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SPECIAL ARTICLE

Chikungunya fever, falciparum malaria, dengue fever, Japanese encephalitis... are we listening to the warning signs for public health in India?

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Abstract

The 2005-6 epidemic of Chikungunya fever highlights the weaknesses of public health in India. The failure to control mosquitoes, and the illnesses transmitted by them, has resulted in recurrent outbreaks all over the country. This is inevitable given the larger scenario: neglect of the basic requirements of health; poor political support for health; a weak public health capacity; centralised programmes for control based on selective interventions, and poorly-planned development projects which have created conditions ideal for the outbreak of disease. All these issues are concerns for public health ethics and must be addressed to tackle the problems posed by mosquito-borne as well as other communicable diseases.

* * *

"If disease is an expression of individual life under unfavourable conditions, then epidemics must be indicative of mass disturbances of mass life ... Epidemics resemble great warning signs on which the true statesman is able to read that the evolution of his nation has been disturbed to a point which even a careless policy is no longer allowed to overlook." (1)

Rudolph Virchow's insights are prescient more than a century and a half after they were made as we continue to wrestle with the old epidemics of tuberculosis and malaria, new epidemics like HIV disease, cardiovascular diseases and cancer, and resurgent epidemics of dengue and Chikungunya fever.

This essay seeks to address the issues for ethics and public health posed by the resurgence, after 32 years, of an epidemic of Chikungunya fever in India. It places Chikungunya in the context of other mosquito-borne illnesses, which are taking a heavy toll of health and life in India.

The disease and the epidemic

Chikungunya fever, which takes its name from the Makonde language's graphic description of the patient's state (bent over and unable to walk upright), is a mosquito-borne viral illness. It is spread by the bite of the *Aedes* mosquito, which also spreads dengue fever. The triad of symptoms consists of fever, severe joint pain, and rash. It can be confused with dengue in the early stages, but the joint pain in Chikungunya is more severe, and there is usually no bleeding. The fever is self-limiting like other viral illnesses but the joint pains can be both incapacitating in the acute phase, and also very prolonged, with some people

unable to return walk or work for weeks, months and, rarely, years (2).

Diagnosis is generally based on clinical features; serologic tests based on detecting antibodies to the virus are available only in national level referral centres, and newer techniques like RT-PCR are of only theoretical interest in an epidemic situation. Like most other viral illnesses there are no specific antiviral drugs and treatment is symptomatic, with non-steroidal anti-inflammatory drugs given for pain and fever. There is no vaccine and prevention and control of the disease rest entirely on control of the *Aedes* mosquito, and protection against its bite.

Large urban outbreaks of Chikungunya have been reported in Kolkata and Chennai in 1960. It was last seen in Barsi in Maharashtra where it involved as much as 37.5 per cent of the town (3). It has continued for decades, apparently at a low prevalence (4).

The epidemic which started in end-2005 affected – according to official estimates – more than 1.3 million people in more than 150 districts in eight states (5). Karnataka and Andhra Pradesh were the worst-affected states.

Chikungunya, like most other illnesses, is not a notifiable disease and most patients went to private doctors for treatment. Informal reports from different parts of India suggest that the epidemic was even larger than implied by the government's figures. For example, doctors at the Mahatma Gandhi Institute of Medical Sciences, at Sevagram in Maharashtra, reported that outpatient attendance trebled and there were up to 90 admissions daily in medicine wards alone (6). Government health centres and even private pharmacies ran out of paracetamol and other pain-relieving drugs.

Apart from the scale of the epidemic the predominant involvement of rural areas and attack rates of up to 45 per cent in families of those affected were striking features. More than 2,300 cases of suspected Chikungunya fever were reported in Nandigaon, Andhra Pradesh, a village with a population of 8,000. In urban areas the worst affected were those living in slums. Deaths have been recorded, mostly in the elderly and usually due to other co-morbidities but occasionally to complications like encephalitis (7). However the illness itself spelled disaster for lakhs of poor families surviving on manual labour, with entire families incapacitated by joint pain, for months. There are reports of people being forced into debt and farm-related activities being badly affected (8).

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Health care responses to the epidemic

Initially there was some confusion about the nature of the problem, because of a lack of previous experience with an epidemic of fever and arthralgia. But even after people started rushing to doctors in thousands, it took two months for the National Institute of Virology to confirm the diagnosis (9).

This proved to be a windfall for many private practitioners. In Nagpur district, community halls were rented to cater to patients. Patients across rural India were given the staple fare of injections, antibiotics, saline, and even steroids. Doctors in rural Haryana cashed in on the dengue panic and informed their patients that they were suffering from dengue, but that the treatment would prevent it from turning fatal.

Everyone jumped on the Chikungunya treatment bandwagon. The State Transport Corporations distributed "preventive" homoeopathic medicines to more than 100,000 employees (10). Spiritual foundations organised free medical camps, some in association with district medical administrations (11), advocating yoga, meditation and breathing techniques – as treatment and prevention for a mosquito-borne illness.

Incidentally, the response of private practitioners to a predominantly self-limiting and non-fatal condition was in sharp contrast to their behaviour during the dengue outbreak in Delhi where patients were immediately referred to public hospitals. Similarly, patients are routinely tested for HIV without their consent and those who test positive face denial of care, discharge and discrimination when their status becomes known.

Public health response

The public health response consisted of despatching medical teams and medical camps – essentially a health care response. There was no widely publicised advisory for patients or doctors about the nature of the disease, its management, and ways to prevent it. Thermal fogging machines were used (12), though guidelines emphasise that they have limited effect on the mosquito population (13); also, spraying gives the community a false sense of security and affects their efforts to reduce the source of the mosquito's breeding – which is the more important action. But it is a highly visible action and conveys the message that the government is doing something about the disease. Such stunts were combined with political declarations: the chief minister of Andhra Pradesh, himself a doctor, promised to eradicate mosquitoes in three years (14).

Are such practices ethical when people are not even aware of how the disease is transmitted and how they can protect their family from it?

Other epidemics of mosquito-borne diseases

The epidemic of Chikungunya has to be seen as a resurgent viral illness in the context of other epidemics of mosquito-borne illnesses which have become a regular feature in the country. Dengue fever has been causing annual outbreaks in many parts of urban and rural India. When it manifests as a dengue haemorrhagic shock syndrome it has a mortality of 50-70 per cent. Japanese encephalitis kills over 30 per cent in those affected and 50 per cent of those who survive are left with

neurological damage. An outbreak of Japanese encephalitis in eastern Uttar Pradesh in 2005 killed more than 1,000 people. Finally, malaria, transmitted by several species of the *Anopheles* mosquito, has become more difficult to treat, more expensive, and deadlier than ever before.

Almost half of malaria cases in India are due to *Plasmodium falciparum*, which can kill. The parasite has become increasingly resistant to the cheapest drug, chloroquine. Starting in 1994, the outbreaks of *P falciparum* malaria have resulted in large numbers of deaths in Rajasthan, Assam, Nagaland and Andhra Pradesh. The largest number of deaths from *falciparum* malaria occurs in tribal India, where we work. In just two weeks we have seen three patients die because they came in too late, and every day we see patients who might die but for care. *Falciparum* malaria is one of the few infections which can kill a person in the span of a day. In its severe form it requires the most intensive care, a blood bank, dialysis facilities and a ventilator, all virtually inaccessible for rural Indians.

Anopheles and *Aedes*: changing the rules of the game

The government's strategy to control all vector-borne diseases is based on its strategy for malaria. Malaria, the archetype of all mosquito-borne diseases, is seen more often in rural than in urban areas. It is transmitted by *Anopheles* mosquitoes that breed in clean water, have a long flight range, and bite at night. *Anopheles* mosquitoes vary in their preference for human or animal blood; *Anopheles culicifacies*, the chief rural vector, is happy with cattle blood.

Chikungunya and dengue are transmitted by the *Aedes* mosquito which used to be considered an urban mosquito but Chikungunya is prevalent today in both rural and urban areas today. *Aedes* can breed in clean as well as somewhat polluted water, has an average flight range of 100 metres, bites in the daytime, and chiefly human beings. Thus it breeds in and around human habitations, in water bodies such as storage tanks, desert coolers, even septic tanks. It can breed all year round in our cities and not simply during outbreaks (15). *Aedes* eggs can withstand long periods of drying and dormant eggs inside old tires are known to have been transported over great distances. In short, human activities contribute greatly to the survival and spread of *Aedes* mosquitoes.

The malaria control strategy consists chiefly of residual spraying with insecticides like DDT in rural areas, use of insecticide-treated bed nets, and early diagnosis and prompt treatment of patients in an attempt to interrupt transmission.

However, the *Aedes* mosquito is largely resistant to DDT (16). Other malaria control measures don't apply to dengue control; insecticide-treated bed nets are irrelevant when the mosquito bites during the day. The only way to prevent dengue and Chikungunya is for people to know where the mosquito is breeding in each house and locality, and take individual and community action to eliminate it. Mosquito repellents are effective but beyond the reach of the poor. Space spraying to kill adult mosquitoes should be used cautiously, in exceptional cases.

The health care and public health responses to epidemics

One must distinguish between health care with public health. Typhoid may be treated with drugs but the public health response is to provide a safe water supply. Any large-scale outbreak of illness requires a health care response to address the deficiencies in the diagnosis and treatment at various levels of health care. But it also demands a comprehensive and long-term public health response, which addresses the deficiencies in public health measures that made the epidemic possible.

Most epidemics in India are not followed by a long-term response. The public and the media accept their recurrences as inevitable accompaniments of the "seasons", which can at best be contained, only to recur next year. In this model of public health, typhoid fever, hepatitis and cholera are dealt with separately rather than as diseases caused by a contaminated water supply. Malaria, dengue, chikungunya and filariasis are similarly treated as different problems though they all point to a failure of mosquito control. There is no overarching public health response to the enormous burden of water-borne and vector borne diseases, apart from a national anti-malaria programme

The warning signs of the epidemic for public health in India

"Microbes are nothing -- the terrain everything."

Louis Pasteur's understanding of microbes and their ecology was far more sophisticated than the current view of treating "bugs" with "drugs" and vaccines. Indeed, sanitary reforms in 19th century Europe addressed the terrain -- the horrific living conditions of people -- with improvements in living conditions, water supply, sanitation and sewage disposal, reforms of wages and working conditions and access to a socialised system of education and health care. Such facilities may seem utopian in India, where people struggle to meet even their most basic needs. But they can be achieved with political will, as demonstrated by Cuba, which is far more constrained for resources than India is. However, our policymakers increasingly espouse a vision of public health that depends on newer drugs, vaccines and micronutrients and not on the basic needs of human beings that lead to a better life and less disease.

The germ-centred view of the Chikungunya outbreak treats it as a separate viral disease and focuses on the purely viral or immunological reasons for its resurgence. Thus the scale of the epidemic was attributed to people's low immunity to the virus (17). But Chikungunya outbreaks do not occur in Singapore, where nobody is immune to the virus either. The increasing intensity of mosquito-borne illnesses points to our abysmal failure to control mosquitoes. We must address the wider issues that make us so vulnerable to recurrent epidemics.

A. Neglect of the basic requirements for health

Health depends, at the barest minimum, on access to adequate food, sufficient safe water, housing and sanitation. The provision of these basic requirements dramatically brought down the occurrence of communicable diseases in the West, long before

modern vaccines or antibiotics were discovered. We should address these foundations of public health while we create public health foundations.

This need is urgent because the situation is worsening. The primacy of food, safe water and sanitation was emphasised in the Alma Ata charter for primary health care. Over the years, the concept of primary health care as all-encompassing and holistic has changed to refer to highly selective, technology-oriented, minimalist health care at the primary level.

The *per capita* availability of food grain in India has seen a dramatic decline of 20 kg from the early 1990s to the present day, when it stands at a level close to that seen around Independence (18). Current levels of nutrition in Indian children are below those seen in sub-Saharan Africa (19). Yet we claim a 10 percentage point poverty reduction. The reduction of food grain allocation through the Public Distribution System to only 25 kg per family, irrespective of family size, will further worsen the situation. Yet few experts in public health raise their voices against this step.

A purely germ- and vector-based view of disease tends to obscure the fundamental relationship between under-nutrition and the risk of developing diseases. The prevalence of acute hunger has been considered crucial to the intensity of an epidemic and its lethality (20).

Access to safe water and sanitation are key issues for both water-borne and vector-borne diseases. The absence of effective water chlorination, and contamination of water with sewage during its distribution, inflict a host of diseases such as dysentery, typhoid and hepatitis A and E. In the absence of a reliable water supply people must store water, and the storage containers, in turn, become breeding grounds for *Anopheles stephensi* and *Aedes aegypti* mosquitoes.

But access to these basic requirements, as well as to responsive health care, is socially and politically determined and there are gross inequities across social classes in India. The poorest 20 per cent have double the mortality rates of the top 20 per cent of the population. A very small part of the total population of India bears a disproportionate burden of malaria mortality.

B. Ecological changes and vector-borne "diseases of development"

The incidence of microbial diseases declines when economic development is associated with social development. On the other hand, when economic development is divorced from social development, the incidence of disease may increase. This is happening right in front of us in India.

The Malaria Institute of India, now the National Institute of Communicable Diseases, had clear guidelines for the environmental control of malaria. These include guidelines to be followed during the construction of drains, roads and irrigation projects. These environmental measures for reducing mosquito breeding have been forgotten in the enthusiasm for chemical-based control.

The landscape of India is undergoing irrevocable changes with urbanisation, industrialisation, irrigation, green-revolution agriculture and infrastructure development. Many of these changes are creating new breeding sites. *Falciparum* malaria, earlier seen mainly in north-eastern and central India, is now endemic even in Rajasthan. Japanese encephalitis now affects West Bengal, Uttar Pradesh, Andhra Pradesh, Karnataka and Goa.

Urbanisation and vector-borne diseases

Urbanisation is seen as a driver of India's economic growth. Unfortunately, when the poor migrate to cities, they encounter a degrading environment, much worse than their homes in rural India, due to a singular lack of provision of low-cost housing. Slums inevitably arise, with their problems of inadequate water supply, drainage, waste disposal and sanitation, leading to recurrent outbreaks of mosquito- and water-borne diseases. Open drainage, which is often mixed with sewage, is a feature of most cities. New construction pays scant regard to drainage, impeding the flow of water and creating conditions of water logging every monsoon. The burden of disease in slums can be gauged from the annual parasite index (API), the number of smear-positive malaria cases per thousand population. The API calculated in a Delhi slum, during the course of a Malaria Research Centre study in 1982, was 496.6 (21). That is, every second slum dweller had malaria that year.

Irrigation

If the urban environment now breeds malaria, which was so far considered a rural disease, the green revolution, mismanaged irrigation and ill-planned infrastructure development are contributing to the emergence of the typically urban diseases of dengue and Chikungunya in rural areas, in addition to worsening the malaria situation. *Anopheles* and *Culex* can breed in rice fields, slow-moving streams, and pools. Poorly designed hand pumps leave open water collections that breed thousands of mosquitoes. Intermittent tap-based water supply, which is now becoming a feature in many villages, is forcing people to store water in large containers, where *Aedes aegypti* can breed.

Consider the following:

- There was a 32-fold increase in the rate of smear-positive *falciparum* malaria and hundreds of deaths in the Narmada valley, where malaria was previously rare (22).
- The Indira Gandhi Project, with its 8,000 km of badly managed canals, has caused seepage and water-logging of 8,600 hectares of land, and completely altered the ecology of the region. The resultant heavy mosquito breeding was responsible for an epidemic of *falciparum* malaria in Rajasthan in 1994 which claimed 1,200 lives (23).
- Irrigation and the increasing use of groundwater have also changed the nature of crops to more water-intensive crops such as rice and sugarcane. Rice fields offer breeding sites for mosquitoes including the vector of Japanese encephalitis.

Road construction

Poorly organised road construction can also lead to mosquito breeding. Burrow pits accumulate water and serve as breeding sites. The congregation of construction workers, often from malaria-endemic zones, creates a reservoir of infection. People get bitten because there is no proper housing and as they have no access to effective health care the infection spreads unabated. All of this amounts to a perfect recipe for a malaria outbreak.

C. Neglect of primary health care

The difficulties of disease control are compounded by our neglect of the comprehensive primary health care approach. Without a system of responsive, first-contact care, it is not possible to diagnose a sufficient proportion of patients early enough to interrupt transmission in the community, whether of *P falciparum* or *M tuberculosis*. In the case of malaria, for example, slides take weeks to get reported and patients are given incomplete presumptive treatment that contributes to increasing drug resistance.

Wherever social and economic problems exist and the access to primary health care is poor, the malaria situation is bad. It is not surprising that 50 per cent of all malaria deaths in the country occur in the tribal areas of six states, which are also marked by poor public health indicators.

D. Fundamental problems with national health programmes

Another major factor in this discussion is the fundamental problems with national health programmes. This merits a separate discussion, but the following points must be noted:

Paucity of data and underestimation of disease burden

None of our national health programmes has reliable data on the magnitude of the disease, which would determine planning and allocation of resources, and serve to gauge the success or failure of the program. The National Anti Malaria Programme (NAMP) contends that the incidence of malaria, based entirely on the results of blood smears collected by the multi-purpose workers, is now merely 1.87 million cases (2003 figures) from the high of 6.47 million in the 1970s (24). However, studies by the Malaria Research Centre (MRC) have indicated such incidence data to be a gross underestimation. In a rural area, a comparison of incidence data from a single primary health centre revealed 63 malaria cases while MRC recorded, during the same period in the same population, 1,784 malaria cases (25). In an urban area, the incidence was seen to be nine times the official figure (26). A paper in *The Lancet* last year provided evidence that the World Bank falsified incidence data for malaria in projects in India supported by it, which did not even correspond to the national vector borne disease control programme figures for these states (27). How can we address critical public health problems in this scenario of denial and obfuscation?

The "one size fits all" approach

Malaria is a disease affected profoundly by local conditions of temperature, rainfall, vector and human behaviour, vector sensitivity to insecticides, topography and breeding sites. The

initial success of the anti-malaria programme in the 1960s was reversed by the 1970s with six million cases reported annually. A major reason was that DDT was the "one size fits all" technological fix for mosquito control. When the vector became resistant to DDT, the programme collapsed. Non-*Anopheles* mosquitoes, urban areas and mosquito breeding got little attention, setting the stage for *Aedes* breeding.

Going against the evidence

Sixty to seventy per cent of malaria cases in the country are transmitted by *A culicifacies*. Widespread resistance of *A culicifacies*, not merely to DDT but even to other pesticides, is a fact acknowledged by the Malaria Research Centre (28). Despite this, it continues to be a mainstay of the programme. There is a need for evidence-based public health in developing countries, in this era of evidence-based medicine.

E. Obsession with germs and vaccines

Many strains of *Streptococcus pneumoniae*, which is responsible for a large part of childhood mortality, are now resistant to cotrimoxazole and, less often, to penicillin. Multi-drug resistant (MDR) tuberculosis is a major problem in previously treated patients with TB. *Falciparum* malaria is resistant to chloroquine in many parts of the country, leading to proposals for changing the treatment of *falciparum* malaria to the much more expensive artemisinin-based combinations. Infections once thought to be treatable are becoming untreatable. New antimicrobial drugs are being followed by drug-resistant strains with equal rapidity. And the response to the emergence of drug-resistant strains is to look for new drugs.

All these organisms spread through the same old pathways. Surely it is more cost-effective to tackle the conditions that favour the spread of the pathogens, and conditions that promote the development of disease, rather than get lost in the details of individual agents. For example, it is cheaper to provide safe drinking water to the entire population than to vaccinate every individual with the Hepatitis A vaccine, the typhoid vaccine and the cholera vaccine (the list leaves out many diarrhoeal pathogens for which there, at present, is no vaccine). It is cheaper (and, of course, better, from the starving person's viewpoint) to have enough food to eat than to wait for some new vaccine to prevent tuberculosis. Most new vaccines are univalent, which means that they protect against the one disease for which they are meant. On the other hand, adequate food and safe drinking water and vector control protect against multiple diseases at the same time.

The talk of vaccines and newer drugs is a politically convenient ploy to divert attention from the failure of basic public health measures, a failure that makes epidemics possible. It is also an excuse for not doing anything. Vaccines cannot be a stand-alone intervention; they are only one of the tools of public health to complement other public health measures.

F. Lack of capacity to respond to public health problems

There are vast lacunae in our current ability to respond to an outbreak of a communicable illness, or manage our public health

programmes, due to the lack of facilities and trained personnel. Though tuberculosis is the single most important killer disease in the country, it is only in the past decade that microscopy facilities for the diagnosis of tuberculosis have been created at the primary health centre level. Earlier sputum samples had to be examined at the district level centre. Even now, there are no state facilities to diagnose drug-resistant tuberculosis, though medical colleges may have an magnetic resonance imaging machine and a state-of-the-art intensive care unit. Malaria diagnosis at the village or sub-centre level is still marked by long delays. In a situation of an outbreak of cholera, there is a lack of facilities for confirming the diagnosis at the district level and sometimes, even at the state level. We routinely isolate and identify *Vibrio cholerae* at our rural hospital, but the district medical officer told the local press that diagnosis could only be made by the National Institute of Communicable Diseases.

At the district level, clinicians who are uninitiated in the practice of public health hold the post of district medical officers. It is disconcerting to find that many states do not have entomologists to guide interventions in the national vector borne disease control programme. One entomologist remarked in the context of the Chikungunya epidemic, "Fumigation failed to wipe out mosquitoes, but entomologists have been virtually eliminated from India's public health system." (29) We need environmental engineers familiar with interventions for reducing mosquito breeding sites in relation to infrastructure projects, and we need anthropologists and social scientists who can chart new directions in malaria control with community participation.

The way ahead

"It isn't that they can't see the solution. It is that they can't see the problem." – G K Chesterton

These epidemics offer to all of us concerned with the health of the Indian people a moment of truth. Shall we ignore the messages? If so, at what cost? Shall we continue to find it acceptable that a child saved from the disability of polio dies of a pneumonia made severe by underlying malnutrition, or is killed by the next wave of Japanese encephalitis or dengue? Shall we land poor families into debt because severe typhoid requires now a third generation cephalosporin for its treatment? Shall we merely supply rapid diagnostic tests and artemisinin-based combination treatments to tribals with malaria acquired by a poorly executed irrigation project?

The refrain of health care and public health professionals is that the social and political factors are outside their domain. But are we even articulating health problems to our administrators and politicians as problems that cannot be solved by medical technology of drugs and vaccines but also require the application of social technology? In our own domains, do we do all that we can to reduce the economic cost of disease to our people? At other levels, did we protest when the government in 1981 allocated only Rs two crore to a TB programme for more than a million patients – as a result of which half a million died prematurely in India? Or when funding to the malaria control

programme was cut by 40 per cent in 1994? Shall we protest now when a severely undernourished people are further deprived of food security? Should we in public health continue to be apologists for faulty social policies and processes, cloak results in terms of germ and diseases, and push pills, micronutrients and vaccines? Public health in India needs skilled professionals but it also requires strong advocates.

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