Larval Source Management (LSM) in Mauritius

Malaria was first introduced to the island of Mauritius from mainland Africa during the mid 19th century [1]. Over a century of malaria control campaigns ensued, including large indoor residual spraying (IRS) operations and widespread larval source management (LSM) projects [2]. Mauritius was declared malaria-free in 1973 by the World Health Organization [3]. However, after a series of cyclones from 1975 to 1976, the country saw a resurgence of Plasmodium vivax when migrant workers from malaria endemic countries arrived on the island to repair the damage caused by these cyclones. Once again, the country assumed a control campaign with IRS, larviciding and robust surveillance. Since 1997 no indigenous cases of malaria have been reported in Mauritius and the country is now in the ‘prevention of reintroduction’ phase [4]. LSM remains a mainstay of the Prevention of Reintroduction Program (PRP), along with a strong surveillance system and a passenger screening program.

**Background**

- **Site characteristics:** Mauritius is an island situated in the Indian Ocean, 850km to the east of Madagascar (Fig. 1).
- **Climate:** There are two well-marked seasons: summer and winter. Summer is generally accompanied by heavy showers and occasional cyclones while dry or semi-dry conditions prevail in winter. Mean annual temperature varies with seasons and altitudes, ranging from 21-23°C in summer in the coastal region, and between 16-18°C in winter. Annual rainfall varies from 600-1900mm near the coast to 2500-4450mm in the uplands. The true rainy season extends from December to April.
- **Primary and secondary vectors:** Anopheles funestus and An. arabiensis were responsible for malaria epidemics between the mid 19th and mid 20th centuries [2]. In 1948, a vector control scheme based on DDT IRS led to the elimination of An. funestus from Mauritius by 1950, with a subsequent fall in the incidence of malaria. This scheme failed to control An. arabiensis however, which has never been eliminated from the island.
- **Main type of breeding sites:** Anopheles gambiae mainly breeds in clean, fresh sunlit water bodies.
- **Malaria transmission:** No autochthonous cases of malaria have been reported in Mauritius since 1997 however imported malaria cases among visiting or working expatriates and residents returning from malaria endemic countries still occur, with 54 imported cases in 2011.

**The larval source management program**

- **Structure of the control program:** In 2009 the Integrated Vector Management (IVM) Concept was introduced and the public is now involved in reducing larval breeding sites through environmental modification (e.g. maintenance of drains and storm drains and management of solid and bulky waste), which reduces dependence on larvicides. Members of the community are educated by health inspectors who have Power of Entry granted by the 1925 Public Health Act, according to which it is a legal requirement for individuals to remove breeding sites around their homes [5]. Routine larviciding is also conducted island-wide.
- **Baseline mapping and data collection:** All breeding sites in target areas are mapped and new breeding sites are detected during routine surveys once a month.
- **Larviciding:** Former foci of malaria transmission, highly productive breeding sites identified through entomological surveillance and standing water within a 500m radius of the residences of imported cases and migrant workers are treated fortnightly with temephos (Fig 2). In addition,
**Bacillus thuringiensis** var. *israelensis* (Bti) is currently applied in nine villages in 40 to 50 housing units.

- **Larval and adult surveillance:** Routine surveys for larvae and adult mosquitoes are carried out once a month at nine sentinel sites (one per district). Reports are sent to local health offices for appropriate action.

- **Funding:** The PRP is funded totally by the Government of Mauritius, of which the annual cost per capita is US$2.06 (2008 US$) or 0.83% of total public health expenditure [5].

- **Other malaria control interventions:**
  - Epidemiological and entomological surveillance
  - Good case diagnosis and management, free health care (prophylaxis and treatment)
  - Vector control
    - DDT spraying at ports of entry (although this is currently being phased out)
    - Aircraft disinsection
  - Monitoring & evaluation
  - Health education

Long lasting impregnated nets (LLINs) and mass drug administration (MDA) are not currently used in Mauritius. LLINs are provided only to known malaria inpatients.

Specifically, LSM in Mauritius is a compliment to a robust surveillance system and a passenger screening program which reduce the risk of importation and indigenous transmission [5]. A recent review and analysis aimed to assess the impact of the passenger screening arm of the PRP and concluded that this program suppresses the risk of indigenous transmission of approximately 1.7%–7.5% each year [5]. To our knowledge, the impact of the LSM component of the PRP remains to be established.

**Challenges**

- Mauritius remains **receptive** to malaria since the vector *An. arabiensis* is still present.
- **The risk of re-introduction** of malaria persists due to:
  - The close proximity of Mauritius to malaria endemic countries.
  - The influx of tourists into the country.
  - The influx of migrant workers from endemic countries (particularly India, Pakistan, Bangladesh and Madagascar).
  - Mauritian nationals travelling to malaria endemic countries.
- Low immunity in the population to the malaria parasite.

**References**


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