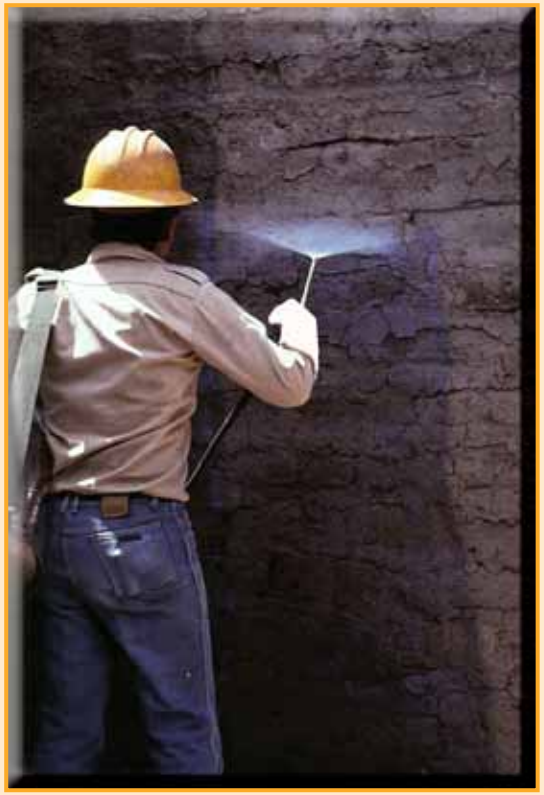
Frequently asked questions on DDT use for disease vector control



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Frequently asked questions on DDT use for disease vector control

1. What is DDT?

DDT (dichlorodiphenyltrichloroethane) is an organochlorine compound that was first synthesized in 1874. In 1935 it was discovered to be a highly effective insecticide, which led to its widespread use as a general pesticide in agriculture. Specific DDT use for disease control began during the Second World War.

DDT was the main product used in the global efforts, supported by WHO, to eradicate malaria in the 1950s and 1960s. This campaign resulted in a significant reduction in malaria transmission in many parts of the world, and was probably instrumental in eradicating the disease from Europe and North America.

2. Why is DDT use for malaria vector control so controversial?

DDT is a persistent organic compound. This means that the compound can stay in the environment long after its initial application as an insecticide (up to 12 years). During this time, DDT and its breakdown products may enter the food chain and accumulate in fatty tissues (bioaccumulation). Harmful effects in the wildlife population have been linked to DDT, including the thinning of eggshells in birds exposed to the compound. There are also fears that DDT may have a long-term impact on human health. Although there is currently no direct link between DDT and any negative human health effect, there is growing evidence that it may disrupt reproductive and endocrine function. Opponents of DDT use for vector control argue that its use should be curtailed on these grounds.

Advocates of the continuing use of DDT as an insecticide for disease vector control base their argument on various factors: the unacceptably high levels of mortality and morbidity caused by malaria, the proven effectiveness of DDT in significantly reducing malaria transmission, the relatively low cost of DDT interventions, and the lack of any sustainable alternative in many endemic countries. They argue that the negative environmental and other effects associated with DDT use in the past reflect the massive uptake and bioaccumulation arising from the high

amounts used as general agricultural pesticide. The amount of DDT used for disease vector control is negligible compared with that used in agriculture. The advocates also argue that when strictly used indoors, as recommended by WHO, DDT poses very little if any environmental threat.

3. Can DDT currently be used for malaria vector control?

Yes, DDT may be used for the control of the mosquito vectors of malaria. DDT use for malaria vector control is, however, strictly governed by the protocols of the Stockholm Convention on Persistent Organic Pollutants (POPs) and the specific recommendations of WHO. The Stockholm Convention allows DDT production and use for public health purposes only (disease vector control). Countries opting to use DDT are required to provide information to WHO and the Secretariat of the Stockholm Convention on the amount of DDT used and conditions of such use every three years. Detailed reporting procedures have been jointly developed by WHO and the Secretariat of the Stockholm Convention.[1, 2]

4. How is DDT used for malaria vector control?

WHO recommends indoor residual spraying of DDT for malaria vector control.[3]

Definition of indoor residual spraying

Indoor residual spraying may be defined as the application of a liquid insecticide with long-lasting residual properties which dries to form a crystalline deposit on the sprayed surface. A lethal dose of the insecticide is absorbed by insects that come into contact with the surface. The insecticide is applied to the indoor resting places of the vectors.

Indoor residual spraying of DDT has also been shown to have an excito-repellent (agitate and repel) effect on mosquitoes. Spraying DDT on walls therefore has the added benefit of reducing the number of mosquitoes entering indoor spaces.

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[1] The Stockholm Convention on Persistent Organic Pollutants entered into force on 17 May 2004.

[2] UNEP (2001). *Stockholm Convention on Persistent Organic Pollutants (POPs).* UNEP/Chemicals/2001/3. 50 pp. (Document available at: www.pops.int)

[3] WHO (2000). *WHO Expert Committee on Malaria. Twentieth Report.* Geneva, WHO Technical Report Series, No. 892.

Dosage of DDT used for indoor residual spraying

The recommended dosage for indoor residual spraying of DDT is 1–2 grams (g) active ingredient per square metre (m^2) of sprayed surface. The insecticide is normally effective for 6 months or more, depending on the local climate and the conditions of the sprayed surface. Two applications every year are therefore generally sufficient where there is year-round malaria transmission.

5. Is DDT the only insecticide used for indoor residual spraying?

No, DDT is not the only insecticide used for indoor residual spraying. WHO recommends 12 insecticides from four different chemical classes for indoor residual spraying. These insecticides and their recommended dosages are shown in the following table.

Insecticides recommended by WHOPES for indoor residual spraying against malaria vectors[4]

Insecticide compounds and formulations	*Class*	*Dosage (g/m^2)*	*Duration of effective action (months)*
Alpha-cypermethrin WP and SC	P	0.02–0.03	4–6
Bendiocarb WP	C	0.1–0,4	2–6
Bifenthrin WP	P	0.025–0.05	3–6
Cyfluthrin WP	P	0.02–0.05	3–6
DDT WP	OC	1–2	> 6
Deltamethrin WP, WG	P	0.020–0.025	3–6
Etofenprox WP	P	0.1–0.3	3–6
Fenitrothion WP	OP	2	3–6
Lambda-cyhalothrin WP	P	0.02-0.03	3–6
Malathion WP	OP	2	2–3
Pirimiphos-methyl WP and EC	OP	1–2	2–3
Propoxur WP	C	1–2	3–6

EC: emulsifiable concentrate; WG: water-dispersible granules; WP: wettable powder; SC: suspension concentrate; OC: organochlorine; OP: organophosphate; C: carbamate; P: pyrethroid

[4] Najera JA, Zaim M (2002). *Malaria vector control – Decision-making criteria and procedures for judicious use of insecticides.* WHO, Geneva, WHO/CDS/WHOPES/2002.5. (Document available at: www.who.int/ctd/whopes/docs/JudiciousUseRev.pdf)

6. When should indoor residual spraying of DDT be done?

The criteria for indoor residual spraying of DDT for malaria vector control should be clear and science-based. This is essential to ensure that DDT use is both appropriate and effective in reducing the local burden of malaria. Some key criteria are described below.

Vector behaviour and susceptibility

Indoor residual spraying is determined by the resting and feeding habits of the mosquito vector. Deciding on a programme of indoor residual spraying of DDT in preference to other options such as insecticide-treated nets should therefore be guided by a thorough understanding of the behaviour of the vector and the human population in relation to the risks of disease transmission. Indoor residual application of DDT may have very little impact, for instance, if the malaria vector tends to rest and bite outdoors, and does not enter houses.

Information on vector susceptibility and tolerance to DDT should be up-to-date and backed up by an effective pesticide resistance management strategy to ensure continuing pesticide effectiveness. Local vector resistance or increased tolerance to DDT may affect its overall effectiveness. Where there is resistance to pyrethroids, DDT effectiveness may be reduced by cross-resistance. In this event, one method of slowing vector resistance is to widen the choice of insecticides used for indoor residual spraying and rotate the use of those currently effective against mosquitoes (though this will probably increase operational costs).

Where DDT should be used

In theory, indoor residual spraying of DDT may be carried out in almost all eco-epidemiological situations in which disease vectors feed and rest indoors. However, it has been shown to be most effective in reducing the overall malaria burden in unstable transmission areas, areas with marked seasonal transmission peaks and disease outbreaks, and highland areas. If indoor spraying of DDT is carried out just before the transmission period or seasonal peaks, it may disrupt vector population dynamics and shorten transmission periods or even suppress epidemic outbreaks entirely. To be effective in preventing epidemic outbreaks, DDT intervention must be based on reliable prediction of seasonal disease foci. It is therefore necessary to have a good understanding of the risks and benefits associated with the use of DDT in a particular locality before a decision to use the compound is made.

Public acceptance

Indoor residual spraying is most effective, whichever insecticide is used, when coverage in a targeted community is high. The effectiveness of indoor residual spaying of DDT may therefore be undermined if it is poorly accepted by targeted populations. Some people may refuse outright to allow their house to be sprayed; others may clean or re-plaster sprayed walls in order to hide the white residues left by DDT application, thus reducing its effectiveness.

Use of alternate interventions

DDT should be applied as part of an integrated vector management (IVM) strategy.[5] This ensures that options for control of local malaria vectors are determined by a solid understanding of local eco-epidemiological conditions and therefore locally appropriate and effective.

Studies have shown, for example, that insecticide-treated nets are as effective as indoor residual spraying in reducing malaria transmission in many eco-epidemiological settings. Other non-DDT interventions that can be used in the context of IVM include alternative insecticides such as pyrethroids, environmental modifications to eliminate vector breeding places, and biological control (e.g. bacteria, fungi, nematodes, copepods, larvicidal fish). Any decision to use DDT and/or another intervention option should be made only after careful evaluation of effectiveness and prioritization, to ensure that available resources are used in a most cost-effective manner.

Cost of DDT use for disease vector control

While the cost of applying DDT has been shown in some settings to be lower than the cost of using insecticide-treated nets, the total cost of a DDT programme may eliminate this advantage if no attempt is made to maximize programme efficiency. Operational costs for DDT application in widely dispersed and isolated populations may be prohibitive because of the need to transport spraying personnel and equipment.

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[5] In simple terms, IVM is the concurrent use of two or more locally appropriate and effective vector control interventions (chemical and/or non-chemical) in a carefully structured and managed operation to limit disease transmission as much as possible. Intervention options are selected on the basis of local ecology, disease epidemiology, human population parameters (behaviour, livelihood, etc.), available resources and probable efficacy of implementation.

7. What other requirements can ensure effective DDT use in indoor residual spraying?

Human and technical resources in the form of good management and spraying practices are required in order to achieve a significant and sustainable reduction in the local malaria burden. Other factors that must be borne in mind are the scope and technical proficiency of the programme (e.g. staff skills and training, equipment, decision-making pathways, institutional framework), financial resources, and human and environmental safety. These requirements, however, are typical of any intervention on disease transmission.

Indoor residual spraying must be done by trained technicians. Effective DDT use is also subject to public acceptance, and access to homes will be granted only to personnel who are seen as trustworthy. Spraying personnel should therefore be carefully selected and made aware of relevant cultural issues.

General procedures for indoor residual spraying of insecticides are covered in detail in WHO's *Manual for indoor residual spraying – application of residual sprays for vector control.*[6]

Safe DDT management and use

It must always be remembered that DDT poses a potential risk for the environment and human health. Every effort should therefore be made to protect human health adequately and to prevent insecticide release into the environment. This applies especially to insecticide storage and transportation. It is important to evaluate the potential risks associated with local methods of pesticide handling and transportation and to implement adequate preventive measures.

Safe DDT management and use are more pressing issues in countries with a decentralized or decentralizing policy that delegates responsibility for pesticide management to local authorities. Judicious use and safe management of DDT are fostered by developing clear criteria for DDT use in malaria control, transparent decision-making and direct accountability.

The Stockholm Convention on Persistent Organic Pollutants (POPs) advocates the use of "best available techniques" and "best environmental practices" when dealing with pesticides such as DDT:

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[6] WHO (2000). *Manual for indoor residual spraying – application of residual sprays for vector control.* WHO/CDS/WHOPES/GCDPP/2000.3 Rev.1 (Document also available online at: www.who.int/ctd/whopes/docs/irs_manual.pdf)

- "Best available techniques" are the most effective and advanced operational activities and methods for reducing the release and subsequent environmental impact of pesticides.
- "Best environmental practices" are the most appropriate combination of environmental control measures and strategies that can be applied.

Effective regulatory mechanisms must be in place to ensure that DDT is not used for non-recommended purposes. The Stockholm Convention therefore recommends that any country using DDT for malaria vector control should undertake a comprehensive evaluation of the adequacy and effectiveness of its existing legal instruments, regulations and policies in respect of DDT importation and management. A centralized regulatory and administrative authority should be set up to supervise DDT procurement or importation and use, thus guaranteeing the quality of any imported insecticide used.

The establishment of a comprehensive and active national DDT inventory is also highly recommended, as it will ensure that any DDT imported or used is closely audited.

Public education/training

Information, awareness and education aimed at policy- and decision-makers as well as the general public should be a major component of DDT use for disease vector control. These should include awareness-raising programmes targeted at the most vulnerable members of the community, including women and children and the less well-educated.

The goal should be to involve all stakeholders and provide tools to guide the individual and community in selecting appropriate personal and environmental protection.

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