A PRIMARY SCHOOL-BASED CURRICULUM FOR THE CONTROL OF NUISANCE AND VECTOR MOSQUITOES IN THE CARIBBEAN – A PRELIMINARY REPORT

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Introduction

The Americas, with special reference to those areas considered tropical and sub-tropical have for centuries been known as a fertile area for a plethora of vector-borne diseases. Among these are yellow fever and dengue fever (DEN), known to exist in the Caribbean for at least 200 years (Zinzer 1967). During the middle of this century, dengue was a relatively unknown disease in the West Indies. This was due in part to a major effort on the part of the Pan American Health Organization and its Member States to eliminate the vector mosquito, *Aedes aegypti* from the hemisphere. By the late 1960's and early 1970's all but two countries had eradicated the species, leaving only the United States and Venezuela as remaining strongholds for eventual reinfestations. By the late 1970's and early 1980's, programs for
the elimination of the dengue vector species faltered and gradually *Ae. aegypti* was re-introduced. This process was repeated in country after country in the Caribbean until nearly all the territories, where it once had been eliminated, were reinfested. Only the Cayman Islands and Bermuda managed to remain free of the dengue vector.

With the increased significance of the vector species, dengue re-appeared in the West Indies as seen by the first pandemic caused by dengue type 1 (DEN-1) virus. The disease, clinically known in old literature as "breakbone fever", caused major epidemics in 1977 and 1978. It commenced in Jamaica and during the ensuing two years, swept virtually throughout the Caribbean, in both the windward and leeward islands, then spread to the mainland causing outbreaks in central and south American, and as far north as Mexico and into the United States (Anon. a 1979).

In 1981, the first major epidemic of the more serious form of dengue occurred in Cuba, not simply classical dengue, but dengue haemorrhagic fever (DHF) with shock syndrome. Dengue serotype 2 (DEN-2) was introduced, causing clinical symptoms with major haemorrhagic manifestations. This new disease phenomenon occurred in epidemic proportions with 344,203 cases of which 116,143 were hospitalized and 157 deaths reported (Personal communica-tions, G. Guzman).

Caribbean country programs, previously devoid of the dengue vector during the period when eradication was popular, now had unacceptably high levels of *Ae. aegypti*. in most communities. All three phenotypes of *Ae. aegypti*, are found in the Caribbean, and apparently are effective vectors, transmitting the flavivirus, to susceptible individuals.

In many cases countries were ill equipped to face DEN and DHF outbreaks, and medical resources were stretched to their limits, being overwhelmed by the number of cases. Since 1981 a total of 23 countries in the Caribbean, Central and South America have experienced outbreaks of DHF and many more have suffered epidemics of classical dengue (see Table 1).

Development

It became clear by the mid 1980's that government public health services charged with the responsibility of carrying-out pest and vector control in the Caribbean were unable to keep the levels of *Ae. aegypti* sufficiently low to prevent outbreaks of dengue. Leaders in the field of public health and health education called for additional resources to be made available to combat the scrourge of DEN and DHF.

Therefore, it was accepted that there should be a sharing of responsibility for vector control not only between ministries of health and environment, and public health departments, but also with non-health sectors departments such as ministries of education, communities, and even families and individuals. The latter two being most important in terms of their contribution to the provision of breeding sites for *Ae. aegypti* in and around residential dwellings.

In addition, it was recognized that public schools had a vital role to play in teaching youth, the rising generation, about effective environmental hygiene practices. Students could become agents for change with respect to being taught to apply correct environmental health principles about the prevention and or elimination of breeding places used by the dengue vector species in and around schools and homes.

In 1985, a pilot project (Boss et al., 1998), funded by the World Health Organization (WHO), the Panel of Experts for Environmental Management (PEEM), the Pan American Health Organization (PAHO) and the local government of St. Lucia was implemented. The goal of the pilot study was, as determined by community leaders, to reduce the incidence of *Aedes* mosquitoes, rodents and to improve solid waste management practices.

Over a one-year period, two participating communities in St. Lucia, with guidance from the Ministries of Health and the Environment, and Community Development along with PAHO/WHO devised activities to accomplish the goal of no dengue mosquitoes, no rats and no garbage. The project at the community level involved action groups such as women's organization, youth sports clubs, elementary schools, and the private sector. Training was provided locally by the Ministry of Health for more than 30 individuals who became vector control volunteers in the two villages.

Each volunteer was taught communication skills in order to meet with neighbors about key environmental health issues. Over time villagers received multiple visits from the volunteers, they conducted knowledge, aptitude and practice (KAP) surveys along the lines of the goals of the project to reduce levels of the household mosquito, *Ae. aegypti,* eliminate rodent harborage sites and to stimulate interest in the public regarding good environmental hygiene. Two primary schools were involved using simple curricula materials about the dengue mosquitoes, rats and nuisance insects. Students participated in poster competitions, the writing and inacting of skits, and crafting of calypso lyrics about vermin. Local businesses contributed prizes and trophies.

Despite a dengue outbreak, which occurred in the capital city of Castries, St. Lucia during the year of the pilot study, not a single case of dengue was reported from the two pilot study areas. The villages were involved in clean-up campaigns resultantly removed more than 100 dump truck loads of rubbish. Families and individuals not only cleaned up their yards, but also painted their houses and water standpipes with increasing pride in their surroundings.

Source reduction principles were taught by the volunteers, including the covering of drums and barrels placed beneath gutters to collect rainwater, in which the dengue mosquito so freely breed. The elimination of tins, jars, tires, coconut husks, and miscellaneous discarded containers were encouraged, aimed at reducing well-known *Ae. aegypti* breeding sites. All vector control measures were carried out in the absence of larviciding with temephos sand-core granules, which normally are placed in water storage containers by the public health inspectors. Source reduction activities by the community resulted in a drop, in the commonly used *Ae. aegypti* house index, from the pre-treatment level of around 35% to less than 5%.

During the clean-up campaign, abandoned vehicles and discarded appliances were removed and dumped into one of the community's erosion gullies, then filled and leveled with dirt. Subsequently on that site a field for soccer was created. Impressed with the community's self-help initiative, the government erected a community center, a much needed and appreciated facility. Eventually the campaign was introduced island-wide, but with less outstanding results.

The Italian government, traditionally a strong supporter of vector-borne disease research, learned of the pilot project's success and eventually funded a 15 country project, as part of PAHO's Caribbean Cooperation in Health (CCH) initiative. The project was established along similar lines of the St. Luica experience with an integrated community-based vector control approach and included a primary school environmental health curriculum component as a means of trying to build in sustainability. The aim was to teach primary school age children about the importance of having an *Ae. aegypti* free

environment around their schools and homes through the application of basic environmental sanitation measures.

As part of the integrated community-based vector control project, a Health and Family Life Education (HFLE) school module was developed by two of us (AW and MN), with support from the PAHO health educator[1] to address issues of environmental health and the reduction of pests and insect vectors. In 1994/95 nine counties of the 15 participating countries used selected elements of the HFLE environmental health curriculum module with the goal of reducing pests and insect vectors (see table 2).

During the summer of 1998, one of us (ABK) visited Barbados, the Bahamas, Grenada, St. Kitts and Nevis, St. Lucia and St. Vincent on behalf of PAHO. During the visits, meetings were held with officials from the ministries of health and environment and ministries of education as a follow-up of the primary school pilot project with respect to an expanded use of the curriculum on pests and insect vectors (HFLE) module to other primary schools. The results are as follows:

In the Bahamas during 1996/97 school year, all 14 of the country's "Family Islands" schools selectively used components of the HFLE curriculum nation-wide from Kindergarten to the 12th grade.

In June 1996, after the curriculum had been introduced throughout the education system, a Children's Environmental Summit was organized by the Ministry of Education and Training in Nassau with more than 100 children participating. The agenda addressed issues of concern to the children who engaged in debates, made presentations and held group discussions on a variety of topics ranging from solid waste management, environmental hygiene and insect vectors and pests to coastal pollution. In July of that same year, the Ministry of Education held an Annual Teacher's Workshop for maximizing student potential with the theme of "Quality Education". Among the courses taught was that of "Science-Vector Education". The latter was conducted in cooperation with PAHO and WHO for Teachers of Primary School Sciences, Family Life and Health Education.

In November 1996, workshops and community meetings were held on Vector Control Education in the Bahamas. The overall objectives being to: 1) strengthen the capacity of teachers to implement the School Health and Family Life Education curriculum module, "Reducing Pests and Insect Vectors" and 2) encourage greater awareness among the community on vector control education (Anon. b 1996).

Also in that year, a booklet was prepared containing samples of some materials produced by teachers and students who participated in vector control education lessons (Anon. c 1996). The document contained poems, songs, plays and crossword puzzles on mosquitoes, diseases, cockroaches and houseflies. One of the poems written by Raynell A. Kemp, an 11 year from the Nassau Bahamas Mabel Walker Primary School was entitled, "Pests and Rodents". It went like this:

Mosquitoes, Mosquitoes, everywhere
Why don't they just disappear!
Mosquitoes, biting, biting me
Roaches crawling all around
Rats biting dogs and cats
We need a pied piper in town
Come, boys! And come, girls!
Come, moms and dads!
Let's get together; its not hard
To change our world and make a cleaner place!
Community participation is the key!
For this to work we must agree
To clean the garbage from our streets
And make our yards all clean and neat!

In addition, visits were made by one of us (ABK) to at least two schools in each of the aforementioned islands to obtain an idea of how the environmental health module was accepted and adapted. Although most of the schools were not in session at the time (some of the visits were made in June and August), it was possible in September 1998 to access to some degree, what residual impact the environmental health (HFLE) curriculum may have had upon the school's environment. For example, at one school on St. Kitts/Nevis, the children had cleaned and leveled a rocky playing field, removing trash and large rocks, thereby making a place for soccer. At another school, students not only cleaned-up the grounds, but planted flowers to beautify the area. In other schools, posters and signs about nuisance insects and school sanitation were in use.

Conclusion

The significance of the application of the HFLE school curriculum in terms of an impact upon vectors of disease such as dengue is not yet verifiable. However, should the application of the environmental health curriculum for the reduction of pests and vectors be expanded in both primary and secondary schools throughout the Caribbean one can surmise that there eventually will be a change in attitude and perhaps patterns of behavior about the environment and vector mosquitoes such as *Ae. aegypti* in the West Indies. Hopefully such will translate into correct adult behavior regarding an abhorrence of mosquito breeding sites.

It is felt that in time that the correct application of the HFLE curriculum principles will bear fruit and impact upon the environment leading to a reduction in the breeding of mosquito pests and vectors. In the long run a combination of community participation and school curricula with a focus upon environmental health, as commenced with the CCH funded Italian Project, may prove to be more sustainable, effective and of greater value in disease reduction than traditional public health program's vector control activities. From experiences reported from the Bahamas and elsewhere, it has been seen that children, in public schools can be taught basic principles of environmental sanitation thereby increasing their awareness of environmental hygiene issues, which they find important. The ultimate goal of such an expanded environmental health teaching effort is to obtain result in the reduction of pests and vector mosquitoes breeding which occurs at present so freely within the urban environment. Such an educational program may in the long run have a positive impact in reducing vector-borne diseases such as dengue fever.

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Table 1. Dengue haemorrhagic fever occurrence in the Americas by country and year.

COUNTRY	1ST CASE OF DHF	1ST DHF EPIDEMIC
CUBA	1981	1981
SURINAME	1982	1993
MEXICO	1984	1995
NICARAGUA	1985	1994
ARUBA	1985	-
DOMINICAN REPUBLIC	1986	1995
COLOMBIA	1985	1990
ST. LUCIA	1986	-
EL SALVADOR	1987	1987
VENEZULA	1989	1990
BRAZIL	1990	1993
HONDURAS	1991	1995
FRENCH GUIANA	1991	1991
PANAMA	1995	-
GUADELOUPE	1995	-
GUATEMALA	1995	-
JAMAICA	1995	1995
BARBADOS	1995	1997
COSTA RICA	1995	-
DOMINICA	1995	-
ST. KITTS & NEVIS	1995	-
MATINIQUE	1995	-
TRINIDAD & TOBAGO	1997	1997

Table 2. List of countries participating in school-based, integrated vector control project for the control of *Aedes aegypti* for primary schools in the Caribbean.

NAME OF COUNTRY	STATUS OF PROJECT
BAHAMAS	Implemented nation-wide in 1997.
BARBADOS	Expanding beyond pilot school phase in 1998.
DOMINCA	Pilot project being expanded.
JAMAICA	Pilot project in two schools. Ministry of Education, considering expanding to all primary schools.
MONTSERRAT	Pilot project.
ST. KITTS & NEVIS	Pilot project being expanded to other school in 1998.
ST. LUCIA	Pilot project being expanded to other schools in 1998.
ST. VINCENT AND THE GRENADINES	Pilot project in 1995-1996 being expanded.
GRENADA	Being implemented in two pilot schools in September 1998.

[1] Ms. Pat Brandon, Health Educator, PAHO, Caribbean Program Coordinator's Office, Bridgetown, Barbados