

these letters having bioweapons? Delivery systems of bioweapons through letters, books and parcels make it easy for a bioterrorist to disseminate the germs throughout the environment. Bioterrorists can also use food as a vehicle for the biological, chemical or radiological agents. So food safety and security should be ensured by the public health system to avoid this sort of vulnerable situation. Rapid and dedicated food-testing laboratories should be developed. Registration of all the domestic and foreign food manufacturing and packing facilities should be done with the department of Food and Public Distribution System in India. The registration information can be vital to detect the origin of the problem during widespread food-borne diseases⁷. Thus, the strategies against bioterrorism involve prevention of an

attack, detecting bioweapons, and quick relief in the event of biowar.

Premier research establishments in India should open up exclusive laboratories dedicated to the prevention of attack by bioterrorists. Scientists along with their work force should be specially trained in counter-defence activities. Because bioterrorism activity is not country- or region-specific, there may be spreading of diseases to larger areas. There should be global efforts and laws to avoid bioterrorism. Research is under way to formulate biochips, and advanced biosensors to detect biological agents and toxins, so that in the event of an outbreak, a fast-track response is put in place⁸. We should keep track of all these activities to prepare ourselves against bioterrorism, before it is too late.

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An appropriate season for conducting night blood survey for detecting microfilaria in Lymphatic Filariasis Elimination Programmes*

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Lymphatic filariasis (LF), a neglected parasitic disease, is one of the leading causes of morbidity, social stigma and economic loss in many tropical and sub-tropical countries¹. More than a billion people are at risk in more than 80 countries. Over 120 million have already been affected by it; over 40 million of them are seriously incapacitated and disfigured by the disease. One-third of the global burden of LF infection lives in India, another one-third in Africa and the remaining distributed in South Asia, the Pacific and the Americas². Although there have been significant advances in the diagnosis and detection of parasite, such as immuno-diagnostics and ultrasound, no stage- and species-specific tools are available to detect the presence of active infection, intensity of infection or to discriminate between past and current infection³. Recently, it has been found that Og4C3 antigen testing could indicate the presence of the adult worm, and being a quantita-

tive test, this could be applied as a prognostic marker⁴. However, in terms of simplicity and detection of transmission potential, the filariasis control programmes largely depend on detection and identification of microfilaria (Mf) in blood samples. Detection of microfilaria by finger prick during night-time is the standard and reliable method for detecting infection in the field, and also in the evaluation of control strategies for the control of LF⁵.

Mf of nocturnally periodic *Wuchereria bancrofti* circulate between 1800 and 0600 h in the peripheral blood of an infected human and this is known as 'microfilarial periodicity'⁶. This coincides with the 'biting periodicity' of *Culex quinquefasciatus* as a vector of Bancroftian filariasis⁷. Thus the nocturnal periodicity of both the parasite and the vector mosquito facilitates the transmission of LF. The presence of human filarial infective larvae (L3) in vector mosquitoes indicates a need for the examination of blood samples from that locality for case detection³. Generally it is presumed that Mf are produced continuously by adult

gravid worms of *W. bancrofti* round the year and can be detected in any month or season during the peak hours of microfilarial periodicity. Though the lifespan of microfilaria has been suggested to be 6–12 months⁸, it is more frequently considered to be a couple of months^{9,10}, and to maintain the transmission; the vector should pick up these Mf within this period. After this period, the unpicked Mf may disappear from the peripheral blood and the fate of these Mf is not known.

The pre-patent period (from the entrance of L3 to the appearance of Mf in the peripheral blood) is estimated at about 9 months for *W. bancrofti* and the lifespan of adult worms is 5–10 years^{11,12}. Also, information on the frequency, quantum and seasonality of Mf production by adult gravid worms of *W. bancrofti* is limited. In this context, it is logical to hypothesize that the production of Mf by gravid females of *W. bancrofti* synchronizes with the peak transmission months or the period just prior to it, when there is a high density of vector mosquitoes, thereby facilitating effective or successful infection and infectivity in them.

*The views expressed here are of the authors only and do not reflect the views of their institute.

In view of the above arguments, the seasonality of Mf production and that of vector mosquitoes are likely to result in a peak LF transmission during certain months of a year. This is the reason for more infection and infective vector mosquitoes during peak transmission months than the other months of the year. There are studies which have reported that even though a person was detected positive for adult worm by ultrasound, remained Mf negative even after examining 16 ml of filtered peripheral blood, he/she was positive for filarial antigen¹³⁻¹⁵. In this case, the peripheral blood would have been collected during a non-transmission season when the Mf production by the adult worm was at a low level or the adult could not have produced any Mf at all. Further, it had been found that a considerable proportion of such smear-negative patients are capable of infecting the vector mosquitoes¹⁶. The appropriate reason for this 'smear negativity' but 'vector positivity' is likely due to the active 'probing and feeding' of vector mosquitoes using certain unknown signals that could facilitate the concentration of Mf in the peripheral blood when compared to routine smear collection which is only a passive process.

Though there are reports of residual transmission during non-transmission months^{17,18}, the chances of encountering Mf positivity in vector mosquitoes and human hosts are less when compared to indoor resting collection (IRC) and night blood survey performed during the transmission season. As there is coincidence between periodicity of Mf in the peripheral blood and biting periodicity of *C. quinquefasciatus*, it is reasonable to assume about the essentiality of such a phenomenon for successful transmission during the peak transmission season. Hence, restricting IRC of mosquitoes only during the transmission months is likely to be more productive and cost-effective than conducting the same throughout the year. In a recent report on evaluation of the effect of mass drug administration with diethyl carbamazine citrate to interrupt transmission of LF, IRC has been being carried out only during October–March in a year, as more than 75% of infected mosquitoes were collected during this period¹⁹. This implies that these

months are conducive for LF transmission when compared to other months of the year. Correspondingly, it is logical to assume that most of the gravid female worms produce Mf preferably during these months and hence confining the night blood survey for detecting Mf during this season would not only be more productive, but also more sensitive. In support of this view, an earlier study conducted in Calicut, with 86 bancroftian Mf carriers, had brought out the variation in Mf density with a peak in the post-monsoon season, October–December²⁰. Further, the peak period coincided with favourable breeding (high adult density) and transmission season (high infectivity rate) of vector mosquitoes in the area. The result of this study indicates that post-rainy transmission months are suitable for conducting night blood survey for detecting Mf in filariasis elimination programmes.

To summarize, our review probes into the simple relationship existing between sampling, seasonality, Mf production by adult worms and prevalence of MF at community level, which has not been attempted during these years. Hence, it would be cost-effective to conduct night blood surveys during those months, i.e. October–March when we obtain more than 75% of mosquitoes that are infected. This may yield desirable data for the estimation of prevalence of Mf in the community. However, well-planned studies are needed to validate this hypothesis, though there are ethical constraints.

It is also suggested that mass drug administration with DEC could be successfully implemented prior to the transmission season (pre-monsoon period) to reduce both Mf density and prevalence of Mf to low levels, which could result in achieving low infection and infectivity rates in vector mosquitoes even during the peak transmission season. This would eventually have significant impact on the interruption of transmission in the control of lymphatic filariasis.

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