Policy and practice

Containing artemisinin resistance of *Plasmodium falciparum* in Myanmar: achievements, challenges and the way forward

*Thar Tun Kyaw1, Thaung Hlaing2, Krongthong Thimasarn3, Khin Mon Mon4, Gawrie N. L. Galappaththy3, Valaikanya Plasai5, Leonard Ortega6*

**ABSTRACT**

Artemisinin resistance is a major threat to global malaria control and elimination efforts. Myanmar detected the first indication of the resistance in 2009 in the eastern part of the country, bordering Thailand. Since 2010, WHO has played a vital role in ensuring that a comprehensive programme on the containment of the resistance is in place. This paper documents achievement made in terms of output, outcomes and early impact on malaria from July 2011 to December 2013. It also identifies enabling factors to success and, most importantly, challenges awaiting the national programme and its partners.

Key words: malaria, Myanmar, artemisinin resistance

**Background**

The malaria elimination goal, as recommended by the World Health Organization’s Global Malaria Programme (GMP) relies heavily on the effectiveness of a few tools; among them antimalarials. Artemisinin has been used widely in the Greater Mekong Subregion (GMS) since 1995, and in Myanmar as first-line treatment since 2002. While the therapeutic efficacy of artemisinin-based combination therapy (ACTs) remains at satisfactory level globally, two locations in the world have confirmed artemisinin resistance “hotspots”. Both foci are located in the GMS, namely, the western border of Cambodia and Thailand and the western border of Thailand bordering Myanmar’s Tanintharyi and Bago regions and Mon state. In Myanmar, evidence of suspected artemisinin resistance was reported in 2009, and confirmed in 2011.

To date, no next-generation antimalarials are on the horizon, thus artemisinin resistance is a major threat to progress made in the past decade, with possible serious global implications for malaria elimination. The Myanmar national malaria programme has joined the global community in the containment of artemisinin resistance since April 2011 by initiating the Myanmar artemisinin resistance containment (MARC). This paper documents the process, current achievements, enabling factors, as well as lessons learned during early implementation of the programme.

**MARC – Strategic framework for artemisinin-resistance containment in Myanmar**

Efforts to contain the spread of artemisinin resistance in Myanmar started since its first indication in 2009, even though artemisinin resistance was not confirmed until 2011. WHO Myanmar’s Malaria Unit has been one of the major forces behind the initiation of artemisinin-resistance containment in Myanmar since early 2010. With financial assistance from the Bill and Melinda Gates Foundation (BMGF), the MARC framework was developed in 2010 through consultation and brainstorming sessions of the Malaria Technical and Strategy Group (TSG), building on the Cambodia–Thai containment project with the strategy developed in 2008. Later on, the framework also benefited from technical guidance from the Global Plan For Artemisinin Resistance Containment (GPARC). The Myanmar Ministry of Health endorsed the framework in April 2011, and activities started in July 2011. MARC specific objectives are shown in Box 1.

At the outset, from July 2011 to 2012, financial resources for MARC rolling out came primarily from the Three Diseases Fund (3DF), which later became Three Millennium Development Goals (3MDG) Fund in 2013. A total of US$ 9 million was mobilized through the 3DF to roll out MARC from July 2011 to 2012 and another US$11 million from 3MDG for MARC activities in 2013.
MARC aims at delaying the spread of artemisinin-resistant parasites, and reducing transmission, morbidity and mortality of falciparum malaria. Out of 330 townships of Myanmar, MARC targets 52 townships, 21 in Tier 1 (strong evidence of suspected resistance), and 31 in Tier 2 (unclear evidence of suspected resistance), but bordering Tier 1 area). Tier 3 refers to areas endemic to *Plasmodium falciparum* with no evidence of artemisinin resistance and limited contact with Tier 1 areas. Eight implementing partners (IPs)—implement MARC activities with funding from 3DF. An additional four partners implement MARC activities with either their own funding, or other sources of funding. Key strategies include a multisectoral approach and integrated interventions in scaling up of case management, reduction of drug pressure, and improved access to quality treatment and malaria prevention among targeted population groups, particularly mobile populations. Because MARC relies on a multisectoral approach, coordination among implementing partners is vital to success. The TSG coordinates among partners at higher levels, and at implementing level, local committees. This mechanism ensures strong public–private partnership in MARC implementation.

### MARC major activities and outputs, 2011–2013

- Set up of screening points along the Thai–Myanmar and Myanmar–China border areas to detect malaria among migrants, and mobile malaria clinics to reach hard-to-reach areas to improve access to quality treatment.
- A monotherapy replacement programme using affordable or free-of-charge quality ACTs through the private sector, and public–private partnership.
- Insecticide-treated nets and long-lasting insecticidal nets (ITNs/LLINs), and, in certain areas, indoor residual spraying together with personal protection measures to limit transmission in containment areas.
- Activities to advocate for the support of containment of artemisinin resistance among partners and stakeholders. These activities are for example, meetings with the affected communities, other governmental agencies, and the private sector, including private practitioners.
- Therapeutic efficacy studies (TES) and day 3 parasitaemia studies for evidence-based policy and strategic development.
- System strengthening for timely and improved information: epidemiological and entomological surveillance. Surveys of households, health facilities and private vendors.
- Training activities to support the above activities: microscopists at state or region level; BHS, VBDC staff; volunteers at villages and at worksites for case detection and treatment, as well as LLIN distribution.
- Public-private partnership initiation for: migrant mapping, case management, LLIN/ITN distribution, and artemisinin monotherapy replacement.
- Documentation: information, education and communication (IEC) material and behaviour change communication (BCC) material for different target populations such as private practitioners, volunteers, and the affected community; guidelines for the treatment and prevention of malaria among mobile/migrant populations; national drug policy; and migrant mapping.

### MARC achievements during 2011–2013

While it has been merely 30 months since the first implementation of MARC, the project has achieved its two goals. First, malaria mortality and morbidity has declined in MARC’s target areas in the two years (Table 1); and second, TES results, as well as day 3 parasitaemia studies, detected no new suspected resistance in Tier 3, but results in the containment areas along the eastern border of Myanmar are still inconclusive due to high population movement across this border and inaccessibility in conflict areas.

Significant outcomes of MARC in containment areas since July 2011:
- improved access to quality diagnosis and treatment through volunteers, both in villages and at worksites, as well as a network of private physicians and clinics in the 52 townships;
Kyaw et al.: Containment of artemisinin resistance in Myanmar

- increased coverage of personal protection through increased use of LLINs, reintroduction of IRS and improved knowledge of target populations through IEC and BCC activities;
- improved compliance of private sector to national drug policy;
- national drug policy, including a policy to ban artemisinin monotherapy;
- mapping of migrants at local level for microplanning of malaria control;
- standardized and computerized surveillance system strengthened and expanded into township level in Tier 1;
- a system for early detection of artemisinin resistance along the border.

### Table 1: State and region wise malaria morbidity and mortality, Myanmar, 2008–1012

<table>
<thead>
<tr>
<th>No.</th>
<th>MARC/ Non-MARC</th>
<th>State/ Region</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Morbidity rate*</td>
<td>Mortality rate**</td>
<td>Morbidity rate</td>
<td>Mortality rate</td>
<td>Morbidity rate</td>
</tr>
<tr>
<td>1</td>
<td>Non-MARC</td>
<td>Ayarwaddy</td>
<td>3.72</td>
<td>0.70</td>
<td>2.02</td>
<td>0.57</td>
<td>3.68</td>
</tr>
<tr>
<td>2</td>
<td>Non-MARC</td>
<td>Bago (West)</td>
<td>6.64</td>
<td>1.19</td>
<td>7.51</td>
<td>1.19</td>
<td>6.55</td>
</tr>
<tr>
<td>3</td>
<td>Non-MARC</td>
<td>Chin</td>
<td>44.72</td>
<td>2.87</td>
<td>44.75</td>
<td>2.33</td>
<td>37.09</td>
</tr>
<tr>
<td>4</td>
<td>Non-MARC</td>
<td>Magway</td>
<td>7.77</td>
<td>1.11</td>
<td>6.06</td>
<td>0.80</td>
<td>7.34</td>
</tr>
<tr>
<td>5</td>
<td>Non-MARC</td>
<td>Mandalay</td>
<td>2.95</td>
<td>0.75</td>
<td>2.71</td>
<td>0.44</td>
<td>3.45</td>
</tr>
<tr>
<td>6</td>
<td>Non-MARC</td>
<td>Rakhine</td>
<td>42.04</td>
<td>3.74</td>
<td>35.10</td>
<td>2.91</td>
<td>37.09</td>
</tr>
<tr>
<td>7</td>
<td>Non-MARC</td>
<td>Sagaing</td>
<td>18.12</td>
<td>2.69</td>
<td>16.45</td>
<td>3.19</td>
<td>19.68</td>
</tr>
<tr>
<td>8</td>
<td>Non-MARC</td>
<td>Shan (East)</td>
<td>5.55</td>
<td>0.78</td>
<td>4.70</td>
<td>0.11</td>
<td>4.84</td>
</tr>
<tr>
<td>9</td>
<td>Non-MARC</td>
<td>Shan (North)</td>
<td>12.96</td>
<td>4.37</td>
<td>12.65</td>
<td>4.08</td>
<td>14.46</td>
</tr>
<tr>
<td>10</td>
<td>Non-MARC</td>
<td>Shan (South)</td>
<td>8.60</td>
<td>3.13</td>
<td>8.07</td>
<td>2.81</td>
<td>9.13</td>
</tr>
<tr>
<td>11</td>
<td>Non-MARC</td>
<td>Yangon</td>
<td>1.25</td>
<td>0.22</td>
<td>0.61</td>
<td>0.20</td>
<td>0.59</td>
</tr>
<tr>
<td>12</td>
<td>Non-MARC</td>
<td>MARCH Bago (East)</td>
<td>11.62</td>
<td>1.47</td>
<td>9.68</td>
<td>1.46</td>
<td>9.25</td>
</tr>
<tr>
<td>13</td>
<td>MARC</td>
<td>Kachin***</td>
<td>23.18</td>
<td>7.18</td>
<td>45.20</td>
<td>6.91</td>
<td>70.09</td>
</tr>
<tr>
<td>14</td>
<td>MARC</td>
<td>Kayah</td>
<td>26.64</td>
<td>1.20</td>
<td>24.70</td>
<td>0.30</td>
<td>22.98</td>
</tr>
<tr>
<td>15</td>
<td>MARC</td>
<td>Kayin</td>
<td>12.37</td>
<td>3.93</td>
<td>12.75</td>
<td>2.02</td>
<td>14.13</td>
</tr>
<tr>
<td>16</td>
<td>MARC</td>
<td>Mon</td>
<td>9.14</td>
<td>1.71</td>
<td>8.24</td>
<td>2.17</td>
<td>8.98</td>
</tr>
<tr>
<td>17</td>
<td>MARC</td>
<td>Tanintharyi</td>
<td>24.30</td>
<td>4.48</td>
<td>21.22</td>
<td>3.50</td>
<td>24.12</td>
</tr>
<tr>
<td></td>
<td>Nationwide</td>
<td></td>
<td>10.75</td>
<td>1.84</td>
<td>10.00</td>
<td>1.64</td>
<td>11.70</td>
</tr>
</tbody>
</table>

*Morbidity rate/1000 population
**Mortality rate/100 000 population
*** MARC covers all townships in the State/Regions mentioned except in Kachin. In the latter, four of 18 townships are covered. The four townships contribute around 1/3 of total cases in the State.
MARC’s enabling factors

First, Myanmar’s NMCP was able to capitalize on the strong networks of private physicians in Myanmar in the provision of quality assured antimalarials. Second, not-for-profit local professional organizations, such as Myanmar Health Assistant Association in Myanmar and many others, have fostered the control efforts. Third, external financial and technical supports from numerous partners made it possible for the programme to conceive and implement such an ambitious project. Finally, strong political will to support malaria control and elimination efforts of the Ministry of Health has played a vital role in the success of MARC as well as regular malaria control achievements.

Challenges in implementing MARC

While MARC has tremendous success since its inception in April 2011, the programme continues to face challenges in the coming years:

1. Civil unrest in some containment areas have limited access, and imposed significant difficulties to its implementation. It also contributed to high turnover of trained staff posted in villages or work sites inflict additional cost of recruiting and training of new ones.

2. Communication barriers due to cultural and language difference between malaria service providers and recipients have impeded the effectiveness of the programme.

3. Inadequate coordination at all levels, from national to state/region, to township, and to village levels, as well as among national level and sub-recipients, resulted in ineffective management of programme activities.

4. Overlapping of areas of activity at lowest level of implementation due to many IPs has caused confusion among staff. Volunteers for case management in villages and at worksites, for example, were implemented by several partners, thus they faced different recruitment, job descriptions, and training manuals and process.

5. While increased coverage of LLIN and ITN among target populations is one of MARC’s major objectives, these are mobile population and migrants. This factor together with outdoor transmission in the forest continues to pose technical challenges to MARC’s future achievement.

6. Smooth transition of MARC as project activities to become an integral part of malaria control remains a challenge.

7. Enhanced economic opportunities due to several reasons, including the supportive political environment in Myanmar, the Mekong economic corridor, as well as the Asian Economic Community (AEC), will contribute to increased non-immune population movement into malarious areas, thus posing further challenges for artemisinin-resistance containment in GMS.

8. Long and cumbersome processes of grant negotiation and administration delayed the commencement of containment activities by several months. Grant agreement signing, and fund transferring require much attention and energy.

9. Donors were not adequately coordinated. This had led to fragmentation of implementation and reporting, as well as confusion among workers under different implementing partners.

Conclusions and the way forward

Implementation of MARC started 30 months ago, focusing on using a multisectoral and integrated approach in implementing various antimalarial interventions in containment areas, and with funding from 3DF, and later 3MDG. Several important outcomes and two early impacts were achieved in containment areas according to MARC’s two goals: reduced morbidity and mortality; and no further artemisinin resistance were detected outside know foci.

It is imperative for all parties to embrace lessons learned, both positive and negative. Successes from Myanmar that can be repeated elsewhere are, for example, enhanced public–private partnerships in implementation of malaria activities, and replacement of artemisinin monotherapy due to concerted efforts among multisectoral partners. How MARC-implementing partners overcame challenges encountered during its 3-month implementation can also be beneficial elsewhere.

From 2014 onwards, containment of artemisinin resistance in Myanmar will become an integral part of the efforts under the GMS regional artemisinin resistance initiative (RAI), with funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) and BMGF. 3MDG will continue to provide additional funding for artemisinin-resistance containment activities in Myanmar beyond 2013, possibly until 2016, focusing on two main activities: (1) improved access to diagnosis and treatment to target populations in containment areas; and (2) provision of locally appropriate vector control measures and personal protection.

While it is good news that funds continue to pour into Myanmar, multiple donors together with multiple implementing partners requires careful planning and adequate coordination. Maintaining what was achieved in the face of rapid changes in administrative and finance mechanisms, as well as increased technical issues, continues to pose challenges to Myanmar NMCP and WHO. This phenomenon is not unique to Myanmar, however. The donor community can work together to ensure that the technical implementing partners are not unnecessarily burdened by administrative requirements.

REFERENCES


How to cite this article: Kyaw TT, Hlaing T, Thimasarn K, Mon KM, Galappaththy GNL, Plasai V, Ortega L. Containing artemisinin resistance of Plasmodium falciparum in Myanmar: achievements, challenges and the way forward. WHO South-East Asia J Public Health 2014; 3(1): 90–94.

Source of Support: Nil. Conflict of Interest: None declared.
Contributorship: TTK provided information, TH provided information, KT wrote the paper, KMM provided information, GNLG wrote the paper, VP wrote the paper, LO reviewed the paper.