Malaria as a Public Health Hazard in India
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Mosquitoes maybe synonymous with malaria, but clearly there is more sting to the tale: A bite can cause many deadly vector-borne diseases like filariasis, encephalitis, dengue, chikangunya and kala-azar. Malaria, however, remains the most rampant of these maladies and, therefore, poses the greatest threat to public health, globally.

Defined by ecotype, or the geographically distinct genetic variety of mosquitoes that spread the disease namely, forest, urban, rural, industrial, border and migration, malaria is particularly rampant in South, East and Southeast Asia.

An estimated 2.2 billion, living across the Asia-Pacific region are exposed to the disease. And 91 per cent of Indians are in danger of being infected by the malaria causing plasmodium vivax and plasmodium falciparum.

The tiger mosquito of the Aedes species (Ae Albopictus & Ae. aegypti) is an epidemiologically important vector for the transmission of many viral pathogens like west-nile virus, yellow fever virus, St. Louis encephalitis, dengue and chikangunya while *Ae. Aegypti* chiefly transmits the yellow fever disease.

A 1953 survey stated that every year 75 million people in India fell prey to the infection and eight lakhs of them succumb to the disease. This confirmed an identical estimate made in 1947 and led to the birth of the National Malaria Control Programme, which was successful in dramatically reducing the incidence of the disease to just 100,000 in 1964.

Buoyed by these results, the government launched the National Malaria Eradication Programme in 1958. However, owing to a complex slew of technical and execution issues, the disease came flooding back and 6.45 million cases were reported in 1976.

However, with the Urban Malaria Scheme and the Modified Plan of Operation (MPO) taking effect around the same period, the number of cases was again reduced to 2 million by 1977, a year which also marked the launch of the *Plasmodium falciparum* Containment Programme (*Pf*CP).

But the 1990s saw the arrival of insecticide-resistant forms of mosquitoes that exhibited pronounced exophilic vector behavior and proliferated rapidly owing to the availability of extensive vector breeding grounds created by water resource development projects, urbanization, industrialization and human resistance to chemical control of vectors. According to the latest figures of the National Vector-Borne Disease Control Program (NVBDCP), every year 1.5-2 million confirmed cases of malaria are reported of which 1000 people die.

Other than the National Filarial Control Programme of 1955 which covers the entire nation, there are anti-larval and anti-parasitic measures active in 199 towns across 13 states and four Union

Territories to eliminate vector-borne afflictions. However, after being on the verge of eradication, Kala-azar, reappeared in Bihar and West Bengal in the 1970s and spread to more states subsequently. The status of this disease as also of Japanese Encephalitis is being monitored by the National Malaria Eradication Programme (NMEP).

Similarly, the National Vector Borne Disease Control Programme is designed to prevent and control malaria and other vector-borne diseases. Diseases like malaria have survived and spread despite all these initiatives, because programmes designed to fight them have been historically plagued by factors like: a) under-estimation of requirements; b) low conviction and misconceptions regarding the use of pesticides; c) inadequate capacity building; d) poor advocacy and e) weak inter-sectoral linkages within the health domain.

In recognition of the above factors, in 1977 the government shifted its focus from eradicating to controlling the disease with measures like selective spraying of insecticides and renamed the National Malaria Eradication Programme as the National–Anti Malaria Programme.

In 2003, malaria control was integrated into the National Vector Borne Disease Control Programme (NVBDCP). In 2005, the government launched the National Rural Health Mission (NRHM), with an agenda that includes the control of vector-borne diseases.

Vector-borne afflictions continue to play havoc with public health also because of the inadequate use of modeling and other techniques to quantify the effect of both the diseases and the interventions meant to control them on the economic and social development of communities and the problems endemic to inter-sectoral collaborations.

Among the other disabling factors are: poor management of insecticides, limited interaction of decision-makers with entomologists and vector control specialists, failure to place the disease in the context of other social issues, inability to appreciate the public health risk of vector-borne diseases in low transmission settings and insufficient use of health education and law enforcement for containing the diseases. Though biomedical strategies such as active and passive case-detection and treatment are in vogue, preventive measures continue to lag.

Beside malaria, outbreaks of dengue are triggered by factors like rapid growth in urban population and international travel and weak mosquito control measures. Other reasons for the prevalence of the diseases in rural areas are mismanaged irrigation and ill-planned infrastructure development. Quite alarmingly there has been a 32-fold increase in the rate of smear-positive falciparum malaria in the Narmada Valley, where malaria was previously rare.

In India environmental factors which impede the eradication of malaria and other mosquito-borne diseases can be attributed to irrevocable changes caused by urbanization, industrialization, irrigation, green revolution agriculture and infrastructure development. These have created new breeding sites for falciparum malaria in states like Rajasthan. Japanese encephalitis now affects West Bengal, Uttar Pradesh, Andhra Pradesh, Karnataka and Goa.

It is now known that the Indira Gandhi project – an 8000-km maze of poorly conceived canals—was responsible for large scale seepage that left 8,600 hectares of land waterlogged. Other than altering the ecology of this region, it created massive breeding grounds for mosquitos and led to an epidemic of falciparum malaria in Rajasthan in 1994, which claimed 1,200 lives. On the other hand, irrigation and increased use of ground water have also changed the nature of crops, which results in breeding sites for mosquitoes including those that transmit Japanese encephalitis.

The government strategy to control vector-borne diseases is focused on malaria, which is more prevalent in rural than urban areas and is transmitted by the Anopheles mosquitoes. Chikangunya and dengue are transmitted by the Aedes and the former *is* now prevalent in both rural and urban areas.

The public health department of MCD provides preventive and promotional health care services through its anti-malaria operations and public health and epidemiology divisions. Of these the anti-malaria operation provides all technical support, policy guidelines and logistics to zonal health departments for prevention and control of vector-borne diseases. The malaria control strategy revolves around residual spraying of insecticides like DDT in rural areas and use of insecticide-treated bed and nets.

The Government of India has introduced social marketing of Insecticides Treated Nets (ITN), which has proved effective in combating mosquito-borne diseases, especially malaria. On the other hand, according to the Malaria Research Centre (MRC) around seventy per cent of malaria cases in the country are caused by *A culicifacies*, a strain of mosquitoes resistant to DDT and other pesticides.

The absence of reliable data with the mosquito control programme on the magnitude of the disease hinders planning and allocation of appropriate resources, which in turn defeats the programme itself. Based entirely on the results of blood smears collected by multi-purpose workers, the National Anti-Malaria Programme (NAMP) contends that the incidence of malaria in 2004 was a mere 1.87 million as against 6.47 million in the 1970s. However, studies by the MRC show that this is a gross underestimation of facts. For example, in a particular rural pocket figures from a primary health centre revealed 63 cases of malaria whereas research conducted by MRC in the same period at this very pocket and on the exact same population revealed a staggering 1,784 cases. In an urban area, the incidence was seen to be nine times the official figure.

A paper in The Lancet last year provided evidence that the malaria incidence figures published by the World Bank for its projects in India were false and did not even match the national vector borne disease control program figures for those states. The question that stares us in the face, therefore, is: How do we deal with this huge public health menace in a scenario marked by denial and obfuscation?

Moreover, mosquitoes may be rapidly adapting to new environmental conditions, something borne out by the fact that biological factors are among the most often quoted reason for the failure of anti-malaria initiatives. Other than the main non-biological factors already enumerated, insufficient funding, limited availability of skilled people and poor quality private services are large impediments.

These factors significantly detract from our ability to respond to an outbreak of a communicable illness, or manage our public health programmes. Media vehicles like television, newspapers, and radio seldom attribute malaria related information to doctors or health staff, reducing the effect of the communication. To control mosquito-borne diseases and their spread it is critical to understand how environmental factors affect the distribution and densities of different species of vectors and how effectively control-measures reduce vector-human contact, vector survival and the overall intensity of pathogen transmission. Also effectiveness would depend on collaboration with local communities, other stakeholders (like ministries of agriculture, environment, or sewer and water-works) and public health regulatory and legislative frame works.

By embedding vector-management principles into the development policies of relevant agencies, organizations and civil society with a stress on collaboration within and between public and private sectors, we might achieve much better results. Equally important would be the need to strengthen channels of communication among policymakers and disease control programme managers, ensuring rational use of available resources through a multi-disease control approach, adoption of non-chemical and chemical vector-control methods and integration of the various disease control measures.

Enhanced public awareness, preventive education and public cooperation help are key components of any successful anti-malaria programme. The public health campaign must, therefore, stress upon personnel protection techniques and information that creates general awareness on reducing mosquito habitats and mosquito borne disease cycles. It must also encourage health care provider to promptly report cases of human encephalitis and other mosquito-borne diseases.

Despite the successful employment of comprehensive integrated malaria control programmes, a great deal more needs to be done to strengthen the vector control components if we are to move towards eradication. To this end the malaria control programme must gain access to reliable data and improve its capacity to use such data for decision-making and re-evaluating current vector control programmes including their control tools and case-detection and treatment strategies. In the end it must deduce how much and what types of vector control inputs are required to achieve malaria elimination.

The Malaria Institute of India, now the National Institute of Communicable Diseases, has clear guidelines for the environmental control of malaria, including the ones to be followed during the construction of drains, roads and irrigation projects. These environmental measures for reducing mosquito breeding are often forgotten in the enthusiasm for chemical-based control. The World

Bank has been assisting the Indian government for the control of malaria for over a decade. Between 1997 and 2005, a Malaria Control Project, partially funded by IDA credit, was implemented in select states and districts. In 2009, under the government's new national malaria control policy, malaria prevention was strengthened by the adoption of Long-Lasting Insecticides-Treated Nets (LLINs). Currently, the World Bank's National Vector Borne Disease Control and Polio Eradication Support Project (2008-2013), support the government in implementing the new policy, strengthening the service delivery system and measuring outcomes. This project is being implemented in a phased manner in 93 of the most endemic districts in eight states, covering over 100 million people.