Aspects of Vector Borne Disease Control

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India was once a pioneer in Medical Research. Plague Research (The Great Plague Commission of 1900s) and Malaria Research par excellence were done in India by Indian and British stalwarts during the pre-independence days and the few decades following Independence. But where are we now? Now the trend is, not problem oriented research but project oriented and paper publishing research and competition at every level. Hard field work has given way to cozy research in air conditioned laboratories equipped with computers, with readymade commercially available and easy to operate test kits, etc. The emphasis is now on: “How many papers you have published, how much grants you were able to generate, and how many Ph.D.s you have produced”. Everything is time bound now. No more adventure or curiosity to find solutions to solving our problems. No more long term research. Lots of restrictions are also imposed on the scientists by so many committees, mainly on any work involving animals. How any work on subjects like Ecology, epidemiology, entomology, Zoonoses, etc., could be conducted? These publication oriented University type ‘research’ are mostly funded by foreign universities / organizations. (Dr.Barcelato, once with WHO/TDR, called these SAFARI and SURVIVAL research). “Science cannot be quantified by number of papers published. Don’t waste time duplicating material or doing pedestrian work. You may as well feed data (mostly junk) to a computer – and bang comes a paper. You go into science to solve problems, not to find ingredient of success”, so said Dr.Venkataraman Ramakrishna, the Nobel laureate. He also added that India should develop a culture that would produce more cutting edge research and producing role models whom one who could follow. He felt the reason why Indian scientists do so well when they go abroad was because they see lot of role models. They come across scientists who were doing more specific work and were engaged in front line research. This aspect is sadly lacking in our country.

It is really sad the National Vector Borne Disease Control Programme, had done a magnificent job in the past, that too in a vast country like ours has recently been facing unjustified criticism... You can’t compare India with small countries like Sri Lanka, Malaysia, Swaziland, etc., which had shown spectacular results in “eradicating” diseases like malaria. In India, there is so much ecological diversity, a very large population, and many problems associated with administrative, bureaucratic, social and political set up, considering that health is a state subject and no single individual or authority can enforce matters. One wonders how positive things are still happening in our country.

Being a vintage scientist of the previous century, having started my career in 1953, I am sharing my views here and have ventured to give suggestions. I think biomedical research as it is being carried out is lopsided and need correction. The type of research carried out at present will only enrich one’s curriculum vitae, but does not help in disease control. May be it is futuristic, as is claimed, but what about the present? Epidemics will therefore continue to occur. Then there is wrong diagnosis of the diseases. Classical examples exist when Malaria is classified as Dengue and vice versa, Kyasanur Forest Disease (KFD) was notified as typhoid and lot of misdiagnosis of Scrub Typhus and Leptospirosis, due to ignorance. Also, many times “quickie” results were obtained by using commercial test kits, which have compounded the problem. Any disease may be grafted upon malaria, or rather supervene in a patient already malaria-stricken, as Wilbur Downs had pointed out. Then the question of active surveillance to detect diseases in time does not exist anymore. In countries like Sri Lanka and Swaziland, what distinguishes them most are the excellent surveillance mechanisms they have. These include “active case detection,” which sends officers to the site of every new case to test anyone living in the vicinity of patient zero — crucial because communities where malaria thrives tend to be isolated, and inhabitants often develop resistance, meaning they have few symptoms and are unlikely to go to a hospital. .

We have missed the bus as we had reduced drastically the role of Entomologists. We under estimated the powerful six legged enemy (Frontline. 30 Sept 2016). A lot has been said and written about this aspect. Many times it is due to ignorance.

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For malaria and lymphatic filariasis, which are environment related diseases we should have put more emphasis on source reduction and environmental manipulations to control vectors. Though there is enough published evidence to show that C. quinquefasciatus, is an inefficient (published information available) but the only vector of bancroftian filariasis, and that a high level of transmission was taking place only due to the very high vector density, the vector breeding profusely in many habitats, and therefore it is easy to control filariasis transmission by drastic reduction of vector breeding (you do not have to eliminate it) we ignored this. China eliminated Filaria by mass drug administration of DEC alone with selective vector control, environmental and limited insecticidal. But we are using DEC, but riding piggy back on Albendazole, an intestinal antihelminth, since multinational drug companies sponsor them.

Many Vector Borne Viral Diseases are of zoonotic origin; they exist in nature independently of man and his domestic animals. The foci present well defined ecological peculiarities where the pathogen and natural hosts are associated, often through an intermediate vector. The environmental factors determining this association are climate, soil vegetation and topological features. These serve as reliable indicators of the existence of certain diseases (Example: areas at the edge of deserts with burrowing rodent may harbor Cutaneous leishmaniasis, as in Rajasthan; areas at the junction of mountains, forests and agriculture fields or grasslands may be expected to harbor tick borne diseases like KFD, RSSE, etc). These natural foci which were called silent zones of diseases may remain undetected, until ecological changes due to developmental activities result in vector proliferation and susceptible human beings come into contact with them. With accurate ecological studies on these aspects, similar foci in other areas could be detected before human infection takes place. This is what we should be doing. Look at the innumerable foci for KFD detected in recent years in many pockets all along the Western Ghats from Gujarat down south all the way to Kerala. Apart from isolated safari visits by research teams, and publishing a few papers, I do not think there are any long term studies on the zoonotic cycle which alone can tell you why it is reappearing. Some of the diseases are called NTDs (neglected tropical diseases) and these do not attract attention of government/research bodies, unless it flares up in epidemic form and many die.

In Japanese Encephalitis (JE) man is the dead end host. Small animals and birds were suggested as possible (and over-wintering) reservoirs. Pigs and in some situations, ducks as found out in Burdwan, may be amplifiers. Cattle help in the multiplication of the vectors. The appearance of the first human JE case marks the end of the disease process because there are already thousands of infected mosquitoes. Any anti mosquito measures taken at this time, is only a public relations exercise, not a public health measure (Combating a killer, Frontline, 30 Nov 2012). The epidemiology is such, by the time you detect a human case, it is almost the end of the epidemic. But that is when vector control measures are undertaken. In the absence of an effective vaccination, early detection and prompt hospitalization of cases are the only remedies. Our researchers are more interested in finding molecular structure and antigenic variations of the virus particle! We should be able to predict the huge increase in vector populations by continuous monitoring of the vector population in potential areas. In the United States they have mosquito abatement districts, manned by entomologists, and in India we had downgraded the entomological fraternity.

In the case of dengue also we should look for a sylvan cycle with Aedes albopictus as vector and monkeys as sylvatic hosts. Dengue occurs throughout the tropical region and spreads into sub-tropical and warm temperate zones where Aedes aegypti is present. In presence of Aedes aegypti, dengue always occurred in endemic form. In Malaysia, it was reported that Aedes aegypti is the vector in coastal region while Aedes albopictus is the vector in the interior. Chikungunya, causing severe fever with polyarthitis, is at present an urban disease in India. Both Aedes aegypti and Aedes albopictus have been incriminated as vectors. There is only one piece of evidence to suggest a sylvan cycle for this virus. A strain of this virus was isolated from Aedes africanus caught in Zika forest indicating that there is also a sylvan cycle other than man/Aedes aegypti/Aedes albopictus cycle. The forms of hemorrhagic dengue and Chikungunya disease are essentially urban diseases with a cycle between man and mosquito, though the occurrence of Chikungunya cases in typically rural areas in Tamil Nadu was recently reported.

Another emerging disease (not a new one to science) is scrub typhus and many cases have been reported from various parts of India in recent years. This again is an environment related zoonotic disease. Unplanned urbanization and exploitation of forests and the interface are the reasons. The vector is a trombiculid mite and the maintaining hosts are usually field rats, mice etc. Other incidental hosts are birds such as warblers, pheasants, quails, fowls etc. These are important as they distribute the mites over a longer range. Man is only a casual host and is of no importance in the life cycle of the vector. At one time the Armed Forces Medical College, Poona, did a lot of work. But we do not have much information on whether we are prepared to face recurrence of any future epidemics.

We should take note of the most recent example of ZIKA virus, which had created a stir (or fear) in the new world, particularly Brazil. We have known Zika for 70 years, but it was never considered a public health problem.
It had occurred throughout Asia and Africa, but it has been sporadic and silent. This virus was isolated for the first time in Uganda in 1947 from a sentinel monkey, and later from Aedes africanus mosquitoes. There are also reports of isolations from Ae. Aegypti, a known vector of Dengue, Chikungunya and Yellow Fever. Zika antibodies have been found in several countries of West Africa and now from Brazil and many other South and Central American countries. Zika is transmitted by the day biting mosquito, Aedes aegypti. Actually evidence of Zika virus presence in India was available as early as 1950s. The Rockefeller foundation did the first ever serological survey in 1949-50 in some parts of India. They had collected blood samples from indigenous residents from several states and tested them for neutralizing antibody against each of 15 different viruses known or believed to be arthropod borne. But significant numbers of the sera neutralized Zika. There is however no record, as yet, of the isolation of zika virus from the Indian subcontinent. Its prevention and control, in case this virus becomes a public health problem in India, will pose enormous concerns for the authorities. Already Dengue and Chikungunya are major public health problems and their effective control is beset with difficulties. It is only a matter of time before Zika also becomes one.

There is animal involvement in the natural cycle of many viruses, e.g. Wild birds in Western Equine Encephalitis (WEE), ardeid birds in the case of Japanese Encephalitis, many animals, including primates, and birds, in the case of KFD; wild monkeys in the case of Yellow Fever (fortunately not yet a problem in India), etc. In the case of Dengue, bats have been shown to be involved; Chikungunya virus had also been isolated from Aedes africanus collected from African forests. In all these cases some of the arthropod vectors are common and some different. Being zoonotic diseases, some mammals may be definitive hosts in some cases, and in some others they may be intermediate hosts. Many small mammals, which have high population turn overs, may harbor the virus infecting and distributing their ectoparasites, and also play the role of reservoirs of the virus in nature. Some animals may be amplifiers of the virus; some others, like cattle, may be multipliers and distributors of the vector population. It is thus a complex biocenotic relationship between the infective agents and various non human hosts and vectors occurring in the forest ecosystem. Man is of course the ultimate victim (Disease Ecology, Frontline, and July 25, 2014). The epidemiological picture varies in the case of different viruses. And now Zika virus, where monkeys, forest environment, Aedes aegypti are all involved—it is essential to know more about its natural cycle. Who knows, we may have to deal with Yellow Fever also sooner than later. Let us not be complacent. It is said that of all the viruses with the potential to shift from animals into humans and the most likely to do so are those that have bats as reservoir hosts. It should be noted that bats have evolved long before man in the early Eocene period. KFD virus was found circulating in a closed colony of an insectivorous bat (Rhinolophus rouxi) in a disused well in Shimoga District, Karnataka. KFD virus was also isolated from Ornithodoros. ticks parasitizing these bats. This indicates that the viruses were existing in closed cycles for ages (Tracking arboviruses, Frontline, 4 August 2017).

It is a pity that we have lost the culture of doing cutting edge infectious diseases research, when one considers investigative research on the zoonotic origin of these diseases, the most neglected aspect of research in our country. Scientists in other countries (like Uganda) have discovered dozens of diseases and pioneered a viral surveillance system that has played a critical role in curbing potential epidemics.

But do we have any mechanism /infrastructure for vigilantly monitoring for potential public health crises in the first place and aggressively containing them once they arise. Jorge Boshell’s excellent exposition on the Epidemiology and natural cycle of KFD following more than a decade of intensive study in the Shimoga forests, in Karnataka, is a magnum opus model to be followed in studies on new diseases such as Zika. A virus has got fantastic propensity to survive; nothing but exhaustive research in the natural environment can unravel the mysteries. His study is a classical example of how to go about investigating a disease of unknown etiology. There was really a multidisciplinary approach, and long painstaking work in a evergreen forest for more than 14 years. This was thanks to the Rockefeller Foundation. Can we repeat such studies now?

We should have a extensive viral surveillance system on a continuing basis. Diagnostic facilities; ecological surveys; studies on all aspects of environment like climate, vegetation, topography; epidemiological aspects and population dynamics of human hosts; and most important of all, the vectors involved—their actual and potential to carry diseases, their distribution in space and time, etc. are the need of the hour. People have to stay in the field where the problem exists, to achieve even some of the objectives. Many scientists are not prepared to stay for even short durations in the field (I spent 17 long years in a field station), because their future career, now, depends on the number of “quickies” they publish, with “impact” factors, but their work need not necessarily be relevant to the problem at hand.

It is really pitiable that the current status of entomological research and the priorities laid out in the various research institutes and colleges is discouraging. I also feel that what is stated above with reference to medical entomology applies well and equally to other aspects of science as well. It is sorrowful that most of our younger contemporaries
are ‘recreating’ organisms in the cyberspace and treating them as models to work on to solve real-life problems, something similar to making love to mannequins. It is indeed sad. Biomedical education is not any more free of this hassle; developed nations especially struggling to get cadavers to help their students learn from reality. They teach medicine with phantom heads and mannequins. We are living in a world of artificiality and I am not sure where this is going to lead us to. When Neil Armstrong landed on moon, or rather claimed to have landed on moon, a message ran across that he did not; and all was stage managed. I am not sure of the veracity of this but just citing it as an analogy. Today’s molecular approaches are very similar to the above. We are informed of things that none can see, perceive, and visualize.

Today’s biologists speak in terms of outcomes that are unverifiable and untestable. I do not say that all molecular biology is bunkum; but some aspects are. But I think all of that needs to be pitched on sound logic and sequenced, rational, convincing evidences --- the very foundation of science and scientific approach. It is sad that molecular research is being prescribed for every kind of problem in India for which solutions have to be found only through field work. Many new technologies are being suggested –like for example release of genetically modified mosquitoes, without a proper understanding. One has to ask about the fundamental differences between a mammal and an insect such as a mosquito. Mosquitoes breed in millions. Mammalian populations find their own balances, exception being man. If this population continues to be unchecked, may be, man could soon also succumb to this natural phenomenon. Darwinian Theory holds. People are making a serious mistake, in thinking that mosquitoes can be on par with mammals. For the foreseeable future, we have to manage mosquito-borne diseases through environmental, safe chemical and innovative drug therapies. People get lured by some exciting new discoveries, but before jumping on the band wagon they should ponder whether it is applicable in all cases. We have knocked our heads against this type of thinking long enough.

The top echelons in administration also cannot help much, because they are bound by rules and regulations. The very approach and planning process for biomedical research in India, particularly in the field of Vector Control, in my opinion, is skewed. A lot of introspection is needed for us to progress.