वेक्टर VECTOR पत्रिका

Newsletter of ICMR-Vector Control Research Centre, Puducherry

In this Issue

From the Director's Desk

India, like rest of the world, is currently reeling under the impact of COVID-19 pandemic. This emergent situation has posed several challenges to the citizenry to re-work their lives and create a new normal in their respective professions. Research is no exception! ICMR is in the forefront of this pandemic and the exemplary services rendered by the council in India's preparedness and fightback will be written in golden letters in the medical history of this country. I took the reins of the ICMR-VCRC on 2nd July, 2019. Among various key decisions taken, it was decided on Hindi Day to start bilingual newsletter named as "VECTOR". This biannual publication will show case invited articles from the scientists of the institute and its field stations, guest articles, news of significance with regard to vector borne diseases scenario, research needs and their management in the country and at the global level. This inaugural issue has received overwhelming response as eight research articles have been included in this issue. Vector control Research Centre is WHO recognized centre for research and training in lymphatic filariasis and integrated vector management. VCRC has a great talent pool of Scientists and Technical Officers who undertake research on malaria, filariasis, dengue, chikungunya, zika, Japanese encephalitis, Kyasanur Forest Disease and Scrub Typhus. Training to develop critical mass of trained manpower is VCRC's longstanding goal and vision. Accordingly, VCRC runs M.Sc. Public Health Entomology course as an affiliate of Puducherry University and adds to the overall national capacity and preparedness to effectively deal with vector borne diseases in the country. In March 2020, in collaboration with Society for Vector Ecology (SOVE), National Academy of Vector Borne Diseases and National Vector Borne Diseases Control Programme, a national capacity building training workshop was organized at the centre which was attended by 26 entomologists nominated by NVBDCP, New Delhi from different states of India. Eminent speakers were invited to address the Scientists of the VCRC from different national institutes and Universities. The centre organized tree plantation and cleanliness activities during the 'Swachhta pakhwada'. The Communication unit of the institute actively disseminated the happenings and achievements on facebook and twitter. International Women's Day was celebrated at the centre on 6th of March 2020. The VCRC journal club organized talks by the scientists of the Institute. The Research and Integrity Unit (RIU) very actively, scrutinized 47 manuscripts and 10 patent applications of the Scientists and Technical Officers of the institute. As a welfare activity, general and dental health of the staff was checked by the Apollo Hospital staff at the centre. Despite the pandemic situation impacting the normal functioning of the institute, ICMR-VCRC made significant progress in the research and development activities. It is proud moment for us to inform that Six of our staff members analysed over 2300 of the 28000 COVID-19 samples as part of the national sero-surveys conducted in the country. Finally, I wish all a pleasant reading of this inaugural issue of the 'Vector' and also wish all and their families safe days ahead. Jai Hind!

ICMR-Vector Control Research Centre
Department of Health Research, Ministry of Health & Family Welfare, Govt. of India
Indira Nagar, Medical Complex, Puducherry – 605 006
Telephone: +91-413-2272396, 2272041
Email: director.vcrc@icmr.gov.in Website: www.vcrc.icmr.org.in

Merits of triple drug regimen (Ivermectin, DEC, Albendazole) over double drug regimen (DEC, Albendazole) as a superior strategy to eliminate lymphatic filariasis

K. Krishnamoorthy, S. Subramanian
Senior Consultants, ICMR-VCRC, Puducherry, India

Lymphatic filariasis (LF) in human is a mosquito-borne parasitic disease caused by three filarial parasites viz., *Wuchereria bancrofit*, *Brugia malayi* and *Brugia timori*. This disease is the second leading cause of permanent and long-term disability and in 1996 about 1.2 billion people in 72 countries were estimated to bear the risk of infection. In 1997, LF was identified as one of the six diseases that can be potentially eliminated for which strategies are available (Ottesen et al., 1997). In response to the World Health Assembly resolution, Global Programme to Eliminate Lymphatic Filariasis (GPELF) was launched in 2000. The aims of GPELF are to eliminate LF as a public health problem by 2020 through mass drug administration (MDA) of albendazole in combination with Diethylcarbamazine (DEC) or ivermectin for 5-6 years to interrupt transmission and alleviation of morbidity and disability in affected persons. The programme has made significant progress, by 2018, the programme had delivered about 7.7 billion drug treatments to more than 910 million people in 69 of 72 endemic countries. So far, 16 countries have been validated by WHO as having eliminated LF as a public health problem (WHO, 2020) and 597 million (42%) people no longer require mass treatment.

In India, LF caused by *Wuchereria bancrofit* and *Brugia malayi* is prevalent in 257 of the 736 districts with about 600 million people at the risk of infection. National programme to eliminate LF was launched in India in 2004 and all the endemic districts are covered. MDA with DEC and Albendazole (DA) is the strategy to interrupt transmission. Since 2008 the programme achieved 100% geographical coverage and has made significant progress. MDA was stopped in 100 districts following interruption of transmission and are under post MDA surveillance. MDA is continued in the remaining districts, despite many rounds of MDA. Persistence of infection and risk of transmission could be due to sub-optimal coverage and sub-optimal effect of MDA. Under these circumstances, it would be hard to meet the deadline for achieving the goal before 2021. The national programme was looking for an alternate strategy to accelerate the LF elimination programme.

Randomized control trials and pilot scale studies tested a single dose of triple-drug co-administration with Ivermectin, Diethylcarbamazine and Albendazole (IDA) against filariasis and compared with the standard double drug combination of diethylcarbamazine and albendazole (DA) in Papua New Guinea (PNG) (Thomsen et al., 2016; King et al., 2018) and Cote d'Ivoire (Ouattara et al., 2016). The trial results showed that IDA is superior to DA in clearing microfilariae (Mf) without any serious adverse events. A larger trial showed that a single dose of IDA cleared Mf and maintained for at least three years in 96% of the treated Mf carriers (King et al., 2018). Additional benefit of adding ivermectin is its action against ectoparasites such as lice and scabies mites and a broad-spectrum coverage against soil transmitted helminthic infections (Fischer et al., 2017; Omura and Crump, 2014). Simulation studies suggested that IDA could accelerate LF elimination by reducing duration of MDA from 5-6 rounds to 2-3 rounds (Irvine, et al., 2017; Stolk et el., 2018).

Following randomized controlled trials (RCT), a large scale multi-country community study was conducted in five countries representing areas with persisting infection despite a number of annual MDA rounds with DA (India, Haiti, and Fiji) and areas with no prior MDA (Papua New Guinea and Indonesia) showed that a single dose IDA (ivermectin, 200 µg/kg; diethylcarbamazine,6 mg/kg; plus albendazole, a flat dose of 400 mg) IDA was safe (Gary et al., 2019). In the following section the merits of IDA over DA are discussed based on the findings of a study conducted by the ICMR-Vector Control Research Centre. This open label community study compared the safety, acceptability, efficacy and effectiveness of IDA.

Safety: As many as 4758 and 4160 participants were treated with IDA and DA respectively. About 8.3% of the participants treated with IDA had adverse events and it was 6.4% after DA. Almost 90% of the adverse events

were mild (grade 1) after both treatments (Fig. 1) and were self-limited or resolved fully with symptomatic treatment. AEs were more common in CFA or microfilaremia positive persons compared to uninfected persons after both treatments. AEs among microfilaria carriers were significantly higher after IDA (40.5%) than after DA (20.2%). Higher rates of adverse events can be attributed to clearance of microfilaria and IDA can be considered to have the potency in clearing higher proportion of Mf carriers. No participant experienced any serious AE and therefore IDA has no safety concern.

Acceptability: Acceptability of IDA was assessed by a community survey, key informants and focus group discussions. The mean acceptability score [MAS, range 9 (poorest) – 36 (highest)] was calculated based on 9 indicators, each with score ranging from 1 (strongly disagree) to 4 (strongly agree). A mean score of ≥18 was considered as critical cut-off for acceptability. The mean acceptability score was 27 and 26 in IDA and DA arm respectively, and it was above the critical level of >18, which was considered acceptable (Fig. 2). High level of acceptability could be attributed to the level of support reported to have received from the treatment team. However, about 76% of the respondents expressed that the number of tablets was a concern with IDA, while it was about 41 % with DA. Over 90% of the respondents reported their willingness to continue IDA-MDA and recommend to others. As scabies and head louse were not common among the study population, the additional benefits of IDA were not perceived by the community.

Efficacy: Efficacy of IDA and DA was assessed in terms of clearance of infection by retesting of antigen and Mf positive cases after 12 months post treatment. A cohort of 269 and 213 Mf positive individuals were retested after IDA and DA respectively. Complete clearance of Mf was observed in 84% of the Mf positive cohorts after IDA and 62% after DA (Table 1). IDA could clear 22% more cases. Higher reduction in microfilaria count was observed after IDA (86.5%) compared to 71.1% after DA, with 25% more reduction after IDA. About 10% of 1080 individuals positive for CFA retested after 1-year post treatment with IDA were negative while 15.3% of 889 CFA positive cases after DA were negative. Both the drug regimens were not effective in clearing CFA.

Effectiveness: Effectiveness of treatments was assessed by comparing the pre and 12 months post-MDA prevalence of Mf and CFA, and mean Mf count between IDA and DA, by screening a cross section of the population in each arm. A total of 3584 and 3549 individuals in the communities under IDA and DA were screened for Mf 1-year post treatment. The Mf prevalence declined from 6.8 to 3.5% (reduction:48%) after IDA, and from 6.2 to 5.4% (reduction: 13.2%) after DA, indicating that IDA could additionally reduce Mf prevalence by 24%. Reduction in the geometric Mf-count was 52.6% in the IDA area and 18.8% in the DA area. The higher reduction in Mf prevalence and density was maintained after a single dose of treatment with IDA.

Screening of 3584 individuals in the communities under IDA after 1-year post treatment showed CFA prevalence of 27.9%. Prevalence of CFA after 1-year post treatment with DA was 26.5%. The change in CFA prevalence was not significant after treatment in both arms, indicating that neither IDA nor DA was effective in clearing antigeneamia.

Both RCT and community trials showed that IDA was well tolerated with acceptable safety profile in LF-endemic populations, AE rates did not differ significantly after treatment with IDA or DA. The results indicate that IDA can be used as a safe and more effective drug regimen in MDA programme to accelerate LF elimination in areas that currently receive DA. WHO recommended IDA as an alternate strategy to achieve elimination with fewer rounds than DA with effective coverage (WHO, 2017).

Five countries (Samoa, India, Guyana, Kenya, Timor Leste and Indonesia) have introduced IDA as an alternate strategy to achieve elimination. All the three antifilarial drugs are supplied to the member countries as donation from WHO. Endemic countries are scaling up areas under IDA which requires huge supply of Ivermectin. Supply of Ivermectin is a major challenge. With the advantages of IDA based MDA, community compliance can be ensured. Data from the countries implementing IDA are expected to provide more information on the merits of IDA.

Table 1. Status of Mf-positive cohort one-year post-MDA by drug regimens

Drug regimen (Cohort)	Pre-MDA		Post-MDA		
	No. Mf-positives	Median MfC* per 60µl(range)	No. Mf positive (%)	Median MfC*per 60µl (range)	No. Mf-negative (% clearance)
IDA (326)	269	9 (1-712)	43 (16.0)	5 (1-228)	226 (84.0)
DA (265)	213	8 (1-315)	81 (38.0)	4 (1-196)	132 (62.0)

*MfC = Microfilaria count

Table 2. Prevalence of Ag and Mf at baseline and one-year post MDA with DA and IDA

Drug	Pre-MDA				Post-MDA				% change in		
									Prevalence		
	No. tested	No. Ag +ve (%)	No. Mf +ve (%)	Geo. Mean Mfc (range)	No. tested	No. Ag positive (%)	No. Mf positive (%)	Geo. Mean Mfc (range)	CFA	Mf	Geo. Mean Mfc
IDA	4782	1259 (26.3)	326 (6.8)	0.19 (07-12)	3584	1001 (27.9)	127 (3.5)	0.09 (0-543)	+6.1	-48.0	-52.6
DA	4272	1031 (24.1)	265 (6.2)	0.16 (08-35)	3549	939 (26.5)	191 (5.4)	0.13 (0-262)	+10	-13.2	-18.8

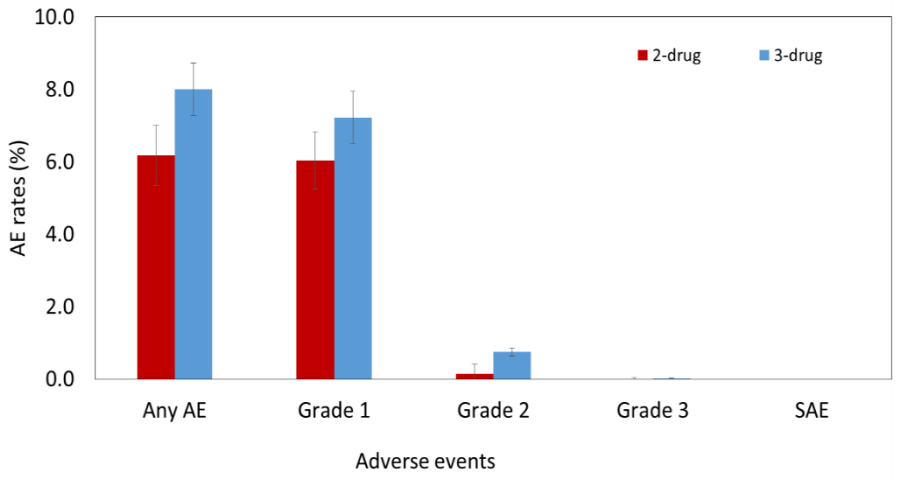


Figure 1. Adverse events (95% CI) by treatment and grades of adverse events

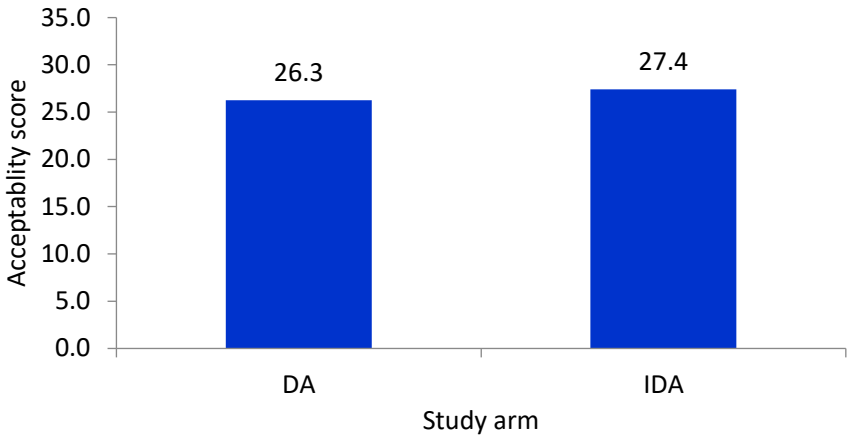


Fig. 2 Acceptability of IDA and DA to the community

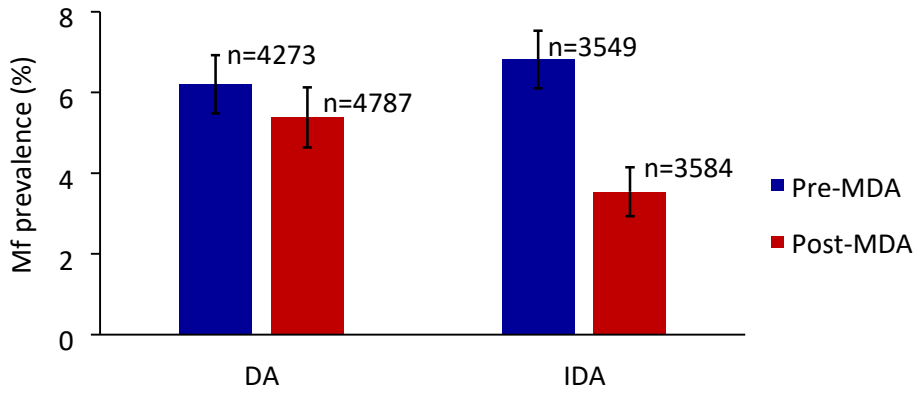


Fig. 3. Microfilaria prevalence at baseline and one-year post MDA with DA and IDA

References

1. Fischer PU, King CL, Jacobson JA, Weil GJ. Potential Value of Triple Drug Therapy with Ivermectin, Diethylcarbamazine, and Albendazole (IDA) to Accelerate Elimination of Lymphatic Filariasis and Onchocerciasis in Africa. PLoS Negl Trop Dis. 2017;11(1):e0005163. Epub 2017/01/06. doi: 10.1371/journal.pntd.0005163. PubMed PMID: 28056015;PubMedCentral PMCID: PMCPMC5215784.

2. Irvine MA, Stolk WA, Smith ME, Subramanian S, Singh BK, Weil GJ, et al. Effectiveness of a triple-drug regimen for global elimination of lymphatic filariasis: a modelling study. Lancet Infect Dis. 2017; 17 (4):451–8.https://doi.org/10.1016/S1473-3099(16)30467-4 PMID: 28012943.

3. King CL, Suamani J, Sanuku N, Cheng YC, Satofan S, Maki E, et al. A trial of a triple drug treatment for lymphatic filariasis. N Engl J Med. 2018; 379(19):1801–10.; PubMed Central PMCID: PMC30403937. https://doi.org/10.1056/NEJMoa1706854 PMID: 30403937

4. National Vector Borne Disease Control Programme. Accelerated plan for elimination of lymphatic filariasis. Ministry of Health and Family Welfare, Government of India, 2018.

5. Omura S, Crump A. Ivermectin: panacea for resource-poor communities? Trends Parasitol. 2014;30(9):445-55. Epub 2014/08/19. doi:

10.1016/j.pt.2014.07.005. PubMed PMID: 25130507.

6. Ottesen EA, Duke BO, Karam M & Behbehani K. Strategies and tools for the control/elimination of lymphatic filariasis. Bulletin of the World Health Organization 1997;75:491–503.

7. Ottesen EA. The global programme to eliminate lymphatic filariasis. Trop Med Int Health. 2000; 5 (9):591–4. PMID: 11044272.

8. Ouattara AF, Kouadio O, Bjerum C, Koudou BJ, Meite A, Kazura JW, et al., editors. High efficacy of a single dose of co-administered ivermectin, diethylcarbamazine and albendazole in treatment of lymphatic filariasis in Cote d'Ivoire. 65th Annual Meeting of the American Society of Tropical Medicine and Hygiene; 2016 Nov 13–17; Atlanta.Oakbrook Terrace, IL: American Society of Tropical Medicine and Hygiene; 2016.

9. Stolk WA, Prada JM, Smith ME, Kontoroupis P, De Vos AS, Touloupou P, et al. Are alternative strategiesrequired to accelerate the global elimination of lymphatic filariasis? Insights from mathematical models. Clinical Infectious Diseases. 2018;66(suppl_4):S260-S6.

10. Thomsen EK, Sanuku N, Baea M, Satofan S, Maki E, Lombore B, et al. Efficacy, Safety, and Pharmacokinetics of Co-administered Diethylcarbamazine, Albendazole, and Ivermectin for Treatment of Bancroftian Filariasis. Clin Infect Dis. 2016; 62(3):334–41. https://doi.org/10.1093/cid/civ882 PMID: 26486704.

11. Weil GJ, Bogus J, Christian M, Dubray C, Djuardi Y, Fischer PU, et al. (2019) The safety of double- and triple-drug community mass drug administration for lymphatic filariasis: A multicenter, open-label, cluster-randomized study. PLoS Med 16(6): e1002839. https://doi.org/ 10.1371/journal.pmed.1002839

12. WHO. The Global Programme to Eliminate Lymphatic Filariasis: Progress Report 2000–2009 and Strategic Plan 2010–2020. Geneva: 2011.

13. World Health Organization. Global programme to eliminate lymphatic filariasis: progress report, 2017. Wkly Epidemiol Rec. 2018;91(44):589-604. PubMed PMID: 28984121.

Plasmodium falciparum foci among tribes over three and half decade in Koraput district of Odisha State, India

S. S. Sahu

Scientist–F & OIC, ICMR-VCRC Field Station, Koraput, Odisha, India

Malaria continues to be one of the most prevalent vector borne diseases in south-east Asia region, and approximately 41% of malaria cases of this region occur in India (World malaria report, 2019). With only 3.8% of the country's population, Odisha State accounted for 41% of India's malaria burden during 2016, and the remote, heavily-forested regions with scattered tribal populations were the most vulnerable (NVBDCP, 2019; Pradhan et al., 2019). But in 2019, there is a great decline of malaria cases observed in India. The success of reduction of malaria cases in India is largely due to substantial decline of the cases in the highly malarious State of Odisha. The reported malaria cases in the Odisha State declined by 90.7% (from 384,668 in 2016 to 35,775 in 2019) and deaths dropped by 90.9% (from 77 to seven) during the same period (NVBDCP, 2019).

Malaria is a major health problem in Odisha due to the State's vast forest cover and tribal settlements. Despite the perceptible declining trend observed in Odisha State, malaria is still persisting in the State and active transmission continues in the inaccessible, hilly and forested villages of the State (Pradhan et al, 2019). The asymptomatic carriers in the community act as a silent reservoir for continuing residual transmission (Sahu et al, 2013).

Koraput is one among the 30 districts of Odisha State, with many forests and hills, contributing 9.6% of the total malaria cases, 10.5% of *Plasmodium falciparum* cases and 2.6% of deaths due to malaria, during 2016. Malaria prevalence is an important epidemiological parameter to understand the situation of malaria in an area, which can be determined either by sample blood survey or mass blood survey. A survey conducted 34 years ago in the district highlighted the prevalence of malaria with a hyper-endemic status. During 1986, ICMR-VCRC has assessed the malaria prevalence by a sample survey in 37 villages in the district covering

10,733 (60.6%) population using the gold standard microscopy method. The results of the study showed that a total of 833 (7.8%) blood smears was found positives with malaria parasites. Among 833 positives, 714 were *P. falciparum*, 86 were *P. vivax*, 12 were *P. malariae* and 21 were mixed infections. Out of all positive cases, 650 (78.0%) were asymptomatic and 127 (15.2 %) cases had gametocyte in their blood (Table 1) (Rajagopalan et al, 1990).

After two and half decades i.e. during 2010-11, a study was conducted to assess the extent of malaria prevalence in the district by screening 12,045 (16.1%) population in 135 villages. Among them, 1,983 (16.5%) were found positive for malaria parasites and 1565 (78.9%) cases were asymptomatic. Out of all positive cases, 152 cases (7.7%) had gametocytes in their blood (Table 1) (Sahu et al, 2013). Further, after a gap of two years, a study was conducted during 2013 in two highly endemic sub-centres (SCs) covering 19 villages of Koraput district which showed that, out of 1606 blood smears, 224 (13.9%) was found positive with malaria parasites (*P. falciparum*: 216, *P. malariae*: 2 and *P. vivax*: 6) and 91.5% (n=205) among them was asymptomatic. The gametocyte rate among the asymptomatic cases was 15.1% (n=31) (Table 1) (Gunasekaran et al, 2019).

After four year, a sample blood survey was conducted during 2017 in 20 villages of two highly endemic sub-centres (SCs) of Koraput district. A total of 972 blood smears were collected. The results showed that, 20.9% (205) people were found positive with malaria (*P. falciparum*: 195, *P. vivax*: 9 and mixed infection of *pf* and *pv*: 1). Among the positive cases, 75.1% (154) were asymptomatic and the gametocyte rate among the asymptomatic cases was 8.4 % (Table 1) (Sahu et al, 2020).

The above cited studies conducted in Koraput district over three and half decades indicate that the district was hyper-endemic for *falciparum* malaria. This parasite species was predominant in Koraput district, even in early part of 20th century (Rajagopalan et al, 1990). Most of the villages in the district are scattered and are situated on hilltops or foothills. The health care services and communication facilities were inadequate and poor which led to hindrance in routine malaria control operations. Timely indoor residual spraying operations could not be carried out in time due to hard terrain and inaccessibility of interior villages. Even if sprayed, the quality and coverage of spraying were inadequate due to lack of supervision. Due to these reasons and the persistence of considerable number of asymptomatic asexual and sexual cases in the community, malaria transmission continued in the district resulting in the persistence of malaria in the district.

However, after the implementation of national strategic plan for malaria elimination (NSP) during 2017, the Koraput district implemented two new strategies for elimination of malaria i.e., mass distribution of long-lasting insecticidal nets (LLINs) and a State sponsored programme ‘‘Durgama Anchalare Malaria Nirakaran’ (elimination of malaria in inaccessible regions), in short DAMaN and observed a decline of 89.5% malaria incidences (API 3.1 in 2019 as against 29.5 in 2017) (Pradhan et al, 2019). Recently, a sample survey conducted during 2018 in same two SCs of Koraput district which were screened on 2017 showed that there is great decline of parasite positive rate among the screened population. Out of 935 tested population, only seven (0.75%) were found positives with malaria and all the 7 *falciparum* cases are asymptomatic and one had gametocytes (Table 1). It is evident from this analysis that the reduction of both symptomatic and asymptomatic cases observed in Koraput district during the year 2018 and 2019 were due to mass distribution of LLINs and DAMaN (Pradhan et al, 2019).

Currently, the district is having low transmission of malaria as API was 3.1 in 2019. The evidenced/ established asymptomatic parasite reservoirs found in the district might play an important role for focal transmission with the available efficient malaria vectors like *Anopheles fluviatilis* and *An. culicifacies* (Sahu et al, 2020). Hence, regular screening of asymptomatic malaria parasites and low-density in the district is highly necessary to ensure zero transmission of malaria as observed elsewhere (Okell et al, 2012, Steenkeste et al, 2010).

Table.1 Prevalence of asymptomatic malaria cases in Koraput district

Year	Population screened	Malaria positives (%)	No. of asymptomatic cases (%)	No. of gametocyte carriers (%)
1986	10,733	833 (7.8)	650 (78.0)	127 (15.2)
2010	12,045	1,983 (16.5)	1,565 (78.9)	152 (7.7)
2013	1,606	224 (13.9)	205 (91.5)	31 (15.1%)
2017	1,940	205 (20.9)	153 (75.0)	13 (8.4%)
2018	935	7 (0.75)	7 (100.0)	1 (14.3%)

References

1. World Health Organization. *World Malaria Report 2019*. Available from: *https://apps.who.int/iris/bitstream/handle/10665/275867/9789241565653-eng.pdf*, accessed on February 28, 2020.
2. National Vector Borne Disease Control Programme. *Malaria situation in India.* Directorate of National Vector Borne Disease Control Programme. Directorate General of Health Services, Ministry of Health & Family Welfare, Government of India; 2019. Available from: *http://nvbdcp.gov.in/*, Accessed on: March 02, 2020.
3. Pradhan MM, Meherda PK. Malaria elimination drive in Odisha: Hope for halting the transmission. J Vector Borne Dis 2019; *56*: 53-5.
4. Rajagopalan PK, Das PK, Pani SP, Jambulingam P, Mohapatro SSS, Gunasekaran K, Das LK: Parasitological aspects of malaria persistence in Koraput district, Orissa, India. Indian J Med Res 1990, *91*: 44-51.
5. Sahu SS, Gunasekaran K, Vanamail P and Jambulingam P. Persistent foci of *falciparum* malaria among tribes over two decades in Koraput district of Odisha State, India. *Malar J* 2013, *12*:72.
6. Gunasekaran K, Sahu SS, Nallan N, Vijayakumar T, Subramanian S, Behera KP, Pradhan MM, Jambulingam P. Comparative efficacy of two rounds of indoor residual spraying of DDT 75% @ 1g/m^2 with that of DDT 50% @ 1g/m^2 against the malaria vectors in India. *Acta Trop* 2019,*194*: 123–34.
7. Sahu SS, Sonia T, Dash S, Krishnamoorthy N, Swaminathan S, Gunasekaran K and Purushothaman J. Evaluation of long-lasting indoor residual spraying of deltamethrin 62.5 SC-PE against malaria vectors in India Malar J 2020, *19*:19.
8. Okell LC, Bousema T, Griffin JT, Ouédraogo AL, Ghani AC, Drakeley CJ. Factors determining the occurrence of submicroscopic malaria infections and their relevance for control. Nat Commun. 2012;3:1237. doi: 10.1038/ncomms224.
9. Steenkeste N, Rogers WO, Okell L, Jeanne I, Incardona S, Duval L, Chy S, Hewitt S, Chou M, Socheat D, Babin FX, Ariey F , Rogier C. Sub-microscopic malaria cases and mixed malaria infection in a remote area of high malaria endemicity in Rattanakiri province, Cambodia: implication for malaria elimination Malar J 2010; *9*; 108.

Why the tribal population of Western Ghats are prone to Leishmaniasis?

Prasanta Saini and N. Pradeep Kumar
ICMR-VCRC Field Station, Kottayam, Kerala, India

Leishmaniasis is a vector-borne intracellular protozoan parasitic disease prevalent in the tropical and subtropical regions of the world. There are evidences on the incidence of this disease, long back from the first century AD. This malady locally referred as Kala-azar, Black fever, Aleppo boil, Dum Dum fever, Sirkari disease, Sahib's disease etc. from 18th century is currently catalogued as a neglected tropical disease with the second highest mortality rate according to WHO (1). An estimated 700,000 to 1 million new cases and 26000-65000 deaths are annually reported in association with leishmaniasis globally (2). This disease persisted across civilizations, and is still prevalent in our modern world especially among the most underdeveloped communities with the tag 'poor man's disease' (3). It is often attributed to the poor living conditions, inaccessibility to proper health

care systems, financial backwardness, illiteracy and lack of awareness among these poverty-stricken sections of the society.

According to WHO, India is one among the 10 most affected countries today with 130 million of its population currently at the risk of leishmaniasis (2). Even though active government interventions are being implemented at par with the National Kala-Azar Elimination Programme, the recurrence of sporadic cases, emergence/resurgence of endemic areas, prevalence of Post Kala-Azar Dermal Leishmaniasis (PKDL), difficulties in clinical diagnosis, symptomatic resemblances with other diseases etc. are hindering the efforts for complete elimination of this disease in India. Leishmaniasis has three major clinical manifestations constituting visceral, cutaneous and mucocutaneous forms. Visceral leishmaniasis (VL) affecting the reticulo-endothelial system diagnosed with the enlargement of liver and spleen (Figure 1A) is the most fatal form, if left untreated. As the name suggests, cutaneous leishmaniasis (CL) is characterised by the infection of dermal macrophages (Figure 1B) while the mucosal layer is affected in the case of mucocutaneous leishmaniasis (MCL).

In the early 20th century, William Leishman and Charles Donovan independently identified the presence of Leishman Donovan bodies in the infected spleen samples of expired patients. Later the causative parasite was characterised to be a protozoan belonging to *Leishmania sp*. These parasites complete their digenetic lifecycle with an intracellular amastigote form in the host and a highly motile promastigote form in the vector. Further investigations confirmed the vector involved to be Phlebotomine sand flies. There are no clinically approved, vaccines available for the treatment of this disorder. However, therapy with antimonial drugs or Liposomal Amphotericin B infusion and miltefosine oral drugs are the major remedial measures currently followed (4).

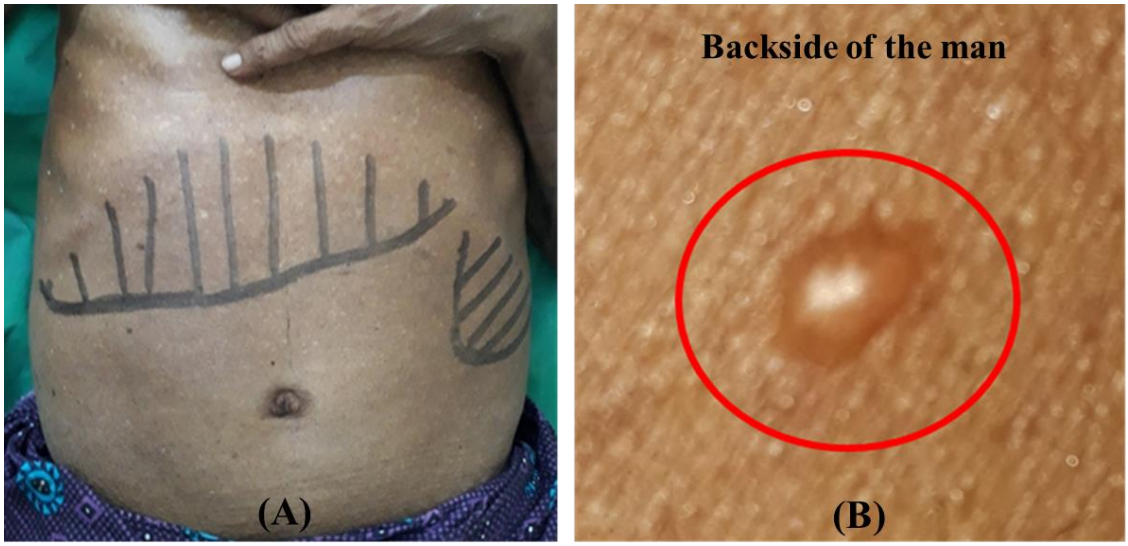


Figure 1: A) Hepatosplenomegaly in VL patient; B) Cutaneous nodule in CL patient

Apart from the endemic zones of VL in eastern India and CL in western India, recently we have observed a hike in the rates of occurrence of leishmaniasis in the southern India across the Western Ghats region. It was also noticed that the major fraction of these sporadic cases of leishmaniasis were being reported from the tribal inhabitants in the foothills of Western Ghats in Kerala. This region is a home for approximately 5 lakh aboriginal people known as 'adivasis' belonging to the Scheduled Tribes, according to the Census of India, 2011. There are more than 35 major tribal groups in Kerala ranging from the most primitive groups like 'Kattunaikkan' to the most populous and more uplifted 'Paniyars' (5). A consolidated information on the different tribal groups prevalent in Kerala, their geographical distribution and social characteristics are presented in Table 1. This marginalised social category suffers from a worrisome burden of poverty and underdeveloped living conditions. Despite the rehabilitation interventions like Tribal Rehabilitation Development Mission (TRDM),

Eco Development and Tribal Welfare Programme etc. initiated by the central and state government, a sizable fraction of these indigenous people prefer nomadic life in the interiors of the forest (Figure 2A, 2B).

Table1: Geographical distribution and lifestyle of tribes in Kerala

Type of Community	Tribal name	Districts	Occupation
Primitive	Cholanaykkan, Kadar, Kattunaykkan, Koragar, Kurumbar	Malappuram, Kozhikode , Palakkad Thrissur, Kannur, Kasargod	Forest produce, Fishing, Agriculture labour
Under-developed	Aadiyan, Aranadan, Eravallan, Irular, Kanikar, Mahamalasar, Malakuruvan, Malapandaram, Malavedan, Malavettuvan, Malasar, Malayan, Mannaan, Mudugar, Ulladan, Vettakuruman	Kannur, Wayanad, Malappuram, Palakkad, Thiruvananthapuram, Kollam, Idukki, Kottayam, Pathanamthitta, Thrissur, Ernakulam, Kozhikode	Agriculture, Animal Husbandary, Domestic Labour, Hawkers, Craft works, Forest produce
Marginally- developed	Hill pulaya, Karimpalan, Kudiya, Kurichiyan, Kuruman/ Mullu kuruman, Mala arayan,Malapanickar, Mariti, Mavilan, Mudhuvan, Palliyar, Paniyan, Thachamadan, Uraly, Wayanad Kadar	Kannur, Wayanad, Malappuram, Palakkad, Idukki, Kottayam, Thrissur, Kasargod	Agriculture, Animal Husbandary, Domestic Labour, Hawkers,Craft works, Forest produce, Business, Government jobs

Lack of sufficient health care, exposed lifestyle and malnutrition culminate in limited or extreme manifestations of various communicable and non-communicable diseases among the tribal people. Recently our group identified expanded prevalence of CL among the Kannikar tribes of Agasthyamala localised in the southern end of Western Ghats (6). We have also observed an increasing rate in occurrence of VL/CL among the tribal communities (Paniyar, Ulladan, Malayan, Kattunaikkan, Cholanaikkan etc.) throughout the region (unpublished data). This thickly forested region is characterised by its tropical climate, evergreen rain forest ecosystem, reduced human activities, humid and shady microhabitats and are highly conducive for sandfly breeding and proliferation. As this region encompasses one of the major biodiversity hotspots in India, vector control activities are very limited. Xenodiagnosis studies have identified natural infection with *Leishmania* parasites in the *Phlebotomus argentipes* (vector) population of this region (7). It was also noted that dogs could act as a reservoir host for *Leishmania* parasites on detection of parasitic infection among the domestic dogs of Kannikar tribes (8). The persistence of circulation of this parasite within the host, vector and reservoir host populations of Western Ghats cast a threat over the well-being and healthy sustenance of these particularly vulnerable sections of indigenous people.

Nomadic Tribe in Western Ghats Primitive Kadar Tribe

Figure 2: Primitive tribes in Western Ghats

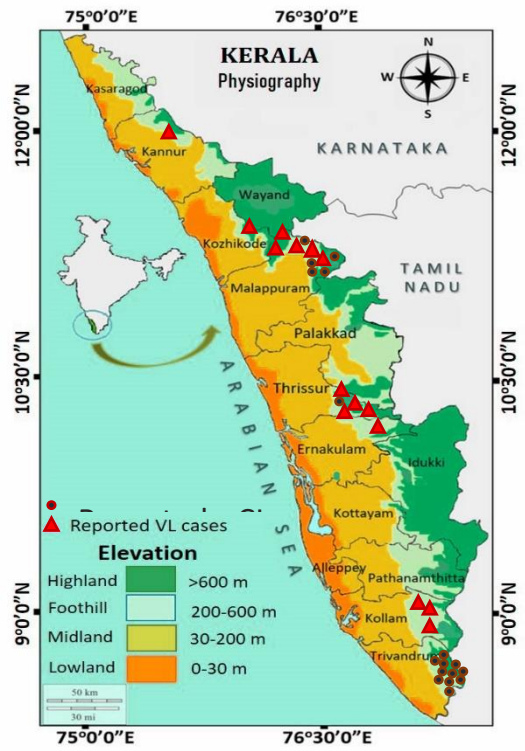


Figure 3: Distribution of VL/CL cases reported during 2010-2020 along the Western Ghats region

We observed the prevalence of 32 cases with differential manifestations of leishmaniasis across the foothills of Western Ghats region in the last decade (Figure 3). Surprisingly, most of the cases were found amongst the tribal communities and the remaining cases were identified to be living in close proximity to the forest ecosystem in the foothill region. Among the diagnosed tribal patients, 11 cases from Kannikar tribe were suffering from CL. The next focus area is localised within Malappuram district with 5 VL/CL cases from the tribal communities (Paniyar, Kattunaikkan, Cholanaikkan,). Kollam (Malayan), Thrissur (Malayan) and Ernakulam (Ulladan) also had aboriginal people with leishmaniasis. Two of the VL patients died, despite the health care support provided as the cases were diagnosed in their terminal stages. It should also be noted that leishmaniasis cases are grossly underreported in India owing to the difficulties in clinical diagnosis, reduced number of reported cases, socioeconomic backwardness of the affected individuals, lack of awareness regarding the disease, absence of active surveillance etc. Hence it is highly probable that there are more number of cases yet to be identified over this region.

All the reported cases could be indigenous in origin as the infected people had no past histories of travel to endemic regions or exposure to endemic population. However even the rehabilitated groups of tribal people continued visiting deep forest for prolonged or short durations to collect the forest produce like honey, firewood, medicinal herbs, spices, fruits, etc. for earning their livelihood. Most of them live in houses with thatched roof with unplastered flooring and walls made of mud, bricks or bamboo. The poorly lit, humid interiors; the cracks and crevices on the walls, the firewood stacks stored in the houses etc. do serve as optimal resting sites for the sandflies. Moreover, their reluctance to use proper clothing and insect repellents further increase their exposure to sandfly bites. Environmental conditions conducive for the vector proliferation and the elevated vulnerability of the host population to the infection are two major factors determining the pace of transmission of leishmaniasis.

In the case of cutaneous lesions, these people prefer indigenous traditional herbal treatment. The similarity with other common ailments, self-healing properties of the dermal infection, reduced impact of the disorder in

their quotidian life etc. make them ignorant towards CL (9). However, people have often described alienation in the society and difficulties in securing matrimonial alliances due to the deformities on the skin. We have already characterized that *Leishmania donovani* is involved in the cutaneous forms observed in the Western Ghats, (6) which typically cause VL in North Eastern India. The underlying factors responsible for this differential localisation of this infection remains to be investigated. This atypical manifestation further poses caution on its visceralising potential in adjoining urban areas (10). The variations in the immune profile of the individuals of these isolated tribal communities could also have a significant role in the severity and type of clinical manifestation. Inaccessibility to efficient healthcare provisions, misconceptions, lack of awareness and financial backwardness often restrain these people from seeking proper treatment. The increasing prevalence of indigenous VL is also alarming. As the parasite circulation is evident across this region, the potential of the disease to disseminate among the communities and to the surrounding urban/semiurban localities should not be undermined. Thus, it is crucial that we ensure active entomological and epidemiological surveillance and better care for these disregarded fraction of people.

Acknowledgement

We acknowledge Ms. Aswathy Joji, Project Technical Officer for drafting the write up and Mrs. Jessu S Mathew, Technical Officer-B for providing information about the Tribes in Kerala.

References

1. Alvar J, Vélez ID, Bern C, Herrero M, Desjeux P, Cano J, Jannin J, den Boer M; WHO Leishmaniasis Control Team. Leishmaniasis worldwide and global estimates of its incidence. PLoS One. 2012;7(5): e35671.
2. WHO,2019 (https://www.who.int/leishmaniasis/en/)
3. Alvar J, Yactayo S, Bern C. Leishmaniasis and poverty. Trends Parasitol. 2006;22(12):552-7.
4. Rodrigo C, Weeratunga P, Fernando SD, Rajapakse S. Amphotericin B for treatment of visceral leishmaniasis: systematic review and meta-analysis of prospective comparative clinical studies including dose-ranging studies. Clin Microbiol Infect. 2018;24(6):591-598.
5. Kakkoth, Seetha. The Primitive Tribal Groups of Kerala: A Situational Appraisal. Studies of Tribes and Tribals. 2005;3: 47-55.
6. Kumar NP, Srinivasan R, Anish TS, Nandakumar G, Jambulingam P. Cutaneous leishmaniasis caused by Leishmania donovani in the tribal population of the Agasthyamala Biosphere Reserve forest, Western Ghats, Kerala, India. J Med Microbiol. 2015;64(Pt 2):157-63.
7. Srinivasan R, Kumar NP, Jambulingam P. Detection of natural infection of Leishmania donovani (Kinetoplastida: Trypanosomatidae) in Phlebotomus argentipes (Diptera: Psychodidae) from a forest ecosystem in the Western Ghats, India, endemic for cutaneous leishmaniasis. Acta Trop. 2016;156: 95-9.
8. Jambulingam P, Pradeep Kumar N, Nandakumar S, Paily KP, Srinivasan R. Domestic dogs as reservoir hosts for Leishmania donovani in the southernmost Western Ghats in India. Acta Trop. 2017; 171:64-67.
9. Nandha B, Srinivasan R, Jambulingam P. Cutaneous leishmaniasis: knowledge, attitude and practices of the inhabitants of the Kani forest tribal settlements of Tiruvananthapuram district, Kerala, India. *Health Education Research*. 2014; 29(6):1049–1057.
10. Kariyawasam KKGDUL, Selvapandiyan A, Siriwardana HVYD, Dube A, Karunanayake P, Senanayake SASC, Dey R, Gannavaram S, Nakhasi HL, Karunaweera ND. Dermotropic Leishmania donovani in Sri Lanka: visceralizing potential in clinical and preclinical studies. Parasitology. 2018;145(4):443-452.

Flea - As a vector

K. Athisaya Mary
Senior Technical Officer, Microbiology & Molecular Biology, ICMR-VCRC, Puducherry, India

Introduction: Vector is a living organism, typically a biting insect that can transmit infectious diseases between humans/animals to humans and the diseases caused by them are called as vector-borne diseases (VBDs). Although vectors are found in both temperate and tropical regions, they are more common in tropical regions, where insects prevail, and sanitary conditions are not adequate. Flea is one such vector (Fig: 1). Fleas are flightless small insects. They are ectoparasites (external parasites) of birds and mammals and survive by consuming the blood of their host. They lack wings, but have strong claws which prevent them from being dislodged from their hosts easily. They are usually dark coloured (for example, the reddish-brown cat flea), with a proboscis, or stylet, adapted to feeding by piercing the skin and sucking host's blood through their epipharynx.

Life cycle: Fleas come under holometabolous insects, and undergo four lifecycle stages of egg, larva, pupae, and adult (Fig: 2). Depending on the species the number of eggs laid range from 2-7 dozen per batch. In life time, a female flea can lay 5000 or more eggs, which rapidly increase their numbers. The larvae of the flea emerge from the eggs. Larvae feed on any available organic material such as dead insects, faeces, conspecific eggs and vegetable matter. The entire larval stage lasts from 4 to 18 days. With adequate supply of nutrients, after three larval stages, the larvae develop to pupae and weave silken cocoons. Within the cocoon, the larva moults for a final time and undergoes metamorphosis into the adult form. This can take just 4 days. Generally, an adult flea lives only for 2 or 3 months. Once the flea reaches adulthood, its primary goal is to find blood and then to reproduce. Fleas feed on a wide variety of warm blooded vertebrates including humans, dogs, cats, rabbits, squirrels, ferrets, rats, mice and birds.

Diseases caused by flea: Fleas are known to carry a number of diseases that are transferable to human beings through their bites. Fleas are vectors for viral myxomatosis virus), bacterial (*Rickettsial - Rickettsia typhi, Rickettsia felis, Bartonella henselae*), protozoan (*Trypanosome*) and helminthic (*Hymenolepiasis*) parasitic diseases of humans and other animals. Bacterial diseases carried by fleas include murine or endemic typhus (Fig: 3) and bubonic plague. The oriental rat flea, *Xenopsylla cheopis*, is a vector of *Yersinia pestis*, the bacterium which causes bubonic plague. The infected fleas feed on rodent reservoir of this bacterium, such as the black rat *Rattus rattus*, and then infect human populations with the plague (Fig: 4). This has happened repeatedly from the ancient times as witnessed by plague epidemic in Mumbai, India in 1896 -1897 (Fig: 5) and the Plague of Justinian in 541–542 AD. The Black Death pandemic between 1346 and 1353 AD had very likely killed over a third of the population of Europe. The outbreaks killed up to 200 million people across Europe between 1346 and 1671. The Great Plague of London, in 1665, killed up to 100,000 people. Added to the diseases caused by the flea, their presence as an ecto-parasites itself as well as blood-feeding often results in allergic reactions and can cause a substantial blood loss. Flea-associated dermatitis is the most common dermatological reason for pet owners for veterinary consultation, making appropriate flea control absolutely necessary.

Flea as biological weapon: Because fleas carry many diseases particularly plague, they have been used as a biological weapon. During World War II, the Japanese army dropped fleas infested with *Y. pestis* in China (Bossi *et al*., 2004). The bubonic and septicemic plagues are the most probable forms of the plague that would spread as a result of a bioterrorism attack that used fleas as a vector.

Flea control: To prevent flea infestation the common strategy in veterinarian practice is regular application of parasiticides. The fact that fleas are major nuisance pests, and as a matter of public health importance, its control is definitely necessary. The pharmaceutical world, provides a lot of different flea control products with many of them exhibiting almost 100% efficacy. But the major differences with regard to the speed of action and the development of resistance, are due to the active substances. If an active substance possesses a fast mode of action, the probability decreases that transmission of

pathogens occurs within the remaining feeding time. With a proven active ingredient, imidacloprid, can effectively stops flea feeding within minutes.

The major issue in flea is the development of resistance with frequently used flea control products. The flea control measures should be designed in such a way that it minimises the risk of resistance due to incorrect dosing. Often, biological factors such as reinfestation from refugia on domestic and wild animals, or not adjusting insecticide application to variations in humidity and temperature or cultural conditions such as substrates or even carpet types may cause failures in controlling them. In 1999, a global flea susceptibility program to monitor possible resistance developments against imidacloprid in fleas has been started, but so far the insecticide is effective.

References: Primary source: https://en.wikipedia.org/

1. Bossi P *et al.*, (2004). "Bichat guidelines for the clinical management of plague and bioterrorism-related plague". Euro surveillance. 9 (12): Article 12.

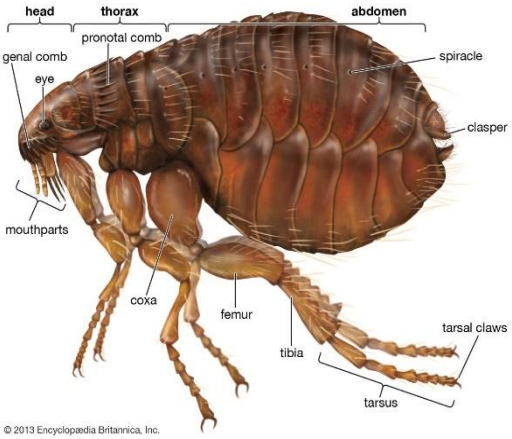


Fig. 1. Adult Flea
Source: 2013 Encyclopaedia Britanica.Inc

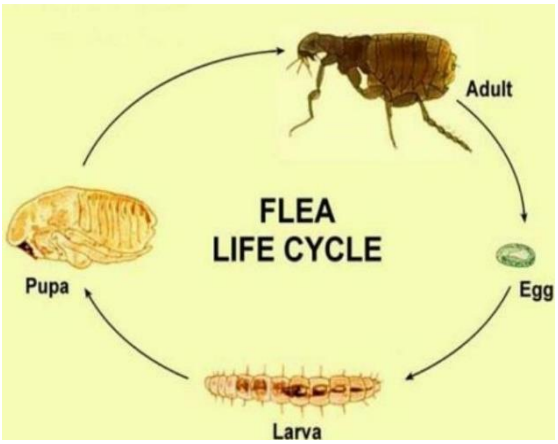


Fig. 2. Life Cycle of Flea
Source: vectorstock.com

Fig. 3. Patient with murine typhus rashes
Source: SpringerLink

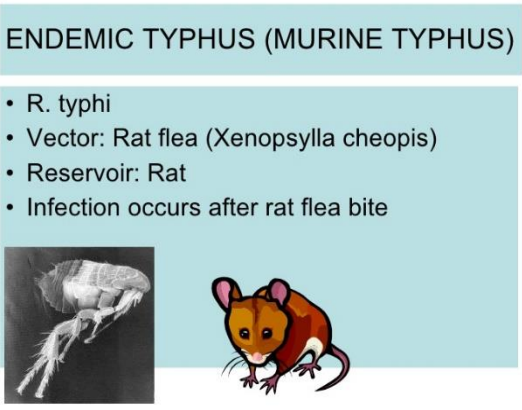


Fig. 4. Murine typhus pathogen, vector, reservoir
Source: www.slideshare.net/sasiprasad/rickettsia

Fig. 5. Plague epidemic at Bombay, India 1896-1897
Source: Public health/The Indiaforum.in

An Overview of Current Knowledge on Ticks in India

A. Elango
Principal Technical Officer, Vector Biology & Control, ICMR-VCRC, Puducherry

Introduction: Ticks are obligatory hematophagous ecto-parasites widespread globally and also vectors or reservoirs for the transmission of pathogenic fungi, protozoa, viruses, rickettsia and other bacteria during their feeding process on the hosts. Worldwide ticks are vectors of human diseases second to Mosquito vectors. Approximately 30 % of the emerging infectious diseases are vector-borne, which include. From the medical and veterinary point of view, about 100 arthropod-borne infections are associated with 116 tick species (32 argasid species and 84 ixodid).

Life cycle: Hard tick life cycle consist of egg, six-legged larva (24-253 days), eight-legged nymph (75-183 days), and Adult (152-568 days). Ixodid ticks have one-host, two-host or three-host lifecycles. In the one-host lifecycle, larva, nymph and adult stages remain on the host and detach before laying eggs (Ex. *Boophilus sp*). In the two-host lifecycle, larvae and nymphs remain on the same host and the adults feed on next host (Ex. *Hyalomma sp*). In the triple-host lifecycle, all three stages feed on different hosts *(Ex. Haemaphysalis sp)*. Life span of the hard tick from egg to adult is from one to three years. Male tick takes smaller amount of blood meal before mating and dies after mating. The female takes blood meal before mating and lays egg from about 1000 to 20000 depending on the species. Life cycle of the soft ticks consists of egg, six-legged larva, two or more eight-legged nymph stages, and each stage feeds smaller blood meal on different host. Soft ticks deposit 20 to 50 eggs in a batch after each blood meal. Unlike the soft ticks, which mate in the vegetation, ixodid ticks copulate while on their host.

Tick Taxonomy: In India, only 50 tick species were recorded before discovery of the Kyasanur Forest Disease (KFD) and incrimination of ticks as vectors in Shivamoga district, Karnataka. Worldwide, ticks fall in three families belonging to order Ixodida (Hard Ticks): and 896 species. The Nuttalliellidae family is monotypic, containing single species *Nuttalliella namaqua* which is not recorded in India. The Argasidae family (soft ticks) consists of 193 species worldwide. Of these, 18 species belong to the genera *Argas* (10), *Ornithodoros* (7) and *Otobius* (2) that are recorded in India. The Ixodidae (Hard ticks) comprises 702 species in 14 genera: *Amblyomma* (130), *Anomalohimalaya* (3), *Bothriocroton* (7), *Cosmiomma* (1), *Cornupalpatum* (1), *Compluriscutula* (1), *Dermacentor* (34), *Haemaphysalis* (166), *Hyalomma* (27), *Ixodes* (243), *Margaropus* (3), *Nosomma* (2), *Rhipicentor* (2) and *Rhipicephalus* (82). Of these, 88 Ixodid ticks belong

Fig :1 *Haemaphysalis spinigera*

to genera *Ixodes (11)*, *Amblyomma (12)*, *Rhipicephalus (8)*, *Dermacentor (3)*, *Haemaphysalis (44)*, *Nosomma (1),* and *Hyalomma (9)* are recorded in India.

Pathogen transmitted by Ticks: Ticks are vectors or reservoirs of pathogenic fungi (Dermatophilosis). Protozoa (*Babesia*), Nairovirus (Crimean–Congo hemorrhagic fever (CCHF), Powassan encephalitis, Soldado virus, Issyk-Kul fever virus , Eyach virus , Colorado tick fever, Mono Lake virus); Flavivirus (Omsk Hemorrhagic fever, Kyasanur forest disease (KFD), and others tick-borne encephalitis (TBE); *Rickettsia spp*. (Rocky Mountain spotted fever, Brazilian spotted fever, Mediterranean spotted fever, African tick bite fever, Indian Tick Typhus (ITT); *Anaplasma* bacteria (Human granulocytic anaplasmosis), *Ehrlichia* bacteria (Human monocytic ehrlichiosis) and *Borrelia* bacteria (Lyme disease and relapsing fever), *Francisella* (Tularemia), and *Coxiella* bacteria (Q (Query) fever), etc. and transmit them during their feeding process to the Human.

Major Tick Vectors in India: *Haemaphysalis spinigera* (Fig. 1)*, H. turturis* etc., (KFD), *H. anatolicum anatolicum*

(CCHF), *Rhipicephalus sanguineus* and *Rh. haemaphysaloides* (ITT), *Ixodes ricinus* (Lyme disease), and *H. intermedia* (Ganjam Virus) are the major vectors recorded in India. Tick larvae become infected during feeding on the small mammal reservoir and the parasites are transmitted to nymph and adult transstadially (Ex. KFD and Lyme disease). On the other hand, infected female passes the infection to the offspring through transovarial transmission and transstadially to the adult ticks (Ex. *Rickettsia sp*., CCHF virus and Ganjam Virus). Tick nymph stage is infective to the human host in KFD and Lyme disease. However, adult tick is the infective stage in the case of CCHF. Human to human transmission occurs only in CCHF via percutaneous or permucosal exposure to the blood and the body fluids containing the virus.

Human tick-borne diseases in India: Tick borne diseases are re-emerging in various states of India. Kyasanur Forest Disease is currently reported in Karnataka, Goa, Maharashtra, Kerala and Tamil Nadu. Every year the disease is expanding into new areas of Western Ghats. Crimean-Congo haemorrhagic fever (CCHF) has been reported in Gujarat, Rajasthan and Uttar Pradesh. Indian tick typhus (ITT) in humans have been reported in Tamil Nadu, Pondicherry, Delhi, Uttar Pradesh and Karnataka. Lyme disease has been reported in Kerala. The rare disease like Ganjam virus has been reported in Tamil Nadu and Q fever in Pondicherry has been reported.

Control: Various insecticidal formulations can be applied to domestic pets, such as dogs to rid them of their ticks. Recommended treatments include solutions of 0.5 % Malathion, 0.1 % Dichlorvos (DDVP), 1 % Carbaryl, and 0.1 % Dioxathion, Alternatively, dusts of 5% Carbaryl or 3-5 % Malathion can be applied for effective tick control.

An insight into Insect Pathology lab: The story of the biolarvicide, *Bacillus thuringiensis* serovar *israelensis* (Bti) (VCRC B-17)

I. Geetha
Senior Technical Officer, Microbiology & Molecular Biology, ICMR-VCRC, Puducherry, India

In the beginning....

During the 1970s, a VCRC research group comprised of Dr. A. Gajanana, Mr. U. S. Bheema Rao and Dr. R. K. Chandrahas, Dr. K. N. Panickar and Ms. M. Geetha Bai working in a rented building in Lawspet, Pondicherry, initiated studies on biological control agents of mosquitoes. Agents viz., *Romanomermis iyengari,* a mermithid nematode and protozoans, *Nosema algerae*, *Thelohania*, *Amblyspora indicola* parasitizing mosquito larvae were studied.

The focus on the biological control agents then shifted to the world of microbes after the arrival of Dr. K. Balaraman in the year 1978. He initiated the work on bacterial and fungal pathogens of mosquito larvae. The laboratory was named as “Insect Pathology Lab”, in short “IP lab”. The Insect Pathology research team included Mr. U. S. Bheema Rao and Dr. A. M. Manonmani, apart from Dr. K. Balaraman and then was joined by Dr. S. L. Hoti. Mr. U. S. Bheema Rao and Dr. K. Balaraman isolated larvicidal bacilli, *B. alvei* and *B. brevis* in the year 1979. Soon, in 1980, Dr. Hoti and Dr. Manonmani isolated a strain of *Bacillus thuringiensis* serovar *israelensis* (*Bti*) (VCRC B-17) and with this the story of *Bti* began. Dr. M. Kuppusamy joined the team subsequently and contributed to the development of fermentation process for *Bti* assisted by Dr. G. Prabakaran. Dr. P. K. Rajagopalan, then Director sent a note on *Bti* research at VCRC to Prof. V. Ramalingaswami then Director General of and the effort of the team was highly appreciated by DG, ICMR.

As per the suggestions of the DG, ICMR, a manuscript on the isolation of the VCRC B-17 joined the pages of *Current Science* in the year 1981. A small story on VCRC B-17 was covered by the Daily News, an English-language newspaper in Sri Lanka (now published by the Associated Newspapers of Ceylon Limited (Lake House), (a government-owned corporation) on 3rd March, 1982, in the column “Foreign features”. VCRC’s

acclaim for its pioneering work was also acknowledged with appreciation by Dr. H. De Barjac of Pasteur institute (WHO reference centre for bacterial mosquito pathogens) in Paris, who rated the mosquito larval toxicity of B-17 as '5 star'.

In the year 1982, the VCRC had applied to the Ministry of Environment for clearance to carry out field trials with *Bti* in the natural breeding habitats of mosquitoes. When this request for field trials was being processed by the Ministry of Environment, Dr. K. Balaraman was in Prague, Czechoslovakia as a WHO trainee in the Institute of Insect Pathology under Dr. J. Weiser. At that time, Dr. Kunthala Jayaraman, Professor of Molecular biology, Madurai Kamaraj University, who was also a member of the committee, brought to the notice of Prof. V. Ramalingaswami, DG, ICMR, that field release of *Bti* may affect non-target organisms such as silk worms and honey bees. The then, DG, ICMR, appointed Dr. L. N. Mohapatra, from Department of Microbiology, AIIMS, New Delhi to visit the VCRC (1982) and give recommendation on the issues raised by Dr. K. Jayaraman on *Bti*. He visited VCRC in 1982 and verified the records maintained in the laboratory. Shortly, a detailed report was on its way to DG, ICMR.

The report submitted by Dr. L. N. Mohapatra tipped the scales in favour of the field trials with *Bti* and soon, Dr. P. K. Rajagopalan wrote a letter to the DG, ICMR requesting him to obtain clearance from the Environmental Ministry again, and this time, the letter was reciprocated with the clearance to carry out field trials with *Bti* in natural breeding habitats of mosquitoes. The effect of *Bti* on honey bees and silk worms was investigated by Dr. P. Jambulingam and Dr. A. M. Manonmani at VCRC, and it was found that the concerns regarding the ill effects of *Bti* were baseless, as there were none.

Bti research soon became intense, but mass production of *Bti* was slow and tedious as it was done using petri dishes, due the lack of "Fermentor". But as the saying in Tamil goes, "vallavanukku pullum aayutham" (even a blade of grass is a weapon to the mighty), so did the Insect Pathology team; ingeniously found a way to overcome this obstacle, which could have stumped any elite team. The team converted a vertical autoclave into a fermentor with aeration facility but no agitation. At that time, luck knocked at the door of VCRC and fortune smiled on the team with the arrival of Dr A. Dubitskij, Secretary, Steering Committee of Biological Control of Vectors, WHO, Geneva. During his visit to VCRC, he was amazed to see the ramshackle fermentor and appreciated the scientific and technological skill of the team. And so, when a project proposal was submitted by the VCRC in the year 1983, he didn't hesitate to grant funds to buy a 20 L fermentor (Bioengineering, USA) in the Steering Committee.

However, further research on development, formulation and field evaluation of *Bti* would be possible with a 100 L fermentor. It was in the year 1987 that this grave need was met with, when Dr. P. K. Rajagopalan, who visited WHO Headquarters, Geneva to attend the Steering Committee received quotation for a 100 L fermentor. On his return to India, Dr. P. K. Rajagopalan went to the ICMR HQ in New Delhi, met the then DG, Prof. A. S. Paintal and obtained his approval for the purchase of the fermentor (M/S Bioengineering, USA) and also a cheque for Rs. 28 lakhs. It was truly a golden era because, one can imagine how many long-drawn processes and legal procedures one had to go through to purchase an expensive instrument with such a big sum (today the 100 L fermentor costs about 2.5 crores) in the times we live in now. Back then was a time when it was possible, with no time-consuming formalities.

Untiring research work by the team on *Bti* pushed technology to a new frontier and translated from lab to land. The new fermentor did wonders for VCRC. Research on *Bti* was on the fast lane, thanks to the simplified production technology. Years of research, innovation and the untiring efforts and dedication of the team finally paid off: *Bti* was tested against larvae of *Anopheles* and *Culex* breeding in different habitats in Nagapattinam, Vedaranyam, Pondicherry, Rameswaram, Malkangiri, Shertallai and in Bangalore. Almost all the Senior Scientists and many of the technical staff of ICMR- VCRC were part of the field evaluation.

Further, the VCRC's *Bti* water dispersible powder (WDP) formulation was sent for evaluation to

Professor Mir S. Mulla (USA), Dr. Bonepet Napompeth (Thailand) and to Dr. Lee (Malaysia), channelized by the Steering committee of Biological Control of Vectors (BCV/WHO/TDR) and the test reports were found to be highly encouraging.

Patenting of *Bti* (VCRC B17)

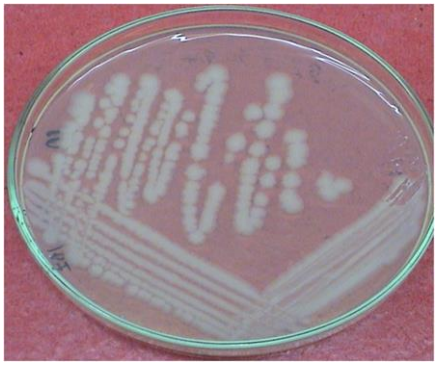
The team was enthused to move ahead with patenting not only by the readiness of *Bti* technology but also the efficacy of *Bti* proved by scientists in-house and overseas. Dr. Rajagopalan, always found directions for his Scientists to move forward and penned a letter to Prof. Ashok Parthasarathy, Secretary in the Department of Scientific and Industrial Research (DSIR) (who later served as Science and Technology Adviser to former Prime Minister Indira Gandhi for nearly 10 years) about VCRC's *Bti* technology. Prof. Parthasarathy then wrote to Mr. N. K. Sharma, Managing Director of National Research Development Corporation (NRDC), New Delhi to further the technology. Mr. N. K. Sharma responded to the letter by sending the NRDC officials Mr. R. S. Dayal and Mr. D. C. Joshi to VCRC. Detailed discussion on the technology were held and patent attorneys from Calcutta, L. S. Davar & Co were identified to draft the patent document. In the year 1989, the historical event of the patenting of the second technology of ICMR and first process technology of VCRC was done through NRDC. The first patent for VCRC, for *Bti* technology was granted in the year 1999.

The research team worked further to draft the "know-how package" for *Bti* and VCRC reached a milestone in *Bti* research by transferring the technology to Tuticorin Alkali Chemicals & Fertilizers Pvt. Ltd, Chennai, in the year 1998. For registering the formulation of *Bti* with the Central Insecticides Board (CIB), data was generated through multi-centric field test(s) with the assistance of ICMR-National Institute of Malaria Research (ICMR-NIMR), New Delhi.

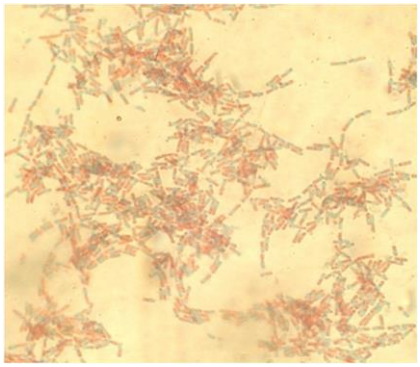
This story on *Bti*, unfurls the events that happened for over 4 decades in the world of the VCRC. Today, ICMR-VCRC holds the pride of licensing the Bti technology to 20 commercial firms. *Bti* of ICMR-VCRC will continue to play a significant role in the control of vector borne diseases in times to come.

Acknowledgements: I thank Dr. K. Balaraman, Dr. S. L. Hoti and Dr. A. M. Manonmani for making the story possible by walking down the memory lane and Dr. P. Jambulingam for critically editing the content.

Disclaimer: The contents of the article was narrated by Dr. K. Balaraman, Deputy Director (Sr. Gr) (Rtd.) one of the inventors of *Bti* technology and this story was developed based on the information given by him. Scientists involved in testing the efficacy of *Bti* were Dr.K. Gunasekaran, Dr. N. Pradeep Kumar, Dr. S. Sahu, Dr. S. Sabesan, Dr. N. Balakrishnan, Dr. M. Kalyanasundaram and Dr. N. Arunachalam.



VCRC B17 colony on agar medium



VCRC B17 smear stained by Schaeffer spore stain showing cells and spores

Fermenter

A brief note on the Mite and Tick research

P. Philip Samuel*, R. Govindarajan*, R. Krishnamoorthi# and A. Krishna Kumari#
*ICMR-VCRC FS Madurai and #ICMR-VCRC, Puducherry, India

Mites and ticks belong to the Order Acarina which is one of the seven Orders of the Class Arachnida, one of the largest Classes of the Phylum Arthropoda. Mites and ticks have worldwide distribution. The most obvious difference between mites and ticks are their sizes. Mites are microscopic creatures that are generally less than a millimetre and are difficult to see with naked eye. The ticks can be seen with the naked eye and are generally 1 millimeter long, but can expand up to 3 centimeter in length after feeding. Mites can feed on plants and animals while ticks live on animal hosts. Both mites and ticks transmit disease to their hosts.

Scrub typhus is a zoonotic disease, caused by *Orientia tsutsugamushi*, an obligate intracellular bacterium (Family: Rickettsiaceae) transmitted to humans by the bite of larval *Leptotrombidium* mite Chiggers. Humans are accidental hosts in this zoonotic disease. A project was initiated to record the occurrence of the Trombiculid vectors in Tamil Nadu and Kerala.

Entomological and rodent surveillance were undertaken in these scrub typhus affected areas. Sherman traps and wonder traps were placed in the study areas to capture rodents and shrews, found freely close to human habitats. In each area, 50 traps were set outdoors (peri-domestic areas) with scrubby vegetation and rodent burrows. Traps were set in the evening (6.00 pm) and retrieved in the next day morning (7.00 am). Rodents were anesthetized and the mites and ticks were harvested from the captured rodents/shrews. Ticks were collected by hand picking method from different animals present in a household. All the animals were thoroughly searched for the presence of ticks throughout the body like head, ear, face, shoulder, abdomen, leg, udder etc. The chigger mites and ticks collected from these animals were preserved in 80% ethanol, transferred to clearing agent and mounted in Hoyer's medium, examined under microscope and identified up to species level.

Collection details:

Survey conducted in Thiruvananthapuram district, Kerala, yielded a total of 19 species of mites and ticks comprising of 3 families namely Trombiculidae (18 species chiggers) and Ixodidae (1 tick species) which were recovered from 5 species of rodents/shrews in rural areas. Survey conducted in Vellore, Krishnagiri, Dharmapuri and Madurai districts of Tamil Nadu, showed rodents/shrews belonged to 2 Families, three sub families and 5 genera and 6 species. These animals carried 20 species of mites and ticks comprising of 18 species of trombiculid mites (18 species of chigger mites belonged to 3 Tribes, 6 Genera, 2 Subgenera) and 2 species of Ixodidae ticks classified under 1 Family, 2 Genera and 2 species. Ticks collection from Madurai recorded 15 species of ticks collected from 1224 domestic animals harboring 11 species of ticks from cow, 9 species of ticks from goat, 4 species of ticks from dogs, 3 species of ticks from cat and 1 species of tick from fowl

Table 1: Distribution of chigger mites and ticks recorded in the World (Peng et al 2016 & Alberto et al 2010), and in India (Fernandes & Kulkarni, 2003, Geevarghese and Mishra, 2011)

Specimens	World				India				Present study			
	Family	Sub family	Genera	Species	Family	Sub family	Genera	Species	Family	Sub family	Genera	Species
Chigger mites	1	3	33	3000	1	2	28	204	1	1	9	28
Ticks	3	0	17	773	2	0	9	85	1	0	5	15

Table 2: Species composition of chigger mites from rodents/shrews (2017-2018)

S. No	Name of the species	District	Total identified
1	*Leptotrombidium deliense*	1,2,3,4,5	721
2	*Leptotrombidium discrepans*	5	19
3	*Leptotrombidium rajesthanense*	1,3,4,5	9
4	*Leptotrombidium fulmentum*	5	13
5	*Leptotrombidium keukenschrijveri*	3	4
6	*Leptotrombidium indicum*	3,	96
7	*Leptotrombidium delimushi*	2,3,5	34
8	*Leptotrombidium insigne*	3,4,5	7
9	*Leptotrombidium kulkarni*	3,5	26
10	*Leptotrombidium spilleti*	3,5	41
11	*Leptotrombidium dehraduense*	2,3,5	33
12	*Leptotrombidium jayewickremei*	3	23
13	*Schoengastia kanhaensis*	1,3	3
14	*Schoengastiella argalea*	3	4
15	*Schoengastiella pracipua*	5	10
16	*Schoengastiella helata*	5	6
17	*Schoengastiella bengalensis*	5	8
18	*Schoengastiella ralagea*	5	12
19	*Schoengastiella ligula*	2,3,4,5	115
20	*Herpetacarus schlugeri*	4	92
21	*Microtrombicula kanjutekrii*	4	75
22	*Microtrombicula khurdagencosa*	4	31
23	*Ascoschoengastia indica*	2,3,5	43
24	*Trombicula hypodermata*	3,4,5	60
25	*Neotrombicula fujigmo*	5	12
26	*Neotrombicula microti*	5	7
27	*Neotrombicula sp.*	3	6
28	*Walchia rustica*	5	3

1-Dharmapuri, 2-Krishnagiri, 3-Vellore, 4-Madurai, 5, Thiruvananthapuram

Table 3: Species composition of ticks from different animals (2017-2018)

S.No	Name of the species	District	No. collected	Source of collection (Host)
1	*Amblyomma integrum*	4	14	cow
2	*Boophilus annulatus*	4	17	cow
3	*Boophilus decoloratus*	4	213	goat, cow
4	*Rhipicephalus sanguineus*	4	306	cat, goat, dog, cow, rodent
5	*Boophilus microplus*	4	273	Cat, goat, cow
6	*Haemophysalis turturis*	4	31	fowl
7	*Haemophysalis* (*Kaiseriana*) *spinigera*	4	16	goat, cow
8	*Hyalomma* (*Hyalomma*) *anatolicum*	4	12	goat
9	*Haemophysalis intermedia*	4	53	goat, dog, cow
10	*Rhipicephalus turanicus*	3,4	39	goat, dog, shrew
11	*Rhipicephalus haemaphysaloides*	4	9	cow
12	*Hyalomma* (*Delpyiella*) *brevipunctata*	4	11	cow
13	*Hyalomma* (*Delpyiella*) *kumari*	4,5	32	goat, dog, shrew
14	*Haemophysalis* (*Kaiseriana*) *bispinosa*	3,4	97	Cat, goat, cow, rodents, shrews
15	*Haemophysalis paraturturis*	4	9	cow

3-Vellore, 4-Madurai, 5, Thiruvananthapuram

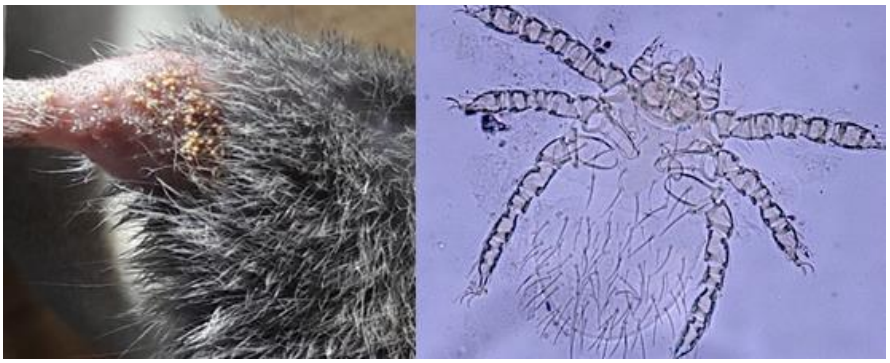


Figure 1: Trombiculidae chigger mites

Figure 2: Ixodidae ticks

Public health importance of ticks and mites

This collection showed the prevalence of medically important chigger mites like *Leptrombidium* (*Leptrombidium*) *delicense, Schoengastiella ligula (Scrub typhus)* and ticks *Amblyomma integrum* (Otoacariasis)*; Boophilus decoloratus & Rhipicephalus sanguineus* (Indian tick typhus); *Haemophysalis turturis & Haemophysalis spinigera* (Kyasanur Forest disease); *Hyalomma anatolicum* (Crimean-Congo haemorrhagic fever & Theileriosis); *Rhipicephalus turanicus & Haemophysalis intermedia* (*Coxiella* and *Rickettsia*); *Boophilus annulatus* & *Boophilus microplus* (Babesiosis) which denotes the potential risk for the transmission of the emerging zoonotic diseases. This study added to the existing knowledge on the mites and ticks from this area to formulate appropriate vector control measures by the public health authorities for the control of zoonotic diseases. IEC awareness campaigns are to be taken up to sensitize the public about these diseases. Different risks factors like epidemiological, behavioural and environmental risk factors pertaining to these areas need to be identified and appropriate measures should be taken up to sensitize the public. The current knowledge on mites and ticks load in these areas brings forth the main reasons for the sudden resurgence of the scrub typhus cases in many places. This study provides an invaluable data to pay proper attention to formulate appropriate vector control strategies by the public health authorities to control the acari-borne zoonotic diseases.

Need for addressing social determinants of health for sustained vector borne disease control.

A. Krishna Kumari
Senior Technical Officer, Epidemiology, Biostatistics & Operation Research, ICMR-VCRC, Puducherry, India

In India, VBDs have been a public issue for decades and have reached epidemic proportions and become a serious threat to the health and wellbeing of the population (Kapur, 2017). The Directorate of National Vector Borne Disease Control Programme (NVBDCP) is the Nodal agency for prevention and control of 6 major VBDs (malaria, lymphatic filariasis, leishmaniasis, dengue, chikungunya and Japanese encephalitis) in India (NVBDCP, 2020).

As per the epidemiological triangle concept, the host, vector and agent under the influence of environmental factors together are responsible for the cause and spread of communicable diseases (Gulis and Fujino, 2015). At present, the strategy adopted for VBD prevention/control is mainly directed towards the agent i.e. parasites and vectors (NVBDCP, 2020) in the form of vector management and disease management alongwith supportive measures such as Information Education and Communication (IEC) programmes (NVBDCP, 2020). However, the environment in which the host lives, and his/her socio-economic status and living conditions (social determinants) are also, important factors that determine the host's susceptibility to vector borne diseases (Karmali, 2016, Kapur, 2017, Degroote et al, 2018, Bardosh et al, 2018.

Realizing the importance of the social determinants, on the health of individuals and the communities, the WHO formed a Commission on the Social determinants of health (CSDH) in 2005, to find out the social causes of poor health and suggest solutions (WHO, 2020). The CSDH was set up by Dr JW Lee, the former Director-General of WHO in March 2005. The Commission gave its recommendations in 2008, which include, improvement of daily living conditions, tackling the inequitable distribution of power, money and resources, measurement and understanding the problems and assessment of the impact of action (WHO,2020).

The objective of this presentation was to highlight the importance of widening the scope of VBD control activities to target the environment and host factors (social determinants of health) also. This can be achieved through (1) Intersectoral collaboration with govt. /non govt. agencies (2) linking VBD control programmes with existing government welfare programmes for the poor such as employment generation programmes, housing schemes, programmes that provide basic civic amenities: such as toilets, water supply, electricity; nutrition, health care, etc. (3) raising awareness on rights of the people (4) mobilizing women's collectives (5) 'Swatchh Bharat' (6) and finally, involving the community in VBD control programmes. ICMR-VCRC, through its Technology Mission project for the control of Brugian filariasis in Shertallay taluk, Kerala, has demonstrated, that disease /vector control and economic gains to the community can be achieved together through innovative inter-sectoral collaborative programmes in partnership with different agencies like the departments of Agriculture, rural development and the National Bank for Agriculture and Rural Development (NABARD)(VCRC, 1992).

To conclude, though we often use the term Neglected Tropical Diseases, actually it is not the diseases that are neglected, but it is the neglected people, the weaker sections of the society, and neglected environment that is causing the diseases. Therefore, future efforts should be towards uplifting the poor and protecting the environment for a world free of vector borne diseases.

References

1 Kapur W (2017) Chaturvedi A (Ed) Policy gaps in prevention of vector borne diseases in India Cornell public review. September 6, 2017.Accessed from the website http://www.cornellpolicyreview.com/policy-gaps-prevention-vector-borne-diseases-india/ Accessed on 14.05.2020.

2 National vector borne disease control programme (NVBDCP) (2020) Accessed from the website https://nvbdcp.gov.in/index.php. Accessed on 15.5.2020.

3 Gulis, G., & Fujino, Y. (2015). Epidemiology, population health, and health impact assessment. *Journal of epidemiology*, *25*(3), 179–180. Accessed from the website https://doi.org/10.2188/jea.JE20140212.

4 National vector borne disease control programme (NVBDCP) (2020) Accessed from the website https://nvbdcp.gov.in/index.php. Accessed on 15.5.2020.

5 National vector borne disease control programme (NVBDCP) (2020) Accessed from the website https://nvbdcp.gov.in/index.php. Accessed on 15.5.2020.

6 Karmali M, Weinstock D. Introduction to emerging vector-borne disease and cities workshop proceedings. Can Comm Dis Rep 2016; 42:197. https://doi.org/10.14745/ccdr.v42i10a01.

7 Degroote, S., Zinszer, K., & Ridde, V. (2018). Interventions for vector-borne diseases focused on housing and hygiene in urban areas: a scoping review. Infectious diseases of poverty,7(1), 96. https://doi.org/10.1186/s40249-018-0477-5.

8 Bardosh KL, Ryan SJ, Ebi K, Welburn S, Singer B. Addressing vulnerability, building resilience: community-based adaptation to vector-borne diseases in the context of global change. Infect Dis Poverty. 2017 Dec 11;6(1):166. doi: 10.1186/s40249-017-0375-2. Erratum in: Infect Dis Poverty. 2018 Jan 30;7(1):5. PMID: 29228986; PMCID: PMC5725972.

9 WHO (2020) The Commission on Social Determinants of Health - what, why and how?

10 https://www.who.int/social_determinants/thecommission/finalreport/about_csdh/en/ Accessed on 15.5.2020

11 WHO (2020) The Commission on Social Determinants of Health - what, why and how? https://www.who.int/social_determinants/thecommission/finalreport/about_csdh/en/ Accessed on 15.5.2020.

12 Vector Control Research Centre (1992) Control of Brugian filariasis: A community approach. Misc. Publ. VCRC (19):1992.

ICMR-VCRC Mosquito Museum: A National Facility

R. Natarajan
Principal Technical Officer (Retd.), Mosquito Museum, ICMR-VCRC, Puducherry, India

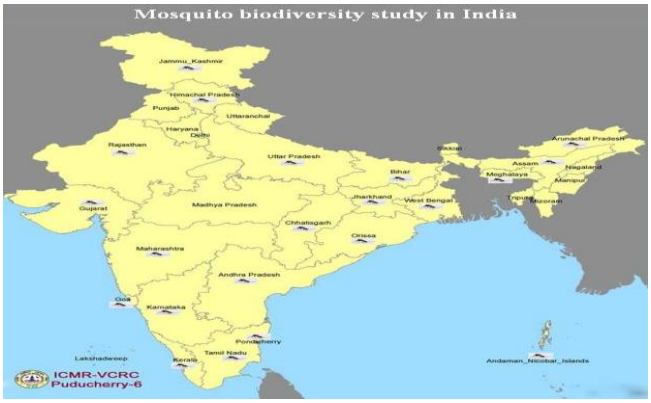
Information on mosquito biodiversity and species distribution in India is vital not only to monitor the dynamic relationship between the risk of transmission of various mosquito-borne diseases and human population, but also to design appropriate intervention measures to prevent the spread of the diseases, due to trade and transport. Museum specimens serve many purposes viz., verification/confirmation of species identifications, to extend the facilities to end-users like researchers and trainee and provide a database of geographical distribution of mosquitoes including vectors in a geographical area of a country.

The Vector Control Research Centre (ICMR), Puducherry established a Culicid biodiversity cell in the year 2000 with an aim to collect mosquitoes, identify, curate, catalogue, and deposit in the ICMR-VCRC mosquito museum. Since the establishment of mosquito museum, a periodic addition of species, updating of records and publications of the mosquito specimens in the museum has been an ongoing activity. Extensive collections were made in the different geographical regions including high altitude regions of the Western Himalayas, the Western Ghats, the Eastern Ghats, Coastal and other regions of India.

At present the museum has 22 genera comprising 312 species. The collection consists of a total of 43,388 adult specimens, of which 36,816 are individually mounted on insect minuten pins, while the rest are held in stock vials. It also includes 3979 male and female genitalia and 14,131 larvae, larval exuviae, and pupal exuviae mounted on microscope slides. Out of 312 species, 167 have been linked with their larval and pupal exuviae. Representative specimens collected from 20 states and 3 Union Territories are available for ready reference.

ICMR-VCRC Museum studies described 8 new species and 28 New records from the country. Of the above 312 species, 152 species of mosquitoes were DNA bar-coded and the sequences were deposited in the gene bank. The museum facility is being utilized by the Ph.D. scholars, students from both National and International Universities. The programme personnel from Central Health Services, State Health Services, NGOs and trainees are also availing the benefit of the Museum.

Faunistic surveys will be continued in the remaining areas of the country to augment the existing list of species of mosquitoes housed in VCRC Museum. DNA barcoding species shall be carried out. Revision and updating of taxonomic status of mosquito species of India shall be undertaken.



National Workshop for Entomological Capacity Building/Strengthening

A. N. Shriram
Scientist-C, Division of Vector Biology and Control, ICMR-VCRC, Puducherry, India

Vector Borne Disease (VBDs) go beyond geographical boundaries. India has a lot of common ground with respect to the presence of vectors and emerging arboviral pathogens, with the neighbouring countries of Asia. Over the last two decades, entomological strength, technical manpower and capacity has dwindled all over the country. As an interim measure, young graduates and postgraduates have been employed as consultants in different states. Being a highly technical profession, these untrained personnel need induction and refresher training to effectively discharge their duties as public health entomologists. Therefore, there is an urgent need of human resource development and capacity building in the country for the control and elimination of VBDs especially malaria, filariasis, dengue, chikungunya, KFD, leishmaniasis, scrub typhus and other emerging arboviral infections etc. Realizing this, the Society for Vector Ecology (SOVE, Indian Region), ICMR-Vector Control Research Centre (VCRC), National Academy of Vector Borne Diseases (NAVBD) and NVBDCP joined hands and organized a National workshop at VCRC Puducherry from 9-13 March 2020. This was customized for the programme needs and for updating knowledge and skills of the State Entomologists and Consultants, in an effort to strengthen our national capacity in order to meet the challenges of emerging VBDs.

The workshop was inaugurated on 9th March, 2020 by Dr P. K. Das, former Director of ICMR-Vector Control Research Centre. Dr Das also presented a workshop key note address. Dr T. Arun IAS, Collector of Puducherry, Dr. Mohan Kumar, Director of Health Services and Dr S. Ganesan, State Programme Officer NVBDCP also spoke on the occasion. Dr Kalpana Baruah, Joint Director NVBDCP spoke on the need for national capacity building and lauded this combined effort.

There were 16 sessions and four key note addresses between 9-13th March 2020. In all, there were 26 resource persons/faculty from different parts of the world who presented in person or remotely. During these sessions, 24 lectures covering Lymphatic Filariasis (LF), malaria, arboviral infections, scrub typhus, Kyasanur Forest Disease (KFD) and visceral leishmaniasis were delivered by eminent faculties of national and international repute.

Altogether 10 hands-on practical training sessions were conducted by VCRC Scientists and Technical Officers. There were also three remote presentations from the World Health Organization (WHO), Geneva by Dr Raman Velayudhan and Dr Rajpal S. Yadav. Dr Norbert Becker, from German Vector Control Association, University of Heidelberg, Germany also made presentation remotely.

Besides, there were four sponsors' lectures on different vector control products and appliances. A total of 22 Entomologists hailing from different states and union territories of India and two students from the Department of Epidemiology and Public Health, Central University of Tamil Nadu (CUTN), Tiruvarur, Tamil Nadu attended the workshop. The participants also went on to field ecology trip during the workshop.There were simple yogic exercises conducted between the sessions to make learning comfortable and pleasurable.

The valedictory function of the workshop was held on 13th March, 2020. Prof. A. P. Dash, Vice Chancellor of Central University, Tamil Nadu was the Chief Guest. Certificates were distributed to the participants of the workshop on this occasion. The performance of the trainees was assessed by comparing their performance before and after the workshop by conducting Pre and Post-tests. Participants' feedback was taken for improvements in the future training courses.

Inauguration: **Lighting the lamp**
L-R: Dr P K Das, Chief Guest, Dr Ashwani Kumar, Director VCRC, Dr Steve Mulligan, Vice-President, SOVE, Dr T Arun Kumar Collector, Dr Mohan Kumar, Director Health Services, Puducherry, Dr Kalpana Baruah, Joint Director, NVBDCP & Dr Nisha Mathew, Scientist F, VCRC

Inaugural Key Note Address: Dr P K Das
Environment and Vector Borne Diseases: Challenges

Dr S Subramanian delivering lecture in one of the sessions

Hands on Training to Entomologists

Trainees and Resource Persons
Sitting: L-R: A. N. Shriram, C. Sadanandane, Kalpana Baruah, S. Sabesan, M. Kalyanasundaram, Ashwani Kumar, P K Das, Steve Mulligan, Susan Mulligan, K Gunasekaran, K Krishnamoorthy and S. Subramanian Standing: L-R H K Raju and trainees

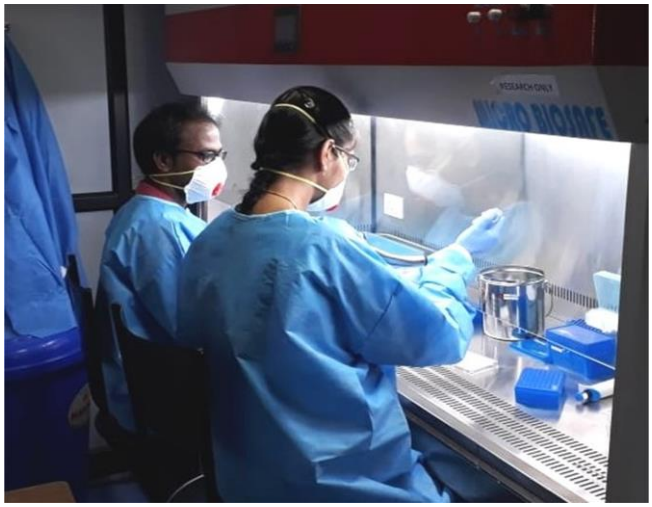
Valedictory Function
Chief Guest Prof A P Dash, Vice Chancellor, Central University of Tamil Nadu, Tiruvarur delivering the Valedictory Address

Proud VCRC-COVID-19 Warriors

Indian Council of Medical Research, New Delhi, in collaboration with Dept. of Health and Family Welfare conducted a community based sero-survey to estimate the prevalence of SARS-CoV-2 infection in India. The survey was coordinated by ICMR's National Institute of Epidemiology (NIE) and National Institute of Research in Tuberculosis (NIRT), Chennai. The survey was conducted in randomly selected 71 districts from 21 states covering 28,400 adults by collecting venous blood samples. The prevalence was estimated by testing the sera samples for the presence of Anti SARS CoV-2 IgG antibodies using the ELISA kit developed by ICMR-National Institute of Virology and manufactured by Zydus Cadila. To expedite the process of testing, at the request of Director of ICMR-NIE, a team of technical staff were deputed at NIRT, Chennai for 6 days by the Director ICMR-VCRC. The team comprised of 6 technical staff (Ms. T. Sankari, Technical officer-C, Mr. S. Muthukumaravel, Technical Officer - B, Mr. A. Sakthivel, Technician -II, Ms. S. Vaishnavi, Technician -II, Ms J. Esther Nirmala Mary Technician-II, Ms V. Shakila, Technician-I) who expressed their readiness and interest to work despite the risks involved in COVID-19 hotspot area. Our team ICMR-VCRC reached NIRT, Chennai on 25th May 2020. We set up the laboratory with spectrophotometer, plate washer and other consumables to perform the assay for the detection of SARS-CoV-2 specific IgG antibodies. Altogether, 2192 samples were processed. The results were analysed, consolidated and sent to the co-ordinator, NIRT on daily basis. The task was accomplished with the team effort all the way and the team ICMR-VCRC is proud to be part of the national COVID-19 sero-survey. VCRC is proud of our corona warriors and salute their spirit.

ICMR-VCRC Team for COVID-19 Sero-Survey sample testing

Processing of samples for the detection of SARS-CoV-2 specific IgG Antibodies



Biosafety safety Level-2 cabinets are used for addition of sera samples in the SARS-CoV-2 virus antigen coated micro titre plate.

Human Resource Development Unit
V. Vasuki
Scientist-E, ICMR-VCRC, Puducherry, India

Observation of 'Swachhta Pakhwada'

As per communication received from the MHRD Education, Puducherry for observation of 'Swachhta Pakhwada', 2020, on 16.01.2020, first and second year students of M.Sc. Public Health Entomology course of ICMR-VCRC took 'Swachhta' pledge that they are concerned about the earth and our nature, will keep the premises clean, conserve water, make the environment plastic free and grow trees to provide O_2. A plantation, cleanliness and water conservation drive were held in the institute premises in which all students actively participated from 17.01.2020 to 31.01.2020

Swachhta Pledge, Plantation of saplings

Celebration of 'MATRIBHASHA DIWAS'

As per the communication received from MHRD vide UGC lr. D.O.No.F.14-5/2018(CPP-II) dated 14.02.2020 for celebration of '**MATRIBHASHA DIWAS'** the International Mother Language Day was celebrated on 21.02.2020 to promote the dissemination of mother tongue, to create awareness of linguistic and cultural traditions throughout the world and to inspire solidarity based understanding, tolerance and dialogue among the students by conducting various activities like Elocution, Singing, Essay Writing etc.

'Swachhta' Pledge by M.Sc. Public Health Entomology students

Plantation of sapling by M.Sc. PHE students during 'Swachhta Pakhwada'

Awarded gold medal for getting 1st rank in MSc PHE

Mr. Mohamad Nihad, MSc. PHE student (2017-19 batch) being the 1st rank holder at University level received Gold Medal from our honourable Vice-President of India, Shri Venkaiah Naidu at Pondicherry University on 25th Feb. 2020.

The following 6 students were awarded Ph.D. during the convocation

Sl. No	NAME	DEPARTMENT
1	Ms. K. Patricia Anitha	Microbiology
2	Mr. K. Shankar	Microbiology
3	Mr. P. Aarumugam	Zoology
4	Mr. M. Selvakumar	Zoology
5	Mr. C. Mani	Zoology
6	Mr. N. Velayudham	Zoology

Gold medal award receiving by Mr. Mohamad Nihad from Hon. Vice -President of India.

Elocution competition among M.Sc. PHE students on the occasion of 'Matribhasha Diwas'

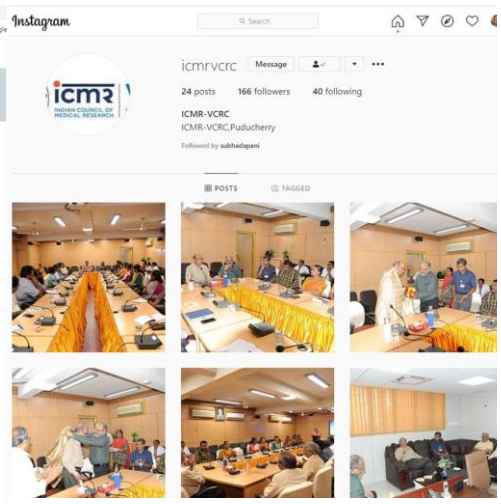
Communication Unit Activities at the VCRC for Social Media

Nisha Mathew & Y. Srinivas Murty
ICMR-VCRC, Puducherry, India

Communication unit initiated by ICMR to cover various institute activities of scientific/workshops/seminars at social media platforms such as Facebook, Twitter & Instagram. The following posters were shared in social media by the Communication unit of ICMR-VCRC. Puducherry.

https://www.facebook.com/ICMR-Vector-Control-Research-Centre-Puducherry

https://twitter.com/ICMRVCRC



https://www.instagram.com/icmrvcrc

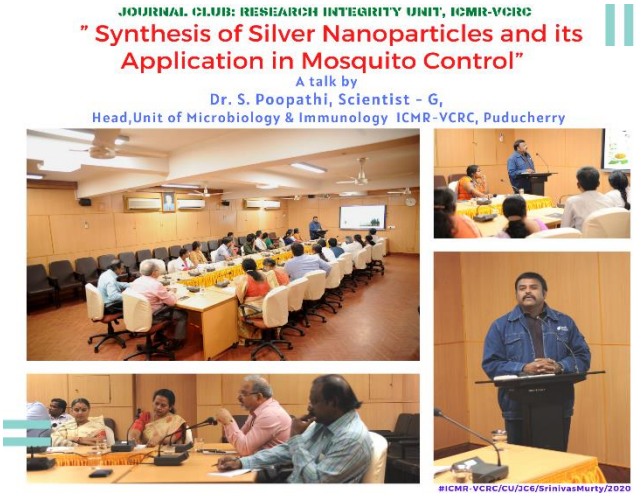
Journal Club Meetings under (Research Integrity Unit)

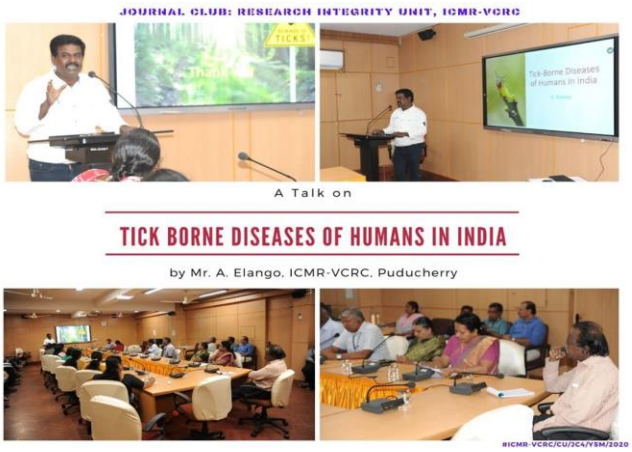
1. Guest Lectures by Eminent Scientists

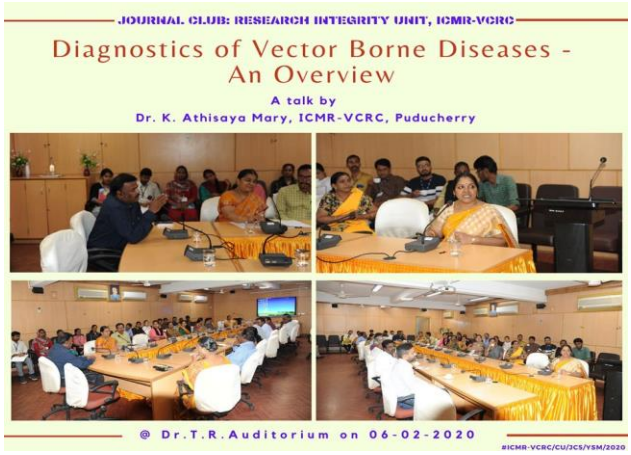
ICMR-VCRC, Puducherry started Journal club meeting under Research Integrity Unit, by inviting expert scientists from outside VCRC for guest lectures. Dr. T. S. Keshav Prasad, Professor, Centre for Systems Biology & Molecular Medicine, Yennepoya University, Mangaluru presented talk on “Proteogenomics”. On invitation to VCRC on 02.01.2020, Prof. Partha. P. Majumder, President of Indian Academy of Sciences & Prof. at National Institute of Biomedical Genomics & Prof. at Indian Statistical Institute, Kolkata delivered a Lecture on “Genomics; What’s all this Excitement?”, Dr. P. K. Pathanjali, Scientist H (Retd.) from Institute of Pesticide formulation Technology presented talk on “ Pesticide formulations Overview: Past practices, recent developments & future trends” and interacted with the Scientists and students of the ICMR-VCRC.

2. Lectures by ICMR-VCRC Scientists and Technical Officers

The VCRC journal club organizes lectures by the VCRC scientists and Technical officers twice a month. Dr. Ashwani Kumar, Director, presented inaugural lecture titled 'Surveillance based estimation of burden of malaria in India', Dr. S. Poopathi, Scientist- G, VCRC delivered a lecture on 'Synthesis of Silver Nanoparticles and it application in Mosquito control', Mr. A. Elango, Principal Technical Officer presented a talk on Tick borne diseases of Humans in India. Dr. K. Athisaya Mary, Senior Technical officer delivered a talk on 'Diagnostics of vector borne disease – An overviews'. Dr. Krishna Kumari presented lectures on 'Need for addressing social determinants of health for sustained vector borne disease control'.







3. Guest Lectures outside ICMR-VCRC

Dr. Ashwani Kumar delivered a talk on 'Role of ICMR-VCRC in shaping policies on Vector Borne Disease Control in India' at National symposium on Multilateral Initiatives Againt Arboviral Disease (NSAD-2020) at Udaipur (Rajasthan), 4-6 Januaruy 2020.

'Swachh Bharat Abhiyan'

'Swacchata Pakhwada' was started with a vision to mainstream 'swacchata' activities across Instituitions. The programme was enthusiatcally implementation in ICMR-VCRC, Puducherry. The staff and students of M.Sc. Public Health Entomology participated in the tree plantation drive in the campus and generated awareness on creating useful items out of waste materials in the sorrounding and cleanliness drive in the campus and village activities – 'Say no to plastics', etc.

Republic Day Celebrations Director, Dr. Ashwani Kumar hoisted National Flag on 71st Republic Day of India at ICMR-VCRC, Puducherry and addressing the gathering of officials, staffs and their family members, he emphasized the importance of

Republic day in the India context and remembered on this occasion our national heroes & freedom fighters, who sacrificed their lives to give us a republic. Later Dr. Kumar dwelt upon the achivement's of the ICMR-VCRC and presented Award to Mrs Vijayalaxmi, Staff Nurse for rendering selfless services.

International Women's Day Celebrations

International women's day celebration was held on 6th March 2020 with the theme "I am for generation equality: Realizing women's rights". The event was celebrated with enthusiasm, involvement and cooperation of the women and, particularly men staff of our Centre at the Head quarters and Field Stations at Kottayam, Kerala; Koraput, Odisha and Madurai, Tamil Nadu. The Chief Guest of this occasion, Dr. Swaramya, Laprascopic Surgeon, New Medical Centre, Puducherry, delivered a talk on "Woman's Health is Family's Health, leading to National Health" a topic very much relevant to the occasion. As a part of welfare measure to our women employees of ICMR-VCRC, Dr. Sankardevi, Senior Gynecologist (Retd), Maternity Hospital, Puducherry, gave a detailed presentation on the "Health issues of a woman: from menarche to menopause". She also interacted with the women on particular issues related to their health and the health problems due to stress in the working places. Competitions were held for the staff and the students for indoor games (carom, chess) outdoor game (Badminton) and Rangoli (Kolam Potti). Competition on cooking without fire was held for both men and women staff and students. Prizes were distributed to the Runner up and winners of the various competitions. Self Defence for women was demonstrated by Silambam Expert Mr. Mariselvam, with the assistance of M.Sc. Public Health Entomlogy students to protect women at the time of physical/sexual assault in the working places and outside the work premises.

Former DG, ICMR – Dr. V.M.Katoch visited the ICMR-VCRC

An informal home coming visit of Former Secretary DHR and DG, ICMR, Dr. V.M. Katoch on 09.01.2020 brought joy to the ICMR-VCRC. He was greeted by the Director and the staff. Dr. Katoch greeted all the old collegues and addressed the gathering of officials and staff and encouraged

all staff members to devleop scientific temper to set and achieve high targets towards elimination of vector bone diseases and lauded the achievements of ICMR-VCRC.

Dr. Ashwani Kumar welcoming the Dr. V. M. Katoch (Above) and Inaugrating the Rally on Sidha Day (Below)

A rally on the occation of Sidha Day celebration was organised by Central Council for Reseach in Sidha, Puducherry on .09.01.2020, where Chief Guest Director, Dr. Ashwani Kumar flagged the Rally.

Superannuation On successful completion of service, Shri B. Kumerson, Senior Technician III retired from active service on 30th April 2020. Director lauded Shri B. Kumerson's dedication and contribution to the institute which he termed as exemplary and praiseworthy. Director and Staff wished him a happy post-retirement life.

Events at the Centre

Sl.no	Date	Event	Section/Scientist
01	01.01.2020	Director Addressed all the staff on New Year	Dr. Ashwani Kumar
02	02.01.2020-03.02.2020	A Talk on 'Genomics: What's all this excitement?' By Prof. Partha P. Majumdar, President of Indian Academy of Science, Professor and founder Director of DBT-National Institute of Biomedical Genomics, Professor of Indian Statistical Institute, Kolkatta	Prof. Partha. P. Majumdar
03	04.01.2020-06.01.2020	'Role of VCRC in shaping policies on VBDs in India' at National Symposium on 'Multilateral Initiatives against Arboviral diseases (NASD-2020)' at Udaipur, Rajasthan, organised by Laboratory of Public Health Entomology, Dept. of Zoology, University College of Science, Mohanlal Sukhadia University	Dr. Ashwani Kumar
04	09.01.2020	Director, VCRC flagged a Rally on the occasion of 'Sidha Day' organised by Central Council for Research in Sidha, Puducherry	Dr. Ashwani Kumar
05	09.01.2020	Dr. V. M. Katoch former DG, ICMR visited ICMR-VCRC and addressed the staff	
06	16.01.2020	'Swechhta' pledge on 'Swacchta Pakhwada' by M. Sc. Public Health Entomology students	HRD
07	17.01.2020	Plantation of sapling around VCRC campus by M. Sc. PHE students during 'Swacchta Pakhwada'	HRD
08	21.01.2020	Cleanliness drive at the campus by M. Sc. PHE students during 'Swacchta Pakhwada'	HRD
09	26.01.2020	Republic day celebration at ICMR-VCRC campus	Dr. Ashwani Kumar & ICMR-VCRC staff
10	27.01.2020	Competition 'Out of waste' creating useful items out of waste materials in the surroundings by M.Sc. PHE students for 'Swacchta pakhwada'	Dr. V. Vasuky, HRD
11	29.01.2020	A talk by Mr. A. Elango on Tick Borne Diseases of Human in India for Journal club meeting (Research Integrity Unit), ICMR-VCRC	Mr. A. Elango
12	30.01.2020	Tree Plantation drive at ICMR-VCRC campus by Director Dr. Ashwani Kumar as part of 'Swatchh Bharat Abhiyan'	Hygiene Committee Dr. B. Nanda
13	04.02.2020	Institutional Animal Ethics Committee meeting held at Dr. T. R. Rao auditorium	IAEC, Dr. Panneer
14	05.02.2020	Institutional Human Ethics Committee meeting held at Dr. T. R. Rao auditorium	IHEC, Dr. Nisha Mathew
15	06.02.2020	A talk by Dr. Athisaya Mary on topic: 'Diagnostic of Vector Borne Diseases- An overview' at the ICMR-VCRC for Journal Club Meeting (Research Integrity Unit)	Dr. Athisaya Mary
16	13.02.2020	Dental-Eye camp held for VCRC staff organised by Apollo Dental care, Blood test of staff by Dr. Mohan Diabetes and Eye check up by Dr. Agarwal Eye, Puducherry	Hygiene Committee
17	13.02.2020	Expert visit to ICMR-VCRC for review of Wolbachia project	Dr. D A Gadkari Dr. Sarala K Subba Rao
18	19.2.2020	A talk by Dr. P.K. Pathanjali, Scientist H, IIFT, Gurgaon on the topic 'Pesticide formulation overview: Past practices, recent developments & future trends' in a Journal club meeting (Research Integrity Unit), ICMR-VCRC	Dr. P. K. Pathanjali
19	24.2.2020	Tree Plantation drive at various schools of Puducherry as a part of 'Swatchh Bharat Abhiyan'	Hygiene Committee Dr. B. Nanda
20	03.3.2020	A talk by Dr. S. Poopathi on the topic 'Synthesis of silver nano particles and its application in Mosquito control' for Journal club meeting (Research Integrity Unit), ICMR-VCRC.	Dr. S. Poopathi
21	05-06-03.2020	Workshop on "Gender Sensitization and Sexual Harassment of Women at Workplace" held at Dr. Ambedkar Institute of Productivity (AIP), National Productivity Council (NPC), Chennai. Tamil Nadu.	Dr. K. Athisaya Mary, & Mrs. D. Indumathi
22	09.03.2020-13.03.2020	SOVE workshop - National Workshop for Entomological Capacity Building / Strengthening	Entomologists from different states of India (24)
23	31.03.2020	COVID-19 surveillance and support meeting held at Directorate of Health Services, Puducherry	Dr. Ashwani Kumar
24	25.05.2020	ICMR-VCRC technical staff visited NIRT, Chennai to set up the laboratory to perform the assay for the detection of SARS-CoV-2 specific IgG antibodies in coordination with NIRT.	
25	26.05.2020	Institutional Human Ethics Committee meeting held at Dr. T. R. Rao auditorium	IHEC, Dr. Nisha Mathew
26	24.06.2020	Institutional Animal Ethics Committee meeting held at Dr. T. R. Rao auditorium	IAEC, Dr. Panner

Ownership and other issues of the Vector newsletter abide by the Rule 8 of the Newsletter Registration (Central) Rules, 1965.

Form IV

See Rule 8

Place of publication	:	ICMR-Vector Control Research Centre Indira Nagar, Medical complex, Puducherry – 605006
Periodicity of publication	:	Half yearly (June & December)
Name of the publisher & editor	:	Dr. Ashwani Kumar
Nationality	:	Indian
Address	:	ICMR-Vector Control Research Centre Indira Nagar, Medical complex, Puducherry – 605006
Name and address of the owner who own the newsletter owner holding more than one per cent of the total capital	:	ICMR-Vector Control Research Centre Indira Nagar, Medical complex, Puducherry – 605006
Email address	:	director.vcrc@icmr.gov.in
Website	:	www.vcrc.icmr.org.in

I, Dr. Ashwani Kumar , hereby declare that the particulars given above are true to the best of my knowledge and belief.

Date:

Ashwani Kumar
Signature of the Publisher