Risk and receptivity: malaria vector surveillance in an elimination setting

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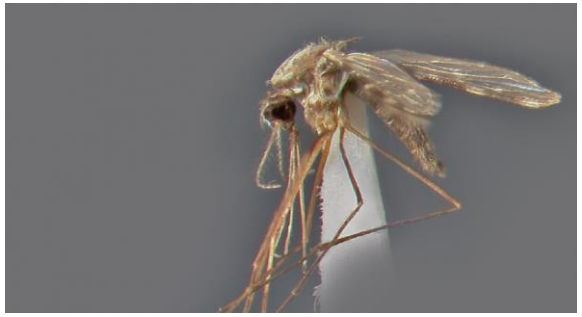
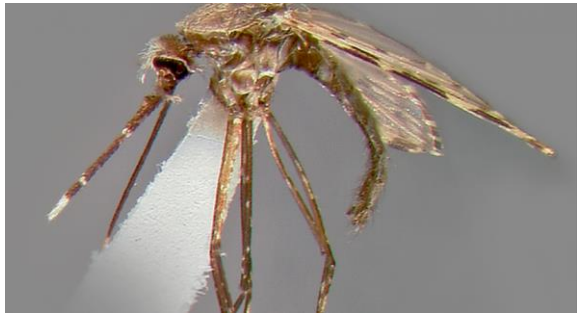
Assessing malaria risk & receptivity

- Malaria can only be acquired through the bite of an infectious *Anopheles* mosquito
- Assessing the risk of malaria in any given area or region is therefore based on the occurrence of *Anopheles* vector populations
- These are generally classified as either major or secondary vectors via a loosely defined classification system based on their measured or inferred contributions to malaria transmission
- For example, five *Anopheles* species are currently implicated as malaria vectors in South Africa. Two of these are the major vectors *Anopheles funestus* sensu stricto and *An. arabiensis*.

Assessing malaria risk & receptivity

- These two species tend to associate closely with human communities (especially *An. funestus*) from whom they acquire most of their blood meals, and are, therefore, responsible for the bulk of locally acquired malaria cases.
- Secondary vectors include *An. vaneedeni*, *An. parensis* and *An. merus*. They are secondary vectors because: they interact with human communities to a lesser extent than the major vectors, they are rarer, or they are less susceptible to *Plasmodium* infections making them comparatively inefficient vectors.
- Secondary vectors can play prominent roles in malaria transmission and should not be dismissed during vector control operational research and planning.





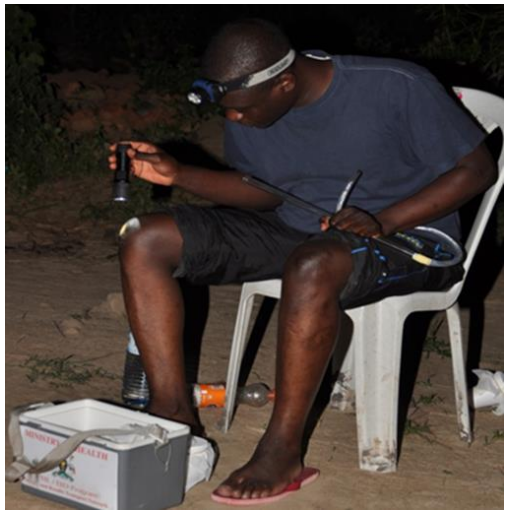
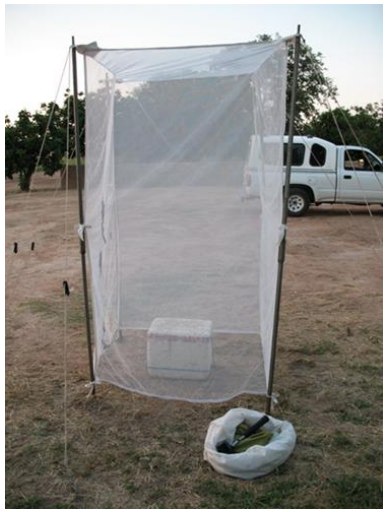
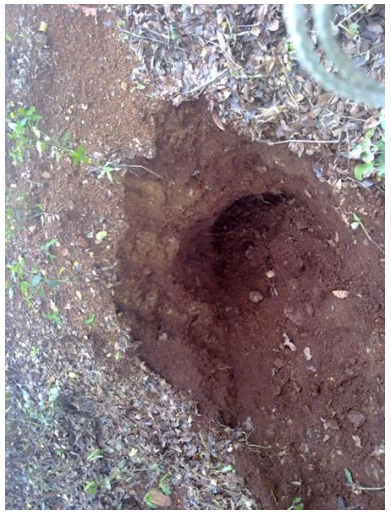
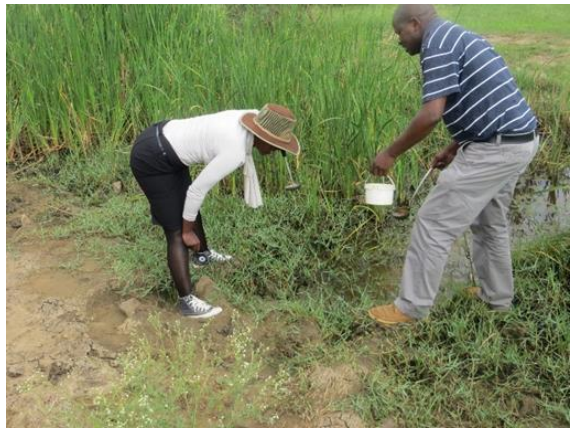
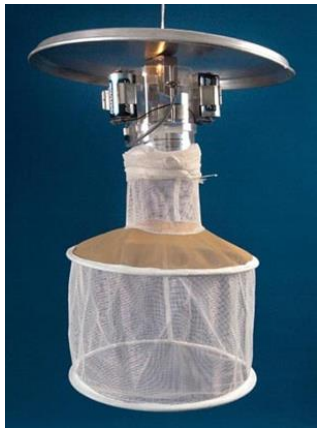
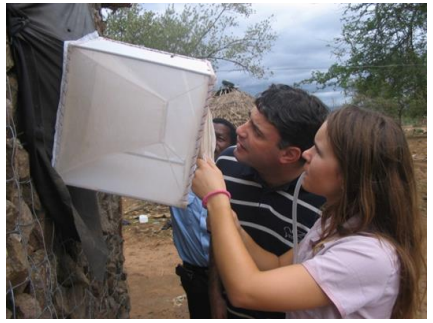
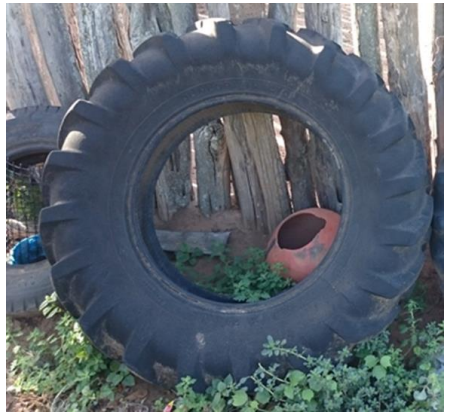
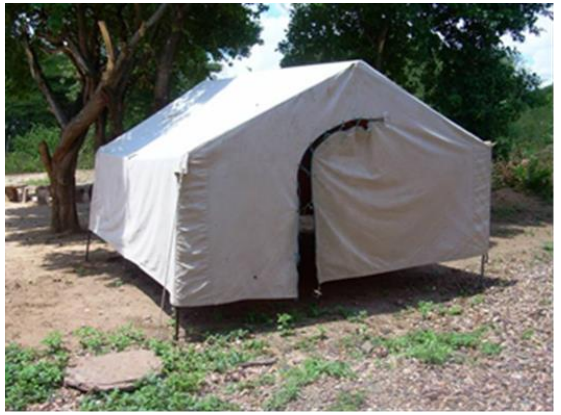
Determining vector status

- It is hypothesized that all *Anopheles* spp have the potential to transmit malaria, and so the most important determinant of whether a species is a vector or not depends primarily on their interaction with humans
- Other important determinants of vector status in *Anopheles* populations include their feeding habits, especially the timing and frequency of blood feeding, their relative level of immunity to malaria infections, their relative density/abundance (which tends to vary by season), and the average longevity of adult females (which can be expressed in terms of the number of gonotrophic cycles they can complete)

Vector surveillance and risk of re-establishment

- Assessing risk and receptivity in a malaria-free area that was previously endemic for the disease involves regular or at least periodic surveillance for *Anopheles* mosquitoes.
- This is necessary in order to assess the risk of re-establishment should significant parasite importation occur.
- Parasite importation occurs mainly via cross-border movement of infected persons who may be only mildly symptomatic, but nevertheless carry high enough parasite loads to enable onward transmission.
- Vector surveillance for the assessment of risk & receptivity should include a range of appropriate sampling methods.

Sampling mosquitoes indoors and outdoors


Important surveillance indicators

- *Anopheles* species assemblage
- Insecticide susceptibility / resistance in known or suspected vector populations by species
- Vector population densities by season
- Feeding behaviours – indoors vs outdoors, host choice & peak biting times
- Resting behaviours – indoors vs outdoors
- Breeding behaviours – preferred breeding sites and types of habitat for aquatic stages

This information enables an assessment of the risk of malaria re-establishment, and can be used for planning vector control operations—i.e. appropriate methods and insecticide choice—should local transmission occur. A standard response to the occurrence off locally acquired malaria in 'cleared up' areas is implementation of the foci clearing system. Routine vector control may also be implemented in some areas considered to be high-risk. Examples include LLIN distribution and targeted IRS such as strip-spraying.

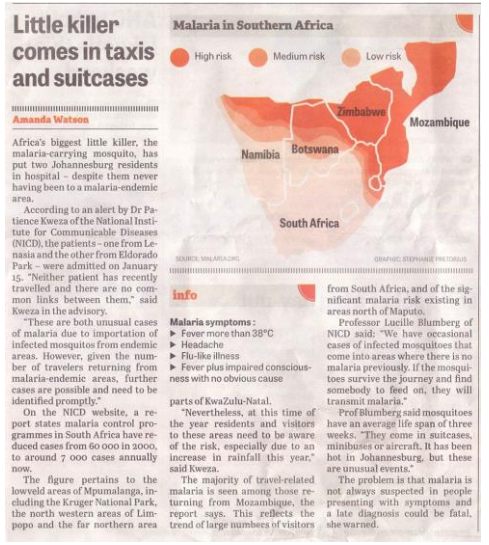
Odyssean malaria

- Parasites can also be transported to non-endemic / malaria free areas via the inadvertent importation of infectious mosquitoes.
- This tends to result in local transmission of malaria to one or a small number of persons who have no recent travel history to an endemic region.
- South Africa's Gauteng Province, which is non-endemic, records up to 15 Odyssean malaria cases per year. These are likely caused by the importation of infections *Anopheles* mosquitoes from neighboring countries and/or South Africa's endemic provinces.

Year	Cases	Deaths	CFR
1996-2004	46	6	13%
2007-2012	17	2	12%
2013	4		
2014	7	2	29%
2015	21	1	5%
2016	8	1	13%
2017	21	5	24%
2018	15	5	33%
2019	7	1	14%
2020	2	1	50%
2021	10		
2022	7	1	14%
2023	1		
Total	**166**	**25**	**15%**

Odyssean malaria – Gauteng Province

- Odyssean malaria investigations in Gauteng Province strongly suggest that infectious mosquitoes are imported mainly via road transport i.e. long-distance cars, taxis, busses, trains and trucks.
- Entomological investigations at index houses are conducted to establish if any *Anopheles* breeding is taking place. There is no expectation of finding the actual culprit mosquito/es.
- Response: If *Anopheles* breeding is established, or if there are follow-on local cases in the near vicinity of an index house, then vector control and personal protection measures are indicated. The standard response, however, is community outreach in terms of signs and symptoms, and an alert to all health facilities to consider malaria as a differential diagnosis in patients with unexplained fever, even if they don't have a recent travel history to an endemic area.
- Insecticidal treatment of vehicles at border-crossings is not recommended.



Little killer comes in taxis and suitcases

Amanda Watson

Africa's biggest little killer, the malaria-carrying mosquito, has put two Johannesburg residents in hospital – despite them never having been to a malaria-endemic area.

According to an alert by Dr Patience Kweza of the National Institute for Communicable Diseases (NICD), the patients – one from Lenasia and the other from Eldorado Park – were admitted on January 15. "Neither patient has recently travelled and there are no common links between them," said Kweza in the advisory.

"These are both unusual cases of malaria due to importation of infected mosquitos from endemic areas. However, given the number of travelers returning from malaria-endemic areas, further cases are possible and need to be identified promptly."

On the NICD website, a report states malaria control programmes in South Africa have reduced cases from 60 000 in 2000, to around 7 000 cases annually now.

The figure pertains to the lowveld areas of Mpumalanga, including the Kruger National Park, the north western areas of Limpopo and the far northern area

Malaria in Southern Africa

High risk Medium risk Low risk

Zimbabwe Mozambique Namibia Botswana South Africa

SOURCE: MALARIA.COM GRAPHIC: STEPHANIE PRETORIUS

info

Malaria symptoms:

- Fever more than 38°C
- Headache
- Flu-like illness
- Fever plus impaired consciousness with no obvious cause

parts of KwaZulu-Natal.

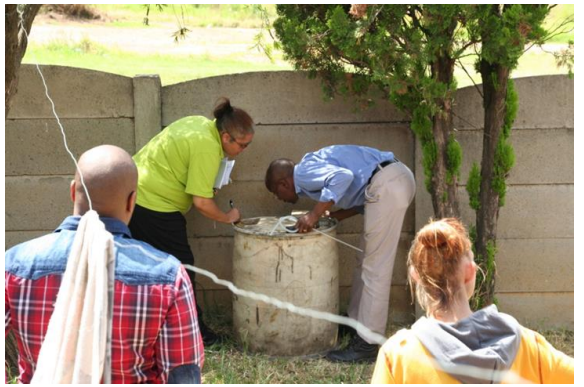
"Nevertheless, at this time of the year residents and visitors to these areas need to be aware of the risk, especially due to an increase in rainfall this year," said Kweza.

The majority of travel-related malaria is seen among those returning from Mozambique, the report says. This reflects the trend of large numbers of visitors from South Africa, and of the significant malaria risk existing in areas north of Maputo.

Professor Lucille Blumberg of NICD said: "We have occasional cases of infected mosquitoes that come into areas where there is no malaria previously. If the mosquitoes survive the journey and find somebody to feed on, they will transmit malaria."

Prof Blumberg said mosquitoes have an average life span of three weeks. "They come in suitcases, minibuses or aircraft. It has been hot in Johannesburg, but these are unusual events."

The problem is that malaria is not always suspected in people presenting with symptoms and a late diagnosis could be fatal, she warned.



'Malaria should be actively sought in febrile patients in whom there is no obvious cause of fever, even if the history is not suggestive.'

Questions / Discussion