Global Malaria Programme



Global report on insecticide resistance in malaria vectors: 2010–2016



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ABBREVIATIONS AND ACRONYMS

Ace-1R	insensitive acetylcholinesterase
CDC	US Centers for Disease Control and Prevention
DDT	dichlorodiphenyltrichloroethane
GPIRM	Global plan for insecticide resistance management in malaria vectors
GST	glutathione-S-transferase
IQR	interquartile range
IRM	insecticide resistance management
IRS	indoor residual spraying
ITN	insecticide-treated mosquito net
kdr	knockdown resistance
LLIN	long-lasting insecticidal net
NMCP	national malaria control programme
РВО	piperonyl butoxide
PMI	US President's Malaria Initiative
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme

2010-2016 AT A GLANCE

Resistance monitoring

Monitoring for vector resistance to insecticides commonly used in malaria control was not conducted or was not reported for all malaria endemic countries between 2010 and 2016. For those that did monitor, this was usually not done every year. Limited information was available on resistance intensity and resistance mechanisms.

- Number of countries (of 91 endemic) that reported any monitoring data: 79
 - for resistance frequency/status:¹72
 - for resistance intensity:10
 - for resistance mechanisms:² 32

Resistance status

Pyrethroid resistance was common and widespread in major malaria vectors across the five WHO regions that had ongoing malaria transmission in 2016.

- Number of countries (of 72 monitored between 2010 and 2016) for which resistance was confirmed in at least one vector to at least one pyrethroid insecticide of those that conducted monitoring: 56 (77%).
- Number of sites (of 2145 monitored between 2010 and 2016) at which pyrethroid resistance was confirmed in at least one vector to at least one pyrethroid insecticide of those monitored: 1375 (64%).

Resistance to the three other insecticide classes commonly used in IRS was confirmed in major malaria vectors across the five WHO regions that had ongoing malaria transmission in 2016, with countries commonly reporting resistance to multiple classes.

- Number of countries (of 72 monitored between 2010 and 2016) for which resistance was confirmed in at least one vector species to a total of:
 - no insecticide classes:³ 10
 - one insecticide class: 12
 - two insecticide classes: 13
 - three insecticide classes: 19
 - four insecticide classes: 18

Resistance frequency

Pyrethroid resistance frequency (as indicated by median mosquito survival in bioassays) increased between 2010 and 2016.

- Pyrethroid resistance frequency increased:
 - significantly in An. funestus s.l.: 32% increase, from 26% to 58%
 - moderately in An. gambiae s.l.: 13% increase, from 21% to 34%
 - slightly in other malaria vectors: 5% increase, from 10% to 15%

There were small overall median changes (≤5%) in resistance frequencies to organochlorines, organophosphates and carbamates between 2010 and 2016, with

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