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# Insecticide Resistance – Databases and Global Status Update

Malaria Vector Control Unit

RBM Vector Control Working Group 10<sup>th</sup> Annual Meeting  
Geneva, Switzerland  
28 - 30 January 2015

# WHO Global Technical Strategy for Malaria, 2016 – 2030

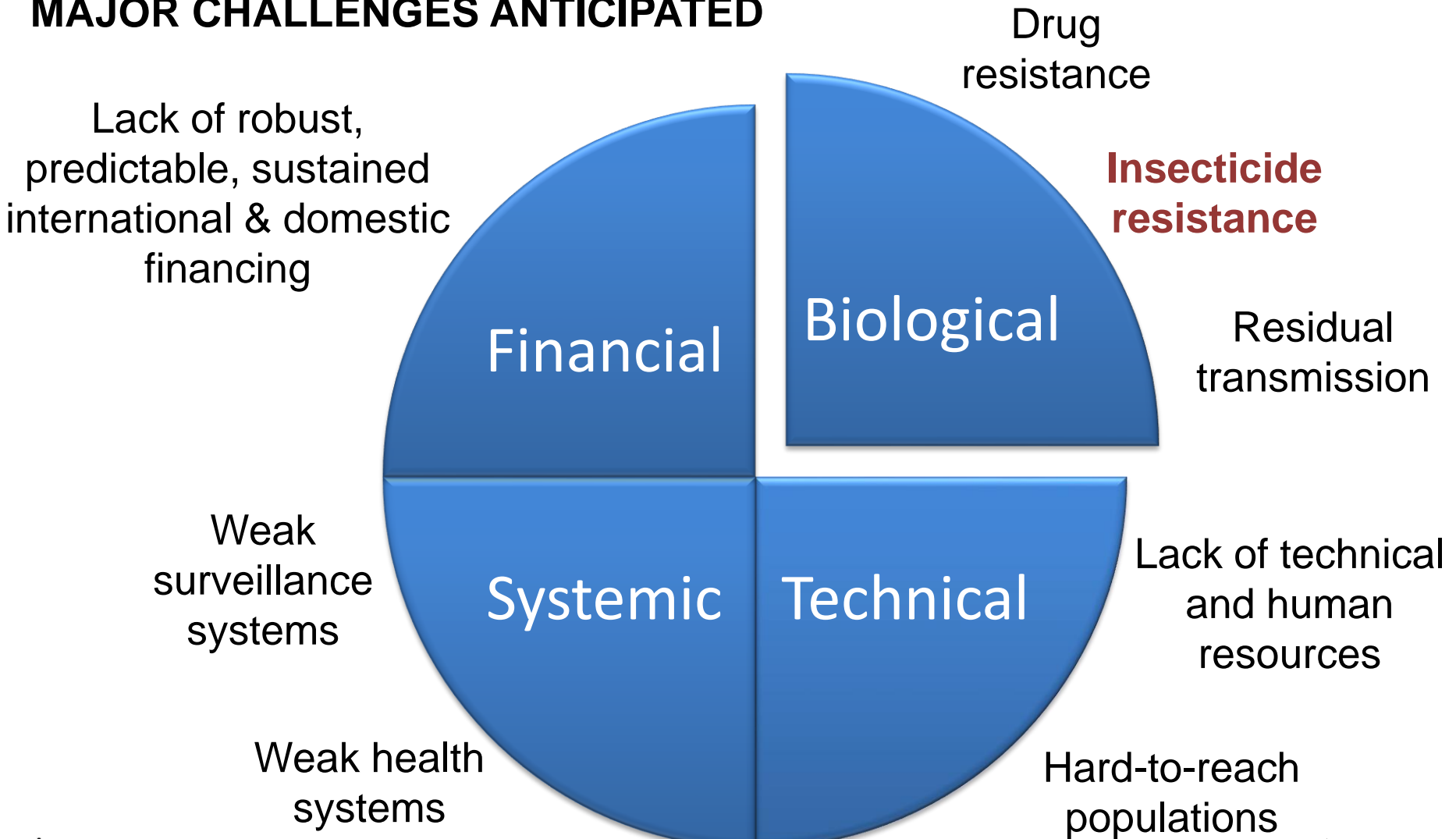


## DRAFT GLOBAL TECHNICAL STRATEGY AT A GLANCE

Vision – A world free of malaria			
Goals	Milestones		Targets
	2020	2025	2030
1. Reduce malaria mortality rates globally compared with 2015	≥40%	≥75%	≥90%
2. Reduce malaria case incidence globally compared with 2015	≥40%	≥75%	≥90%
3. Eliminate malaria from countries in which malaria was transmitted in 2015	At least 10 countries	At least 20 countries	At least 35 countries
4. Prevent re-establishment of malaria in all countries that are malaria-free	Re-establishment prevented	Re-establishment prevented	Re-establishment prevented

# WHO Global Technical Strategy for Malaria, 2016 – 2030

## MAJOR CHALLENGES ANTICIPATED



# Global Plan for Insecticide Resistance Management in malaria vectors (GPIRM): a call to action



*May 2012 - If we take action now, we can stay ahead of the curve and maintain the fabulous gains that we have made.*

# Global Plan for Insecticide Resistance Management in malaria vectors (GPIRM): a call to action

- 5-pillar strategy

## Short-term (~3 years)

*Preserve susceptibility and slow the spread of resistance on the basis of current knowledge, and reinforce monitoring capability and activities*

## Medium-term (3–10 years)

*Improve understanding of IR and tools to manage it, and adapt strategy for sustainable vector control accordingly*

## Long-term (≥10 years)

*Use innovative approaches for sustainable vector control at global scale*

### Five pillars of strategy

I

Plan and implement insecticide resistance management strategies in malaria-endemic countries.

II

Ensure proper, timely entomological and resistance monitoring and effective data management.

III

Develop new, innovative vector control tools.

IV

Fill gaps in knowledge on mechanisms of insecticide resistance and the impact of current insecticide resistance management strategies.

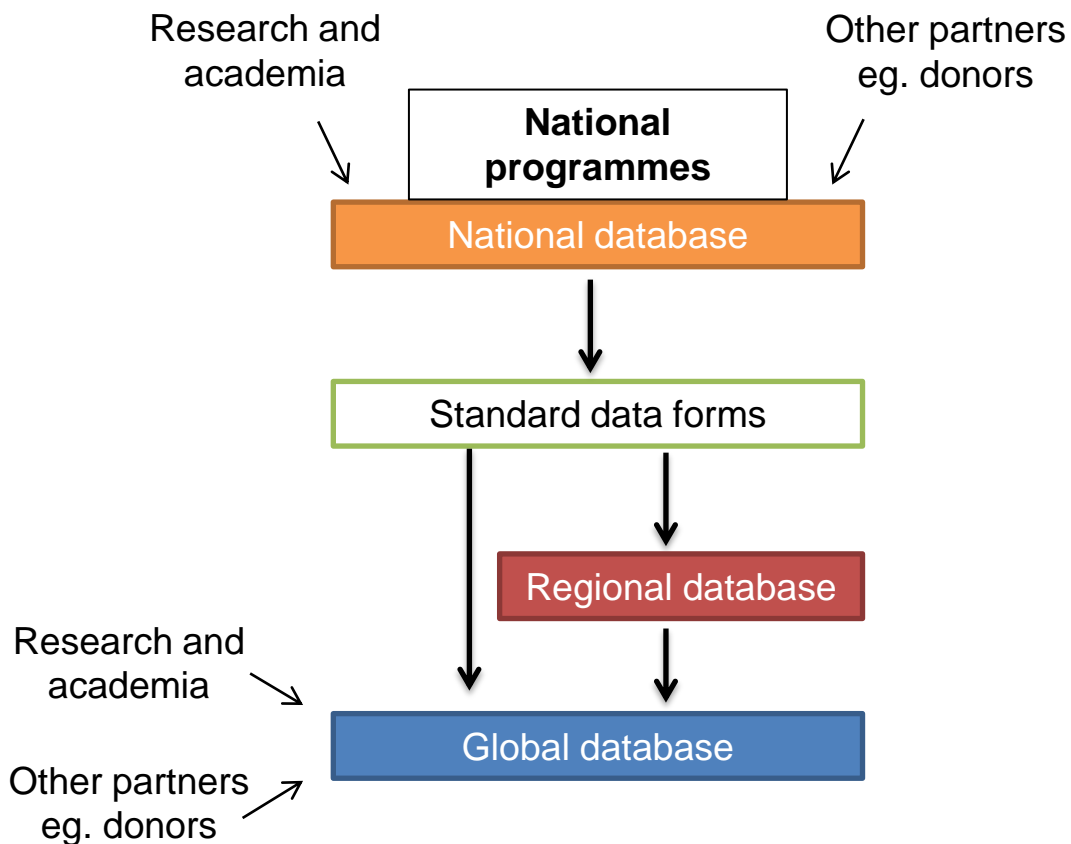
V

Ensure that enabling mechanisms (advocacy, human and financial resources) are in place.

# Databases

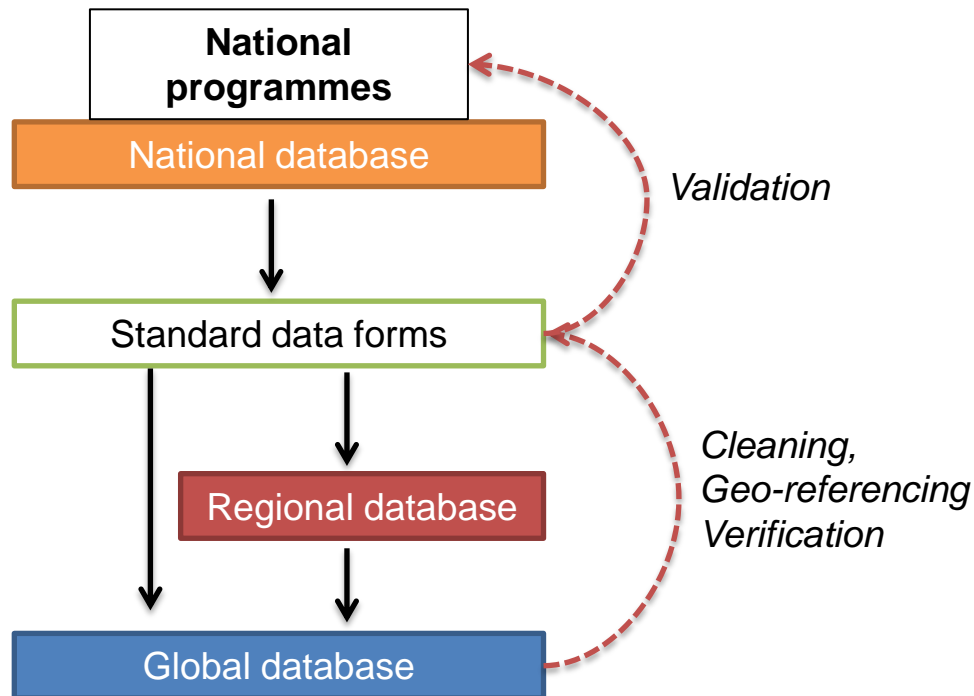
# Insecticide resistance data: Reporting

## DATA CONSOLIDATION (2000-2014)



# Insecticide resistance data: Reporting

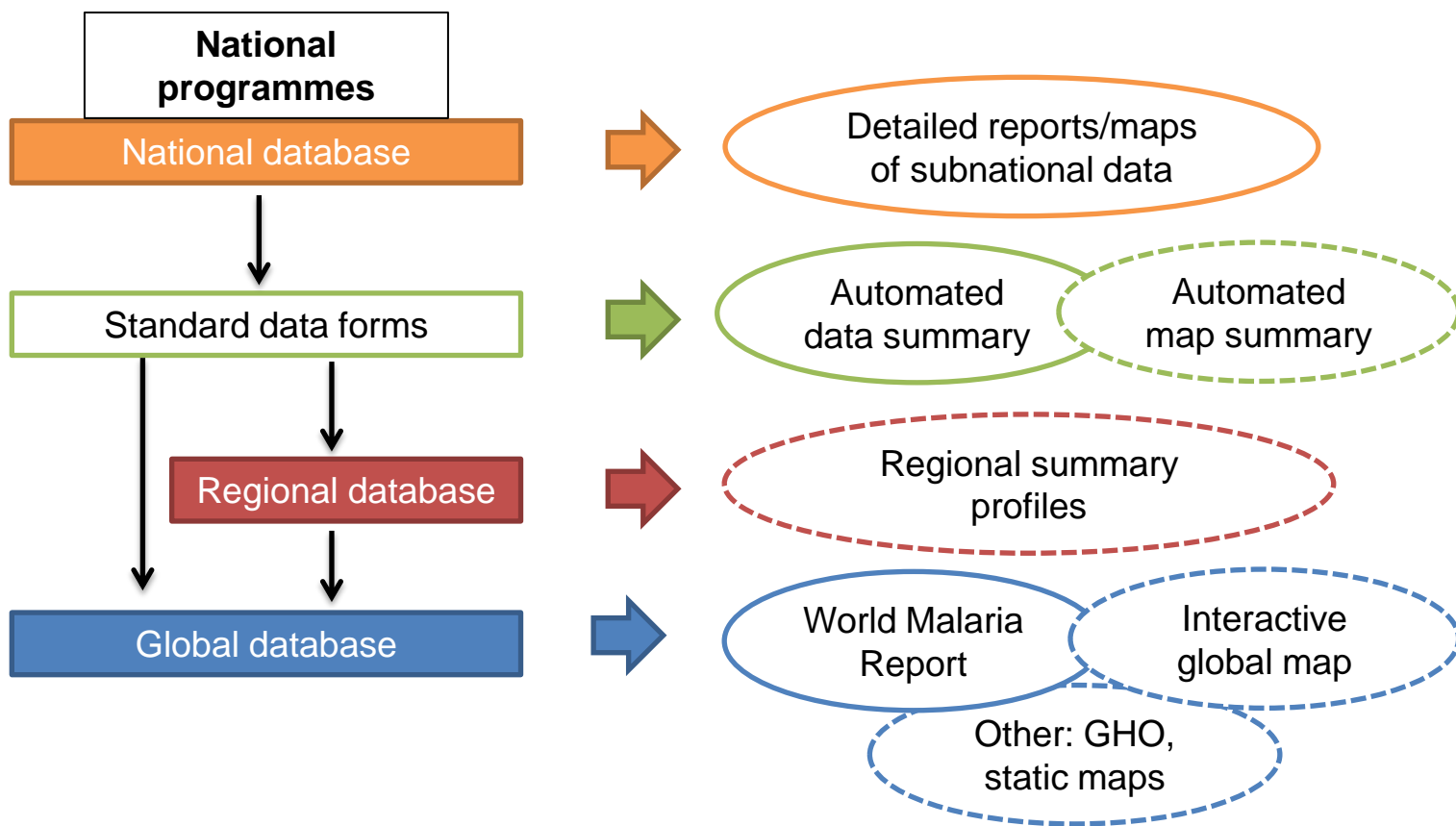
## FEEDBACK





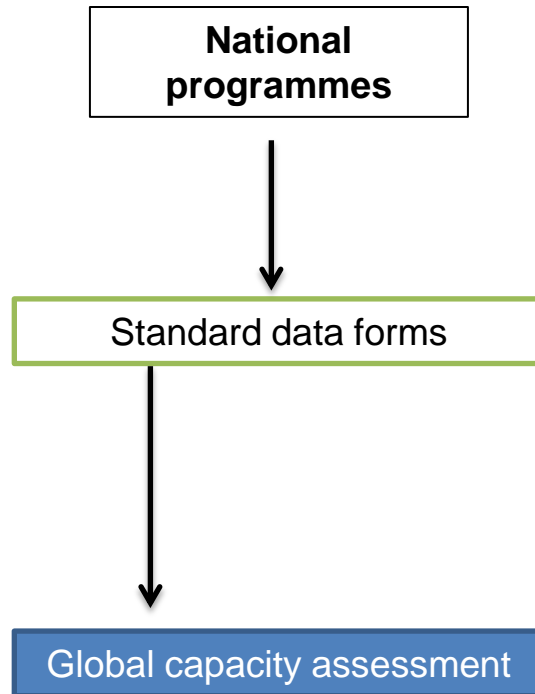
# Insecticide resistance data: Reporting

## OUTPUTS



# Entomological Capacity: Reporting

## PARALLEL PROCESS



# Insecticide resistance data\*: Reporting status

Africa		E. Mediterranean		Europe		Americas		South East Asia		Western Pacific	
Algeria	Liberia	Afghanistan	Azerbaijan	Argentina	Bangladesh	Cambodia					
Angola	Madagascar	Djibouti	Georgia	Belize	Bhutan	China					
Benin	Malawi	Iran	Kyrgyzstan	Bolivia	DPR of Korea	Lao PDR					
Botswana	Mali	Pakistan	Tajikistan	Brazil	India	Malaysia					
Burkina Faso	Mauritania	Saudi Arabia	Turkey	Colombia	Indonesia	Papua New Guinea					
Burundi	Mayotte					Philippines					
Cameroon	Mozambique					Republic of Korea					
Cabo Verde	Namibia					Solomon Islands					
CAR	Niger					Vanuatu					
Chad	Nigeria					Viet Nam					
Comoros	Rwanda										
Congo	Sao Tomé										
Côte d'Ivoire	Senegal										
DRC	Sierra Leone										
Eq. Guinea	South Africa										
Eritrea	South Sudan										
Ethiopia	Swaziland										
Gabon	Togo										
Gambia	Uganda										
Ghana	UR Tanzania (M)										
Guinea	UR Tanzania (Z)										
Guinea-Bissau	Zambia										
Kenya	Zimbabwe										
						Haiti					
						Honduras					
						Mexico					
						Nicaragua					
						Panama					
						Paraguay					
						Peru					
						Suriname					
						Venezuela					

**Data available for 81 countries**  
**Verification process ongoing**

No data received  
 Confirmed that there are no data available (2000-2013)  
 Confirmed that there are no data available (2011-2013)  
 Feedback / confirmation pending  
 Data finalised

\*WHO susceptibility tests and CDC bottle bioassays



# Global Insecticide Resistance Database: overview

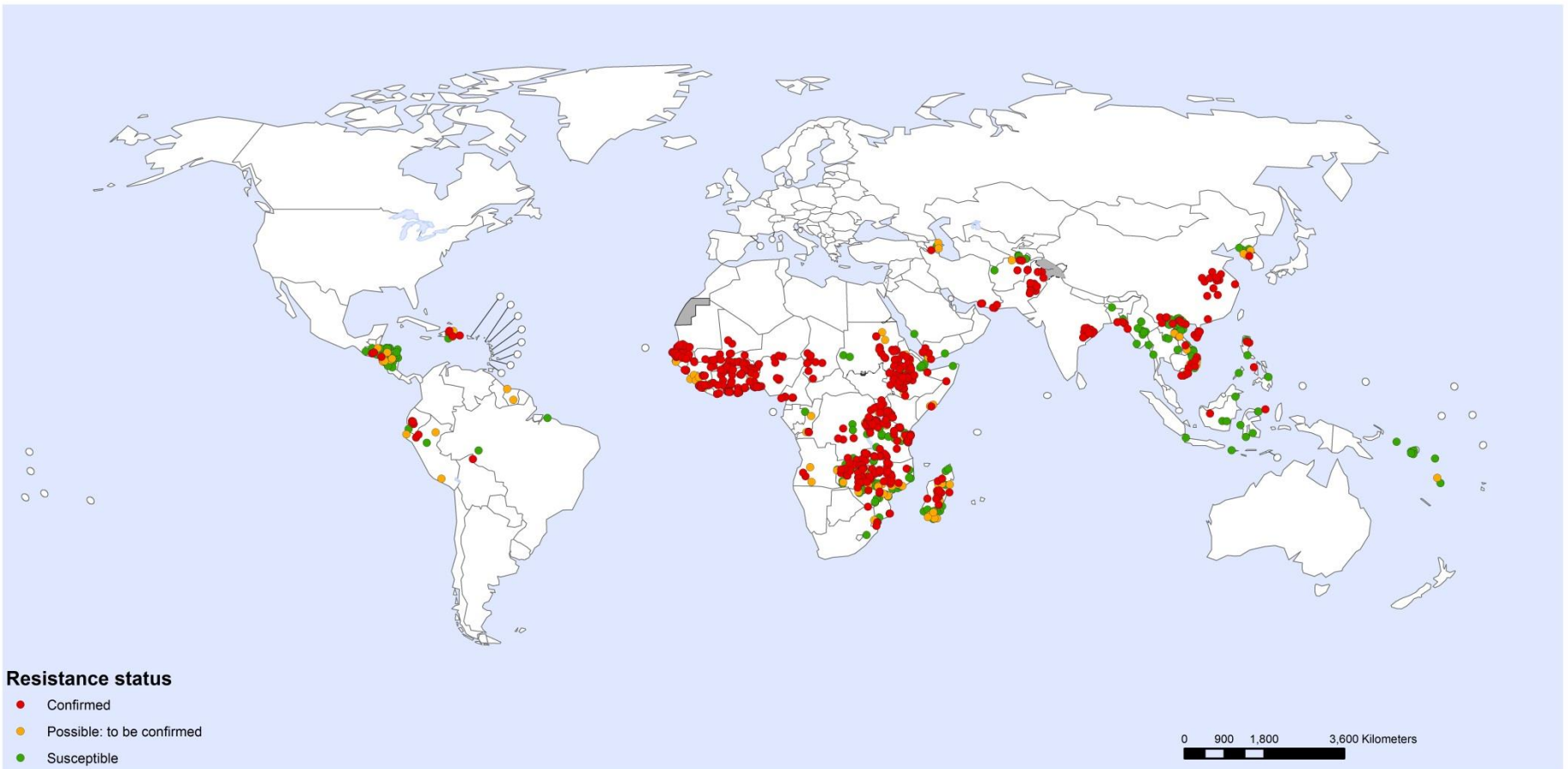
	REPORTED DATA	FILTERED DATA (STANDARD INSECT. + DOSE)
Years	1947 - 2014	1947 - 2014
Countries	81	80
Localities	2090	1988
Vector species names	105	91
Insecticides + doses	189	31
<b>TOTAL BIOASSAY DATA POINTS</b>	<b>13,533</b>	<b>11,932</b>
	(95.4% tube tests, 4.6% bottle bioassays)	(96.1% tube tests, 3.9% bottle bioassays)
Mechanism types	6	
<b>TOTAL MECHANISMS DATA POINTS</b>	<b>768</b>	

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# Global Status Update

# Insecticide resistance: data reported for 64 countries since 2010

## Reported insecticide susceptibility status for malaria vectors (2010-2014)



*Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.*

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

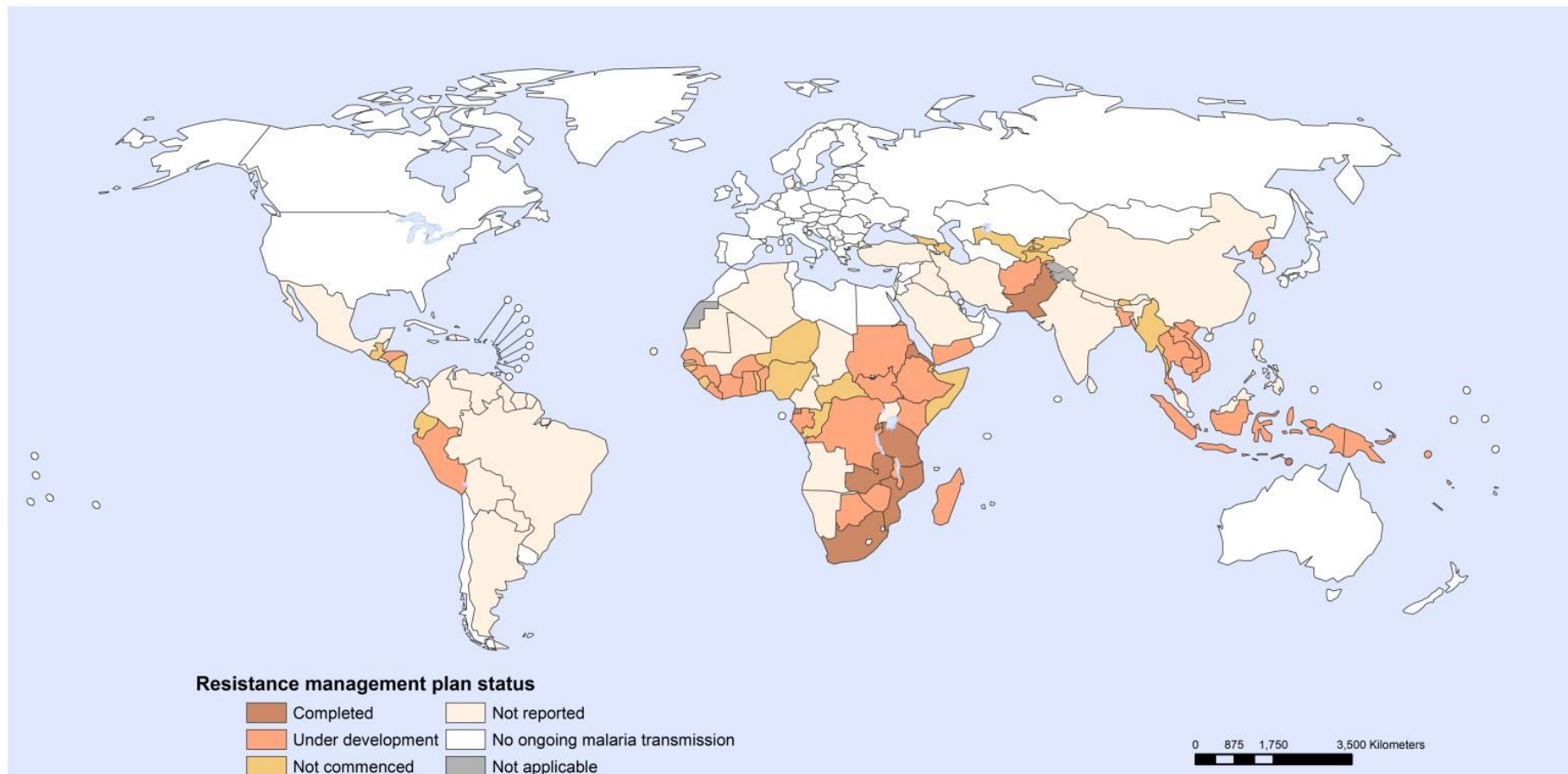
Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
World Health Organization



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# National IR monitoring & management plans: completed for 10 countries

## Status of national insecticide resistance monitoring and management plan (2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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World Health Organization

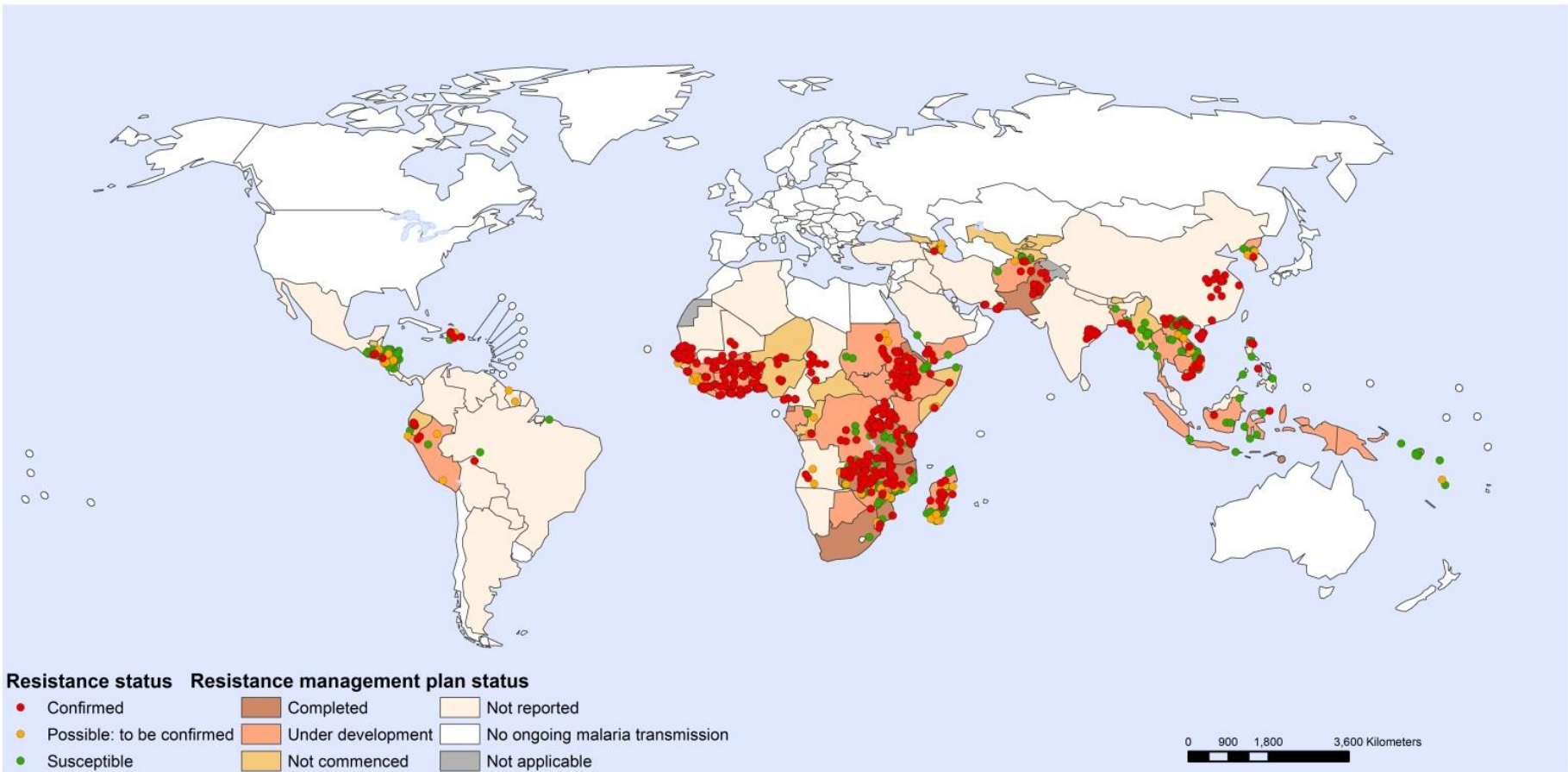


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# Many countries with resistance do not yet have IRM plans – especially outside of Africa

Reported insecticide susceptibility status for malaria vectors (2010-2014)  
and status of national insecticide resistance monitoring and management plan (2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
World Health Organization



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# Pyrethroid resistance: 45 countries and 58% of surveyed sites

## Reported pyrethroid susceptibility status for malaria vectors (2010-2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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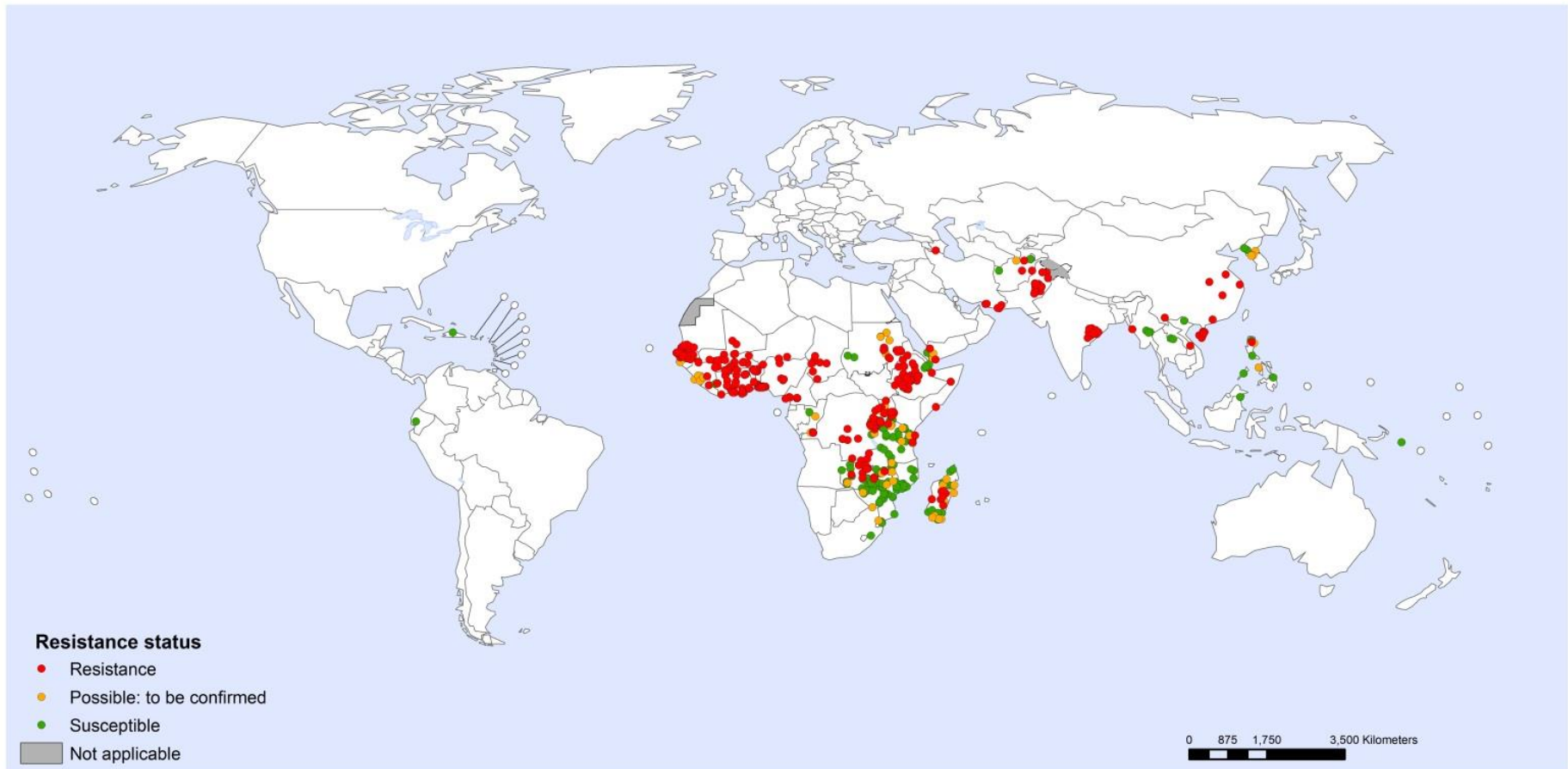
Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
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# Organochlorine resistance: 36 countries and 60% of surveyed sites

## Reported organochlorine susceptibility status for malaria vectors (2010-2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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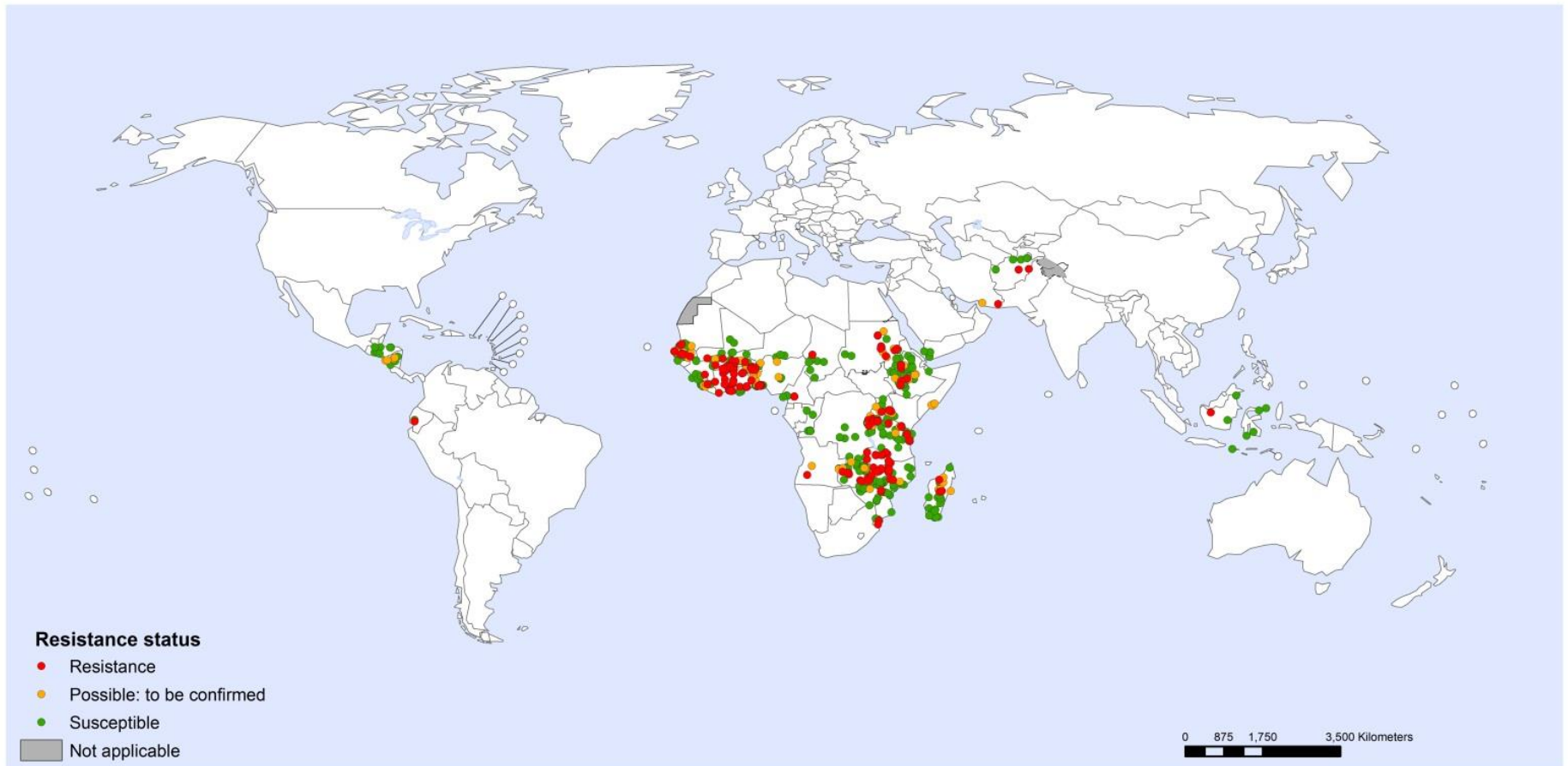
Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
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# Carbamate resistance: 29 countries and 29% of surveyed sites

## Reported carbamate susceptibility status for malaria vectors (2010-2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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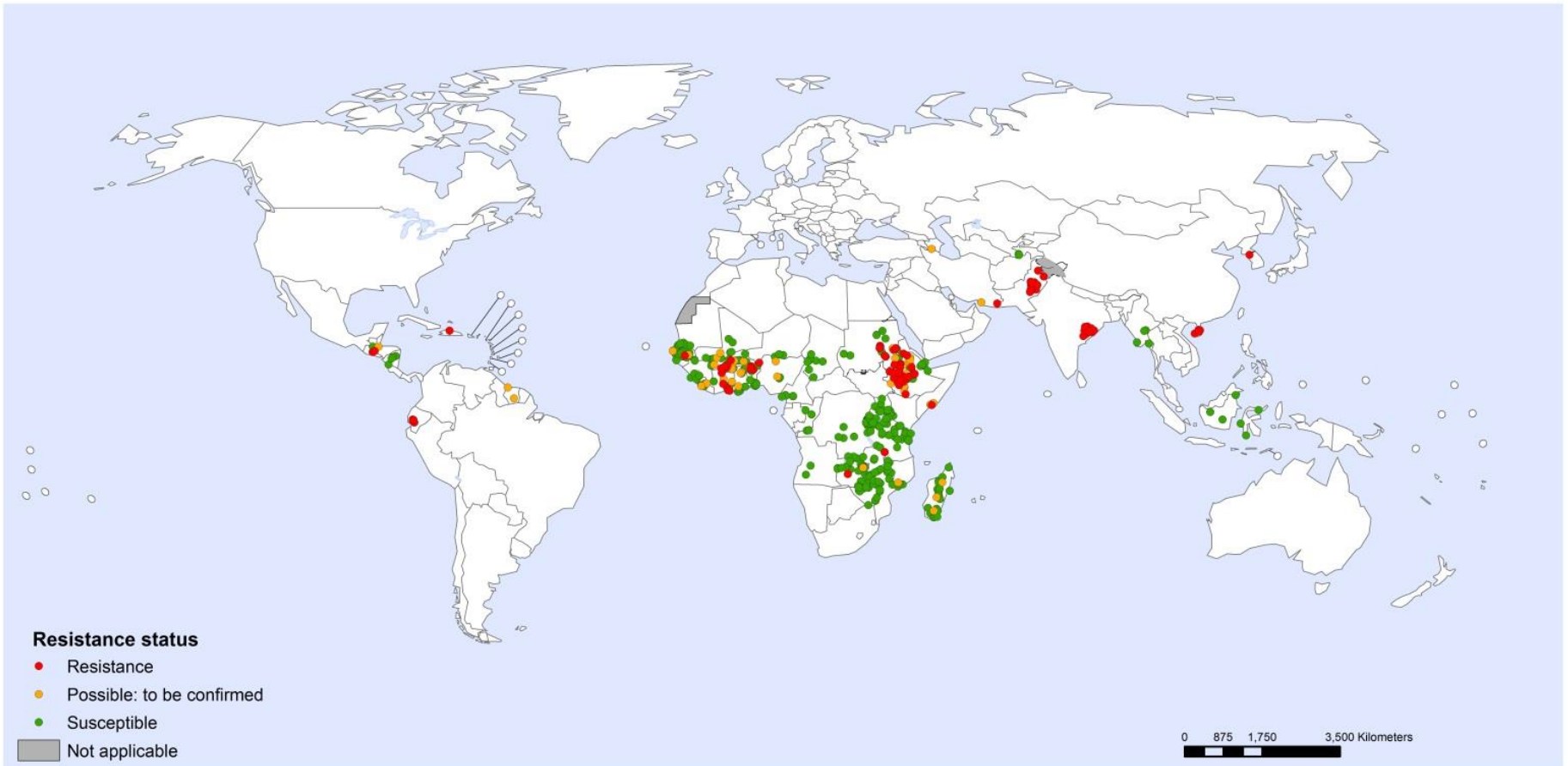
Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
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# Organophosphate resistance: 18 countries and 22% of surveyed sites

## Reported organophosphate susceptibility status for malaria vectors (2010-2014)



Where multiple insecticide classes or types, mosquito species or time points were tested, the highest resistance status is shown.

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Data Source: World Malaria Report 2014  
Map Production: Global Malaria Programme  
World Health Organization

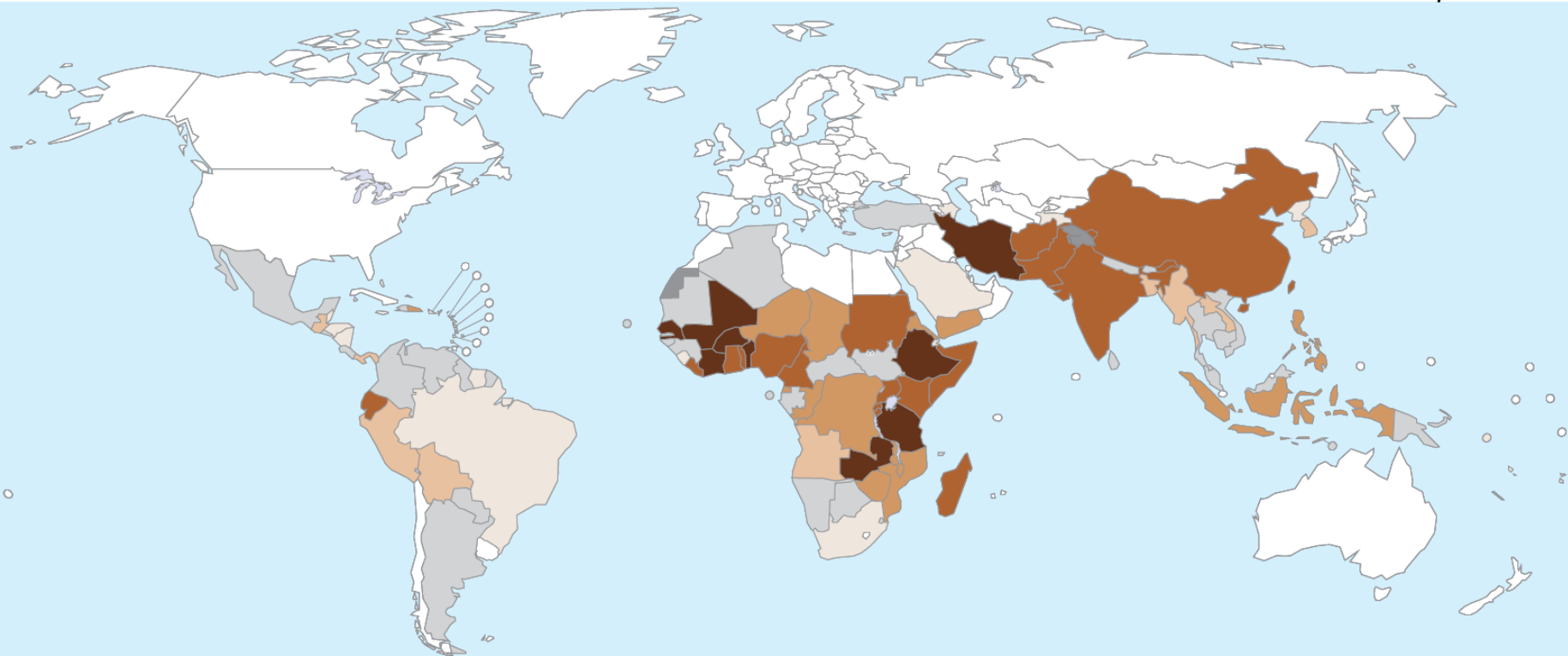


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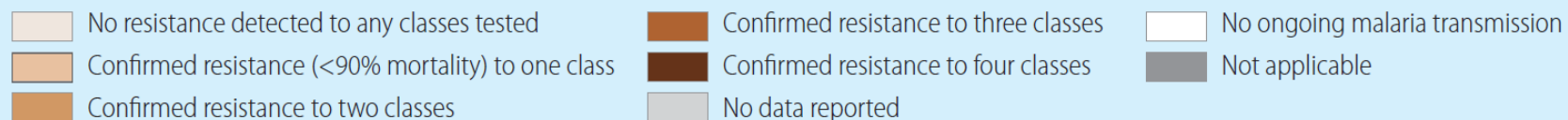
# Resistance to multiple insecticide classes: 40 countries and 33% of surveyed sites

Countries reporting resistance since 2010, by number of insecticide classes (as of October 2014)

Source: World Malaria Report 2014

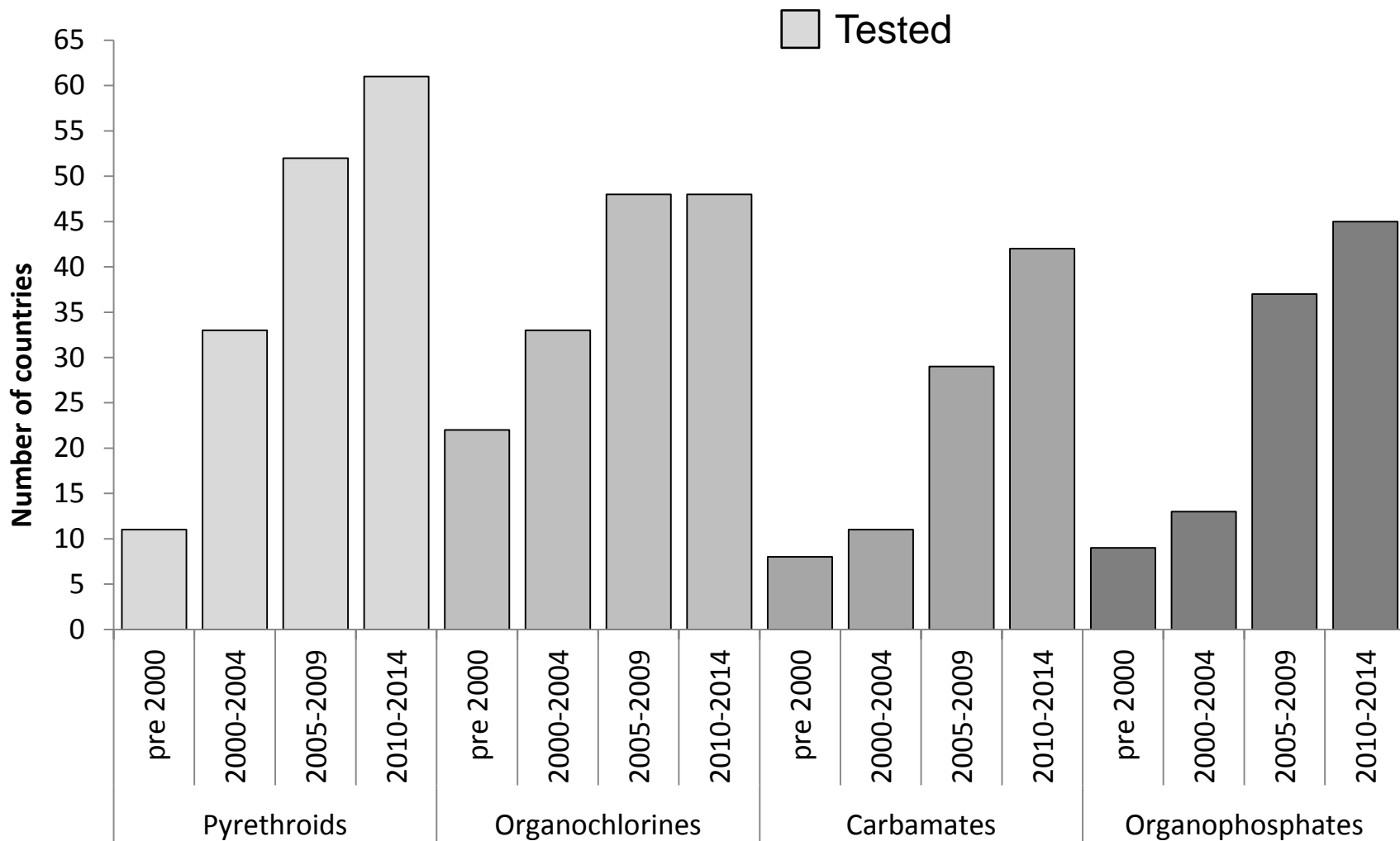


Reported resistance status from standard tests

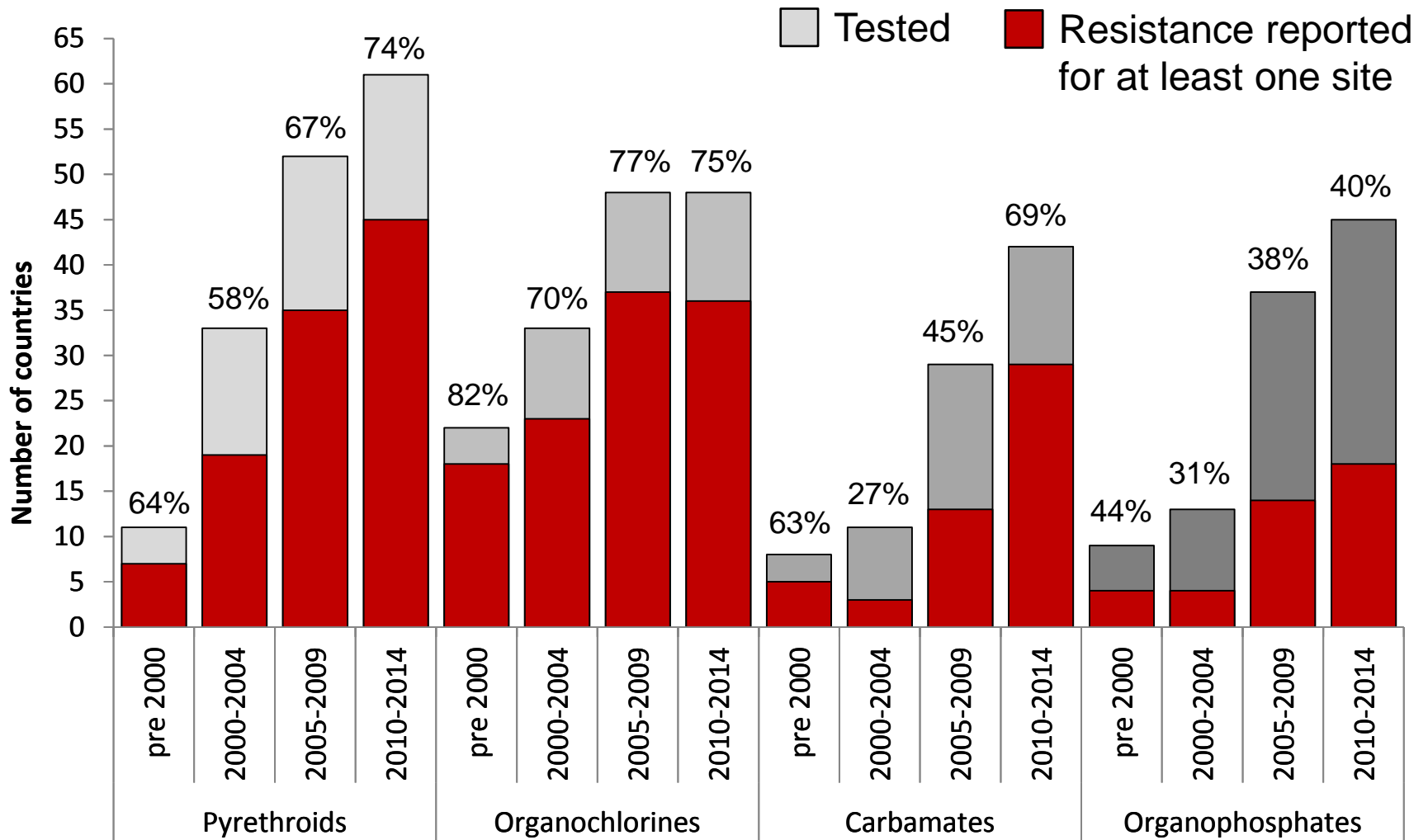


Source: National malaria control programme reports, African Network for Vector Resistance, Malaria Atlas Project, President's Malaria Initiative, published literature

# Preliminary trends analyses: resistance testing has increased for all four classes



# Preliminary trends analyses: resistance frequency increasing?

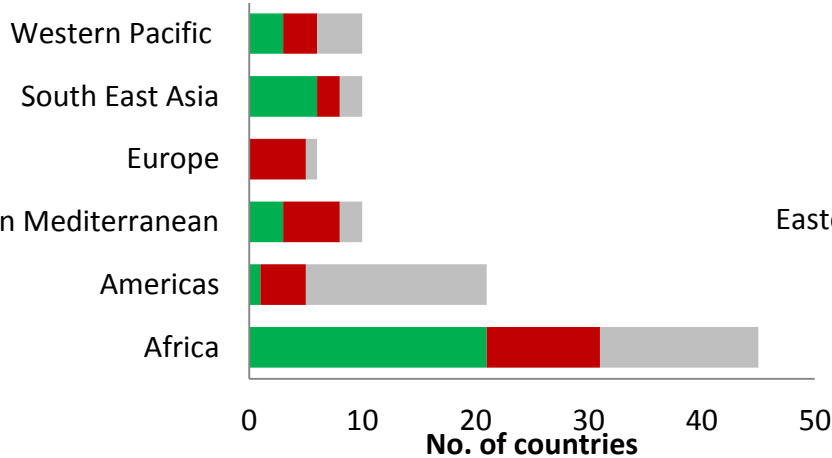




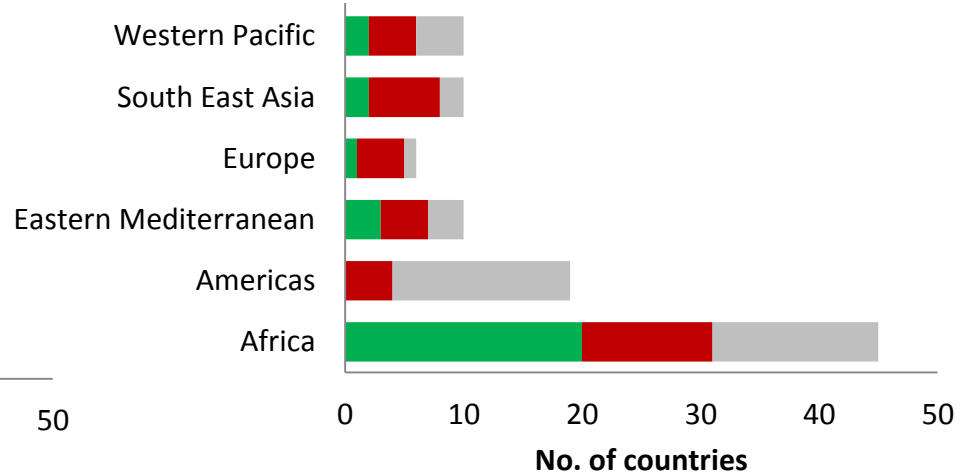
# Entomological Capacity: requires enhancement

■ Present   
 ■ Absent   
 ■ Not reported

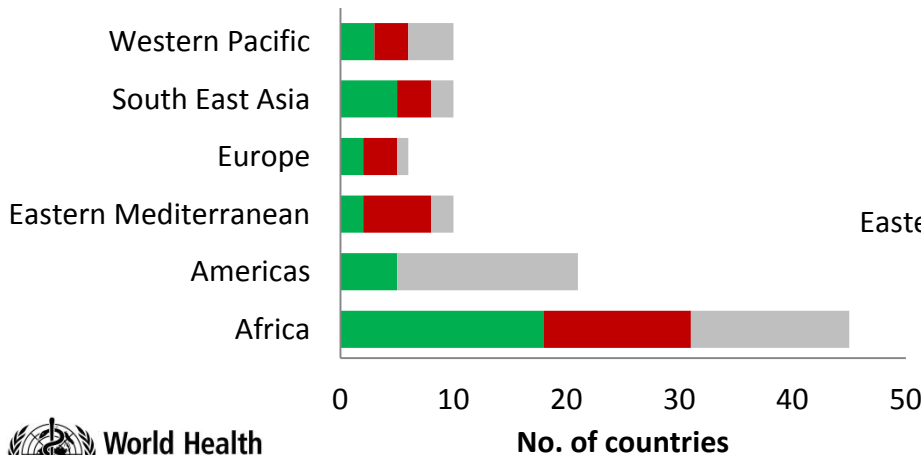
## Insectary:



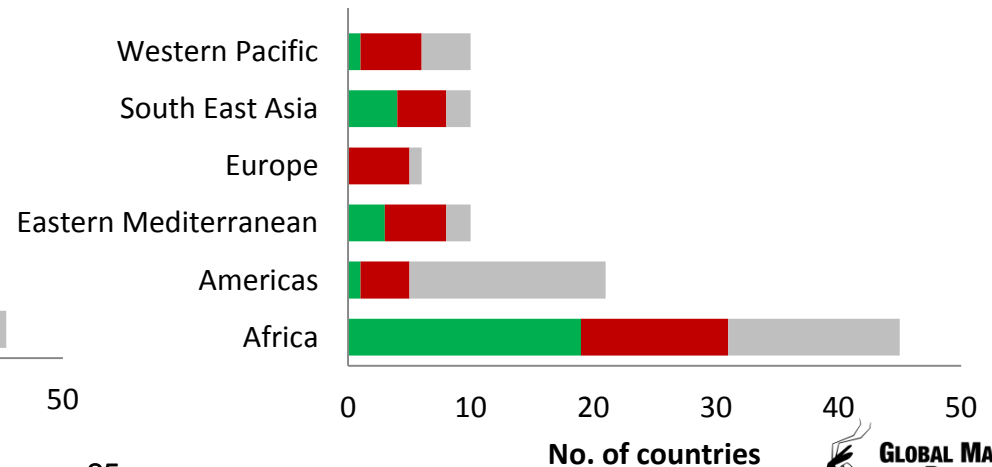
## Molecular lab:



## National IR database:



## National committee of experts:




# Reporting and Mapping: Challenges

- Data quality
  - No established comprehensive national IR monitoring plan
  - Low vector densities so tests often conducted with <100 *Anopheles*
  - Limited expertise to support data collection – especially for mechanisms
  - Incomplete or inaccurate data recording or entry
  - Inconsistencies in test procedures
- Data management
  - Lack of an established national insecticide resistance database
  - Limited personnel to manage available information
  - Complicated and overlapping data that are not easy to summarize
  - Sparse or incomplete data precludes identification of trends
- Data sharing
  - No efficient mechanism for sharing up-to-date information between partners
  - Misconception that sharing of data will limit publication opportunities
  - Late or incomplete reporting to WHO

# Planning for IRM: Framework for Development of National Resistance Monitoring and Management Plans

- Outlines the content and key considerations when developing and documenting national IRM plans
- Includes guidance on situation analysis and implementation framework, plus annual workplans
- Not intended to be rigid and prescriptive but designed to offer countries a framework while ensuring:
  - adherence to GPIRM objectives
  - a degree of standardisation across countries in the structure and content of plans



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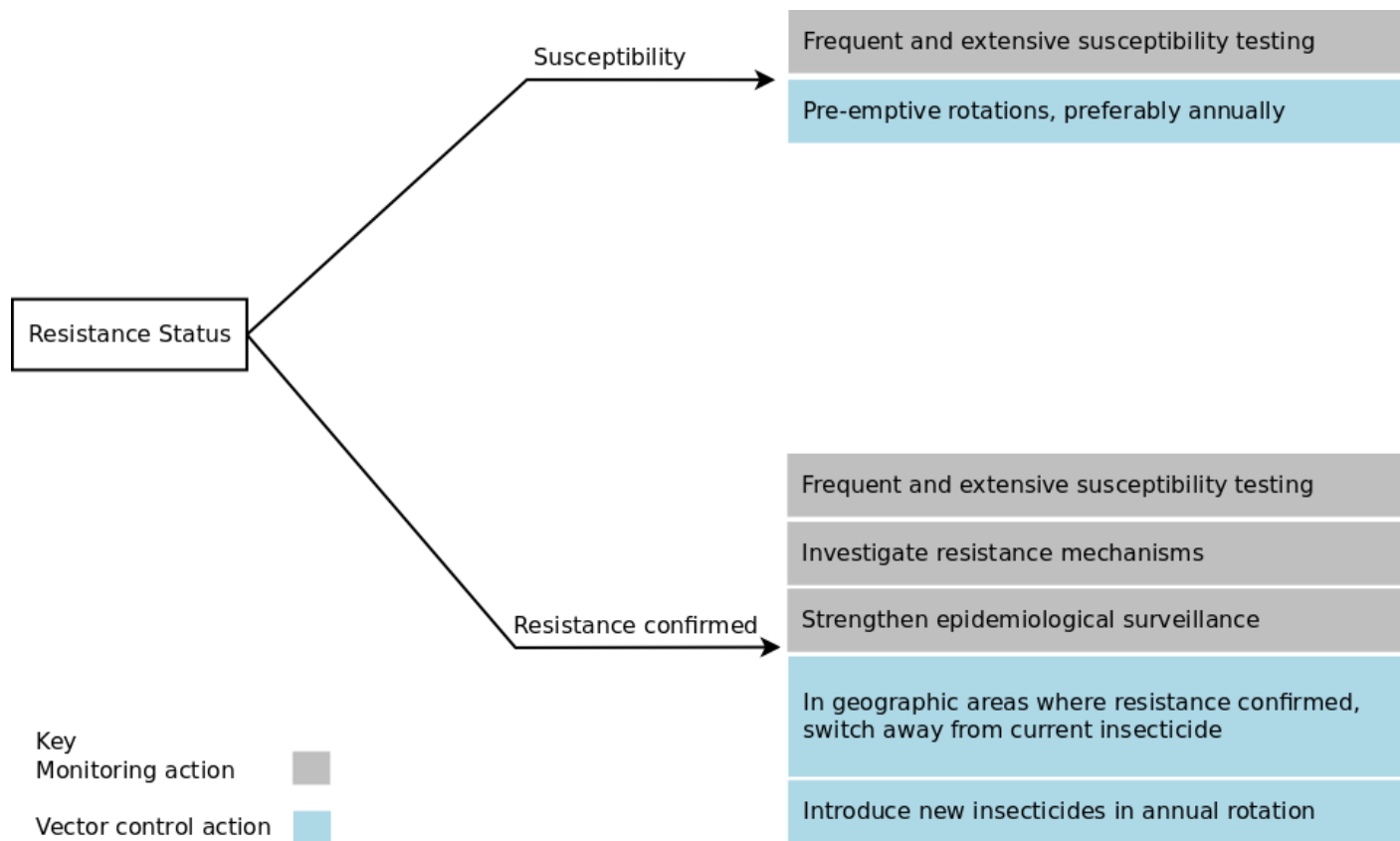
**FRAMEWORK FOR DEVELOPMENT OF NATIONAL INSECTICIDE RESISTANCE MONITORING AND MANAGEMENT PLANS**

DRAFT FOR LIMITED CIRCULATION  
May 2014  
- Please provide feedback to [gmp-ir@who.int](mailto:gmp-ir@who.int) -

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# Planning for IRM: Framework for Development of National Resistance Monitoring and Management Plans

- Example response tree: *Areas in which IRS is the primary intervention*



# Future WHO plans for addressing insecticide resistance and entomological capacity

- Support to countries for development of national insecticide resistance monitoring and management plans
- Inclusion of additional mechanisms data in global database
- Development of insecticide resistance data management tools:
  - Online interactive platform for mapping country-level resistance data
  - Excel add-on tool to support mapping of national resistance data
- *Ad hoc* review of resistance monitoring procedures and related issues
- Bi-regional training on entomology/vector control including insecticide resistance
- Development of a global insecticide resistance response plan
- Advocacy for action and resource mobilization to propel implementation of GPIRM

**Thank you!**