Insecticide Resistance Action Committee

Insecticide Resistance: why it matters, and what we can do about it

Swiss TPH: Winter Symposium 2016

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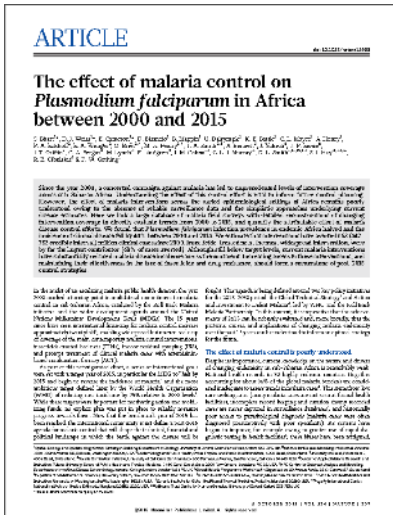
IRAC?

- Insecticide Resistance Action Committee (IRAC)
  - Specialist technical group of the agrochemical industry association CropLife International
  - Formed in 1984
  - Provides a coordinated industry response to the development of resistance in insect and mite pests

"Resistance Management for Sustainable Agriculture and Improved Public Health"

Insecticide Resistance

- It has been estimated that between 2000 and 2015, ca. 450 million cases of malaria have been averted as a result of pyrethroid treated LLINs (Bhatt et al 2015)


ARTICLE

The effect of malaria control on *Plasmodium falciparum* in Africa between 2000 and 2015

- Any significant reduction in their efficacy due to resistance, will greatly impact these gains

The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015 S Bhatt, et al. Nature, 526, 207-211, 2015
http://dx.doi.org/10.1038/nature15535

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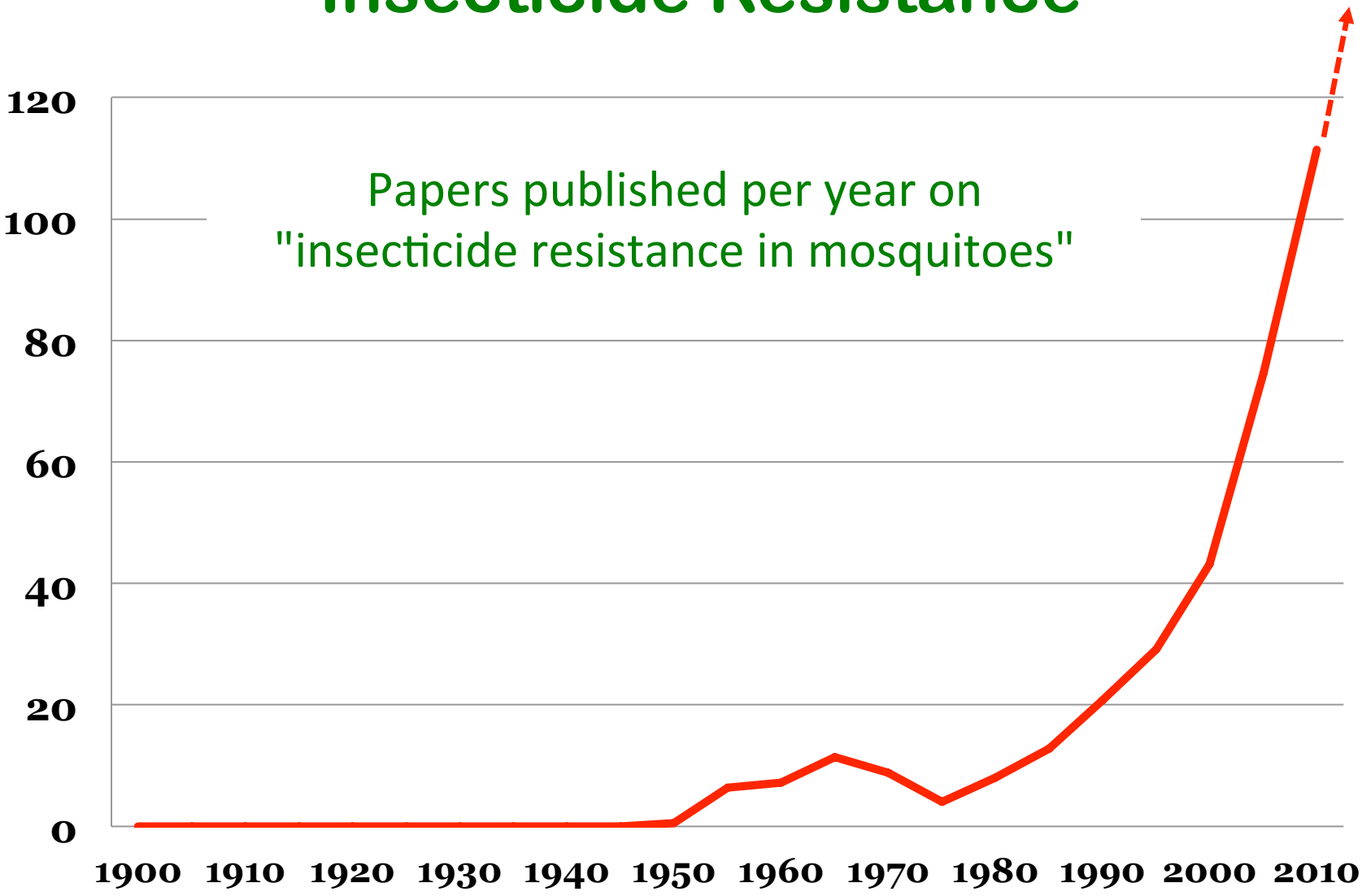
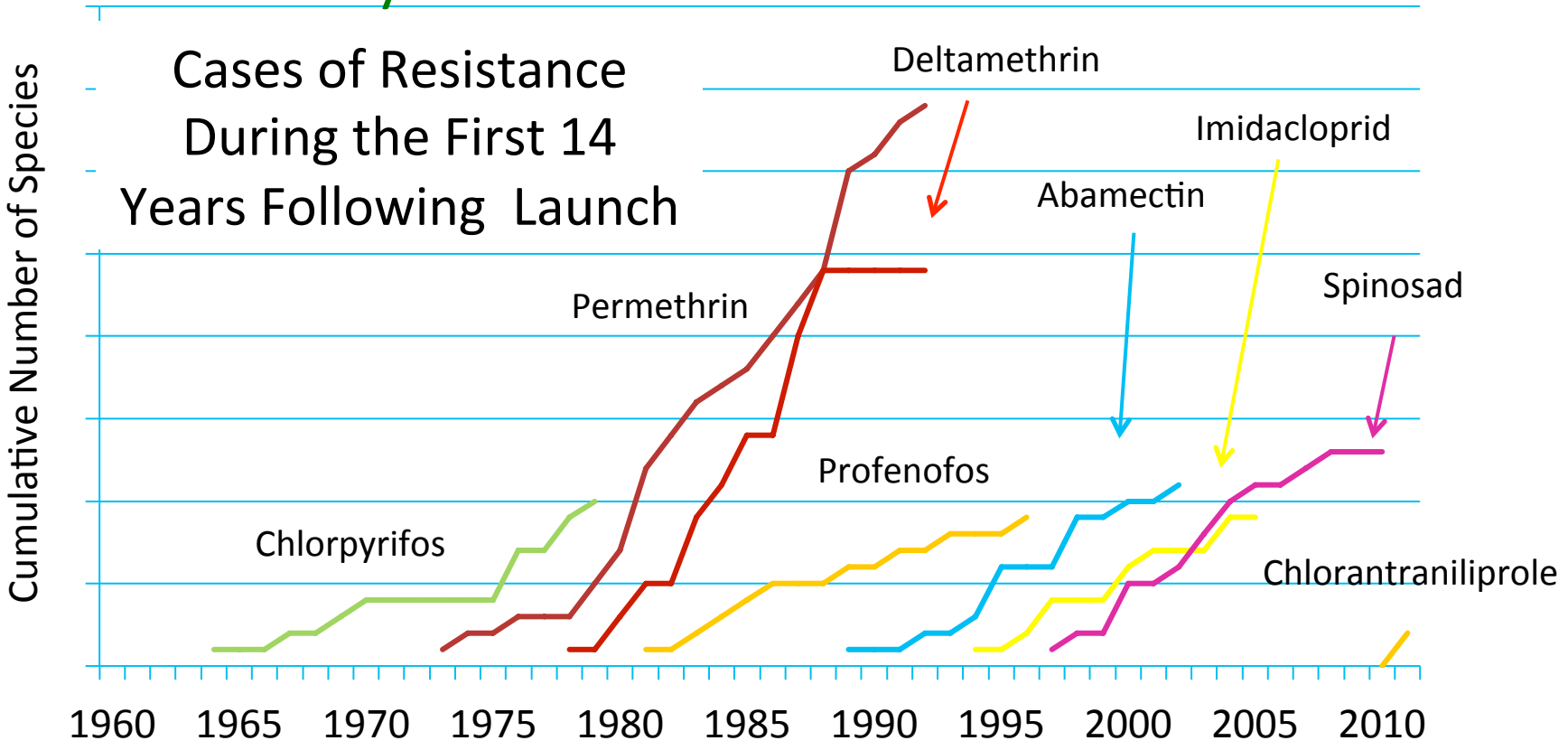
Insecticide Resistance



Source: Medline search, Trina Padoll 2013

Insecticide Resistance

- Resistance can, and will, eventually develop to any commercially used insecticide



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Insecticide Resistance

- Mosquitoes don't become resistant to insecticides *per se*…
- They can, and do, become resistant to insecticide based control interventions

- Pedantic semantics?
  - Highlights that how we undertake vector control will impact the development of resistance

Insecticide Resistance

- IRAC definition:

  "A heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species"

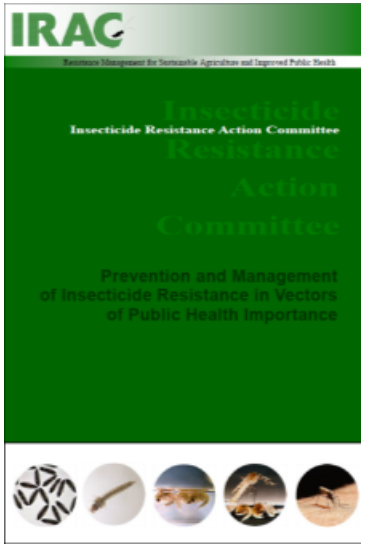
Insecticide Resistance

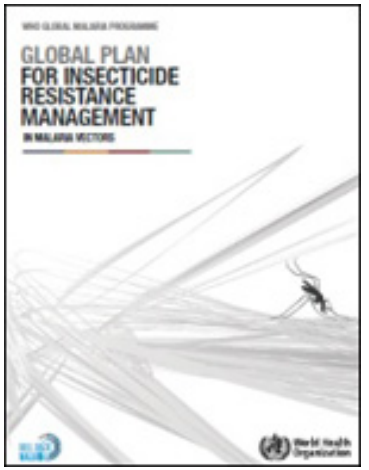
- Susceptibility of an insect population to a class of insecticides can change, without it becoming "resistant"

- However, understanding changes in susceptibility is key to managing resistance
  - Once you have resistance, it may be too late…

Insecticide Resistance Management

- Rotations
- Mosaics
- Mixtures
  - of insecticides with different modes of action, to which the target population is susceptible
  - However, this implies that you have multiple effective insecticides with different MoA





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Insecticide Resistance Management

- Why don’t we have sufficient insecticides to undertake effective IRM in Vector Control?

Relative market value

Agricultural and non-crop insecticides $54 Billion

Vector Control $1 Billion

Source: Phillips McDougall report 2013.

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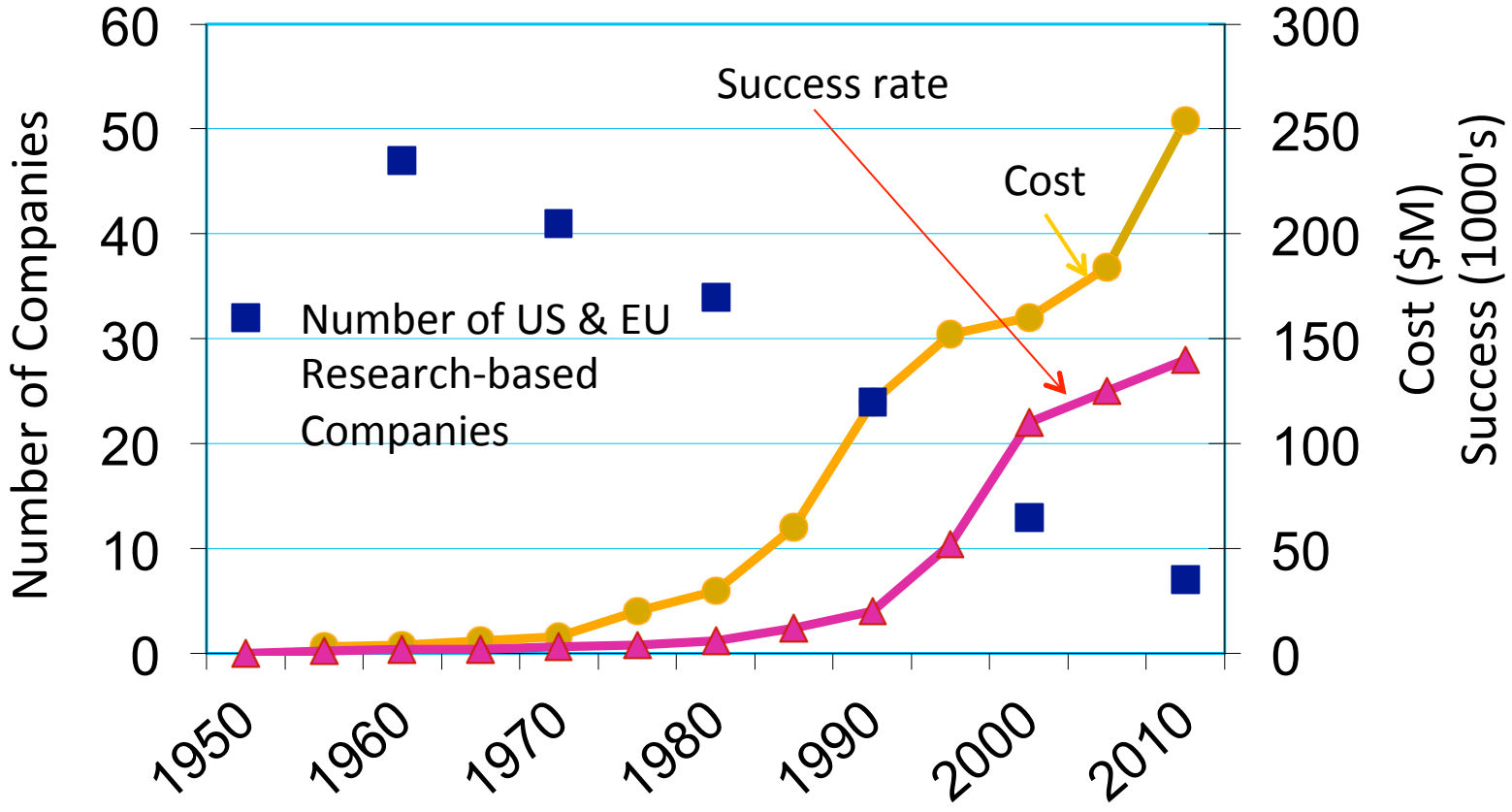
Fewer new insecticides



Success rate = number of cpds that need to be screened for each product found

Data from GT Brooks 1974, RL Metcalf 1980, W. Klassen 1995 Philips McDougal, 2003, CropLife 2011

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Vector Control

- Unlike Crop Protection, the Vector Control adulticide market is not conducive to product innovation
  →fewer products for IRM
  - Relatively small size vs cost of development of novel mosquito adulticide
  - Tender business encourages development of products that “satisfy” not “excel”
  - Entrance to regulated market through “equivalence” destroys motivation to invest in innovation

Loss of insecticides

- Existing insecticides can be lost from the market, or their uses restricted
  - More stringent regulation
  - Insecticide resistance
  - Market dynamics
  - “Supra-regulatory” pressure

  - Market size/structure
  - Relationship of VBD and poverty

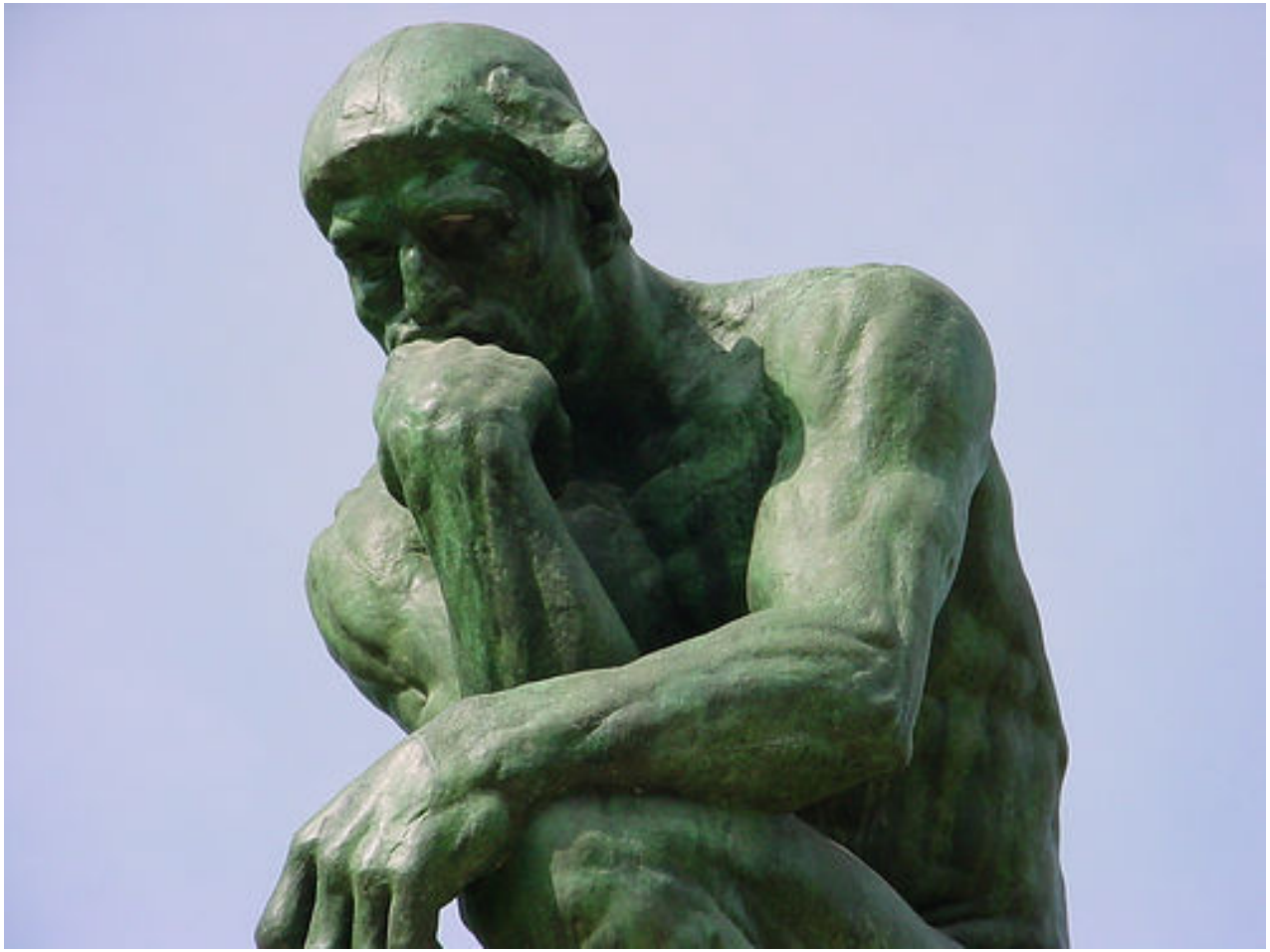
Loss of insecticides

- In agriculture this has lead to products being lost, but others with features that are perceived to be more desirable, being developed

Loss of insecticides

- Agriculture has had an active pipeline of new insecticides; historically, VC has not…

IRM: Cost or Investment?



IRM: cost or investment?

- Cost:
  - Measured by financial and opportunity costs
    - Short term view

- Investment: not so easy to measure…
  - DALY, GDP, GNW (Gross National Well-being)?
  - ROI, Short/medium/long-term?
  - NPV, assuming business as usual, paradigm shift, eradication?
  - Value of maintaining insecticide susceptibility

Valuing susceptibility

- Value of susceptibility = Cost of resistance?

- Susceptibility should be considered a “public good”
  - Can we put a value on it, and distribute it more equitably?

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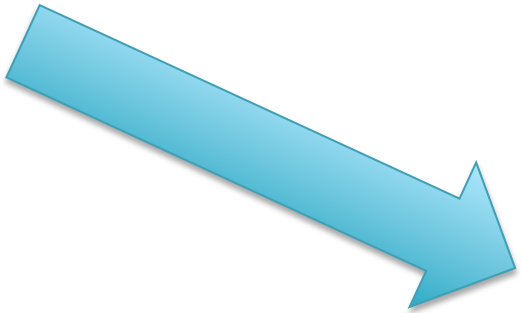
Change our thinking

Holding out for next resistance breaking insecticide



Implementing “resistance resilient VC programmes”

Resistance resilient programmes

- Integrated Vector Management (IVM) – holistic approach to VC – undertaking all activities that minimise mosquito interaction with humans
- Insecticides should not be the only intervention to be considered
  - Even more important when novel insecticides come to the market

Susceptibility, not resistance

- To protect a property from fire, we use a smoke detector, not a detector of big piles of ash

Resistance monitoring

Susceptibility monitoring

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Resistance Management Strategies

- Information is valuable, but lack of information should not be an excuse for inactivity

- However, efficacy of the VC programme must be maintained
  - IRM does not mean using ineffective VC interventions
  - Use effective interventions in ways that maintain their long-term efficacy

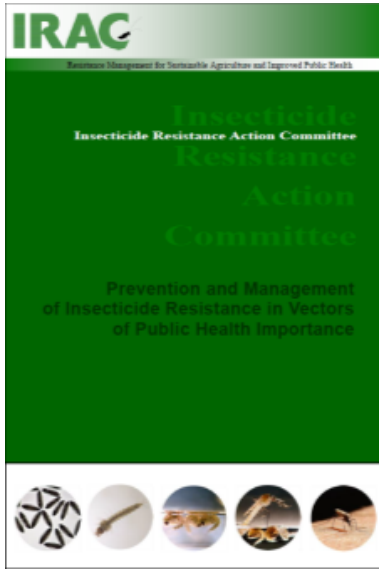
Resistance Resilient Programmes

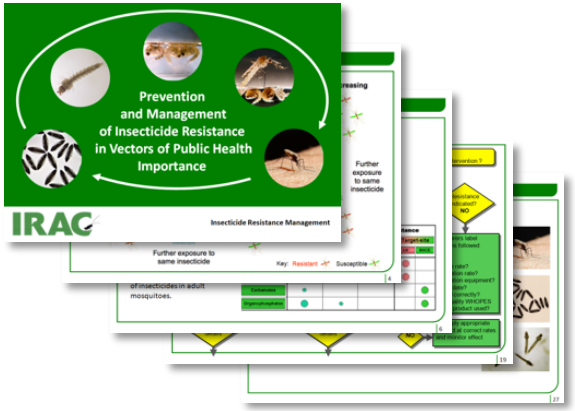
- IRM, within the context of Integrated Vector Management (IVM), taking a holistic and systems approach
- IVM activities should be applied regardless of evidence of susceptibility change
- Aim to maintain effectiveness of the VC programme, and its constituent parts for as long as possible
  - Where to draw the boundary of the system?
  - IVM to support prevention/management of drug resistance?

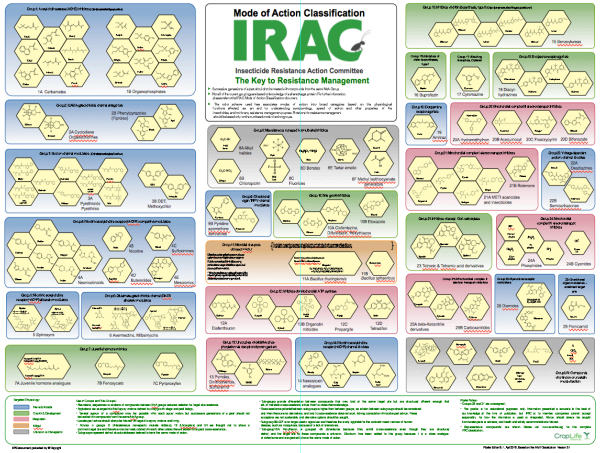
Insecticide Resistance: why it matters, and **what we can do about it**

- Continued support for the development of new VC interventions
- Research/modelling to identify the value of insecticide susceptibility, and the best way to preserve, and equitably distribute it
- Evaluate and report the value of IRM activities in VC, not just the cost
- Education in, and implementation of, IRM in the context of IVM – building "resistance resilient vector control programmes"

Sources of information on IRM







www.irac-online.org

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Thank you for your attention

With thanks to the IRAC Public Health Team

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