ITNs, IRS,... Do we miss something???

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ITNs and IRS: not effective against outdoor and/or early biting vectors

Insecticide treated nets (ITNs) and Indoor Residual Spraying (IRS) have contributed significantly to a worldwide decrease of malaria, but:

- IRS has little impact on outdoor resting vectors
- ITNs do not affect outdoor and/or early biting vectors.

Outdoor and/or early biting has been observed for several malaria vectors e.g. An. dirus, An. minimus and An. maculatus in South-East Asia1,2 (Fig. 1-4), An. gambiae s.s. and An. arabiensis in Africa3,4 (Table 1), and An. darlingi in Latin America5.

For elimination of malaria additional vector control measures are needed for tackling the outdoor and early biting vectors.

Pressure of ITNs and IRS might select outdoor and/or early biting vectors

- Variation in foraging behavior exists between vector species without pressure of vector control measures (VC) (Fig. 1 and 2). Therefore VC can result in selection of vector species more adapted to early and/or outdoor biting, such as An. arabiensis in Africa, and An. maculatus and An. dirus in Asia.
- Also within a vector species, e.g. in An. arabiensis, genetic variation is present between indoor and outdoor biting mosquitoes6,7. VC can thus also result in selection of subpopulations of vector species.

For elimination of malaria additional vector control measures are needed for tackling the outdoor and early biting vectors.

There is a need for additional vector control measures for early and/or outdoor biting vectors and outdoor resting vectors (Table 2). Research should be done, for example, on the additional value of the use of repellents as personal protection measure, before and after sleeping time (i.e. additional to use of ITNs), against bites of malaria vectors.