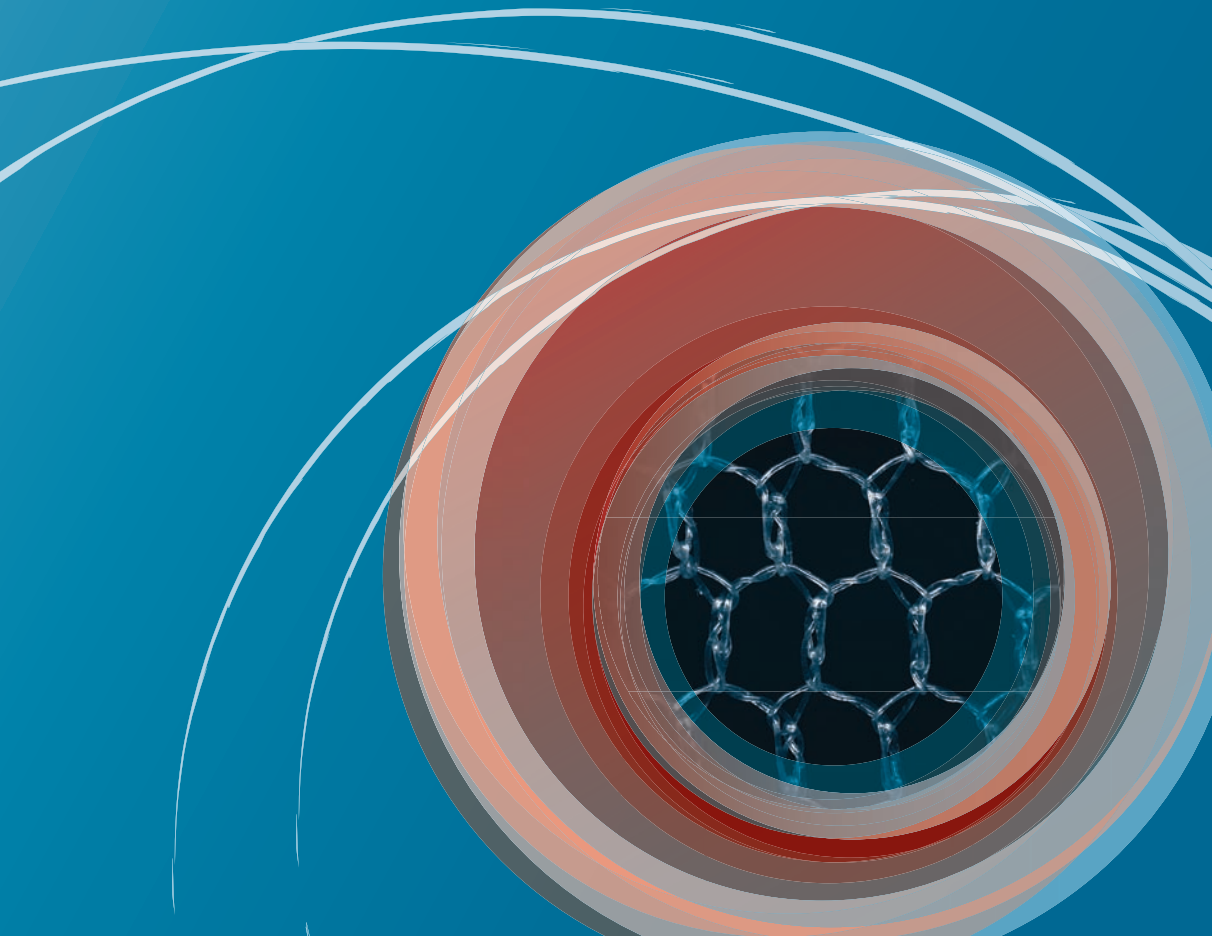
World Health Organization

LONG-LASTING INSECTICIDAL NETS FOR MALARIA PREVENTION

A manual for malaria programme managers

TRIAL EDITION



Global Malaria Programme

Long-lasting insecticidal nets for malaria prevention

A manual for malaria programme managers

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Figure 5 was adapted from a working paper entitled: "*A framework of strategic options for the integrated delivery of insecticide-treated nets and immunization*" by Ms Jayne Webster, LSHTM and Ms Jenny Hill, LSTMH.

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SECTION 1

Introduction

This trial edition manual is designed as a practical guide on malaria prevention through the use of insecticide-treated nets (ITNs), particularly long-lasting insecticidal nets (LLINs)[1]. It is intended for national malaria control programmes (NMCPs) that have opted to use LLINs to protect some or all populations at risk.

Correctly used, LLINs provide protection to individual users. When a high proportion of people sleep under them, LLINs may also have a role in controlling vector mosquitoes, thus reducing transmission and the risk of malaria to other community members.

To realize their full potential, LLINs should be deployed as a vector control intervention – which implies that the programme objective should be full coverage of all population groups in areas where LLINs are the chosen method for malaria prevention. However, the manner in which full coverage should be achieved may vary with the epidemiological characteristics and operational situation in particular areas. In areas of intense transmission, for example, where young children and pregnant women are the most vulnerable, full protection of these groups is the immediate priority during progress towards full coverage. In areas of low transmission, where all age-groups are vulnerable, national programmes should establish priorities on the basis of the geographical distribution of the malaria burden.

Recent experiences have demonstrated that it is possible to increase LLIN coverage rapidly through mass distribution schemes or antenatal care services. In most high-burden countries, ITN coverage is still below agreed targets (*1*). The best opportunity for

[1] Long-lasting insecticidal nets (LLINs) are identified by the code LN in WHO specifications for these products.

rapidly scaling-up malaria prevention is free or highly subsidized distribution – through existing public health services (both routine and campaigns) – either of LLINs or of full-value vouchers/coupons. LLINs should be considered a public good for populations living in malaria-endemic areas.

Although this manual focuses on the implementation of LLINs, programmes that have successfully maintained coverage through regular treatment of conventional nets may continue to do so while assessing the scope for improvement and expansion through the introduction of long-lasting treatment technologies. Several companies are developing long-lasting treatment products that may prove cost-effective in treatment/re-treatment schemes, where applicable.

Rapid, results-oriented scale-up, led by the public sector, requires a strong managerial approach. Ministries of health in endemic countries need to assume responsibility for policies, planning and monitoring of outcomes as well as for coordination with other programmes, sectors and partners. This manual is thus aimed primarily at managers of NMCPs or vector control programmes. It should prove equally useful for responsible officers at regional and district levels as well as for managers and technicians involved in implementation of LLIN interventions within nongovernmental organizations (NGOs), the private sector and other partners in malaria control.

This manual builds on the various guidelines on implementation of ITN interventions that have been published (some by WHO), incorporating recent experience with LLINs and with novel modes of delivery.

The following field guides on LLIN delivery strategies will be developed from this trial edition manual:

– Integrated LLIN campaigns;

– Stand-alone LLIN campaigns;

– Routine LLIN delivery with Expanded Programme on Immunization (EPI); and

– Routine LLIN delivery with antenatal services.

Scope of the manual

Evidence on ITNs

Section 2 summarizes the relevant scientific evidence on ITNs. It includes the rationale for seeking full population coverage among populations for whom LLIN is the preferred intervention.

Planning

Section 3 deals with the first steps in planning – the setting of targets for outcome (coverage rate) and outputs (number of LLINs to be delivered). The need for precise definition of the target populations for protection with LLINs is emphasized.

Delivery strategies

Section 4 reviews the experience with LLINs, concluding that high population coverage is best achieved by free or highly subsidized delivery – through existing public health services (both routine and campaigns) – either of LLINs or of full-value vouchers/coupons. Different modalities can be used according to local epidemiological and operational situations. In areas of intense transmission[1], where young children and pregnant women bear the highest burden, they are the priority groups to be initially targeted through antenatal and immunization services.

Implementation

Guidance on implementation is given in Sections 5–7. Section 5 reviews procurement and logistics, Section 6 the communication activities necessary to ensure that the recipients of LLINs use them correctly, and Section 7 the steps involved in micro-planning according to the selected mode of implementation.

to be continued

[1] Stable malaria areas are areas where people develop protective immunity and where malaria burden is borne mainly by children under 5 years of age and pregnant women.

Monitoring and evaluation

Monitoring and evaluation are covered in Section 8, which emphasizes the monitoring of coverage through surveys, using standardized methods. Monitoring of outputs is based on calculating the number of LLINs delivered to end-users every year against the needs of the target population. This section includes guidance for monitoring at all levels through simple instruments and systems that can be integrated into those applied for maternal and child health, where antenatal care and EPI are channels for delivery.

Operational research

Section 9 deals with the priority questions that programmes need to address through applied field and operational research in order to maintain effective implementation.

Determining human and financial resources

Section 10 reviews the human resource and financial implications of LLIN implementation.

SECTION 2

Evidence on insecticide-treated nets

2.1 Impact on overall childhood mortality and malaria-related morbidity

On the basis of five community-randomized trials, a Cochrane review concluded that, when full coverage is achieved, ITNs reduce all-cause child mortality by 17% on average compared with no nets (relative rate (RR) 0.83, 95% confidence interval (CI) 0.76–0.90), in sub-Saharan Africa (*2*). This implies that, in general, 5.5 lives could be saved per year for every 1000 children under 5 years of age protected.

The review also concluded that ITNs reduce clinical episodes of uncomplicated malaria caused by Plasmodium falciparum and P. vivax by 50% (range 39–62%), as well as reducing the prevalence of high-density parasitaemia. One study showed a 45% reduction in the incidence of severe malaria. Protection against forest malaria has recently been demonstrated in the Amazon region and in Cambodia (*3*), which confirms that personal protection against malaria is an important aspect of the action of ITNs.

In Africa, compared with a control situation in which there were no mosquito nets, use of ITNs increased mean birth weight by 55 g (95% CI 21–88), reduced low birth weight by 23% (RR 0.77, 95% CI 0.61–0.98), and reduced miscarriages/stillbirths by 33% (RR 0.67, CI 0.47–0.97) in the first to fourth pregnancies. Placental parasitaemia was reduced by 23% in all pregnancies (RR 0.77, CI 0.66–0.90) (*4*).

In Uganda, a combination of co-trimoxazole prophylaxis, anti-retroviral therapy and ITNs substantially reduced the frequency of malaria in adults with HIV (*5*).

The use of ITNs, especially LLINs, is one of the cheapest and most effective interventions against malaria. In a recent analysis of the cost of five ITN and two IRS (indoor residual spraying) programmes

in Africa, LLINs were found to be significantly cheaper to use than conventionally treated nets. For LLINs lasting 3 years, the costs per death averted and per DALY (disability-adjusted life year) averted were less than half those for conventional ITNs. The study's findings also suggest that, in high-transmission areas, where most of the malaria burden is carried by children under 5 years of age, and assuming that LLINs can be effectively targeted to this population group, the use of LLINs is four to five times cheaper than IRS which cannot be targeted to children alone. The annual cost per LLIN averaged US$ 2.10 (range 1.48–2.64), which corresponds to US$ 1.05 per person protected per year.

All mosquito nets work by acting as a physical barrier to vector mosquitoes, thus affording personal protection against malaria to the individuals using the nets. The pyrethroid insecticides used to treat nets have an excito-repellent effect that adds a chemical barrier to the physical one; this increases the protective efficacy of the mosquito net by further reducing human–vector contact. The insecticide kills mosquitoes that come into contact with the ITN/LLIN; thus, by reducing the vector population, ITNs/LLINs provide protection for everyone in the community, even people who do not sleep under a net themselves (*6, 7*). ITNs/LLINs work in this case as a vector control intervention in reducing malaria transmission. A recent study has shown that relatively modest coverage (30–60%, depending on the ecological scenario) of all adults and children can achieve equitable, community-wide benefits (*8*).

The mass effect on vector population and transmission is the main reason for this manual recommending full coverage of all people at risk of malaria in areas targeted for malaria prevention through LLINs. Further support for this position derives from the following:

- In the randomized controlled trials in Africa, where the protective efficacy of ITNs in young children and pregnant women was demonstrated, all age-groups were covered (*2*).
- Both adults and children contribute in varying degrees to infecting vector mosquitoes and should be protected to control transmission. The contribution of adults to the reservoir of transmission is likely to be more important than has been assumed in the past (*9*).

2.2 Impact on diseases other than malaria

The effectiveness of ITNs has been demonstrated against a range of other vectors involved in the transmission of diseases such as leishmaniasis (*10*), Japanese encephalitis (*11*), lymphatic filariasis (*12*) and Chagas disease (*13*). However, more rigorous studies are needed to show or confirm the impact of ITNs on disease incidence. Population acceptance and use of ITNs is also enhanced by the fact that treated nets protect against nuisance mosquitoes and kill head lice and bedbugs.

2.3 Long-lasting insecticidal nets (LLINs)

LLINs are nets that are treated at factory level by a process that binds or incorporates insecticide into the fibres. They are designed to maintain their biological efficacy against vector mosquitoes for at least 3 years under recommended conditions of use in the field, obviating the need for regular insecticide re-treatment. When tested in the laboratory, the insecticidal efficacy of the nets should persist through at least 20 WHO standard washes (*14*).

The following three LLINs are currently recommended by WHO:

1. Permethrin-incorporated net (*15*) – an LLIN made of high-density polyethylene monofilament yarn blended with 2% (w/w) permethrin (see Fig. 1) – an active ingredient content of about 1000 mg/m^2. Only a small proportion (2–5%) of the insecticide is available at the surface of the yarn; when this is removed through normal use or by washing, it is progressively replaced by diffusion of permethrin from within the polymer. This migration of the active ingredient is essential for the efficacy of the net. The permethrin-incorporated LLIN is made of wide mesh (4 mm x 4 mm) and is available in different colours, shapes and sizes. Duration of protective efficacy is at least 5 years under recommended conditions of use.
2. Deltamethrin-coated net (*16*) – an LLIN made of multifilament polyester netting treated with deltamethrin (55 mg/m^2). The deltamethrin is mixed in a resin that coats the netting fibres and releases the insecticide progressively, so that the net retains efficacy after repeated washings. Polyester netting is commonly

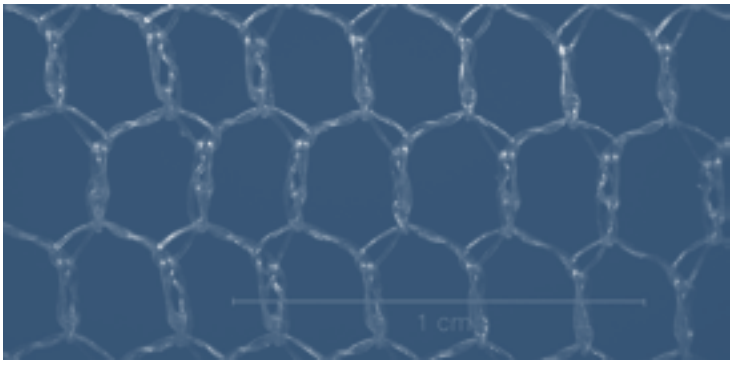


Figure 1. Example of netting material made of high-density polyethylene monofilament yarn

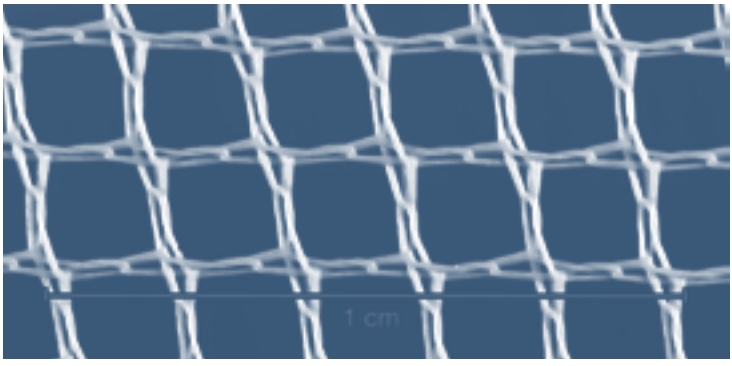


Figure 2. Example of netting material made of polyester multifilament yarn (flat)

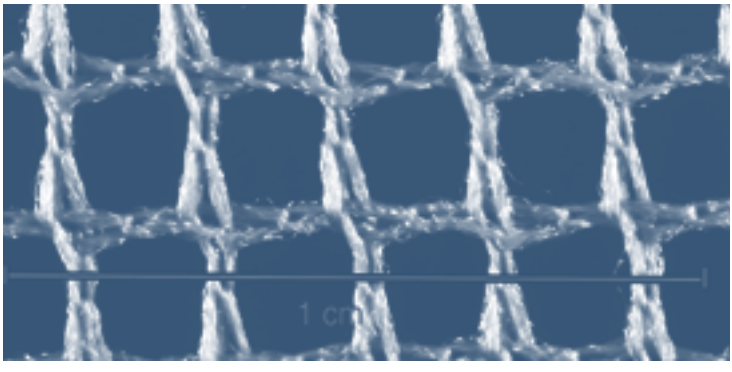


Figure 3. Example of netting material made of polyester multifilament yarn (texturized)

made of flat (see Fig. 2) or texturized (see Fig. 3) multifilament yarn. In texturized yarn, filaments have a wavy shape that is effected mechanically just after extrusion. Flat and texturized yarns have similar physical characteristics, including strength. However, texturized yarn is softer than flat yarn and nets tend to absorb slightly more water (and insecticide) than those made of flat yarn. Deltamethrin-coated nets are available in different shapes, sizes and colours.

3. Alphacypermethrin-coated net (*17*) – an LLIN made of multifilament polyester netting treated with alphacypermethrin at a target dose of 200 mg/m^2 of fabric. It contains a textile auxiliary that binds alphacypermethrin in a special coating to the fibres of the net. The net is available in different shapes, sizes and colours.

The effective life of insecticide-coated polyester LLINs under field conditions is currently being assessed. The strength and duration of the netting material itself (e.g. 75 or 100 denier multifilament polyester) might be a limiting factor unless it can be further improved.

2.4 Long-lasting insecticidal treatment kits

Many nets currently in use are neither long-lasting nor adequately treated. Long-lasting treatment kits are an emerging technology. These kits include a dose of binder (usually a resin), which is mixed with the recommended volume of water before the insecticide is added. As the net dries after dipping in the insecticide solution, the resin polymerizes around the fibres, binding the insecticide.

Nets treated with such kits should become long-lasting according to the above-mentioned criteria for LLINs, but it will be essential to follow the instructions for use and to ensure that nets are made of the materials recommended by the manufacturers of the kits. The use of long-lasting treatment kits, once available, is likely to have significant operational implications. In countries with a high number of conventional nets their use creates the opportunity for a parallel interim strategy; however, such a strategy should be seen only as interim and assumes that ongoing programmes and policies are in place to provide LLINs as replacements over time. As with LLINs, it will be essential that only WHO-recommended kits are used.

SECTION 3

Setting objectives and targets

3.1 Goals, general objectives and specific objectives (outcome targets)

The goal is the long-term aim to which the intervention will contribute. In specific relation to the LLIN intervention, it might be stated as follows:

- to contribute to the reduction of malaria-related mortality and morbidity in Country X.

In contrast, an objective needs to be time-bound and precise. The specific objective – often referred to as the target or outcome target – of the intervention should be set in terms of level of coverage of the target population. An outcome target could be, for example:

- to achieve, by the year 2015, 80% LLIN coverage in the population at risk of malaria in Country X.

3.2 Target populations and coverage

Precise definitions of target populations are essential for planning. The following points need to be considered:

- For LLINs, the target population is part of, or identical to, the population at risk of malaria (i.e. all those living in endemic and epidemic-prone areas).
- For vector control, definition of the target population should refer to well-defined geographical areas. The target population is always the total population within the defined areas.
- The definition of a target population must be independent of operational constraints and annual plans for scaling-up. Thus, the target population is the one that should ultimately be protected by LLINs (the population eligible for LLIN protection).

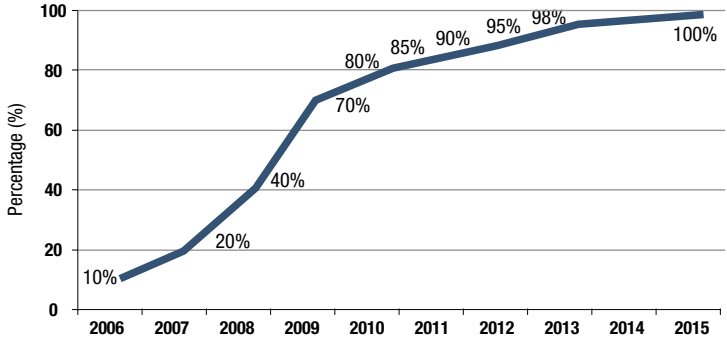
- LLINs should be deployed with the primary objective of reducing malaria transmission. To achieve the required impact on vector mosquitoes, high coverage within a target community is essential. Where the number of available LLINs would be insufficient to cover the total population in a particular district, the best option in a high-transmission area would be to distribute LLINs initially to vulnerable groups in all villages during progress towards full coverage; in low-transmission areas, the aim should be to achieve immediate full coverage of LLINs in targeted villages.
- The population data for current population and annual growth should be based on the official figures used by national authorities.

3.3 Disaggregation of outcome targets by year

Outcome targets should be disaggregated as annual targets and subpopulation targets.

Establishing annual targets is relatively easy. For example, if the starting coverage in 2006 were 10% and the final outcome target for 2015 were 100%, scale-up could be by annual increments of approximately 10%. However, it would be sensible to adapt this to an S-shaped curve (see Fig. 4). Implementation in the earliest years, which constitute a learning phase, may be relatively slow; it should then accelerate until the final 10–20%, which may be more difficult to achieve. Of course, a programme that is already in the steep upward phase should seek to maintain its momentum. Scaling-up too slowly may give rise to social tensions, if some sections of the population feel that they have been obliged to wait.

Figure 4. **Example of a plan to increase coverage from 10% to 100% annual targets with relatively small increments in the beginning and towards the end**



3.4 Disaggregation of outcome targets by subpopulations

In this context, "subpopulations" may refer to geographical areas or to vulnerable groups. In areas of intense transmission, the initial aim may be high coverage among vulnerable groups, with coverage subsequently extended to others. In other transmission areas everybody is vulnerable, and priority would normally be given to achieving high coverage among geographically defined populations known or believed to have the highest disease burden. In principle, countries with both unstable and stable malaria areas should apply the two approaches as appropriate.

Disaggregation for prioritization of young children and pregnant women requires knowledge of the size of these subpopulations and of the existing levels of coverage. Official national data should be used to establish size, but the following rules of thumb for developing countries with high under-5 mortality and high fertility rates can be applied to establish an initial overview for macro-level planning:

- The number of children under the age of 5 years is about 18% of the total population.
- The number of pregnant women is about 4% of the total population.

Thus, in general, children under 5 years of age and pregnant women make up about 22% of the population.

3.5 Output targets

For LLIN implementation, output is defined in terms of delivery of LLINs to end-users. An end-user may be a mother or another person who will either use the LLIN or ensure that one or more members of the household will use it.

In micro-planning (see Section 7), output targets must be disaggregated by month and district. The annual output target, *t*, is calculated as the number of LLINs that need to be delivered to end-users over the year to reach the annual outcome target.

The calculation of *t* must take into account the number of useful LLINs present in the population at the beginning of the year, the number that need to be present at the end of the year, and the number of LLINs that will expire during the year. In addition, recent experiences indicate that LLINs delivered to target populations are reduced by losses of about 15% in the first year, 10% in the second and 5% in subsequent years. As a rule of thumb, it is therefore recommended that 10% be added to the number of LLINs calculated from outcome targets and expiry of insecticidal effect. Thus, the output target, *t*, is calculated for a year as:

$$t = ((c_1 - c_0)/s + e) \times 1.1$$

where:

c_1 is the number of persons to be covered by the end of the year;

c_0 is the number of persons covered at the end of the previous year;

c_1 and c_0 are calculated by multiplying the target population by the respective coverage rates (outcome targets);

s is the average number of persons sleeping under one LLIN (it is generally assumed that $s = 2$);

e is the number of LLINs needed to replace those distributed in previous years and expiring during the year – depends on the useful life of the LLIN in question;

x 1.1 is to increase by 10%.

Example 1

If the target population is initially 1 000 000, the annual population growth rate 2.5% per annum, the useful life of the LLINs in question 3 years, and the outcome targets as indicated in section 3.3, the output targets are calculated as shown in Table 1.

In year 3, for example, we have:

c_1 (number of persons to be covered by end of year 3) =

population at end of year 3 x coverage target =

1 076 891 x 70% = 753 823

c_0 (number of persons covered at end of year 2) =

population at end of year 2 x coverage target =

1 050 625 x 40% = 420 250

The increase in the number of people to be covered over the year is ($c_1 - c_0$) and the LLINs needed to cover them ("to expand") is $(c_1 - c_0)/2 = 166\,787$.

We need to add e = LLINs needed to be replaced = number of LLINs delivered 3 years before = output target of year 0 (that is 55 000) and arrive at "LLINs needed" = $(c_1 - c_0)/2 + e = 221\,787$. Multiplying by 1.1 to cover the possible 10% loss gives output target for year 3:

$$t = ((c_1 - c_0)/2 + e) \times 1.1 = 243\,966$$

Example 2

Similar calculation of output targets using LLINs with a useful life of 5 years is presented in Table 2 below. If LLINs with a useful life of 5 years are used, there will be a need for replacement of LLINs only from year 5. In the long term, the output target will approximate the annual replacement need, which will be equal to (target population/2/5) x 1.1.

Assumptions

- It is assumed that output targets are met every year.
- The high variability of the output targets is related to the variation in the annual increments of the coverage target. It is assumed that coverage at the beginning of year 0 is 0%.
- Over time, the output target will approximate the annual replacement need, which is equal to (target population/2/3) x 1.1 for LLINs with a 3-year useful life, and (target population/2/5) x 1.1 for LLINs with a 5-year useful life.

For delivery to children under 5 years of age and pregnant women, the output targets are usually calculated on the basis of the delivery mode (see section 4.1.2). It is then necessary to check that the outputs that can be achieved through the selected modes of delivery will achieve the outcome targets for those groups (see section 3.4).

Table 1. Calculating output targets in "country *x*" using LLINs with a useful life of 3 years

VARIABLE	CALCULATION	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Population	Increase 2.5% p.a.	1 000 000	1 025 000	1 050 625	1 076 891	1 103 813
Coverage target (%)	Decided by programme	10%	20%	40%	70%	80%
Persons to be covered	c = (population) x coverage target (%)	100 000	205 000	420 250	753 823	883 050
LLINs needed to expand	$(c_1 - c_0)/2$	50 000	52 500	107 625	166 787	64 613
LLINs needed to replace	e = LLINs delivered 3 years before (t–3)	0	0	0	55 000	57 750
LLINs needed	$(c_1 - c_0)/2 + e$	50 000	52 500	107 625	221 787	122 363
Output target	$t = ((c_1 - c_0)/2 + e)$ x 1.1	55 000	57 750	118 388	243 966	134 600

Table 2. Calculating output targets in "country *x*" using LLINs with a useful life of 5 years

VARIABLE	CALCULATION	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
Population	Increase 2.5% p.a.	1 000 000	1 025 000	1 050 625	1 076 891	1 103 813	1 131 408
Coverage target (%)	Decided by programme	10%	20%	40%	70%	80%	85%
Persons to be covered	c = (population) x coverage target (%)	100 000	205 000	420 250	753 823	883 050	961 697
LLINs needed to expand	$(c_1 - c_0)/2$	50 000	52 500	107 625	166 787	64 613	39 323
LLINs needed to replace	e = LLINs delivered 5 years before (t–5)	0	0	0	0	0	55 000
LLINs needed	$(c_1 - c_0)/2 + e$	50 000	52 500	107 625	166 787	64 613	94 324
Output target	$t = ((c_1 - c_0)/2 + e) \times 1.1$	55 000	57 750	118 388	183 466	71 074	103 756

SECTION 4

Selection of delivery strategies

4.1 Review of delivery channels

A number of systems are available for delivering LLINs to households – public sector, private sector and a mix of public and private. This manual focuses on the responsibilities of the public sector.

Models for public-sector delivery of LLINs fall into two categories:

- Targeted distribution to vulnerable groups in intense transmission areas through:
  - antenatal care; and
  - immunization programmes.

  Further detail is shown in figure 5.
- Delivery to the total population within a defined geographical area through:
  - scale-up based on prioritization of geographical areas in countries with unstable malaria and limited populations at high risk; and
  - campaign-like delivery in emergency situations as part of relief efforts, sometimes combined with other interventions such as food aid.

Although distribution to all age-groups may have been practised for longer periods, especially in Asia, there is less documentation on the experiences. In contrast, targeted public-service distribution to vulnerable groups, which has expanded rapidly in Africa since 2002, is well documented and is probably the best option for rapidly increasing coverage in high-burden countries.

Sustained targeted distribution, to vulnerable groups only, allows full coverage of the targeted communities to be achieved rapidly.

4.1.1 Targeted delivery to vulnerable groups

Delivery of LLINs with antenatal care

Delivery of LLINs with antenatal care offers significant advantages in allowing the protection of both pregnant women and children under the age of 1 year (provided that infants sleep with their mothers). It is practised or planned in many countries. Delivery can be done in two ways:

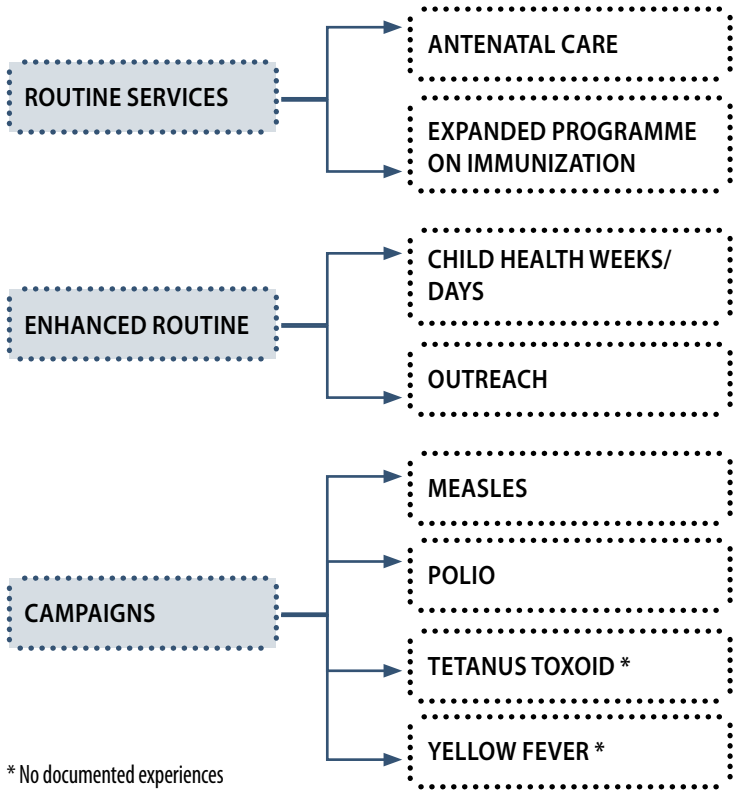
- providing a free or highly subsidized LLIN (i.e. direct product); or
- providing a voucher or coupon that can be exchanged for an LLIN at a commercial or other pre-identified outlet.

Antenatal care coverage rates in most African countries are above 60%, so this channel can provide good – but not 100% – coverage: most pregnant women have their first antenatal consultation only after the 20th week, so the protection in pregnancy through this channel alone is incomplete. However, antenatal care coverage is increasing in most countries, and the delivery of LLINs through this channel may well prove to make this type of care more popular. With an effective communication strategy, the provision of LLINs may also persuade women to start their antenatal care consultations earlier.

Delivery of LLINs with immunizations

Delivery of LLINs to children along with immunizations may be through the Expanded Programme on Immunizations (EPI). Delivery of LLINs with EPI presents an opportunity for reaching children less than 1 year old. In most malaria high-burden countries, EPI coverage rates are already over 60% and, with internationally agreed coverage targets, are rising. A number of countries have had good experiences combining LLIN distribution with EPI, several of them through the Accelerated Child Survival Development Initiative, supported by UNICEF.

Figure 5. Models for delivery of LLINs combined with maternal and child health and immunization services



Most commonly, LLINs have been delivered with measles vaccination, which is scheduled at age 9 months, or with DTP3 (third dose of diphtheria toxoid, tetanus toxoid and pertussis vaccine) at 12–14 weeks. In some places, LLINs have been delivered at the first contact with EPI – which is particularly relevant when LLINs have not been delivered at antenatal clinics. Delivering LLINs at the first EPI contact means that later immunization contact can be used to screen again whether the child has an LLIN or not. The distribution of an LLIN at the time of routine immunization should be recorded on the child's immunization card. Again, the scheme may deliver the direct product or a voucher/coupon that can be exchanged at a commercial or other pre-identified outlet.

Child health weeks/child health days

Child health weeks or days are used to deliver a minimum package of services to children aged 0–59 months. The primary intention is to reach children aged more than 1 year who have not completed their EPI vaccinations, to encourage increased use of routine services, and to increase coverage with child survival interventions that may include EPI vaccines, vitamin A supplementation, deworming treatment and LLIN delivery.

Immunization campaigns

Immunization campaigns in which the LLINs may be integrated include measles supplementary immunization activities (SIAs), poliomyelitis national or subnational immunization days (NIDs or SNIDs) and, potentially, emergency campaigns such as for yellow fever.

Mass campaigns, based on fixed vaccination points, are well suited for rapid scale-up of LLIN coverage. The follow-up phases of measles campaigns, which target only children under 5 years of age, are ideal because they combine the advantage of fixed vaccination posts with that of identical target age groups – in addition to nationwide coverage. Measles catch-up campaigns are less suitable because their target age group includes children up to 15 years of age, although distribution of LLINs to all children under 15 years could provide for full coverage of the population. However, this latter option can be considered if sufficient funds are available, especially in countries with low coverage that still have to carry out a measles catch-up campaign.

Polio NIDs or SNIDs are less suitable because of the rapid, house-to-house delivery of oral polio vaccine. They should be considered for LLIN distribution only in special circumstances, for example when a fixed-base vaccination campaign is not foreseen within a 12-month period or when the NID is based mainly on fixed-post vaccinations.

Tetanus toxiod (TT) campaigns target women of child-bearing age (15–45 years old) in hard-to-reach areas. Normally, three rounds of these campaigns are planned, the first two being usually 1 month apart, followed by the final round, 6 months later. The target group may not directly correspond to that for LLIN distribution, but women could be advised to bring their children under 5 to receive an LLIN.

4.1.2 Full population coverage and delivery through antenatal care and immunization programmes

Although antenatal care and immunization programmes target specific groups, the use of LLINs makes it possible to achieve full population coverage through these channels. The provision of one LLIN per infant and one per pregnant woman would result in nine LLINs distributed per 100 people per year, assuming five pregnancies and four infants annually per 100 people in the total population in most malaria-endemic countries. If the LLINs have a useful life of 5 years and each LLIN is used by two people, 90% of the population would be covered at the end of 5 years.

In reality, however, there will be losses of LLINs due to tearing and diversion; moreover, the coverage of antenatal care and immunization services is below 100%, and most currently available LLINs do not last for 5 years. To achieve high LLIN coverage quickly, most countries will have to provide additional LLINs through, for example, measles or polio immunization campaigns. If campaigns that include LLIN delivery take place every 4 years, this strategy – in combination with delivery through antenatal and immunization services – will provide full population coverage in 4–5 years, provided that LLINs are effective for 5 years. With LLINs lasting 3 years, coverage rates would be between 39% and 75%, and additional distribution mechanisms would be needed. This indicates the significant advantage of LLINs that last 5 years compared with those that last only 3.

Countries can reach their short-term targets for LLIN coverage through such integrated approaches. Combined efforts may have a synergistic effect. Experience to date indicates that ITN/LLIN distribution stimulates demand and increases coverage for vital immunization and antenatal care services.

4.2 Experiences with commercial and social marketing, cost-recovery, service charges and vouchers/coupons

4.2.1 Commercial marketing

In a number of countries, more nets have been delivered through the commercial market than by other mechanisms; in Sahelian

countries which have a strong tradition of using nets, there is even evidence that commercial availability can lead to relatively equitable distribution (*18*). However, most of these nets are not treated, and there is no evidence that high coverage of insecticide treatment can be achieved through commercial channels. Indeed, the commercial market may be problematic for LLINs: genuine LLINs are more expensive than the untreated nets widely available on the retail market, while counterfeit LLINs, at a lower price, could easily become widespread through commercial channels.

4.2.2 Social marketing

Social marketing approaches to delivering ITNs have evolved to include a variety of distribution mechanisms, including the use of existing commercial channels, subsidized commercial channels and public health facilities, as well as promotion campaigns. Social marketing has been part of a multi-pronged strategy to deliver ITNs to pregnant women through antenatal care and to the general population through a combination of community-based and private sector distribution, the latter mainly in urban centres.

4.2.3 Cost-recovery and service charges in public services

Public-sector delivery has in the past applied cost-recovery or partial cost-recovery, also known as cost-sharing. In most settings, cost-sharing schemes have varied in their success in achieving high coverage and have been generally more effective in urban than in rural areas – resulting in socioeconomic disparities in coverage.

Delivery of ITNs completely free of charge has worked well for pregnant women through antenatal care in Kenya (*19, 20*) as well as among rural Kenyan children through complimentary approaches (*21*), and with immunization campaigns in Ghana (*22*), Niger (*23*) and Togo (24). To improve motivation and the quality of implementation, health staff in some countries are allowed to apply a small service charge for delivering ITNs. Such a charge should be low enough for end-users to afford and high enough to be an incentive for health workers to deliver ITNs to target groups, give necessary information and manage ITNs well. The advantage of service charges over cost-

recovery is that administration is easier, as the funds should stay in the health facility. However, service-charge systems require precise regulation, direct communication from the programme to the end-users, and effective supervision.

4.2.4 Vouchers/coupons

One way of delivering LLINs is by providing the target population with vouchers or coupons that can be exchanged for goods at commercial retail outlets, either free or at heavily subsidized prices. As commercial demand and the commercial market are strengthened in this way, the burden on the public health system of distributing ITNs, including LLINs, and of all the associated logistic and management tasks, is significantly reduced. Although voucher/coupon systems are managerially demanding, and setting them up requires specialized administration, they have been seen as an ideal way for the public sector to target priority groups and ensure that they can afford the LLINs, while simultaneously strengthening the commercial sector to improve sustainability. The level of subsidy for vouchers/coupons ranges from 40% to 100%.

While there have been several pilot schemes for delivery to pregnant women, the United Republic of Tanzania is the only country to have adopted this approach on a national scale to target pregnant women attending antenatal clinics (*25*).

4.2.5 Conclusions

Integration into existing health systems, especially immunization and antenatal care activities, offers a practical solution to distribute LLINs while achieving high and equitable coverage.

1. In countries with low coverage, scaling-up should be achieved by means of free or highly subsidized delivery of LLINs through public services. Important management and health system challenges are involved but the approach makes rapid scaling-up simpler than do the alternatives.
2. Countries that have already achieved relatively high coverage should assess their achievements, especially in terms of coverage, equity and potential for reaching those who have not yet been

reached. Systems and mechanisms that work well in the context of a public-sector led national plan should be maintained while scaling-up to achieve full coverage of the target population.

3. Commercial markets are valuable sources of nets, and this may be increasingly important when long-lasting treatment kits (which would be provided mainly through public services) become available. Where strong commercial markets exist or are developing, they should be encouraged: malaria control programmes should communicate their plans to commercial sector representatives, to allow them to anticipate market growth.
4. The role of vouchers/coupons should be considered in the light of local experience. If a voucher/coupon system has not been built up and shown to be effective, it should be considered only if there is already a viable commercial market and the necessary expertise for establishing a voucher/coupon system is available. In campaigns, vouchers/coupons may be practical temporary tools to facilitate the logistics of bulky ITNs/LLINs distribution.

4.3 Selection of strategies for scaling-up ITN coverage through the use of LLINs

4.3.1 In endemic areas with intense malaria transmission (stable malaria)

1. All pregnant women in the LLIN target population should receive an LLIN as early as possible in pregnancy. Each pregnant woman should be educated about using the LLIN for herself and, if possible, one other person. After delivery, and until the child has its own LLIN, that second person should be the newborn/infant.
2. All infants should receive at least one LLIN. An infant whose mother has not received an LLIN during pregnancy should receive one at the first EPI consultation. In addition, all infants should receive an LLIN when they have completed their vaccination schedule, normally with measles vaccination at 9 months. However, in countries with high measles and low DTP3 coverage rates, the LLIN may be delivered at DTP3 as an incentive. The parent or carer should be taught that the LLIN is to be used by the infant plus one additional person (who may be the mother or another relative but should preferably be another young child).

3. Measles vaccination campaigns, especially follow-up campaigns, should be used as much as possible to deliver LLINs to children under 5 years of age in areas where coverage rates are low. If possible, one LLIN should be given to each child (but not more than two per carer).
4. Other activities that target, for example, remote and underserved populations or people living in complex emergency situations may be used for combined health interventions, including LLINs. The target group may be young children, children and pregnant women, or everybody (at a ratio of 1 LLIN per 2 persons), depending on the conditions. Problems of access may make full population coverage "in one go" more efficient than targeting, but issues of financial resources, logistics, education and follow-up need to be carefully reviewed and planned.
5. If malaria in people with HIV/AIDS is a major problem, the possibility of providing LLINs through services targeting these people should be explored.

Although antenatal care and immunization programmes target specific groups, the use of LLINs makes it possible to achieve full population coverage through these channels in 4 years if LLINs with a useful life of 5 years are used.

Figure 6 provides an algorithm for designing LLIN provision through antenatal care and immunization services which can be applied for a country, a district or an individual mother–child pair.

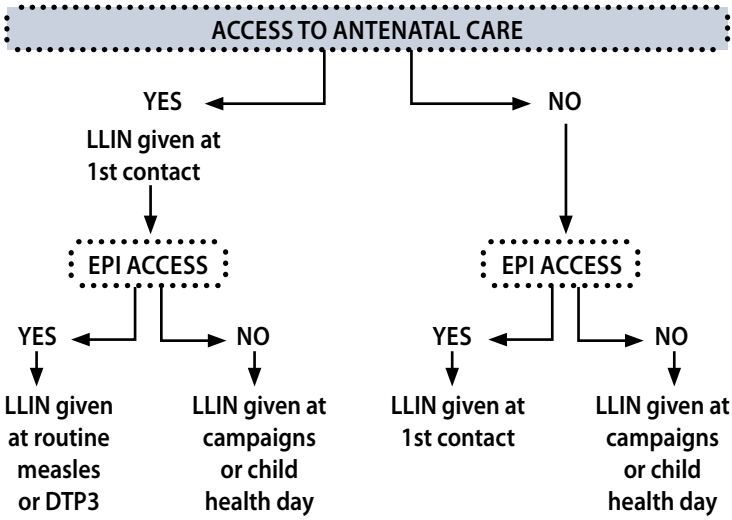
4.3.2 In endemic areas with low malaria transmission

LLINs should be delivered to all people (1 LLIN per 2 persons) within a short period and should focus initially on priority target areas selected on the basis of:

– higher burden of malaria within areas targeted for LLIN implementation (and if practicable),
– limited access to health services.

Phased expansion to protect all target populations in the remaining areas should be undertaken as resources and capacity improve.

Figure 6. **Decision tree for delivering one LLIN per pregnancy at antenatal care plus one per child under 5 years with immunizations**



Many countries with areas of low malaria transmission already have a programme infrastructure that is suitable for IRS, conventional ITNs and LLINs. However, additional resources may be needed to achieve full coverage of the most underserved populations. In relation to these populations, which are often marginalized, malaria control can be a driving force for the development of health services and even for economic development. Within the malaria control programme, the highly "visible" provision of LLINs may be a linchpin for social and political mobilization (*26*).

1. In areas where malaria is an occupational risk (e.g. for forest workers), the programme must be adapted to address the specific population groups concerned and the settings in which they are exposed. It may be necessary to use nets of very specific design, such as hammock nets, and to adopt specific communication strategies.
2. In some areas with moderate transmission, epidemiological data may indicate that young children and pregnant women carry a disproportionate malaria burden. They may then be targeted with the same priority they would have in areas of intense transmission.

SECTION 5

Procurement and logistics

5.1 Procurement

Obtaining and maintaining an adequate supply of LLINs has proved a challenge for most programmes. Procurement of LLINs requires a lead time of between several months and a year to allow for tendering, shipment and customs clearance. Importation procedures are often complex, and availability of funds also plays a part. The long delays in procurement that were experienced during the early stages of LLIN implementation were due to limitations in both the number of producers and initial production capacity. The situation has now improved – there are now more producers and overall production capacity has increased sharply.

Some manufacturers provide regular information on lead times to their distributors and other partners. For routine systems where funding is assured over a period of time, careful forecasting of need and regular standing orders with manufacturers can help in the procurement process.

5.1.1 Sources of LLINs

To ensure the long-lasting efficacy and safety of LLINs, which are an emerging technology, only LLINs that have been tested and recommended by WHO should be purchased. Guidelines, recommendations and specifications on netting materials are published by the Global Malaria Programme and are listed on its web site (http://www.who.int/malaria/itnguidelines.html). Market updates and information on products, manufacturers and prices can be found on the web site of the Roll Back Malaria Partnership Malaria Medicines and Supplies Service (http://www.rollbackmalaria.org/mmss).

The following questions should be used to help make decisions about the sourcing of LLINs:

- How many LLINs will be required to cover the target population or group?
- What are the current sources of WHO-recommended LLINs?
- Are the characteristics of the LLIN (price and durability) in line with the available financial resources and the delivery system adopted or planned?
- What types of LLIN have already been distributed in the target communities?
- What type of LLIN (shape, colour, size, netting material, etc.) would people prefer to use?
- Will more than one type of LLIN be made available?
- From which sources will LLINs be procured?
- Are the services of institutions with central procurement systems to be used?

5.1.2 Ordering systems

Depending on the scope and time-frame of the intervention, ordering of LLINs can be based on bulk purchase, a standing order, or re-ordering at set intervals or in response to demand. The advantages and disadvantages of these methods are summarized in Table 3.

If storage space is available, it is efficient to order the required quantities in bulk from the relevant manufacturers or suppliers. However, if the intervention will continue for an indefinite time period and there is an expectation that the quantity of LLINs will increase over time, it is advisable to make an initial bulk order and re-order in response to demand.

Table 3. Advantages and disadvantages of different approaches to ordering

Bulk buying	
Advantages	Possible economies of scale. Reduced chance of demand exceeding supply (stock-outs).
Disadvantages	Excess of stocks if output is inadequate. Maximum storage space needed.
Standing order	
Advantage	Ensures a regular supply.
Disadvantage	May not be adequate to cope with seasonal fluctuations in demand.
Flexible standing order	
Advantage	Ensures a regular supply that can be decreased or increased according to demand.
Disadvantages	Problematic if poor communication. Supplier may not be able to respond to larger variations.
Order as required	
Advantage	No stockpiling.
Disadvantage	Risk of stock-outs, which can decrease the motivation of consumers and agents.

5.1.3 Ordering through procurement agencies

Some international organizations and NGOs are highly experienced as procurement agents. Partnerships – for example with other national programmes – might enable LLINs to be procured at lower prices. Procurement of LLINs through procurement agencies can have some advantages, including the following:

- It ensures that only good quality LLINs that fulfil WHO specifications will be purchased.
- Quality control is usually carried out by the procurement agencies.
- Procurement agencies are well placed to negotiate lower prices and have easier access to stocks (including their own stocks).
- Procurement agencies can organize shipment more efficiently.
- Some organizations such as WHO and UNICEF enjoy import duty waiver concessions.

5.1.4 Shipping

For international consignments, the following are the principal concerns that need to be addressed:

- duration of sea freight (minimum 2 months);
- congestion at destination ports;
- availability of proper equipment to off-load containers at destination ports;
- adequate storage space at ports;
- length of time necessary for customs inspection and clearance;
- in-country availability of adequate numbers of trucks for transportation; and
- possible problems involved in overland transportation, including distances and likely weather conditions.

If ITNs/LLINs are procured from local manufacturers, logistic aspects must be carefully planned in advance, ensuring that:

- transportation method (air, sea, road or rail) is defined and confirmed when a contract is awarded;
- orders are reconfirmed 1 month before goods are ready for shipment.

5.2 Logistics

As shown in Table 4 below, LLINs have different weight and volume characteristics; the implications of these for storage and transport are discussed in the three subsections that follow.

Those with responsibility for logistics must be able to ensure adequate storage capacity and reliable transport at all levels, as well as precise timing. The timing is critical if LLIN distribution is to coincide with vaccination schedules. The planning of logistics must include, a detailed budget for all transport and storage needs. Most importantly, logistic mechanisms must ensure adequate supervision and control of all operations and full accountability at every stage.

Table 4. Characteristics of LLINs relevant to logistics

Characteristics	Multifilament polyester LLIN (75 den)	Monofilament polyethylene LLIN (> 150 den)
Weight per LLIN	440 g	625 g
LLINs per bale	100	40
Weight per bale	42 kg	29 kg
Volume per bale	0.1727–0.1894 m^3	0.127 m^3
LLINs per 40-ft container	36 900	16 800

5.2.1 Storage

Bales of LLINs are well and securely packed; the nets are essentially non-perishable and are usually individually wrapped in sealed plastic bags. Nevertheless, it is important to ensure that warehouses are clean and dry. Further, as pesticide products, LLINs have limited shelf-life and prolonged storage should be avoided as far as possible.

Bales are relatively easy to handle, being light enough to be moved manually. The principal concern in their storage is thus one of volume rather than weight. The very large volumes involved make it critical that there is adequate storage capacity at all levels.

The tightly packed and tied bales can be stacked several layers high (up to a height of 5 m) without any damage to the bottom layers. In theory, 5.8 bales of polyester LLINs occupy a volume of 1 m^3; in practice, 4 bales/m^3 is a reasonable working figure. Thus, if a warehouse space is 10 m x 20 m with a storage height of 3 m, available volume is 600 m^3, which would accommodate 600 x 4 = 2400 bales or a total of 240 000 polyester LLINs.

Monofilament polyethylene LLINs can be stored at 6 bales/m^3, so that the same warehouse volume of 600 m^3 would accommodate 3600 bales or 144 000 LLINs of this type.

Determination of storage needs is based on annual output target. In the example given earlier, involving a scale-up plan for a population of 1 000 000 (see Table 1), this varied from 55 000 to 134 000 LLINs over a 5-year period. For multifilament polyester LLINs, this corresponds to a storage space of between 138 m^3 and 337 m^3 – relatively modest volumes that should be easy to find in most countries. However, the corresponding volumes needed in countries with populations of, for example, 10–100 million, are not necessarily available.

Storage space can often be rented, but rental costs would then have to be weighed against the possibly greater cost of staggered delivery.

In integrated campaigns, the availability of adequate storage at distribution sites – and often a large number of intermediate drop-off points – must also be considered, and it is critical to ensure that LLINs are in place in time to coincide with immunization activities.

5.2.2 Stock management

Stock management is relatively simple because LLINs are well packed and do not deteriorate physically. Stock management should be based on the "first in, first out" rule, making a methodical approach particularly important when containers are off-loaded in a large warehouse. Bales must be stacked in the same way throughout the operation, to create equal piles each identified by a bin card. Bales must be carefully counted by at least two individuals during off-loading of the containers; this provides a double-check of the quantities indicated on the bills of lading.

Adequate supervision and control of storage operations are essential aspects of logistics, together with full and demonstrable accountability.

5.2.3 Transport

Although LLINs are usually individually wrapped and bales robustly packaged, every transport vehicle must be equipped as a minimum with a tarpaulin for the protection of its loads.

As for storage, the principal consideration in the transport of LLINs is one of volume rather than weight. Travelling on good roads, a typical 25-ton semi-trailer truck can carry the equivalent of the contents of a 40-foot container; correctly loaded, an 8-ton truck can carry 140 bales.

In the example cited earlier, of scaling-up coverage of a population of 1 000 000, the 55 000 LLINs could be handled in two sorties, and 134 000 LLINs in four sorties, by an 8-ton truck, off-loading the required quantities in each district. Critically, this depends on there being adequate storage space in each district for a year's supplies – otherwise, deliveries could be staggered.

At the district level, LLINs could be handled by the logistic mechanisms that are usually an essential component of an EPI integration strategy. Onward transport of LLINs from district level storage to health facilities could be done by the vehicles normally used to carry medicines, vaccines and other supplies within the district – most often bicycles and motorcycles. The coverage achievable in this way is summarized in Table 5.

Initial experiences in some countries indicate that it is possible to transport 4–6 LLINs on a bicycle and 10 on a motorcycle, in addition to a vaccine carrier. Table 5 presents simplified assumptions on the LLINs needed for delivery to infants through routine EPI and to pregnant women through antenatal care. In relation to these needs, the coverage (infants and pregnant women only) that can be achieved for small communities of 1000–5000 using bicycle or motorcycle transport 1–4 times a month has been calculated. Table 5 also indicates sub-district transport requirements for supplying health facilities with catchment populations of up to 20 000 using a four-wheel-drive (4x4) vehicle carrying 150 LLINs.

Table 5. Coverage of infants and pregnant women achievable using bicycle, 4x4 vehicles and motorcycle transport for outreach

Total pop.	Infants (4%)	Pregnant women (4%)	Required LLINs per year	Required LLINs per month	LLIN per type of transport (no.)	Frequency of sessions	Potential achievement (%)
Bicycle (for regular outreach with immunization)							
1 000	40	40	80	7	4	1 / month	60
1 000	40	40	80	7	5	1 / month	75
2 000	80	80	160	13	6	2 / month	90
Motorcycle (for regular outreach with immunization)							
2 000	80	40	160	13	10	1 / month	75
2 000	80	40	160	13	10	2 / month	150
5 000	200	80	400	33	10	4 / month	120
4x4 vehicle (for restocking at sub-district levels)							
10 000	400	400	800	200	150	quarterly	75
15 000	600	600	1200	300	150	quarterly	50
20 000	800	800	1600	400	150	quarterly	38

NOTES 1. Weight of one LLIN = 650 g approximately.

2. Assumptions for carrying capacity:
   - one person with bicycle and vaccine carrier can carry 4–6 LLINs weighing 2.6–4.0 kg
   - one person with motorcycle and vaccine carrier can carry 10 LLINs weighing 6.5 kg
   - a 4 x 4 vehicle with mobile team members and vaccines and equipment can carry 150 LLINs weighing 97.5 kg

SECTION 6

Communication strategy

6.1 Introduction

Effective communication is essential to ensure that LLINs are provided to, and properly used by, the target populations. Key areas of knowledge and aspects of behaviour vital to LLIN programming include the following:

- recognition of malaria risk groups when relevant for the programme objectives and strategies, and hence prioritization of these risk groups for LLIN use;
- transmission of malaria is by night-biting mosquitoes;
- where and how LLINs may be accessed;
- the multiple benefits of sleeping under LLINs;
- the role of LLINs, in terms of both personal protection and their mass effect, in malaria prevention and control;
- the importance of proper hanging of LLINs and of sleeping under them every night;
- advantages of LLINs over conventionally treated nets; and
- how and when LLINs should be washed.

Essential practical information regarding LLINs should be disseminated, in local languages, as frequently as possible through mass media (television, national and local radio channels). The messages given out should concern the availability, regular use and washing of LLINs. For example:

- Protect your health – every family member should sleep under an LLIN every night.
- Who should get LLINs, when and where?
- Should the LLIN be free? If not, how much should it cost?

- Do not wash your LLIN more than 4 times per year. Wash it gently in soapy water without prolonged soaking.
- Washing progressively reduces the power of LLINs against mosquitoes.

Communication of these messages before, during and after distribution of LLINs is essential. New practices will rarely be adopted without extensive communication and advertising efforts, repeated frequently over a prolonged period of time.

6.2 Essential components of a communication strategy

Development of a communication strategy for LLINs should first identify the content of the strategy, the target audience for the strategy, and the difference that will be made by reaching that audience. The communication tools, channels and methods should then be defined, including possible cross-linkages and programme efficiencies. Monitoring and evaluation tools and methods for assessing the effect of the communication activities should be developed and implemented, and should extend beyond simply counting the number of radio spots broadcast or leaflets produced. Multi-channel approaches will maximize the reach of the strategy.

6.3 Communication techniques and channels

Maximum effectiveness relies on the use of multiple communication techniques, including interpersonal and participatory communication, supported by repeated mass communication: individuals, households and the community in general should be involved, as well as health services, policy-makers and partners.

6.4 Participatory communication

Communication within and between households is important so that individuals have an opportunity to discuss malaria prevention, including LLINs, and treatment behaviours and how they can be adopted within a specific cultural and socioeconomic setting.

Effective communication between households and health professionals is also important, so that new information about LLINs can be integrated into the knowledge base of the community. It is also important that community members are aware of their options, for example, that pregnant women can receive a free LLIN during antenatal care visits, or through outreach services arranged at a time and a place which best suits the community members.

6.5 Interpersonal communication at service delivery level

Health workers at health facilities and community health volunteers should provide key information during one-to-one encounters – especially when treating patients with malaria and during antenatal care and EPI attendance. Additionally, health talks can be given to small groups, especially those waiting for health services; pre-recorded audio and video tapes may be used in this context and demonstrations, e.g. of the correct way to hang LLINs, can be extremely useful.

Existing materials, such as flipcharts, guidelines, leaflets and flash cards, should be adapted as necessary to support interpersonal communication within the context of an integrated curriculum for training health workers in malaria treatment and prevention. Interpersonal communication should be included in the general training package for health workers to help them to improve their client management skills.

6.6 Mass media communication

Mass media approaches, including radio, posters and newspapers, should be used to amplify key issues and stimulate discussions at community, district and national levels. The development of appropriate messages and materials remains an essential element of any communication strategy for LLINs.

A survey on the reach and coverage of the various communication channels – radio, television, newspapers, etc. – is recommended. This will help in the selection of the channels to be used. Material development and design will include the following stages:

- Design. Messages and materials should be created in partnership with community members, in a participatory process. Key messages generated in this way will then be subjected to a national technical review by a communication task group made up of health authorities and partners.
- Pretesting. Once drafted, all materials will be pretested at community, health facility and national levels; the comments generated will be reflected in the final products.
- Broadcasting

– Radio is often the primary medium used because of the breadth of its reach and its cost-effectiveness. Airtime can be arranged on stations listened to by the target audience and broadcasts scheduled for the times of day that they listen. Radio serial dramas can be a most effective means of delivering messages about behaviour change.

– Television spots and mobile video vans. Although the reach of television is relatively limited in endemic countries, television spots can have a significant influence on key decision-makers. Additionally, programmes can be broadcast through mobile video units travelling from place to place, at schools, markets, festivals and other public gathering places. Video is most effective when it is accompanied by an educational/promotional presentation and interaction with an audience.

On both radio and television, popular and trusted personalities can be used to reinforce messages.

- Informative print materials such as signs, posters and billboards are used to identify LLIN distribution points, including antenatal care and EPI facilities. Brochures and leaflets can provide simple information on priority groups, how to hang and look after an LLIN, etc., and these can be taken home from the distribution point by community members. Health workers in health facilities can use these materials to help teach families how to use LLINs.

The quantity of materials to be produced should be sufficient to cover the entire target population and will be determined by the number of outlets and communities.

A distribution plan should include development of a distribution list of partners, indicating the quantities of material they should

receive. With a view to improving future materials and messages, feedback should be sought on the effectiveness of these materials in changing knowledge and behaviour.

6.7 Political advocacy

Political advocacy programmes target political leaders, ministers and key decision-makers in an effort to ensure that malaria is placed firmly on the development agenda and that a favourable political environment is created. To be effective, advocacy must be sustained and repeated – regularly and over a prolonged period. Advocacy efforts often focus on malaria days and weeks but may also rely on person-to-person communication, small meetings and visual presentations.

SECTION 7

Micro-planning

Micro-planning is the process whereby central level managers work together with health workers at intermediate and service delivery levels to answer the following questions:

- What services and related activities can be implemented over a year in an effort to achieve the objectives of a national plan?
- Who will do what, when and where, with what resources and in collaboration with whom?
- What does the periphery need from the centre in order to deliver the agreed services and activities?

In the early stages of a programme, the involvement of central-level managers is intense; as programmes mature, a more "hands-off" approach should be adopted so that the focus can shift to monitoring and early detection of problems.

7.1 Combining LLIN delivery with antenatal care and EPI

7.1.1 Micro-planning at national level

Programme partners (antenatal care and EPI) should be consulted when an outline scale-up plan is prepared. This plan will be based on the aim of "saturating" antenatal care and EPI services with LLIN delivery over a period of 1–3 years. Phasing is normally district by district: in the initial phase, the "easiest", i.e. most manageable, districts could be selected, but more problematic districts should be included as soon as possible.

Current and projected coverage rates of antenatal care and EPI in the districts that will be involved year by year will determine the quantities of LLINs to be delivered annually to each district. These figures can also be the basis for procurement provided that adequate storage space has been secured at central level.

The main training and communication materials and management instruments to be used should be drafted early in consultation between the programmes involved, so that they can be discussed during district-level micro-planning. These materials include, as a minimum:

- training material for staff delivering LLINs (trainer's and trainee's modules);
- communication materials; and
- tools for supervision and monitoring.

7.1.2 Micro-planning at district level

The quantities of LLINs to be delivered to each district and the delivery schedules must be refined by micro-planning at district level.

Visits to a few districts

In many countries there are too many districts to allow the central-level malaria control team to visit all of them for micro-planning before activities start. Visits by malaria control staff together with antenatal care and/or EPI staff to two or three districts should then be arranged. A checklist should be prepared before the visits, covering such activities as the following:

- review of maps of the district indicating health facilities and catchment populations, including demographic information used for antenatal care and EPI;
- checking the antenatal care and EPI coverage rates by sub-district or health facility;
- checking the staffing situation for antenatal care and EPI;
- checking the availability of transport to the district, between health facilities and for outreach;
- checking that storage space is adequate for planned volumes – 6 months' or a year's supplies, for example:
  - ◊ checking monitoring and supervision systems with antenatal care and EPI colleagues;
  - ◊ mapping health partners to ascertain who does what, where and how, with what resources?

Meetings should be held with key district health staff, including those responsible for antenatal care and EPI, and possibly with partners, to determine:

- output targets per health facility;
- the staff who will be involved;
- training and communication;
- transport: vehicles, maintenance and fuel;
- service charges (if no policy has been established) – cost of LLIN, management of service charges;
- training materials, monitoring/supervision instruments and communication materials that have been drafted.

In addition, one person should be designated as the district LLIN supervisor. If there is someone who is already responsible for malaria, he or she will be the logical choice; otherwise, the best option may be to add responsibility for LLINs to the duties of a district EPI manager or other reliable administrator.

These various elements must then be built into an activity plan that covers the budget, commodities to be delivered, timelines, milestones, targets and monitoring. This plan must be finalized during the meeting, submitted for approval according to local administrative practice, and communicated appropriately, for example to the local authorities.

7.1.3 Workshop for district-level staff

The experiences from a few districts should be used as a basis for designing a workshop for representatives of all the districts to be involved in the first year. Workshop participants and facilitators should be identified and the representative of each district must be advised of the data and information that they should bring to the workshop. District micro-plans should be drafted during the course of the workshop.

7.1.4 Consolidating national planning

On the basis of district level micro-planning, central-level supervision and monitoring needs including staffing, training (of trainers) and

transport – should be defined. The national plan for scale-up of LLIN coverage through antenatal care and EPI will then be a distillation of all plans for district level, intermediate level (if applicable) and central level. It should include a timetable and a budget, be submitted for approval by relevant departments of the ministry of health, and shared with relevant partners.

7.1.5 Decentralizing

As experience and skills accumulate in the health system, responsibilities for planning and management should be devolved to district level. In larger countries, the intermediate level may be particularly important at this stage. Local authorities and communities should be involved as much and as early as possible in stewardship. It may often be possible to broaden the terms of reference of other bodies, set up, for example, for AIDS programmes or immunization, to include malaria as well.

7.2 Combining LLIN delivery with immunization campaigns

Many of the principles of combining LLIN delivery with immunization campaigns are the same as those of combining delivery with antenatal care and EPI, except for a greater need for precision: all supplies and trained staff must be in the right places, countrywide, by the target dates agreed with the immunization programme. Countries with no previous experience of organizing "measles and malaria" campaigns are advised to seek technical collaboration or assistance, for example from WHO, UNICEF or the International Federation of Red Cross and Red Crescent Societies.

7.2.1 Checklist for planning

National-level preparatory steps

❖ **9–12 months before the campaign**

- Hold national planning meeting or workshop to:
  - discuss objectives and expectations with malaria and immunization stakeholders;
  - obtain commitments for resources, technical support, etc.;

– decide on where, when and how each stakeholder will contribute to planning and implementation of the campaign.

- **Develop a fully costed national work-plan for the integrated campaign:**

– the work-plan and budget must be finalized no later than 9 months before the beginning of the planned campaign.
– the plan should be itemized by functional areas, e.g. procurement, logistics, training, social mobilization, advocacy.
– the work-plan must have specific, measurable, time-limited and realistic objectives.
– the LLIN target population must be decided upon, its size determined and selection criteria agreed.
– specific tasks must be fully detailed, e.g. number and type of documents needed for training and advocacy, details and budgets for planned training sessions for volunteers (e.g. training on micro-planning, criteria for LLIN deployment at distribution points).

- **Prepare/place orders for LLINs no later than 9 months before the start of the campaign and preferably earlier. Decisions must therefore have been reached on:**

– the type of LLIN and the number to order;
– the type of distribution strategy to be adopted.

- **Distribute guidelines for district-level micro-plans to all target districts.**

❖ **6–9 months before start of campaign**

- Hold a second stakeholder meeting to assess progress.
- Set the training schedule: training of trainers workshop.
- Develop advocacy and social mobilization strategies, and submit budget requests.
- Distribute funds for training, advocacy and social mobilization to subnational focal points.

❖ **1–4 months before start of campaign**

- Complete all training sessions for volunteers and health workers.
- Implement national advocacy strategy.
- Follow-up procurement and logistics closely.

Subnational tasks to prepare for campaigns

❖ **9–12 months before start of campaign: start district micro-planning**

- Determine target population and LLIN needs and communicate these to national level.
- Identify migratory and displaced populations and any potential population movements (normal cross-border movements, migration for farm-related work, etc.).

- Identify local operational difficulties, e.g. inaccessible communities, poor local demand for LLINs, areas of civil unrest.
- Establish administrative focal points in each district and community.
- Determine the number and location of vaccination and LLIN distribution posts.

❖ **7–9 months before start of campaign: write up micro-plans and resource requirements**

- Finalize the number and composition of local teams for each vaccination and LLIN distribution post (in close collaboration with EPI district management).
- Determine the number of supervisors required.
- Quantify local resource needs (per-diem payments, transport, logistic support, etc.).

❖ **1–6 months before start of campaign: district micro-plans finalized**

- Volunteers and staff trained.
- Resources mobilized and remaining gaps identified.
- Each team for a vaccination/LLIN post trained on how to deliver LLINs (including eligibility criteria, post set up, recording, etc.).
- Tally sheets for LLINs distributed (recording, for example, number of children and/or carers receiving LLINs).
- Checklists for supervision and itineraries for visiting vaccination/LLIN delivery posts developed by supervisors.
- Local secure storage sites for LLINs and/or vouchers established.
- Social mobilization and communication plans.

During campaigns

Subnational issues

- Supervision:
  - supervisors record time of visit to each post and note any problems/issues identified;
  - problems arising from the LLIN distribution policy are monitored.
- Record keeping:
  - number of children and/or carers receiving LLINs and/or vouchers recorded;
  - any LLIN stock-outs recorded together with corrective actions taken by supervisors.

National issues

- Help assess and respond to unforeseen events.
- Maintain communication strategy to ensure maximum turnout by population.

After campaigns

Subnational issues that might be assessed through surveys

- Evaluation of operations:
  - assess adequacy of number of sites, volunteers, health care workers, supplies, etc.;
  - assess adequacy of local social mobilization efforts;
  - assess coverage: were district targets reached?
  - community health education: was adequate information given on proper use and care of LLINs?

National issues

- Evaluation:
  - collate and analyse LLIN stock-outs and other operational problems;
  - assess social mobilization and advocacy strategies: were targets met?
  - finalize plans for household survey to assess LLIN ownership and use by target populations;
  - share lessons learned and best practices with all districts;
  - Health Management Information System (HMIS): what should/can be collected in a HMIS to improve data quality.
- Campaign guideline revision. Use experiences to revise:
  - national guidelines for subnational training, support of micro-planning, etc.;
  - training for district-level health workers;
  - national advocacy strategy;
  - social mobilization strategies.

7.2.2 Cost implications, pre-planning and planning stages for integration of LLINs with immunization campaigns

All additional costs related to combined LLIN distribution (e.g. materials, managerial expenses, logistics, advocacy, community mobilization and evaluation) should be borne by the malaria control programme. Integration of LLIN distribution should be part of the EPI district micro-planning process, starting 6 months before the SIA target date. Timelines for immunization supplies must also be applied for LLINs: thus, all supplies should be cleared through customs and available to the programme 1 month before the SIA target date at the latest.

7.2.3 Matching number of vaccination targets to number of LLINs

Within the integrated approach, the deployment strategy can be either one LLIN per child or one LLIN per carer; typically, there will be 60% as many carers as children. In a country where ITN coverage of children under 5 years of age is less than the target of 60%, the deployment strategy for malaria control should preferably be one LLIN per child: since the number of eligible children is known, this strategy simplifies micro-planning.

Where the strategy is one LLIN per carer, the number of carers can only be estimated. Nevertheless, no more than two LLINs per carer should be given, because distribution of LLINs may reach a large number of children aged 5 years and above. This strategy is preferred when funding is insufficient to provide one LLIN per child or the existing LLIN coverage is higher than 50%.

7.2.4 Reserve stock

A reserve stock of LLINs – usually 10% of the required number, but 15% in remote locations – is essential at each vaccination point to compensate for underestimation of need or deliberate over-presentation by the population. This is particularly true for the strategy of one LLIN per carer. At locations that are easily accessible, it may be more cost-effective to hold part of the reserve stock in the form of 100% redemption vouchers/coupons: reserves of actual LLINs are needed mostly in places where it is difficult for the population to redeem the vouchers. After the campaign, vouchers/coupons could be redeemed at temporary local facilities set up in the areas where they are needed and located so that carers have to travel no more than 5 km distance in order to redeem their vouchers/coupons.

7.3 Other strategies for delivering LLINs

Other strategies for the delivery of LLINs are usually simpler by virtue of not being combined with other health programmes. Many countries already have their own relevant experience to build on; for

them, this manual will provide guidance principally in the following areas:

- (possibly) the introduction of LLINs;
- precise definition of the LLIN target populations; and
- precise calculation of output targets and the application of a new monitoring system (see Section 8).

Since the LLIN programme should aim for full population coverage, for many countries with endemic high transmission it will be rational to undertake campaigns that provide one LLIN per two people in all age-groups as a means of reaching the poorest and most underserved populations.

SECTION 8

Monitoring and evaluation

8.1 Introduction

The purpose of programme monitoring is to make timely, accurate and relevant information available to providers and managers at all levels as a means of assessing progress against targets and detecting problems, so that remedial action can be taken.

This monitoring and evaluation framework focuses on monitoring of the programme elements outlined below. The indicators are those shown in the table and described in detail in Annex 2.

Monitoring category: OUTPUTS

Issue to be addressed	Methodology
Does the programme deliver adequate numbers of LLINs to end-users on time (indicators 1, 5 and 6)?	Management information from peripheral level
Are these LLINs retained by the people to whom they are delivered (indicator 2)?	Population surveys
Is the distribution in the population equitable (indicator 3)?	

Monitoring category: OUTCOME (COVERAGE)

Issue to be addressed	Methodology
Do the end-users use the LLINs (indicator 4)?	Health facility data experimentally for pregnant women and infants
Has the target coverage been reached?	

Process indicators (output) are defined only for LLINs, because this manual is concerned only with scaling-up of this type of net.

8.2 Process monitoring at central level

8.2.1 Monitoring delivery against need of total population

The monitoring framework is designed to compare output (delivery of LLINs) with the quantitative needs of the target population. This will ensure that performance indicator data are comparable between countries, between areas and over time; however, such comparisons should supplement, rather than replace, comparison of actual outputs with those planned for a given time-period.

For determination of the needs of populations with normal age-group distribution, it is assumed that two persons can generally use one LLIN. The stationary LLIN need, which is the number of LLINs that must be present in a given population for full coverage is therefore equal to LLIN target population divided by 2. This number is of course not truly "stationary" but increases with population growth.

The number of LLINs delivered is defined as those handed over to end-users – persons who will sleep under them or carers (usually mothers). The data should be obtained from health services, including those managed by partners, using tally sheets and forms for monthly summaries (see Annex 3, "Instruments for monitoring"). If vouchers/coupons are used, it is the number redeemed against LLINs that corresponds to LLINs delivered. Data from the commercial sector should be included if possible, but only for LLINs sold to end-users who are part of the target population.

The LLIN delivery gap is the number of LLINs that still need to be delivered at a given point in time for the population to be fully protected. Before any LLINs are delivered, the LLIN delivery gap is equal to the stationary LLIN need. Immediately after delivery, the LLIN delivery gap is equal to the stationary LLIN need minus the quantity delivered. Once delivered LLINs reach the end of their useful life (*x* years), they no longer count. The delivery gap is therefore calculated as follows:

LLIN delivery gap =
stationary LLIN need – number of LLINs delivered less than *x* years ago.

It is assumed that all LLINs delivered to the population are immediately taken into use and that they need to be replaced at the end

of their useful life. The essential concept is the LLIN delivery gap, the number of LLINs that still needs to be delivered, for the population to be fully protected. Further LLIN delivery needs to ensure that enough LLINs are available to allow for full replacement of LLINs after 3 or 5 years.

As described for Indicator 2 (see Annex 2), the delivery gap is calculated at the beginning of a year. Table 6 (a continuation of Table 1) shows how the output indicator will behave in a programme using LLINs with a useful life of 3 years, provided that the programme adheres strictly to a plan for gradual scale-up. It can be seen that the delivery gap (Dg = LLIN delivered less than 3 years before) decreases as population coverage increases, and that the indicator – proportion of LLINs delivered against total needed – gradually increases towards 100%. When 100% coverage has been reached, and is maintained, the value of the indicator should be 100%.

Example 1

If the target population is initially 1 000 000, the annual population growth rate 2.5% per annum, the useful life of the LLINs in question 3 years, and the outcome targets are as indicated in section 3.3, the output targets are calculated as shown in Table 6.

In year 3, for example, we have:

c_1 (number of persons to be covered by end of year 3) =

population at end year 3 x coverage target =

1 076 891 x 70% = 753 823

c_0 (number of persons covered at end of year 2) =

population at end of year 2 x coverage target =

1 050 625 x 40% = 420 250

The increase in the number of people to be covered over the year is $(c_1 - c_0)$ and the LLINs needed to cover them ("to expand") is $(c_1 - c_0)/2$ = 166 787

We need to add e = LLINs needed to replace = number of LLINs delivered 3 years before = output target of year 0, 55 000, and arrive at "LLINs needed" = $(c_1 - c_0)/2 + e$ = 221 787. To cover the possible 10% loss, we multiply by 1.1 and find: output target for year 3, $t = ((c_1 - c_0)/2 + e) \times 1.1$ = 243 965

Table 6. Proportion of LLINs (useful life 3 years) delivered against total needed

VARIABLE	CALCULATION	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Population	Increase 2.5% p.a.	1 000 000	1 025 000	1 050 625	1 076 891	1 103 813
Stationary net need	Population/2	500 000	512 500	525 313	538 445	551 906
Annual need	Population/2/3	166 667	170 833	175 104	179 482	183 969
Coverage target (%)	Decided by programme	10%	20%	40%	70%	80%
Persons to be covered	c = (population) x coverage target (%)	100 000	205 000	420 250	753 823	883 050
LLINs needed to expand	$(c_1 - c_0)/2$	50 000	52 500	107 625	166 787	64 613
LLINs needed to replace	e = LLINs delivered 3 years before	0	0	0	55 000	57 750
LLINs needed to achieve coverage targets	$(c_1 - c_0)/2 + e$	50 000	52 500	107 625	221 787	122 363
Output target	$t = ((c_1 - c_0)/2 + e)$ x 1.1	55 000	57 750	118 388	243 965	134 600
Delivery gap, *Dg*	*Dg* = stationary net need (LLINs delivered less than 3 years before)	500 000	457 500	412 563	362 308	189 554
Output target/ delivery gap[a]	t/Dg (%)	11%	13%	29%	67%	71%

[a] Indicator 1: proportion of LLINs delivered against total need.

Table 7. Proportion of LLINs (useful life 5 years) delivered against total needed

VARIABLE	CALCULATION	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Population	Increase 2.5% p.a.	1 000 000	1 025 000	1 050 625	1 076 891	1 103 813
Stationary net need	Population/2	500 000	512 500	525 313	538 445	551 906
Annual need	Population/2/5	100 000	102 600	105 063	107 689	110 381
Coverage target (%)	Decided by programme	10%	20%	40%	70%	80%
Persons to be covered	c = (population) x coverage target (%)	100 000	205 000	420 250	753 823	883 050
LLINs needed to expand	$(c_1 - c_0)/2$	50 000	52 500	107 625	166 787	64 613
LLINs needed to replace	e = LLINs delivered 5 years before ($t-5$)	0	0	0	0	0
LLINs needed to achieve coverage targets	$(c_1 - c_0)/2 + e$	50 000	52 500	107 625	166 787	64 613
Output target	$t = ((c1 - c0)/2 + e) \times 1.1$	55 000	57 750	118 388	183 466	71 074
Delivery gap, Dg	Dg = stationary net need (LLINs delivered less than 5 years before)	500 000	457 500	412 563	307 307	137 302
Output target/delivery gap[a]	t/Dg (%)	11%	13%	29%	60%	52%

[a] Indicator 1: proportion of LLINs delivered against total need.

Table 7 provides similar details for LLINs with a useful life of 5 years.

Table 8 shows how this indicator would work in implementation if the programme were to run into certain difficulties and be unable to deliver as planned for some years; however, it is intended only as an example – obviously, programme managers will use their own data. In the example below, the actual output, through programme monitoring, remains relatively lower than the planned output. Therefore, the delivery gap does not decrease as much as it should (i.e. as it does in Table 6).

The last line shows the number of LLINs delivered as a proportion of the planned figures. This indicator may be misleading when viewed in isolation: the 134% for LLINs delivered relative to plan in year 4 reflects only that the programme is trying to catch up after having suffered some delays. In reality, a programme would probably re-plan its input and output targets annually, so that the indicators of implementation against plan will have values below 100%. This indicator is essential for short- and medium-term management, but it does not reflect progress in relation to long-term targets.

Example 2

Example of calculation in Table 8: in year 3, the stationary LLIN need is 538 445. The number of LLINs delivered less than 3 years before is 55 000 (in year 2) plus 60 000 (in year 1) = 115 000; subtracting 115 000 from 538 445 yields 423 445, which is the actual delivery gap for year 3 below. Note that the LLINs delivered 3 years before need to be replaced in the year in question and should therefore not be subtracted in the calculation of the delivery gap.

It is recommended that programmes also monitor inputs, i.e. number of LLINs acquired, and compare this figure with the delivery gap. The monitoring of inputs is important – an inadequate input is an early warning sign, and continued low outputs in the face of high inputs point to implementation bottlenecks. Number of LLINs acquired should be defined as the number of LLINs that enter into the possession of the NMCP and its partners in a given year. However, it is more complicated to define a denominator for an input indicator

Table 8. Monitoring actual delivery in relation to delivery gap and annual plan

VARIABLE	CALCULATION	YEAR 0	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Population	Increase 2.5% p.a.	1 000 000	1 025 000	1 050 625	1 076 891	1 103 813
Stationary LLIN need	Population/2	500 000	512 500	525 313	538 445	551 906
Output target	$t = ((c_1 - c_0)/2 + e)$ x 1.1	55 000	57 750	118 388	243 965	134 600
Delivery gap, *Dg*	*Dg* = stationary LLIN need $(t_1 + t_2)$	500 000	457 500	412 563	362 308	189 554
Output/delivery gap*	*t/Dg* (%)	11%	13%	29%	67%	71%
Actual output, A	*A* (monitoring data)	50 000	60 000	55 000	130 000	180 000
Actual delivery gap, *ADg**	*ADg* = stationary LLIN need LLINs delivered less than 3 years before	500 000	462 500	415 313	423 445	366 906
Actual output/actual delivery gap	*A/ADg* (%)	10%	13%	13%	31%	49%
Output/plan	*A/t* (%)	91%	104%	46%	53%	134%

[a] Indicator 1: Proportion of LLINs delivered against total needed.

than for an output indicator, because it would be necessary to include data on LLINs in stock and in the population; monitoring of inputs has therefore not been included in this framework.

8.2.2 Outputs related to priority population groups

Pregnant women and children reaching the age of 12 months emerge at relatively constant and well documented rates in most target populations. These rates therefore provide highly convenient and accurate denominators for delivery to these two groups.

Pregnant women

When a country has a policy for delivery of LLINs to pregnant women in the target population, it should apply Indicator 5, Proportion of pregnant women in target population receiving an LLIN. The definition and calculation of the indicator are simple. In most programmes with pregnant women as a priority group, maintaining the value of this indicator at 100% will be a long-term objective. For better understanding of the situation of the programme, the value of this indicator should be compared with the percentage of pregnant women having at least one antenatal consultation. This will make it possible to assess the extent to which non-attainment of the 100% level is due to limited coverage of antenatal care and the extent to which it is due to insufficient delivery through the existing antenatal care network.

Children under the age of 5 years

A policy of providing young children in the target population with LLINs is usually implemented through campaigns – especially in combination with measles vaccinations – or in combination with routine immunization (EPI).

Implementation through routine immunization/child health activities should in the long term aim at delivery mainly to infants. Delivery to infants can be monitored by Indicator 6, Proportion of infants in the target population receiving an LLIN, and the value of this indicator should be compared with the proportion of young children fully immunized.

8.3 Process monitoring at peripheral level

8.3.1 Health facility level

Monitoring is essential at all health facilities from which delivery takes place. The data required concern delivery and stock management. Examples of the forms to be used are provided in Annex 3 (Forms 1 and 2).

Delivery

Delivery of LLINs should be monitored daily by the use of tally sheets. When delivery is targeted to villages, a daily tally sheet should be completed for each village and should include:

- village (name),
- health facility responsible,
- district,
- date,
- total population,
- number of households,
- number of LLINs delivered.

Form 1 should be used when delivery is made through routine child immunization or child health services; Form 2 should be used when delivery is effected through antenatal care services.

Stock management

Stock management is simple but crucial. The data acquired are self-explanatory and form part of the monthly report (Annex 3, Form 3). All entries and exits, with associated dates, should be recorded in a ledger or logbook and should be reconciled with a monthly check of the stock. In addition, the dispatch notes from the unit that provided the LLINs should be kept in a binder. Whenever LLINs are received into the health facility stock, a confirmation of receipt form is completed by the health facility's LLIN stock manager and sent to the stock manager at the district (or other) level that supplied the LLINs. Every time LLINs are provided to a service (antenatal care, immunizations, child health days), a confirmation of receipt form

must be completed and signed by the person receiving the LLINs on behalf of that service and kept in the binder.

Use of data at the health facility

The catchment populations of health facilities are not usually sufficiently well defined to allow population-based monitoring. Nevertheless, data should be assessed monthly as described for the district level (Form 4). Monitoring at health facility level should always include:

- comparison of monthly output (per service) with planned output (which can be done as a graph);
- quarterly check of stock management by the person responsible for the health facility in collaboration with the person responsible for financial matters.

Monthly reporting

All data on delivery and stock management should be consolidated on the monthly report from the health facility (Form 3). Most malaria-endemic countries have an EPI monthly reporting system, with a single page of EPI data being sent from the health facility to the district level each month. Both the required LLIN data and IMCI (Integrated Management of Childhood Illness) data can be integrated into the EPI form, or they can be sent as two pages of one "Integrated Child Survival Monthly Report". Likewise, the tally sheet can be integrated with an EPI (and IMCI) tally sheet.

8.3.2 District and higher subnational levels

In large countries, where districts may have as many as 1 million inhabitants, the rules that follow may be applied at sub-district level.

Delivery

Monthly delivery data are consolidated from monthly health facility reports and, where applicable, from reports and tally sheets applied directly by the district health management using Form 4.

Stock management

Stock management follows the same principles as at health facility level (see section 8.3.1).

Use of data at district level

The monthly data on delivery are compared with:

- planned outputs, using graphs of each month's actual delivery against planned delivery; if no monthly figures exist, then planned annual delivery divided by 12 should be used; and
- delivery gap at the beginning of the year (indicator 1); the cumulated monthly delivery is compared with the year's delivery gap, as shown in Figure 7 and Table 9.

Figure 7. Percentage of delivery gap filled

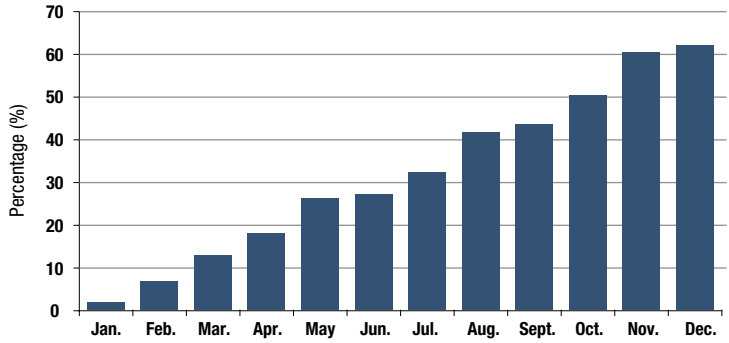


Table 9. Percentage of delivery gap filled

	Delivery gap	Delivery	Cumulative delivery	Delivery gap filled (%)
Jan.	10 000	200	200	2
Feb.	10 000	500	700	7
Mar.	10 000	600	1300	13
Apr.	10 000	500	1800	18
May	10 000	800	2600	26
Jun.	10 000	100	2 700	27
Jul.	10 000	600	3 300	33
Aug.	10 000	900	4 200	42
Sept.	10 000	200	4 400	44
Oct.	10 000	700	5 100	51
Nov.	10 000	1 000	6 100	61
Dec.	10 000	200	6 300	63

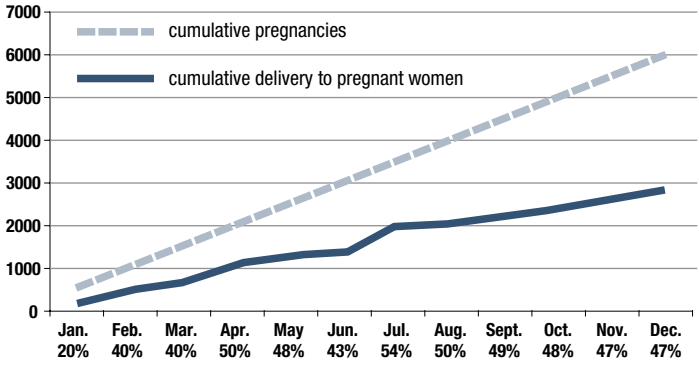
If there is a policy of delivery to pregnant women and infants, the number in each category is compared with, respectively, the number of pregnancies and the number of infants reaching age 12 months using cumulated data by month (see Fig. 8). If possible, the data are also presented as a graph.

As at the health facility level, it is essential that there be a quarterly check of the stock management by the persons responsible for the health facility and for financial matters, collaboratively.

Monthly reporting

All data on delivery and stock management should be consolidated on the district monthly report form (Form 4). The district person responsible prepares a short monthly narrative report analysing and interpreting the data and proposing any changes that he or she feels are needed. The report includes comments on the work of health facilities and is discussed with the district director and possibly the district health committee.

Figure 8. Cumulative pregnancies and LLINs delivered



The monthly report is the basis for action at the district level and may include requests for support from higher levels. When finalized, it is sent directly from the district to:

- the national programme at central level;
- all intermediate health administrative levels; and
- all health facilities participating in the programme.

Using data and "Reaching Every District" components

Wherever possible, LLIN delivery through antenatal care and EPI should be integrated with the efforts of the RED[1] ("Reaching Every District") initiative. The implications are that data should be discussed at all quarterly meetings of the community with health facility staff, monthly meetings of health facility staff with the district team, and quarterly meetings between district staff and provincial staff and between provincial staff and national staff. Child survival data and indicators should be discussed at all supervisory visits and meetings between the community, health facility, district, provincial and national-level staff. Provincial and district supervisory visits provide an opportunity to evaluate the functioning of the information system (e.g. timeliness, completeness of reporting) and ascertain whether the trend graphs are kept up to date.

8.3.3 National and subnational level

Monthly reports from districts to higher levels are consolidated and data are analysed in the same way as at the district level. If there is stock management at subnational level, a monthly report similar to that for district level is prepared and is also sent to all higher levels.

- Every quarter, a consolidated report is prepared at either national or sub-national level, with in-depth analysis of programme progress towards its targets; delivery data are compared with coverage data (including mapping). These quarterly reports are used for decision-making at various levels, particularly in planning procurement, training and education for the following year.
- Data on LLINs are included in the annual report of the NMCP and in other relevant reports as usually applied in the country.

8.4 Monitoring coverage

Coverage of LLINs is usually monitored by representative surveys in the target population, which also provide information on LLIN ownership and retention and on equity of access (indicators 2 and 3). These indicators are generally considered to be output

[1] www.who.int/immunization_delivery/systems_policy/red/en/index.html

indicators, although some may prefer to classify them as outcome denominators because of the way in which they are collected. Innovative and efficient methods have recently been described for obtaining coverage data for young children and pregnant women through questions asked at EPI contacts.

8.4.1 Monitoring coverage by surveys

Surveys for obtaining information on LLIN coverage – corresponding to Indicators 3 and 4 –are well standardized (*27*).

In summary, the standard methods rely on representative sampling within a country, based on census data. Selected households are visited by trained staff who see all mosquito nets in the household, classify them as untreated nets, conventional ITNs or LLINs, and note their physical condition. (As countries move towards reliance on LLINs, it is important that survey staff are familiar with the LLINs used in the country so that they can recognize them.) Household members are recorded by age and socioeconomic status and are questioned to establish whether each member slept under one of the nets the night before the survey.

The surveys thus provide information on ownership and coverage of untreated nets, conventional ITNs and LLINs for the total population, socioeconomic quintiles, and priority groups such as children under 5 years of age and pregnant women. Questionnaires can be adapted to cover other risk groups or risk factors.

Current surveys rarely provide district-specific information. Nation-wide surveys are costly and are generally carried out once every 3 years at most. There is a clear need for collaboration with other branches of the NMCP to ensure that surveys are carried out more frequently and with greater coverage.

8.4.2 Monitoring coverage through questions asked at EPI contacts

In an adaptation of a method piloted in Benin, questions about LLIN use the previous night are asked at EPI contacts DTP1, 2 and 3, and measles. This method is also related to the malaria–IMCI exit interview method piloted in Ghana and Zambia.

Rationale

There are two general ways of gathering information at the health facility and district levels – by population-based method (survey, lot quality assurance sampling) or at health service contacts. Population-based methods (see section 8.4.1) are more representative but are not practical for district teams and health facilities to carry out frequently and regularly. Collecting information at health service contacts is feasible, but the information may not be entirely representative. Gathering information during EPI contacts, however, offers two major advantages:

- As EPI coverage increases, any bias relating to a lack of representativeness is progressively reduced.
- A substantial percentage of children are vaccinated during outreach sessions far from the health facility. When combined with information from EPI contacts at fixed health facility, information gathered at outreach sessions would substantially reduce potential bias related to distance from the health facility.

Coverage questions

Because it is important to take into account the workload of EPI staff, it is proposed that only a maximum of two malaria and two IMCI questions be considered in the first year.

The coverage questions all afford health education opportunities and fit with the paediatric best practice of "anticipatory guidance". In other words, the questions serve as an opportunity to provide essential information about health practices that could reduce severe morbidity and mortality in the coming several months. The questions also help to promote continuous awareness among health facility staff of the importance of LLINs, appropriate antimalarials, oral rehydration therapy, and exclusive breastfeeding.

At the DTP3 contact, the caretaker would be asked if the child receiving DTP3 had slept under an LLIN the previous night.

All the children for whom the question was asked would be tallied. The numbers from the tally sheet would be transferred to the health facility monthly reporting form summing, separately, tallies for static and outreach services. The health facility can then calculate

the coverage for each intervention, for total and separately for static and outreach services.

Numerators and denominators for indicators

To calculate LLIN coverage, the numerator is the number of children who slept under an LLIN the previous night and the denominator is the number of children receiving DTP3 or measles immunization for whom the question was asked.

At the district level, coverage by health facility should be examined and noted. Health facility data would be summed (as for EPI) and included in the district EPI summary reporting form.

Similar methodology can be applied to pregnant women at antenatal care services.

8.5 The supervision, monitoring and evaluation plan

A supervision, monitoring and evaluation plan can be finalized only once the first steps of micro-planning have clarified the following:

- How does monitoring and evaluation work for the current malaria control programme and/or the programmes with which malaria control will collaborate?
- What human resources are available and can be made available for supervision and monitoring at each level of the health system?

In addition, decisions must be made about whether monitoring and supervision at district level will be embedded in the structure of a malaria control programme structure, or whether LLIN monitoring and supervision will be integrated with EPI and/or antenatal care.

Once these questions have been addressed, it is possible to prepare a detailed plan, which must:

– include definition of indicators, design of instruments, and rules for transmission, analysis, interpretation and presentation of reports as well as feed-back;
– identify the human resources needed (and include job descriptions if necessary) to carry out the different functions at different levels as well as recruitment and training;

– include supervision and monitoring as an integral part of the overall LLIN plan;
– specify the frequency and coverage of population surveys, with follow-up micro-planning.

It is essential that the supervision, monitoring and evaluation plan is prepared with a clear calendar of activities and outputs for all health system levels. The continued confidence of the population, the ministry of health, other sectors and partners hinges on timely, solid reporting. The following questions should be addressed:

- Which survey data provide an acceptable baseline on coverage against which to gauge progress?
- Which surveys (e.g. Demographic and Health, Malaria Indicator, or Multiple Indicator Cluster) are planned to provide follow-up monitoring data?
- Which partners (especially scientific institutions) could take responsibility for population surveys?

SECTION 9

Implementation research

Implementation research is expected to cover the technical, operational and managerial constraints related to ITN/LLIN implementation.

Research issues and priorities should be identified jointly by the decision-makers, implementers and the potential researchers. Those involved in management or field activities in particular should draw attention to specific problems that are encountered in the field and problems that are likely to arise and that may warrant investigation. Ideally, and to the greatest extent possible, implementation research must be undertaken jointly by, or with close collaboration between, the implementers and the researchers; if this is not possible, they should at least all participate in planning and in the interpretation of the data collected.

9.1 Insecticide resistance and its operational implications

For reasons of efficacy and safety, only pyrethroid insecticides are currently recommended for the treatment of mosquito nets. However, pyrethroid resistance already exists in some major malaria vectors throughout the world, especially in Africa. Moreover, resistance to a given pyrethroid usually results in resistance to all pyrethroids (cross-resistance). Mosquitoes that carry a specific genetic mutation known as kdr (knockdown resistance) at the target site of the insecticide are resistant not only to all pyrethroids but also to DDT, which acts on the same target site. Resistance may also be due to the presence of modified enzymes or overproduction of specific enzymes that detoxify (degrade) insecticides before they can kill the vector mosquito (referred to as metabolic resistance).

The operational impact of resistance on the efficacy and effectiveness of ITN/LLIN interventions is not yet fully understood. Its magnitude may depend on the insecticide, on the vector species and on the resistance mechanism. Although there is convincing evidence in some parts of west Africa that kdr mutation alone does not reduce the personal protection provided by ITNs/LLINs, more information is needed on its impact on effectiveness under programme conditions. Additional investigations have to be carried out to assess the impact of resistance in vectors of other diseases as well as the impact of metabolic resistance alone or in combination with kdr.

Monitoring of insecticide resistance must be carried out at national level, through a network of sentinel sites, as an integral component of the malaria control programme. Bioassays (test kits available through WHO) are the principal means of monitoring resistance, complimented when possible by biochemical/molecular assays; they are essential to detect resistance and reduction in mosquito mortality. Biochemical/molecular assays are important to identify resistance mechanisms, to measure their frequency in resistant mosquito populations, and to assess trends over time, especially when resistance management tactics are implemented.

9.2 Other topics for implementation research

Other research topics that can be identified within the implementation chain from planning to sustained end-use and maintained efficacy include:

- determinants of use of LLINs by populations and sub-populations;
- determinants of non-use of LLINs;
- preferences for different types of LLINs;
- the duration of LLIN efficacy under field conditions (physical strength, duration of insecticidal activity);
- how LLINs are washed and how frequently;
- how regular use of LLINs can be stimulated, including where there is no noticeable mosquito nuisance;

- use of long-lasting treated netting material for personal protection, e.g. long-lasting treated hammocks for prevention of forest malaria;
- how community-level washing practices compatible with the use of ITNs, including LLINs, can promoted;
- sleep patterns and LLIN use.

SECTION 10

Determining human and financial resources

10.1 Human resources

Once a decision has been reached on the goal of the LLIN intervention, the staffing, training and supervision required for each activity must be assessed. Assessment can be based on the following questions:

- How many staff are required to carry out all the proposed activities?
- How many staff do the various partner organizations have available for these activities?
- Will additional staff be required? By which organizations?
- How many new staff will be needed? What type of skills will they need?
- What training will need to be carried out? Which staff need training? How many staff require training?
- What supervision is needed? For whom? By whom?
- How will supervision be carried out?

10.2 Training

All key participants in the LLIN intervention, including health staff and partners, should take part in training sessions in preparation for implementation. Training for implementation should follow a "cascade" pattern, for instance, central level training the provincial/regional level, provincial/regional level training the district level, and the district level in turn training facility-level health workers. Training approaches should be simple but should strive to address the specific needs of different levels of the delivery system. Training sessions should be as interactive as possible and should include case

studies and exercises as well as group work to stimulate discussion. Plans developed at the national level should detail training needs for different levels, methods and key areas of focus, training and resource materials, the agenda, a "what–who–where–when" framework, and a budget.

10.3 Financial resources

Unit costs for commodities are available from the Malaria Medicines and Supplies Service (MMSS) website (http://www.rollbackmalaria.org/mmss) Sources and Prices. Most programmes have the knowledge and experience to prepare budgets. The costing tool prepared by WHO (see http://www.who.int/malaria/rbmgfatmassistance.html under "Budgeting and Financial Analysis") is useful, both in its entirety as a tool or as a checklist.

Another reference for costing and cost-effectiveness of ITN and IRS Programmes is the standardized methodology used by Yukich et al. in which five ITN and two IRS programmes operating at large or national scale in sub-Saharan Africa were assessed comparatively[1].

[1] Yukich J, Tediosi F, Lengeler C. *Operations, costs and cost-effectiveness of five insecticide-treated net programs (Eritrea, Malawi, Tanzania, Togo, Senegal) and two indoor residual spraying programs (Kwa-Zulu-Natal, Mozambique)*. Final draft. Basel, Swiss Tropical Institute, 2007 (available at www.rollbackmalaria.org/partnership/wg/wg_itn/docs/Yukich2007.pdf).

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16. *Report of the seventh WHOPES Working Group meeting. Review of VectoBac WG, PermaNet, Gokilaht S-5EC.* Geneva, 2–4 Dec. 2003. Geneva, World Health Organization, 2004 (WHO/CDS/WHOPES/2004.8).

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Annex 1 – Terminology

Mosquito net (net)

A device made of netting material that allows the passage of air, which, when placed over and around a sleeping person as a physical barrier, protects that person from mosquito bites.

Insecticide-treated net (ITN)

A net that repels, prevents blood feeding and/or kills mosquitoes after contact as a result of the presence of insecticide on the netting material. Insecticide-treated nets are either conventionally treated nets or long-lasting insecticidal nets.

Conventionally treated net

A net that has been treated, with one of the six insecticides recommended by WHO[1], by dipping within the past 12 months. To ensure insecticidal effect, nets should be re-treated after three washes or at least once a year.

Long-lasting insecticidal net (LLIN)

A factory-treated mosquito net with insecticide incorporated within or bound around the fibres, or a mosquito net treated with a long-lasting insecticidal treatment kit, which retains its biological activity for at least 20 WHO standard washes under laboratory conditions and 3 years of recommended use under field conditions without re-treatment.

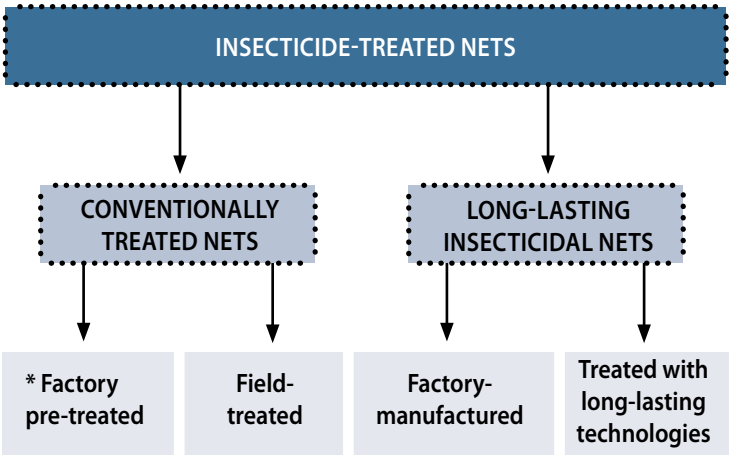
Long-lasting insecticidal treatment kits

Kits that include insecticide and binder and that can be used in the field to convert untreated nets into long-lasting insecticidal nets.

Useful insecticide-treated net (term used in programme planning and monitoring)

A long-lasting insecticidal net that has been delivered to the end-user less than *x* years ago, where *x* is the estimated functional life (duration of insecticidal effectiveness) of the net when used normally. For the currently available WHO-recommended brands of LLIN, *x* is 3 or 5 years; however, this figure may need to be adjusted according to local experience – or a conventionally treated net.

[1] *Malaria vector control: decision making criteria and procedures for judicious use of insecticides.* Geneva, World Health Organization, 2003 (WHO/CDS/WHOPES/2002.5 Rev.1).



*The purchase of factory pretreated nets other than LLINs is not recommended because of the excessive variations observed in insecticide dosages.

Annex 2 – Core and programme indicators for implementation of LLINs

KEY TERM DEFINITIONS

- **Household:** person, or group of related or unrelated persons who live together in the same dwelling unit, acknowledge one adult male or female as the head of the household, share the same housekeeping arrangements, and are considered to constitute one unit. In cases where several people live together in the same house but each has separate eating arrangements, they should be counted as separate 1-person households.
- **ITN:** mosquito net that has been conventionally treated (by dipping) with a WHO-recommended insecticide within the 12 months preceding the survey[1] ; or a useful long-lasting insecticidal net (LLIN).
- **ITN target population:** identical to LLIN target population in countries implementing only LLINs, and identical to LLIN target population plus all members of the population in areas targeted for implementation of conventional ITNs with regular net treatment in countries, where the latter modality is part of the programme.
- **LLIN:** a mosquito net with insecticide incorporated within or bound around fibres, which retains its insecticidal effect for at least 3 years without re-treatment[2].
- **LLIN target population:** that part of the population at risk of malaria living in areas where the LLIN is chosen as a vector control intervention.
- **LLIN delivery gap:** number of LLINs that need to be delivered to reach full coverage of the target population. The calculation is based on the total number of useful LLINs needed in the LLIN target population for full coverage. From this total is subtracted the number of LLINs already delivered that have not reached the end of their useful life and will not reach it during the current year.
- **Number of pregnancies in the target population:** calculated according to official national figures, as used by antenatal care and immunization programmes.
- **Number of infants in the target population:** number of infants surviving to the age of 12 months according to the official data used by immunization programmes for other antigens than BCG.
- **Useful LLIN:** LLIN that has not expired (i.e. that has been delivered up to 3 or 5 years before the survey, depending on the brand).
- **Total need:** total number of useful LLINs that must be present in the target population for full coverage, assuming that on average two persons can sleep under one LLIN.

Delivery gaps (*assessment of access may refine the estimation of the delivery gap*)**:**

- for LLINs that last 3 years: population divided by 2, minus total number of LLINs delivered during the preceding 2 years.
- for LLINs that last 5 years: population divided by 2, minus total number of LLINs delivered during the preceding 4 years.

Assumptions: on average, two persons can sleep under one LLIN and currently recommended LLINs have a useful life of 3 or 5 years from the time they are delivered to the end-user.

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1. *Instructions for treatment and use of insecticide-treated mosquito nets.* Geneva, World Health Organization, 2002 (WHO/CDS/RBM/2002.41), p.24.
2. For details, see: *Guidelines for laboratory and field testing of long-lasting insecticidal mosquito nets.* Geneva, World Health Organization, 2005 (WHO/CDS/WHOPES/GCDPP/2005.11), p. 1.

<table>
<tr><th colspan="4">INDICATOR 1: PROPORTION OF LLINs DELIVERED AGAINST TOTAL LLINs NEEDED (OUTPUT)</th></tr>
<tr><td>CALCULATION</td><td colspan="3">• Numerator: number of LLINs delivered to target population over a year.
• Denominator: number of LLINs that need to be delivered at the beginning of the year to achieve full coverage in the target population (LLIN delivery gap).</td></tr>
<tr><td>PURPOSE</td><td colspan="3">This indicator measures the performance of the programme in terms of service delivery and progress towards full coverage.</td></tr>
<tr><td colspan="4">DATA COLLECTION</td></tr>
<tr><td>Method
Continuous programme monitoring.
Data may be disaggregated by delivery mode.</td><td>Tools
Tally sheets.
Monthly integrated child survival forms. Aggregate reporting forms, national programme reports.
Reports from public sector programme partners or sub-contractors such as NGOs.</td><td>Level
Health facility, district, national.</td><td>Frequency
Monthly at health facility and district level.
Annually at national level.</td></tr>
<tr><td>INTERPRETATION & USE</td><td colspan="3">• Measures progress towards full coverage of the targeted population.
• At subnational and national levels, the numerator should also be used to assess progress towards monthly and annual targets, corresponding to planned coverage levels.
• As a programme scales up, the gap should become smaller, until it reaches a steady state around the annual replacement figure.
• Few programmes will reach 100% for this indicator during the early years of implementation, but it should increase year by year towards 100%.</td></tr>
</table>

INDICATOR 2:	**PROPORTION OF LLINs OWNED BY TARGET POPULATION AGAINST TOTAL LLINs NEEDED (OWNERSHIP)**		
CALCULATION	• **Numerator:** number of useful LLINs present in surveyed households in the LLIN target population. • **Denominator:** total number of persons living in the surveyed households in the LLIN target population.		
PURPOSE	This indicator measures the level of LLIN ownership and access in the target population.		
DATA COLLECTION			
Method Representative household sample surveys such as: • Malaria Indicator Surveys (MIS), • Demographic and Health Surveys (DHS), • Multiple Indicator Cluster Surveys (MICS), or • "Add on" surveys e.g. EPI Cluster Surveys.	**Tools** Household questionnaire listing every member of the target population who slept in the house the night before the survey.	**Level** National. In some cases, subnational.	**Frequency** • 2–3 years • 5 years • 5 years • Occasionally
INTERPRETATION & USE	This indicator allows assessment of the effectiveness of LLIN delivery. If ownership is lower than expected from output data on delivery, it is essential to find out why (LLINs sold, given away, discarded because of excessive wear and tear, etc.). If, on the other hand, ownership is higher than expected, the population may be able to acquire LLINs from alternative sources, and it may then be justifiable to reduce programme procurement and delivery. If ownership is far higher than use (see indicator 5), the need for more communication may be greater than the need for additional nets.		
LIMITATIONS	Not all countries are covered by DHS and MICS. Since these surveys are performed during the dry season, and only every 5 years, available data are on average 3 years outdated. In countries where only part of the population is at risk of malaria, national coverage might underestimate effective coverage in targeted at-risk populations. Unless specific provisions are made in the sampling scheme, district-level assessment is not undertaken. EPI Cluster Surveys are done occasionally and only in some countries. Additional MIS should be conducted between DHS and MICS surveys and wherever DHS and MICS are not conducted.		

<table>
<tr><th colspan="2">INDICATOR 3:</th><th colspan="3">PROPORTION OF HOUSEHOLDS WITH AT LEAST ONE ITN (PENETRATION)</th></tr>
<tr><td>CALCULATION</td><td colspan="4">• Numerator: number of households surveyed within ITN target population with at least one ITN. Data should be disaggregated by conventional ITN or LLIN if both are found.
• Denominator: total number of households surveyed within ITN target population. Data should be disaggregated by conventional ITN target population or LLIN target population if applicable.</td></tr>
<tr><td>PURPOSE</td><td colspan="4">This indicator measures household ITN possession among the population at risk for malaria and targeted for insecticide-treated net implementation.</td></tr>
<tr><td colspan="5">DATA COLLECTION</td></tr>
<tr><td>Method
Representative household sample surveys such as:
• Malaria Indicator Surveys (MIS)
• Demographic and Health Surveys (DHS)
• Multiple Indicator Cluster Surveys (MICS)
• “Add on” surveys e.g. EPI Cluster Surveys</td><td>Tools
Household questionnaire listing every member of the target population who slept in the house the night before the survey.</td><td colspan="2">Level
National, in some cases, subnational</td><td>Frequency
• 2–3 years
• 5 years
• 5 years
• Occasionally</td></tr>
<tr><td>INTERPRETATION & USE</td><td colspan="4">This indicator provides a measure of ITN programme penetration. When compared with access and effective coverage indicators, it provides information about equity (whether ownership is widespread in the population or concentrated in few households). It also allows comparison with earlier surveys, in which it was the only ITN related indicator measured.</td></tr>
<tr><td>LIMITATIONS</td><td colspan="4">Not all countries are covered by DHS and MICS. They are performed during the dry season, and only every 5 years, thus available data are on average 3 years outdated. In countries with only part of the population at risk of malaria, national coverage might underestimate effective coverage in targeted populations at risk. Unless specific provisions are made in the sampling scheme, district-level assessment is not provided. EPI Cluster Surveys are done occasionally and only in some countries. Additional MIS should be conducted in the interim between DHS and MICS surveys and where DHS and MICS are not conducted.</td></tr>
</table>

<table>
<tr><th colspan="2">INDICATOR 4:</th><th colspan="2">PROPORTION OF TARGET POPULATION WHO SLEPT UNDER AN ITN THE NIGHT BEFORE THE SURVEY (OUTCOME)</th></tr>
<tr><td>CALCULATION</td><td colspan="3">• Numerator: number of persons surveyed who reported sleeping under an insecticide-treated net (ITN) the night before the survey
• Denominator: total number of persons surveyed who slept in the surveyed households the night before the survey</td></tr>
<tr><td>BREAKDOWN</td><td colspan="3">The indicator should be disaggregated for children under 5 years, pregnant women and others and, if possible, also for socioeconomic quintiles. Reporting should also differentiate between LLINs and conventionally-treated nets and respective target areas, if applicable.</td></tr>
<tr><td>PURPOSE</td><td colspan="3">This indicator measures the level of ITN use by the target population.</td></tr>
<tr><td colspan="4">DATA COLLECTION</td></tr>
<tr><td>Method
Representative household sample surveys such as:
• Malaria Indicator Surveys (MIS),
• Demographic and Health Surveys (DHS),
• Multiple Indicator Cluster Surveys (MICS), or
• “Add on” surveys e.g. EPI Cluster Surveys.</td><td>Tools
Household questionnaire listing every member of the target population who slept in the house the night before the survey.</td><td>Level
National.
In some cases, subnational.</td><td>Frequency
• 2–3 years
• 5 years
• 5 years
• Occasionally</td></tr>
<tr><td>INTERPRETATION & USE</td><td colspan="3">This indicator assesses the effects of the programme on the access to insecticide-treated nets (whether long-lasting or conventional) and on behaviour of the target population. Disaggregated data is essential, when the programme prioritizes children under 5 and pregnant women, but is also useful in other situations for assessing equity among age and gender groups and socioeconomic strata.</td></tr>
<tr><td>LIMITATIONS</td><td colspan="3">Not all countries are covered by DHS and MICS. These surveys are performed during the dry season and only every 5 years; thus available data are on average 3 years out of date. In countries with only part of the population at risk of malaria, national coverage might underestimate effective coverage in targeted populations at risk. Unless specific provisions are made in the sampling scheme, district-level assessment is not provided. EPI Cluster Surveys are done occasionally and only in some countries. Additional MIS should be conducted in the interim between DHS and MICS surveys and where DHS and MICS are not conducted.</td></tr>
</table>

<table>
<tr><th colspan="2">INDICATOR 5:</th><th colspan="3">PROPORTION OF PREGNANT WOMEN IN TARGET POPULATION, WHO RECEIVE AN LLIN (OUTPUT)</th></tr>
<tr><td>CALCULATION</td><td colspan="4">• Numerator: number of LLINs delivered to pregnant women belonging to LLIN target population over a year.
• Denominator: number of pregnancies occurring in the target population over the same year.</td></tr>
<tr><td>PURPOSE</td><td colspan="4">This indicator measures the performance of the programme in terms of service delivery to protect pregnant women in programmes, for which pregnant women are considered a priority group for LLIN protection and where special delivery modes targeting them have been established.</td></tr>
<tr><td colspan="5">DATA COLLECTION</td></tr>
<tr><td>Method
Continuous programme monitoring.</td><td>Tools
Tally sheets used at antenatal care services. Monthly forms from health facilities, aggregate reporting forms from districts, national quarterly and annual programme reports. Reports from public sector programme partners or subcontractors such as NGOs.</td><td>Level
Health facility, district, national.</td><td>Frequency
Monthly at health facility and district. Quarterly and annually at national level.</td></tr>
<tr><td>INTERPRETATION & USE</td><td colspan="4">Measures progress towards full coverage of the targeted population.
At subnational and national levels, the indicator should also be used to assess progress towards monthly and annual targets, corresponding to planned coverage levels.</td></tr>
<tr><td>LIMITATIONS</td><td colspan="4">The indicator does not assess how early in pregnancy the LLIN is delivered, or whether it is retained and correctly used.</td></tr>
</table>

INDICATOR 6:	**PROPORTION OF INFANTS IN TARGET POPULATION RECEIVING AN LLIN (OUTPUT)**		
CALCULATION	• **Numerator:** number of LLINs delivered to infants belonging to LLIN target population over a year. Where vouchers are used, vouchers redeemed should be included. • **Denominator:** number of infants in the target population who reach the age of 12 months over the same year.		
PURPOSE	This indicator measures the performance of the programme in terms of service delivery to protect infants and young children in programmes, for which these are considered a priority group for LLIN protection and where special delivery modes targeting them have been established.		
DATA COLLECTION			
Method Continuous programme monitoring.	**Tools** Tally sheets used at EPI and child health services. Monthly forms from health facilities, aggregate reporting forms from districts, national quarterly and annual programme reports. Reports from public sector programme partners or sub-contractors such as NGOs.	**Level** Health facility, district, national.	**Frequency** Monthly at health facility and district. Quarterly and annually at national level.
INTERPRETATION & USE	Measures progress towards full coverage of infants and young children. At subnational and national levels, the indicator should also be used to assess progress towards monthly and annual targets, corresponding to planned coverage levels.		
LIMITATIONS	The indicator does not assess at what age the LLIN is delivered, nor whether it is retained and used correctly. More detailed analysis of delivery service data will make an assessment of the median age of delivery possible, but this should be interpreted in conjunction with data on delivery to pregnant women. If LLINs are delivered to pregnant women, they should preferably be given to infants only when they approach the age of 12 months. The target group for delivery is infants and young children. Health education should promote the sharing of LLINs between infants who receive the LLINs and children under 5 years of age, and continued use by these until the end of the useful life of the LLINs. In the early days of a programme and when LLINs with a useful life of 3 years are used, supplementary distributions to under-5s are necessary for the full coverage of these children.		

Annex 3 – Instruments for monitoring

Form 1. Tally for LLIN coverage assessment and delivery integrated with child health activities, including template for annotation on child's immunization/health card

Form 2. Tally for LLIN delivery integrated with antenatal care, including template for annotation on antenatal care card

Form 3. LLIN delivery, coverage assessment and logistics – health facility monthly report

Form 4. LLIN delivery, coverage assessment and logistics – district monthly report

Form 5. LLIN delivery, coverage assessment and logistics – province monthly report

Form 6. National quarterly report on LLIN implementation

FORM 1 **Tally for LLIN coverage assessment and delivery integrated with child health activities**

PROVINCE:________ DISTRICT:________ DATE: from ________ to ________ Outreach ....
HEALTH FACILITY: ________________ FIXED: ________________ Campaign........................
Place..........................

COVERAGE ASSESSMENT		
At DTP3: slept under LLIN last night?		Total
YES	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
NO	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
TOTAL	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
LLIN DELIVERY		Total
At 1st EPI contact (not measles)	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
At measles (9–11 months)	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
At other child health activity before age 12 months (specify ....)	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
Total 0–11 months		
At other child health activity age 12–59 months (specify..................................)	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o	
Grand total delivered at 0–59 months		

To note on child's immunization/health card

Did mother receive LLIN at antenatal care?	YES ☐	NO ☐	DATE
LLIN given at first EPI contact	YES ☐	NO ☐	DATE
LLIN given at measles	YES ☐	NO ☐	DATE
LLIN given at other activity	YES ☐	NO ☐	DATE

FORM 2 **Tally for LLIN delivery integrated with antenatal care consultation**

PROVINCE:______________ DISTRICT:______________ DATE: from__________ to__________ Outreach........................

HEALTH FACILITY:______________________ FIXED:______________________ Place........................

LLIN DELIVERY	
At 1st antenatal care	
LLIN given	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o
LLIN not given	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o
TOTAL 1st antenatal care	
At 2nd or later antenatal care	
LLIN given	o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o | o o o o o
Total LLINs given	

To note on antenatal care card

Did the woman receive LLIN at 1st antenatal care?	YES ☐	NO ☐	DATE
Did the woman receive LLIN at later antenatal care?	YES ☐	NO ☐	DATE

FORM 3 **LLIN delivery, coverage assessment and logistics – health facility monthly report**

PROVINCE:_____ DISTRICT:_____ MONTH_____ YEAR_____ HEALTH FACILITY_____

POPULATION _____ Children under 5 years of age: …… of which …… under 1 year of age

Pregnancies per year …… pregnancies/month…… live births/month……

COVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
Pregnant women: LLIN delivery				
LLINs delivered				
TOTAL antenatal care contacts in month				
LLINs delivered / total 1st antenatal care contacts in month (%)				
LLINs delivered / pregnancies per month (%)				
Infants: coverage assessment at DTP3				
Total attended				
Slept under LLIN last night				
Estimated coverage (%)				
Infants: LLIN delivery				
LLINs delivered at 1st contact				
LLINs delivered at measles				
LLINs delivered at other				
Total LLINs delivered				
LLINs delivered to newborns per month (%)				

OVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
Children: 12–59 months LLIN delivery				
LLINs delivered at measles				
LLINs delivered at other				
Total LLINs delivered				
Other LLIN delivery (> 5 years not pregnant)				
Grand total LLINs delivered				

LOGISTICS				
Stocks of LLINs	Begin.....	Received.....	Delivered.....	End.....
Stock-out during month	YES ☐	NO ☐		
Deliveries to others (specify where, when, who)				

FORM 4 **LLIN delivery, coverage assessment and logistics – district monthly report**

PROVINCE:_____ DISTRICT:_____ MONTH_____ YEAR_____

No. of HEALTH FACILITIES_____ No. of HEALTH FACILITIES REPORTED_____ No. of HEALTH FACILITIES REPORTED ON TIME_____

POPULATION_____ Children under 5 years of age:. . . . . of which. . . . . under 1 year of age

Pregnancies per year . . . . . pregnancies/month. . . . . live births/month . . . . . .

COVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
Pregnant women: LLIN delivery				
LLINs delivered				
TOTAL 1st antenatal care contacts in month				
LLINs delivered / total 1st antenatal care contacts in month (%)				
LLINs delivered / pregnancies per month (%)				
Infants: coverage assessment at DTP3				
Total attended				
Slept under LLIN last night				
Estimated coverage (%)				
Infants: LLIN delivery				
LLINs delivered at 1st contact				
LLINs delivered at measles				
LLINs delivered at other				
Grand total LLINs delivered				

COVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
LLINs delivered to infants				
LLINs delivered at 1st contact				
LLINs delivered at measles				
LLINs delivered at other				
Grand total LLINs delivered				

LOGISTICS							
Stocks of LLINs	Begin.....	Received.....	Delivered.....	End.....			
Stock-out during month	YES ☐	NO ☐					
Deliveries to health facility:	A ☐	B ☐	C ☐	D ☐	E ☐	F ☐	G ☐

COVERAGE ASSESSMENT AND SERVICE BY HEALTH FACILITY	A	B	C	D	E	F	G	DISTRICT
Catchment population								
LLINs delivered to pregnant women/ pregnancies/month (%)								
Estimated coverage at DTP3 (%)								
LLINs delivered to infants/newborns/month (%)								
Total LLINs delivered in month								
Total LLINs delivered since beginning of year								
Delivery gap at beginning of year								
Cumulative delivery/delivery gap (%)								

FORM 5 **LLIN delivery, coverage assessment and logistics – province monthly report**

PROVINCE:_____ No. of DISTRICTS:_____ MONTH _____ YEAR _____

POPULATION _____ Children under 5 years of age:..... of which..... under 1 year of age

Pregnancies per year ..... pregnancies/month..... live births/month .....

COVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
Pregnant women: LLIN delivery				
LLINs delivered				
Total 1st antenatal care contacts in month				
LLINs delivered/total 1st antenatal care contacts in month (%)				
LLINs delivered/ pregnancies/month (%)				
Infants: coverage assessment at DTP3				
Total attended				
Slept under LLIN last night				
Estimated coverage (%)				
Infants: LLIN delivery				
LLINs delivered at 1st contact				
LLINs delivered at measles				
LLINs delivered at other				
Total LLINs delivered				
LLINs delivered to infants/ live births/month (%)				
Children: 12–59 months LLIN delivery				
LLINs delivered at measles				
LLINs delivered at other				
Total LLINs delivered				

COVERAGE ASSESSMENT AND SERVICE DELIVERY	FIXED	OUTREACH	CAMPAIGN	TOTAL
Other LLIN delivery (5+yrs not pregnant)				
Grand total LLINs delivered				
LOGISTICS				
Stocks of LLINs	Begin.....	Received.....	Delivered.....	End.....
Stock-out during month	YES ☐	NO ☐		
Distributed to District	A ☐	B ☐	C ☐	D ☐ E ☐ F ☐ G ☐

COVERAGE ASSESSMENT AND DELIVERY BY DISTRICT	A	B	C	D	E	F	G	PROVINCE
Population								
LLINs delivered to pregnant women/pregnancies/month (%)								
Estimated coverage at DTP3 (%)								
LLINs delivered to infants/newborns/month (%)								
Total LLINs delivered in month								
Total LLINs delivered since beginning of year								
Delivery gap at beginning of year								
Cumulated delivery/delivery gap (%)								

FORM 6 National quarterly report on LLIN implementation

YEAR: _____ QUARTER: _____

LLIN target population at mid-year	of which ..... under 1 year of age and ..... aged 12–59 months
ITN target population at mid-year, if different:	pregnancies per year: .....
Year of start of LLIN delivery:.....	type of LLIN:..... effective life = ... years
Total LLINs delivered in preceding years.....	total LLINs delivered less than *x* years ago .....
Total LLINs expired in preceding years	total LLINs expiring this year..... total LLINs expiring next year.....
LLIN delivery gap at beginning of year.....	supply gap at beginning of year.....

	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4	YEAR
LLINs delivered in current year					
% of delivery gap filled cumulatively					
Delivery to pregnant women/all pregnancies (%)					
Delivery to infants/all live births (%)					
Estimated coverage at DTP3 (%)					
Supplies received					
% of supply gap filled cumulatively					

PROVINCE	A	B	C	D	E	F	G	TOTAL
LLIN population								
LLINs delivered to pregnant women/all pregnancies (%)								
Estimated coverage at DTP3 (%)								
LLINs delivered to infants/all live births (%)								
Total LLINs delivered in quarter								
Total LLINs delivered since beginning of year								
Delivery gap at beginning of year								
Cumulative delivery/delivery gap (%)								
LOGISTICS								
Stocks of LLINs	Begin.....	Received.....	Delivered.....	End.....				
Stock-out during month	YES ☐	NO ☐						
Distributed to Province:	A ☐	B ☐	C ☐	D ☐	E ☐	F ☐	G ☐	