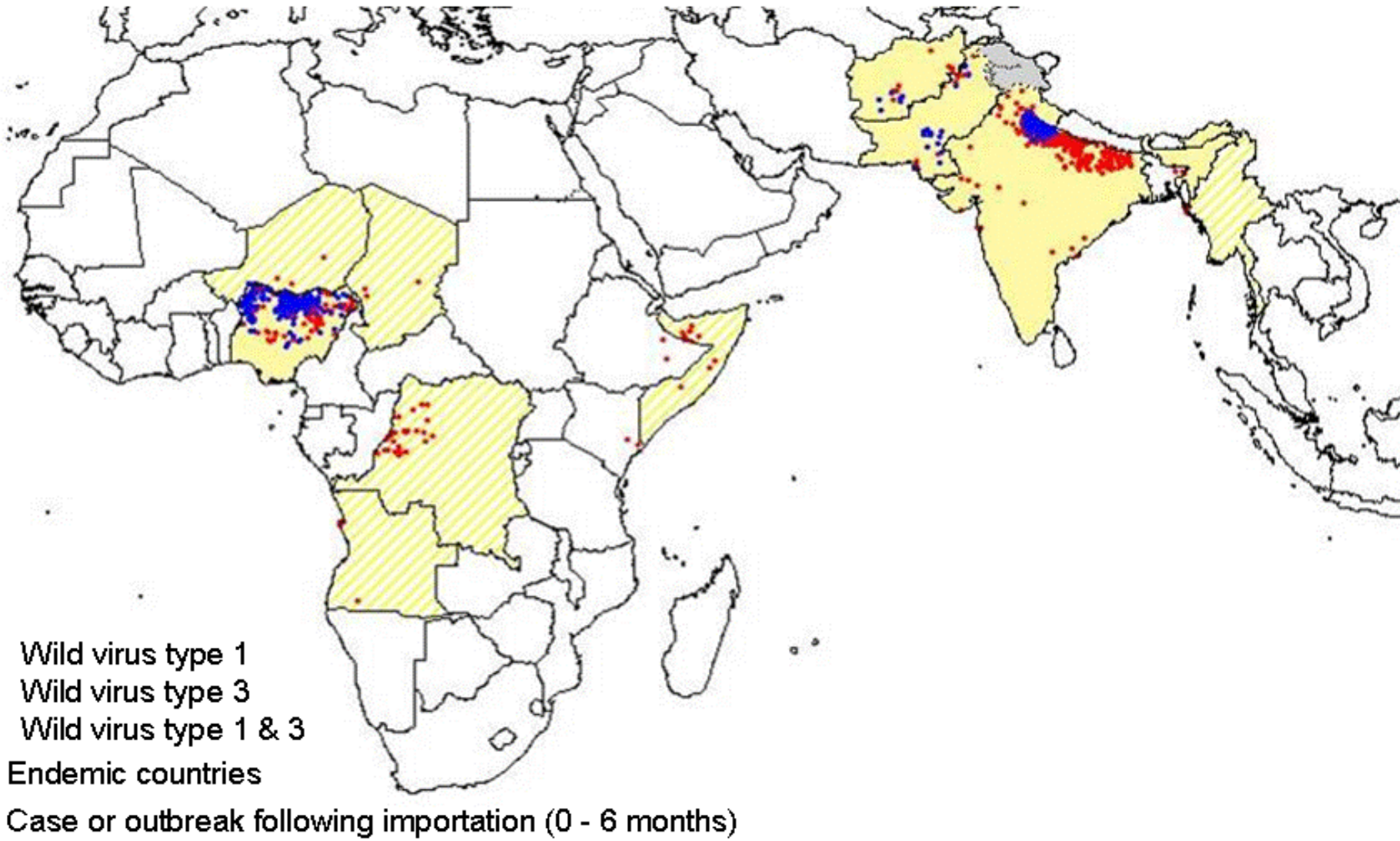
District with wild virus

New district with wild virus

New district with wild virus

Data in WHO HQ as of 21 Aug 2007

Wild Poliovirus*, 29 Aug 2006 to 28 Aug 2007



As of 01 January 2006, Egypt and Niger were reclassified as non-endemic countries.

*Excludes viruses detected from environmental surveillance and vaccine derived polio viruses.
Data in WHO HQ as of 28 Aug 2007

The boundaries and names shown and the designations used on this map d
the expression of any opinion whatsoever on the part of the World Health O
concerning the legal status of any country, territory, city or area or of its auth
concerning the delimitation of its frontiers or boundaries. Dotted lines on ma
represent approximate border lines for which there may not yet be full agree

Two Critical Poliovaccine Problems

Unknown in 1988

- OPV-derived strains can be excreted for years
  - 20 cases excreted >6 months: 8 cases, >3 years
  - One case with 27 years excretion:
    - High titer and virulent in monkeys
  - No secondary cases due to contact
- OPV-derived strains can spread silently for years although rarely causing paralytic disease
  - Recombinant OPV caused 4 or 5 small outbreaks
  - Scattered reports of one to a few paralytic cases

WHO End Game Strategy

- Continuing polio vaccination with NIDs in all developing countries through 2012
  - IPV to be used in some industrialized countries
  - OPV to be used in most developing countries

- Stop global transmission by December 2009
- Surveillance for Certification – 2010-2012

- December 2012 – stop all OPV vaccination:
  IPV to continue in some industrialized countries

Three critical questions

- Is wild poliovirus eradication possible?
- Can eradication be adequately certified so as to permit vaccination to stop?
  - Wild poliovirus
  - Vaccine-derived poliovaccine viruses
- What is “Plan B” if the answer to either question is “no”?

Is wild poliovirus eradication possible?

- Yes -- in theory
  - No animal reservoir and no chronic carriers
  - Practical demonstrations over large areas
  - Wild poliovirus 2 transmission has apparently been stopped

Can eradication be confirmed?

- How certain can one be that transmission of wild poliovirus has stopped?
  - Five endemic countries with large areas having limited health services and/or civil war
    - Afghanistan, Pakistan, Somalia, Angola, DRC
  - Sudan, with "good" surveillance indicators, discovered wild polioviruses in 2005
    - Type 1 strains from 3 years previously
    - Type 3 strains from 4+ years previously
- Possibility of confirming that vaccine-derived OPV strains have been stopped – zero

Vaccine for the post-eradication era if routine OPV use is stopped

- IPV is not an option for developing countries
  - Cost
  - No household spread to help protect slum areas
  - Little intestinal immunity to stop fecal-oral spread
- Reliance on OPV for emergency only is impractical
  - Very large quantities needed for NIDs
  - Cost of maintaining standby production capacity
  - Annual costs of storage and replenishment of stocks

- *If, in 2012, WHO announced that polio had been eradicated, would you, Minister of Health, be willing to stop polio vaccination in your country?*

- Considerations
  - Population immunity, within 4 years, would be the same as before vaccination began
  - Poliovirus spreads rapidly
    - Large-scale containment is necessary.
    - Could enough vaccine be obtained quickly enough?
    - How long might it take for the health staff to be mobilized to undertake an NID?

Summary observations

- Many cases of polio have been prevented
- In many countries, polio eradication efforts have strengthened EPI as was intended
- Global polio eradication would require a far more intensive effort than now
- Even if apparently achieved, eradication could not be confirmed

A rational future

- Accept now that in the longer-term a continuing program of polio vaccination is essential and must be planned for in all national immunization programs
- Pursue wild poliovirus eradication so long as donors and endemic countries are willing, recognizing the still formidable obstacles and efforts required

For now, dreams of other eradication programs should be shelved until:

- *Needed technologies are available*
- *Comprehensive plans have been developed*
- *Proposed strategies have been validated*
- *There is a carefully considered international commitment*