Factors critical to smallpox eradication

Graduate Seminar

2 November 2012

Realities of the smallpox eradication program -- I

- Perception of severity – high with 30% CFR
  - In some cities, entire hospitals dedicated to smallpox
  - All countries doing some vaccination altho limited in area
- Support for the program – mixed, barely adequate
  - World Health Assembly – luke-warm; passed by 2 vote majority;
    - Director General opposed the program
  - Key support -- USA; USSR; Sweden; USAID supported and opposed
    - Voluntary contributions were difficult to obtain
  - WHO Regional Offices – One RD assisted; two were neutral; one opposed
  - Country level –At first, passive acceptance; a few actively supported;
    - three were major problems (Nigeria, Ethiopia, Somalia)
  - Religious beliefs – some problems with orthodox Christians and Muslims

Realities of the program -- 2

- Practical considerations

  Cost of vaccine – 1 to 2 cents per dose

  Protective efficacy -- >95% with one dose; immune for 10+ years

  Heat stability – tested to retain potency for 30 days at 37 C.

  Easy to administer – bifurcated needle

  Vaccine supply – U.S. provided 50 mil/year/USSR 25 mil/year

  Need for at least 250 mil/year. Being produced in 40+ labs

  Quality control (Canada, Netherlands) showed that <10% met minimum standards. Consultants write manual and aid labs

- Strategy Part A -- Systematic vaccination to reach 80%

  Assessment teams check 5 to 10% sample at 7 to 10 days

  If below standard, repeat vaccination throughout area

Denotes quality control points

Realties of the program -- 3

- Strategy – Part B – Surveillance-containment – New concept
  - (First demonstrations in Nigeria and Madras, India)
  - All health units to report smallpox cases weekly
  - Containment teams to go to area to collect epi information and to vaccinate contacts and near neighbors
  - Continuing epi review and modification of strategy
  - Data compiled and reports frequently and widely distributed

- Program administration
  - International staff – never more than 150 in the field; 73 nationalities
  - HQ staff – 10 people including 2 administrators and 3 secretaries
  - Delegation of authority and responsibility; support for field staff
  - Field staff to be 30% of time in the field

- Target for completion of program – 10 years; missed by 9 months and 26 days

Principal key factors

- Continued, active support for the program from articulate, responsible individuals. Many played roles but two were the sine qua non: David Sencer, Chief of CDC and Dmitri Venediktov, Deputy Minister of Health, USSR

- An ample supply of certified, potent and heat-stable vaccine meeting international requirements

- Continuing surveillance for cases, epidemiological analysis, and an evolving strategy based on field observations and surveillance data

- Strategy for transition of program into a broader health structure

  1974 Birth of EPI – surveillance with vaccination

Factors critical to smallpox eradication

Graduate Seminar

2 November 2012

Realities of the smallpox eradication program -- I

- Perception of severity – high with 30% CFR
  - In some cities, entire hospitals dedicated to smallpox
  - All countries doing some vaccination altho limited in area
- Support for the program – mixed, barely adequate
  - World Health Assembly – luke-warm; passed by 2 vote majority;
    - Director General opposed the program
  - Key support – USA; USSR; Sweden; USAID supported and opposed
    - Voluntary contributions were difficult to obtain
  - WHO Regional Offices – One RD assisted; two were neutral; one opposed
  - County level –At first, passive acceptance; a few actively supported, three were major problems (Nigeria, Ethiopia, Somalia)
  - Religious beliefs – some problems with orthodox Christians and Muslims

Realities of the program -- 2

- Practical considerations
  - Cost of vaccine – 1 to 2 cents per dose
  - Protective efficacy -- >95% with one dose; immune for 10+ years
  - Heat stability – tested to retain potency for 30 days at 37 C.
  - Easy to administer – bifurcated needle
  - Vaccine supply – U.S. provided 50 mil/year/USSR 25 mil/year
    - Need for at least: 250 mil/year. Being produced in 40+ labs
    - Quality control (Canada, Netherlands) showed that <10% met minimum standards. Consultants write manual and aid labs
- Strategy Part A -- Systematic vaccination to reach 80%
  - Assessment teams check 5 to 10% sample at 7 to 10 days
  - If below standard, repeat vaccination throughout area

Denotes quality control points

Realties of the program -- 3

- Strategy – Part B – Surveillance-containment – New concept
  - (First demonstrations in Nigeria and Madras, India)
  - All health units to report smallpox cases weekly
  - Containment teams to go to area to collect epi information and to vaccinate contacts and near neighbors
  - Continuing epi review and modification of strategy
  - Data compiled and reports frequently and widely distributed
- Program administration
  - International staff – never more than 150 in the field; 73 nationalities
  - HQ staff – 10 people including 2 administrators and 3 secretaries
  - Delegation of authority and responsibility; support for field staff
  - Field staff to be 80% of time in the field
- Target for completion of program – 10 years; missed by 9 months and 26 days

Principal key factors

- Continued, active support for the program from articulate, responsible individuals. Many played roles but two were the sine qua non: David Sencer, Chief of CDC and Dmitri Venediktov, Deputy Minister of Health, USSR
- An ample supply of certified, potent and heat-stable vaccine meeting international requirements
- Continuing surveillance for cases, epidemiological analysis, and an evolving strategy based on field observations and surveillance data
- Strategy for transition of program into a broader health structure
  - 1974 Birth of EPI – surveillance with vaccination

Eradication of polio –notable landmarks—a personal view **2Nov.2012**

1980 September -- The famous "what next do we eradicate meeting" – Fogarty Center, NIH

Global smallpox eradication declared by World Health Assembly in May
Keynote addresses by Frank Fenner and D.A.Henderson
Both assert there is no candidate disease for eradication given available technology
Led by Alan Hinman, eradication becomes a preoccupation of a number of CDC staff

1985—Expert consultant group meets to discuss a proposed polio eradication program in the Americas with a 1990 target
EPI Director de Quadros is persuasive; even the Chairman agrees

Meanwhile – Albert Sabin continues as articulate eradication advocate joined by Rotary International which pledges to raise $100 million by its 100th anniversary (2002)

1988 March – Talloires, France: a meeting of UN Agency heads convene as "The Task Force for Child Survival" to discuss global health initiatives. Two key participants present a draft proposal seeking endorsement for specific health targets to be achieved by 2000 – these include the global eradication of neonatal tetanus, measles, and polio. No plans, data, rational, or cost estimates are provided. There is minimal discussion.

Notice of the meeting is in a document "Declaration of Talloires" which indicates what was presented at the meeting. There was no formal action and discussions were brief. The chief rapporteur advised that eradication be narrowed to polio and with the caveat that a research program be pursued to find a far more antigenic, heat-stable vaccine. The Declaration materializes in May at the World Health Assembly with a WHO Polio Eradication Program to be carried out within the EPI framework. The target for eradication is set as 2000.

1991 – The last case of polio occurs in the Americas. Meanwhile, the idea of a WHO sponsored polio vaccine research program is dropped.

1990s – Unexpected complications –

- Diagnosis of polio requires laboratory confirmation – a lab network must be developed
- Recombinant vaccine strains spread to cause outbreaks
- Immunodeficient vaccinees are discovered who excrete vaccine virus for months to years.
- Wild poliovirus can circulate undetected, despite surveillance, for 4 to 5 years

2004 – First special 3 year intensive "all out" effort to end polio in 2007
2007 – Second special 3 year intensive "all out" effort to end polio in 2010
2010—Third special 3 year intensive "all out" effort to end polio by December 31, 2012

Reference: Muraskin, W. (2012) *Polio Eradication and Its Discontents: A Historian's Journey Through an International Public Health (Un)Civil War,* Orient Black Swan, New Delhi.

Originally stated goal – cessation of continuing transmission of wild poliovirus—subsequently modified to include all vaccine derived polioviruses capable of causing paralytic disease.

Challenges

- Certification will require at least 5 years to certify the absence of wild poliovirus during which vaccination and continuing surveillance will be required. The costs will be substantial. At this point, the program is costing $1.1 billion per year. Donors are restless and potential donor funds for international health initiatives are stressed.

  National motivation is generally low. Polio has never ranked among the top 20 or so infectious disease problems in any developing country (e.g. Ghana—33rd of 48). The polio threat is acknowledged to be primarily of concern to industrialized countries. Developing country participation was originally justified on the grounds that the funds for EPI (within which the polio program was to function) would bolster the broader and more important EPI initiatives (such as measles and tetanus control). Unfortunately, several EPI programs have curtailed the use of other than poliovaccines.

- Are the Vaccine-Derived Poliovirus (VDPV) strains equivalent to wild poliovirus strains in virulence and/or transmissibility? *If they are, eradication is de facto impossible.*

  Chronic shedders of VDPVs have been identified who excrete virus for months to years. However, knowledge of the epidemiological behavior and virology of the VDPVs is incomplete. Available data indicate that VDPVs associated with continuing spread are recombinant strains that incorporate different Coxsackie virus strains. The behavior of recombinant types 1 and 3 suggest that they are much less transmissible and perhaps less virulent than wild virus strains. Type 2 is more of a puzzle. However, neither the epidemiology nor the virology of the VDPV strains, that I have seen, is sufficiently complete to provide definitive answers.

- Present strategy focuses on inactivated polio vaccine (IPV) and strategies for its progressive introduction and use throughout the world as soon as possible. I see no prospects, financially or operationally, for such a substitution in EPI programs. The cost of IPV per dose is 20 times or more than OPV; it must be given percutaneously and thus would require added personnel unless incorporated into some multi-antigen formulation. Without the possibility of spread of OPV strains in the high-risk slum areas, coverage would inevitably be lower and the threat of possible outbreaks would be greater.

- I see no likelihood of most donors continuing support for a polio eradication program now 12 years beyond its projected target date and with costs (now $1.1 billion year) steadily rising. A new strategy incorporating OPV is *the only possible answer* although funds even for such a program would be difficult to secure.