

Case Study on Calculating Immunization Coverage Indicators

Purpose:

- Know how to calculate coverage from records
- Interpret and use coverage data for program action

Materials:

- Handout with formulas for immunization-coverage rates, drop-out rates, and the number of unimmunized children
- Handout with examples of problems and their causes

Time: 1.5 hours

Steps:

1. Discuss the method of calculating immunization coverage from health-center tally sheets. Totalling tally sheets is the first step in calculating coverage, as it is a record of the number of individuals (children or women) who have been vaccinated in a particular area.
2. Distribute and review the handout “Formulas for Calculating Immunization Coverage.” If desired, begin the review by asking participants: “What information do you need to calculate immunization coverage in a certain area?” Emphasize that it is not the total number of doses distributed that is needed, but the number of children or women who received a dose of a specific vaccine. Explain that coverage is expressed as a percentage of the target population.
3. Divide participants into three groups:
 - One group to calculate DTP1 coverage in 2003
 - One group to calculate DTP3 coverage in 2003
 - One group to calculate measles vaccine coverage 2003
 -(Note: the trainer should calculate the correct coverage ahead of time.)

Ask them to use these data to calculate the coverage rate for their assigned target group.

4. Explain that each group should calculate the number of unimmunized children as well as the DTP3 dropout rate. Explain that for immunization programs, coverage and dropout rates are used as indicators of the availability, accessibility and use of services, as well as other program characteristics.
 - DTP1 coverage indicates availability of access to and initial use of immunization services by children.
 - DTP3 coverage indicates continuity of use by parents, client satisfaction with services and capability of the system to deliver a series of vaccinations.
 - Measles coverage indicates protection against a disease of major public-health importance.
 - DTP1 to DTP3 coverage rates indicate the quality of services as perceived by parents and the quality of communication between parents and health workers.
5. The next part of the analysis is to categorize the problem present in each area in 2003. There are four situations:

1: No problem	Drop-out rates are low = good utilization DTP1 coverage is high = good access
2: Problem	Drop-out rates are high = poor utilization DTP1 coverage is high = good access
3: Problem	Drop-out rates are low = good utilization DTP1 coverage is low = poor access
4: Problem	Drop-out rates are high = poor utilization DTP1 coverage is low = poor access

6. Explain that participants should specify in column “r” the quality of access (good or poor) depending on the value of the DTP1 coverage (“good” is defined, in this exercise, as DTP1 coverage $\geq 80\%$ in the target age group, and “poor” corresponds to a DTP1 coverage in the target age group $< 80\%$).
7. Explain that participants should specify in column “s” the quality of utilization (good or poor) depending on the value of the drop-out rate (“good” is defined, in this exercise, as a drop-out rate in the target age group $< 10\%$, and “poor” corresponds to a drop-out rate in the target age group $\geq 10\%$).
8. Explain that participants should write the number of the problem category (1, 2, 3, or 4) in column “t”. The next step is to decide the area (listed in column “a”) which should receive top priority when starting to implement the identified solutions. Participants should complete column “u”, writing the order of priority against each area.
9. Upon completion of calculations, ask each group to examine trends in coverage levels. Is coverage low or falling? What are the possible causes? As a group, brainstorm about the differences in coverage between areas and possible causes. Discuss what action managers can take if coverage and dropout indicate problems.

Formulas for Calculating Immunization Coverage from Routine Data

Routine coverage estimates are calculated using statistics collected by health workers.

$$\text{DTP1 coverage} = \frac{\text{Number immunized by 12 months with DTP1 in 2003}}{\text{Number of surviving infants < 12 months of age in 2003}} \times 100$$

$$\text{DTP3 coverage} = \frac{\text{Number immunized by 12 months with DTP3 in 2003}}{\text{Number of surviving infants < 12 months of age in 2003}} \times 100$$

$$\text{Measles coverage} = \frac{\text{Number immunized by 12 months with measles in 2003}}{\text{Number of surviving infants < 12 months of age in 2003}} \times 100$$

Unimmunized children = target population minus immunized children in target age group

$$\text{DTP1-DTP3 dropout rate} = \frac{\text{Doses of DTP1 administered} - \text{Doses of DTP3 administered}}{\text{Doses of DTP1 administered}} \times 100$$

Example: Identifying Problems and their Possible Causes

Problems	Possible Causes of Problems
Parents do not bring children in for additional immunizations (utilization problem)	1. Health workers have not clearly explained to parents what vaccinations are due, when they are due, and why they are needed. 2. Health workers do not understand what vaccinations are due, when they are due, and why they are needed. 3. Barriers discourage parental return, (e.g., hours of clinic operation, cost, long waits). 4. Health workers do not clearly explain to parents when vaccinations are administered at the clinic. 5. Health workers have not shown parents respect or conveyed an interest in the child's health.
Children and mothers are not immunized when coming to the clinic for sick visits (utilization problem)	1. Health workers forget to check records or ask about what vaccines and doses a child/mother has received. 2. Health workers do not understand the contraindications for immunizations or health workers do not understand that immunizations may be given to mildly ill children. 3. Health workers fail to explain to parents that it is often acceptable to immunize a mildly ill child. 4. Immunizations are not available on that day. 5. Immunization supplies are not available.
Health workers cannot determine what immunizations a child has received (utilization problem)	1. Health workers forget to remind parents to bring the immunization card. 2. Clinic records are not organized so that it is easy to find a child's records.
Children are not receiving all vaccines that they are eligible to receive during a visit (utilization problem)	1. Health workers do not understand what vaccinations are due, when they are due, and why they are needed. 2. All immunizations are not available or offered at the clinic on the same day. 3. Supplies of some immunizations are not sufficient.
Children never come to the clinic to begin immunization (access problem)	1. The clinic is located too far away. 2. Clinic hours are not convenient or are not understood by the community. 3. Outreach activities are too infrequent, or their timing is not understood by the community. 4. Cultural, financial, racial, gender or other barriers are preventing use of immunization services.

Source: WHO (2002) Increasing Immunization Coverage at the Health Facility Level. Geneva, Switzerland: World Health Organization.

Immunization Module: Vaccine Supply and Stock Management

Study Session 5 Vaccine Supply and Stock Management

Introduction

This study session deals with how to determine vaccine needs and how to keep your stock of vaccines in a reliable way, so that your immunization programme will not be interrupted as a result of shortage of supply. We also explain how to avoid wastage of vaccines by reducing the risk that the stock will pass its expiry date. The study session involves a lot of calculations using basic mathematics (addition, subtraction, multiplication and division) and using letters to represent values that you will need to measure or estimate. You are advised to apply your own data after each of the examples given here, to help you understand how the calculations apply in your setting.

Learning Outcomes for Study Session 5

When you have studied this session, you should be able to:

- 5.1 Define and use correctly all of the key words printed in **bold**. (SAQs 5.1, 5.3 and 5.4)
- 5.2 Calculate the size of the target population in your community and forecast their vaccine needs, using three different methods. (SAQs 5.1 and 5.2)
- 5.3 Calculate vaccine wastage rates and wastage factors and apply them to orders of vaccine stocks to minimise wastage. (SAQs 5.1 and 5.3)
- 5.4 Calculate the minimum and maximum quantities of vaccines required for a stated supply period and manage the critical stock level effectively. (SAQ 5.4)

5.1 Estimating vaccine needs

Vaccine management involves estimating the number of vaccine doses, diluents and injection equipment (e.g. syringes, needles) needed for a particular population over a stated supply period. In order to run an efficient and effective immunization session you need to have an adequate supply of vaccines of acceptable quality. This is essentially dependent on reliable planning and monitoring. You might have heard from mothers in the community that the health facility ran out of vaccines and their child could not be immunized. On the other hand, health facilities may have an excess stock of vaccine that has passed its expiry date and has to be thrown away. You should try to ensure that these situations do not arise in your Health Post (Figure 5.1).



Figure 5.1 Fura *kebele* Health Post, in the Southern Nations, Nationalities and Peoples Region (SNNPR) of Ethiopia, has been commended for meeting high performance targets. (Photo: Janet Haresnape)

Before we move on, remind yourself of the meaning of some key terms from previous study sessions.

- What is the expiry date?

[Hide answer](#)

- The **expiry date** is the (international calendar) date after which a vaccine, diluent or other consumable item should not be used for the purpose of immunization, because of possible loss of *potency* (vaccines; diluents) or *durability* (syringes, needles and other items).

Potency refers to the ‘strength’ or ‘effectiveness’ of a vaccine; **durability** refers to the time period that equipment such as syringes or needles remain in good condition (how long they last).

e now consider how you can determine the vaccine needs for your Health Post. There are three methods based on:

- size of the target population for immunization
- previous vaccine consumption data
- size of the scheduled immunization sessions.

You will learn about each of these methods in the sections that follow. But you should note that vaccine requirements are likely to vary a lot from one *kebele* to another; the stocks required for your immunization programme may be very different from the examples used in this study session.

5.2 Estimating vaccine needs based on the size of the target population

5.2.1 What is the target population?

The **target population** is the number of people who are eligible for vaccination with a particular vaccine. We use the letters ‘pt’ to represent the target population in calculations.

- [You learnt about tetanus toxoid (TT) vaccine and all the other the vaccines available in the EPI in Ethiopia in Study Sessions 2 and 3.] For *tetanus toxoid (TT) vaccine* the target population is the total number of pregnant and non-pregnant **women in the childbearing age-group** (15–49 years). (Children will usually be protected from tetanus by receiving three doses of pentavalent vaccine at 6, 10 and 14 weeks of age.)
- For *BCG vaccine*, the target population is all **live births** (i.e. complete expulsion from the mother, regardless of duration of pregnancy, showing any evidence of life).
- For *all other vaccines* in the Expanded Programme on Immunization (EPI) in Ethiopia, the target population is all **surviving infants** (i.e. survive to their first birthday).

To calculate vaccine needs based on the target population, you need to know the *size of the target population*, the *number of doses* required according to the EPI schedule, and the *percentage immunization coverage rate* you have been given as the target in your annual activity plan (Figure 5.2).

FURA KEBELE HEALTH POST 2003 E.C. PER ANNUAL ACTIVITY PLAN PERFORMANCE MONITORING CHART											
		TOTAL POPULATION 6348									
		1st QUARTER		2nd QUARTER		3rd QUARTER		4th QUARTER		TOTAL	
		P	A	P	A	P	A	P	A	P	A
1	BCG	247	247	247	247	247	247	247	247	988	988
2	PENTAV	222	222	222	222	222	222	222	222	888	888
3	PENTAV	222	222	222	222	222	222	222	222	888	888
4	PENTAV	222	222	222	222	222	222	222	222	888	888
5	PENTAV	222	222	222	222	222	222	222	222	888	888
6	TT+2 PW	247	247	247	247	247	247	247	247	988	988
7	TT+2 NPW	247	247	247	247	247	247	247	247	988	988
8	TT+2 MW	247	247	247	247	247	247	247	247	988	988

[View larger image](#)

Figure 5.2 Annual activity plan performance for immunizations in Fura *kebele* with a total population of 6,348 people in 2003 E.C. (Ethiopian calendar, or 2010 in the European calendar). (Photo: Janet Haresnape)

In Figure 5.2, the column headed ‘eligible’ gives the number in the target population for each vaccine. You can see that the health workers in this Health Post planned to immunize 100% of the eligible children and 100% of the pregnant women (TT+2 PW, pregnant women receiving more than 2 doses of TT vaccine). Columns headed P refer to ‘planned’ numbers for immunization, and A are the ‘actual’ numbers immunized — in the first quarter of the year, they exceeded their targets for all categories except TT+2 NPW (non-pregnant women of childbearing age receiving more than 2 doses of TT).

Next, we will show you how to use data from an area similar to that of your *kebele* to calculate the target population for vaccination, so you can construct an annual activity plan for immunization like the one shown in Figure 5.2.

5.2.2 Calculating numbers in the target population

Table 5.1 (on the next page) shows an estimate of the target population for immunization in a *kebele* with a total population of 5,000. A figure of 4% of the Ethiopian population is usually taken to estimate the coverage required for all live births and surviving infants. You can assume that (on average) about 23% of the Ethiopian population will be women of childbearing age, of whom about 4% will be pregnant in a typical year.

Table 5.1 Estimating the target population (pt) for immunization in a kebele with a total population of 5,000.

Category	% of total population	Estimated number in target population
Live births	3.6	180
Surviving infants	3.4	170
Women of childbearing age (pregnant and non-pregnant)	23	1,150

You estimate the target population by multiplying the total population by the percentage in a particular category; for example in Table 5.1:

Expressing a percentage as a decimal number is easy, e.g. 90% is the same as 0.9; 23% is the same as 0.23, and 4% is the same as 0.04.

- The estimated number of women eligible for TT vaccination (Figure 5.3) is $5,000 \times 23\%$ (or 0.23) = 1,150
- The estimated number of children eligible for all other EPI vaccines is $5,000 \times 4\%$ (or 0.04) = 200, if you take the simple average of 4%. If you use the Ministry of Health indicators of live births (3.6%) and surviving infants (3.4%), the numbers will be 170 and 180 respectively.



Figure 5.3 About 23% of the Ethiopian population are women of childbearing age (pregnant and non-pregnant combined). (Photo: Ali Wyllie)

- Look back at Figure 5.2. What was the estimated target population eligible for TT immunization in Fura kebele in the year shown?

[Reveal answer](#)

5.2.3 Calculating required doses based on the immunization schedule

In addition to calculating the number of people in the target population, you also need to know the number of doses required in the EPI schedule in order to immunize everyone (total coverage). You learned about the EPI schedule in Study Sessions 2 and 3, but we repeat the key points in Table 5.2. We use the letters 'dn' to represent the number of doses in calculations.

Table 5.2 Vaccine schedule by age and number of doses.

Vaccines		Schedule by age	Number of doses in schedule (dn)
BCG		At birth	1
Pentavalent		At 6, 10 and 14 weeks	3
Polio (OPV)		At birth, 6, 10 and 14 weeks	4
PCV10		At 6, 10 and 14 weeks	3
Measles		At 9 months	1
		On reaching childbearing age	
Tetanus toxoid		Ideally all women of childbearing age should receive five doses of tetanus toxoid.	At least 2

- If you have an estimated 200 surviving infants in your *kebele*, how many doses of pentavalent vaccine would be needed to complete the EPI schedule for all these children? Use the data on % of total population in Table 5.1.

[Hide answer](#)

- The target population is 170 surviving infants, so you would need 510 doses to complete the EPI schedule for all of them, because each surviving infant should have three doses of pentavalent vaccine.

.2.4 Immunization coverage targets

You now know how to calculate the annual vaccine needs for immunization of everyone in the target population. The EPI policy is to immunize 100% of the target population, but you may not be able to reach everyone in the target population in one year (for example, if your *kebele* includes very remote areas). Your annual action plan will include a percentage target from the *woreda* health office for the **immunization coverage rate** — the percentage of the eligible population that has been agreed as your objective for immunization with each of the EPI vaccines this year. The performance of your Health Post will be measured against this target.

If the annual target is *less* than 100% for a particular vaccine, you can estimate the number of vaccine doses you will actually need as follows. Start with the number of doses required to immunize *everyone* in the target population (i.e. total coverage), and multiply that number by the agreed (lower) percentage target for immunization coverage in your setting. We use the letters ‘ic’ to represent the percentage target for immunization coverage in calculations. Now look at the example in Table 5.3. (Your targets will be different.)

Table 5.3 Estimate of actual vaccine doses needed for various percentage targets for immunization coverage in an imaginary population of 5,000. (ic stands for immunization coverage target)

Vaccine	Number of doses for 100% coverage	% coverage target (ic)	Actual number of doses needed
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BCG (1 dose)	200	90	180
Polio (4 doses)	800	90	720
Pentavalent (3 doses)	600	100	600
PCV10 (3 doses)	600	90	540
Measles (1 dose)	200	80	160
Tetanus toxoid (2 doses)	2,300	65	1,495

- How many doses of TT vaccine would you need to immunize the eligible women in Table 5.3 with *three* doses per woman, if you increased the percentage coverage target to 70%?

[Hide answer](#)

- Total 100% coverage with three doses would require 3,450 doses. If the coverage target is 70%, the actual doses required would be $3,450 \times 0.7 = 2,415$ doses.

Note that you can use the same method of calculation to estimate the number of ampoules of specific diluents required to reconstitute the freeze-dried vaccines (BCG and measles), and your requirement for injection equipment.

5.2.5 Vaccine wastage rates and wastage factors

Using calculations like the one in Table 5.3 enables you to determine the number of vaccine doses you need. However, some vaccine doses may be wasted during the year for various reasons (Box 5.1 on the next page). The **wastage rate** is the percentage of vaccine doses that are wasted. The general guideline on the amount of vaccine wastage that is considered acceptable for different types of vaccines is also shown in Box 5.1.

Box 5.1 Vaccine wastage

Some reasons for vaccine wastage:

- Some unused doses may have to be thrown away, e.g. because they have passed their expiry date or lost their labels.
- Some doses may be spoilt for one reason or another (e.g. vaccines damaged by storage at the wrong temperature).
- Some vials or ampoules may be broken during transport and handling.

Acceptable vaccine wastage rates:

- For liquid vaccines supplied in single or two-dose vials (e.g. pentavalent vaccine and PCV10), a wastage rate of 5% is acceptable.
- For OPV, a wastage rate of 10% is considered acceptable.

- For liquid vaccines supplied in multi-dose vials of 10 or more doses, a wastage rate of 15% is acceptable.
- For reconstituted vaccines, wastage rates of 50% for BCG and 25% for measles vaccine are considered acceptable.

Calculating the wastage factor

The **wastage factor** is the factor (number) that you multiply your estimated vaccine needs by, in order to allow for some doses being wasted. We use the letters 'wf' to represent the wastage factor in the following equation:

- $\text{wastage factor (wf)} = 100 \div (100 \text{ minus the \% wastage rate})$
- where the wastage rate is the number of doses wasted, expressed as a percentage.

Note the 'brackets first' rule. In equations that include brackets around some of the numbers, you always calculate the answer to whatever is *inside* the brackets *first*, before you do anything else.

- If the wastage rate is 30%, what is the wastage factor?

[Hide answer](#)

- $$\begin{aligned} \text{Wastage factor} &= 100 \div (100 - 30) \\ &= 100 \div 70 \\ &= 1.43 \end{aligned}$$
- Therefore, if 30% of the doses are wasted, the wastage factor will be 1.43.

Now you have learned how to calculate the basic values you need to estimate your vaccine needs for the target population. These values are the target population (pt), the number of doses in the schedule (dn), the immunization coverage target (ic) and the wastage factor (wf).

5.2.6 Calculating annual vaccine needs from the size of the target population

To calculate the annual vaccine needs for your immunization programme from the size of the target population, you need to multiply together the four values explained in Sections 5.2.1 to 5.2.4 of this study session. The calculation can be summarised using the equation shown below:

- $\text{Annual vaccine needs} = \text{pt} \times \text{dn} \times \text{ic} \times \text{wf}$

The equation uses the following values:

- target population (pt)
- number of doses in the schedule (dn)
- target immunization coverage (ic) expressed as a decimal number (not a percentage)
- wastage factor (wf).

- The calculation is as follows:

- o number of surviving infants (pt) = 200
- o number of pentavalent doses in the EPI schedule (dn) = 3
- o target coverage rate (ic) expressed as a decimal number = 0.9 (90%)
- o wastage factor (wf) = 1.33

$$\begin{aligned}\text{Annual pentavalent vaccine needs} &= \text{pt} \times \text{dn} \times \text{ic} \times \text{wf} \\ &= 200 \times 3 \times 0.9 \times 1.33 \\ &= 178\end{aligned}$$

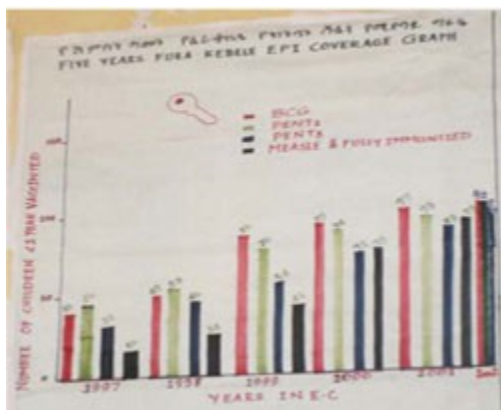
- In this example, 718 doses of pentavalent vaccine would be needed annually. Remember that the requirement in your own *kebele* may be different.

Now we turn to the second method of calculating vaccine needs.

5.3 Estimating vaccine needs on the basis of previous consumption

This method is based on the consumption of vaccines during the previous reporting period (usually the previous year). Some adjustment may be necessary if you believe that there has been any increase in the population size since the previous vaccine consumption was recorded. This method is useful for a Health Post where the stock management is good, but there is insufficient information on immunization objectives and targets for the next action plan. It is also useful when placing short-term orders.

In a *kebele* where stock management is efficient, there is likely to be good information on previous vaccine consumption. For example, you can probably see from the red bars in Figure 5.4 that 97 babies were immunized at birth with BCG in this *kebele* in 2001 (Ethiopian calendar). So this number could be used to predict the BCG vaccine requirement in the following year.



[View larger image](#)

Figure 5.4 EPI coverage for infants aged under one year during a five year period at Fura *kebele*, SNNPR, Ethiopia; years are in the Ethiopian calendar (E.C.). (Photo: Janet Haresnape)

5.3.1 Calculating annual vaccine needs from previous consumption

For this calculation, we use an equation based on the stock of vaccine at the beginning and end of a particular period, the vaccines received during that period, and the vaccines lost, destroyed or thrown away during that period. The equation is given below:

- Annual vaccine needs (in doses) = $(i+r) - (f+l)$

Remember the ‘brackets first’ rule; calculate the sums inside the brackets *first*, before you do anything else.

The equation includes the following numbers of doses:

- initial vaccine stock at the beginning of the period (i)
 - vaccines received during the period (r)
 - stock remaining at the end of the period (f)
 - lost, destroyed or expired doses (l).
-
- Use the above equation to calculate the annual vaccine needs (in doses) for pentavalent vaccine in a particular *kebele*, in which the initial stock at the beginning of the year was 250 doses, and the quantity received during the year was 1,250 doses. At the end of the year there were 500 doses remaining in stock. The quantity lost during the year was 125 doses.

[Hide answer](#)

- The answer is calculated as follows:
Annual vaccine needs = $(i+r) - (f+l)$
 $= (250 + 1,250) - (500 + 125)$ doses
 $= 1,500 - 625$ doses
 $= 750$ doses
- In this example, the estimated annual pentavalent vaccine need based on previous consumption is 750 doses.
- In the example given in Section 5.2.5, the estimated annual pentavalent vaccine need, based on the *size of the target population*, was 718 doses. However, the estimate based on the *previous year's consumption* (see above) was 750 doses. If both these imaginary examples had come from the same Health Post, what explanations could you suggest for the difference between the two estimates?

[Reveal answer](#)

5.4 Estimating vaccine needs based on the size of immunization sessions

Now we show you how to calculate vaccine needs based on the *size of immunization sessions*. This method is appropriate if you cannot determine the rates of vaccine wastage, or vaccine stock management is not good. The equation you should use to estimate the annual vaccine needs by this method is given below:

Annual vaccine needs = posts x weeks x sessions x vials x doses, where:

- posts = number of immunization sites
- weeks = number of weeks the service is delivered during the year
- sessions = number of immunization sessions per week
- vials = number of vials opened per immunization session
- doses = number of doses per vial.

Table 5.4 shows how to calculate vaccine needs based on the size of immunization sessions in an imaginary example, using a vaccine supplied in multi-dose vials containing 10 doses per vial.

Table 5.4 Calculation of annual vaccine needs based on the size of immunization sessions.

immunization posts	weeks delivered	sessions per week	vials per session	doses per vial	total doses
1	x 48	x 2	x 1	x 10	= 960

So the vaccine needs for this particular multi-dose vaccine, based on the size and number of vaccination sessions = 960 doses per year.

- Why do you think an estimate based on the size of the immunization sessions is likely to be *higher* than one based on previous consumption?
- [Hide answer](#)
- An estimate based on the size of the immunization sessions assumes that *all* of the scheduled immunization sessions will actually be held for each of the scheduled weeks in the year. But if some sessions cannot be held (for example, if there was a shortage of vaccine, or if the health worker was ill), then the actual number of vaccine doses given would be *lower* than estimated using the method illustrated in Table 5.4.

5.5 Ordering vaccines

In the previous section you learnt how to estimate vaccine needs. Vaccines are very expensive, so it is important to ensure that the ordered vaccines will be used and not spoiled. The World Health Organization (WHO) recommends that every order for vaccines should take into account the considerations in Box 5.2. There are some new terms in this box which are explained below it.

Box 5.2 Considerations for vaccine ordering

Health facility staff should always use an EPI Vaccine and Injection Materials Stock Record (see Figure 5.5) to help them to:

- Avoid stock *shortages*, especially when mass immunization campaigns are planned.
- Avoid stock *excesses*, by not ordering excess stock, or exceeding the recommended storage periods.
- Avoid situations where vaccines *expire* during their storage period.
- Ensure that the other necessary stocks (e.g. diluents, syringes, needles; wick and paraffin or kerosene for refrigerators, etc.) are ordered at the same time as the vaccines.
- Organise stock using the principle of ‘*bundling*’ for all supplies required delivering an immunization session.
- Ensure that there are adequate *cold chain* storage facilities (both in capacity and temperature; see Study Session 6).

The form is titled 'EPI VACCINES AND INJECTION MATERIALS STOCK RECORD'. It includes a header section for facility information and a main table with columns for Date, Received, Issued, and Balance. The table is designed to track stock levels over time, with rows for each day of the month.

[View larger image](#)

Figure 5.5 This stock record should be kept up to date at all times to ensure that stock shortages and stock excesses are avoided.

Bundling refers to the practise of organising related stock all together in ‘bundles’ consisting of the correct numbers of all the items you need during an immunization session:

- good quality vaccines and diluents
- auto-disable (AD) syringes (or single-use disposable syringes and needles, if these are still used)
- safety boxes, etc.

Auto-disable (AD) syringes were mentioned in Study Session 4, and are specially modified disposable syringes with a fixed needle; an AD syringe is automatically disabled after it has been used once, because the plunger cannot be pulled back a second time. The WHO recommends that immunization programmes use AD syringes for all vaccinations, to prevent re-use of contaminated injection equipment.

The **cold chain** is fully described in Study Session 6, and refers to the network of refrigerators, cold stores, freezers, cold boxes and vaccine carriers, and their efficient organisation and maintenance, so that vaccines are kept at the right temperature at all times. This ensures that vaccines keep their potency during their transportation and storage at all stages, from leaving the factory to the point of administration to the target population.

Storage of vaccines is a major challenge. Vaccines are easily damaged during storage if the cold chain is not maintained. Therefore it is important to divide the vaccine supply into manageable periods for the purpose of ordering stocks. A Health Post will usually have a shorter supply period (four weeks) than a health centre. The next section explains how to calculate the quantities of vaccine needed for a specific supply period.

5.5.1 Calculating quantities of vaccine for a particular supply period

The vaccine needs for a specific storage or supply period (in this case, 12 months or 48 working weeks) can be calculated using the following equation:

$q_{\text{period}} = (q_{\text{year}} \div 12) \times p_{\text{supply}}$ when the supply period is given in months, or $q_{\text{period}} = (q_{\text{year}} \div 48) \times p_{\text{supply}}$ when the supply period is given in working weeks. where:

- q_{period} = vaccine needs for the period
- q_{year} = annual vaccine needs
- p_{supply} = supply period (in months or weeks).

You can see an example of vaccine needs calculated in weeks in the following question.

- If the number of doses of vaccine required for one year in an imaginary *kebele* is 2,000, how many doses would be needed for a two-week period?
- In this example, the annual vaccine needs $q_{\text{year}} = 2,000$ and the supply period p_{supply} is 2 weeks.

The vaccine needs for one week would be $2,000 \text{ doses} \div 48 \text{ working weeks}$.

So the vaccine needs for the period (q_{period}) of 2 weeks is $(2,000 \div 48) \times 2 = 83 \text{ doses}$.

Therefore, 83 doses would be required for a two-week period in this example.

5.5.2 Calculating the minimum stock level

The time between the date of ordering vaccines and the date when you collect them may not be as soon as you would wish it to be. There may be an increase in vaccine demand that you want to respond to quickly, but you may find there are unexpected delays in restocking. Therefore, you should always aim to keep a minimum amount of vaccine in stock. The **minimum stock level** is the minimum number of vaccine doses that should be in the refrigerator when the next supply of

vaccines is collected. Usually, the minimum stock is taken as 25% of the total vaccine needs for the supply period.

The minimum stock level can be calculated using the following equation:

- $s_{\text{mini}} = q_{\text{period}} \times 25\% \text{ (or } 0.25\text{)}$

where s_{mini} is the minimum stock level and q_{period} is the vaccine needs for the period.

- Imagine that at a particular Health Post, the number of doses of oral polio vaccine (OPV) required for a 2 week supply period is 80. If the minimum stock should be 25% of the total vaccine needs for the supply period, what should the minimum stock level be at this Health Post when the next supply of vaccine is collected from the health centre? (Remember that 25% is expressed as 0.25 in calculations.)
- [Hide answer](#)
- The number of doses of OPV required for 2 weeks is 80.

The percentage required as minimum stock is 25% (0.25).

So the minimum stock is 80×0.25 doses, or 20 doses.

This means that there should be at least 20 doses of OPV in stock at this Health Post when the next supply of vaccine is collected.

5.5.3 Calculating the maximum stock level

You have learned that vaccines are easily damaged and that they are very expensive. It is not good practice to keep an unnecessary amount of vaccine in stock. The **maximum stock level** is the maximum number of vaccine doses that should be present in the refrigerator *immediately after* a new supply has been collected from the health centre.

The maximum stock level can be calculated using the following equation:

- $s_{\text{maxi}} = q_{\text{period}} + s_{\text{mini}}$

where s_{maxi} is the maximum stock level, q_{period} is the vaccine needs for the period, and s_{mini} is the minimum stock level.

- Think again about the Health Post where the number of doses of OPV needed for a 2-week supply period is 80 and the minimum stock level is 20 doses. What should the maximum stock level of OPV be in this Health Post?

[Reveal answer](#)

If your supplies of vaccine *exceed* your maximum stock level, it may be wise to consider returning some vials to the higher level.

5.5.4 Calculating the critical stock level (or ‘time to order’)

It is important to be aware of your vaccine stock, and to place your next order at the right time. The **critical stock level** (or ‘time to order’ level) is the number of vaccine doses in stock at the time when it is absolutely necessary to place a new order. ‘Time to order’ calculations take into account the level of vaccine consumption while waiting for the new supply. This precaution is necessary to prevent the vaccine stock from dropping below the minimum stock level before the new order can be collected. The **delivery time** is the time interval between the day the vaccines are ordered and the day that you collect them from the health centre.

The critical stock level can be calculated using the following equation:

- $S_{\text{critical}} = q_{\text{delivery}} + S_{\text{mini}}$, where:
 - S_{critical} is the critical stock level
 - q_{delivery} is the number of doses needed during the delivery time, and
 - S_{mini} is the minimum stock level.
- $q_{\text{delivery}} = (q_{\text{period}} \times t_{\text{delivery}}) \div n$, where:

The number of doses required during the delivery time (q_{delivery}) can be calculated using the following equation:

- t_{delivery} is the number of days between placing the order and collecting new vaccines
- n is the number of days in the supply period (i.e. the period that the health facility maintains its vaccine stocks at, or above, the minimum level).

Now attempt Activity 5.1 to calculate the critical stock level for an imaginary Health Post. You will need paper and a pen or pencil to help you make the calculations.

Activity 5.1 Calculating the critical stock level

At a particular Health Post, it often takes 2 working days for the HEW to collect her new supply of vaccines after ordering them from the health centre, which is 15 km away along difficult tracks. The number of doses of OPV she needs for a supply period of 2 weeks is 80 doses.

What is the critical stock level (or ‘time to order’ level) for OPV at this Health Post? Assume that the minimum stock level is 25% of the number of doses needed for the 2-week supply period (10 working days).

Write down all your calculations so that it is clear how you reached your answers. Do this before you check our answer below.

[Reveal answer](#)

In the next study session you will learn about keeping vaccines and diluents safe and effective by maintaining the cold chain. This is vitally important in reducing wastage, as well as maintaining the potency of the vaccines.

Summary of Study Session 5

In Study Session 5, you have learned that:

1. Vaccine management is important because vaccines are easily damaged and they are very expensive.
2. Accurate estimation of all stock requirements avoids shortages and prevents wastage from excessive orders; good vaccine stock management is essential to the smooth running of immunization sessions.
3. There are three methods of estimating annual vaccine needs, based on:
 - o size of the target population
 - o previous consumption levels
 - o size of immunization sessions.
4. These methods can also be applied to estimates of other immunization supplies, such as diluents and injection equipment.
5. It is essential to keep the EPI Vaccine and Injection Materials Stock Record up to date; this will help you to avoid stock shortages and stock wastage.
6. It is good practise to organise stocks of vaccines, diluents, syringes, needles and safety boxes together in bundles.
7. It is important to ensure that vaccine stocks do not fall below the recommended minimum level, or rise above the recommended maximum level, and that you order new supplies when the stock falls to the critical level.

Self-Assessment Questions (SAQs) for Study Session 5

SAQ 5.1 (tests Learning Outcomes 5.1, 5.2 and 5.3)

Imagine that you are working in a *kebele* with a total population of 5,700, and that 5% of the total population are children aged 0 to 11 months. There is only one immunization site — your Health Post. You have been given a target of 90% immunization coverage for pentavalent vaccine for the year. The wastage rate has been agreed as 5%.

- Based on the national EPI schedule for this vaccine, calculate the annual pentavalent vaccine needs, based on the size of the target population in this *kebele*.

[Reveal answer](#)

SAQ 5.2 (tests Learning Outcomes 5.2)

Imagine that in your *kebele* you plan to deliver two sessions of immunization per week for 45 weeks of the year. Your Health Post is provided with PCV10 (Synflorix) vaccine in multi-dose vials of 2 doses per vial, and at each immunization session 5 vials are used.

- Estimate the annual PCV10 vaccine needs for the Health Post, based on the size of the immunization sessions.

[Reveal answer](#)

SAQ 5.3 (tests Learning Outcomes 5.1 and 5.3)

If the wastage rate for oral polio vaccine (OPV) is 10%, what wastage factor would you need to use when calculating the annual OPV needs, based on the size of the target population?

[Hide answer](#)

Answer

The wastage factor is calculated from the wastage rate (expressed as a percentage), using the following equation:

- Wastage factor (wf) = $100 \div (100 - \% \text{ wastage rate})$

In this example, the wastage rate for OPV has been set at 10%. So the wastage factor is:

- $wf = 100 \div (100 - 10) = 100 \div 90 = 1.11$

Therefore, the wastage factor is 1.11.

SAQ 5.4 (tests Learning Outcomes 5.1 and 5.4)

- a. How much PCV10 vaccine would be required by the Health Post mentioned in SAQ 5.2 for a 2-week period?
- b. What is the minimum stock level for PCV10 vaccine for a 2-week period for this Health Post?
- c. What is the maximum stock level for PCV10 vaccine in the same period?

[Hide answer](#)

Answer

- a. In the example given in SAQ 5.2, there are two immunization sessions per week. Five multi-dose vials of PCV10 each containing 2 doses is used per session, so 20 doses are needed per week. Therefore the number of doses required for a 2-week supply period in this *kebele* is 40 doses.

- b. The minimum stock level is generally taken to be 25% (or 0.25) of the requirement for the supply period, which in this example is 2 weeks. The equation needed to calculate the minimum stock level for a 2-week period is:
 - o $S_{\text{mini}} = q_{\text{period}} \times 0.25$ (25% expressed as a decimal number is 0.25)
 - o where q_{period} is the number of doses required for the supply period, which in this example is 40 doses.
 - o $S_{\text{mini}} = 40 \times 0.25 = 10$ doses.
 - o So the minimum stock level for PCV10 vaccine for a 2-week period in this *kebele* is 10 doses.
- c. The maximum stock level for PCV10 for a 2-week period in this *kebele* is calculated from the following equation:
 - o $S_{\text{maxi}} = q_{\text{period}} + S_{\text{mini}} \quad S_{\text{maxi}} = 40 + 10 = 50$ doses
- d. So the maximum stock level for PCV10 vaccine for a 2-week period in this *kebele* is 50 doses.

Calculating annual vaccine needs from the size of the target population

To calculate the annual vaccine needs for your immunization programme from the size of the target population, you need to multiply together the four values explained in Sections 5.2.1 to 5.2.4 of this study session. The calculation can be summarised using the equation shown below:

- Annual vaccine needs = $pt \times dn \times ic \times wf$

The equation uses the following values:

- target population (pt)
- number of doses in the schedule (dn)
- target immunization coverage (ic) expressed as a decimal number (not a percentage)
- wastage factor (wf).
- Calculate the annual vaccine needs for pentavalent vaccine for a target population of 200 surviving infants, using the equation given above. Remember that three doses of this vaccine per child are needed for full immunization. Assume the target coverage rate is 90% and the wastage factor is 1.33 in this example.

[Hide answer](#)

- The calculation is as follows:
 - o number of surviving infants (pt) = 200
 - o number of pentavalent doses in the EPI schedule (dn) = 3
 - o target coverage rate (ic) expressed as a decimal number = 0.9 (90%)
 - o wastage factor (wf) = 1.33

Annual pentavalent vaccine needs = $pt \times dn \times ic \times wf$

$$\begin{aligned} &= 200 \times 3 \times 0.9 \times 1.33 \\ &= 718 \end{aligned}$$

- In this example, 718 doses of pentavalent vaccine would be needed annually. Remember that the requirement in your own *kebele* may be different.