This framework provides guidance on the development of a national insecticide resistance monitoring and management plan, including content and key considerations to be taken into account. It is designed to help countries ensure adherence to the objectives and recommendations of the Global plan for insecticide resistance management in malaria vectors.

**Background**

- Insecticides are critically important for malaria prevention. An estimated 663 million cases of malaria have been averted in sub-Saharan Africa since 2001 as a result of the scale-up of malaria control interventions: of these, 69% of cases were averted through the use of mosquito nets treated with insecticides and 10% through indoor residual spraying of insecticides.

- Resistance to insecticides has been found in all major malaria vector species and to all four insecticide classes currently recommended for nets and sprays. Failure to mitigate insecticide resistance will eventually result in increased malaria burden and have significant cost implications for malaria prevention.

- The *Global plan for insecticide resistance management in malaria vectors* (GPIRM) outlines a comprehensive plan for action to address insecticide resistance. However, implementation of the GPIRM has been slow at national level.²

- This framework provides additional guidance to support countries in developing insecticide resistance monitoring and mapping plans (IRMMPs), with an aim of securing the required financial resources to conduct essential monitoring activities. These activities are an integral part of the vector control component of any national malaria strategic plan.
Summary of guidance

The framework includes an overview of the key elements of an effective national plan to monitor and manage insecticide resistance, as well as a guide for establishing an annual workplan to support implementation. The following is an overview of the recommended structure and content for an IRMMP.

A1. Executive summary

The executive summary should provide a concise overview of the overall plan and of the human and other resources required for implementation.

A2. Situational analysis

A comprehensive and thorough situational analysis will provide an analytical review of relevant data on the current malaria situation in a country. It should include:

- A brief overview of the country’s malaria epidemiology and current vector control interventions;
- A brief summary of insecticide compounds and formulations registered and the amounts used;
- A detailed description of the malaria vector species that are present, their insecticide susceptibility status and their resistance mechanisms, where known;
- A brief summary of key evidence on malaria vector control and of any knowledge gaps;
- A list of the partners involved in insecticide resistance monitoring or management activities;
- Identification of risks and of financial, human and other resource constraints that may impede the implementation of a comprehensive IRMMP; and
- An indication of the measures in place to address the various challenges.

A3. Implementation framework

This section should clearly state the objectives, rationale, and methodology of the IRMMP, as well as the structures and mechanisms for supporting effective implementation in the country and the proposed resistance monitoring and management activities. Details to include are:

- Monitoring: the criteria used to select established and proposed insecticide resistance monitoring sites; the mosquitoes to be targeted for testing and the procedures; the specific type or types of tests that will be used; data recording and reporting procedures; and a summary of procurement and supply schedules.

- Management: the status and proposed membership of a decision-making body to coordinate national activities and ensure that any change in vector control policy or an IRMMP can be funded and implemented effectively, including an outline of the process for interpretation of test results and their policy implications.

- Additional information: tasks, activities and timelines; human resource requirements; comprehensive budget and potential sources of funding; risks and how to address these.
B. Annual workplan

An annual workplan for IRMMP implementation should also be devised that includes a clear definition of the main tasks and associated activities, along with timelines for their implementation for the year and a comprehensive budget. A sample workplan and budget template are included in the guidance.

Challenges and opportunities

Vector control planning and implementation activities that are in line with insecticide resistance management practices can be challenging. Data may be sparse, there are currently few resistance management options, and resources may be limited. Thus, a national plan and data on insecticide susceptibility are imperative to inform how current and new tools should best be used. A robust IRMMP will help secure support for national activities inform the use of new vector control tools that will soon be available, and provide further options for insecticide resistance management.

Next steps

Countries developing IRMMPs should proceed to finalize and integrate these documents into existing national strategic plans for malaria. WHO is available to provide technical support for the development and implementation of these plans. Please contact gmp-ir@who.int for more information.

Notes


QUESTIONS AND ANSWERS

Dr Jan Kolaczinski, Coordinator, Entomology and Vector Control Unit, WHO Global Malaria Programme; Dr Tessa Knox, Technical Officer, Entomology and Vector Control Unit, WHO Global Malaria Programme

1. What is insecticide resistance and what threat does it pose to tools used to fight malaria?

Jan: Insecticide resistance is an evolutionary response to selection pressure. One of the ways we fight malaria transmission is by using insecticides to kill large amounts of mosquitoes at the same time. However, some mosquitoes may survive exposure to insecticides due to certain genetic characteristics. These mosquitoes then pass this ability on to their offspring, and so forth, resulting in an increasingly resistant population over time.
Tessa: And this is a concern because the vast majority of gains made against malaria since 2000 can be attributed to insecticide-based interventions, namely insecticide-treated bednets and indoor residual spraying of insecticides. Recently we’ve seen increases in vector resistance to insecticides used in these tools and are concerned that this may threaten their effectiveness at preventing malaria.

Jan: At the moment, there is ongoing debate in the malaria community around the extent to which effectiveness is being reduced by resistance. From history we know that insecticide resistance can have an impact on malaria control efforts using indoor residual sprays. But bednets work both because they are impregnated with insecticides that kill mosquitoes and because they serve as a physical barrier between an infective mosquito and a person. So it can be difficult to identify the extent to which the effectiveness of the nets is impacted by insecticide resistance alone. A recent large evaluation across five countries found that treated nets still reduced malaria in study areas with moderate levels of resistance to the pyrethroid insecticides used on the bednets.

2. How is insecticide resistance measured?

Tessa: One way to measure resistance is to collect mosquitoes or their larvae, raise them or their progeny to adult mosquitoes, and then expose the adults to a fixed dose of insecticide on paper lining a plastic tube or coated on the inside surface of a glass bottle. The percentage of mosquitoes that survive exposure to the insecticide is an indication of whether or not there is resistance in mosquitoes from that location. WHO has outlined test procedures to guide countries in finding out where insecticide resistance is present, how intense it is, and what the underlying causes or mechanisms are.

3. How do countries use the data they’ve collected?

Jan: The data are meant to help countries make strategic decisions as to which interventions they deploy. And making decisions around insecticide resistance management is tough: it’s not just a question of what countries should do, but rather what they can do. Depending on the data, you might have very few options and the preferred options might be significantly more expensive. Newer tools may be more effective, but if they cost more it could compromise the number of people that can be covered with vector control. Having robust data is critical to inform these difficult decisions.

Tessa: Another important use is for global advocacy. Right now, we have a lot of data that clearly illustrate the extent of the insecticide resistance problem. And that’s not to be underestimated: any investment into development of new vector control tools – such as those to address insecticide resistance – needs to be guided by good data.

4. What led to the development of guidance for national programmes to develop plans to monitor and manage insecticide resistance?

Jan: Until recently, the collection of insecticide susceptibility data was not done regularly and was not really seen as a priority. When you have limited resources, you don’t start collecting new data unless you can see how it will inform new choices. The choices for malaria vector control have been limited – but that is about to change. New tools such as those using new insecticides will soon be available, and data on insecticide resistance will be critical to inform how and where they should be used.
Tessa: Also, the evidence base on insecticide resistance has been steadily growing, and there is a clear need for ongoing, frequent, and representative monitoring of the situation. Countries should be generating enough data to inform decision-making and then using that data in an optimal way. The national programme should be in the driving seat: from managing a database that is updated on a regular basis so that they always have at their disposal the most up-to-date and complete information possible, to using that information to plan and implement data-driven vector control.

Jan: We developed the framework to help countries think strategically through this and other aspects of a national plan to monitor and manage resistance. The framework guides countries through the process of developing a situation analysis, an implementation plan, and an appropriate budget. The idea is to end up with a comprehensive plan that can be incorporated into the larger national strategic plan.

5. What additional advice do you have for countries developing resistance monitoring and management plans?

Jan: Funding is available for countries to do this work, such as through the Global Fund. We really encourage countries to explore various funding options – a fully costed plan will assist in this. A number of countries have already finalised national plans, and these serve as a good example. WHO is committed to provide technical support to national programmes in the development and implementation process through our country and regional offices, and can also be contacted at gmp-ir@who.int for further information.

Notes
