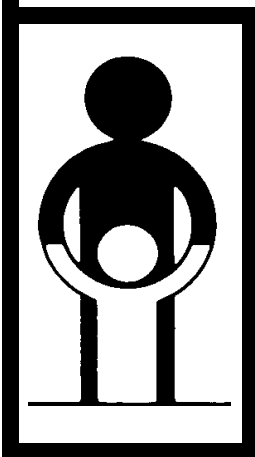


Module 2: EPI vaccines



DEPARTMENT OF VACCINES
AND BIOLOGICALS



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Table of contents

<i>List of figures</i>	<i>iii</i>
List of figures	iii
About this module	iv
1. BCG vaccine	1
2. Oral polio vaccine	4
3. Diphtheria-pertussis-tetanus vaccine	6
4. Hepatitis B vaccine	9
5. Measles vaccine	11
6. Yellow fever vaccine	13
7. Tetanus toxoid	15
8. <i>Haemophilus influenzae</i> type b (Hib)	17
9. Summary	19

List of figures

Figure 2-A: Needle position for injection of BCG vaccine (intradermal).....	2
Figure 2-B: Needle position for injection of DPT vaccine (intramuscular)	7
Figure 2-C: Abscess caused by unsterile syringe or incorrectly administered..... injection	8
Figure 2-D: Needle position for hepatitis B injection (intramuscular).....	10
Figure 2-E: Needle position for measles injection (subcutaneous).....	12
Figure 2-F: Needle position for injection yellow fever vaccine (subcutaneous)	14
Figure 2-G: Different needle positions.....	21

About this module

This module describes seven EPI disease-preventing vaccines:

- **bacillus Calmette-Guérin (BCG) vaccine (tuberculosis vaccine);**
- **oral polio vaccine (OPV);**
- **diphtheria-pertussis-tetanus (DPT) vaccine;**
- **hepatitis B (HB) vaccine;**
- **measles vaccine;**
- **yellow fever vaccine;**
- **tetanus toxoid (TT).**

For each vaccine the description explains:

- **what it is;**
- **how it is stored;**
- **when it is given;**
- **the number and size of doses;**
- **where and how it is given;**
- **any side-effects that may occur.**

Side-effects of EPI vaccines are uncommon and the benefits of their use far outweigh any discomfort that might occur.

A section on contraindications follows the descriptions of the vaccines.

1. BCG vaccine

1.1 What it is

BCG vaccine protects against tuberculosis in infants.

The letters, B, C and G stand for bacillus of Calmette and Guérin. “Bacillus” describes the shape of a bacterium; Calmette and Guérin are the names of the people who developed the vaccine.

BCG vaccine comes in powder form and before use must be reconstituted with the accompanying diluent. The reconstituted vaccine is even more sensitive to heat than the powder and must therefore be used within six hours or disposed of.

Before the reconstitution of BCG, measles and yellow fever vaccines they are more heat stable than OPV and certain other vaccines but after reconstitution they are less stable.

1.2 How it is stored

BCG vaccine and diluent should be stored at a temperature between 0 C and +8° C.

BCG vaccine is not damaged by freezing.

Store BCG vaccine and its diluent side-by-side in a refrigerator or vaccine carrier.

1.3 When it is given

BCG vaccine is given at birth or as soon as possible thereafter.

It should not be given to children who have signs and symptoms of AIDS.

1.4 The number and size of doses

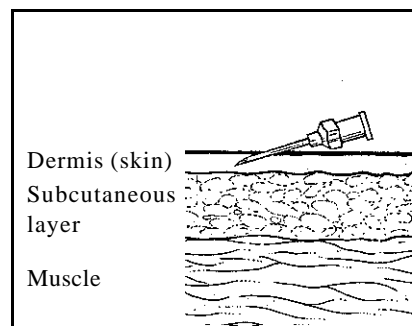
One dose of 0.05 ml.

If there is no scar at the injection site six weeks after a BCG immunization, the injection must be repeated. If there is still no scar six weeks after the second injection the child should be referred to a physician.

1.5 Where and how it is given

BCG vaccine is usually injected in the top layer of the skin of the upper left arm. Health workers use the same place on every child for BCG injections so that everyone knows where to look for the scar.

Figure 2-A: Needle position for injection of BCG vaccine (intradermal)



1.6 Side-effects

Normal reaction

When BCG vaccine is injected a small raised lump appears at the injection site. This usually disappears within 30 minutes.

After approximately two weeks a red sore develops which is 10 mm in diameter (the size of the end of an unsharpened pencil).

The sore remains for another two weeks and then heals. A small scar, about 5 mm across, remains. This is a sign that the child has been effectively immunized.

Swelling of glands or formation of abscess

Sometimes the glands in a child's armpit or near the elbow swell up after injection with BCG vaccine, or he or she may develop an abscess. Swollen glands or abscesses occur because:

-
- an unsterile needle or syringe was used;
 - too much vaccine was injected;
 - the vaccine was injected under the skin instead of in its top layer.

BCG: Administration guidelines

	Recommendation	Comment
Age	Birth	If not given at birth, any time thereafter.
Dose size	Usually 0.05 ml	See the manufacturer's instructions. If child is over 1 year old, give 0.1 ml.
Number of doses	One	
Injection site	Upper left arm in top layer of skin.	

2. Oral polio vaccine

2.1 What it is

Oral polio vaccine (OPV) gives protection against the three types of virus that cause polio.

It is a liquid that comes in two types of containers: small plastic bottles that work like droppers, and glass vials with droppers in a separate plastic bag. As from January 1996 all OPV vials supplied by WHO/UNICEF have had a vaccine vial monitor (VVM) attached. The VVM shows health workers whether the OPV in the vial to which the monitor is attached is safe to use.

2.2 How it is stored

OPV should be stored at a temperature between 0° C and +8° C.

It is easily damaged by heat but is not harmed by freezing.

2.3 When it is given

OPV should be given at:

- birth;
- 6 weeks of age;
- 10 weeks of age;
- 14 weeks of age.

The interval after the second and third doses must be **at least** four weeks.

2.4 The number and size of doses

Four doses are given, each of two drops.

If a child has diarrhoea, give OPV as usual but administer an extra dose, i.e., a fifth dose, at least four weeks after he or she has received the last dose in the schedule.

2.5 Where and how it is given

OPV is dropped in the mouth with the dropper that comes with the vaccine.

2.6 Side-effects

OPV has no side-effects.

Oral polio vaccine: Administration guidelines

	Recommendation	Comment
Age	Dose 0 – birth Dose 1 - 6 weeks Dose 2 - 10 weeks Dose 3 - 14 weeks	There must be at least 4 weeks between doses 1 and 2 and between doses 2 and 3.
Dose size	Usually two drops.	See the manufacturer's instructions.
Number of doses	Four	
Immunization site	Mouth	

3. Diphtheria-pertussis-tetanus vaccine

3.1 What it is

Diphtheria-pertussis-tetanus (DPT) vaccine is made from:

- diphtheria toxoid;
- pertussis vaccine;
- tetanus toxoid.

If DPT vaccine stands for a long time it separates from the liquid and looks like fine sand at the bottom of the vial. Shaking the vial mixes the vaccine and liquid again.

3.2 How it is stored

DPT vaccine should be stored at a temperature between 0° C and +8° C.

The diphtheria and tetanus toxoid parts of DPT vaccine are damaged by freezing. Pertussis vaccine is damaged by heat.

To check if DPT vaccine has been frozen, shake the vial. If granules appear a short time afterwards the vaccine has been spoiled and you must dispose of it. This is called the shake test (see Module 3).

3.3 When it is given

DPT vaccine should be given at the ages of:

- 6 weeks;
- 10 weeks;
- 14 weeks.

The interval after the first and second doses must be **at least** four weeks.

DPT vaccine should NOT be given to children over 5 years of age or to children who have suffered a severe reaction to a previous dose of this vaccine. Instead, a combination of diphtheria and tetanus toxoids (DT) should be given.

3.4 The number and size of doses

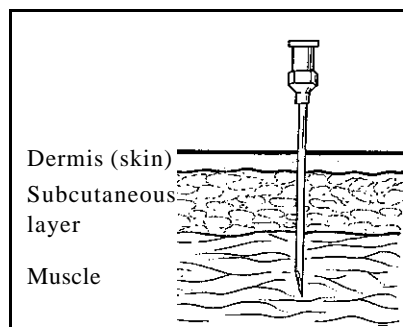
Three doses are given, each of 0.5 ml.

DPT boosters: Many countries recommend a booster dose of DPT vaccine at the age of 12 to 24 months. Ask your supervisor about the policy in your country.

3.5 Where and how it is given

DPT is injected into the muscle in the outer part of the thigh.

Figure 2-B: Needle position for injection of DPT vaccine (intramuscular)



3.6 Side-effects

Reactions to DPT vaccine are usually mild. They include:

Fever: A child may have fever the evening after receiving DPT vaccine. The fever should disappear within a day.

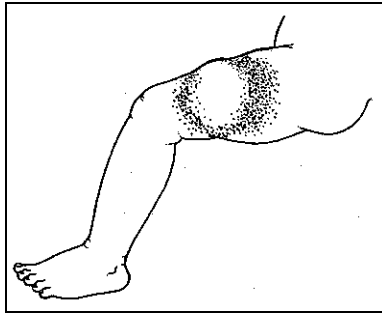
Note. Fever that begins more than 24 hours after a DPT injection is unlikely to be a reaction to the vaccine.

Soreness: Some children have pain, redness or swelling at the injection site.

Abscess: An abscess may develop a week or more after a DPT injection. This can happen because:

- an unsterile needle or syringe was used;
- the vaccine was not injected into the muscle.

Figure 2-C: Abscess caused by unsterile syringe or incorrectly administered injection



DPT: Administration guidelines

	Recommendation	Comment
Age	Dose 1 - 6 weeks Dose 2 - 10 week Dose 3 - 14 weeks.	If a child is not given DPT vaccine at 6 weeks, give it as soon as possible thereafter. Wait 4 weeks between doses. Complete all 3 doses before 6 months of age to avoid side-effects, which are commoner after that age.
Dose size	Usually 0.5 ml for each dose	See the manufacturer's instructions.
Number of doses	Three	
Injection site	Muscle of upper thigh.	Never immunize in the buttock.

4. Hepatitis B vaccine

Many countries include hepatitis B vaccine in their national immunization programmes or plan to do so in 1997.

4.1 What it is

Hepatitis B vaccine is a cloudy liquid that comes in a vial or a prefilled syringe. It does not have to be reconstituted.

If hepatitis B vaccine stands for a long time it separates from the liquid and looks like fine sand at the bottom of the vial. It must be mixed by shaking.

4.2 How it is stored

Hepatitis B vaccine should be stored at a temperature between 0° C and +8° C.

Both heat and freezing damage hepatitis B vaccine.

Use the shake test to find out if it has been frozen (see Module 3).

4.3 When it is given

Two different schedules are used, depending on when the disease is likely to be transmitted.

In places where transmission at birth is likely, the recommended schedule is:

- at birth, the same time as BCG vaccine and OPV0;
- at 6 weeks, the same time as DPT1 and OPV1;
- at 14 weeks, the same time as DPT3 and OPV3.

Where transmission at birth is less likely, the recommended schedule is:

- at 6 weeks, the same time as DPT1 and OPV1;
- at 10 weeks, the same time as DPT2 and OPV2;
- at 14 weeks, the same time as DPT3 and OPV3.

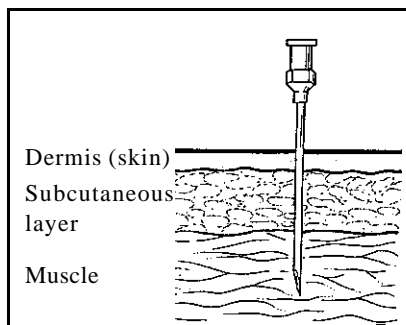
4.4 The number and size of doses

Three doses are given, each of 0.5 ml.

4.5 Where and how it is given

Hepatitis B vaccine is injected in the muscle of the upper thigh.

Figure 2-D: Needle position for hepatitis B injection (intramuscular)



Note. When DPT vaccine is given at the same time as hepatitis B vaccine, do not inject both in the same thigh.

4.6 Side-effects

A child may develop a mild fever for one or two days after an injection of hepatitis B vaccine.

Hepatitis B vaccine: Administration guidelines

	Recommendation	Comment
Age	Dose 1 - birth or 6 weeks Dose 2 - 6 or 10 weeks Dose 3 - 14 weeks	Ask your supervisor about the schedule in your country. Wait at least 4 weeks between each dose.
Dose size	Usually 0.5 ml for each dose	See the manufacturer's instructions.
Number of doses	Three	
Injection site	Muscle of the upper thigh	Never immunize in the buttock.

5. Measles vaccine

5.1 What it is

Measles vaccine comes in powder form together with a diluent. Before it can be used it must be reconstituted.

Reconstituted measles vaccine must be used within six hours or disposed of.

Note In countries where vitamin A deficiency occurs, vitamin A is often given at the same time as measles vaccine.

5.2 How it is stored

Measles vaccine and diluent should be stored at a temperature between 0°C and +8°C.

Dry measles vaccine is not damaged by freezing.

5.3 When it is given

Measles vaccine is usually given as soon as possible after 9 months of age.

Maternal antibodies against measles last longer than other antibodies, so immunization with measles vaccine is often not effective before 9 months of age. However, in special situations, for instance in urban areas with high measles transmission or where children below 9 months of age are getting measles, two doses may be given – at 6 months and 9 months of age.

Note: All children between 6 and 9 months of age who are admitted to hospital should be given a dose of measles vaccine. This should NOT be marked on their immunization cards. Another dose should be given at 9 months of age.

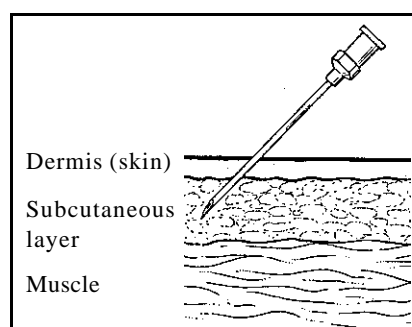
5.4 The number and size of doses

One dose of 0.5 ml is given.

5.5 Where and how it is given

Measles vaccine is injected into the subcutaneous layer of the upper left arm.

Figure 2-E: Needle position for measles injection (subcutaneous)



5.6 Side-effects

A mild fever and rash lasting one to three days may occur approximately a week after immunization.

Measles vaccine: Administration guidelines

	Recommendation	Comment
Age	9 months	If a child is not immunized at 9 months, immunize as soon as possible thereafter. A child aged 6 to 9 months who is immunized with measles vaccine when hospitalized should receive a second dose at 9 months of age.
Dose size	Usually 0.5 ml	See the manufacturer's instructions.
Number of doses	One	
Injection site	Subcutaneous injection in the upper right arm	

6. Yellow fever vaccine

Yellow fever vaccine is recommended as part of the national immunization programme in countries where the disease is endemic.

6.1 What it is

Yellow fever vaccine comes in powder form and must be reconstituted with its diluent before use.

Reconstituted vaccine must be used within six hours or disposed of.

6.2 How it is stored

Yellow fever vaccine and diluent must be stored at a temperature between 0°C and +8°C.

Reconstituted yellow fever vaccine is easily damaged by heat but not by freezing.

6.3 When it is given

Yellow fever vaccine is usually given at 9 months of age, at the same time as measles vaccine. It should NOT be given to children aged under 6 months.

Children who have signs and symptoms of AIDS vaccine should not be given the yellow fever vaccine.

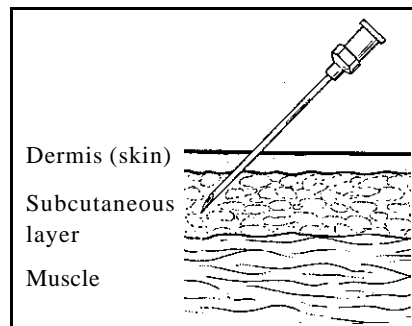
6.4 The number and size of doses

One dose of 0.5 ml is given.

6.5 Where and how it is given

The vaccine is given subcutaneously in the upper arm.

Figure 2-F: Needle position for injection yellow fever vaccine (subcutaneous)



When administered at the same time as measles vaccine it should be injected in the other arm.

6.6 Side-effects

Children may get fever, headache or mild muscle or joint pain after an injection of yellow fever vaccine.

Yellow fever vaccine: Administration guidelines

	Recommendation	Comment
Age	9 months	Not younger than 6 months.
Dose size	Usually 0.5 ml	See the manufacturer's instructions.
Number of doses	One dose	
Injection site	Subcutaneous in the upper arm	

7. Tetanus toxoid

7.1 What it is

Tetanus toxoid (TT) is given to women of childbearing age to prevent neonatal tetanus. It is the same tetanus toxoid as that given to children in DPT vaccine.

When given to a woman who is or becomes pregnant, the antibodies that form in her body cross the placenta into the fetus. These antibodies protect the baby against tetanus during birth and for a few months thereafter. They also protect the woman against tetanus.

When tetanus toxoid stands for a long time the vaccine separates from the liquid and looks like fine sand at the bottom of the vial. Shaking the vial mixes the vaccine and liquid again.

7.2 How it is stored

Tetanus toxoid should be stored at a temperature between 0°C and +8°C. It should never be frozen.

7.3 When it is given

To reduce the risk of neonatal tetanus, tetanus toxoid is recommended for all women of childbearing age. Your country has a policy on when to begin immunizing women with tetanus toxoid.

7.4 The number and size of doses

Five doses are given, each of 0.5 ml.

The periods of protection provided by the different doses are indicated in the following table.

Tetanus toxoid: periods of protection

Dose	When given	Period of protection
TT1	At first contact with woman of childbearing age, or as early as possible in pregnancy.	No protection
TT2	At least 4 weeks after TT1.	3 years
TT3	At least 6 months after TT2.	5 years
TT4	At least 1 year after TT3.	10 years
TT5	At least 1 year after TT4.	All childbearing years

7.5 Where and how it is given

Tetanus toxoid is injected into the muscle of the upper arm.

7.6 Side-effects

After injection a woman may have mild pain, redness, warmth, and swelling for one to three days at the injection site. This reaction may be more common after later doses than earlier ones.

Tetanus toxoid: Administration guidelines

	Recommendation	Comment
Age	As soon as possible after a woman reaches childbearing age	Some countries count DPT doses given in childhood as part of the recommended number of TT doses.
Dose size	Usually 0.5 ml	See the manufacturer's instructions.
Number of doses	Five	Provide protection during childbearing years.
Injection site	Muscle of upper arm	

8. *Haemophilus influenzae* type b (Hib)

Many countries include *Haemophilus influenzae* type b (Hib) vaccine in their national immunization programmes or are planning to do so.

8.1 What it is

Hib vaccine is safe and highly effective. It prevents meningitis, pneumonia, epiglottitis, and other serious infections caused by the Hib bacterium.

Available in two formulations (liquid or freeze-dried), each of which is available as monovalent or combination preparations. Many countries give Hib as a combined vaccine with DTP, or DTP and hepatitis B.

Note. Hib vaccines protect against *Haemophilus influenzae* type b but do not prevent diseases caused by other types of *Haemophilus influenzae* (i.e. bronchitis, otitis and sinusitis). They do not prevent meningitis and pneumonia caused by other agents.

8.2 How it is stored

Hib vaccines should be stored between 2°C and 8°C.

If liquid vaccine is frozen, discard it.

8.3 When it is given

Hib immunization schedules differ from country to country depending on the type of Hib vaccine used and the schedule for other vaccines.

In general, the scheduling practices below are followed (for most Hib vaccine preparations, three doses are given. The interval between doses is not less than one month).

Age	Vaccines
6 weeks	DTP1, OPV1, HepB1, Hib1
10 weeks	DTP2, OPV2, HepB2, Hib2
14 weeks	DTP3, OPV3, HepB3, Hib3

8.4 The number and size of doses

Three doses are given. The size of a dose is 0.5 ml.

8.5 Where and how it is given

Hib vaccine is given by intramuscular injection in the anterolateral aspect of the thigh (infants) or deltoid muscle (older children).

It can be given at the same time as DTP, OPV; IPV, and HepB vaccines without ill effect. If Hib vaccine is given on the same day as another vaccine in a separate syringe, it should not be injected in the same limb.

8.6 Side-effects

A child may develop fever or irritability for a short time after immunization. Redness, swelling, and pain where the injection was given may occur in about 25% of children receiving vaccines.

Hib vaccine: Administration guidelines

	Recommendation	Comment
Age	<ul style="list-style-type: none"> Dose 1 – 6 weeks Dose 2 – 10 weeks Dose 3 – 14 weeks 	<ul style="list-style-type: none"> If a child is not immunized at six weeks, immunize as soon as possible thereafter. Interval between doses is not less than one month.
Dose size	Usually 0.5 ml for each dose	
Number of doses	Three (for most commonly available preparations)	See the manufacturer's instructions.
Injection site	Anterolateral aspect of the thigh (infants), deltoid muscle (older children)	If Hib vaccines is given on the same day as another vaccine, it should not be injected in the same limb.

9. Summary

9.1. Immunization schedule for children

Age	Vaccines	Hepatitis B vaccine*	
		Scheme A**	Scheme B**
Birth	BCG, OPV0	HB1	
6 weeks	DPT1, OPV1	HB2	HB1
10 weeks	DPT2, OPV2		HB2
14 weeks	DPT3, OPV3	HB3	HB3
9 months	Measles Yellow fever		

* Scheme A is recommended in countries where newborns are at risk of being exposed to hepatitis B through their mothers.

* Scheme B is recommended where this risk does not exist.

9.2 Contraindications for immunization

There are FEW contraindications for immunization. All vaccines should be given on schedule, even when a child has a low-grade fever, a mild cold, diarrhoea or other mild illness.

If a child has diarrhoea when you give BCG vaccine, administer another dose at least four weeks later.

If a child has diarrhoea when you give OPV, administer an extra dose, i.e., a fifth dose, at least four weeks after he or she has received the last dose in the schedule.

- DPT vaccine should NOT be given to children over 5 years of age or to children who have suffered a severe reaction to a previous dose of this vaccine. Instead, a combination of diphtheria and tetanus toxoids (DT) may be given.
- Neither BCG nor yellow fever vaccines should be given to children who have signs and symptoms of AIDS.

9.3 Giving vaccines at the same time

All EPI vaccines are safe and effective when given at the same time.

- Inject them in different parts of the body.
- Do not give more than one dose **of the same vaccine** to a client in one session.
- Space doses of the same vaccine at least four weeks apart.

9.4 New vaccines

Some countries have included vaccines other than those described here in their national immunization programmes or may add them in the future. They include: mumps, rubella, Japanese B encephalitis, meningitis, *Haemophilus influenzae type b*, *Streptococcus pneumoniae*, typhoid fever, and cholera vaccines. Ask your supervisor which vaccines are included in your national programme.

New vaccines are being studied. Research is taking place to make vaccines more stable, to combine them so that fewer injections are needed, and to make them easier to give.

9.5 Summary of injection sites

Vaccine	Kind of injection	Injection site
BCG	Intradermal	Upper left arm
DPT	Intramuscular	Outer part of thigh
OPV	Oral	Mouth
Hepatitis B	Intramuscular	Outer part of thigh
Measles	Subcutaneous	Upper left arm
Yellow fever	Subcutaneous	Upper right arm
Tetanus toxoid	Intramuscular	Upper arm

Intradermal = into the skin.
Intramuscular = into a muscle.
Subcutaneous = under the skin.

Figure 2-G: Different needle positions

