Foundations of Global Health

Communicable Diseases (Part 2): Programs, Control & Elimination Efforts

We’ve taken on the major health problems of the poorest: tuberculosis, maternal mortality, AIDS, malaria – in four countries. We’ve scored some victories in the sense that we’ve cured or treated thousands and changed the discourse about what is possible. – Dr. Paul Farmer

AIDS and malaria and TB are national security issues. A worldwide program to get a start on dealing with these issues would cost about $25 billion… by what?, a few months in Iraq. – Jared Diamond, author Guns, Germs, & Steel

Learning Objectives

• Identify disease prevention, control and elimination efforts
• Describe the progress towards eradication of poliovirus and guinea worm
• Distinguish between control programs for HIV, Malaria & TB
• Outline successful interventions against communicable diseases

30 Years After Smallpox…

• Potential eradication of poliomyelitis and guinea worm
• Global Polio Eradication Initiative largest public health program ever attempted
• Behind schedule to meet target deadlines

Poliovirus

• Family: Picornaviridae
• 3 serotypes (wild)
  – Type 1: frequent outbreaks
  – Type 2: eliminated
  – Type 3: geographically confined
• Vaccine derived strains can also circulate
• Fecal-oral transmission
• Human reservoir
• 95% asymptomatic cases (ratio 200:1)

Epidemiology

• World Health Assembly adopted eradication goal 1988
• Last case in United States in 1979
• Western Hemisphere certified polio-free in 1994
• Worldwide decline:
  – 1988: 350,000 paralytic cases
  – 2008: 1606 cases

Polio already eradicated in >100 countries

(1) & one type of poliovirus already eradicated

Recurrent importations into polio-free areas

Slide Source: Rotary International
Future Challenges

- Eradication not been met due to failure to vaccinate enough children with multiple doses
- Variety of reasons continue to hinder campaign
  - Nigeria: rumors about vaccine safety led to suspended polio immunizations in 2003 – 2004
  - Afghanistan/Pakistan: political instability or armed conflicts
  - India: underserved populations difficult to reach

4 Strategies to STOP Polio

- Routine immunization
  - high infant-immunization coverage
  - 4 doses of oral polio vaccine (OPV) within 1st year
- National Immunization Days
  - mass immunization campaigns
  - conducted in 2 rounds, 1 month apart
  - 3 to 5 years required to interrupt transmission, sometimes longer
- Surveillance
  - find, report, investigate cases of acute flaccid paralysis
- Supplementary Immunization Activities (SIAs)/ mop-up campaigns
  - targeted, large scale immunization campaigns following new polio cases
  - house to house calls

Financing, 1988 to 2010: $7.13 billion

Deployment of STOP members by country, 1999-2009
Rotary International

- World's first service club organization
  - 1.2 million members in 33,000 clubs worldwide
- Since 1985, volunteers work to eradicate polio under the motto Service Above Self

- PolioPlus program
  - Estimated to raise $1.2 billion for eradication
  - Funds operational costs (transportation, vaccine delivery, social mobilization, health worker training)
  - National Immunization Days

Polio eradication targets 2010-2013

<table>
<thead>
<tr>
<th>Year</th>
<th>Goal</th>
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<tbody>
<tr>
<td>2010</td>
<td>Cessation of all wild polio transmissions</td>
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<tr>
<td>2011</td>
<td>Cessation of all polio outbreaks with onset in 2009*</td>
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<tr>
<td>2012</td>
<td>Cessation of all polio outbreaks in at least 24 endemic countries**</td>
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<tr>
<td>2013</td>
<td>Cessation of all wild polio infections in the world</td>
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<tr>
<td>2014</td>
<td>Initial validation of polio eradication</td>
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* validated when < 6 months without a case genetically linked to a 2009 importation (i.e. by mid-2010)
** validated when > 12 months without a case genetically linked to the re-established virus (by mid-2011)
*** validated when > 12 months without a case genetically linked to an indigenous virus (by mid-2013)
**** validation will require at least 3 years of zero wild polio cases in the presence of appropriate surveillance across all World Health Organization regions

Polio: The Final Inch

- 99% reduction in cases since 1988
- Stronghold in 4 countries—fewer cases reported in 2010
- Re-established transmission in 23 other countries from importation
- In 2009, over 361 million children immunized in 40 countries, with 273 SIAs
- Very, very close—hardest part is reaching every child (Final Inch)

Dracunculiasis: Guinea Worm

- Parasitic worm Dracunculus medinensis known as "Guinea worm"
- Ancient disease called the fiery serpent
- 3.5 million cases reported in the 1980s from 20 countries
  - Impoverished people, lack access to clean water
- Parasite migrates under the skin to emerge from feet or joints
- Debilitating disease

Guinea Worm Map

- Where Guinea Worm Is Found
  - Map showing affected countries in Africa and Asia
  - Infected countries: 2007-2010
  - Re-infected countries: 2000-2007
**Good Indicators**

- **Easy diagnosis** (presence of emerging worm)
- Cyclop transmission vector is not a mobile vector
- Limited incubation period in both cyclops and humans
- **Effective, low cost interventions**
- Limited geographic distribution, seasonal timing
- Government political commitment
- **No known animal reservoir**

**Recent Estimates**

**Guinea Worm Eradication Efforts**

- Education campaigns
- Treatment of water sources with insecticides
- Filters for drinking water
- NO VACCINE or MEDICINE used

**Control Programs: Triple Threat**

- Communicable diseases continue to cause large burden on Global Health
- **Triple Threat:**
  - HIV
  - Malaria
  - Tuberculosis
  - Brief discussion on successful programs for control of these diseases
- Eradication or elimination remains a distant goal

**Triple Threat = MDG 6**

- **Target 6a:** Halt and begin to reverse the spread of HIV/AIDS
  - Lower HIV prevalence among population aged 15-24 years
  - Increase condom use at last high-risk sex
  - Increase knowledge of HIV/AIDS in population aged 15-24 years
- **Target 6b:** Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it
  - Provide access to antiretroviral drugs to progressive cases
- **Target 6c:** Halt and begin to reverse incidence of malaria & other major diseases
  - Lower incidence and death rates associated with malaria
  - Increase # of children under 5 sleeping under insecticide-treated bednets
  - Increase anti-malarial drug treatment of children under 5 with fever
  - Lower incidence, prevalence and death rates associated with tuberculosis
  - Increase # of TB cases detected and cured under DOTS
HIV in United States

- More than 1 million people living with HIV
  - 1 out of 5 do NOT know they are infected
- Every 9½ minutes someone is infected
- 56,300 new infections in 2006—complacency?!
- People with HIV still develop AIDS
- More than 14,000 people with AIDS still die each year (US), even with new therapies

100% Condoms Program

- Widespread sex industry in Thailand
- HIV prevalence in brothel sex workers increased from 3% (1989) to over 15% (1991)
- 100% Condom Programme started in ’91
  - No condom, no sex
  - Monitored condom use in brothels
  - Scheduled medical check-ups on sex workers
  - Education campaigns
  - Free condoms
- Tracing of STD infections to brothels = fines
- Dramatically lowered incidence of HIV infections

Condom King

- Mechai Viravaidya is a physician and fantastic public health program manager
  - Led programs that dramatically cut Thailand’s population growth rate & new HIV infection rate
- Started NGO called Population & Community Development Association (PDA) in 1974
  - Largest non-profit organization in Thailand with 600 employees and over 12,000 volunteers
  - Reached over 10 million people in 18,000 villages
- Effective educational methods:
  - Condom-blowing competitions
  - “Cops and Rubbers” campaign
  - Cabbages and Condoms restaurants
- HIV rate declined by 75% between 1990-2003!
HIV/AIDS Treatment Timeline

**3 x 5 Initiative (WHO)**
- **Launched by UNAIDS & WHO in 2003**
- **Ambitious goal of providing ART treatment to 3 million people in 50 developing countries by 2005 (3x5)**
  - Planned to train over 100,000 health workers, improve health infrastructure
  - But, over $5 billion funding shortfall
- **Did not reach the target goal until 2008**
- **World is still very far from providing ART to all HIV/AIDS patients (universal coverage)**

**HIV/AIDS Spending Timeline**

**President’s Emergency Plan for AIDS Relief**
- **Introduced in 2003 (PEPFAR v.1) by former President George W. Bush**
- **Largest commitment by any nation to combat a single disease**
  - Cornerstone & largest component of U.S. Global Health Initiative
- **In 2008, reauthorized for $48 billion through 2013 (PEPFAR v.2)**
  - Prevent 12 million new infections
  - Treat 3 million people living with AIDS,
  - Care for 12 million people (esp. orphans)
- **Transition from EMERGENCY response to sustainable initiative, with country ownership, multilateral partnerships, and strengthen health systems**

**Dramatic Increase in ART Coverage**

**Differences of Prevention**
- **Uganda**
  - Abstain
  - Be faithful
  - Condomise
- **PEPFAR v1**
  - Abstinence for youth, including the delay of sexual debut & abstinence until marriage
  - Being tested for HIV and being faithful in marriage and monogamous relationships
  - Correct and consistent use of condoms for those who practice high-risk behaviors
Malaria

• WHO attempted to eradicate malaria globally in the 1950s-1960s, but failed
  – Now, the best strategy is control
  – Elimination is even considered a possibility for some regions!

• Caused by parasite called Plasmodium
  – 4 species: falciparum, vivax, malariae, ovale
  – Falciparum causes 95% of deaths

• Symptoms: intense fever in 24-72 hour intervals, nausea, headaches, muscular pain
• Transmitted by Anopheles mosquito

Burden of Malaria

• Ancient disease - perhaps the most important human infectious disease
• Over 500 million infected annually
• 3 million deaths/year
  – an African child dies every 30 seconds from malaria
• 2.2 billion people at risk
  – Anti-malarial drugs available, but resistance is a huge problem

Malaria transmission areas and reported drug resistance, 2004

President’s Malaria Initiative (PMI)

• In 2005, United States launched PMI
  – Led by USAID but implemented together with CDC
  – 5 year initiative ($1.2 billion) to rapidly scale up prevention and treatment programs
  – 15 countries with high malarial burden in sub-Saharan Africa
• Reauthorized in 2008 ($5 billion) for 2009-2014 as part of Global Health Initiative
  – Continues & expands support to 17 focus countries (blue outline, map)
• Decrease by ½ the burden of malaria in majority of at-risk populations in Africa
Malaria Vaccine Initiative

- No malaria vaccines in clinical trials in 1985
- Great progress on this “neglected” disease now—16 candidates in clinical development (2006) with several others in early testing
- One vaccine (RTS,S) is in late-stage clinical trials—could be licensed as early as 2011!

Insecticide Treated Bed Nets (ITNs)

- ITNs are personal protection to reduce illness & death from malaria
  - Several studies have shown ITNs reduce under 5 child mortality from all causes by 20%
  - Effective control measure
- WHO recommends all people in at risk areas use them, especially vulnerable groups of pregnant women and children
  - Should be provided free
- Providing enough nets and resources for delivery in Africa remains a MAJOR challenge
  - Global Fund & PMI support universal access to ITNs
- You TOO can help—$10 donation buys 1 net for a family in need. Purchase nets through NGOs, such as Nothing But Nets or Malaria No More

Mycobacterium tuberculosis (TB)

- Bacterial infection (Gram + rod)
- Humans are only significant natural reservoir
- Airborne human-to-human transmission
- Antibiotic therapy takes 6 to 12 months to cure
  - Recent development of MDR-TB & XDR-TB of great concern
- Estimated 1/3 of world population has latent infection
  - More than 8 million new cases annually
  - ~3 million deaths annually
  - Causes more deaths worldwide than HIV


New Cases of TB Map

MDR-TB in New Cases Map
Treatment program developed by WHO during ’80s & ’90s for TB
DOTS = directly observed treatment, short course chemotherapy
- Health care provider directly monitors TB patient take antibiotics
- Ensure compliance to drug regimen, limits development of MDR-TB & XDR-TB
- Improved cure rate for majority of patients!!
- DOTS-Plus includes additional antibiotics for treatment of MDR-TB
Now, DOTS covers a broad umbrella of programs to limit spread of TB (political commitment, case detection, standard treatment, effective drug supply, monitoring)

Practice Questions
- What strategies are used to eradicate polio? What indicators make it possible? What challenges will make it difficult?
- What strategies are used to eradicate guinea worm? What indicators make it possible?
- What diseases constitute a triple threat to global health?
- Name 2 examples of HIV control programs.
- How do control programs for HIV differ from that of malaria than TB?

In Summary
- Communicable diseases are very important to the global burden of disease
- Eradication, near elimination, and control of infectious disease are possible through effective public health programs
- Extensive funding and resources are needed to implement effective control and elimination programs
- HIV/AIDS and malaria take an enormous toll in Sub-Saharan Africa
- HIV/AIDS is fueling the TB epidemic
- Communicable diseases have considerable economic and social consequences