Global **Malaria** Programme

Vector alert: *Anopheles stephensi* invasion and spread

Horn of Africa, the Republic of the Sudan and surrounding geographical areas, and Sri Lanka

AUGUST 2019 (UPDATED DECEMBER 2019) INFORMATION NOTE

IDENTIFIED THREAT

Anopheles stephensi, a highly competent vector of *Plasmodium falciparum* and *P. vivax*, is considered an efficient vector of urban malaria. In parts of India, two biological forms of *An. stephensi* – "type" and "intermediate" – have also emerged as efficient vectors in rural areas, due to changing agricultural and water storage practices and urbanization. The third form – "mysorensis" – is considered to be a poor vector, although it has been involved in malaria transmission in certain rural areas in Afghanistan and Iran. Until 2011, the reported distribution of *An. stephensi* was confined to certain countries in South-East Asia and large parts of the Arabian Peninsula. Since then, the vector has been reported from Djibouti (2012), Ethiopia (2016), Sri Lanka (2017) and most recently from the Republic of the Sudan (2019). In the Horn of Africa, the vector seems to be spreading from its first site of detection (Djibouti) to neighbouring countries. *An. stephensi* typically breeds in containers or cisterns with clean water, and the vector appears to quickly adapt itself to the local environment (including cryptic habitats such as deep wells); it also survives extremely high temperatures during the dry season, when malaria transmission usually reaches a seasonal low. In addition, the genetic background of introduced *An. stephensi* seems to confer resistance to multiple insecticide classes, posing potential challenges to its control.

The World Health Organization (WHO) considers the spread of *An. stephensi* to be a major potential threat to malaria control and elimination in Africa and southern Asia. This vector alert has been developed to urge WHO Member States and their implementing partners – especially those in and around the Horn of Africa, the Republic of the Sudan and surrounding geographical areas, and in Sri Lanka – to take immediate action, as outlined below.

World Health Organization

WHAT SHOULD AFRICAN COUNTRIES, ESPECIALLY THOSE IN AND AROUND THE HORN OF AFRICA, DO NOW?

Countries should take the following actions:

- Update existing national vector surveillance strategies and guidelines to integrate *Anopheles stephensi.*
- Actively conduct surveillance for *An. stephensi* in urban and peri-urban areas, in addition to routine surveillance in rural areas, through sampling of its aquatic stages, because methods for collecting adults yield low numbers. Typical breeding sites are human-made containers, particularly water storage containers inside and outside the home, rainwater collections, roof tops, wells, large human-made cisterns, and even clean water ponds. Given the overlap in breeding sites with those of *Aedes* spp., national malaria control programmes are encouraged to seek close collaboration with national entities responsible for the control of arboviral vectors, as envisaged under the *Global vector control response 2017–2030* (https://www.who.int/vector-control/publications/global-control-response/en/).
- Rear larvae or pupae to adults, and identify *An. stephensi* based on morphological characteristics of the adult female. **Fig. 1**, below, shows how to differentiate *An. stephensi* from the *An. gambiae* complex.
- Describe the ecology of *An. stephensi*, to help guide control measures.
- Report any new detection of *An. stephensi* to WHO by completing the "*WHO form to report detection of invasive* Anopheles *vector species* (https://www.who.int/docs/default-source/documents/publications/gmp/whogmp-invasive-species-reporting-form) and emailing it to vectorsurveillance@who.int. The detection will then be displayed on the Malaria Threats Map (https://apps.who.int/malaria/maps/threats/).
- If sufficient larvae or pupae are found, these should be reared to adult stage, so that insecticide resistance can be evaluated using WHO susceptibility test procedures. Test results should be reported to WHO alongside data on the occurrence of the vector.
- Specimens should be preserved in Eppendorf tubes on silica gel for molecular analysis, both to confirm the initial morphological identification and to study population dynamics across a recently invaded area. Pinned voucher specimens should also be kept.
- International Health Regulations (IHR 2005) should be enforced to ensure that any points of entry are free of vectors, to minimize the risk of any further spread of *An. stephensi*.

WHAT SHOULD COUNTRIES DO IN AREAS WHERE THE VECTOR HAS BEEN DETECTED?

Where the vector has been detected, countries should do the following:

- Undertake interventions directed against *An. stephensi*, with the aim of eliminating this species from the invaded areas. This will require an intense effort towards enhancing and expanding the surveillance and control activities currently being implemented.

- Ensure that the immediate focus for the control of *An. stephensi* is on managing vector breeding sites in urban and periurban environments. Recommended activities include:
    - removal of breeding sites, where feasible, including filling in of disused wells;
    - modification to prevent vector breeding, including the installation of hermetically sealed lids to water storage containers; and
    - where breeding site removal or modification is not feasible, treatment with WHO prequalified chemical or biological larvicides, following WHO guidelines.
- Direct local authorities to map remaining breeding sites and inspect them for larval breeding once a week.
- Consider the feasibility of introducing core control tools directed against adult mosquitoes, namely LLINs or IRS, in areas where *An. stephensi* is found and where these interventions are not already being used.
- Install mechanical barriers (e.g. window and door screening) to prevent female mosquitoes from entering human dwellings, the aim being to reduce day-time resting opportunities and thus reduce both "dry season mosquito survival" and human exposure.
- Enact or introduce by-laws to regulate water storage practices and construction work, to avoid the creation of potential breeding sites.
- Enforce IHR (2005), to ensure that airports and other points of exit are free of vectors. Treat departing aircraft and ships to remove insects, following WHO guidance.
- Raise public awareness of this mosquito species, including the integration of messages on *An. stephensi* into existing information education and communication (IEC) materials and programmes for dengue vectors where these exists. The aim of IEC activities is to contribute to the reduction of breeding sites and to prevent vector proliferation.

HOW SHOULD INTERVENTIONS BE MONITORED AND EVALUATED?

To monitor and evaluate, countries should do the following:

- Base monitoring and evaluation activities on experience gained in the original distribution areas of the vector (e.g. in India and Iran, as described above) given that Africa's experience with *An. stephensi* is limited. An active effort should be made to build an evidence base to inform control and elimination of this vector in Africa.
- Monitor the presence or absence of *An. stephensi* larvae in identified breeding sites to evaluate the effectiveness of antilarval interventions.
- Survey urban and periurban areas for the creation or presence of mosquito breeding sites to evaluate the effectiveness of regulation and activities designed to reduce the number of breeding sites.

Fig. 1.
Differentiating *An. stephensi* from the *An. gambiae* complex, based on morphological characteristics of adult females

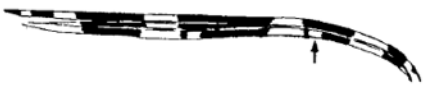
SEPARATION OF *Anopheles gambiae s.l.* AND *Anopheles stephensi* ON MORPHOLOGICAL CHARACTERS OF THE ADULT FEMALES

1. Speckled legs -- BOTH SPECIES

NOTE: neither of these species has the hind tarsomeres 4+5 entirely white (unlike *An. maculipalpis* and *An. pretoriensis*)

2. 2nd and 3rd main dark areas of costa and 1st vein of wing

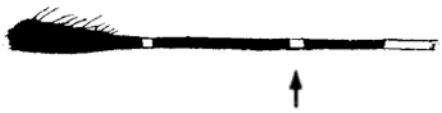
An. gambiae s.l.
One spot in each dark area



An. stephensi
Two spots in the 2nd area, none in the 3rd area

3. Female palps

An. gambiae s.l.
Not speckled
Sub-apical pale band very narrow



An. stephensi
Speckled
Sub-apical pale band equal to apical band