

Long Lasting Insecticidal Nets: current status & programmatic issues

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What is a long lasting insecticidal net (LLIN)?

A net treated at factory level with insecticide either incorporated into or coated around fibers, resisting to multiple washes and whose biological activity last as long as the net itself (3 to 4 years for polyester nets, 4 to 5 years for polyethylene ones).

Why do we need LLINs?

Washing removes insecticide: from various studies, there is converging evidence that after 3 to 5 washes, insecticide is removed from nets that have been treated by conventional dipping. Under programme conditions, unless nets can be systematically retreated after 3 washes as recommended by WHO, the protective efficacy provided by conventionally treated nets might be lower to much lower than expected, especially if nets are frequently washed (e.g. once a month).

Dipping of colored nets: recently, preliminary investigations have shown that during dipping, colored polyester nets may load much less insecticide than white nets, therefore not having the expected level of efficacy or losing their efficacy after even the first wash. Investigations are on going to better understand this phenomenon and eventually propose practical solutions. In between, whenever possible, the use of white nets should be preferred.

Factory pre-treated nets other than LLINs: it has been recently shown that polyester factory pre-treated nets other than LLINs have quite variable insecticide dosages, usually much lower than expected (including white nets). WHO is advising programmes to avoid ordering factory pre-treated nets other than LLINs.

LLINs offer a practical solution in terms of wash resistance, safe use of colored nets and purchase of ready-to-use pre-treated nets, pending they fulfill specifications. So far, quality control checks carried out by WHO and UNICEF with the two LLINs either recommended or under testing by WHO have shown excellent compliance to specifications on both insecticide treatment and netting specifications.

LLINs currently on the market?

Olyset Net: this is a polyethylene net with 2 % permethrin incorporated within fiber. Over time, insecticide migrates to the surface of the yarn, replacing the one that has been removed by washing. This migration being a temperature dependent process, exposure of nets to heat after washing (e.g. few hours to sun) can accelerate it. After up to 5 years of continuous use in the field, Olyset still contain 50 % of the original permethrin content. Around 65 % of the nets have still the full efficacy as defined by WHO (either 95 % KD or 80 % mortality respectively 1H and 24 H after a 3 minutes exposure). After 7 years, the permethrin content was still 35 % of the original content. No more than 20% of the nets were still effective in killing mosquitoes (based on a 3 minutes exposure). However, when these 7 years old nets were tested in tunnels (free flying mosquitoes having to pass through a holed netting to reach the bait and take a blood meal), the average mortality was 56.8 % and the blood feeding inhibition as high as 92 %.

Olyset is effective in providing personal protection against malaria vectors for at least 5 years and its use is recommended by WHO. It is yet unclear to which extent Olyset can provide a consistent high mortality of mosquitoes throughout this 5 years period, especially if nets are washed frequently or the air temperature is relatively low (slowing down migration of permethrin). Exposing Olyset to sun after washing, as previously recommended by the manufacturer, would certainly increase the killing effect on mosquitoes (accelerating permethrin migration). However, this would not be practical. In addition, it may shorten the duration of the protective efficacy with the risk that this protection might be shorter than the life span of the net itself. Therefore, WHO does not recommend heating Olyset nets after washing.

A high mortality rate of vectors would be needed only when the objective of the programme is to achieve community protection through a mass impact of the treated nets on the mosquito population. However, it should be stressed that such protection, equivalent to that obtained with indoor residual spraying, can be achieved only if a very high proportion of the human population (e.g. > 80%), is effectively protected by nets treated with an insecticide that kills mosquitoes.

PermaNet: is polyester net treated with 55 mg/m² deltamethrin. Insecticide is diluted in a wash resistant resin, which is coating the fibers. PermaNet is claimed to resist to 20 standard washes. A first PermaNet has been submitted to WHO for evaluation in 2001. However, field results have been variable due to heterogeneous quality of the product. A new generation, PermaNet 2, has been submitted for evaluation early 2003. Results will be reviewed by WHO early December 2003 and recommendations on its use made accordingly. PermaNet is available in white as well as in different colors.

Following WHO suggestions, the company has developed a strict quality control scheme: every batch a chemical analysis (HPLC) and a wash resistance test are made. QC results are provided to customers with the corresponding batch number labeled on every net. The company is offering a free service for follow-up of insecticide concentrations on nets in use. Samples have to be collected by programmes (e.g. after 1 year) and sent to the company for analysis. Based on the actual concentration, a prediction is made on the expected life duration of the treatment and is rapidly sent back to users.

Other LLINs: A number of other LLINs are under development. Incorporation of pyrethroids into conventional netting fibers (polyester, polypropylene) will soon facilitate access of many net producers to the long lasting treatment technologies. Another attractive technology recently developed consists in treatment kits that can be used in the field by simple dipping and which provide a true wash resistant treatment. This technology will be extremely useful for the treatment of the many nets currently in use.

Other long lasting insecticidal fabrics: the incorporation technology has been applied for the treatment of plastic sheetings used in emergencies. Plastic sheets are the first item provided to refugees. With insecticide incorporated, this sheeting becomes a ready to use tool providing protection against malaria and reducing fly populations during the acute phase of any emergency which lasts usually around 6 months. This product has been tested by WHO under Phases 1 and 2 and is now under large scale field testing in Africa.

Preliminary results have been very encouraging. A similar technology is being developed to produce films for roof or wall lining used to improve precarious habitats (including in slums), providing protection against endophilic vectors and domestic pests in addition to improving domestic comfort. Such product may supplement or replace ITNs or IRS when these tools cannot be used. Long lasting treatment technologies are also being developed to produce repellent clothing for outdoors personal protection against blood sucking arthropods.

Advise to control programmes on the purchase and use of ITNs:

- Be informed of WHO recommendations (regular updates on LLINs or technical information's on netting materials and insecticides)
- Preferably use WHO recommended LLINs, especially if difficulties in ensuring proper retreatment rates are anticipated
- Avoid purchase of factory pre-treated nets other than LLINs
- In case LLINs are not available or are not preferred, purchase non treated nets with insecticide treatment kit(s) bundled
- When and where possible, use ITNs for multi-disease prevention (e.g. malaria + leishmaniasis or lymphatic filariasis)
- Check, whenever possible, quality of nets and insecticides using WHO specifications
- Ensure regular re-treatment of conventional nets already in use, preferably providing treatment free and, once available, using the new long lasting dipping treatment kits.