Framework for a national plan for monitoring and management of insecticide resistance in malaria vectors

Webinar

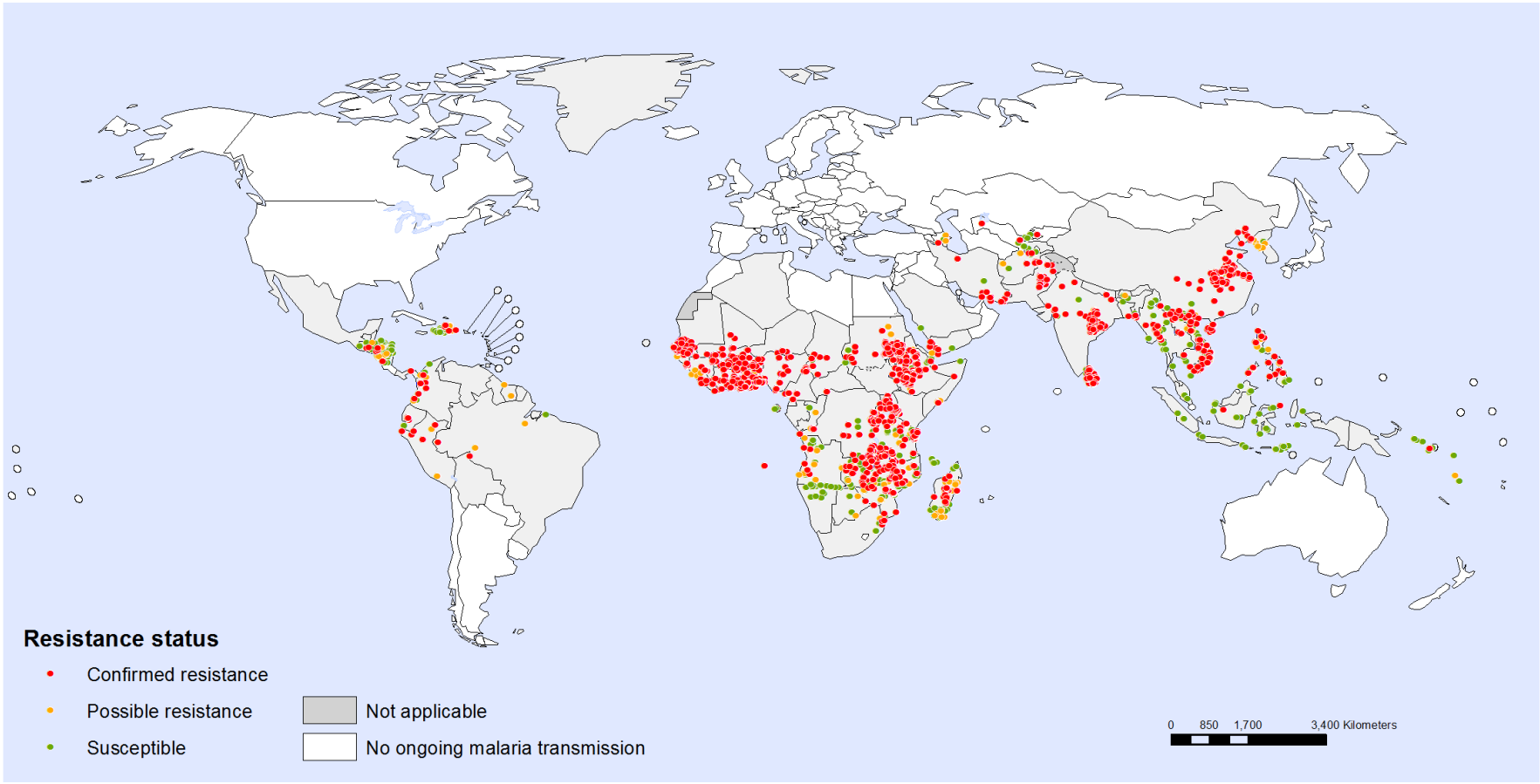
25 July 2017

Global **Malaria** Programme

World Health Organization

Insecticide resistance in malaria vectors

Reported insecticide susceptibility status for malaria vectors, 2010–2015



Data shown are for standard dose bioassays. Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

Data Source: World Malaria Report 2016
Map Production: Information Evidence and Research (IER)
World Health Organization

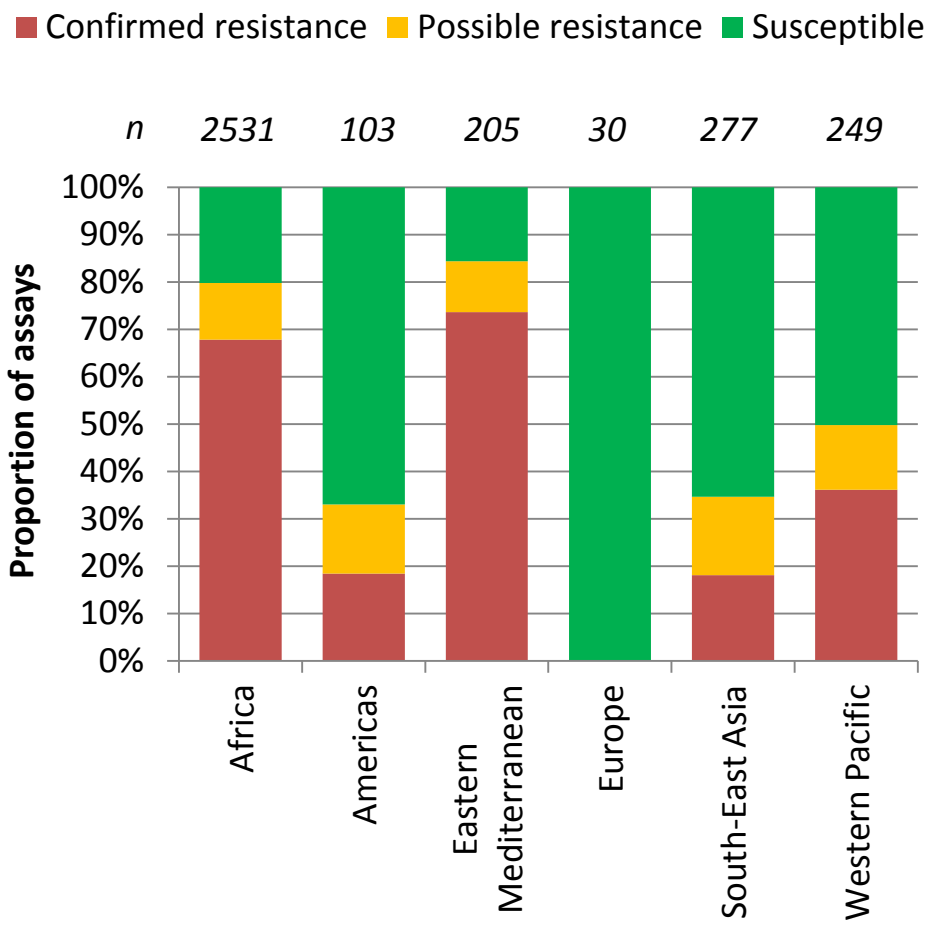
World Health Organization

Resistance confirmed: 60 countries; all major vectors; all 4 insecticide classes

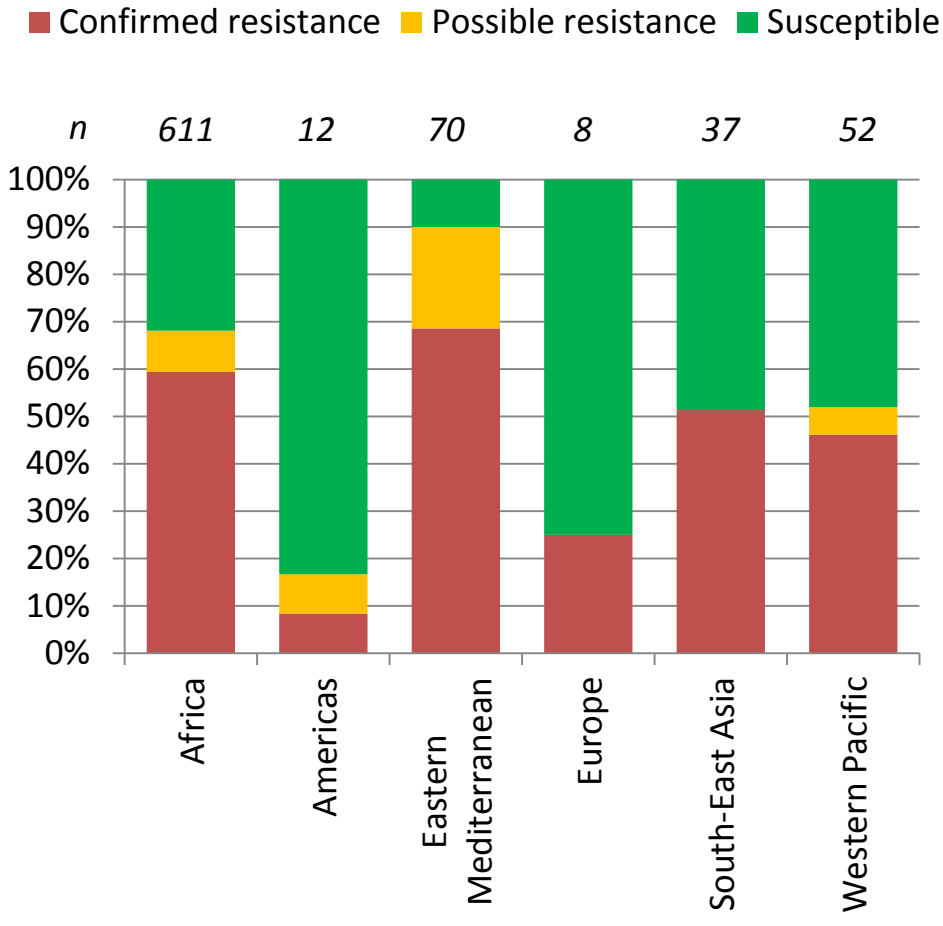
Resistance detected across all regions and insecticide classes

Outcomes from standard resistance bioassays, 2014-2017, by WHO region

PYRETHOIDS



ORGANOCHLORINES



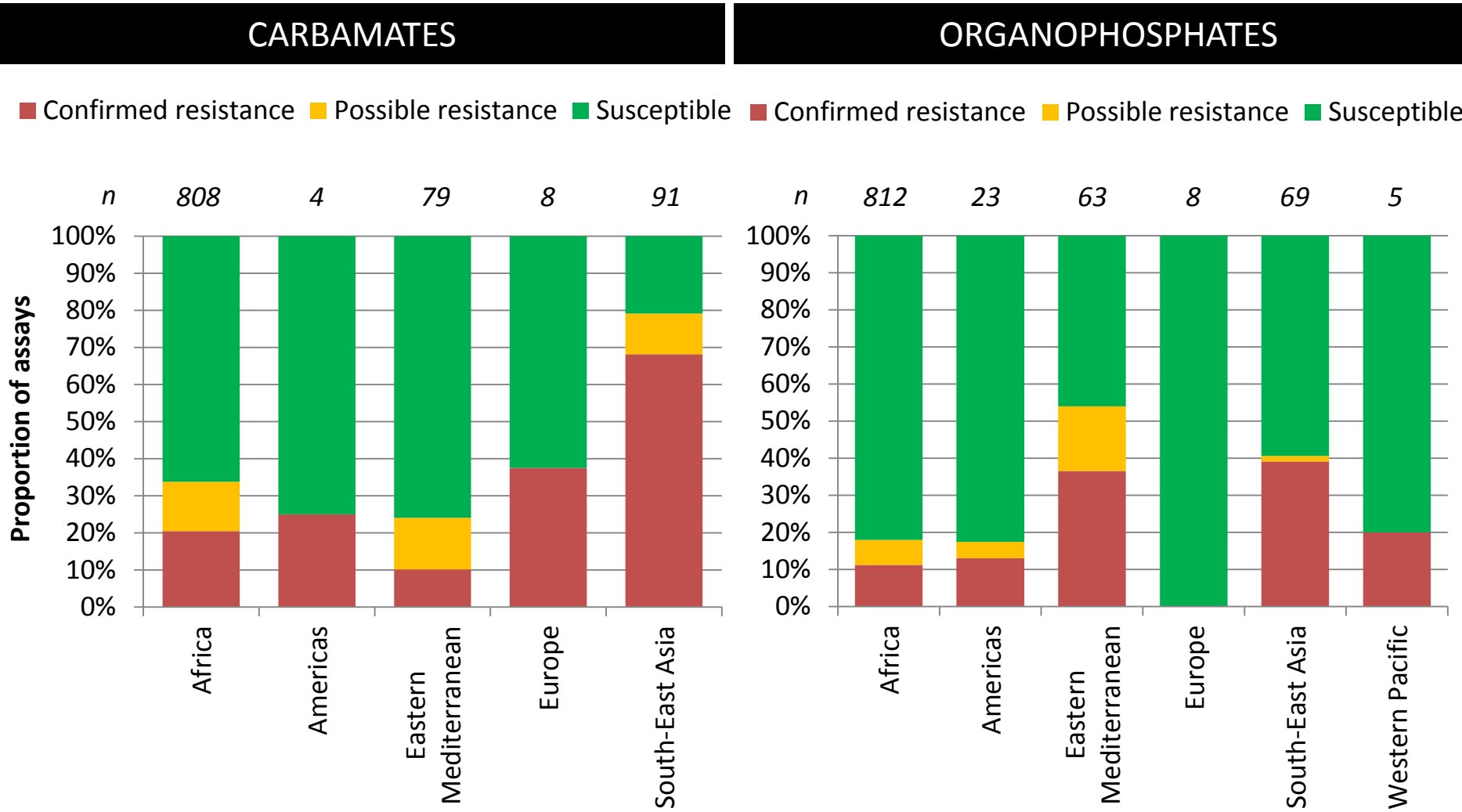
Global Malaria Programme

Source: WHO insecticide resistance database

World Health Organization

Resistance detected across all regions and insecticide classes

Outcomes from standard resistance bioassays, 2014-2017, by WHO region

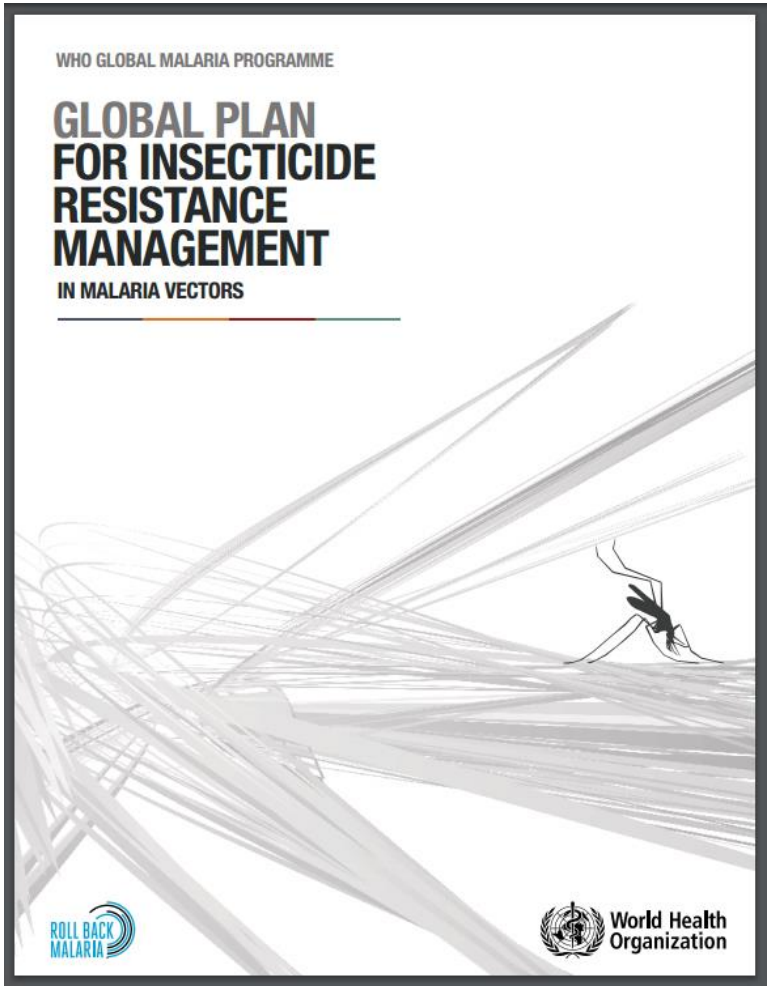


Global Malaria Programme

Source: WHO insecticide resistance database

World Health Organization

Global plan for IR management (GPIRM)

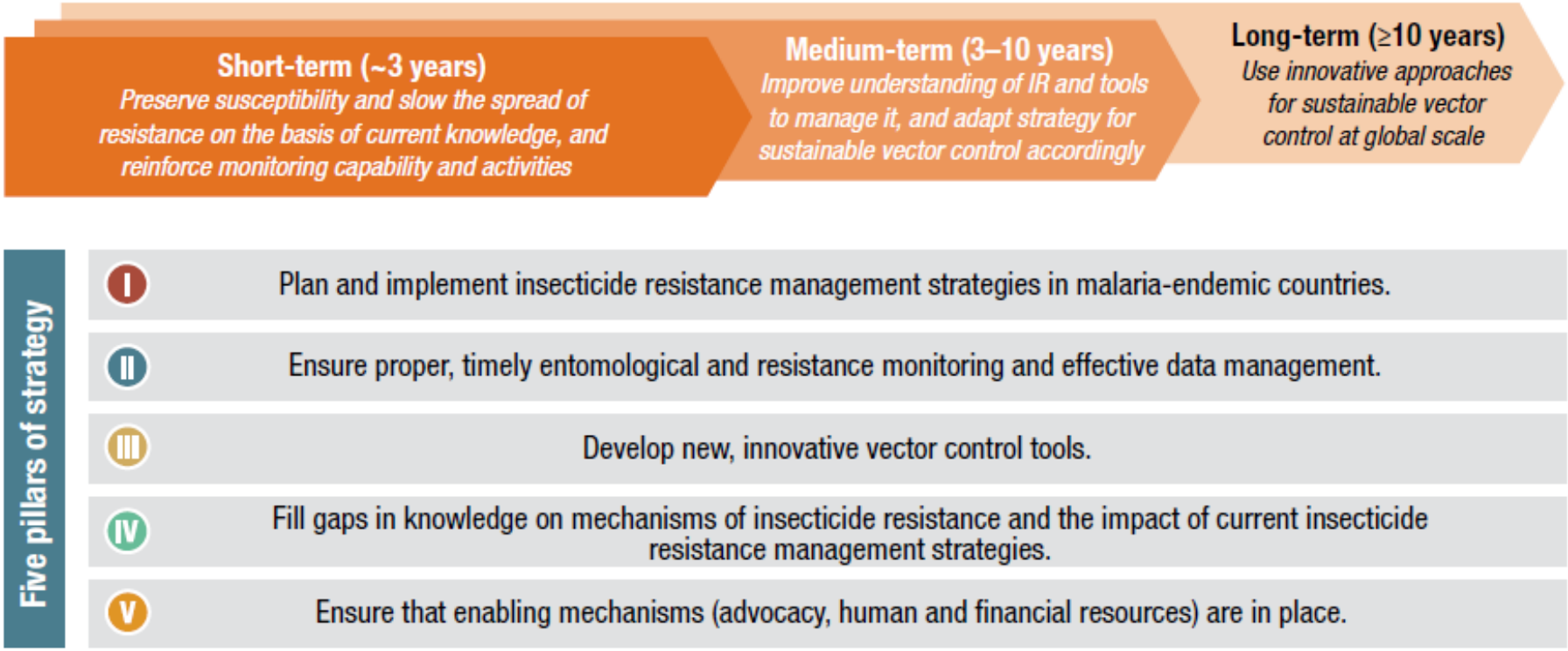


http://www.who.int/malaria/publications/atoz/gpirm/ - *released May 2012*

- Insecticide resistance threatens to reverse recent gains in malaria control.
- Urgent efforts should be taken to prevent the emergence and spread of resistance.
- Countries are urged to develop and implement comprehensive insecticide resistance management strategies.

Five pillars of GPIRM

Figure 1: Five pillars of the Global Plan for Insecticide Resistance Management in malaria vectors



IR, insecticide resistance

1 Including areas in which there is evidence of control failure, areas with significant resistance to pyrethroids, areas with a high malaria burden and intensive use of pyrethroid-based vector control interventions (so that control failure would have devastating consequences) or areas with unknown status of resistance.

Implications of insecticide resistance

WHO-coordinated multi-country evaluation

- Conducted 2009–2016 in Benin, Cameroon, India, Kenya and Sudan.

Primary objectives

- To assess trends in insecticide resistance status and underlying mechanisms in main malaria vector species in response to different interventions.
- To determine the impact of insecticide resistance in malaria vectors on the protective effectiveness of LLINs and IRS, and therefore on malaria disease burden.

Evaluation design

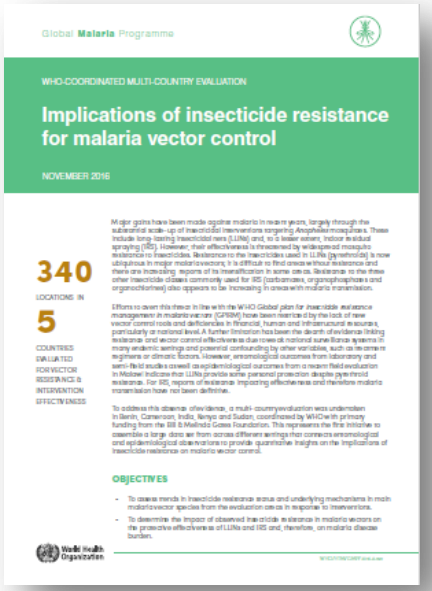
- See: Kleinschmidt et al. (2015) *Malaria Journal* 14:282

Summary of study outcomes

- There was **no evidence of an association between malaria disease burden and pyrethroid resistance** across all locations.
- There was **evidence that LLINs provided personal protection against malaria in areas with pyrethroid resistance**. There was no difference detected in LLIN effectiveness between higher and lower pyrethroid resistance.
- Impact on community effect was not measured and levels of resistance were moderate.
- Similar results were found from a study in Malawi (Lindblade et al. 2015)

Implications for vector control & surveillance

- Universal coverage with effective vector control of all at-risk populations is essential to protect against malaria.
- LLINs continue to provide protection even in the face of resistance, but transmission is still occurring. New tools and strategies are required to proceed to elimination.
- Countries are urged to develop and implement national insecticide resistance monitoring and management plans.
- Better measures of insecticide resistance are needed that correlate with operational impact.



http://www.who.int/malaria/publications/atoz/insecticide-resistance-implications/ - November 2016

Main methods for monitoring resistance

Images: Sven Torfinn/WHO

WHO susceptibility test

CDC bottle bioassay

Updated test procedures for monitoring resistance

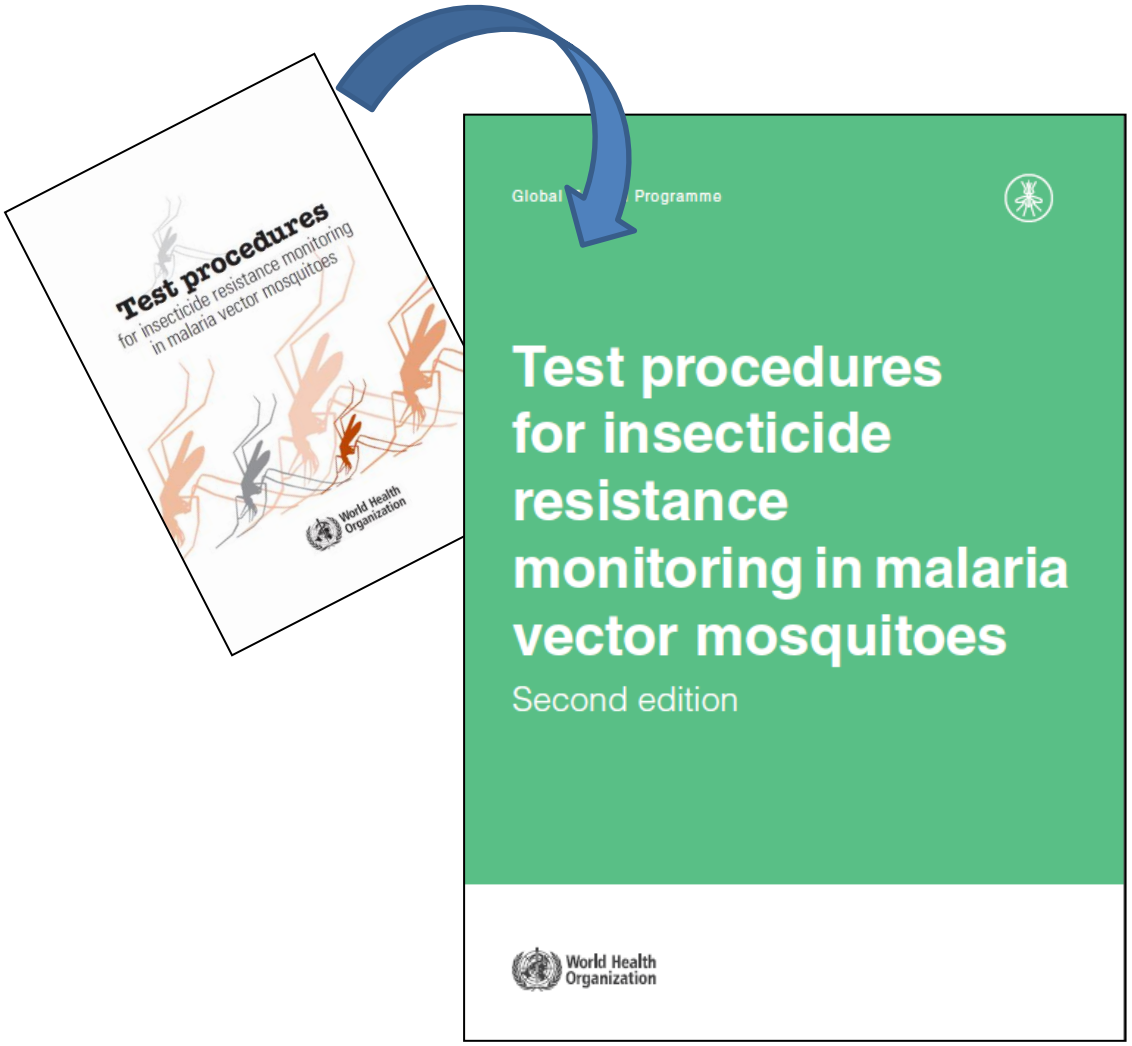


Image: Sven Torfinn/WHO

http://www.who.int/malaria/publications/atoz/9789241511575/ - November 2016

Insecticide resistance monitoring is essential

It is essential to conduct insecticide resistance monitoring on at least an annual basis.

When resistance is detected, further investigations should be initiated to:

- ✓ Measure resistance intensity
- ✓ Identify resistance mechanisms

Based on this information, appropriate options to respond to emerging resistance can be identified and implemented.

Image: Sven Torfinn/WHO

Insecticide resistance management is essential

- Current options for resistance management are limited
- Ultimately, new tools as well as **new active ingredients** for both LLINs and IRS are needed for the management of insecticide resistance

Image: Sven Torfinn/WHO

Limited options – but need to plan for the future

LLINs

Now: nets with pyrethroid or pyrethroid + synergist

In process: nets with pyrethroid + other AI

IRS

Now: formulations of pyrethroid, DDT, carbamate or organophosphate

In process: formulations of other AI or pyrethroid + other AI (mixture)

✓ Multiple classes can be used in rotation or mosaics

Combination of IRS and LLINs:

Now: pyrethroid LLINs plus non-pyrethroid IRS can be used to manage resistance - but limited evidence that combining reduces malaria burden.

✓ Programmes should focus on delivery of either IRS or LLINs at high coverage and high quality rather than adding to compensate in deficiencies of the first.

Insecticide resistance management is complex

Defining the appropriate insecticide resistance management strategy for a given situation is **highly complex**, as it depends on multiple entomological, ecological, epidemiological and operational considerations.

Image: Sven Torfinn/WHO

Framework for IR monitoring and management

- Framework provides guidance to countries for developing national plans to monitor and manage insecticide resistance, and to assist in securing the required financial resources to conduct essential monitoring activities.
- Framework is adaptable and designed to help countries ensure adherence to the objectives and recommendations of the GPIRM.

http://www.who.int/malaria/publications/atoz/9789241512138/ - March 2017

How IRMMPs feed into NMSPs

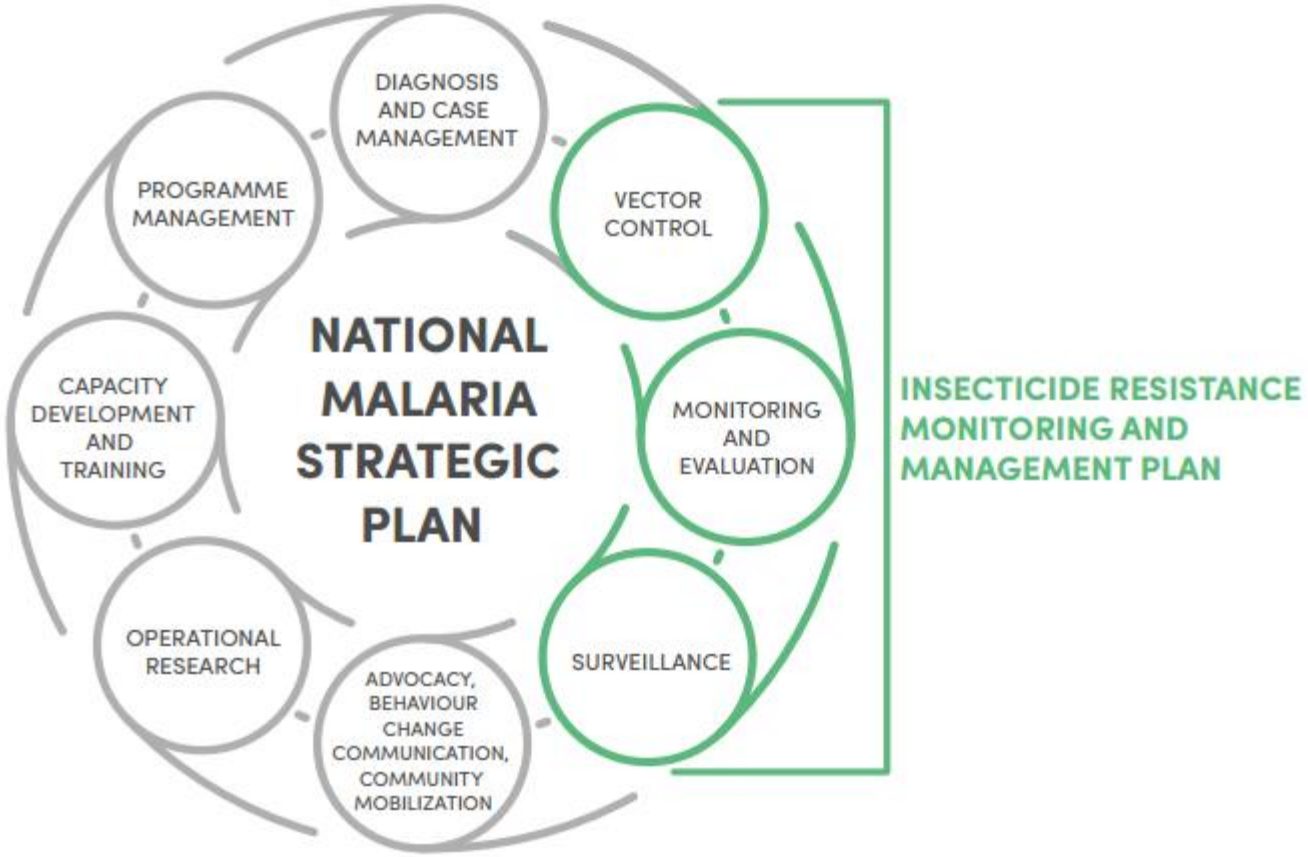


FIG. 1
Simple graphical representation of how an IRMMP feeds into the national malaria strategic plan

Key elements of an IRMMP

- **Executive summary** – a concise overview of the plan's objectives, rationale, monitoring methodology and decision-making process.
- **Situational analysis** – provides an analytical review of relevant data on a country's malaria situation.
- **Implementation framework** – states the criteria, structures and mechanisms to support implementation, as well as tasks, activities, human resources and budget.
- **Annual workplan** – includes annual tasks, timelines and budget.

Situational analysis overview

A **situational analysis** should include summaries of the following:

- The country's malaria epidemiology and current vector control interventions;
- Insecticide compounds and formulations registered and the amounts used;
- Malaria vector species that are present, their insecticide susceptibility status and their resistance mechanisms;
- 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 implementation; and
- An indication of the measures in place to address the various challenges.

Implementation framework overview

The **implementation framework** should include details on:

- **Monitoring**: 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**: 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 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.

Sample annual workplan (excerpt from full table)

FIG. 7
Example of a table outlining tasks, objectives, activities, body responsible and timelines

TASK	OBJECTIVES	ACTIVITY	RESPONSIBLE	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
Capacity building	To enable appropriate insecticide resistance monitoring and management through human and infrastructural capacity enhancement	Recruit necessary personnel to fill identified gap	NMCP	x	x																		
		Conduct training of established and new personnel (followed by ongoing mentorship)	NMCP / partners			x				x				x				x				x	
		Improve laboratory and insectary facilitates and procure necessary equipment	NMCP / research institute	x	x											x	x						
Insecticide resistance monitoring	To conduct annual evaluations of insecticide resistance at all sentinel sites to support evidence-based decision-making	Establish sentinel sites	NMCP	x	x																		
		Carry out field collections of larvae (or bloodfed adults as required)	NMCP	x		x		x		x		x		x		x		x		x		x	
		Rear larvae to adult mosquitoes in field insectary	NMCP	x		x		x		x		x		x		x		x		x		x	
		Conduct morphological species identifications (and using other techniques as required)	NMCP / research institute	x		x		x		x		x		x		x		x		x		x	
		Conduct bioassays with discriminating and intensity concentrations	NMCP	x		x		x		x		x		x		x		x		x		x	
		Conduct synergist-insecticide bioassays	NMCP		x		x		x		x		x		x		x		x		x		x
		Enter data electronically into standard spreadsheet	NMCP		x		x		x		x		x		x		x		x		x		x
Quality assurance and control	To conduct periodic evaluations of vector control interventions at selected sites to support evidence-based decision-making	Develop and implement monitoring and evaluation plan for interventions (residual efficacy, durability)	NMCP / partner			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		Conduct monitoring and evaluation activities	NMCP / partner	x		x		x		x		x		x		x		x		x		x	
		Enter data electronically into standard spreadsheet	NMCP / partner		x		x		x		x		x		x		x		x		x		x
Data management and dissemination	To streamline system for reporting of insecticide resistance monitoring as well as quality monitoring data	Develop standard national spreadsheets for data reporting, and disseminate to partners involved in data collection	NMCP / WHO	x																			
		Establish and maintain national insecticide resistance database	NMCP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Next steps

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