Imported malaria case investigation and precautionary vector control: Leanyer, Darwin, March/April 2011
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Abstract

An imported case of Plasmodium vivax malaria diagnosed in a Darwin patient returning from overseas had mosquito infective gametocytes present. An entomological investigation revealed 2 and 3 Anopheles farauti sl and 56 and 81 adult Anopheles bancrofti at 2 natural wooded harbourage sites within 1 km of the patient urban residence, which prompted a precautionary Ultra Low Volume fog of nearby harbourage areas to kill any possibly infected adult Anopheles mosquitoes. Follow up indicated no reported environmental effects and no subsequent malaria transmission. These standard investigation and control procedures have been successful in preventing any cases of introduced or local transmission of malaria in the Northern Territory since they were instituted in 1974.

Key words: malaria; Ultra Low Volume (ULV) fogging; bioresmethrin; vector control; Northern Territory; Anopheles farauti

Introduction

The Northern Territory (NT) is currently considered free of endemic malaria.1 The NT has effective protocols in place in the event of imported malaria cases,2,3 with no recorded incidence of introduced transmission (malaria cases arising directly from an imported case by local transmission), since the last endemic case in Australia in 1962 at Roper River, NT. This is in contrast to north Queensland where there have been a number of local outbreaks of introduced malaria.4 However, the NT is both receptive and vulnerable to malaria transmission, due to the presence of a number of competent potential Anopheles vector mosquitoes, and a history of imported cases each year reported in patients that have either travelled to or are newly settled immigrants from overseas malarious areas.

An imported case of Plasmodium vivax malaria was recently diagnosed in a patient returning from overseas whose blood tests showed that mosquito infective gametocytes were present. The Medical Entomology (ME) unit of the Centre for Disease Control (CDC), NT Department of Health (DoH) was notified of the case and after entomological investigation, recommended a precautionary Ultra Low Volume (ULV) insecticide application for adult Anopheles mosquitoes.

Case details

On 30/03/11, ME was notified of an NT resident who had recently returned from India (11/03/11) and presented with an infective case of imported P. vivax malaria. The onset date was estimated to be 20/03/11. The patient had been infective for at least 3 days at home before hospital admission and subsequent medical treatment on 26/03/11. The patient’s residence was located near the Leanyer swamp on the fringe of the suburb of Leanyer in Darwin. Due to the close proximity of the residence to active Anopheles breeding and harbourage areas, the seasonal favourable period for Anopheles vectors, and the number of days that the patient was in an infective stage, the assumption was made that the patient could possibly have been bitten by local Anopheles vector mosquitoes, and therefore the case required an entomological investigation.

Vector longevity and risk periods

A previous scientific study of vector longevity and the risk of malaria transmission in the NT suggested that “the period of greatest risk for malaria transmission in Darwin was from April to August”.5 This was largely due to the increasing presence of older females that are of a potentially infective age towards the early to mid dry season (May, June and July).5 The period in which female Anopheles mosquitoes become infective, after biting an infected person with the infective gametocytes, and hence able to pass on the malaria parasite to humans, is 8-16 days for P. vivax. Therefore a mosquito biting the malaria patient would need to be at least 8 days old before being able to transmit the parasites to another person.

The probability that an individual Anopheles mosquito survives for this long increases during the early to mid dry, particularly with the recent case, which coincided with a record and extended wet season and continued overcast conditions which favour adult survival. The probability of transmission occurring is also a
function of the number of *Anopheles* present at the patients residence or exposure point, and the potential exposure of the patient to mosquito bites. Assuming the patient’s residence or outdoor habits has allowed mosquito exposure, the accepted protocol in the NT is that if there is at least 2 potential vector *Anopheles* at the patient’s residence or 10 *Anopheles* at the nearest *Anopheles* breeding or harbouring area within 1 km of the patient’s residence, this represents a potential for an *Anopheles* mosquito to possibly have bitten the patient and survive to infect another person.

When this occurs, ME usually conducts precautionary insecticide fogging operations aimed at killing or reducing adult *Anopheles* in the area in order to reduce the probability of potentially infective vectors surviving to bite other people. Generally urban residential blocks are not fogged, rather the fogging targets bushland with mosquito harbouring and breeding sites between the urban area of the patient’s residence and the nearest appreciable *Anopheles* breeding areas. The rationale behind this practice is that a blood fed *Anopheles* will generally need to travel back to breeding areas every 2 to 3 days to lay eggs during the 8 days period she needs to survive to become infective. The probability she will be in the breeding and harbouring areas over a 2 to 3 day period is relatively high. This practice also avoids the prospect of complaints in relation to fogging in urban areas.

**Medical Entomology recommendation for ULV precautionary fogging**

On 31/03/11, ME evaluated the abundance of potential *Anopheles* malaria vectors in 2 Encephalitis Vector Surveillance (EVS) trap collections set along the fringe of Leanyer Swamp in the general vicinity of the patient’s residence. Based on the DoH protocol around a proven malaria case, there were sufficient vector *Anopheles* mosquitoes in the vicinity on 22/03/11 (Figure) to warrant a precautionary fogging to kill any possibly infected mosquitoes.

The DoH protocol for Malaria Case Investigation outlines that approval is needed from the Chief Health Officer (CHO) to undertake fogging near residential areas. The last time the DoH undertook fogging was for a malaria case in 2004/05 in the bush area near the Malak suburb.6

**Action taken**

ME received CHO approval to undertake fogging, with the route modified on site to take into account wind direction. There was no fogging of urban streets or urban properties, and the fog was unlikely to have drifted to any urban residences. Fogging only occurred on access tracks around the sewage pond area, the fringe of Leanyer swamp, and adjoining rural properties where residents had given permission.

ME door knocked 6 rural properties in the area to be fogged, and requested permission to carry out fogging operations on those properties nearest to the mosquito harbourage areas. The residents contacted were told of the case of malaria and that fogging was required to prevent any potentially infected mosquitoes from passing on the parasite. Of these properties, all gave approval for ME to enter their property. Residents were asked to cover fish ponds and to close windows and louvres if they kept indoor aquariums. Inquiries also revealed hives of bees on 1 property, so the fog route was adjusted to prevent any spray drift near the hives. Only 4 rural properties were actually fogged due to vehicle accessibility problems.

The fogging operation was carried out from 18:05 – 19:35 pm on 01/04/11. A trailer mounted fogger dispersed an ULV application of bioresmethrin (a pyrethroid insecticide). The bioresmethrin is of very low mammalian toxicity, and is recommended by the World Health Organization for fogging for public health purposes.3

**Follow-up**

The resident with the bee hives contacted ME to inform that the bees were not affected and thanked ME staff for being flexible with the precautionary fogging operation. There have been no cases of introduced malaria in the area following the operation. These standard investigation and control procedures have been successful in preventing any cases of introduced or local transmission of malaria in the NT since they were instituted in 1974.

**Acknowledgements**

We wish to thank those Leanyer residents who gave permission for their properties to be fogged, to Jane Carter of ME for assistance with the fogging operation, and Raelene Whitters of ME for assistance with the Figure.
References


Figure. Leanyer: Imported malaria case location, vector mosquito abundance and actual fog routes