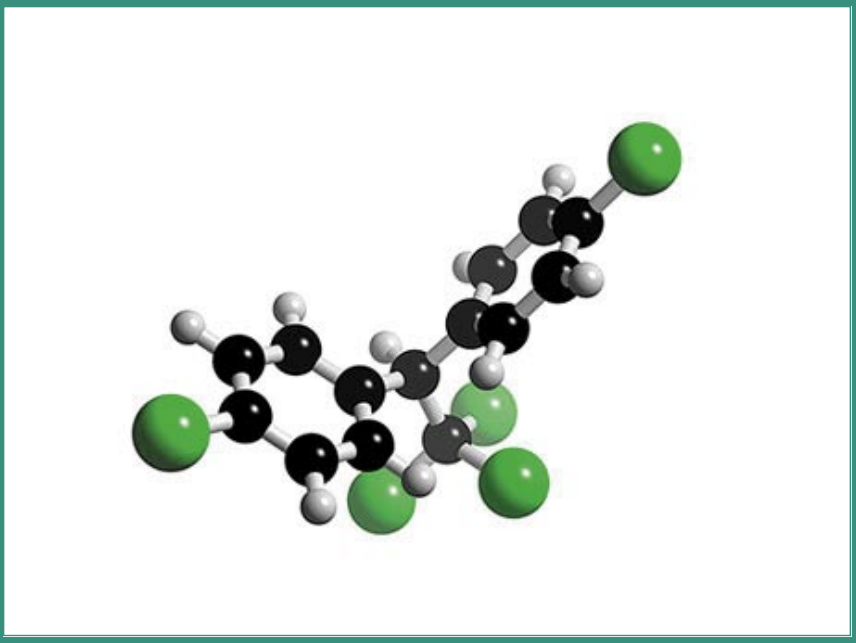
Global Malaria Programme

The use of DDT in malaria vector control

WHO position statement



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1. Introduction

Indoor residual spraying (IRS) is a major intervention for malaria control (*1*). There are currently 12 insecticides recommended for IRS, including DDT.

The production and use of DDT are strictly restricted by an international agreement known as the Stockholm Convention on Persistent Organic Pollutants (*2*). The Convention's objective is to protect both human health and the environment from persistent organic pollutants. DDT is one of 12 chemicals identified as a persistent organic pollutant that the Convention restricts. In May 2007, 147 countries were parties to the Convention.

The Convention has given an exemption for the production and public health use of DDT for indoor application to vector-borne diseases, mainly because of the absence of equally effective and efficient alternatives. WHO actively supports the promotion of chemical safety[1] and, together with the United Nations Environment Programme, shares a common commitment to the global goal of reducing and eventually eliminating the use of DDT while minimizing the burden of vector-borne diseases.

It is expected that there will be a continued role for DDT in malaria control until equally cost-effective alternatives are developed. A premature shift to less effective or more costly alternatives to DDT, without a strengthening of the capacity (human, technical, financial) of Member States will not only be unsustainable, but will also have a negative impact on the disease burden in endemic countries.

This position statement summarizes the issues surrounding the use of DDT for vector-control purposes.

[1] World Health Assembly Resolution 50.13. Promotion of chemical safety, with special attention to persistent organic pollutants, 1997.

2. Why is DDT still recommended?

2.1 Efficacy and effectiveness of DDT

DDT has several characteristics that are of particular relevance in malaria vector control. Among the 12 insecticides currently recommended for this intervention, DDT is the one with the longest residual efficacy when sprayed on walls and ceilings (6–12 months depending on dosage and nature of substrate).

In similar conditions, other insecticides have a much shorter residual efficacy (pyrethroids: 3–6 months; organophosphates and carbamates: 2–6 months). Depending on the duration of the transmission season, the use of DDT alternatives might require more than two spray cycles per year, which would be very difficult (if not impossible) to achieve and sustain in most settings.

DDT has a spatial repellency and an irritant effect on malaria vectors that strongly limit human-vector contact. Vector mosquitoes that are not directly killed by DDT are repelled and obliged to feed and rest outdoors, which contributes to effective disease-transmission control.

2.2 Concerns about the safety of DDT

DDT has a low acute toxicity. However, because of its chemical stability, it accumulates in the environment through food chains and in tissues of exposed organisms, including people living in treated houses. This has given rise to concern in relation to possible long-term toxicity.

The risks that DDT poses to human health are re-evaluated by WHO whenever there is significant new scientific information. In 2000, the Joint FAO/WHO Meeting on Pesticide Residues (*3*) undertook a comprehensive re-evaluation of DDT and its primary metabolites including storage of DDT and its metabolites in human body fat; the presence of residues in human milk and the potential carcinogenicity; and biochemical and toxicological information including hormone-modulating effects. While a wide range of effects were reported in laboratory animals, epidemiological data did not support these findings in humans.

New information published since 2000 is being evaluated, including new epidemiological studies, the particular vulnerability of infants and children,

new understanding of the importance of in utero and neonatal exposures, and up-to-date reported levels in human milk. A draft evaluation in a series of reports, known as Concise International Chemical Assessment Documents, is undergoing peer review, with publication expected in late 2007.

In addition to this updating process, WHO is working to gain a scientific consensus on the appropriate methodology that can be used to assess the risks from DDT exposures in IRS operations. WHO takes into account both potential exposure to homes' inhabitants and to spray operators, and release into the environment.

Based on the most recent information, WHO has no reason to change its current recommendations on the safety of DDT for disease vector control. However, WHO's position on the safety and use of DDT will be revised if new information becomes available on the potential hazards of DDT justifying such a revision.

2.3 Insecticide resistance and the use of DDT

Only insecticides to which vectors are susceptible (including DDT) should be used for IRS. Insecticide resistance in malaria vectors has commonly resulted from the use of the same insecticides for crop protection. In certain settings, products sprayed on crops contaminate malaria vector breeding sites. This direct exposure has resulted in the development of vector resistance in several parts of the world. Despite decades of widespread and intensive application, significant levels of DDT resistance in malaria vectors have been limited to some vector species and geographical areas. Since DDT use is restricted to public health activities, vector populations are no longer exposed to DDT through other applications, which further reduces prospects for selection and spread of vector resistance.

Effective management of insecticide resistance entails the use of several unrelated insecticides in combination or rotation. The 12 insecticides recommended for IRS belong to only four chemical groups, and DDT represents one group by itself. Given the very limited arsenal of recommended insecticides, it is advisable to retain DDT for resistance management until suitable alternatives are available.

3. The use of DDT in disease vector control

In high-transmission areas, such as in most parts of sub-Saharan Africa, IRS and insecticide-treated nets are the most effective interventions to control malaria. When transmission and prevalence of the parasites have been substantially reduced through these two interventions, alternative measures can increasingly contribute in the context of integrated vector management.

> WHO recommends DDT only for indoor residual spraying. Countries can use DDT for as long as necessary, in the quantity needed, provided that the guidelines and recommendations of WHO and the Stockholm Convention are all met, and until locally appropriate and cost-effective alternatives are available for a sustainable transition from DDT. At its third meeting in May 2007, the Conference of the Parties of the Stockholm Convention concluded that there is a continued need for use of DDT in disease vector control. This need will be evaluated every two years.

Many malaria-endemic countries have replaced DDT with alternative insecticides, mostly pyrethroids. In some instances this change has compromised the efficacy of vector-control programmes. For instance, in South Africa the switch from DDT to pyrethroids in 1997 soon resulted in the reappearance of *Anopheles funestus*, a major malaria vector, eliminated from the country for decades and found to be resistant to pyrethroids. This reappearance resulted in severe malaria outbreaks, which justified reintroduction of DDT in 2000. This situation raised awareness of the risks associated with insecticide resistance and potential danger of eliminating DDT too early. Subsequently, several countries in Africa have introduced, or are planning to reintroduce, DDT in IRS operations.

4. Safe and effective use of DDT

DDT should be used under strict control and only for the intended purpose, according to a WHO position statement on IRS (*1*). Using it in any other way would have important consequences, such as the contamination of food and agricultural products, including export goods, with a potential impact on international trade. Effective use and safe storage of DDT rely on compliance with well-established and well-enforced rules and regulations in accordance with national guidelines and with WHO technical guidance. This should be within the context of the Stockholm Convention.

There are strict conditions to be met when using DDT and they are described below.

(i) As DDT is one of the 12 insecticides recommended by WHO for IRS, the prerequisites for safe and effective implementation of IRS (*1*) apply to DDT, including susceptibility status of vectors and proper monitoring of insecticide resistance to implement resistance-management tactics.

(ii) The use of DDT for IRS must be closely monitored and reported to WHO and to the Secretariat of the Stockholm Convention[2].

(iii) To avoid undue exposure of householders and spray operators to DDT, standard operating procedures and national guidelines should be in place and strictly followed. Appropriate management of DDT also entails adoption and enforcement of stringent rules and regulations to avoid leakage (into e.g. agriculture) and misuse (when used in, e.g., domestic hygiene). This includes the possibility of appropriate legal measures in the event that individuals or entities do not comply with this condition.

(iv) To complement the continued review of information on DDT safety by the International Programme on Chemical Safety, there is a need to establish and implement appropriate monitoring strategies to better characterize DDT exposure (to humans and the environment) under the operational conditions in which DDT is used for vector control.

[2] Stockholm Convention on Persistent Organic Pollutants, Annex B, paragraph 4.

(v) The status of insecticide resistance, including to DDT, must be continuously monitored in order to (a) select insecticides to which vectors are susceptible and (b) implement resistance-management tactics, such as rotation of unrelated insecticides.

(vi) The continued need for DDT should be evaluated regularly by the parties to the Stockholm Convention and reports made to WHO and the Secretariat of the Stockholm Convention[3]. The results from these evaluations will depend, among other things, on: insecticide resistance status of local vectors; availability of alternative insecticides; control methods and strategies; and level of funding allocated to malaria vector control.

[2.] Stockholm Convention on Persistent Organic Pollutants, Annex B, paragraph 6.

5. Achieving sustainable malaria vector control in the context of the Stockholm Convention

To improve the cost-effectiveness, ecological soundness and sustainability of vector control, a global strategic framework for integrated vector management (IVM) has been developed (*4*). IVM involves the use of proven vector-control methods, separately or in combination, tailored according to knowledge of local determinants of disease, including vector ecology, disease epidemiology and human behaviour. IVM is based on the premise that effective control requires the collaboration of actors within the health sector itself and their collaboration with other sectors, and the engagement of local communities and other stakeholders.

IRS, including DDT, should be used as a component of an IVM strategy. This ensures that options for control of local malaria vectors are determined by a sound understanding of local eco-epidemiological conditions, and are appropriate and effective. IVM creates opportunities to generate synergies between different vector-borne disease-control programmes: a single intervention can control more than one vector-borne disease, such as malaria, leishmaniasis or lymphatic filariasis, that is transmitted by indoor resting vectors.

Alternative insecticides or alternative vector-control strategies and methods of equivalent efficacy will have to be developed to reduce reliance on DDT. The first step is the development of new formulation technologies to increase residual life of existing insecticides to a level equivalent to that of DDT. Additionally, it will be essential to develop new insecticides or active molecules that will replace DDT, as soon as possible, and that will respond to the challenges of pyrethroid resistance. These steps require a sustained and high level of effort and resource mobilization in the context of public-private partnerships. DDT is still needed today because investment to develop alternatives over the past 30 years has been grossly inadequate.

Non-chemical vector-control methods, such as environmental management or improvement of house construction (e.g. window screens), should be actively promoted. Additionally, greater resources should be allocated to research and development in such methods.

6. Conclusion

DDT is still needed and used for disease vector control simply because there is no alternative of both equivalent efficacy and operational feasibility, especially for high-transmission areas. The reduction and ultimate elimination of the use of DDT for public health must be supported technically and financially. It is essential that adequate resources and technical support are rapidly allocated to countries so that they can adopt appropriate measures for sound management of pesticides in general and of DDT in particular. There is also an urgent need to develop alternative products and methods, not only to reduce reliance on DDT and to achieve its ultimate elimination, but also to sustain effective malaria vector control.

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