

HEALTH BASICS: IMMUNISATION



Six preventable childhood diseases for which vaccines are widely available are measles, pertussis (whooping cough), tetanus, polio, diphtheria and tuberculosis. Of these, measles is the most clearly related to diarrhoea. Diarrhoea often follows an episode of measles, and the combination of the two illnesses can be fatal. It is estimated that up to 26 per cent of diarrhoea-associated mortality could be prevented by measles vaccination¹. Pneumonia, malnutrition and shigella dysentery are complications associated with measles. Preventing measles could also reduce the incidence of malnutrition and vitamin A deficiency, both of which are associated with serious attacks of diarrhoea.

¹ R.G. Feachem and M.A. Koblinsky: Interventions for the control of diarrhoeal diseases among young children: measles immunisation. Bulletin WHO 61, 641-652, 1983.

What is immunisation?

Immunisation is the giving of a vaccine or vaccines to stimulate the body to create immunity against specific diseases. Immunity is the body's ability to protect itself against the bacteria and viruses which cause disease.

Why immunise?

Every year in developing countries 110 million episodes of illness occur which could be prevented by immunisation. As a result 3.5 million children die. Children with these illnesses are also more likely to develop other infections, such as diarrhoea, as their resistance and ability to fight off infection is reduced. Widespread use of vaccines in the developed world is a major factor in the reduced mortality and morbidity from these six diseases and associated illnesses. Immunisation is a more effective

way of using scarce resources than treating diseases after they occur.

The six major childhood immunisations

Measles

- Measles vaccine is made from live measles virus which has been weakened (or attenuated) and is given subcutaneously in one dose. The infection provides long lasting protection against measles. Those vaccinated may feel unwell with a mild fever, and/or rash five to ten days after vaccination.

Diphtheria, pertussis, tetanus

- DPT vaccine combines diphtheria, pertussis (whooping cough), and tetanus immunisations in one injection. The injection is given intramuscularly in three doses four weeks or more apart and protects for at least ten years against the three diseases. Common side effects to the injection include fever and redness and swelling at the injection site.

Polio

- The oral polio vaccine contains the weakened viruses of the three types that cause polio. It usually provides permanent protection against this crippling disease, and is given in three doses 4 weeks or more apart (usually at the same time as DPT). In countries where polio remains endemic, if possible, a child should receive an additional polio vaccination at birth.

BCG

- BCG vaccine is given intradermally (within the skin layer, raising a blister) and guards against tuberculosis (TB). Studies concerning efficacy of the BCG vaccine have produced conflicting reports. Most people agree that it gives good protection against the lethal forms of childhood TB. An ulcer forms at the injection site and heals without treatment, forming a scar.



PAHO photo

Immunisation can reduce mortality and morbidity from common childhood diseases.

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The Expanded Programme on Immunisation (EPI)

The eradication of smallpox by vaccination is one of the greatest achievements of the World Health Organization (WHO). Recognising the serious problem of infectious childhood diseases, and the benefits of immunisation, WHO set up the Expanded Programme on Immunisation (EPI) with the goal of making immunisation services available to all the world's children by 1990. UNICEF also provides vaccines, supplies and equipment, and supports national programmes through social mobilisation efforts. EPI helps national immunisation programmes by providing training, vaccines, equipment, and technical backup. It also supports programme evaluation and field testing of improved equipment and methods.

WHO's EPI has estimated that coverage rates for the vaccines in children under one year old in developing countries (excluding China) are as follows:

Immunisation	June 1987
DPT (third dose)	45 per cent
polio (third dose)	44 per cent
measles	30 per cent
BCG	45 per cent
tetanus toxoid (for women)	21 per cent

Source: WHO/EPI

When EPI began in 1974 these figures were only about five per cent. It is now hoped that the majority of children will be fully immunised within the next few years.

What factors contribute to successful national immunisation programmes?

- *Community* — mothers and families must want immunisations for their children, and know when and where to get them;
- *Personnel* — well-trained staff: health workers who are committed to immunisation and who know how to give vaccines safely and when to give them;
- *Vaccines* — their safety, effectiveness and stability; the 'cold chain' — transportation, storage and handling



WHO/UNICEF photo

Successful immunisation programmes depend on commitment at all levels.

of vaccines to ensure that they are kept at the right temperature and in the right conditions until they are used;

- *Equipment* — for vaccination and sterilization of syringes and needles;
- *Programme management* — including schedules, records, training, monitoring and evaluation and management of money, personnel and supplies;
- *Good supply networks* — to ensure vaccines are delivered when and where needed;
- *Political commitment* — at all levels, to immunisation programmes.

Who should be immunised and at what age?

Infants and children

All children should be immunised against the preventable childhood diseases. The immunisation schedule

describes the number of times that a child needs to be given vaccinations and how far apart each visit should be. Following the *ideal* schedule, each child should be fully immunised by the age of nine months, or soon after, because infants are at greater risk from these diseases. Many countries try to immunise all children under five years of age who may be at risk.

Women

Neonatal tetanus is prevented for several years by immunising women of child-bearing age with at least two doses of tetanus toxoid. After five doses of tetanus toxoid *all* children born subsequently are protected from neonatal tetanus. A woman who received three doses of DPT as a child will greatly increase her infants' protection by two boosters (ideally before or during early pregnancy) when she is ready to bear children. (Hygienic cord treatment can also prevent neonatal tetanus but is not as effective as complete immunisation of the mother.)

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- A schedule recommended by WHO to assure protection at an early age is as follows:

Age	Vaccine	Reason
Birth	BCG*, OPV*	• BCG given at the earliest possible age protects against the possibility of infection from other family members. The extent of protection against polio is increased the earlier the OPV is given.
6 weeks	DPT(1)*, OPV(1)	• An early start with DPT reduces the chances of severe pertussis.
10 weeks	DPT(2), OPV(2)	• Four week intervals between doses give effective protection, and reduce the time a child is exposed without protection, particularly to pertussis.
14 weeks	DPT(3), OPV(3)	
9 months	Measles	• At least 80 per cent of measles in children in the third world can be prevented by immunisation at this age.

N.B. *BCG: *Bacillus Calmette Guerin* (against TB)

*OPV: Oral Poliovirus Vaccine (dose at birth is in addition to the standard schedule of 3 doses)

*DPT: Diphtherial/Pertussis/Tetanus Toxoid

Missed immunisation dates

If it is not possible to bring a child for immunisation on the right day, the immunisation must be given as soon as possible afterwards. Once begun, a series of immunisations must be com-

pleted to be effective. Even if the time between immunisations is longer than recommended, the *next* dose in the polio and DPT series is given; there is no need to start from the beginning again. Only a completed series of immunisations adequately protects a child. In remote areas, and places where for other reasons it is not possi-

- Simplified schedule for remote populations (two contacts as used in parts of West Africa)

Age	Vaccine	Reason
All children 3-8 months old	DPT(1)-IPV(1), BCG	• IPV in two doses is protective against paralytic polio.
All children 9-14 months old	DPT(2)-IPV(2), measles	• In remote areas the average age of contracting measles is delayed to the second and third years of life and later vaccination is still effective.

N.B. IPV: Inactivated Poliovirus Vaccine

DPT-IPV may be obtained in a single preparation

EPI also recommends that OPV be added to this schedule.

- Semi-annual single day 'pulse' campaigns (as used in Brazil)

Age	Vaccine	Reason
All children 0-59 months old	OPV (up to 10 doses)	• After regular vaccination with OPV vaccine, the vaccine virus replaces the naturally occurring disease-causing virus in the environment.
All children 9-23 months old	measles (up to 2 doses)	• Giving a second dose of measles vaccine increases effective coverage.
All children 2-11 months old	DPT (2 doses)	• Third DPT through regular primary health care services in clinics; 2 doses of DPT are partially effective (50-60%) against pertussis.

ble to do this, schedules such as the one below, and mass immunisation days have been used.

Organisation

Vaccine schedules have to suit the circumstances in particular countries. Ideally, most developing countries should follow the WHO recommended schedule of five contacts but this requires an effective health infrastructure to which all people have access. Mass campaigns, with immunisation days, can successfully increase awareness about immunisation and vaccinate large numbers of children. However, only when health systems are developed to ensure regular vaccination of all newly born children every year, will full coverage be achieved.

Reaction to immunisation

After immunisation some children develop mild reactions, such as fever, or a swollen area around the injection site. This is quite normal with some vaccines and may be part of the body's response to developing protection. Parents should be told that this is likely to happen so that they do not worry about it and it does not prevent them:

- from bringing the child back for further immunisation doses; or
- from bringing their other children to the clinic for immunisation.

Can a sick child be immunised?

Mothers sometimes do not bring a sick child for immunisation and if they do, health workers frequently do not immunise them. Mothers and health workers need to know that **all EPI immunisations are safe and effective even if a child is ill** with fever, diarrhoea, vomiting, or respiratory infection. No chance should be missed to immunise a child. This is a recommendation of the EPI.

The benefits of immunisation far outweigh the risks, especially in malnourished children. Only in very few exceptional cases is it not advisable to immunise. For example, a child who has had a severe reaction to DPT (fits, extreme crying) should not be given pertussis immunisation, but should get diphtheria-tetanus vaccine.

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WHO photo by H Page

Oral administration of polio virus vaccine in Columbia.

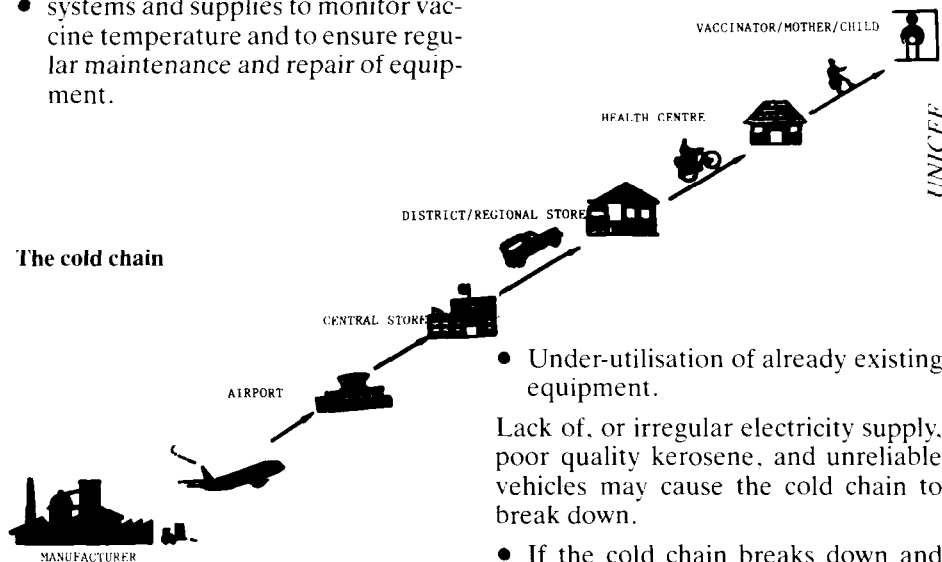
- well trained personnel with clear responsibilities;
- reliable vehicles for transporting vaccines;
- proper refrigeration and icemaking equipment;
- cold boxes and vaccine carriers used at the place where children are immunised;
- centrally organised supply systems to ensure that proper quantities of vaccines are supplied regularly where and when they are needed;
- systems and supplies to monitor vaccine temperature and to ensure regular maintenance and repair of equipment.

What are the problems associated with immunisation programmes?

Vaccines and equipment

- Breakdown of vehicles and equipment — lack of spare parts, repair and maintenance skills, shortage of fuel.
- Under or over-supply of vaccines and other supplies such as needles and syringes at different levels of the cold chain.

The cold chain



Immunising safely

It is important that health workers know how to give *all* injections safely, to avoid causing abscesses or transmitting infections — such as hepatitis B and HIV (the AIDS virus). Each child should be vaccinated with a sterile syringe and a sterile needle. In most places this means that reusable needles and syringes must be sterilised carefully after each injection is given, by boiling them in clean water in a covered pot or in a steam steriliser. Where disposable needles and syringes are used, they must be destroyed after a single use. **Remember:** one child, one needle, one syringe.

Vaccine storage

Each vaccine needs to be kept at the correct temperature to keep it safe, effective and stable. Live polio and measles vaccines are most sensitive to heat, tetanus toxoid least sensitive.

- Under-utilisation of already existing equipment.

Lack of, or irregular electricity supply, poor quality kerosene, and unreliable vehicles may cause the cold chain to break down.

- If the cold chain breaks down and vaccines are exposed to heat they will not be effective. Health workers must be confident that they are giving potent vaccines to children. Vaccines are destroyed by either a lot of heat at once (for example in a closed vehicle) or a small amount of heat on many occasions (for example constantly opening and closing of a refrigerator door). Once a vaccine is spoiled it cannot be restored by cooling it.

What is the cold chain?

The cold chain is the means by which vaccines are continuously maintained at safe temperatures from the time of manufacture until they are used by the health worker. It includes every stage of transportation and storage at international, national and district level — from central cold stores to health centres and clinics down to mobile immunisation teams in remote rural areas. If the cold chain breaks down at any stage and vaccines are exposed to heat (or freeze when they are not supposed to) they will not give effective protection. Six things are needed for a successful cold chain:

Recommended storage temperatures and times are shown below:

Level:	Central store	Regional Health Centre	Transport
Maximum time:	Up to 8 months	Up to 3 months	Up to 1 month Up to 1 week
Measles	-15°C to -25°C		less than +8°C
Oral polio virus	-15°C to -25°C		less than +8°C
DPT		+2°C to +8°C	
Tetanus toxoid		+2°C to +8°C	
BCG		less than 8°C	

NB: DPT and tetanus toxoid must never be frozen.

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- It is not possible to tell whether or not a vaccine has been heat spoiled by looking at it. Instead the temperature must be checked daily at every stage of the cold chain. Cold chain monitors — chemical monitors — which change colour if the temperature goes above a safe limit for a period of time can help to keep a check on this.
 - It is important that effective refrigerators, cold boxes, and insulated vaccine carriers are used. This equipment needs to be carefully maintained to ensure that it works efficiently and maintains the correct temperatures for vaccine effectiveness.
- Lack of understanding about the purpose of immunisation;
 - Traditional views about what is necessary to protect children;
 - Seasonal effects which reduce opportunities for immunisation, e.g. rainy season, harvesting or planting.

In a survey carried out in a Latin American country of 1,145 children, children had not been taken for immunisation or had not completed a series of immunisations because:

- Family had fear of, incorrect ideas about immunisation: 32 per cent;
- Child was ill that day: 29 per cent;
- System failure (access, communication, availability): 18 per cent;
- Family unaware of EPI: 13 per cent;
- Child already had the disease: 6 per cent.

Health workers need to be able to:

- Inform parents where, when and how often their children should be immunised;
- Remind parents to take their children back for follow-up doses;
- Encourage women of child-bearing age to be immunised against tetanus;
- Explain to people about reactions to immunisation and ease their fears.

How can diarrhoeal disease control and immunisation activities be combined?

- *Using every opportunity*

If a child is brought to a clinic with dehydrating diarrhoea and is given ORT, this provides an opportunity for health workers to ask mothers about immunisation, and to immunise the child as needed. This applies if a child is brought to a clinic for any reason. It is particularly important to immunise a child with malnutrition. Many children actually catch measles in a clinic or hospital; this could be prevented by immunisation at the time of exposure. It is important, also, that visits to clinics or health centres are used as opportunities to talk about and to give immunisations. Health cards which combine growth charts and records of immunisation and illnesses are desirable.

• Research

Unanswered questions about immunisations and child health — How do mothers protect their children from illness? When do they bring their children for vaccinations or use ORT? Do they know how to give ORT? Do they know about immunisation schedules? What is the best way to pass on this knowledge? What alternative vaccines or schedules will best protect a child living in remote areas, in difficult environments? These questions can and should be answered through research; diarrhoeal diseases research can provide valuable data for EPI and *vice versa*.

• Promotion and education

For both ORT and immunisations, health education messages must be consistent with people's ideas and beliefs. People must be able to afford the money, time and effort involved. Also the products must be available when they need them.



Visits to health centres and clinics should be used as opportunities for immunisation.

• Management

Planning, supply and logistics, administration, finance and budget, training, supervision, monitoring and evaluation are all important programme components. It is less wasteful of scarce resources and staff if EPI and CDD can share or pool their strength in these areas.

Vaccine development

Current research in diarrhoeal disease vaccines is focusing on developing or improving vaccines against specific organisms which cause diarrhoea such as rotavirus, *enterotoxigenic E coli*, cholera, typhoid and shigella.

Management problems

- Lack of supervision, shortages of trained personnel, or low morale of health workers due to poor pay, poor training, too much to do, intermittent supplies;
- Difficulties in following up mothers and children in families who may migrate to cities or other villages;
- Limited communications create problems for information flow between health workers and supervisors;
- Poor record-keeping, reporting of activities and surveillance.

Community problems

Communities must be involved in the decision to implement immunisation programmes. Families must want to have their children immunised and know why immunisation is important. It is equally important that they know that children may suffer mild side effects from the vaccinations. Specific problems may include:

- Lack of awareness about vaccination;
- Lack of access of health facilities;
- Fear of side effects;

IMMUNISATION: RESOURCE LIST

SOURCES OF INFORMATION AND EQUIPMENT

- **Agency for International Development (AID)**, Office of Health, Bureau of Science and Technology, Agency for International Development, Washington, DC 20523, U.S.A. CONTACT: Dr Kenneth Bart
- **American Public Health Association (APHA)**, 1015 15th Street, NW, Washington, DC 20005, U.S.A. CONTACT: Dr Susi Kessler
- **Appropriate Health Resources and Technologies Action Group (ARHTAG)**, 85 Marylebone High Street, London W1M 3DE, U.K. CONTACT: Ms Suzanne Fustukian
- **Centers for Disease Control**, Public Health Service, Department of Health and Human Services, Atlanta, GA 30333, U.S.A. CONTACTS: Dr Alan Hinman, Dr Stanley Foster
- **Equipment to Charity Hospitals Overseas (ECHO)**, Ullswater Crescent, Coulsdon, Surrey CR3 2HR, U.K. CONTACT: Dr John Townsend
- **Evaluation and Planning Centre for Health Care (EPC)**, LSHTM, Keppel Street, London WC1E 7HT, U.K. CONTACT: Dr Patrick Vaughan
- **International Children's Centre**, Château de Longchamp, Bois de Boulogne, F-75016, Paris, France. CONTACT: Dr N. Guerin
- **Institute of Child Health**, Tropical Child Health Unit, 30 Guilford Street, London WC1, U.K. CONTACT: Professor David Morley
- **League of Red Cross and Red Crescent Societies**, C.P. 372, 1211 Geneva 19, Switzerland. CONTACT: Marianne Enge
- **Pan American Health Organization**, Expanded Programme on Immunisation, 525 23rd Street, NW, Washington, DC 20037, U.S.A. CONTACT: Dr Ciro de Quadros
- **POLIOPLUS PROGRAM, Rotary International**, 1600 Ridge Avenue, Evanston, Illinois 60201, U.S.A. CONTACT: Mr Michael McQuestion
- **Program for Appropriate Technology in Health (PATH)**, Canal Place, 4 Nickerson Street, Seattle, WA 98109, U.S.A. CONTACT: Ms Vivien Tsu
- **Resources for Child Health (REACH)** Project, John Snow, Inc., 1100 Wilson Blvd., 9th Floor, Arlington, VA 22209, U.S.A. CONTACT: Dr Pierre Claquin, Dr Norbert Hirschhorn
- **Save the Children Fund**, 17 Grove Lane, London SE5 8RD, U.K. CONTACT: Dr Peter Poore
- **Teaching Aids at Low Cost (TALC)**, P.O. Box 49, St Albans, Herts. AL1 4AX, U.K. CONTACT: Mrs Barbara Harvey
- **UNICEF**, 866 United Nations Plaza, New York, NY 10017, U.S.A. CONTACT: Dr Terence Hill

- **UNIPAC, UNICEF Procurement and Assembly Centre**, UNICEF Plaus, Freepost — DK2100, Copenhagen, Denmark. CONTACT: Mr Fred Irmer
- **World Health Organization (WHO)**, Expanded Programme on Immunization, 1211 Geneva 27, Switzerland. CONTACT: Dr R. H. Henderson

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AUDIOVISUALS

- Cold Chain — Target Diseases**. (24 slides) TALC.
- Cold Chain**. (24 slides) TALC.
- Primary Child Care**. (240 slides) TALC.
- Severe Measles**. (24 slides) TALC.

NEWSLETTERS

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- EPI Newsletter**. Expanded Programme on Immunisation, PAHO, 525 23rd Street, NW, Washington, DC 20037, U.S.A.
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