Polio eradication-- past, present and future

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The Problem of Polio
Perspectives

- United States
  - Pre-1941 --<5000 paralytic cases/year
  - 1951 -- 23,000 paralytic
  - National Foundation for Infantile Paralysis
    - Major research support for developing a vaccine
    - Polio grown in tissue culture – Salk vaccine in 1955
  - Polio perceived to be a major problem for the U.S. and many industrialized countries.
- Developing countries
  - Not a recognized problem until 1970s
  - Not a high priority among infectious diseases

Steps toward polio eradication

- **1974 – WHO Expanded program on Immunization**
  - Seven antigens – Smallpox, DPT, measles, polio, BCG
- **1985 – PAHO Technical Advisory Group**
  - Following detailed review, TAG recommended polio eradication with target of 1990
  - Program to be integral part of EPI
- **1988 - WHO global polio eradication launched**
  - Intended to be an integral part of EPI
- **Targets to interrupt transmission**
  - 2000 Original target
  - 2002 Revised in 1999
  - 2005 Revised in 2002
  - 2006 Now regarded as most optimistic
- **"Expected" certification of eradication – 2008 or 2009**

Smallpox—much easier to eradicate

	Smallpox	Polio
• Surveillance-Containment		
– Visible rash – all cases		▪ 1/200 with paralysis
– Readily diagnosed		▪ Flaccid paralysis problem
– Minimal demand for lab		▪ Heavy lab demand
– Targeted containment		▪ Area-wide campaigns
• Epidemiology		
– Transmission only by cases		▪ Primarily by asymptomatic
– Moderately contagious		▪ Very contagious

Smallpox vaccine was ideal

Smallpox	Polio
– Heat stable	▪ Labile
– Production in endemic countries	▪ No
– One dose	▪ 5+ OPV: 4+ IPV
– Easily administered	▪ OPV is easy; IPV is not

Two Critical Poliovaccine Problems
Unknown in 1988

- Poliovaccine virus can be excreted for years
  - 28 cases excreted >6 months: 4 cases, >3 years
  - One well studied case with 22 years excretion:
    - High titer
    - Virulent in monkeys
    - Resistant to antiviral therapies
- Poliovaccine virus can revert to virulence
  - Several outbreaks of paralytic disease
    - Egypt, Hispanola, Madagascar, Philippines, Egypt
  - Silent Spread for 2 to ? years

Characteristics – IPV and OPV

	IPV	OPV
Admin.	Needle	Oral
Cost	$1 to $2	8 cents
95% protection	2 (3+)	3 (4-6)
Oral immunity	++++	++++
Intest. immunity	+	++++
Spread in house	0	++++
Use in epidemic	No	Yes

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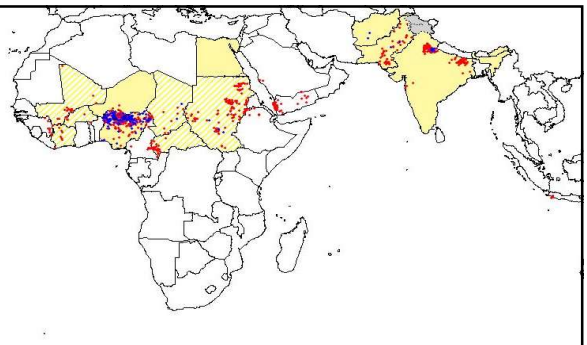

Polio Cases – May 2004 to May 2005 (WHO)

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Countries with polio - 2005

- No. of confirmed cases * 448
  No. of infections 89,600
- Land area (population) of the polio endemic countries (WHO)
  In Africa (9 countries) 4,207,000 sq.mi (290,268,000)
  Japan 146,000 " (127,100,000)
  USA (48 states) 3,173,000 " (279,583,000)
- Countries that are possibly endemic
  Dem Rep of Congo 905,400 " (53,625,000)
  Yemen (220 cases) 182,000 " (18,078,000)
  Ethiopia (20 cases) 437,000 " (65,892,000)

* WHO data as of 7 June (country data as of mid-April to early May)

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Virus Sources for Reemergence

- Polio diagnostic and research laboratories
- Other laboratories with stool specimens
- Areas where surveillance is limited
- IPV production laboratories
- Revertent OPV Polio Strains
- Long Term OPV Carriers

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End Game Strategy

- National Immunization Days throughout endemic areas through 2005
  - Infected areas of Africa, Asia
  - Stop global transmission by December
- Certification surveillance – 2006-2008
  - IPV to be used in many industrialized countries
  - OPV to be used in developing countries
  - Sequester all possible poliovirus
- December 2008 – stop all OPV vaccination:
  IPV to continue in use in industrialized countries

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Is there a problem?

- Can we be certain that transmission has stopped?
  - Many countries with large areas of limited surveillance
    - Congo, Cote d'Ivoire, Angola, Ethiopia, Afghanistan
  - Sudan, with good surveillance indicators discovered in
    - 2005 – Type 1 strains from 3 years previous
      Type 3 strains from 4+ years previous
  - Long-term OPV excretors
    - 28 are known but most excretors have no symptoms
    - Unknown excretors must number in hundreds to thousands
  - Silent OPV transmission to start outbreaks
    - Five outbreaks now documented
    - More are likely as vaccination levels continue to diminish

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Provision of vaccine in the post-eradication era

- IPV is not an option for developing countries and many middle-income areas
  - Cost
  - Lack of household spread would require far more intensive program using needles and syringes
  - Lack of intestinal immunity in areas where transmission is fecal-oral could permit spread of wild or OPV strains
- If polio were again to spread, where would the needed large quantities of OPV come from?
  - Production and storage pose serious problems
  - Standby production capacity is expensive to maintain

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- *If, in December 2008, WHO announced that polio was eradicated after 3 years had passed and no cases were found, would you as a Minister of Health be willing to stop all polio vaccination?*
- Considerations
  - Surveillance, at best, would still be incomplete. There is little reason to believe it will improve over years ahead – in fact, the reverse is more likely
  - Silent excretors or lab escape will remain a possibility
  - Once vaccination is stopped, population immunity, in 4 years will be the same as it was before vaccination began
  - Studies show that poliovirus spreads rapidly, making large-scale containment necessary. If an outbreak were to occur, could vaccine be obtained quickly enough? Could the health staff respond rapidly enough?

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Summary observations

- Many cases of polio have been prevented.
- In some parts of the world, polio eradication efforts have strengthened EPI as was intended
- The costs have been considerable
  - Over $3,000,000,000 in international expenditures
  - Perhaps twice this amount spent by national governments
  - 30 times more than was spent for smallpox
- Likely achievement of eradication remains very uncertain

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Next steps

- Plan now to sustain a long-term control program utilizing both IPV and OPV, as appropriate, in the not unlikely circumstance that eradication is not achieved
- Initiate an intensive research program to develop OPV strains that will not revert to virulence.
- Devote both energy and resources to strengthening the Expanded Programs of Immunization in all countries with special emphasis on measles and DPT vaccines

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~~What next do we eradicate?~~

What are the most critical disease challenges that can be effectively controlled?

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