DENGUE FEVER ON THE ISLAND OF DOMINICA

Dengue and Dengue hemorrhagic fever (DHF) are viral infectious diseases transmitted by the bite of an infected Aedes aegypti mosquito. The four antigenically related but distinct serotypes of the dengue virus are each capable of causing both dengue fever and dengue hemorrhagic fever. The common incubation period for dengue/DHF is approximately 5-6 days. Dengue and DHF are prevalent throughout the islands of the Caribbean. Dominicans often refer to this virus as "breakbone fever" due to it's symptoms. The severe malaise and muscle/joint pains are compared to the feeling of having one's bones broken.

SYMPTOMS

Dengue fever is characterized by a sudden onset of disease. Patients develop a fever that lasts for an average of 3-7 days, intense headache, retro-orbital pains, prostration, joint and muscle pain, rash, redness of skin, loss of appetite, vomiting, and sore throat. Dengue Hemorrhagic Fever is a more severe epidemic form of dengue characterized by hemorrhagic skin lesions. The skin bruises and bleeds easily at puncture sites, and blood spots arise scattered about the extremities, face, and soft palate. There is often a haemorrhaging (bleeding) of the gastro-intestinal tract and an enlargement of the liver. DHF patients have a tendency to develop a shock syndrome (DSS) that could be fatal. The onset of Dengue Shock Syndrome is indicated by signs of circulatory failure between the third and seventh days of the disease. The patient develops a rapid pulse along with cool and blotchy skin. These patients often become restless and then go into a critical stage of shock.

Four main grades of severity are recognized:

grade 1 fever and other classical dengue symptoms
grade 2 grade 1 accompanied by spontaneous bleeding of the skin, gums, and gastrointestinal tract
grade 3 grade 2 accompanied by agitation and circulatory failure
grade 4 profound shock

Grade 1 constitutes typical dengue fever, grade 2 signifies the onset of DHF, and grades 3 and 4 comprise DSS.

RECOGNIZING DENGUE CASES WITHIN THE COMMUNITY

The Ministry of Health of Dominica developed a format for recognizing a dengue outbreak within a community. The indications of a dengue outbreak are as follows:

- The presence of several children who suffer from undiagnosed febrile (fever) diseases. Suspicion increases if these cases fail to respond to the specific treatments for common diseases. (e.g. pneumonia, malaria, etc.)
- Unexplained deaths in the community within one week of the onset of a febrile illness.
- Fever patients that have red spots on the skin and/or bleeding from the nose or gums.
- Fever patients who remain ill despite a drop in temperature; the patient's condition may deteriorate with the development of clammy skin, cold and sweaty extremeties, drowsiness and/or restlessness.
- Panama - 365 recorded cases; the type 1 virus was the most predominant, and there was one confirmed type 3 isolation.
- Nicaragua - 18,700 confirmed cases with 1,100 classified as DHF. There were 2 confirmed isolations of the type 3 virus.
- Dominica - Due to the vigilant prevention and control measures instituted by both the Ministry of Health and the Environmental Health Department, there were only 4 confirmed cases on the island.

Due to both the prevalence of carriers throughout the Caribbean and the large number of *Aedes aegypti* on Dominica, the Ministry of Health began to prepare for a Dominican outbreak in 1995.

In March of 1995 the Ministry of Health sent letters to all health care providers advising them on the imminent threat of a dengue outbreak. Every private practice physician, hospital clinician, and health district physician was provided with a case definition for dengue and DHF/DSS.

The Ministry also held four main meetings throughout the month of April to prepare for the coming epidemic:
1. A meeting was called with all physicians on the island to discuss the case definition and plan a course of action to deal with the possible appearance of DHF/DSS on the island.
2. All environmental health officers working for the Ministry of Health met to discuss the prevention and control measures to be undertaken.
3. The Ministry met with the manager of their central medical supplies unit to discuss the available materials needed for the management of DHF/DSS.
4. The Ministry called meetings with medical laboratories and blood banks to ensure the availability of platelet concentrates, blood, and plasma for the management of DHF/DSS patients.

The Dominican epidemic began in early August of 1995 and ended in mid November. The outbreak peaked during the last week of August and the first week of September when more than 20 cases were consistently documented per week. There were a total of 297 cases with four confirmed cases of DHF, and all virus isolations were of types 1 and 2. Most cases occurred in either children younger than one year of age or in the 10-34 age bracket, and females were more affected than males. (See figure 2 for a more complete breakdown of this data.) Roseau had a very high rate of infection. Several inner city neighborhoods within Roseau were without adequate housing, garbage disposal, or running water facilities - this led to a high density of *Aedes aegypti* in the area. (See figure 1) All four cases of DHF survived due to the swift reactions of prepared physicians and the readily available supplies in all hospitals and clinics.

**FUTURE CONCERNS**

The main concern of the Ministry of Health at this time involves the type 3 viral serotype. The last dengue-3 outbreak on Dominica occurred in 1977. Subsequent outbreaks have all been linked to serotypes 1, 2, and 4. Consequently, all Dominicans born after 1977 have no immunological protection against the dengue-3 strain. Previous exposure to one dengue serotype develops a life-long immunity to that one viral type only; the subsequent exposure to a different serotype is strongly associated with an increased risk of DHF/DSS. Because the populations within the Dominican sub-region have been repeatedly exposed to viral types 1, 2, and 4 within a relatively short amount of time, the introduction of the type 3 virus would virtually ensure the emergence of epidemic DHF/DSS in the Caribbean.
### Figure 1

**DENGUE FEVER CASES BY HEALTH DISTRICTS - 1995**

<table>
<thead>
<tr>
<th>HEALTH DISTRICT</th>
<th># OF CASES</th>
<th>POPULATION</th>
<th>ATTACK RATE PER 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roseau</td>
<td>184</td>
<td>31,343</td>
<td>587</td>
</tr>
<tr>
<td>Marigot</td>
<td>28</td>
<td>8,211</td>
<td>341</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>28</td>
<td>9,944</td>
<td>281</td>
</tr>
<tr>
<td>St. Joseph</td>
<td>27</td>
<td>7,277</td>
<td>371</td>
</tr>
<tr>
<td>Grandbay</td>
<td>18</td>
<td>6,600</td>
<td>272</td>
</tr>
<tr>
<td>La Plaine</td>
<td>6</td>
<td>3,976</td>
<td>150</td>
</tr>
<tr>
<td>Castle Bruce</td>
<td>6</td>
<td>4,165</td>
<td>144</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>297</strong></td>
<td><strong>71,516</strong></td>
<td><strong>415</strong></td>
</tr>
</tbody>
</table>

### Figure 2

**DENGUE FEVER CASES BY SEX AND AGE - 1995**

<table>
<thead>
<tr>
<th>AGE GROUPS</th>
<th>MALES</th>
<th>FEMALES</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1</td>
<td>15</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>1 - 4 yrs.</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>5 - 9 yrs.</td>
<td>14</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>10 - 14 yrs.</td>
<td>16</td>
<td>24</td>
<td>40</td>
</tr>
<tr>
<td>15 - 19 yrs.</td>
<td>17</td>
<td>25</td>
<td>42</td>
</tr>
<tr>
<td>20 - 24 yrs.</td>
<td>20</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>25 - 34 yrs.</td>
<td>29</td>
<td>30</td>
<td>59</td>
</tr>
<tr>
<td>35 - 44 yrs.</td>
<td>9</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>45 - 54 yrs.</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>55 - 64 yrs.</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 65</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>133</strong></td>
<td><strong>164</strong></td>
<td><strong>297</strong></td>
</tr>
</tbody>
</table>
Epidemiologically there are three major population groups who are most at risk for the development of DHF/DSS:

1. Children less than one year of age whose mothers have developed an immunity to a dengue serotype. These children may have maternally derived dengue immunities before their initial contact with the virus.
2. School-aged children who have had previous dengue infections.
3. Any person over one year of age who has previously been infected with the dengue virus.

CONCLUSION
The dedication and vigilance of both the Ministry of Health and the Environmental Health Department keep dengue/DHF under control on this island. This is indeed a great achievement due to the island's near proximity with many dengue-infested Caribbean islands. The prevention and control measures listed above have been in effect since the 1970's, and the environmental health department is continually working to improve this system.

SUGGESTED FURTHER RESEARCH
- Mr. R.A.J. Fortune of the Ministry of Health has a hypothesis that being black may be a protective factor in the development of DHF/DSS. This is based on observations that the majority of Dominica's DHF patients have been lighter skinned visitors/immigrants to the island. Further research could be done on this hypothesis.
- The Aedes aegypti mosquito also carries yellow fever. Further research could determine the effect of the prevention and control measures listed above on the incidence of yellow fever on the island.

SOURCES
- R. A. J. Fortune, MSc, MPH, FIST, Epidemiologist
- G. A. C. Grell MD, FRCP Consultant Physician / Medical Director of Princess Margaret Hospital
- Hague Thomas, Environmental Health Officer
- Greenberg, Raymond S. et al. Medical Epidemiology. Stamford, CT: Appleton and Lange, 1996
PREVENTION AND CONTROL

There is no specific treatment for dengue fever. Vaccine development is difficult due to the presence of four different dengue viral serotypes, each of which may cause the disease. The discovery that protection against only one or two of these serotypes actually increases the risk of more serious disease further complicates vaccine development. There is some progress in the development of a vaccine that could protect against all four serotypes. The only present method of controlling and preventing dengue/DHF is through control of the vector mosquito.

The environmental health department of the Commonwealth of Dominica launched a massive campaign to combat the Aedes aegypti mosquito. The key components of this campaign are routine house calls and community-wide education.

The Environmental Health Department controls a team of ten vector control officers who visit individual households to check for Aedes aegypti breeding areas. The Commonwealth of Dominica is divided into seven health districts that these officers cover systematically: Marigot, St. Joseph, La Plaine, Castle Bruce, Grandbay, Portsmouth, and Roseau. Each officer covers an average of 25 households per day. Most breeding areas are found in stagnant water tanks, empty cans or bottles, old tires, coconut shells, or stagnant eves and gutters. These officers generally eliminate these sites and kill the existing Aedes aegypti on their own, but a team of environmental health workers may be called out if necessary. The vector control officers distribute pamphlets along with verbal information to teach each household about mosquito control. A data entry form is filled out for each household, and the officers submit quarterly reports to the Environmental Health Department. The environmental health office uses this data to compile yearly statistics on the presence of the Aedes aegypti mosquito on Dominica.

These efforts intensify during the dry seasons when mosquito breeding grounds are most prevalent. Stagnant pools form in ravines and gulleys due to the absence of fresh rainwater to flush them out. Congested rivers lead to the formation of swampy areas and stagnant ponds. The environmental health office works to unclog rivers, drain all swampy areas, and keep all waterways running swiftly and smoothly. Health officers control surges in the population of adult mosquitos with pesticide fogging.

The environmental health department also works with the Ministry of Health to organize community outreach programs that inform citizens about dengue prevention. Environmental health officers are continually teaching and working alongside community members and health officials to promote education on dengue prevention and control.

In the future, the environmental health department is hoping to develop some method of controlling the import of dengue carriers. Due to the prevalence of the mosquito vector on the island, one imported case of dengue could easily spark a state-wide epidemic. There is a large amount of population flow among the many Caribbean islands, and many Dominicans shop in Puerto Rico, Trinidad, or Barbados. There is no existing epidemiological control over the Dominican ports of entry, and the funds are not available for the implementation of such a system at this time.

RECENT HISTORY

A rash of dengue outbreaks throughout the Caribbean in 1994 spurred the Dominican Ministry of Health to upgrade dengue policies. The major outbreaks were as follows:

- Puerto Rico - 21,000 recorded cases with a large number of hospitalizations and 6 deaths. Many of these cases satisfied the criteria for DHF. Serotypes 1, 2, and 4 were isolated, but the type 2 virus was the most prevalent.