Immunization
Saves Lives

Diphtheria
Pertussis
Tetanus
Polio
Measles
Tuberculosis
Hepatitis B
Rubella and CRS
Haemophilius Influenza B
How many children die of vaccine preventable diseases?

- WHO estimates that immunization currently averts 2.5 million deaths every year in all age groups from diphtheria, tetanus, pertussis (whooping cough), and measles.

- And yet globally 1.5–2 million children still die each year from diseases for which vaccines are available but not fully utilized. 25–30% of these deaths occur in South-East Asia Region of WHO.

- Vaccination in childhood conserves the most potential years for healthy life.

What is a vaccine?

- Vaccines are biological products that stimulate our immune system to produce disease specific antibodies or immune cells and protect us from disease.

- Vaccines are administered through needle injections, by mouth and by aerosol.

What are the economic benefits?

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Cost Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTaP</td>
<td>$27.00</td>
</tr>
<tr>
<td>MMR</td>
<td>$26.00</td>
</tr>
<tr>
<td>H. Influenza type b</td>
<td>$5.40</td>
</tr>
<tr>
<td>Perinatal Hep B</td>
<td>$14.70</td>
</tr>
</tbody>
</table>

* Above is a list of cost-benefit estimates from ecbt.org, which summarizes previous findings by the CDC.

How vaccines work?

1. A weakened form of the disease germ is injected into the body.

2. The body makes antibodies to fight these invaders.

3. If the actual disease germs ever attack the body, the antibodies will still be there to destroy them.
The benefits of immunization heavily outweigh the costs.

- The elimination of smallpox is estimated to have saved $275 million per year in direct health care costs.
- It is estimated that polio eradication will save governments $1.5 billion per year in vaccine, treatment, and rehabilitation costs.
- It was calculated that a one-year increase in life expectancy improves labour productivity by 4%.

What is Global Immunization Vision and strategy and Decade of vaccines?

WHO and UNICEF have developed a Global Immunization Vision and Strategy (GIVS) for the years 2006–2015. Its goal is to protect more people against more diseases by expanding the reach of immunization to reach the unreached.

Two of the key GIVS goals were to achieve by 2010:

- **Increase coverage:** Countries to reach at least 90% national vaccination coverage and at least 80% vaccination coverage in every district or equivalent administrative unit with three doses of DTP.
- **Reduce measles mortality:** Globally, mortality due to measles to be reduced by 90% compared to the 2000 level.

In the South-East Asia Region, out of an annual birth cohort of 38 million, we are immunizing 28 million (73%) with DTP3.

Below is the regional coverage, as estimated by WHO/UNICEF until 2010.

The EPI immunization schedule in infancy*

**Birth** BCG + OPV + Hep B

**6 Weeks** OPV + DTP OR OPV + DTP + Hep B or Hib OR OPV + Pentavalent BCG (If Not Given Before)

**10 Weeks** OPV + DTP OR OPV + DTP + Hep B or Hib OR OPV + Pentavalent BCG (If Not Given Before)

**14 Weeks** OPV + DTP OR OPV + DTP + Hep B or Hib OR OPV + Pentavalent BCG (If Not Given Before)

**9-11 Months** Measles OR Measles- Rubella OR Mumps-Measles- Rubella

* Schedules may vary by country.

What problems can arise from vaccination?

- Vaccines are extremely safe products. However, like any other medical intervention they do have some adverse effects.
- The commoner adverse effects are mild and clear up quickly. For example slight fever after DTP vaccination.
- Risks of serious adverse effect are extremely rare. Without vaccination, the risk of death or disability from the disease is much higher than the risk of a serious adverse effect from the vaccine.
- From a programme perspective it is more important to prevent program or human errors in vaccine handling as they undermine confidence in the programme.
- Often untoward events occurring coincidentally after vaccination are wrongly thought to be caused by the vaccine.

Where can I find more information?

- [www.who.int/immunization/en](http://www.who.int/immunization/en)
- [www.cdc.gov](http://www.cdc.gov)
- [www.unicef.org](http://www.unicef.org)
- [www.gavialliance.org](http://www.gavialliance.org)
- [www.polioeradication.org](http://www.polioeradication.org)
- [www.measlesinitiative.org](http://www.measlesinitiative.org)
What is diphtheria?

Diphtheria is caused by toxigenic strains of the Diphtheria bacilli, a rod like bacteria. The bacteria produce an exotoxin that may damage nerves and organs such as the heart and kidneys.

The disease manifests with fever and a whitish membrane develops in the back of the throat. There can be swelling of the neck and the heart and nerves may be affected.

Why is vaccination important?

It is estimated that before diphtheria toxoid vaccine became easily accessible in the 1980s, about 1 million cases of diphtheria including 50,000–60,000 deaths occurred each year in developing countries.

Vaccine specifics

- Type: Toxoid (modified toxin giving immunity without producing disease).
- Route: Intramuscular Injection.
- Dose: 3 Doses given at least 4 weeks apart.
- Recommended EPI Schedule: 6 weeks, 10 weeks, and 14 weeks. Boosters may be needed.
- Cost Per Dose: $0.16.
- Administration Notes: Given in combination with Tetanus & Pertussis (DTP).

Vaccine efficacy

Case-control studies showed that 3 or more doses of diphtheria toxoid induced 95.5% (92.1–97.4%) protective efficacy among children aged <15 years.

Adverse effects

- Diphtheria toxoid is one of the safest vaccines available.
- Mild reactions include:
  - Local reactions, light to moderate: redness, pain and hardening at the injection point (11% to 38%).
  - Systemic reactions: transient fever (1%), malaise, aches, flushing.

Coverage

Diphtheria global annual reported cases and DTP3 coverage, 1980-2010

Source: WHO/IVB database, 2011
WHO Member States: Data as of September 2011
Date of slide: 04 October 2011

CDC Pink Book: http://www.cdc.gov/vaccines/vpd-vac/diphtheria/default.htm
Pertussis

What is pertussis (whooping cough)?

Pertussis, also known as whooping cough, is a highly contagious respiratory disease. It is caused by the bacterium Bordetella pertussis.

Vaccine specifics

- Type: Inactivated Whole-Cell (wP) or Acellular (aP).
- Route: Intramuscular Injection.
- Dose: 3 Doses Given at least 4 weeks apart.
- Recommended EPI Schedule: 6 weeks, 10 weeks, and 14 weeks. Boosters needed.
- Cost Per Dose: DTP: $0.16.
- Administration Notes: Given in combination with Diphtheria & Tetanus (DTP).

Vaccine efficacy*

- Significant variation noted in efficacy across populations, ranging from 46% to 92% with diphtheria–tetanus–whole-cell pertussis (DTwP) vaccines.
- The efficacies of aP and wP vaccines vary. However, the best aP vaccines may be less efficacious than the highest-efficacy wP vaccines in preventing whooping cough.

Coverage

Please see DTP3 coverage chart.

Adverse effects

Whole cell pertussis vaccines:

- Minor local reactions such as pain, swelling and redness may occur at injection site.
- Prolonged crying and febrile convulsions are less common (<1 in 100 injections); hypotonic–hyporesponsive episodes are rare (<1 in 1000–2000 injections).
- Anaphylaxis: extremely rare.
- No evidence of neurological reaction or damage.

Primary vaccination with acellular Pertussis vaccines has negligible incidence of adverse effects, but the rate and severity of local reactions tend to increase with each successive DTaP dose.

Why is vaccination important?

- Estimates from WHO suggest that in 2008 about 16 million cases of pertussis occurred worldwide.
- About 195,000 children died from this disease.


CDC Pink Book: http://www.cdc.gov/vaccines/vpdvac/pertussis/default.htm
Tetanus

What is tetanus?
- Tetanus (lockjaw) is a serious disease that causes painful tightening of the muscles, usually all over the body.
- Tetanus leads to death in about 1 in 10 cases.

Why is vaccination important?
- In 2002, the total number of deaths caused by tetanus worldwide was estimated at 213,000.
- In 2004, an estimated 40 million pregnant women were still in need of immunization against birthassociated tetanus, and about 27 million children did not complete their primary tetanus immunization series.
- Immunizing the pregnant mother with tetanus vaccine not only protects her but also her unborn child against neonatal tetanus in the first 4 weeks of life.
- The goals of tetanus control are primarily (i) to eliminate maternal and Neonatal Tetanus globally; and (ii) to achieve and sustain high coverage of 3 doses of DTP and of appropriate booster doses in order to prevent tetanus in all age groups.

Vaccine specifics
- Type: Toxoid.
- Route: Intramuscular Injection.
- Dose: 3 Doses Given at least 4 weeks apart.
- Recommended EPI Schedule: 6 weeks, 10 weeks, and 14 weeks.
- Booster: 1 in early childhood; 1 or 2 more through adulthood.
- Cost Per Dose: $0.16 for DTP, $0.029 for TT.
- Administration Notes: Given Individually as tetanus Toxoid (TT) or in combination with Diphtheria & Pertussis (DTP).

Vaccine efficacy
Protective concentrations of antitoxin are achieved in the majority of vaccinees after completion of 2 doses; a third dose induces immunity in almost 100% of those immunized.

Adverse effects
- Minor local reactions such as pain and erythema are found in 25% to 85% of cases.
- Reactions such as generalized urticaria and anaphylaxis, are rare (1 to 6 cases per million doses administered).

CDC Pink Book: http://www.cdc.gov/vaccines/vpdvac/tetanus/default.htm

Coverage
Please see DTP3 coverage chart.
**Why is vaccination important**

- With currently available vaccines, we can eradicate this disease from the world.
- It is estimated that polio eradication will save governments $1.5 billion per year in vaccine, treatment, and rehabilitation costs.

**Vaccine specifics**

- Type: Live trivalent Oral Polio Vaccine (tOPV) or Inactivated Polio vaccine (IPV). Mono-valent and bivalent OPVs developed mainly for use in campaign settings.
- Route: Oral or Intramuscular Injection.
- Dose: OPV: 4 Doses in Endemic Countries; IPV: 2–3 Doses Depending on Country Schedule. Additional OPV doses during immunization campaigns based on country specific strategies.
- Recommended EPI Schedule with OPV in infancy: 6 weeks, 10 weeks, and 14 weeks of life (Birth dose country specific).
- Cost Per Dose: tOPV: $0.13; IPV: $2–5.

**Vaccine efficacy**

- Vaccine efficacy of OPV variable in different settings.
- Large, case-control studies in Taiwan and Oman showed efficacies of >90% for trivalent OPV.
- Case control studies and vaccine trials in India demonstrate lower efficacy of tOPV in northern India and higher efficacy of monovalent and bivalent OPV than tOPV.

**Adverse effects**

- Both OPV and IPV are very safe vaccines.
- Vaccine Associated Paralytic Poliomyelitis is extremely rare, ranging from 4 cases/ million birth cohort per year in countries using OPV.

**Coverage**

![Graph showing poliomyelitis global annual reported cases and Polio3 coverage, 1980-2010](image)

Source: WHO/IVB database, 2011

WHO/UNICEF estimates

Number of cases: Official coverage: WHO/UNICEF estimates


**CDC Pink Book:** [http://www.cdc.gov/vaccines/vpdvac/polio/default.htm](http://www.cdc.gov/vaccines/vpdvac/polio/default.htm)
**Why is vaccination important?**

- In 1980, before the use of measles vaccine was widespread, there were an estimated 2.6 million deaths from measles worldwide.
- Cumulatively, approximately 12.7 million measles deaths were averted during 2000–2008 as a result of measles immunization activities.
- Recognizing measles as a potentially eradicable disease the 63rd World Health assembly has established interim goals towards measles eradication to reduce measles deaths by 95% by 2015 (compared to 2000).
- Measles immunization is an indicator of progress towards Millennium Development Goal 4 of reducing child mortality.

**Adverse effects**

- Pain and tenderness at the injection site, generally mild and transient.
- Up to 5% experience fevers.
- Serious: Anaphylaxis very rare (in 1/1,000,000 doses of vaccine administered).

**Vaccine specifics**

- Type: Live Attenuated vaccine.
- Route: Subcutaneous or Intramuscular Injection.
- Dose: 2 Doses at least 4 weeks apart.
- Recommended EPI Schedule: 2 doses of which first dose between 9–11 months or at 12 months. Optimal timing and delivery strategy for second dose varies according to measles epidemiology and program strengths in the country.
- Cost Per Dose: Measles: $0.19; MR: $MR: $0.484; MMR: $0.90.

**Vaccine efficacy**

- In children 8–9 months of age – there was a median efficacy of 89.6 %.
- For infants 11–12 months – there was a median efficacy of 99 %.

**Coverage**

Measles global annual reported cases and MCV coverage, 1980-2010

![Measles global annual reported cases and MCV coverage, 1980-2010](chart.png)

Source: WHO/IVB database, 2011
Data as of September 2011
Date of slide: 04 October 2011

**What is measles?**

Measles is a highly contagious respiratory disease caused by the measles virus.

It is one of the most infectious diseases of human beings and can cause death through complications especially in young and malnourished children.

[CDC Pink Book](http://www.cdc.gov/vaccines/vpdvac/measles/default.htm)
Tuberculosis

What is tuberculosis?
- Tuberculosis (TB) is a disease caused by M. tuberculosis (Mt). It is spread from person to person through airborne droplets.
- Lung disease predominates, but Mt may affect any organ. In young children, the bacteria can spread from primary site of infection through blood stream resulting in severe primary disease, including miliary TB and TB meningitis.
- Every year, nearly 9 million people around the world become sick with TB and there are almost 2 million TB-related deaths worldwide.
- The annual risk of TB infection in children in highburden countries is estimated to be 0.5–2%. Childhood deaths from TB are usually caused by meningitis or disseminated disease.

Vaccine efficacy
- Protective efficacy of BCG vaccine is highly variable in different settings.
- Varying results are thought to be attributed to varying strains of TB or the presence of immunityyielding environmental bacilli.
- Protection against TB-related death was 65%, against TB meningitis 64% and against disseminated TB 78%.

Adverse effects of BCG
- Complications following BCG vaccination are rare. Incidence of fatal dissemination of BCG is estimated to be 0.19–1.56 per million vaccines.
- Significant local reactions occur in most cases (>99%) only in immunodeficient persons.

Vaccine specifics
- Type: Live attenuated bacterial vaccine.
- Route: Intra-dermal Injection.
- Dose: 1 Dose.
- Recommended EPI Schedule: Birth or as soon as possible after birth.
- Cost Per Dose: $0.057.

Coverage

BCG global annual reported coverage 1980-2010

Source: WHO/IVB database, 2011
WHO Member States: Data as of September 2011
Date of slide: 04 October 2011

CDC Pink Book: http://www.cdc.gov/vaccines/vpdvac/tb/default.htm
What is Hepatitis B disease?

The Hepatitis-B virus (HBV) attacks the liver causing yellow discoloration of eyes and skin (jaundice) and can be fatal in the acute stage.

- The infection may also become chronic progressing to cirrhosis and cancer of liver and death.
- HBV is spread from infected mother to her child at birth, or from person to person in early childhood.
- Sexual transmission and the use of contaminated needles, especially among injecting drug users, are the other major routes of infection.

Why is vaccination important?

- It is estimated that >2 billion people worldwide have been infected with HBV.
- Of these 360 million are chronically infected, of whom 600,000 individuals die each year from HBV associated diseases.
- Although, HBV infection can be treated with antiviral drugs, vaccination with the Hep-B vaccine remains the mainstay of control in resource constrained settings.

Vaccine specifics

- Type: Recombinant DNA vaccine.
- Route: Intramuscular Injection.
- Dose: At least 3 Doses given at least 4 weeks apart.
- Recommended EPI Schedule in infancy: At birth, followed by 2–3 doses at 6, 10 and 14 weeks of age; no booster dose needed.
- Cost Per Dose: HepB: $0.27; DTP-HepB: $0.69; DTPHib-HepB: $2.25.

Vaccine efficacy

- The primary 3-dose vaccine series induces protection in >95% of healthy infants, children and young adults.

Adverse effects of Hep-B vaccine

- Outstanding record of safety and effectiveness. Local pain at site of injection occurs in <10% of children and 30% of adults.
- Reports of severe anaphylactic reaction are very rare.

Coverage

Hepatitis B 3rd dose global annual reported coverage 1980-2010

CDC Pink Book: http://www.cdc.gov/vaccines/ypdvac/hepb/default.htm
What is rubella and CRS?

- Rubella is an acute, usually mild viral infection causing fever and rash. It mainly affects susceptible children and young adults worldwide.
- Rubella infection of a pregnant woman, especially early in pregnancy may cause a miscarriage or her child may be born with Congenital Rubella Syndrome (CRS).
- CRS can cause permanent defects in eyes (e.g., cataracts), ears (deafness), heart and other organs.

Why is vaccination important?

- The public health importance of rubella infection is because of CRS.
- CRS has no effective treatment but there is a safe and effective vaccine.
- Large-scale rubella vaccination has drastically reduced or practically eliminated rubella and CRS in many developed countries and some developing countries.
- Estimated burden of CRS in 1996 in WHO Regions:
  - 22,000 in Africa.
  - 46,000 in SEAR.
  - 12,634 in Western Pacific.
- Programmatically it is convenient to add rubella control strategies to well-established measles control programmes.

Vaccine specifics

- Type: Live Attenuated viral vaccine.
- Route: Subcutaneous or Intramuscular Injection.
- Dose: 1 or 2 Doses.
- Recommended EPI Schedule: 1st Dose: 9 Months or 12–15 Months; 2nd Dose: 15–18 Months or 4–6 Years.
- Cost Per Dose: MR: $0.484; MMR: $0.90.
- Administration Notes: This vaccine is given in conjunction with measles (MR) or measles and mumps (MMR).

Vaccine efficacy

- All licensed rubella vaccines induce seroconversion rates of approximately 95% or higher after a single dose.

Countries using rubella containing vaccine in national programmes

- As of 2009, 130 out of 193 WHO member states have included rubella containing vaccines in their national immunization programmes.
- 4 out of 11 countries in SEAR use Rubella vaccine.
- Rubella remains an underutilized vaccine in SEAR countries with good measles control activities.

Adverse effects

- Generally mild, particularly in children.
- Common adverse reactions include pain, redness and hardness at the site of injection.
- Joint pains may occur in adult women.
- Anaphylaxis is rare.
Haemophilus Influenza B

Why is vaccination important?
- Hib is estimated to cause at least 3 million cases of serious disease every year and approximately 386,000 deaths.
- Vaccines are the only public health tool capable of preventing the majority of cases of serious Hib disease.

Vaccine specifics
- Type: Conjugate.
- Route: Intramuscular Injection.
- Dose: 2 or 3 Doses in the Primary Series.
- Recommended EPI Schedule in infancy: 6, 10 and 14 weeks of life.
- Cost Per Dose: DTP-Hib: $3.20; DTP-HepB-Hib: 2.25.

What is invasive Hib disease?
- Haemophilus Influenza B (Hib) is a bacterium that infects many organ systems.
- Hib infection can cause pneumonia, meningitis and other invasive diseases. Invasive Hib diseases occur primarily in children aged years, particularly in infants.
- It is difficult to confirm Hib infection through laboratory tests.

Vaccine efficacy
- Randomized controlled trials have produced remarkably consistent data of efficacy between 95% and 100%.

Adverse effects
- Pain and tenderness at the injection site, generally mild and transient.
- Serious adverse events following administration of Hib vaccine are uncommon, making it one of the safest vaccines currently available.

Coverage

WHO recommends that Hib vaccines should be included in all routine infant immunization programmes.

CDC Pink Book: http://www.cdc.gov/vaccines/vpdvac/hib/default.htm
Haemophilus Influenza B