REVIEW ARTICLE

IMMUNIZATION STRATEGIES IN DEVELOPING COUNTRIES AND ITS EFFECTS

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April 2007

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Immunization strategy in developing countries and its effect

The best way to escape from a problem is to solve it-alan saporta.

Abstract

Maintaining good health is important for all of us. A primary health service is important, perhaps the most basic and cost effective is childhood immunization. Immunization against diseases such as polio, tetanus, diphtheria and pertussis saves the lives of approximately three million people each year. Immunization also prevents many more millions from suffering debilitating illness and lifelong disability. Lifesaving vaccines is one of the greatest public health achievements of all time.

A hundred years ago, infectious diseases were the worlds leading cause of death. Epidemics of smallpox and diphtheria would take the lives of millions of people. Over the last 50 years, medical science has developed vaccines to reduce the spread of many killer diseases. But other infectious diseases for which we still lack effective vaccines, such as HIV/ AIDS, Malaria and tuberculosis, continue to cause illness, disability and death. Scientists are working hard to develop vaccines to protect people from these diseases as well.

In this article the focus will be on immunization in developing countries and difficulties in the management, its effects and the perspective of the future. Comparing the vaccination in developing countries with the one in Norway for informational purposes and understanding of the differences in strategies of vaccination

While the impact of immunization on childhood mortality and morbidity has been great, its full potential has yet to be reached. Millions of children still die from vaccine preventable diseases each year. Vaccinating more children and the introduction of new vaccines is the task in the upcoming years.

1.0 History of the vaccine

Edward Jenner (1749-1823) a british physician, performed an experiment in 1796 that would revolutionize the public health: the first scientific evidence of the vaccination principle. Epidemics of smallpox was a big problem at that time. The lethality was more than 30%.

Jenner was a country doctor who inoculated an 8 year old boy with pustule material from cowpox and showed that this protected him against smallpox. With this he proved that the body could develop a resistance against smallpox if a immune response had been developed. Jenner discovered aquired immunity and made the first step into the eradication of smallpox. Smallpox was the first virus that was eradicated by WHO in 1980.

The term vaccination came from the cowpox virus *vaccinia* which in turn derived its name from Latin *vacca* meaning cow. It was after Louis Pasteurs successful immunization experiments in 1885 that the tremendous potential of prophylactic immunisation was fully realized by the public and scientific community. The inoculates he used were accidentally weakened forms of chicken cholera and intentionally attenuated rabies virus, but the mechanisms responsible for immunity were not understood at that time. And thus vaccination attempts were based on trial and error. The worldwide application of vaccines in the last century has accomplished an almost complete control of many life threatening infectious diseases affecting man, e.g: poliomyelitis, diphtheria, measles, mumps, rubella and pertussis.

The relationship between disease and infection has led microbiologists to focus their efforts on understanding the replication strategies and pathogenesis of microbes. They hope to identify key pathological events and to isolate microbial components suitable for incorporation into vaccines.

However injection of inactivated pathogens or isolated split products usually provides minimal or poor protection . The discovery of the so called helper substances, known as adjuvants has dramatically changed the situation and in many cases they significantly increased the levels of protection afforded by a vaccine. In 1925 it was recognized that a variety of substances could increase antigen –specific antibody production when added to diphtheria and tetanus toxoids prior to vaccination. Despite the recognition of many different types of adjuvants there is still little known about their mode of action.

(1,2,15)

2.0 How does the vaccine work

Vaccines stimulate the immune system by activating professional antigen presenting cells such as dendritic cells. Dendritic cells express a number of pattern recognition receptors(PRR) on their surface , receptors that recognize structures on virus and bacteria. These receptors stimulate maturation of dendritic cells that thereafter migrate to regional lymph nodes where they present vaccine antigens to T cells. PRR –ligands of the vaccine are decisive for the efficacy of the immune response. (1)

2.1 Immunity:

Immunity is the ability of the body to tolerate that is indigenous to it and eliminate material that is foreign. The immune system is comprised of organs and specialized cells that protect the body by identifying harmful substances, known as antigens and destroying them by using antibodies and other special substances and cells. (1)

2.2 Innate and acquired immunity

Innate immunity is resistance that exists prior to exposure to the microbe (antigen) and includes host defenses such as barriers to infectious agents (skin and mucous membranes.) certain cells (natural killer cells) and proteins (the complement cascade and interferons) and involves processes such as phagocytosis and inflammation. Innate immunity differs from the aquired by not improving after exposure to the organism and not having a memory.

Function of the innate immune system is killing invading microbes and activating aquired immune processes. Some components of the innate system such as neutrophils only kill microbes whereas others such as macrophages and dendritic cells perform both functions (kill microbes and present antigens to helper T cells which activate the aquired immune process)
Several components of the innate system recognize what is foreign by detecting certain carbohydrates and lipids on the surface of microorganisms that are different from those on human cells. These are detected by the pattern recognition receptors (PRR) By using this strategy these components of the innate system do not have a highly specific receptor for every different microbe but can still distinguish between what is foreign and what is self.

Acquired immunity occurs after exposure to an agent, improves upon repeated exposure and is specific. It is mediated by antibody and by T- lymphocytes (T helpers and cytotoxic T cells) The cells responsible for aquired immunity have long term memory for a specific antigen. Aquired immunity can be active or passive. Macrophages and other antigen presenting cells play an important role in both of these systems. (1)

2.3 Active and passive immunity

Active immunity is resistance induced after contact with foreign antigens. This contact may consist of clinical or subclinical infection, immunization with live or killed infectious agents or their antigens, or exposure to microbial products (toxins and toxoids) The host actively produces an immune response consisting of antibodies and activated helper and cytotoxic T lymphocytes.

Passive immunity is resistance based on antibodies preformed in another host. Administration of antibody against diphtheria, tetanus and botulism makes large amounts of antitoxin immediately available to neutralize the toxins. Preformed antibodies to certain viruses(rabies, hep A and B) can be injected during the incubation period to limit viral multiplication.

Other forms of passive immunity are IgG passed from mother to fetus during pregnancy and IgA passed from mother to newborn during breast feeding. (1)

3.0 Milestones in vaccine development

1885 First use of live attenuated viral vaccine (rabies) in humans

1909 First live attenuated bacterial vaccine (Bacillus Calmette-Guerin/BCG)

1921 Diphtheria toxoid developed

1924 Tetanus toxoid produced

1930s Pertussis vaccine developed

1932 Yellow fever vaccine developed

1940s Diphtheria tetanus pertussis DTP combination introduced

1955 Iinactivated polio vaccine introduced

1963 Measles vaccine introduced

1986 First recombinant vaccine (hep B) introduced

1990 First polysacharride conjugate vaccine (*Haemophilus influenzae* type B) introduced

(Source: WHO. (3))

4.0 The different vaccines available

4.1 Live attenuated vaccines

Live attenuated vaccines are derived from disease causing bacterias or viruses that have been weakened under laboratory conditions. They will grow in a vaccinated individual, but because they are weak they will cause either no disease or only a mild form. Usually, only one dose of this type of vaccine provides life long immunity with the exception of oral polio vaccine which requires multiple doses.

Types: **Virus**: e.g., oral polio vaccine, measles, yellow fever.
Bacteria e.g BCG

4.2 Inactivated vaccines

Inactivated vaccines are produced by growing viruses or bacteria and then inactivating them with heat or chemicals. Because they are not alive, they cannot grow in a vaccinated individual and therefore cannot cause the disease. They are not as effective as live vaccines, and multiple doses are required for full protection . Booster doses are needed to maintain immunity because protection by these vaccines diminishes over time. Inactivated vaccines may be whole cell or fractional.

Whole cell vaccines are made of an entire bacterial or viral cell. (e.g whole cell pertussis or inactivated polio vaccine)

Fractional vaccines composed of only part of a cell, are either protein- or polysaccharide based.

Protein based toxoid are diphtheria and tetanus.

Polysacharride based vaccines are composed of long chains of sugar molecules taken from the surface capsule of the bacteria. Unless coupled with a protein, pure polysacharride vaccines are generally not effective in children under the age of two years. This coupling process is known as conjugation.

Pure: meningococcal,

Conjugate: Hib B

4.3 Recombinant and DNA vaccines:

Are produced by inserting genetic material from a disease causing organism into a harmless cell, which replicates the proteins of the disease causing organism. The proteins are then purified and used as a vaccine.

DNA vaccines represent a new and promising technology that uses DNA to encode the antigen(s) of interest, instead of inoculating with attenuated or inactivated microbes or isolated antigens. Antigen is produced within the transfected cells mimicking a real life viral infection . This vaccine modality has been shown to elicit strong cellular immune responses and is promising for treating diseases where traditional vaccine approaches have failed. In spite of promising results in small animal models, DNA vaccines have so far proven less potent in human clinical trials. (11)

4.4 Mucosal vaccines:

The live oral polio vaccine was the first mucosal vaccine accepted for general use. Since then, Similar vaccines have been developed against typhoid fever, cholera and rotavirus infection and a nasal vaccine against influenza has recently been registered. The only non-living mucosal vaccine on the market today is an oral cholera vaccine consisting of inactivated *Vibrio cholerae* and the B subunit of the cholera toxin. Several groups of scientists are at present working on the development of other mucosal vaccines based on inactivated microbes or parts of them. (12)

5.0Disease transmission and the impact on immunization

An infectious disease is an illness that occurs when an infectious agent is transmitted from an infected person, animal or reservoir to a susceptible host. Some of the factors that influence transmission include:

Contagiousness of the infective agent and duration of infectivity.

Disease fatality and attack rate

Route of transmission (person to person, vector borne, water or food borne)

Population density and size, poverty.

Access to clean water, hygiene and sanitation.

Population immunity and the nutritional status.

A basic concept of public health is that every individual who is protected from a disease as a result of an immunization is one less individual capable of transmitting the disease to others. Individuals who have been immunized serve as a protective barrier for other individuals who have not been immunized, provided that the number immunized has reached a certain level. Reaching and maintaining that level, which varies by communicable disease, provides herd immunity to unimunized individuals. The disease will spread slower in a population if more of the population is immunized. (3,8)

6.0 Safety of vaccines and contraindications.

Local and mild systemic reactions to vaccines are rather common, and are usually well known and described in detail when a vaccine is licensed. Some vaccine reactions are however so rare that they only will be discovered after the vaccine has become available for routine use. Large epidemiological studies are often necessary to decide whether there is a causal relationship or only a coincidence. Recording of adverse events following vaccination and transparency about their existence are important issues in the work to maintain the credibility of vaccines.

There are few true contraindications to vaccination. Children with low grade fever, a cold, diarrhea, vomiting or other mild illness can safely and effectively be vaccinated. Prematurity, low birth weight and breastfeeding are not reasons to withhold a vaccination. It is particularly important that malnourished children are immunized because they are more likely to die from a vaccine preventable disease than well nourished ones. Over the past several years the need for clear policies regarding vaccination of children with HIV infection has been recognized. (1,8,14)

6.1 WHO recommendations for vaccinating children with HIV infection

Policy markers and program staff must address the difficult question of vaccinating children with compromised immune systems. Live attenuated vaccines are a particular risk because the vaccines can cause a form of the disease and children with weakened immune systems may not be able to fight off even a mild infection. This risk must be balanced against the threat of the disease that the vaccine is intended to prevent. One of the biggest problems is that most infants who have been infected with the HIV virus do not show symptoms and its difficult to know if they should be excluded from vaccination. All newborns should receive BCG., also vaccine against measles is given. The overall risk of adverse events from the vaccine is relatively low compared with the risk of measles infection in HIV infected children.

Newborns without symptoms should receive oral polio vaccine. Yellow fever vaccinations should not be given to patients with symptomatic HIV infection nor to pregnant women.
Recent studies in Kenya have shown that one of the biggest obstacles to achieving full immunization in children is the failure to immunize sick children. Controlled scientific studies have shown that vaccination of sick and malnourished children in Africa is both safe and effective. There are no contraindications to immunization. All children admitted to hospital must be screened and if they are eligible for immunization, should receive it upon admission.
Sick children should not be denied their right to protection against vaccine preventable diseases. They are in greatest need of this protection.

(3, 14)

7.0The Norwegian vaccination programme

Present and previous Norwegian child immunization programs

Vaccine against	General vaccination	Introduced	Discontinued	Present
Smallpox	1 dose between age 6 and 18 m	1810	1976	
Tuberculosis	Approx. 14 y	1947		Approximately 14 y
Diphtheria, tetanus, pertussis	3, 4, 5 and 18 m	1952		3, 5 and 12 m
Hib*	3 doses at 3, 5 and 10 m	1992		3, 5 and 12 m
Polio (IPV)	All children < 15 y 3 doses to between 6 and 16 m, 2 doses at 7 and 15 y	1956/57, reintroduced 1979	1965	3, 5 and 12 m, 6 y, 15 y
Polio (OPV)	7, 8 and 10 m, 7 y, 15 y	1965	1979	
Measles	12 m	1969	1983	See MMR
Rubella	Girls at 15 y	1978	1983	See MMR
MMR**	2 doses at age 15 m and 13 y	1983		15 mo and 13 y

*HiB = *Haemophilus influenzae* type B; **MMR = Measles-Mumps-RubellaSource: Norsk folkehelseinstitutt

The prevention of a serious disease spreading across large areas has been the essence of the vaccination programme. The main goal of the vaccinations is to prevent a disease. Not only to protect the individual but to change the epidemiology of the disease and if possible to eradicate it.

BCG was introduced in 1947 , what is interesting is that comparing to other countries which vaccinate infants, Norway chose to vaccinate teenagers(14 year olds) because it was at this age the incidence of acquiring the disease was the highest in the country. Today there are discussions whether the vaccine should be withdrawed from the programme and only be given to people with higher risk of tuberculosis infection. The diphtheria epidemic was during the second world war and was added to the program ten years later as the DTP vaccine. (15)

7.1 The Norwegian vaccination programme in ten years

Local epidemiologic conditions are the most attributing factor to the differences in the vaccination programmes from country to country. In Norway vaccination against hepatitis B and meningococcus C is not included in the programme cause the diseases and their complication are rare in our country.

The question which is brought up now is the introduction of the pneumococcal vaccine into the program. The issue is whether its necessary to give it to all children since the bacteria has several serotypes and the vaccine only covers some of them. It will only apply to some children for which it will prevent a disease. The consequences of the disease makes it important to vaccinate all children with the pneumococcal vaccine.

In the coming years there will be a development in the combination vaccines to prevent multiple injections. The problem is the efficiency of the vaccines if they are combined. The new vaccination program in 2016 can change in the number of vaccines given and different age groups included. But most likely there wont be any significant changes

.An developing issue is the parents considerations about the effects of the vaccine. The diseases are not often seen in developed countries and the question about the necessity of vaccinating children arises by parents. The more successful the vaccination programme is the more difficult it is to withhold the acceptance of the programme. This is the vaccination paradox. Modern vaccines may be very costly, and society needs to consider vaccination against other preventive and curative interventions. An economic assessment of health care programmes implies to quantify costs and assess health consequences in order to set better priorities. The main challenge lies in obtaining valid estimates of health effects and side effects and the consequences of herd immunity and serotype shift. (8,13,15)

7.2 Possible vaccines included in the new programme of 2016

Hepatitis B: epidemiological data in Norway must be considered. Included in a teenager programme?

Chickenpox: necessity and effectiveness must be considered. Vaccinate non immunized teenagers?

MeningococcusC: important if the incidence rises.

Hepatitis A: stay as a travellers vaccine

Influenza vaccine to small children: will be considered.

HPV: 2006/2007 will be a part of the programme after documented effectiveness

Rotavirus: 2006 epidemilogy and need of vaccination is under consideration

Vaccines still under research: Herpes simplex

RSV

HIV

(Source: the Norwegian medical association journals no19. 2006)

8.0 vaccination programmes in developing countries/ vaccines used in national immunization programs in developing countries

Vaccines Used in National Immunization Programs in Developing Countries

Disease	Nature of vaccine	Formulation	Usual number of doses in primary series and route of administration	Comm-on vial sizes*	Stability at 37°C	Damaged by freezing?	Duration of immunity after primary series
Diphtheria	Inactivated: toxoid	Liquid DTP, DT, Td	3 doses of DTP — intramuscular	10 dose 20 dose	High (for approximately 6 weeks)	Yes	Variable; 5 to 10 years
Haemophilus influenzae type b (Hib) diseases	Inactivated: conjugate poly-saccharide vaccine	Both freeze-dried and liq-uid Monovalent, DTP–Hep B+Hib,** and DTP+Hib**	3 doses — intramuscular	1 dose 2 dose 10 dose	High in freeze-dried form When reconstituted, discard after six hours.	Yes, in liquid form Diluent for reconstitution should not be frozen.	Through 5 years of age, the age group most at risk for Hib
Hepatitis B (Hep B)	Recombinant	Liquid Monovalent, DTP–Hep B,** and DTP–Hep B+Hib**	3 doses — intramuscular	1 dose 2 dose 6 dose 10 dose 20 dose	High	Yes	More than 15 years
Measles	Live attenuated	Freeze-dried Monovalent, measles-rubel-la (MR), and measles-mumps-rubella (MMR)	1 dose — subcutaneous	1 dose 10 dose	Medium in dried form. When reconstituted, discard after six hours.	Diluent should not be frozen	Lifelong if boosted by exposure to wild virus; shorter when no wild virus circu-lating
Pertussis	Inactivated whole-cell or protein-based, acellular	Liquid Available as DTP	3 doses of DTP — intramuscular	10 dose 20 dose	50% loss in potency after 1 week	Yes	At least through early childhood
Polio (Oral Polio Vaccine)	Live attenuated OPV contains 3 types of polio virus	Liquid	4 doses — oral	10 dose 20 dose	Loss of 20% potency after 1 day, 50% after 2 days	No	Lifelong if boosted by exposure to wild virus; shorter when no wild virus circu-lating

Vaccines Used in National Immunization Programs in Developing Countries, Cont'd

Disease	Nature of vaccine	Form-ulation	Usual number of doses in primary series and route of administration	Common vial sizes*	Stability at 37°C	Damaged by freez-ing?	Duration of immunity after primary series
Polio (Inactivated Polio Vaccine)	Inactivated, whole-cell IPV contains 3 types of polio virus.	Liquid	3 doses — subcutaneous	1 dose 10 dose	Less than 5% loss of potency per day	Yes	Unknown but suspected to be many years
Tetanus	Inactivated: toxoid	Liquid Monovalent form–TT Multivalent forms–DTP, DT, Td	DTP — 3 doses — intramuscular for children DT — intramuscular for children with contraindications for pertus-sis; booster for children through six years of age. TT or Td — 5 doses — intramus-cular for schoolgirls and women of childbearing age	DTP:10 dose 20 dose DT: 10 dose 20 dose TT and Td: 10 dose 20 dose	High = Stable for approximately 6 weeks High High	Yes Yes Yes	5 years More than 5 years More than 30 years after five doses
Tuberculosis	*Bacillus Calmette–Guérin (BCG),* which is live attenu-ated *Mycobacterium bovis*	Freeze-dried	1 dose — intradermal	20 dose	Medium in dried form When reconstituted, dis-card after six hours.	No, but dilu-ent should not be frozen	Unknown
Yellow fever	Live attenuated	Freeze-dried	1 dose — subcutaneous	10 dose	Medium in dried form When reconstituted, dis-card after six hours.	No, but dilu-ent should not be frozen	10 — 30 years

*Availability of vial sizes varies by vaccine formulation and is subject to change.

** When designating combinations of antigens, — is used when combined antigens are presented in the same vial; + is used when they are presented in separate vials and reconstituted before use.

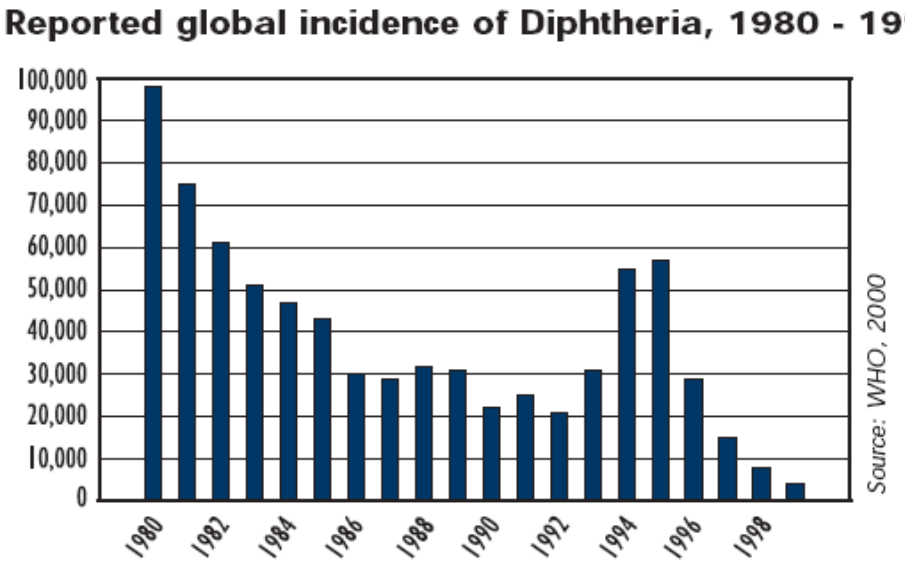
Source: immunization essentials by USAID

8.1 Vaccine preventable diseases.

Diptheria:

Diptheria is a bacterial infection caused by *C.diptheriae*. The infection can involve almost any mucous membrane, but the most common sites are infection are the tonsils and pharynx. This type of diphtheria can lead to obstructed breathing and death. Diphtheria infection results in the formation of bluish-white membrane that can cover the back of the throat. The membrane causes gagging and difficulty swallowing and breathing. Transmission in droplets and mucosal secretions from infected person, skin diphtheria spreads by direct contact with ulcers. In 1999 approximately 5000 cases of diphtheria were reported worldwide. Diphtheria occurs among unimmunized populations or among populations whose immunity has waned.

The largest epidemic since diphtheria vaccine was introduced in national immunization programs occurred from 1990 to 1998 in countries of the former Sovjetunion with over 50000 cases.



Treatment: diphtheria antitoxin and antibiotics(erythromycin or penicillin)

Three doses of diphtheria containing vaccine provide over 95% protection against diphtheria for at least 10 years. (3)

Haemophilus influenzae:

H. influenzae type b (Hib) is the most common cause of bacterial meningitis in children under five years of age and the second most common cause of serious bacterial pneumonia in children after S. pneumoniae.

Transmission is by droplets or saliva.

Population based data on Hib incidence are limited but WHO estimates that Hib causes approximately three million cases of serious disease and approximately 450000 deaths each year.

The vaccine available today given in the first six months of life covers only Hib and not the other types of *H.influenzae*. In 2001 71 countries had included Hib vaccine in their routine immunization schedule. Countries with Hib vaccine coverage rates above 80% for young children have documented a 99% decline in the incidence of invasive Hib disease.

(3)

Hepatitis B

Hepatitis B is a viral infection of the liver. If not fatal acute infection either resolves or progresses to chronic infection which may lead to cirrhosis or liver cancer several decades later. When it resolves patients develop lifelong immunity.

In developing countries hepatitis B infection usually occurs in childhood.

An acute illness typically including jaundice, dark urine, anorexia, malaise, extreme fatigue and right upper quadrant tenderness.

Transmission is through sexual activity, contaminated needles and blood products and delivery.

Child to child transmission through open wounds or shared implements that contain blood or body fluids.

More than two billion individuals alive today have been infected at some time in their lives with hepatitis B. Treatment is interferon or Lamivudine but they are only moderately effective and are expensive and not a realistic option for most people in developing countries.

WHO reccomends that hepatitis B vaccine should be offered to all children under one year of age in all countries. More than 130 developing countries now routinely provide the vaccine, and more are preparing to do so with the support of GAVI and the vaccine Fund.

(3)

Measles:

Measles is responsible for more deaths than any other vaccine preventable disease, killing an estimated 750 000 children each year. Over one half of these deaths occur in sub Saharan Africa. Measels is an acute viral infection characterizied by a variety of symptoms including fever, rash ,cough, conjunctivitis, diarrhea , ear infections, pneumonia, and brain inflammation. Measles is extremely infectious. The virus is transmitted through respiratory droplets. Measles death occur as a result of complications, including pneumonia, acute diarrhea and dehydration, chronic diarrhea with malnutrition and rarely encephalitis.

Treatment is supportive care for complications. Up to 15% of children who are vaccinated before their first birthday do not seroconvert and so are not protected against measles.

In areas where vaccination coverage with one dose of measles is high this failure to seroconvert accounts for a large proportion of the remaining susceptible children.

In 2001 WHO and UNICEF proposed a global strategy for measles mortality reduction that combines routine and supplemental immunization . A combination of approaches is needed to achieve and sustain reduction in measles deaths. The rapid reduction in mortality through supplemental immunization targeting a wide range will last for only a few years unless routine immunization is also strengthened. A comprehensive strategy includes a first dose of vaccine to all infants and guarantee a second opportunity for vaccination. Then monitor the coverage and improve the management of complicated measles cases.

(3)

Pertussis:

Pertussis also known as whooping cough is an acute bacterial diseases affecting the respiratory tract. Worldwide it causes an estimated 300 000 deaths per year.

The disease is characterized by long lasting coughs. Its transmitted through droplets. Infants are at the highest risk. Antibiotics reduce the symptoms if given in the incubation period.

Polio:

In 1988 the world health assembly set a goal to eradicate poliomyelitis worldwide. Since then national governments, WHO, UNICEF, CDC and USAID have been working to achieve the goal of polio eradication.

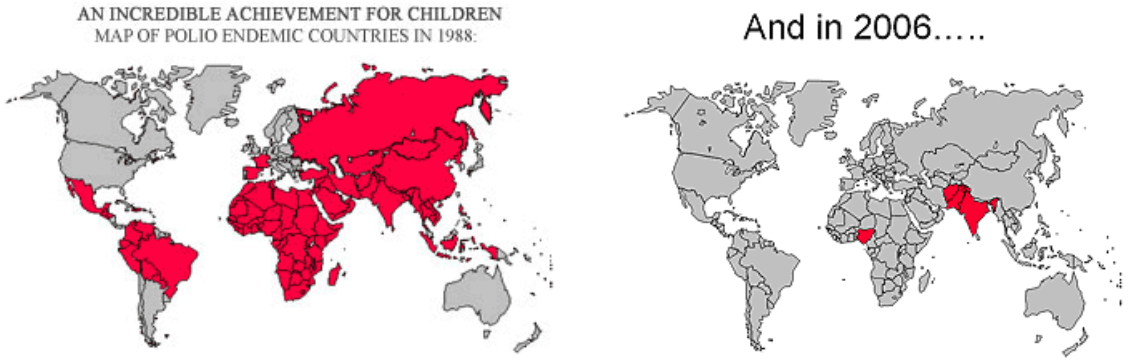
Polio is a disease of the central nervous system caused by polioviruses 1, 2, and 3.

The disease presents with influenza like symptoms and 1 % become paralyzed.

In paralytic polio, severe muscle pain follow the milder symptoms and then paralysis develops. Transmission is from person to person by contact with infected feces or secretions from the nose and mouth.

As a result of the polio eradication initiative there has been a 99% decrease in the number of confirmed polio cases compared with the 350 000 cases reported in 1988.

Polio can occur anywhere in the world. In regions where it has been eliminated such as the Americas, Europe and the western pacfic control measures and certification quality surveillance must be sustained until the disease is eradicated worldwide. The principle of the eradication strategy is as follows. A combination of strategies is being used for polio eradication. These strategies must ensure that immunity remains high and susceptibility low everywhere until there is global agreement to stop vaccinating against polio. (3)



(source: UNICEF)

Tetanus

Tetanus is a common cause of neonatal and maternal mortality, caused by *Clostridium tetani* that is present in animal and human feces. The bacterium produces a toxin that makes muscles rigid, causes spasms and makes breathing diffcult or impossible resulting in death.

Every year an estimated 200 000 infants die from tetanus in their first month of life.

Neonatal tetanus declines as socioeconomic conditions including sanitation and personal hygiene improve. Treatment is nursing care and careful use of drugs which can reduce the case fatality rate in neonatal tetanus from 80% to 50% or lower.

(3)

Tuberculosis:

Tuberculosis is a chronic disease that affects people of all ages and is one of the most important public health problems world wide. National immunization programs use the Bacillus calmette –guerin (BCG) to prevent milliary and meningeal TB in the first years of life. BCG offers limited protection against tuberculosis in older children and adults.

TB is caused by Mycobacterium tuberculosis, it usually attacks the lungs but other parts of the body can be affected.

Transmission is through the air when a person with the disease coughs, spits or sneezes.

Nearly two million people die from tuberculosis each year. It is estimated that nearly 1% of the worlds population is newly infected with tuberculosis each year.

Vaccination of uninfected children with BCG vaccine can provide protection for more than 90% but the protective effect varies. (3)

Yellow fever:

Yellow fever is a viral hemorrhagic fever transmitted by infected *Aedes aegypti* mosquitoes in tropical and subtropical areas. The disease begins with a sudden onset of fever and chills, head , back and muscle pain, nausea and vomiting. These may progress to jaundice and haemorrhaging. Yellow fever surveillance is poor, and the disease is seriously under reported. Although fewer than 5000 yellow fever cases were actually reported in 2000 WHO estimates that in sub Saharan Africa alone 200 000 cases and 30000 deaths are attributable to yellow fever each year. In 2001 more than 30 countries were considered at risk for yellow fever in Africa. Treatment for this disease is only supportive. (3)

AREAS AT RISK OF YELLOW FEVER:

Source: immunization essentials by USAID

9.0 The global effort to immunize all children

In the 1970s at the end stage of the global campaign to eradicate Smallpox the world health organization (WHO) launched the Expanded programme on immunizaton (EPI). Coverage for basic vaccines was an estimated 5 % in developing countries at that time. The EPI goals were to ensure that every child received protection against childhood tuberculosis, polio, diphtheria, pertussis, tetanus and measles by one years of age and to give tetanus toxoid vaccinations to women to protect them and their newborns against tetanus.

During the 1980s, national immunization programs in developing countries made substantial progress in meeting the EPI goal, with the support of WHO, the United Nations childrens Fund/(UNICEF) and the US agency for international development (USAID).As immunization coverage in developing countries soared, EPI was helping lay the foundation for other primary health care services. By 1990 average reported coverage for the six antigens was over 70%. As a result of the increase in coverage, the incidence of vaccine preventable diseases began to fall dramatically.

In the 1990s coverage levelled off and even declined in some countries. There were a number of reasons why it proved difficult to maintain the momentum of the early EPI years. When coverage peaked in 1990, many believed that the job was finished and turned their attention to other immunization activities such as vertical disease eradication programs. Some donors became fatigued with immunisation altogether and noting the declining incidence of vaccine preventable diseases, shifted their resources to other health priorities. Another factor was that the remaining unimmunized children were primarily the hard to reach children with whom routine health services generally had little or no contact.

Furthermore health sector reform and structural adjustments diverted attention away from maintaining effective preventive services in many countries and in some cases created confusion regarding there the responsibility for immunization resided within the health sector. Whatever the reasons the result was a declining investment in training, equipment, logistics and communications.

The deteriorating situation in the 1990s sounded alarms in the public health community, and at the turn of the century, governments and their partners began to renew their commitment to routine immunization services. New coordination and funding mechanisms were set up. Most noteworthy was the formation of the Global alliance for vaccines and immunization. (GAVI) in 1999 which supports immunization efforts worldwide. GAVI is a coalition of governments and international and private sector partners with the purpose of helping countries strengthen immunization services and introduce new and underutlilized vaccines. GAVI provides a forum for partners to agree upon goals, share strategies and coordinate activities. As of 2003, the financial arm of GAVI, the Vaccine Fund, provides financing to over 70 countries to help them reach national and GAVI objectives.

(3)

The lessons of the 1980s and the 1990s and the new opportunities put forth at the turn of the century have set the stage for great strides in national immunization programs. Realizing the potential of immunization requires a commitment from a broad coalition of partners. That coalition involves everyone from the village health worker to the research scientist, from the national EPI manager to the global policy maker, from the donor agency health officer to the minister of health. If these partners can work together in a coordinated strategies that give appropriate attention to all of the essentials of immunization, then the worlds children will face a much safer and brighter future. (3, 9)

10.0 Global immunization strategy by WHO

The need to elaborate a new global strategy on immunization with early and full participation of all stakeholders is urgent. In response to these developments and trends the secretariats of WHO and UNICEF have agreed to draw up a global immunization strategy for the period 2006-2015, seeking the commitment of member states, international and nongovernmental organizations, the private sector and other stakeholders to devote unprecedented attention to immunization at all levels. Building on the achievements of the expanded programme on immunization , the global poliomyelitis eradication initiative and GAVI the proposed strategy aims to protect more people against more vaccine preventable diseases and to ensure the sustainability of immunization programmes and related interventions in diverse social contexts and against a background of changing demographics and econmies and evolving disease patterns. At current levels of coverage, vaccines and immunization avert the death of between two and three million children each year. And an additional one to two million deaths could be prevented annually by 2015 if countries substantially increased coverage with both current vaccines and those in the late stages of development, such as new pneumococcal and rotavirus vaccines.

Although most children who are unreached by immunization programmes live in least developed countries every country has underserved populations and experiences failures in its immunization systems. Special strategies are needed for programmes to contact hard to reach populations on a regular basis and to reach those affected by or vulnerable to outbreaks of vaccine preventable diseases and emergency situations. Furthermore expanding the benefit of immunization to population groups other than infants and women of child bearing age, older children for booster doses and adolescents and adults for epidemic prevention and control, has the potential to prevent even more morbidity and mortality and increase global security against impending pandemics.

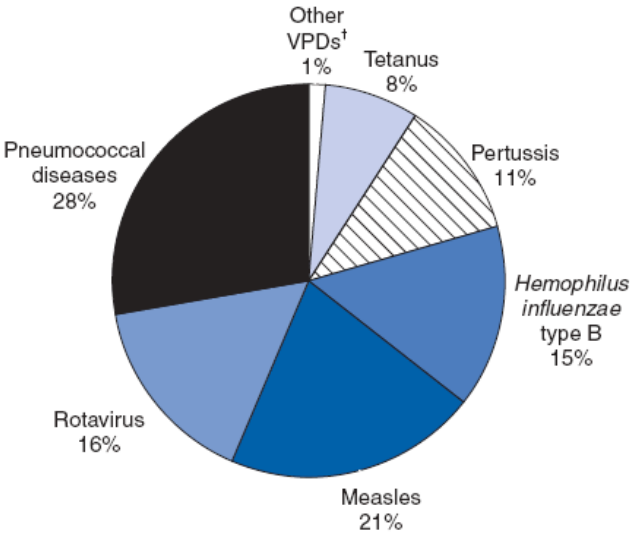
The main reasons for falling rates of vaccination coverage in some countries include the lack of weakness of national and district plans. Insufficient financial resources, poor budgetary and financial planning and management. A necessary approach is to provide all infants with at least four immunization contacts and extending services to school age children, adolescents and adults as appropriate. The proposed strategy includes strengthening on the basis of existing systems, field and laboratory surveillance, data collection and analysis. (4)

11.0 Vaccination strategies.

Vaccine preventable diseases are responsible for a significant proportion of the approximately 11 million deaths that occur annually among children under 5 years of age. Two contemporary vaccination strategies have received massive support from both the public and private sectors. The highest profile public health programme is to eradicate poliomyelitis. Supported by a 1988 resolution of the world health assembly and by a major coalition of international agencies and private organizations the drive to eradicate poliomyelitis is a direct descendant of previous eradication programmes. Based on a strategy of multiple national mass immunization days accompanied by intensified surveillance, poliomyelitis has been eliminated from industrialized countries and is on the verge of being eradicated worldwide.

It is apparent that those countries with the weakest health system will be the last to achieve eradication. As the drive toward poliomyelitis eradication nears its successful end, plans are being made to embark upon a global initiative to eradicate measles. Unlike poliomyelitis measles is an important cause of childhood mortality and its eradication would make an important contribution towards reducing childhood mortality. The global alliance reports that although children in developing countries are scheduled by their national immunization programmes to receive six or seven antigens as part of their routine series of vaccination, children in the wealthier countries in Europe and North America can expect to receive protection against more than 10 vaccine- preventable diseases. This vaccine gap is another example of the inequitable distribution of health services that contributes to the growing difference in mortality between rich and poor. (16)

FIGURE 1. Percentage of deaths from vaccine-preventable diseases (VPDs)* among children aged <5 years, by disease — worldwide, 2002



*An estimated 2.5 million deaths worldwide (of a total of 10.5 million for this age group) are caused by diseases for which vaccines are currently available.
†Diphtheria, hepatitis B, Japanese encephalitis, meningococcal disease, poliomyelitis, and yellow fever. (In older age groups, approximately 600,000 hepatitus B deaths are preventable by routine immunization.)

Source:WHO. The evolution of the child health programme.

12.0 Delivery of immunization services

In order to reduce mortality, morbidity and disability, immunization programs must safely administer potent vaccines to susceptible children and women before they are exposed to vaccine preventable diseases. The immunization schedules recommended by WHO for delivering the primary series of vaccines to children below the age of one year reflects a balance between epidemiology and practicality. Although the approximate ages and intervals between doses in country schedules should not deviate from those that WHO recommends there is no single schedule that is appropriate for all countries. An understanding of local epidemiology and national policy is needed to adapt the recommended schedule to a given country`s needs .(3)

WHO's Recommended Schedule for Primary Series of Childhood Vaccinations in Developing Countries

Age	Vaccines
Birth	BCG OPV0 Hep B*
6 weeks	DTP1 OPV1 Hep B* Hib1**
10 weeks	DTP2 OPV2 Hep B* Hib2**
14 weeks	DTP3 OPV3 Hep B* Hib3**
9 months	Measles Hep B* Yellow fever***

***Only three doses of hepatitis B vaccine are needed for full protection. Hepatitis B vaccination schedules vary by country. See Chapter 12.**

**Hib stands for *Haemophilus influenzae* type b. See Chapter 12.

***In countries where indicated.

Source: immunisation essentials.

Vaccines for measles, polio, diphtheria, pertussis and tetanus have been part of the WHO recommended vaccination series since the inception of the Expanded programme on immunization in 1974. In 1988, WHO recommended inclusion of yellow fever vaccine in routine infant immunization programmes in countries with populations at risk for yellow fever. Hepatitis B vaccine was universally recommended for infants by WHO in 1992. In 1998 WHO recommended that Hib vaccine should be included in routine infant immunization programs.

(5)

12.1 The usage of routine immunization services

Studies in many developing countries show that the great majority of parents view immunization as a worthwhile and relatively easy health practise. Childhood immunization only requires parents to take action about five times in the first year of a childs life and is generally accepted by families and communities. This contrasts with other practises such as exclusive breastfeeding which require repeated and frequent actions on the part of mothers and which are sometimes contrary to cultural norms and beliefs. Scheduling immunization sessions to be accessible is only half the battle, people must actually use the services.

Research from many countries indicates that people will use immunization services at least once if they know what services are offered and where and when they are available. Surveys in a wide range of countries have consistently found that a majority of parents wish to immunize their children but that many encounter obstacles such as lack of information, poor services, time constraints, social, cultural or political barriers and misinformation such as children are safe from vaccine preventable diseases because a religious or supernatural being protects them or that sick children cant be vaccinated. Distance is another important factor. Some people simply do not live within reach of health services. Some of these people live in permanent communities and others are on the move. (nomads and seasonal migrants.)

Strategies for increasing the use of routine services are important. The reasons why people never use immunization services or stop using them after one or two encounters differ from place to place. The strategies focus on reaching the unreached, reducing drop outs, limiting missed opportunities.

Vaccination coverage rates appear higher in cities than in rural areas, these figures may mask pockets of much lower coverage in high risk areas such as urban slums. Reaching unreached populations in urban areas is particularly important epidemiologically because population density increases the intensity of disease transmission. Epidemics occur more frequently in urban than rural areas, resulting in infection of younger children, more severe illness and higher mortality. Chains of transmission, particularly measles and pertussis often begin in cities and towns and then spread to rural areas. The poor sanitation and poor nutrition found in densely populated slum areas weakens residents resistance to disease and increases their risk of severe illness and death.

Improving immunization coverage in urban areas can be complex. In some situations the ministry of health, municipal governments, ministry of local governments share the responsibility for managing and providing vaccination services. . Urban health facilities like their rural counter parts, can marshal the help of the community members and local health teams to identify who is not being reached and to find out why. People who live within walking distance of a health facility may not use its services because of lack of information, cultural or physical barriers or previous negative experience. Different communication and service delivery strategies may be needed to reach populations with diverse language, cultural and socioeconomic backgrounds.

The door to door strategy is sometimes used as a supplemental immunization strategy to reach families that are not served at health facilities and other collection points. This strategy can be effective but it is also expensive in terms of human resources, transport and other costs. Supplemental immunization strategies are used to reach children who have not been vaccinated or have not developed sufficient immunity after previous vaccinations. Strategies differ according to the epidemiology of the disease. Some of the common features are; the target age group is expanded, all children are vaccinated regardless of their immunization status, immunizations do not need to be marked on a vaccination card. Examples include polio national immunization days and measles campaigns. Supplemental immunization strategies should not replace routine services. (3)

12.2 Outbreak response:

When an outbreak of a vaccine preventable disease occurs or is suspected managers must decide whether an immediate vaccination campaign is warranted and if so which populations to target. Target populations for such campaigns are people who are at risk in terms of both age and location. Decisions about target groups, age range, geographic scope and type and duration of response activities should be based on local epidemiological data.

Governments can provide information, treatment, rehabilitative care and special supplementation which is needed. If the response includes vaccination campaigns, health and other public officials should explain that people might already be incubating the disease when they are vaccinated and therefore may get the disease despite being vaccinated. (3)

12.3 Monitoring , evaluation and information management:

Immunization program managers and service providers need a continous flow of information that tells them

- whether immunization services are accessible to the target population.
- How many individuals in the target population are being vaccinated, who is not being vaccinated and why.
- Whether the quality of services meets program standards.
- Whether services strategies are meeting objectives
- Whether mortality and morbidity from vaccine preventable diseases are being reduced.

(3)

12.4 Vaccination cards:

Vaccination cards and other home based records enable parents and health workers to monitor an individuals childs progress toward full immunization. These cards may be the only records health workers have of vaccination history and status if patient registers are not well maintained or for clients who have moved from another health facility. A vaccination record may be a separate document or part of a general child health card. Regardless it should include the childs name, date of birth, address a parents name and the date of each vaccination by dose. (3)

13.0 Global vaccine shortage:

The supply of the six traditional vaccines was more than adequate to meet demand until the late 1990s, some manufacturers then stopped producing these vaccines and as their availability decreased prices began to rise significantly.

By 2002 most vaccines given to children and women in developing countries, including the newer vaccines, were in short supply. Poor forecasting, inefficient use, and sudden increases in demand can add to shortages.

An immunization programs ability to provide vaccination services to all members of the target population depends attention to details. Ensuring that vaccines, supplies, and staff arrive on time and where they are needed requires an integrated system of equipment, people, policies and procedures.

Keeping vaccines at the right temperature is not an easy task, but the consequences of not doing so can be disastrous. Once vaccine potency is lost it cannot be regained. Damaged vaccines must be destroyed, which can leave a country without adequate vaccine stocks and can cause serious budget problems when the losses involve large lots and expensive vaccines. Children and women who receive a vaccine that is not potent are not protected. Storage capacity and supply are two other important issues. Space needs vary at different levels of the system depending on the amount and type of vaccine expected to be stored. In a typical health center , a refrigerator should be expected to hold a one month supply of vaccines. The supply interval must be considered in calculating the amount of space needed to store vaccines. In certain places where roads are impassable during parts of the year, health facilities may need to have a three month supply of vaccines and other supplies delivered just before roads close.

Then there is the possibility of cold boxes and vaccine carriers which are insulated containers that are lined with ice packs to keep vaccines cold. Cold boxes are normally used to transport vaccine from the central level to the provinces, from provinces to districts. Cold boxes are also used for temporary storage when a refrigerator is out of order or being defrosted.
Proper handling of vaccines requires correct packing and storing of vaccines.

14.0 The role of behaviour change:

In country after country studies have shown that most people will use immunization services as long as they do know when and where to bring their children, and those services are available , reliable and friendly. Thus the role of communication activities in achieving these conditions is important but not sufficient. Dissemination of information, training, supervision and other ways of improving services need to be employed in a mutually supportive way to promote complete and timely immunization of women and children. Achievement of immunization goals is affected by the behaviour of many groups including politicians, community leaders, health care providers managers and supervisors, women of reproductive age , parents and children .Indications that various groups are not carrying out the desired behaviours can be found in low immunization coverage data, high drop out rates and increased disease incidence. It is important t o undertake additional information to understand the cause of these problems. (3)

14.1 Facing the problems;

Little knowledge about immunization leads to failure of vaccination programmes. Side effects of the vaccines such as fevers and swelling cause concerns. Distance and the demand to take time off from field work and other children is a problem. There are inconsistency in the service provision. People can arrive to the hospital and there are no medicines left.
Immunization programmes use numerous communication channels to reach parents and other target audiences. From radio and television, to folk media, to community events to counselling at health facilities. Communication experts have found that the best channels for reaching rural people are health care workers, local leaders and groups and in some cases radio. It is generally not very effective to use print materials with low literacy populations or mass media for those with little access to television and other mass media.

As one of the most effective and affordable ways to control infectious diseases, immunization should be a financial priority for national governments and donor agencies. If the financial commitment to immunization services was reduced, the subsequent increase in morbidity and mortality would have serious social and economic consequences. Therefore, immunization clearly requires a sustained commitment even though the incidence of vaccine preventable diseases has been significantly reduced. The primary responsibility for ensuring sufficient financing for immunization services rests with governements of developing countries. Since national governments alone may not be able to provide all of the required funding. It is a shared responsibility of the central government, district governements and communitites to identify and mobilize the necessary resources to sustain safe and effective immunization services. The challenge of sustaining the resources for immunization is a task that falls on many groups. National policy makers need to prioritize immunization services so that they compete successfully with other health services, donors need to provide support in ways that eliminate funding uncertainties and avoid dependencies, and program managers need to take advantage of service delivery efficiencies to minimize costs. All of these partners should assess needs, calculate costs, monitor expenditures, arrange financing and make efficient use of resources without losing sight of the immunisation program goal to minimize the impact of vaccine preventable diseases.
(3)

15.0 Vaccine preventable deaths and the global immunization vision and strategy 2006 -2015

During 2002 the largest number of deaths from vaccine preventable deaths among children less than 5 years were due to pneumococcal disease and rotavirus infection.
During 2002 76 percent of the vaccine preventable deaths occurred in Africa or southeast Asia.

In 2005, WHO and UNICEF worked with partners to create a Global Immunization Vision and Strategy(GIVS) for 2006-2015. This strategy which seeks to expand the reach of vaccination to every eligible person is intended to be used as the basis for developing national plans.

GIVS articulates the WHO and UNICEF visions for global immunization in 2015 and is composed of four strategic areas:

1. protecting more persons in a changing world by improving routine immunization coverage, ensuring at least four immunization contacts per child and expanding immunization programs to all ages.
2. introducing new vaccines and technologies
3. integrating immunization, health interventions
4. create global partnerships to support and finance immunizations.

(5)

16.0 Available vaccines not widely used in developing countries

Available Vaccines Not Widely Used in Developing Countries

Disease and Agent	Identification	Transmission	Occurrence and Incidence	Effectiveness and Limitations of Available Vaccines
Meningococcal meningitis Bacterium *Neisseria meningitidis*	High fever, headache, and stiff neck This form of meningitis can lead to brain damage, hearing loss, or learning disability.	Close respiratory contact with infected individual	Worldwide, especially in the "meningitis belt" in sub-Saharan Africa, causing about 50,000 deaths per year	Polysaccharide vaccine is not very effective in children under two years of age. A conjugate vaccine, which protects children under two for strain A, which causes most epidemics in Africa, is under development.
Pneumococcal pneumonia Bacterium *Streptococcus pneumoniae*	Sudden onset with severe shaking, chills, high fever, chest pain, shortness of breath, rapid breathing, and coughing *S. pneumoniae* causes acute respiratory disease, meningitis, and septicemia.	Droplets, direct oral contact, or through articles soiled with respiratory discharges	*S. pneumoniae* is a leading cause of severe pneumonia in children under age five years worldwide. This bacterium causes more than one million deaths in children every year.	A 9-valent pneumococcal conjugate vaccine that protects infants is on trial in Africa. If trials go well, a license could be granted by 2006.
Rotavirus diarrhea Virus	Vomiting, fever, and watery diarrhea	Fecal-oral route possibly spread by respiratory or other contact; may be present in contaminated water	Worldwide, accounts for over 500,000 deaths and approximately one third of hospitalized cases of severe diarrhea in infants and children.	Work is in progress to improve the effectiveness of recently developed vaccines, limit unwanted side effects, and lower costs. Newer kinds of vaccines also are under development.

Adapted from Chin, 2000. *Control of Communicable Diseases Manual*. See also fact sheets issued by CDC and NIAID.

Available Vaccines Not Widely Used in Developing Countries, Cont'd

Disease and Agent	Identification	Transmission	Occurrence and Incidence	Effectiveness and Limitations of Available Vaccines
Japanese encephalitis Virus	Inflammation involving parts of the brain, spinal cord, and meninges.	Bite of the *Culex* mosquito.	2.4 billion people at risk in Asia/Pacific region; 500,000 cases reported annually; severe neurological damage in one third of survivors.	An inactivated vaccine has been used in several countries. Efforts are ongoing to develop alternatives with improved safety, efficacy and affordability.
Malaria *Plasmodium falciparum; P. vivax; P. ovale; and P. malariae* Parasite	Bouts of fever accompanied by other symptoms, alternating with periods of feelings of freedom from any illness The most severe forms of malaria result in organ failure, delirium, impaired consciousness, and generalized convulsions followed by persistent coma and death.	Person to person through the bite of an infected female Anopheles mosquito	Worldwide, with an estimated 300 million acute cases every year and one million deaths Heaviest toll is in Africa, where 90% of the total deaths occur. Malaria is the leading cause of death in young children.	There is no vaccine available at this time. Research is focusing on two recombinant vaccines. One addresses the pre-blood stage of the parasite and would prevent all infections. The other addresses the parasite's blood-stage and would support the acquisition of natural immunity by allowing a mild form of the disease to develop without the risk of severe disease or death. Another vaccine in development would prevent transmission of the disease from humans to mosquitoes. A combination of these types of vaccine is probable.

Adapted from Chin, 2000. *Control of Communicable Diseases Manual*. See also fact sheets issued by CDC and NIAID.

17.0 Conclusion:

Vaccines are one of medicine`s greatest achievements. Without vaccinations, millions of children and adults would contract serious diseases that are now prevented by vaccines and many would have long lasting effects or even die.

Disease prevention is the key to public health. It is always better to prevent a disease then to treat it. Vaccines prevent disease in the people who receive them and protect those who come into contact with unvaccinated individuals. Vaccines help prevent infectious diseases and save lives. Immunizing individual children also helps to protect the health of our community, especially those people who are not immunized. People who are not immunized include those who are too young to be vaccinated, those who cannot be vaccinated for medical reasons and those who cannot make an adequate response to the vaccine.

Immunization for all is to be seen as a major contribution to human development, but how will it be achieved? Governments around the world and the global health community have committed to increasing immunization coverage rates such that 90 percent of children in every nation will be vaccinated against major childhood illnesses by 2015. Such a high rate of coverage is needed to block disease transmission, significantly decrease deaths and increase the number of children whose healthy early years pave the way for productive and prosperous lives.

Current immunization rates vary widely by nation, with great disparity within many and ten countries in Africa and Asia have lower than 50 percent coverage with the basic DPT vaccine. Public health experts and economists know that attaining and sustaining the goal of 90 percent coverage will take large financial resources well beyond those available today especially if they are to include new vaccines that will soon be available for killers such as pneumonia, diarrheal diseases and malaria. The challenge is finding ways to make these life saving vaccines available to the children and families who need them most.

Vaccination is an important intervention but the production and distribution is challenging.

¾ of the worlds children population are vaccinated but in the preventive work of the disease we must try to reach out to even more of them. Vaccination has got a more central role in the development of new strategies, cooperation and financial issues and helping developing countries. Many new vaccines are under research projects. If we can manage to establish systems that helps people who needs it the most it will improve health, nutrition, survival leading to economical development and political stability in developing countries.

And although it takes a lot of effort and research it does work. The last case of Smallpox in the world was in Somalia in 1977. In 1980 scientists announced that vaccines had been successful at eradicating Smallpox from the world.
Unless we can eliminate the disease it is important that we keep immunizing. Even if there are only a few cases of disease today, if we take away the protection given by vaccination more and more people will be infected and will spread disease to others.

Japan was a good example of this in 1974. They had a successful pertussis vaccination program with nearly 80% of Japanese children vaccinated. That year only 393 cases of pertussis were reported in the entire country and there were no deaths from pertussis. In 1976 only 10% were vaccinated. In 1979 japan suffered a major pertussis epidemic with more than 13000 cases of whopping cough and 41 deaths.

Vaccinations are given to thousands of children to prevent a serious disease which would normally affect some percentage of the population. This distinguishes vaccines from therapeutic interventions. Therefore the principels of research must be thought of the safety of persons. It's a different kind of medication cause its given to healthy individuals especially children. Therefore it is necessary to secure all interventions around the research and prevent any serious complications or side effects.
New and promising vaccines can if distributed according to need be an important step to improved health status in developing countries.

In developing countries where economic development is lacking and literacy rates are low priority must be given to primary health care and to establishment of sustainable health care delivery systems. Since the establishment of the worlds health organizations Expanded programme on Immunization in 1974 the estimated incidence of childhood vaccine preventable diseases has declined significantly.

The ultimate goal of immunization programmes is to prevent or eliminate infectious disease. Epidemiological data about the different vaccine preventable diseases shows us the decline in the incidence of deaths from the disease. The results are promising but its important to keep vaccinating even though the results are positive now to be able to eradicate the disease.For infectious diseases that can only be transmitted from person to person , immunization results

in the elimination of the disease and eventually by good interventions to eradication of the organism. This was the case of smallpox and may be the case with polio and measles. Vaccination is an effective intervention , but still facing large production and distribution challenges. 3 /4 of all children are vaccinated, but we need to reach out to even more of the children.

18.0 Summary

The knowledge and technology we have today has led to the development of vaccines that prevent the population from acquiring vaccine preventable diseases and saves thousands of lives and prevent people from disabilities. The research for new vaccines is dependent on knowledge about infections and the microbes that cause the disease. It must be considered whether the specific vaccines would be useful for the whole population and then it could be used in the specific vaccination programmes in each country. Vaccines used in vaccination programmes not only protects each individual which is vaccinated but changes the epidemiology for the specific disease.

In the future the availability and development of new vaccines will increase, concidering the Norwegian vaccination programme any radical changes are not expected in the next ten years. The newly developed vaccines need to be tested in trials to consider their efficacy and side effects and whether the risks outweigh the benefits if applicated. As a global task this is the eradication of polio and working through the problems in the developing countries to increase the status of immunized children. There are lots of obstacles and problems with increasing the immunization rates in developing countries, but with the specific foundations established specializing on this task the vaccination programmes are some steps nearer to their goal of eradication of diseases and in the future hopefully the epidemiological data of vaccine preventable diseases will show an even higher decrease in mortality.

Addendum of tables included in the paper follows on the next pages.

Vaccines Used in National Immunization Programs in Developing Countries

Disease	Nature of vaccine	Formulation	Usual number of doses in primary series and route of administration	Comm-on vial sizes*	Stability at 37°C	Damaged by freezing?	Duration of immunity after primary series
Diphtheria	Inactivated: toxoid	Liquid DTP, DT, Td	3 doses of DTP — intramuscular	10 dose 20 dose	High (for approximately 6 weeks)	Yes	Variable; 5 to 10 years
Haemophilus influenzae type b (Hib) diseases	Inactivated: conjugate poly-saccharide vaccine	Both freeze-dried and liq-uid Monovalent, DTP–Hep B+Hib,** and DTP+Hib**	3 doses — intramuscular	1 dose 2 dose 10 dose	High in freeze-dried form When reconstituted, discard after six hours.	Yes, in liquid form Diluent for reconstitution should not be frozen.	Through 5 years of age, the age group most at risk for Hib
Hepatitis B (Hep B)	Recombinant	Liquid Monovalent, DTP–Hep B,** and DTP–Hep B+Hib**	3 doses — intramuscular	1 dose 2 dose 6 dose 10 dose 20 dose	High	Yes	More than 15 years
Measles	Live attenuated	Freeze-dried Monovalent, measles-rubel-la (MR), and measles-mumps-rubella (MMR)	1 dose — subcutaneous	1 dose 10 dose	Medium in dried form. When reconstituted, discard after six hours.	Diluent should not be frozen	Lifelong if boosted by exposure to wild virus; shorter when no wild virus circu-lating
Pertussis	Inactivated whole-cell or protein-based, acellular	Liquid Available as DTP	3 doses of DTP — intramuscular	10 dose 20 dose	50% loss in potency after 1 week	Yes	At least through early childhood
Polio (Oral Polio Vaccine)	Live attenuated OPV contains 3 types of polio virus	Liquid	4 doses — oral	10 dose 20 dose	Loss of 20% potency after 1 day, 50% after 2 days	No	Lifelong if boosted by exposure to wild virus; shorter when no wild virus circu-lating

Vaccines Used in National Immunization Programs in Developing Countries, Cont'd

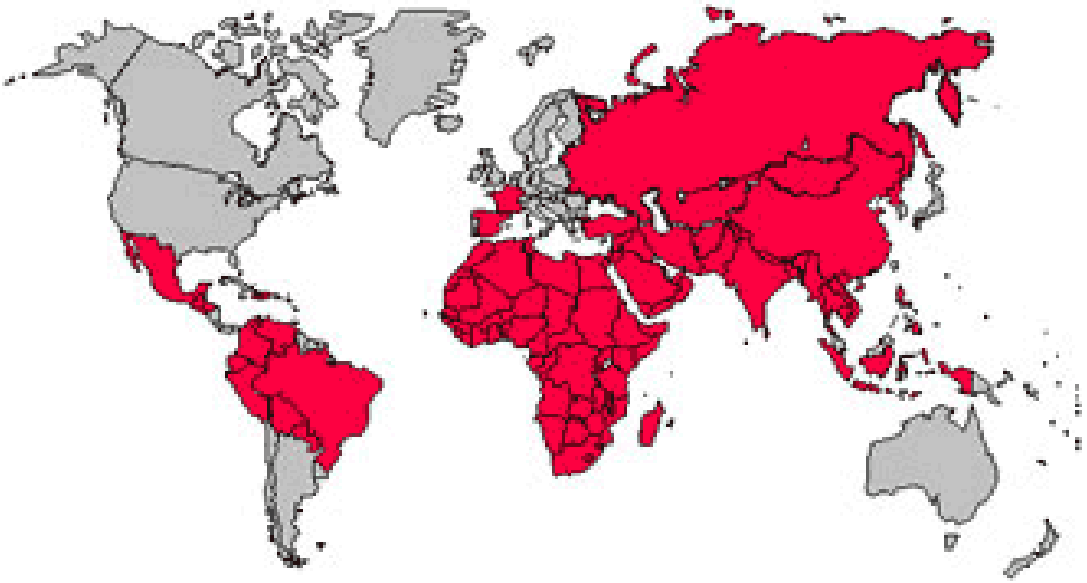
Disease	Nature of vaccine	Form-ulation	Usual number of doses in primary series and route of administration	Common vial sizes*	Stability at 37°C	Damaged by freez-ing?	Duration of immunity after primary series
Polio (Inactivated Polio Vaccine)	Inactivated, whole-cell IPV contains 3 types of polio virus.	Liquid	3 doses — subcutaneous	1 dose 10 dose	Less than 5% loss of potency per day	Yes	Unknown but suspected to be many years
Tetanus	Inactivated: toxoid	Liquid Monovalent form–TT Multivalent forms–DTP, DT, Td	DTP — 3 doses — intramuscular for children DT — intramuscular for children with contraindications for pertussis; booster for children through six years of age. TT or Td — 5 doses — intramuscular for schoolgirls and women of childbearing age	DTP:10 dose 20 dose DT: 10 dose 20 dose TT and Td: 10 dose 20 dose	High = Stable for approximately 6 weeks High High	Yes Yes Yes	5 years More than 5 years More than 30 years after five doses
Tuberculosis	*Bacillus Calmette–Guérin (BCG)*, which is live attenuated *Mycobacterium bovis*	Freeze-dried	1 dose — intradermal	20 dose	Medium in dried form When reconstituted, discard after six hours.	No, but diluent should not be frozen	Unknown
Yellow fever	Live attenuated	Freeze-dried	1 dose — subcutaneous	10 dose	Medium in dried form When reconstituted, discard after six hours.	No, but diluent should not be frozen	10 — 30 years

*Availability of vial sizes varies by vaccine formulation and is subject to change.

** When designating combinations of antigens, — is used when combined antigens are presented in the same vial; + is used when they are presented in separate vials and reconstituted before use.

Source:immunization essentials USAID (3)

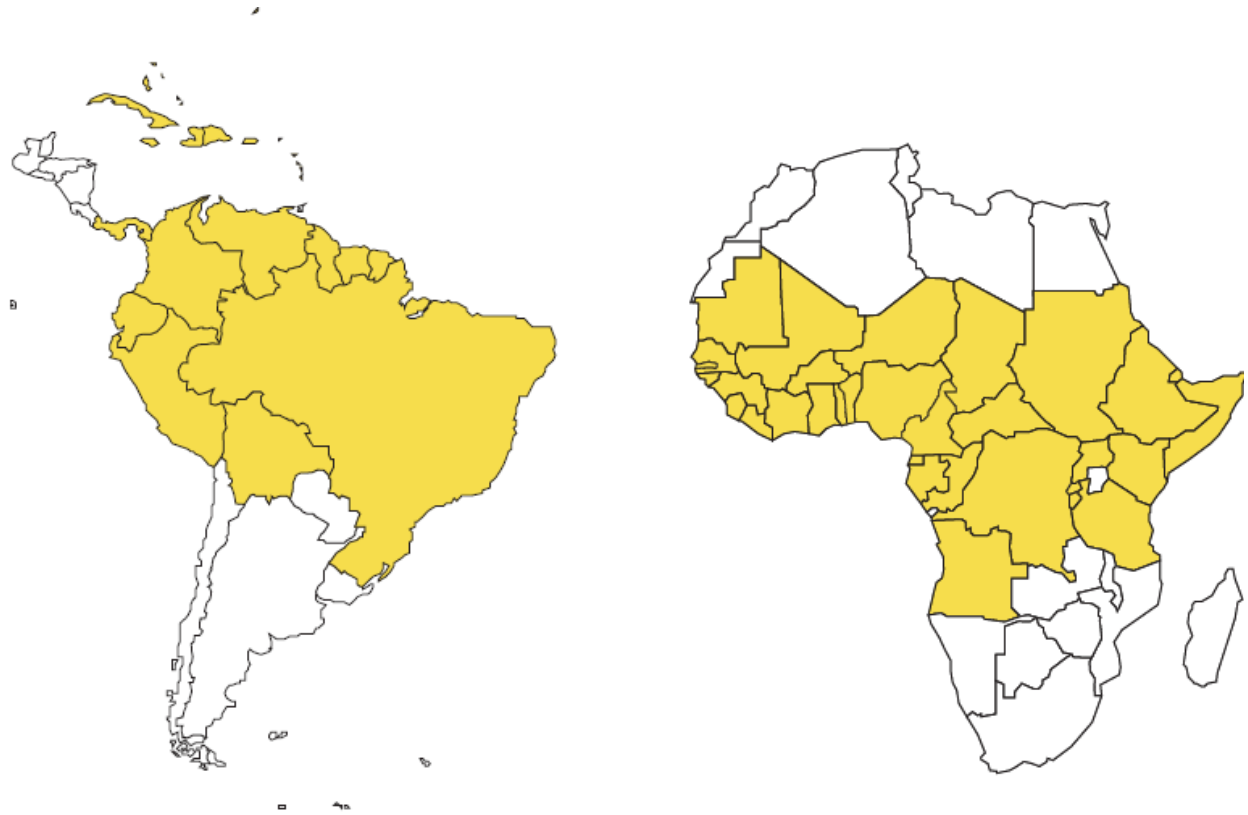
AN INCREDIBLE ACHIEVEMENT FOR CHILDREN
MAP OF POLIO ENDEMIC COUNTRIES IN 1988:



And in 2006.....

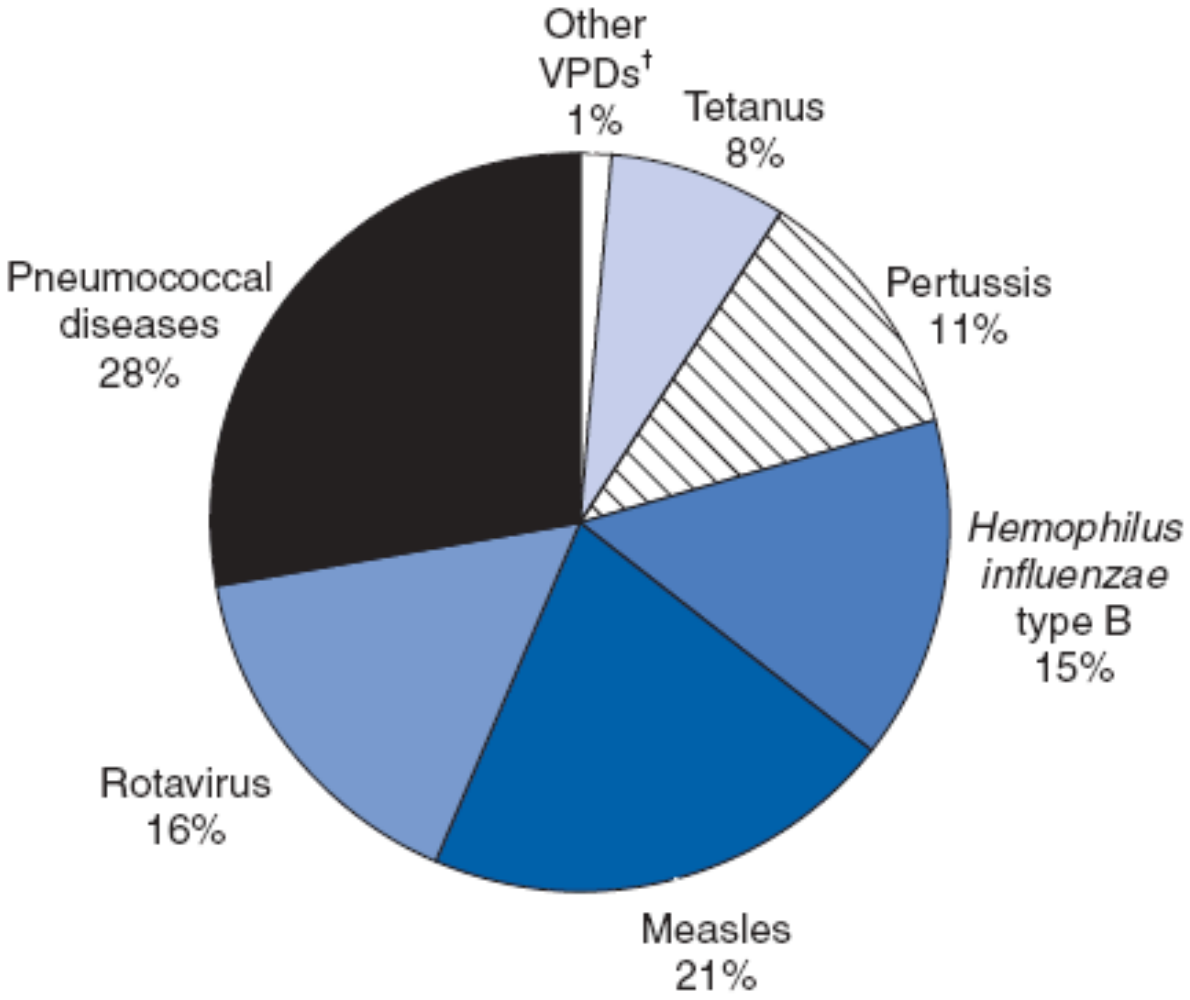
Source: UNICEF

AREAS AT RISK OF YELLOW FEVER:



Source: immunization essentials by USAID

FIGURE 1. Percentage of deaths from vaccine-preventable diseases (VPDs)* among children aged <5 years, by disease — worldwide, 2002



*An estimated 2.5 million deaths worldwide (of a total of 10.5 million for this age group) are caused by diseases for which vaccines are currently available.

†Diphtheria, hepatitis B, Japanese encephalitis, meningococcal disease, poliomyelitis, and yellow fever. (In older age groups, approximately 600,000 hepatitus B deaths are preventable by routine immunization.)

Source: WHO the evolution of the child health programme

WHO's Recommended Schedule for Primary Series of Childhood Vaccinations in Developing Countries

Age	Vaccines
Birth	BCG OPV0 Hep B*
6 weeks	DTP1 OPV1 Hep B* Hib1**
10 weeks	DTP2 OPV2 Hep B* Hib2**
14 weeks	DTP3 OPV3 Hep B* Hib3**
9 months	Measles Hep B* Yellow fever***

***Only three doses of hepatitis B vaccine are needed for full protection. Hepatitis B vaccination schedules vary by country. See Chapter 12.**

**Hib stands for *Haemophilus influenzae* type b. See Chapter 12.

***In countries where indicated.

Source:immunization essentials by USAID

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