New Initiatives in Dengue Control in Singapore

by

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Abstract

The incidence of dengue in Singapore follows the trend in other countries in the region very closely. However, efforts are being made to minimize the number of cases in the country. This is being achieved by the introduction of new tools such as the geographical information system (GIS) for the management of databases and spatial identification of “hotspots” and the use of hand-held terminals (HHT) for the collection of field surveillance data. New initiatives include regular mosquito surveillance of housing estates and crowded places, redesigning of structural habitats, incorporation of heating elements in roof gutters and tracking behavioural changes.

Keywords: DF/DHF, new initiatives, GIS, hand-held terminals, ovitraps, Singapore.

Introduction

Singapore is situated in a geographical region which is endemic for DF/DHF(1,2). The incidence of dengue in Singapore follows very closely the trend in other countries in the region. Although we are affected by the peaks and troughs of dengue in the region, we are making all efforts to minimize the peak (magnitude of the cases) within Singapore.

Aedes control strategies

Broadly, our strategies for Aedes mosquito control include:

(1) Source reduction;
(2) Health education;
(3) Law enforcement, and
(4) Chemical control

Source reduction remains the main focus of our control strategies and the approach is preventive rather than reactive. For example, all construction sites, schools and condominiums are required to engage pest control operators to do regular mosquito control. These are places where activities usually create mosquito-breeding problem, or where there is high density of people to support disease transmission. We also identify certain residential estates as dengue-sensitive areas, and check the
premises and educate the householders on mosquito prevention regularly on a two-monthly cycle. These sensitive areas are reviewed periodically as mosquito population is dynamic.

**New tools used for Aedes control operations**

**Geographical Information System (GIS)**

Since 1998, we have developed and made use of the PC-based geographical information system (GIS) to manage the huge databases on cases and Aedes mosquitoes island-wide. Examples of information stored on the GIS are: patients’ particulars, locations of Aedes breeding, larval densities, species of vectors, habitat types, premises types, and ovitrap locations. The GIS enables us to visualize at a glance “hotspots” where cases or breeding are concentrated so that early control operations can be implemented (Figures 1 and 2). We can also perform spatial and temporal analyses of the data for future planning, such as the review of dengue-sensitive areas; and for day-to-day operation planning such as the boundary of control operations in outbreak areas, the progression of an outbreak, etc.

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**Figure 1. Distribution of dengue cases in Singapore in 2001 shown on GIS**
The use of the GIS has helped us to be more precise in defining problematic areas and in decision-making and we can respond faster to a bad mosquito situation before cases occur. We are in the process of developing GIS models as early-warning indicators of dengue transmission.

**Hand-held terminals (HHT) for field surveys**

Since 2001, our field officers have begun using hand-held terminals (HHT) to input field surveillance data in the field. Previously, they filled in such information on paper forms, which then needed to be keyed into the computer and converted into formats readable by the GIS software. With the HHT, the information is stored in the HHT and then downloaded into a server and read directly by the GIS software. This cuts down time in transferring data and we can analyse the information collected from all field officers on the same day of the survey or by the next day the latest. This has enhanced our capabilities to be prompt in control operations. We are looking into exploiting wireless technologies to send or request information on the HHT wirelessly to or from the server. For example, field officers will be able to retrieve past enforcement or breeding records for any premises without having to return to the office to search for such records.

**Ovitrap**

Ovitrap are autocidal traps which attract Aedes mosquitoes to breed in them, but the adult mosquitoes are unable to emerge and therefore drown in the traps. It has been used mainly as a monitoring tool so far. We are using ovitraps both as a monitoring tool and a control tool. About 2,000 ovitraps are placed in dengue-prone areas all over Singapore to serve as sentinel or monitoring stations. They are useful as we are unable to check every part of Singapore regularly. About 10 ovitraps are placed in each of the monitored areas, and weekly readings of the number of eggs laid, larval counts and
species breeding are recorded. If there is an increase in prevalence or change in the species breeding in the ovitraps from Aedes albopictus to Aedes aegypti, control operations will be launched in the area immediately.

In some outbreak areas where transmission has started spreading outwards, we use ovitraps to contain the outward spread of mosquitoes from the foci of transmission. We have found that cases tend to spread outwards after we removed or neutralized all potential breeding sites within the initial focus, as the remaining surviving infected adult Aedes mosquitoes would fly further out to look for breeding habitats. We now put ovitraps back into the outbreak area to continue providing the mosquitoes a place to breed within the area, and to reduce their population eventually.

We are in the process of researching the optimal layout distribution of ovitraps in the field to give us a better indication of mosquito population. We are also improving the design of the ovitrap to make it tamper-proof so that it does not need to be serviced or checked weekly in areas which are already well under control.

**New Initiatives**

We are constantly looking for ways to improve our effectiveness in Aedes control. Several new initiatives have been or will be taken soon; these are described below:

**Regular surveillance of outdoor areas in public housing estates and crowded places**

Traditionally, it is assumed that the Aedes aegypti mosquitoes breed indoors and people are infected in the home. However, the profile of our cases in Singapore showed that the most prevalent age groups are the teenagers and young adults (Figure 3). These are very mobile groups who do not spend more time at home during daytime most of the days. Children and the elderly people who are not very mobile and are most likely to spend their time in the home, are not the ones most affected. This led us to suspect extradomiciliary transmission. We have also found Aedes mosquitoes breeding in many outdoor habitats, whereas the House index is generally very low (1-2%). Based on these observations, we have implemented, since September 2001, fortnightly checks on outdoor areas in public housing estates where more than 82% of the population reside, and crowded or popular places where people hang out and congregate.

Previously, these outdoor areas were checked on an ad hoc basis only in response to complaints or cases. This new scheme is implemented in the south-eastern, north-eastern and southern parts of Singapore which contribute about 82% of all cases reported. After a month of implementation, we saw quite a sharp decline in the number of cases reported, but it is still too early to draw any conclusion.
Morbidity rates are highest amongst teenagers and mobile adults.

**Redesigning of structural habitats**

We have worked with other building authorities to redesign structural habitats so that these will be mosquito-proof in new developments. Examples are: gutters in bus shelters and houses, bamboo pole holders, gully traps.

**Heating elements in roof gutters**

Roof gutters have been found to contribute significantly to dengue cases and outbreaks in Singapore. Aedes breeding in gutters is usually profuse, and yet gutters are very difficult to reach and maintain. In recent years, we have convinced architects not to build houses or structures with gutters. Also, where gutters can be removed from existing houses, we try to get householders to do so. The problem is with concrete gutters which form part of the structure of the house; these cannot be removed and continue to pose a problem.

The use of heating coils in temperate countries to melt snow in roof gutters gave us the idea of heating up stagnant water in gutters to kill mosquito larvae/pupae. We have done pilot studies using a modified set-up to suit local conditions. Water in gutters was heated up twice a week to 45°C and maintained at this temperature for 3 hours, and the larvae/pupae were killed. The only impediment is the cost of installation, estimated at between US$ 6,000 to US$ 12,000 for a house with front and back gutters, depending on the size of the house. The monthly electrical utility bill is estimated to cost S$ 12 - S$ 36. We are looking into ways to make it conducive for householders with gutters which cannot be removed to install such heating element system.

**Tracking behavioural changes**

Like most vector control authorities, we view public health education as an important ingredient for sustained dengue control. However, one common complaint is that health education efforts seem to be ineffective in eliciting sustained behavioural changes. There could be many reasons why this is so; for example, the message might not be clear; there is a gap in the perception or understanding of the seriousness of the disease; there are too many things to remember; the measures recommended are difficult to carry out; people are too busy; they don’t know how to do it; etc. Very often, mosquito-breeding is a result of negligence rather than commission. Our health education is generally one-way, i.e. we give out information and expect people to receive it. But there is no feedback mechanism to check whether the message is understood and why people do not act if they have understood the message. We will be carrying out a market survey soon to get the feedback from householders on the level of knowledge and action taken in mosquito prevention, and to find the emotive motivators which will make them sustain the efforts. This will help us come up with more effective education strategies.

The aim of public health education is ultimately to change behaviours. Getting the message across to the community is not
enough. There should also be mechanisms to track whether behaviours have been changed and desirable habits formed. We are planning to do a three-month campaign to show residents in landed properties in the south-eastern and north-eastern parts of Singapore what the potential habitats are, and what they must do to remove or prevent breeding. A checklist of all habitats and their number in the premises will be given to the householders to follow-up. During subsequent visits, the habitats and their number will be recorded again. A reduction in or removal of habitats by the householders will be an indication of actual behavioural changes. To sustain the efforts after the 3-month campaign, reminders must be sent periodically as part of the total education and publicity plan.

We will be looking into a publicity plan package for dengue to send out messages at the right time and in a tone that will produce confidence and cooperation and not panic in the public.

**Research initiatives**

In 1999, we launched research initiatives on Aedes mosquitoes to answer questions we have about Aedes mosquitoes and its control.

One very critical need is the development of a good indicator for mosquito population which is easy to obtain or compute at the operational level. Future projects being planned include evaluation of current control methods and tools, life-table studies, behavioural studies on Aedes mosquitoes, GIS models for forecasting dengue, etc.

**Conclusion**

In this paper, I have outlined some of our new initiatives and tools for improving Aedes control, health education and for solving breeding problems. This is by no means the end of our efforts, as the situation on the ground is dynamic and changing all the time. Some of the tools and initiatives would need to be fine-tuned and improved over time, and other new ones introduced to deal with problems that arise. Singapore is fortunate as dengue control efforts do receive a relatively high level of support from the management and politicians. By and large, we are also able to work with other authorities to solve vector breeding problems. Such high-level support and inter-agency cooperation and understanding are very crucial to the success of the dengue control programme, and emphasize the need for vector control authorities to convince and to engage people outside of vector control area, even the private sector (e.g. PR firms), into the programme.

**References**