World Health Organization

GLOBAL MALARIA PROGRAMME

WHO recommendations on the sound management of old long-lasting insecticidal nets

March 2014

Recommendations

1. Residents should be advised through appropriate communication strategies to continue to use long-lasting insecticidal nets (LLINs) – even if they have holes – until another LLIN in better condition is available to replace it.[1] Moreover, communities should be encouraged to regularly repair their LLINs when they become damaged.

2. Residents should also be advised not to dispose of old LLINs[2] in any water body, as the residual insecticide on the net can be toxic to aquatic organisms and especially to fish.

3. National malaria control and elimination programmes should **only** collect old LLINs if it has been ensured that: (a) communities are not left uncovered i.e. new LLINs are distributed to replace old ones, and (b) there is a suitable and sustainable plan in place for safe disposal of the collected material.

4. The collection of old LLINs should **not** divert the efforts and attention of malaria programmes away from their core duties, including the task of maintaining universal coverage.

5. If LLINs and their packaging (bags and baling materials) **are** collected, the best option for disposal is high-temperature incineration. They should **not** be burned in the open air. In the absence of such facilities, the recommended method of disposal is burial. Burial should be away from water sources and preferably in non-permeable soil: see details in *WHO Recommendations on the Sound Management of Packaging for Long Lasting Insecticidal Nets.*[3]

6. National malaria control and elimination programmes should work with national environment authorities to ensure that the information and recommendations in this document are taken into consideration when formulating local guidance and regulations.

1 While there are WHO guidelines on how to measure net durability which include rate of hole accumulation and loss of insecticide, there is no standard threshold to define when a net is 'too old to be used'. Even a net with many holes and with little or no remaining insecticide gives some degree of protection against malaria and other mosquito-borne diseases (as well as against nuisance biting) compared to sleeping with no net at all. Ultimately it is the homeowner/user of the net who will decide when a net is no longer useful although this decision can be influenced by behaviour change communication efforts.

2 Old LLINs are defined herein as those no longer used within households for the purpose of protecting individuals against malaria.

3 World Health Organization. *Recommendations on the sound management of packaging for long lasting insecticidal nets (LLINs).* Geneva, 2011. http://www.who.int/malaria/publications/atoz/recommendations_management_llin_packaging_nov11.pdf

Background

Currently, LLINs and the vast majority of their packaging (bags and baling materials) are made of non-biodegradable plastics. The large-scale deployment of LLINs has given rise to questions on the most appropriate and cost-effective way to deal with the plastic waste that results, given that most endemic countries currently do not have the resources to manage LLIN collection and waste disposal programmes.

WHO issued recommendations on the management of packaging for LLINs[3] in November 2011, though these did not address the issue of disposal of old LLINs. A pilot study was subsequently conducted to examine patterns of LLIN usage and disposal in three African countries (Kenya, Madagascar and Tanzania). Findings of this pilot study along with other background information were presented to the Technical Expert Group on Malaria Vector Control (VCTEG) in March 2014 for review. The VCTEG indicated that the conclusions from the pilot study and from other background information were sufficient to form global recommendations on best practices in relation to managing LLIN waste.

Evidence

The following are the main findings from the pilot study and other background information:

1. LLINs entering domestic use in Africa each year contribute approximately 100 000 tonnes of plastic[4] and represent a per capita rate of plastic consumption of 200 grams per year. This is substantial in absolute terms, but constitutes only approximately 1% to 5% of total plastic consumption in Africa[5] and thus is small compared to other sources of plastic and other forms of plastic consumption.

2. The plastic from LLINs is treated with a small amount of pyrethroid insecticide (less than 1% per unit mass for most products) and plastic packaging is therefore considered a pesticide product/container.

3. Old LLINs and other nets may be used for a variety of alternative purposes, usually due to perceived ineffectiveness of the net, loss of net physical integrity or presence of another net.

4. LLINs that no longer serve a purpose are generally disposed of at the community level along with other household waste by either discarding in the environment, burning in the open, or placing into pits.

5. LLIN collection was not implemented on a large scale or sustained in any of the pilot study countries. USAID found that recycling of LLINs may be feasible but is not practical or cost effective.[6,7] Specialized adaptation and upgrading of recycling facilities would be needed before insecticide-contaminated materials could be included in this process, but this is not a practical option at this time.

4 Based on the assumption of 133 million LLINs delivered to Africa per year with an average weight of plastic of 600 g of netting and 150 g of packaging per LLIN. Each LLIN is assumed to cover 1.5 people for 2.5 years.

5 Estimates for overall plastic consumption in African countries are hard to find. One observational study in Ghana in 2000 estimated average national consumption of 6 – 12kg per person per year, indicating that LLINs and their packing would have comprised 2.5% of total plastic waste. However, assuming that plastic consumption has increased substantially in line with economic development on the continent, the working estimate derived was that LLINs and their packaging currently account for 1% to 5% of total plastic consumption in Africa.

6 http://deliver.jsi.com/dlvr_content/resources/allpubs/countryreports/Mada_LLIN_Recy_Pilo.pdf

7 http://deliver.jsi.com/dlvr_content/resources/allpubs/countryreports/Mada_LLIN_Recy_PhasIII.pdf

6. Two important and potentially hazardous practices are: (a) routine removal of LLINs from bags at the point of distribution and burning of discarded bags and old LLINs, which can produce highly toxic fumes including dioxins,[8] and (b) discarding into water old LLINs and their packaging that may include high concentrations of residual insecticides that are toxic to aquatic organisms, particularly fish.

7. Insecticide-treated plastics can be incinerated safely in high-temperature furnaces[9] but suitable facilities are lacking in most countries. Burial away from water sources and preferably in non-permeable soil is an appropriate method of disposal for net bags and old LLINs in the absence of a suitable high-temperature incinerator.

8. In most countries, ministries of environment (national environment management authorities) are responsible for setting up and enforcing laws/regulations to manage plastic waste broadly. While some countries have established procedures for dealing with pesticide-contaminated plastics it is unrealistic to expect national malaria control and elimination programmes to single-handedly address the problem of managing waste from LLINs. Environmental regulations, as well as leadership and guidance from national environmental authorities, and oversight from international agencies such as the United Nations Environment Programme, are all necessary.

Conclusions

It is important to determine whether the environmental benefits outweigh the costs when identifying the best disposal option for old LLINs and their packaging. For malaria programmes in most endemic countries, there are limited options for dealing with the collection. Recycling is not currently a practical option in most malaria endemic countries (with some exceptions for countries with a well-developed plastics industry). High-temperature incineration is likely to be logistically difficult and expensive in most settings. In practice, when malaria programmes have retained or collected packaging material in the process of distributing LLINs, it has mostly been burned in the open air. This method of disposal may lead to the release of dioxins, which are harmful to human health.

If such plastic material (with packaging an issue at the point of distribution and old LLINs an intermittent issue at household level when the net is no longer in use) is left in the community, it is likely to be re-used in a variety of ways. While the insecticide-exposure entailed by this kind of re-use has not yet been fully studied, the expected negative health and environmental impacts of leaving it in the community are considered less than amassing the waste in one location and/or burning it in the open air.

Since the material from nets represents only a small proportion of total plastic consumption, it will often be more efficient for old LLINs to be dealt with as part of larger and more general solid-waste programmes. National environment management authorities have an obligation to consider and plan for what happens to old LLINs and packing materials in the environment in collaboration with other relevant partners.

8 Dioxins are produced as a result of burning the plastic material and not because of the insecticide.

9 The *Basel Convention Technical Guidelines for the Identification and Environmentally Sound Management of Plastic Wastes and for their Disposal* specify that "The condition for the optimal incineration of material is: Temperature of 850°C-1100°C for hydrocarbon wastes and 1100°C-1200°C for halogenated wastes; sufficient (gas) residence time in the incinerator good turbulence; and excess of oxygen": http://www.basel.int/meetings/cop/cop6/cop6_21e.pdf. See also *Basel Convention Technical Guidelines on Incineration on Land*: http://www.basel.int/meetings/sbc/workdoc/old%20docs/tech-d10.pdf.