Dengue vector surveillance and control in Hong Kong in 2008 and 2009

K.Y. Cheung and M.Y. Fok

Food and Environmental Hygiene Department, China, Hong Kong Special Administrative Region

Abstract

Dengue vector surveillance programmes were implemented in the community and port areas in Hong Kong Special Administrative Region. *Aedes albopictus* was the only *Aedes* vector detected and its distribution was extensive in various areas during the summer months. *Aedes aegypti* was, however, not detected in any area under surveillance. For community surveillance, the monthly ovitrap indices (MOI) of 2008 and 2009 followed a similar trend as in previous years but were generally lower. The highest ovitrap index recorded in 2008 and 2009 was 37.5% and 48.3% respectively, which were much lower than the highest recorded of 70.9% in 2007. Only two surveyed areas in 2009 had ovitrap indices greater than 20.0% for more than two consecutive months, which was more often seen in 2007. Improvement in the dengue vector situation in the past two years could be attributed to the swift response of the agencies concerned upon getting information on surveillance results via the geographic information system. The public was also informed of the results regularly through the Internet and press releases to create awareness to prevent and control the dengue vector. Health education programmes targeted at different organizations/parties were arranged to promote knowledge about dengue vector prevention and control.

**Keywords:** Dengue vector surveillance; ovitrap indices; *Aedes albopictus*; vector control; Hong Kong SAR.

Introduction

Dengue fever has statutorily been made notifiable in China, Hong Kong Special Administrative Region (Hong Kong SAR) since 1994.\[1\] Between 1994 and 2001, the annual number of notifications ranged from 3 to 17 imported cases. In 2002, for the first time, there were 44 confirmed cases recorded, of which 20 were locally infected. There was another local case recorded in 2003 but none since 2004. The number of imported cases remained at 31 from 2004 to 2006, increased to 58 in 2007, and then dropped to 42 in 2008 and 43 in 2009 (Table 1).\[2\]

*Aedes albopictus*, one of the dengue vectors, is commonly found in the Hong Kong Special Administrative Region, and has wide distribution both in urban and rural areas. *Ae. aegypti*, on the other hand, probably has not been an indigenous species in Hong Kong SAR, though it was once discovered on board a vessel from another city in the mid-1950s.\[3,4\]
Dengue vector surveillance and control in Hong Kong in 2008 and 2009

The dengue vector surveillance programme using oviposition traps (ovitraps) in Hong Kong SAR was first introduced in 1998 at the Hong Kong International Airport. Since then, the programme has been gradually extended to cover the community areas and all the port areas. It aims to detect the presence and distribution of the dengue vectors, to monitor and evaluate the effectiveness of dengue vector control work carried out by various agencies, and to make timely adjustments to dengue vector control strategies and measures.

Table 1: Number of imported and indigenous dengue fever cases from 1994 to 2009[2]

<table>
<thead>
<tr>
<th>Year</th>
<th>Imported cases</th>
<th>Indigenous cases</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>1995</td>
<td>6</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>1996</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1997</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>1998</td>
<td>15</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>1999</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>2000</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>2001</td>
<td>17</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>2002</td>
<td>24</td>
<td>20</td>
<td>44</td>
</tr>
<tr>
<td>2003</td>
<td>48</td>
<td>1</td>
<td>49</td>
</tr>
<tr>
<td>2004</td>
<td>31</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>2005</td>
<td>31</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>2006</td>
<td>31</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>2007</td>
<td>58</td>
<td>0</td>
<td>58</td>
</tr>
<tr>
<td>2008</td>
<td>42</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>2009</td>
<td>43</td>
<td>0</td>
<td>43</td>
</tr>
</tbody>
</table>

Methods and materials

Ovitraps were used in this surveillance programme as a tool to detect the prevalence and distribution of aedine mosquitoes. The device was locally manufactured as per specifications. It comprised a simple black plastic container with a straight and slightly tapered side of approximately 200 ml capacity. The opening measured 6.5 cm in diameter, the base diameter was 5.0 cm and the container was 10.0 cm in height. The ovitrap was covered by a black cap with four round holes and a grey umbrella-shaped raised cover to protect the contents in the ovitrap from contamination by unwanted materials, such as pesticidal chemicals, litter, cigarette butts, etc. A brownish wooden tongue depressor was placed diagonally inside the container as an oviposition paddle. For surveys in community areas, tap water which had been dechlorinated for one night was used as the breeding medium in the ovitraps. For surveys in port areas, 10% hay infusion solution, which had been prepared by steeping 125 g of dried grass in 15 litres of dechlorinated tap water in a tightly closed plastic container for seven days, was used as the breeding medium in the ovitraps. A new batch of hay infusion was started seven days in advance as followed in Cambodia.[5]

Community areas

Thirty eight areas with high human concentration, such as housing estates, schools and hospitals, were selected. All the 38 areas were surveyed every month by four teams of paired staff to closely monitor the situation in each area and to obtain a territory-wide picture of the vectorial situation. On average, 55 ovitraps were placed at each selected site. Every month, the ovitraps were set at a distance of at least 100 m from one another.
for one week and then collected and brought back to the laboratory. To serve as a quick reference for taking prompt follow-up action for mosquito control, each of the ovitraps was examined immediately for the presence of mosquito larvae/eggs. The ovitraps were then incubated at room temperature for one week for the eggs, if any, to hatch. All the larvae found in the ovitraps were identified under a compound microscope to species level. The percentage of positive ovitraps retrieved from the field was recorded as the “Ovitrap Index”. “Area Ovitrap Index” (AOI) refers to the ovitrap index of an area whereas “Monthly Ovitrap Index” (MOI) refers to the pooled results of all the ovitraps retrieved from the 38 areas in the same month. MOI reflects the overall vector situation for the month.

For operational purposes, the ovitrap indices were classified into four different categories – Level One: indices less than 5.0%; Level Two: indices between 5.0% and less than 20.0%; Level Three: indices between 20.0% and less than 40.0%; and Level Four: indices at 40% or above. Different actions were taken based on the levels recorded.

Results

Community surveillance

The MOIs of 2008 and 2009 followed a similar trend as previous years but were generally lower (Figures 1 and 2). The MOIs in the first quarters were maintained at a rather low level of 0.0% to 0.2%. However, the indices rose sharply in the second quarter from 2.9% in April to the peak of 14.2% in June 2008 and from 4.8% in April to 19.0% in June 2009. The highest MOIs recorded in 2008 and 2009 were lower than the averages of previous years (23.4% in June for 2000–2007; 22.4% in June for 2000–2008). The MOIs decreased gradually from 14.2% in June to 7.3% in October 2008 and from 19.0% in June to 5.7% in October 2009, and then dropped to 0.1% in December 2008 and 0.0% in December 2009.

In 2008, there were three AOIs that exceeded 20.0% in May. The number of AOIs greater than 20.0% increased sharply to seven in June and further to eight in July. There were two locations found to have AOIs greater than 30.0%, one in June and the other in July. Their AOIs were brought down to below 20.0% in the following month in both cases. All AOIs recorded in August and September were lower than 30.0%. The number of AOIs reaching 20.0% also decreased from eight in July to four in August and further to three in September. The indices remained at a lower level in the last quarter. No activity of aedine mosquitoes was detected in most of the survey areas after November.

In 2009 there were two and one AOIs that exceeded 20.0% in April and May respectively. The number abruptly rose to 12 in June, among which eight AOIs exceeded 30.0% and one AOI even exceeded 40.0%. The number of AOIs that exceeded 20.0% dropped down
Figure 1: Comparison of Monthly Ovitrap Index of 2008 with the average of previous years (2000 to 2007)

![Figure 1 diagram]

Figure 2: Comparison of Monthly Ovitrap Index of 2009 with the average of previous years (2000 to 2008)

![Figure 2 diagram]
Dengue vector surveillance and control in Hong Kong in 2008 and 2009

The highest ovitrap index recorded in 2008 and 2009 was 37.5% and 48.3% respectively, which were much lower than the highest recorded of 70.9% in 2007. None in 2008 and only two in 2009 of the surveyed areas had ovitrap indices greater than 20.0% for more than two consecutive months, which was seen more often in 2007. In general, areas more often recorded with high ovitrap indices (≥20.0%) during summer months were those with vegetated slopes present; whereas for areas where such landscape was lacking/minimal, the ovitrap indices recorded throughout the whole year were usually less than 20.0%.

**Port surveillance**

In 2008, the Port Monthly Ovitrap Index (PMOI) ranged from 0.0% in January through March to 1.6% in June. The variation in PMOIs showed a similar trend as in previous years (Figure 3). The ovitrap indices of all the seven port groups were below 20.0%. The highest index of the port groups (8.3%) was recorded in the Railway Cargoes Handling Areas in July. The ovitrap indices of two other port groups (the Cross Boundary Check-Points on Land and Public Cargoes Working Area) reached the highest in June, and were 7.2% and 5.8% respectively. In 2008, the average PMOI was 0.4%, which was lower than that in 2007 (0.8%).

In 2009, the PMOI ranged from 0.0% in January through March to 1.5% in June. The variation in PMOIs showed a similar trend as in previous years (Figure 4). The ovitrap indices of all port groups were below 20.0%. The highest index of the port groups (11.7%) was again recorded in the Railway Cargoes Handling Areas in June. The ovitrap indices of two other port groups (the Cross Boundary Check-Points on Land and Private Cargoes Working Area) reached the highest in June, and were 7.9% and 8.3% respectively. In 2009, the average PMOI was 0.3%, which was lower than that in 2008 (0.4%).

**Figure 3: Comparison of Port Area Ovitrap Index: 2004-2007 and 2008**

![Graph showing Port Area Monthly Ovitrap Index and average figure of Port Area Monthly Ovitrap Index (2004–2007)](image)
Discussion

The results of the community and port surveillances indicated that *Ae. albopictus* existed in various areas in Hong Kong SAR and its distribution was wide, particularly in summer. High ovitrap indices were recorded repeatedly in some of the areas covered by the surveillance programme, indicating the presence of persistent breeding grounds that needed continuous attention. *Ae. aegypti*, the important vector for the transmission of dengue fever and yellow fever, was, however, not detected in all the areas covered by the community and port surveillance programmes.

The dengue vector surveillance programmes served as a tool not only to monitor the local dengue vector distribution but also to provide objective information to take appropriate actions by the community against dengue vectors. Government departments were able to access detailed information and the results of the surveillances, including locations of positive ovitraps through a geographic information system (GIS) which was accessible by registered users through the government Intranet. They were able to target mosquito control action at venues that fell within the 100 m radius of all positive ovitraps under their purview. The AOIs, MOIs and PMOIs were released to the public through press releases and the Internet to raise their awareness levels about preventing the spread of mosquitoes. Detailed and comprehensive advice on mosquito prevention and control was issued together with the press release. The public were also able to access the information through the Internet. People were advised to pay particular attention to any water accumulation in and near their residences.
At lower levels of the ovitrap index (Levels One–Two) control measures mainly relied on source reduction, e.g. proper disposal of disused articles, empty lunch boxes, containers, etc. Potential breeding sites such as saucers underneath plant pots, surface drainage channels, roadside gully traps or keyholes of manhole covers were inspected weekly and any accumulated water was removed promptly. Larvicides were applied whenever immediate elimination of breeding sources was not feasible. For areas with indices at Level Three or above, an inter-departmental anti-mosquito task force was set up at the district level to coordinate efforts in mosquito control. Relevant nongovernmental organizations, including housing estate management companies and schools, were also invited to participate in special control operations. When the ovitrap index reached Level Four, space spraying of insecticides was carried out at the resting places of adult mosquitoes to contain the mosquito problem.

As in previous years, the government organized annual territory-wide anti-mosquito campaigns in 2008 and 2009 to promote community participation and forge close partnerships between government departments and nongovernmental organizations to control the breeding and spread of mosquitoes.

On health education, health talks were organized for schoolchildren, managements of estates, construction sites, as well as local organizations such as area committees at the district level to disseminate the message of mosquito prevention and control. Training was also organized for pest control personnel in the government. Operatives of pest control contractors providing mosquito control services funded by the government were required to receive proper training on general pest control, including mosquito control and dengue fever.

Conclusions

According to the results of the dengue vector surveillance in 2008 and 2009 in Hong Kong SAR, *Ae. aegypti* was not detected and the activity of *Ae. albopictus* was, in general, under control. The MOIs during this period were all lower than the averages of the past few years. This indicated that the vector problem had been brought under control in 2008 and 2009.

Active participation of the government, local organizations and the public at large was the key to success in controlling the dengue vector. The timely release of the results of dengue vector surveillance to all parties concerned through the GIS and to the public by press releases facilitated prompt remedial actions on vector control. Health education for sustaining public participation in the prevention and control of the vector continued to be one of the key elements in the mosquito prevention programme.
References


