ICMR-NICED

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राष्ट्रीय कॉलरा और आंत्र रोग संस्थान
(भारतीय आयुर्विज्ञान अनुसंधान परिषद्)

ICMR-National Institute of Cholera and Enteric Diseases
(Indian Council of Medical Research)

WHO Collaborating Centre for Research and Training on Diarrhoeal Diseases

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The scientific content of this report belongs to the individual scientist and does not reflect the view of editorial team.

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FROM THE DIRECTOR'S DESK

The Indian Council of Medical Research-National Institute of Cholera and Enteric Diseases (ICMR-NICED) is a premier research organization in the country and has been contributed immensely in the field of enteric disease research. Apart from enteric disease research, the institute has also expanded its research activities to address important public health issues like impact of changing climatic factors on waterborne diseases, emerging multidrug resistance, surveillance of respiratory viruses, diagnosis of emerging viral infectious agents, and programmatic implementation of community-based studies in an attempt to resolve the socio-behavioral determinants associated with HIV at different states of Eastern India. The institute continues its active contribution to support State Health Department through the implementation of community outreach programs, undertaking evidence based research, and striving to promote translational research.

ICMR-NICED has immensely contributed in strengthening the health research capacity at the national level by holding regular workshops through the Divisions of Epidemiology and Data Management, Bioinformatics, HIV/NACO program, and regional VRDL program. The institute has partnered in organizing two international conferences this year: the 14th Asian Conference on Diarrheal Diseases (ASCODD) held at Kochi on 30 Oct to 1 Nov 2017 and the International Conference on Antimicrobial Resistance at ICMR-NICED on 16-17 Feb 2018. Moreover, human resource development was undertaken by NICED through pre and post-doctoral programs, short term training/internship programs of postgraduate students, seminars/workshops for health workers, for technical personnel, academicians, undergraduate/ post graduate students, community outreach programs for school students, common people etc. Last year, ICMR-NICED has recruitment of a total of five new scientists with expertise in research on traditional medicine, immunology, clinical epidemiology, biostatistics and bioinformatics, and electron microscopy to augment the ongoing research and training activities of the institute. Involvement in community awareness generation through activities under the Swachh Bharat campaign, activities in the DST's India International Science Festival, and participation in national science fairs and exhibition has been part of the workflow at ICMR-NICED.

ICMR-NICED is committed for rationalizing data systems and several projects have been initiated in the year where reports have been deployed by online data entry, remote data capturing and online data sharing systems. Further, a data sharing portal has been developed for the dissemination of the clinical and microbiological data from the ongoing diarrheal disease surveillance being conducted at NICED over the past two decades.

Investigations at ICMR-NICED have leveraged knowledge of traditional medicines for identifying active compounds from herbal preparations against enteric pathogens. Ellagic acid was shown to be effective against *H. pylori* in an animal model; the results of this study received wide media coverage. Investigations on the effectiveness of capsaicin against Shigella and Shorea robusta against multi-drug resistant wild isolates of *Salmonella* Typhi and mouse virulent *S.* Typhimurium infections have shown promising results.

The trove of evidences generated by the basic and operational research conducted at ICMR-NICED has resulted in impactful policy directions. Based on the current understanding of the gaps and determinants of diarrheal disease occurrence, a mission mode project has been conceptualized, with the aim to reduce the burden of diarrhea in under five children by deploying multi-pronged interventions. A systematic review of peer-reviewed evidence led to the development of a policy brief on the options for programmatic

implementation of Oral Cholera Vaccine in India. Subsequently, evidence on the burden of cholera in India and the lessons learnt from global implementation of OCVs were presented in the NTAGI meeting to facilitate the policy discussion on OCV operationalization. Additionally, field studies assessing the burden of soil transmitted helminthes (STH) have advised the program implementation of MDA in several states including North Eastern States of India.

ICMR-NICED has responded to calls for strengthening public health program implementation through research by undertaking targeted, time-bound projects to address critical evidence needs. ICMR-NICED has been at the forefront of addressing public health priorities through innovations populating the pipelines of new products for therapeutics, diagnostics, or interventions (vaccines). Three patents have been granted based on the work conducted by the scientists of ICMR-NICED: 1) Multi-serotype outer membrane vesicle (momv) of Shigellae as a novel candidate vaccine; alginate chitosan nano formulations of OmpA for Shigella subunit vaccine; 2)novel *Salmonella* Typhi protein as subunit vaccine; 3)novel pro-apoptotic peptide to kill tumor cells'. The research work complements ICMR-NICED's focus on studying mechanisms of AMR in neonatal sepsis, developing herbal formulations with antimicrobial activities against MDR enteric bacteria, developing new and improved vaccines effective against enteric pathogens and new Point of Care tests for improved diagnosis. ICMR-NICED has focused research on several public health priorities of national significance, like: enteric diseases including cholera, shigellosis, enteric fever; hepatitis B, C, D, E; dengue, chikungunya and acute encephalitis; HIV/AIDS, influenza, and Antimicrobial resistance. Additionally, the scientists and staff of the institute have responded to calls for preparedness against and investigation of outbreaks of Asian influenza in Chittoor district, Andhra Pradesh as members of central Rapid Response Teams (RRTs). The scientists published 55 articles in peer-reviewed journals in the past year, with an average Impact Factor of 3.98, is testimony of the quality of the scientific work being carried out at ICMR-NICED. I would like to acknowledge the extramural funds received from several national and international agencies, which provided us opportunities to address the national needs and goals. Dr. Dutta was conferred with the fellowship of West Bengal Academy of Science and Technology 2017 for her scientific contribution.

The support and cooperation of the scientists, technical personnel, and administrative staff of the institute need special mention. My heartfelt thanks go out to one and all, associated with the institute, for being part of a great team, and for upholding the commitment of this institute to serve for the greater interest of the nation.

Finally last but not the least, I have to mention that ICMR-NICED has been privileged to enjoy the unstinted support of the ICMR Headquarters, New Delhi, without which it would have been impossible to undertake the gamut of activities at the institute. I gratefully acknowledge the support of the DG, ICMR; chief, ECD, ICMR; Program Officer, ICMR and all other staff throughout the year.

Dr. Shanta Dutta

Director & Scientist-G

CONTENTS

RESEARCH ACTIVITIES

BACTERIOLOGY

The Division of Bacteriology has created a benchmark in the field of diarrhoeal disease research by providing laboratory and diagnostic support in epidemiological investigation of diarrhoeal disease outbreaks across all districts of West Bengal and different parts of India. Additionally, this division is also involved in hospital based disease surveillance of diarrhoea cases in and around Kolkata, and in monitoring the "water quality" of potable water sources across all diarrhoea inflicted areas of West Bengal. The reports generated through the surveillance are regularly shared with the concerned hospitals and State Health authorities for adopting better control and preventive strategies to combat diarrhoea in the population.

Enteric fever, caused by *Salmonella enterica* serotype Typhi (*S.* Typhi) and *Salmonella* enterica serotype Paratyphi (S. Paratyphi A), still remains one of major infectious diseases of public health importance affecting pediatric age population of developing nations. Global emergence of fluoroquinolone (FQ) resistance in *Salmonella* typhi (*S.* typhi) has complicated the treatment of typhoid fever patients. Widespread usage of FQs has major influences in reshaping the *S.* typhi resistance patterns. Majority of the isolates were resistant to nalidixic acid (Na^R) associated with Decreased Ciprofloxacin Susceptibility (DCS) (97.6% for *S.* Typhi and 98.4% for S. Paratyphi A).Ciprofloxacin resistance was found in 25.4% of *S.* Typhi strains.Three relapse cases were reported out of 107 hospital-attending typhoid cases. All of them were treated with ceftriaxone (CRO) injection for 7-14 days during the first episode of typhoid fever, which was really alarming. Gradual increase in genetic diversity of ciprofloxacin resistant *S.* typhi isolates was noticed by pulse-field gel electrophoresis (PFGE) and majority of the isolates belonged to the haplotype H58. Information on circulating pulsotypes of ciprofloxacin resistant *S.* typhi with prevalent H58 haplotype is important in containment of deadly organism.

Vaccine Research focuses on the development of novel vaccine candidates against enteric pathogenic bacteria like *Vibrio cholerae*, *Shigella sp.*, *Salmonella sp.*, *Escherichia coli* and *Camplylobacter sp.* for humans as well as livestock. Identification of a number of potential vaccine candidates like outer membrane vesicle based, heat killed bacteria, live attenuated bacteria, chitosan-alginate nanoparticle has been successfully developed and their performance was under evaluation.

Exploration of new arenas of research that encompassed development of non-dairy yogurts from edible quality oil seed flours which was followed by studies on their effect on diarrhoea and hypercholesterolemia. Subsequent processing and level of non-dairy yogurt preparation, including the role of functional food formulation is underway.The ultimate goal of the programme is to develop a combination of single Vaccine Candidate and food based therapy against diarrhoeal diseases.

Our division has focused on studying the mechanism of fluroquinolone resistance in the non-fermenting organism *Acinetobacter*. *Acinetobacter* is a complex genus and the multiple species within the genus exhibits differences both in their capability to cause disease and also in their mechanism of resistance to antimicrobials. Both chromosomal mutations and expression of efflux pumps were responsible for fluroquinolone resistance but there were significant differences in these two mechanisms for *A. baumannii* and nonbaumannii isolates.

Nutrient dependent preferential involvement of specific metabolic pathway provides best fitness to *Vibrio cholerae*, cholera causing bacteria, for its environmental persistence and survival in human intestinal milieu. Close link has been established between functional Entner-Doudoroff pathway and regulation of expression of virulence factors by *V. cholerae*.

We have reported the emergence and dissemination of polymyxin B sensitive *Vibrio cholerae* strains and harbouring Haitian variant traits in different parts of India. This is an important milestone in the history of cholera after 1961 when El Tor *Vibrios* first appeared. The study has established that *V. cholerae* O1 strains are modifying their genetic as well as phenotypic attributes probably to achieve better survival adaptability to the environment in combination with high virulence. So, an active holistic surveillance is required to track the mode of distribution of currently circulating polymyxin B sensitive *V. cholerae* O1 strains in different endemic population to elucidate their clinical and epidemiological significance.

Because of the rise in antimicrobial resistance, an inexpensive, diet-based treatment against *Helicobacter pylori* infection would be of great interest. Recent study paves the way for the preventive and therapeutic use of ellagic acid against *H. pylori* infection and, thus, ellagic acid can be considered a promising antibacterial agent against *H. pylori*-associated gastroduodenal diseases in the humans.

The division is involved in studying the complex relationship between the climate change, precipitation and temperature driven transmission of water borne diseases. The study bears significant translational implications since seasonality, water sources, type of water supply and specific type of microorganisms have a cumulative effect on the human health. The long term findings will not only serve as an evidence for the rapid and inevitable changing climate but will also help analyse the climatic markers to forewarn any impending diarrheal outbreaks, thus reducing the vulnerabilities to human health. We are striving towards unravelling the complex relationship between climate, environment, entero-pathogens and health. Through the ongoing projects in our laboratory, we hope to achieve knowledge, to analyse the climatic markers across different geographical regions, which when translated will directly benefit community life.

Scientists:

Dr. S. Dutta, Scientist G and Director
Dr. A. Palit, Scientist G
Dr. R. K. Nandy, Scientist F
Dr. A. K. Mukhopadhyay, Scientist E
Dr. S. Basu, Scientist E
Dr. H. Koley, Scientist E

Staff

Mr. S. K. Bhowmik, Sr. Technical Officer (2) (till 30.11.2017)
Mr. J. Kharwar, Technical Officer A.
Mr. A. K. Mondal, Technical Officer A
Mr. S. R. Ghosh, Technical Officer A.
Mr. A. Ganai, Technical Officer
Mr. T. Barman, Technical Officer
Mr. S. De, Technical Assistant.
Ms. M. Das, Technician (2)
Mr. R. Balmiki, Technician-C
Mr. M. L. Gupta, Technician-B
Mr. P. Samanta, Laboratory Assistant.
Mr. S. Dey, MTS (General) (he is also assigned to work at Laboratory of Dr. S Dutta, Director & Scientist G and GTPR facility)

Post Doctoral Fellows

Dr. Goutam Chowdhury, (OUP)
Dr. Abhijit Sarkar, (OUP)
Dr. Soma Mitra, (ICMR-PDF)
Dr. Subhasree Roy, (ICMR- RA)
Dr. Raghwan, (NASI)
Dr. Samadrita Sengupta, (ICMR-PDF)

Pre- Doctoral Fellows

Mr. Arindam Naha, (ICMR-SRF)
Ms. Piyali Mukherjee, (ICMR-SRF)
Ms. Somdutta Chatterjee, Ph.D. Thesis Submitted
Mr. Subham Mookerjee, (CSIR-SRF), Ph.D. Thesis Submitted
Ms. Priyasarshini Mukherjee, (UGC-SRF)
Mr. Bipul Chandra Karmakar (DST-SRF)
Mr. Prasenjit Samanta, (CSIR-SRF)
Mr. Debaki Ranjan Howlader, (CSIR-SRF)
Mr. Sounak Sarkar, (Project-SRF)
Ms. Shravani Mitra, (CSIR-SRF)
Ms. Ushasi Bhaumik, (DST-JRF)
Mr. Suhrid Maiti, (Project- JRF)
Mr. Vivek Mondal, (CSIR-JRF)
Mr. Rudra Narayan Saha, (ICMR-JRF)

Ms. Sangita Paul, (CSIR-JRF)
Ms. Sharmi Naha, (Project- JRF)
Mr. Subhankar Mukherjee, (ICMR-JRF)
Ms. Amrita Bhattacharya, (ICMR-JRF)
Ms. Taniya Golder, SRF
Ms. Madhumanti Halder, (UGC- SRF)
Mr. Suvajit Saha, (Project- JRF)
Ms. Sriprana Samajpati (Project-SRF)
Ms. Sampurna Biswas (Project-JRF)
Mr. Gourav Halder (CSIR-JRF)
Research Assistant
Mr. Partha Ganguly (DST- Climate)

Ph. D. Awarded:

Dr. Sambit Roy, received Ph.D. from university of Calcutta

Title of thesis: "Characterization of gluconate utilization system including the Entner-Doudoroff (ED) pathway with special reference to its role in virulence mechanisms of *Vibrio cholerae*"

Dr. Saswati Datta, received Ph.D degree from University of Calcutta

Title of thesis: Carbapenem Resistance in Enterobacteriaceae with neonatal sepsis: transmissible and non-transmissible mechanisms of resistance.

S. Dutta (Principal Investigator)

Studies on antimicrobial resistance and MLVA of Salmonella Typhi and Salmonella Paratyphi A isolates from Kolkata

Enteric fever, a systemic febrile disease transmitted by faeco oral route, continues to be a major public health problem. This disease is usually caused by *Salmonella enterica* serotype Typhi (*S*. Typhi) and Paratyphi (*S*. Paratyphi) A, B and C. Antimicrobial therapy is the mainstay of treatment but emergence of antimicrobial resistance (AMR) has become a major global problem. Subtyping of *S.* Typhi and *S.* Paratyphi A isolates is essential in discriminating the isolates for improved molecular epidemiological investigations. A total of 72 *S.* Typhi isolates and 15 *S*. Paratyphi A isolates were collected from various hospitals in Kolkata, India during April 2017 to March 2018 (Fig 1). Those isolates were tested for AMR profiles, mechanism of AMR & their MLVA subtypes. Majority of the *S.* Typhi isolates were resistant to nalidixic acid (97.2%) followed by ciprofloxacin (37.5%). Isolation rates of MDR (resistance to ampicillin, chloramphenicol, cotrimoxazole) and nonMDR (cotrimoxazole resistant with tetracycline resistance or chloramphenicol resistance) *S.* Typhi isolates were 4.2% and 5.5%. There were no MDR among S. Paratyphi A isolates. 93.3% *S*. Paratyphi A isolates were nalidixic acid and ofloxacin resistant whereas only 13.3% isolates were ciprofloxacin resistant (Fig 2). AMR marker (*bla*TEM-1, *cat*A, *sul*1, *sul*2, *dfr*A15, *str*A-*str*B, class 1 integron with *dfr*A7 & *dfr*A15) genes were detected in both MDR & non MDR *S.* Typhi isolates by PCR (Table 1). A single non-conjugative plasmid of 180 kb was found in all the MDR isolates and 50% (CQNa, 2/4) nonMDR isolates. One (1/4, TQ) nonMDR isolate was without any plasmid. A Single conjugative 50kb, IncN type plasmid was found in one non MDR isolate. 20 *S.* Typhi strains (Fig 3) and 13 S. Paratyphi A (Fig 4) strains were analyzed by MLVA (multi locus VNTR analysis). Seventeen (M1 to M17) and 8 (M1 to M8) MLVA types were formed for *S.* Typhi and S. Paratyphi A isolates respectively. The discriminatory power (D value) of the individual VNTR loci for *S*. Typhi ranged from 0.621 for Sal20 to 0.912 for TR2 and 0.133 for TR40 to 0.796 for Sal02 for S. Paratyphi A. The *D* value of MLVA typing for *S.* Typhi and S. Paratyphi A isolates were 0.934 and 0.847. The study reiterates the importance of monitoring of AMR profiles and molecular subtypes of locally circulating *S.* Typhi isolates for better understanding of the epidemiology, transmission and treatment modalities of the disease.

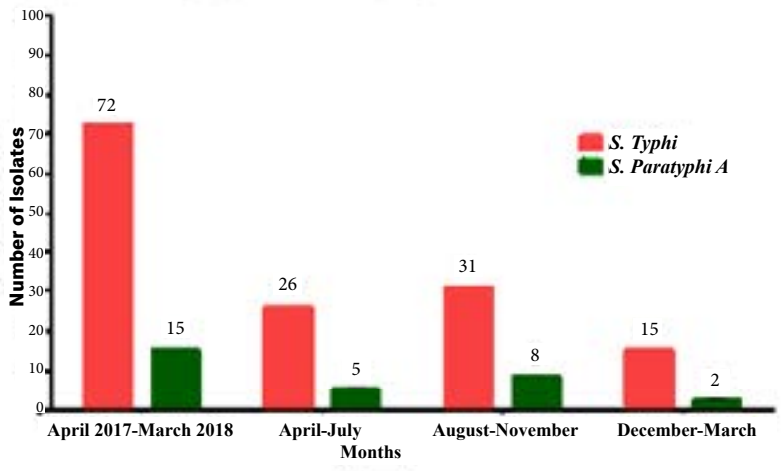

Fig 1: No. of *S.* Typhi (n=72) and *S*. Paratyphi A (n=15) isolates collected within one year period from April, 2017 to March, 2018

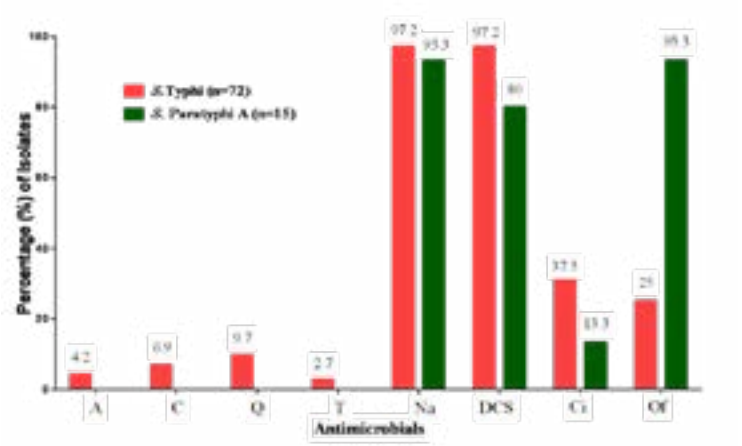

Fig 2: Percentage distribution of antimicrobial resistance of *S.* Typhi and *S.* Paratyphi A Kolkata isolates during 2017-18 (April-March). Interpretation was based on the MIC value of the antimicrobials

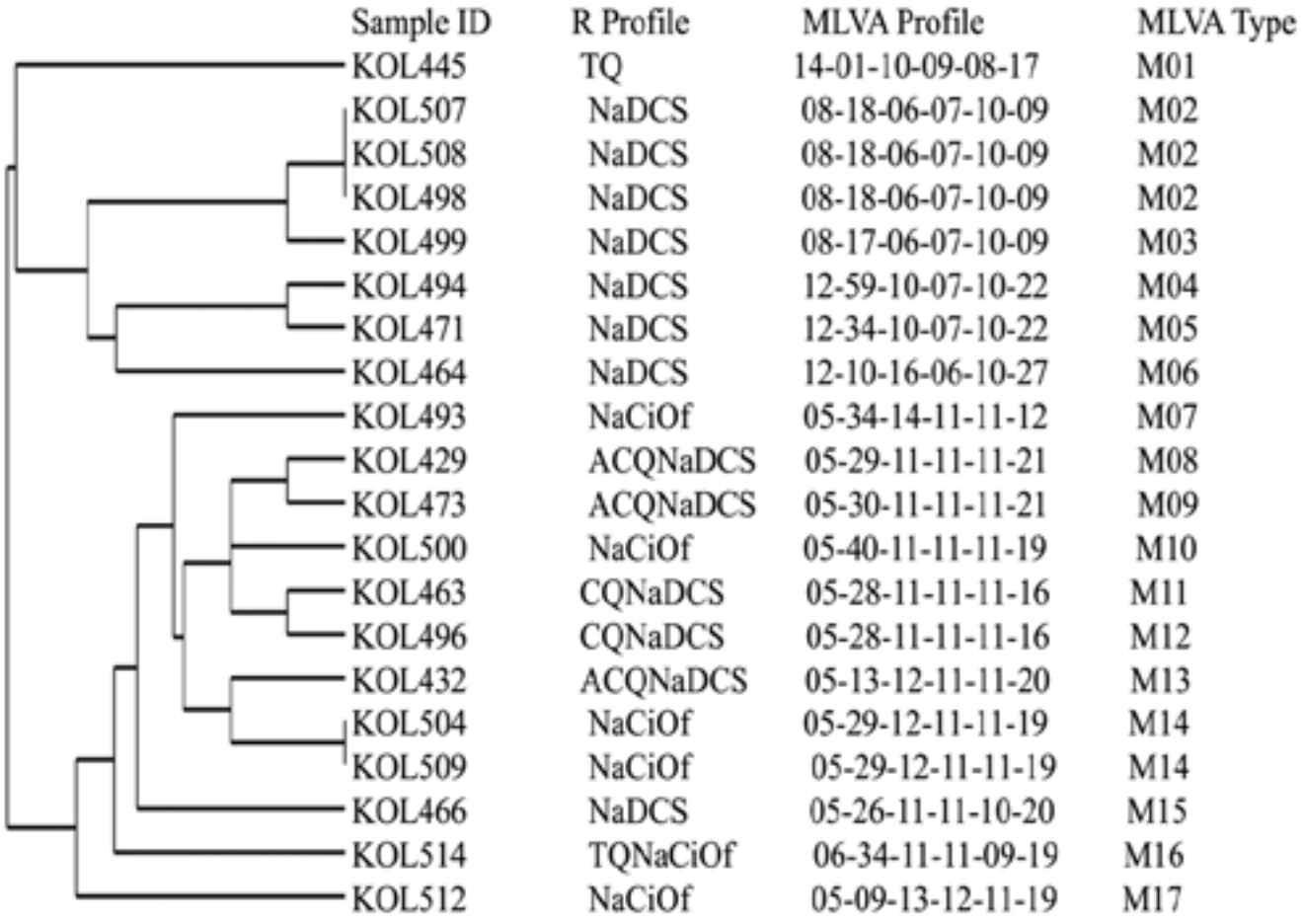

Fig 3: Showing the cluster analysis of MLVA profile of 20 *S.* Typhi isolates from Kolkata, India, 2017-18, cluster analysis is performed by the UPGMA algorithm, and a rooted tree is generated (http://minisatellites.u-psud.fr). A, ampicillin; C, chloramphenicol; Q, co-trimoxazole; T, tetracycline; Na, nalidixic acid; Ci, ciprofloxacin; Of, ofloxacin; DCS, decreased ciprofloxacin susceptibility; VNTR loci starting from TR1, TR2, TR4699, Sal16, Sal20 and Sal02

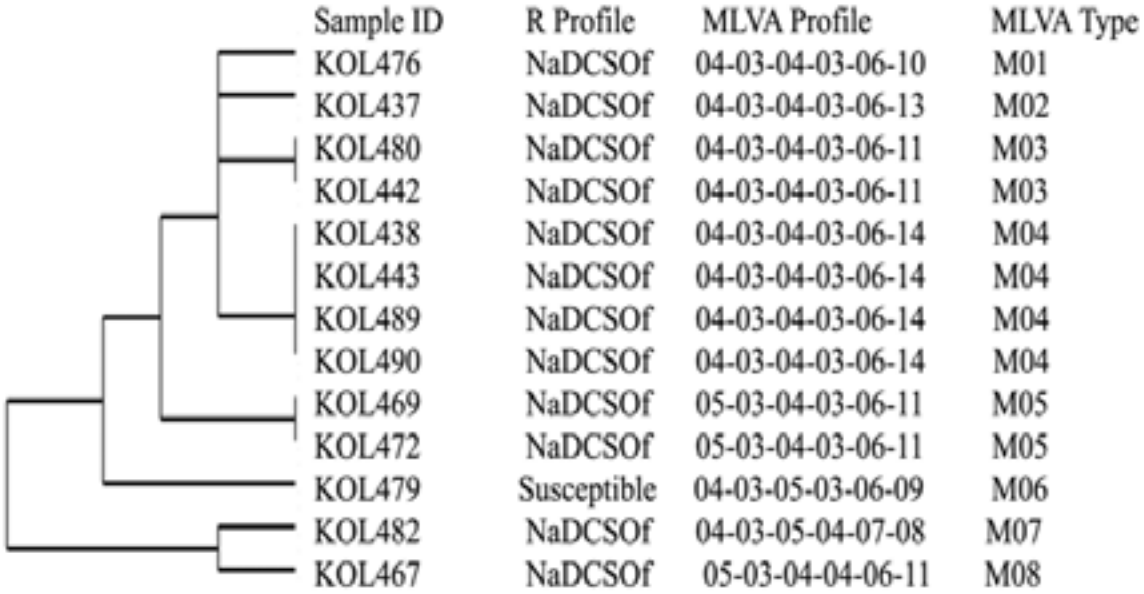

Fig 4: Showing the cluster analysis of 13 S. Paratyphi isolates from Kolkata, India, 2017-18, cluster analysis is performed by the UPGMA algorithm, and a rooted tree is generated (http://minisatellites.u-psud.fr). Pan-susceptible, susceptible to all drugs tested; Na, nalidixic acid; Ci, Ciprofloxacin; Of, ofloxacin; DCS, decreased ciprofloxacin susceptibility. VNTR loci starting with TR5, TR40, TR41, TR43, TR51 and Sal02

Table1: Presence of antimicrobial resistance genes in *S.* Typhi (n= 12) isolates

Sample ID	Antimicrobial resistance group (n)	R Profile	Plasmid Type, size(kb)[a]	Detection of resistance genes by PCR Amplification								
				bla_{Tem}	catA1	strAB	tetA	tetB	sul1	sul2	sul3	Sizes of class 1 integrons(-gene cassettes)[d]
KOL429	MDR (n=3)	ACQNaS	180	+	+	+	-	-	+	+	-	750bp (*dfrA7*)
KOL432		ACQNaS	180	+	+	+	-	-	+	+	-	750bp (*dfrA7*)
KOL473		ACQNaS	180	+	+	+	-	-	+	+	-	750bp (*dfrA7*)
KOL463	Non MDR (n=4)	CQNa	180	+	+	+	-	-	+	+	-	750bp (*dfrA7*)
KOL496		CQNa	180	+	+	+	-	-	+	+	-	750bp (*dfrA7*)
KOL514		TQNa-CiOf	IncN, 50	-	-	-	+	-	+	-	-	1.6kb (*dfrA15,aadA1*)
KOL445		TQS	IncN, 50	-	-	+	-	+	+	+	+	1.6kb (*dfrA15,aadA1*)

Abbreviation used A, ampicillin; C, chloramphenicol; Q, co-trimoxazole; T, tetracycline; Na, nalidixic acid; Ci, ciprofloxacin; Of, ofloxacin; S, streptomycin.

A. Palit (Principal Investigator)

Seasonal dynamics of enteropathogenic bacteria in Gulf of Khambat, Gujrat: its impact on health of coastal population

In the second year of this ongoing project, we visited the counterpart institute CSIR-CSMCRI, Bhavnagar, eastern Gujarat for field expedition in the Gulf of Khambat (GoK). The sampling was undertaken in the Winter to grasp the seasonal effect of environmental determinants on bacterial dynamics in the Gulf where anthropogenic pressure and draining of sewage creates conducive environment for the growth of enteropathogens. Due to the area being inundated, favourable environmental conditions trigger the spread of the pathogens from marine to inland coastal population,via groundwater as transmission vehicle.Water samples were extensively collected from our pre-selected sites followed by physico-chemical analyses and were brought back to NICED (at 4^0C) for bacteriological and molecular analysis.

Physico-chemical analysis

The samples were physico-chemically analysed in situ, viz. Temperature, pH, conductivity and salinity by a hand held multi-meter (WTW, Weilheim, Germany). The turbidity was measured consequently by a portable turbidi-meter (Eurotech, Singapore) (Table 2).

Bacteriological analysis

In the central laboratory, 100µl to 200µl of each sample was serially diluted to obtain microbiological counts like Total Bacterial Count (TBC); Total Coliform Count (TCC); Total *E.coli* Count (TEC); Total Fecal Coliform Count (TFCC); Cultivable Vibrio Count (CVC) by the spread plate method (Table 3).

All the experiments were triplicated and average values were recorded.

Table 2: Physico-chemical indices of different sites of the Gulf of Khambhat

SOURCE / PARAMETERS	TIDE	Gulf of Khambat, Gujarat				
		SITE 1`	SITE 2	SITE 3	SITE 4	SITE 5
TEMPERATURE (^{0}C)	HIGH	27.3	28.8	28.0	25.8	26.9
	LOW	26.0	29.4	29.6	27.3	26.6
pH	HIGH	8.57	8.16	8.4	8.39	8.10
	LOW	8.45	8.68	8.43	8.36	8.23
SALINITY	HIGH	32.4	32.3	35.6	36.7	34.5
(PSU)	LOW	32.5	32.6	35.8	36.5	34.8
TURBIDITY (NTU)	HIGH	150	401	4.66	8.14	82
	LOW	100	409	5.61	7.29	88
CONDUCTIVITY (mS/cm)	HIGH	52.5	52.2	58.3	57.4	54
	LOW	50.5	48.7	58.0	57.5	54.4

Table 3: Bacteriological counts of the different sites of the Gulf of Khambhat

SOURCE	TIDE	Gulf of Khambat, Gujarat				
PARAMETERS		SITE 1`	SITE 2	SITE 3	SITE 4	SITE 5
TOTAL BACTERIAL COUNT (TBC)	HIGH	1200	1090	3370	12300	12000
	LOW	1845	780	3420	17240	16640
TOTAL BACTERIAL COUNT (TBC) ON MARINE AGAR	HIGH	8940	2090	16500	23500	13500
	LOW	5100	4020	61600	41920	13600
TOTAL *E. coli* COUNT (TEC)	HIGH	54	34	0	0	23
	LOW	33	26	0	0	5
TOTAL COLIFORM COUNT (TCC)	HIGH	78	59	0	0	38
	LOW	59	64	0	0	63
CULTIVIABLE *VIBRIO* COUNT (CVC)	HIGH	1368	2352	600	2372	1900
	LOW	402	112	1295	1450	2680

Molecular isolation of the enteropathogens:

Highest preponderance of *V.alginolyticus* was obtained amongst all pathogenic *Vibrios* isolated from the study sites followed by *V. parahaemolyticus* (Table 4). Interestingly, a few *V. cholerae* isolates were obtained from the Gulf but none from the marine samples. *E. coli* was obtained from Gulf as well as Gomti estuarine samples.

Table 4: Site-wise preponderance of enteropathogens in the Gulf of Khambhat

SOURCE	TIDE	Gulf of Khambat, Gujarat				
PARAMETERS		SITE 1`	SITE 2	SITE 3	SITE 4	SITE 5
V. cholera	HIGH	6	3	0	0	0
	LOW	3	1	0	0	0
V. parahaemolyticus	HIGH	8	5	3	2	0
	LOW	6	1	1	1	0
V. alginolyticus	HIGH	25	36	13	15	29
	LOW	17	28	9	11	18
V. vulnificus	HIGH	0	0	0	0	0
	LOW	0	0	0	0	0
V. mimicus	HIGH	0	0	0	0	0
	LOW	0	0	0	0	0
E. coli	HIGH	54	34	0	0	23
	LOW	53	26	0	0	5

A third post monsoon field expedition to the same foci, for subsequent comparative evaluations and implications is in order.

The outcome would help to formulate a “bioenvironmental model” of biotic and abiotic indices and also probable strategies for the prophylactic measures influencing the water milieu of GoK.

Entero-pathogenic Vibrio dynamics in relation to salinity variation in south Bengal riverine and estuarine environment: impact on health of coastal population. The study established the existence of the three distinct study sites based on the yearlong seasonal variation of physico-chemical properties. A salinity-dependant zone demarcation was drawn from the yearlong sample evaluation off the three sites, viz. “no saline” zone (Site I; Howrah; <0.1ppt), a “medium saline” zone (Site II; Diamond Harbour & Kakdwip 0.1 -5 ppt) and a “high saline” zone (Gosaba, Site III; 6-15ppt). Highest salinity was experienced during summer, attributable to greater inflow of the sea water. Lowest salinities were recorded during monsoon due to heavy downpours and run-off from the adjoining areas.

The turbidity level was high (50 to 960 NTU) at the mid saline zone, greater than that of other study sites. The concentrations of SPM at sea-end stations were greater representing the zone of estuarine turbidity maximum (ETM).

V.parahaemolyticus could be isolated from 27/120 (22.5%) samples, prevalent in the high saline zone (Site III) (21/27), to some lesser extent at Diamond Harbour (6/21) and was completely absent at Howrah. 19 samples (15.8%) were found to harbour *V.alginolyticus* and 14 (11.6 %) with *V. vulnificus*, with a slightly higher preponderance at Site III. *V. mimicus* was isolated from 23 samples (19.1%) with highest preponderance at Site I (12/23), followed by Site II (8/23) and Site III (3/23) (Fig 5). *V.cholerae* non-O1/O139 (NOVC) was the most prevalent among all the five species of Vibrios, 42 (35%) samples, with highest abundance at Site I (24/42), salinity <0.1ppt.

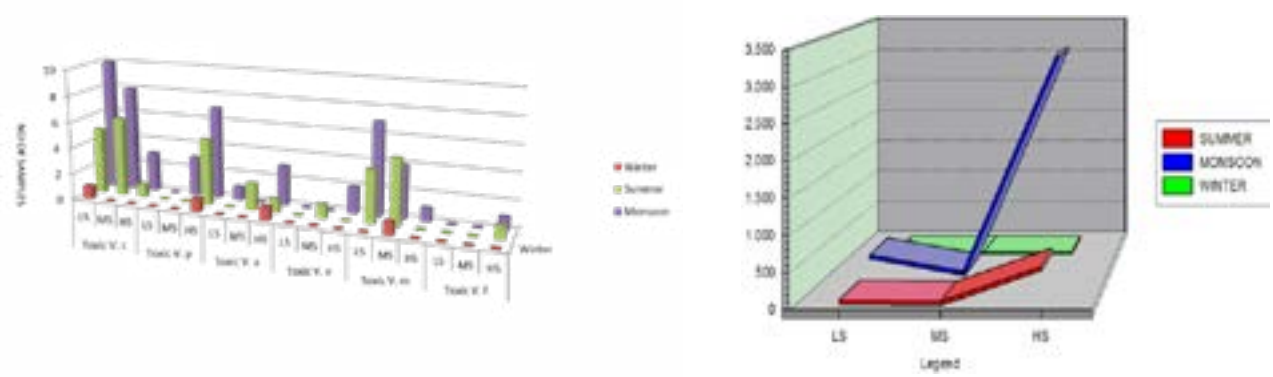

Fig 5: Seasonal prevalence of *Vibrios* amongst all the saline zones (expressed in CVC; cfu/ml)

V.cholerae O1 was present in 19 (15.8%) samples. Seasonal prevalence of *Vibrios* was highest in the monsoon months (20–34°C), followed by summer (24–36°C) and winter (13–18°C) respectively.

68 *V.cholerae* were isolated and analysed. All of the NOVC were negative for *ctx* and O1/O139 (*rfb*) genes, but harboured a host of associated virulence genes (Table 5). Interestingly, the isolates from Howrah depicted higher preponderance of toxin genes than those isolated from Diamond Harbour. The *V.cholerae* from other sites were devoid of any toxin genes.

Table 5: Toxin gene profile of *V. cholerae* isolates at Howrah (HB) & Diamond Harbour (DH)

Sero type	Source	Number of isolates	Toxin genes										
			ctx	*tcp*	*hlyA*	*O1/ O139*	*rtxA*	*tlc*	*zot*	*toxR*	*toxT*	*aldA*	*RJ& LJ*
NOVC	HB	46	0 (0%)	2 (4.3%)	43 (93.4%)	0 (0%)	38 (82.6%)	3 (6.5%)	3 (6.5%)	11 (23.9%)	1 (2.1%)	2 (4.3%)	2 (4.3%)
	DH	22	0 (0%)	0(0%)	21 (95.4%)	0 (0%)	17 (77.2%)	0 (0%)	0 (0%)	4 (18.1%)	1 (4.5%)	0 (0%)	0 (0%)
VCO1	HB	5	4 (80%)	3 (60%)	5 (100%)	5 (100%)	4 (80%)	2 (40%)	3 (60%)	4 (80%)	4 (80%)	4 (80%)	4 (80%)
	DH	1	1 (100%)	0 (0%)	1 (100%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (100%)	1 (100%)	1 (100%)
Total		74	5	5	70	2	59	5	6	24	7	7	7

*NOVC- *V.cholerae* non O1/O139 *VCO1- *V.cholerae* O1

The three year study has established the direct impact of the Vibrio dynamics on the coastal health population. The findings of the study will evidentially address a long term poorly understood diarrheal disease epidemiology within the environment and their implications across the Gangetic delta of Indian subcontinent.

Effect of Climate change on Diarrheagenic *Escherichia coli* in rivers and estuarine environment of Lower Ganga Basin: Impact on health of coastal population

A sizeable chunk of the world's population lack access to adequate and safe water supplies and as a result, waterborne diseases and consequent mortality continues to be a worldwide burden (Batabyal et al 2013, Ramteke et al., 1994). *E. coli* plays a major role in causing diarrhoea and is an emerging group of diarrhoeal pathogen in the Gangetic delta (Mookerjee et al 2014b, Batabyal et al 2013). Environmental surveillance of diarrheagenic *E. coli* in the Gangetic delta of India, has never been conducted inspite of *E. coli* being repeatedly implicated in diarrhoea (Batabyal et al 2014 a, Mookerjee et al 2014b, McLaughlin et al., 1995).

The present study was undertaken to determine the climatic factors of the south Bengal and their seasonal changes, the seasonality of the Diarrheagenic *E. coli* in the aquatic environs of Ganga Basin of West Bengal, isolation, identification and characterization of entero-pathogenic *E. coli* from aquatic and benthic milieu of river and estuarine settings of south Bengal and identification of eco-hydrological factors responsible for distribution and seasonal variation of *E. coli* of river and estuarine origin. Moreover diarrheagenic *E. coli*, ecological variables and diarrheal disease endemicity pattern in South Bengal will also be correlated.

Sampling locations will encompass 6 districts of South Bengal North-24 Parganas, Howrah, Hooghly, Kolkata, East Midnapore and South-24 Parganas (Table 6), along the Hooghly river.

Table 6: Preponderance of *E. coli* & coliform at the different study sites encompassing six districts of South Bengal

SOURCE / PARAMETERS	TIDE	Sampling Sites on lower Ganga basin				
		Barrackpore	Chandannagar	Kolkata	Howrah	Diamond Harbour
Total *E. coli* count (TEC) CFU/mL	HIGH	494	450	655	580	321
	LOW	393	401	351	401	102
Total Coliform Count (TCC) CFU/mL	HIGH	4269	3546	2890	5663	2033
	LOW	3695	3122	2566	4659	1965
E. coli (No. of Isolates)	HIGH	120	112	265	206	99
	LOW	80	95	241	195	85

Preliminary findings revealed high coliform load along with *E. coli* contamination throughout all of the sampling sites. Extensive use of river water for various purposes including of household chores, rituals and bathing contribute towards the huge load of *E. coli.* Highest *E. coli* load was obtained from Kolkata which could be due to the densely populated surroundings along the river bank and heavy water traffic, whereas the least number could be isolated from Diamond Harbour due to comparatively lesser anthropogenic burden. Coliform load was found to be relatively higher upstream where it travels through densely populated cities with the maximum contamination in Howrah attributed to the effect of large efflux of industrial effluents and waste disposal into the river.

The present study will attempt to elucidate the seasonality & ecological variables tounderstand diarrheal disease in the lower Ganga Basin to explain Bengal diarrheal menace for prospective prevention measures. The influence of the changing climate on diarrheagenic *E. coli* seasonality in the riverine-estuarine ecosystem in relation to diarrheal endemicity will be established to develop an effective "biomonitoring tool".

R. K. Nandy (Principal Investigator)

Arabinose (Ara) mediated growth inhibition of pathogenic *Vibrio cholerae* in nutrient broth (NB) and M9 gluconate (M9-Gnt) supplemented media

Co-investigators: T. Golder, A. K.Mukhopadhyay, H. Koley

Episomal expression of cloned proteins requires cloning of target gene(s) under strong promoter of expression vector. In this regard, arabinose (Ara) is widely used as an inducer for P_{BAD} promoters. In case of *Vibrio cholerae* research, use of pBAD vectors gained lots of interest as Ara is nonmetabolizable by *V. cholerae*. In fact, many of the key research on *V. cholerae* virulence factors, regulation of expression of virulence genes, quorum sensing, identification of different metabolic pathways etc. have been carried out with vectors having P_{BAD} promoters. In case of other *Vibrio* species, impact of Ara on biofilm formation has also been reported. Genetic universal tool have been developed on suicide T vector and P_{BAD} promoter system for rapid and efficient gene deletion in *Vibrio species*.

This study showed nonmetabolizable Ara caused growth inhibition of pathogenic *V. cholerae* O1 strains when allowed to grow in nutrient broth (NB) pH 6.6 and M9 minimal media with gluconate (M9-Gnt) as sole carbon source. Complete growth inhibition was noted with Ara concentration ≥0.3% in the growth media. However, such growth inhibition could be reversed by the addition of 1% NaCl or increase of pH to 8.0 of NB. Interestingly, Ara induced growth inhibition was not generalized in nature as presence of 2% Ara failed to show any growth inhibition of *V. cholerae* either in AKI or LB media. Schematic representation of Ara-induced growth inhibition is presented in the figure (Fig 6) In this context, it may be mentioned here that regulation of expression of virulence factors of *V. cholerae* varies extensively in aforementioned three media and are thought be linked with operative metabolic cycles inside the cells. Therefore, it is pertinent to consider that Ara has definitive impact on *V. cholerae* metabolic cycles. It has already been reported that the Entner-Doudoroff pathway is solely required for Gnt utilization by *V. cholerae* and presence of Ara appeared to paly inhibitory role for this pathway. Information on Ara induced *V. cholerae* growth modulation may be considered important while designing complementation/ expression studies in *V. cholerae* using Ara as an inducer.

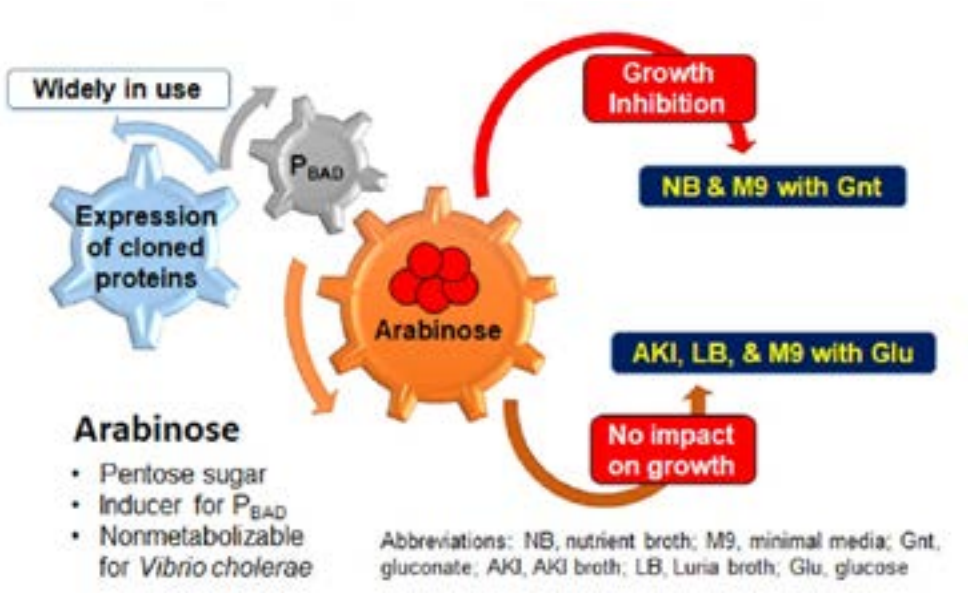

Fig 6: Culture condition dependent growth inhibition of pathogenic *Vibrio cholerae* by arabinose

A.K. Mukhopadhyay (Principal Investigator)

Transmission of newly emerged polymyxin B sensitive *Vibrio cholerae* O1 harboring Haitian genetic traits across India

The epidemiology of global cholera has gone through periodic subtle changes. Cholera is a major health issue in Asian and African countries where sanitation and supply of clean drinking water are limited. The epidemic of cholera in Haiti affected more than 0.8 million people with around 8000 deaths and brought this ancient menace in the forefront of public health programs. Very recently, war-torn Yemen is facing one of the world's worst catastrophic cholera outbreaks. The spread of the outbreak has quickly surpassed Haiti as the largest documented cholera epidemic of modern times. The Gram negative bacterium *Vibrio cholerae* is accountable for this life threatening disease and emerged in time course as different pathogenic and non-pathogenic forms that differ in their virulence and genetic background. Two natural epidemic biotypes of *Vibrio cholerae*O1, classical and El Tor, exhibit different patterns of sensitivity against the antimicrobial peptide polymyxin B. This difference in sensitivity is treated as one of the major markers in biotype classification system for the past several decades. Our study regarding the emergence of polymyxin B sensitive El Tor *V. cholerae* O1 in Kolkata has provided us an impetus to trail the dissemination of the strains harboring this important trait along with Haitian genetic attributes across India. So, we have tested 300 clinical *V. cholerae* O1 strains from 12 states in India and screened for polymyxin B susceptibility. Also, genetic characterization was done to study the *tcpA, ctxB* and *rtxA* genotypes by allele specific PCR and nucleotide sequencing. Studies revealed that 88.9% of the isolates were sensitive to polymyxin B (Fig 7). All the states except Assam had polymyxin B sensitive *V. cholerae* strains and complete replacement with this strain was found in eight of the states (Fig 8). However, from 2016 onwards, all the strains tested showed sensitivity to polymyxin B. Allele specific PCR and sequencing confirmed that all strains possessed Haitian-like genetic traits. So, polymyxin B sensitive strains have begun to spread all over India and probably in other parts of the world that may lead towards revision of biotype classification. We are assuming that the strains are modifying their genetic as well as phenotypic attributes probably to achieve better survival adaptability to the environment in combination with high virulence. So, an active holistic surveillance is required to track the mode of distribution of currently circulating polymyxin B sensitive *V. cholerae* O1 strains in different endemic population to comprehend their clinical and epidemiological consequences.

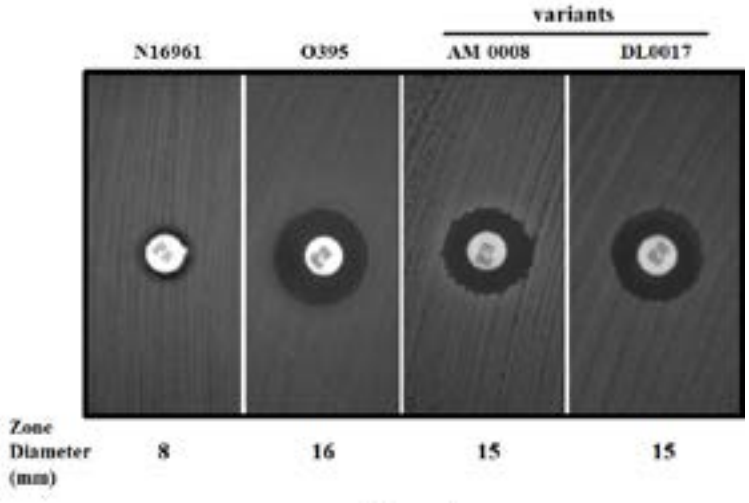

Fig 7: The Zone of Inhibition in Kirby-Bauer Disc Diffusion method for polymyxin B (50U) was determined in El Tor (N16961), Classical (O395) and Newer El Tor variant strains isolated from different parts of India. The Zone Diameter (in mm) is indicated below. Polymyxin B sensitivity was displayed by Newer El Tor variant strains which is the characteristic feature of classical strains. Data are representative of three biological repetitions.

Fig 8: Polymyxin B susceptibility profile of *V. cholerae* O1 in different states in India. Yellow regions indicate the places in India i.e., Andhra Pradesh, Chandigarh, Chhattisgarh, Karnataka, Madhya Pradesh, Odisha, Rajasthan and West Bengal where the polymyxin B sensitive El tor strains found predominantly, green regions represents Delhi, Gujarat, and Maharashtra where both polymyxin B sensitive and resistant strains were prevalent and red region represents Assam where polymyxin B resistant strain is still predominant. The states from where we unable to collect any strains were kept uncoloured.

Involvement of Helicobacter pylori plasticity region genes in increased virulence and the gastroduodenal diseases manifestation in India

Almost all *Helicobacter pylori* infected person develop gastritis and severe gastritis is supposed to be the denominator of peptic ulcer diseases, which may lead to gastric cancer. However, it is still an enigma why few strains are associated with ulcer formation, while others are not related with any disease outcome. Identification of a disease-specific *H pylori* virulence factors prognostic of the consequence of infection still remains elusive. Although a number of putative virulence factors of *H pylori* has been reported (eg, the cag PAI, *vacA, babA*, and *oipA*) to be associated with the clinical outcomes of *H. pylori* infection, they fail to answer the entire process of disease manifestation in all geographical areas in the world, especially in the context of Asian countries. Moreover, there are contradictory results regarding their connotation with diseases. Recently, there has been a significant attention in strain-specific genes outside the *cag* pathogenicity island, especially genes within plasticity regions. Studies demonstrated that certain genes in this region may play important roles in the pathogenesis of *H. pylori*-associated diseases. The aim of this study was to assess the role of selected genes (*jhp0940, jhp0945, jhp0947 and jhp0949*) in the plasticity region in relation to risk of *H. pylori*-related diseases in Indian population. A total of 113 *H. pylori* strains isolated from duodenal ulcer (DU) (n=61) and non-ulcer dyspepsia (NUD) subjects (n=52) were screened by PCR and Dot-Blot to determine the presence of these genes. The comparative study of IL-8 production and apoptosis were also done by co-culturing the AGS cells with *H. pylori* strains of different genotype. PCR and Dot-Blot results indicated that the prevalence rates of *jhp0940, jhp0945, jhp0947 and jhp0949* in the *H. pylori* strains were 9.8%, 47.5%, 50.8%, 40.9% and 17.3%, 28.8%, 26.9%, 19.2% isolated from DU and NUD, respectively. IL-8 production (Fig 9) and apoptotic cell death (Fig 10A and B) were significantly higher in *H. pylori* strains containing *jhp0945, jhp0947 and jhp0949* than the strains lacking those genes. Results indicated that the prevalence of *jhp0945, jhp0947* and *jhp0949* are associated with increased risk of severe diseases in India. Our study showed that presence of *jhp0945, jhp0947* and *jhp0949* were significantly associated with symptomatic expressions along with the increased virulence during *ex vivo* study whereas *jhp0940* seems to be negatively associated with the disease. These results suggest that *jhp0945, jhp0947* and *jhp0949* could be useful prognostic markers for the development of duodenal ulcer in India.

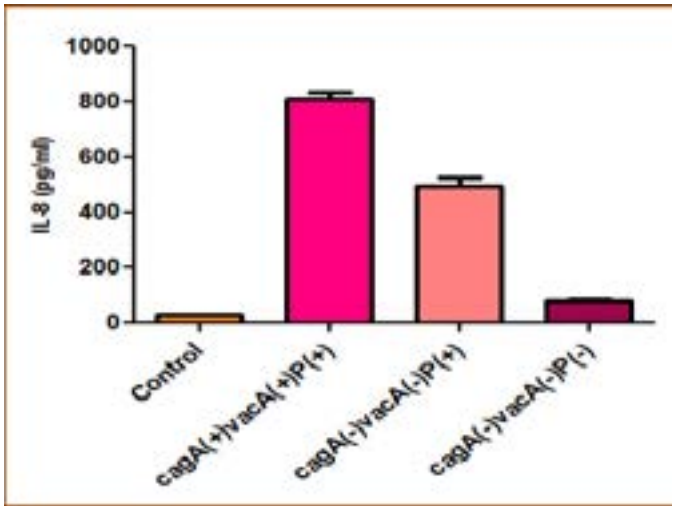

Fig 9: Role of *H. pylori* plasticity region in ex vivo induction of IL-8. *In vitro IL-8* production from AGS cells co-cultured with randomly selected *cagA(+)vacA(+)P(+), cagA(-)vacA(-)P(+),* and *cagA(-)vacA(-)P(-)H. pylori* strains (MOI is 100) for 8 h. IL-8 from culture supernatant was measured using ELISA. Data are expressed as mean ± standard error of mean (SEM) of 3 experiments in duplicates. *vacA* positive and negative denote the *vacA* s1m1 and *vacA s2m2* alleles, respectively.

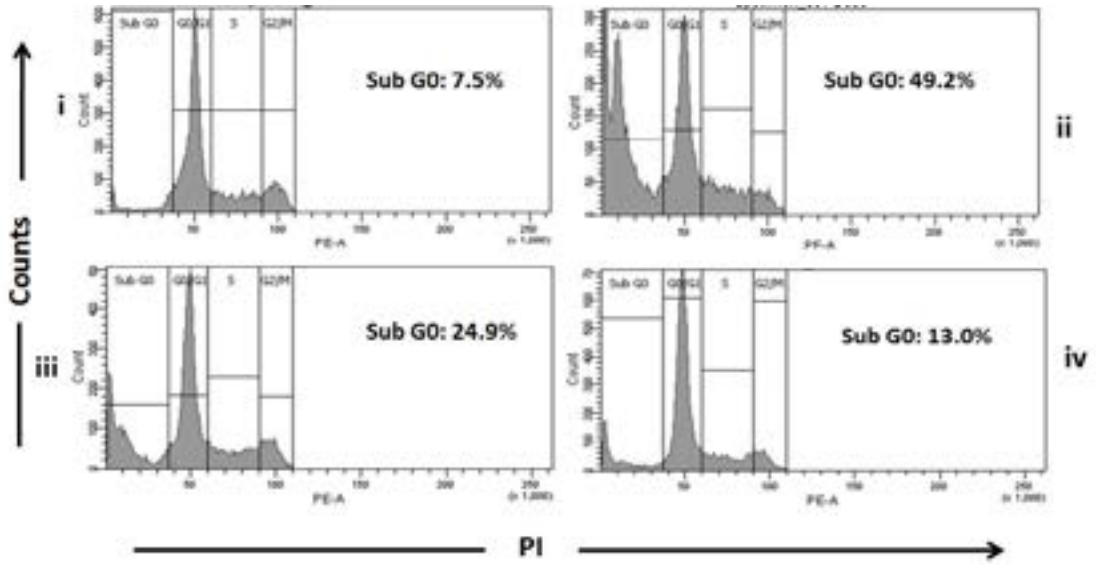

Fig 10 (A): Importance of *H. pylori*plasticity region in cell cycle analysis of AGS cells. (A) Cell cycle analysis of AGS cells (Ai worked as control) co-cultured with different genotypic variant i.e. Aii) *cagA(+)vacA(+)P(+); 6* Aiii) *cagA(-)vacA(-)P(+) and6* Aiv) *cagA(-)vacA(-)P(-).H. pylori* strains for 24 h (MOI is 100), stained with propidium iodide, processed and analysed by flow cytometry. These figures are representative profile of at least three experiments.

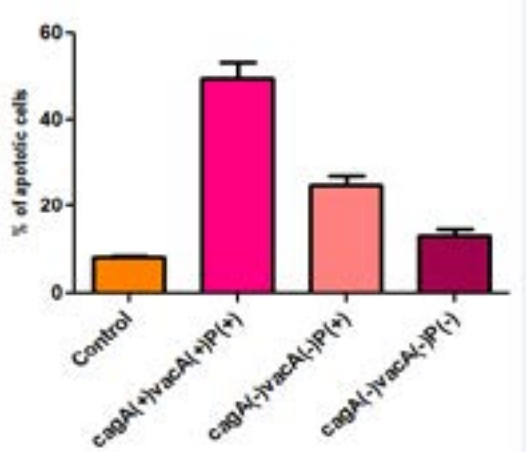

Fig 10 (B): Graphical representation of % apoptotic cells (Sub G0 phase) infected with same group of strains were expressed as mean ± SEM. vacA positive and negative denote the *vacA s1m1* and *vacA s2m2 alleles*, respectively.

S. Basu (Principal Investigator)

Mechanisms of fluoroquinolone resistance: comparison between *Acinetobacter baumannii* and non-baumannii isolated from septicaemic neonates

Co-investigators: S. Roy, S. Chatterjee, A. Bhattacharjee, P. Chattopadhyay, B. Saha, S. Dutta

Acinetobacter is a complex genus and the multiple species within this genus exhibit differences both in their capability to cause disease and also in their mechanisms of resistance to antimicrobials. Of the different species, *A. baumannii* has remained in the forefront causing nosocomial infections and outbreaks in adults and neonates. Nonetheless, non-baumannii isolates have also been reported to cause hospital outbreaks. There is no comprehensive data on mechanisms of fluoroquinolone resistance among *Acinetobacter baumannii* and non-baumannii. This study compared the fluoroquinolone susceptibility and resistance mechanisms between these two groups to understand the differences in the mechanism of resistance .

A. baumannii was predominant (68%) among the non-duplicate *Acinetobacter* analysed. Ciprofloxacin and moxifloxacin resistance was significantly lower in non-baumannii in comparison to *A. baumannii* (Fig11). Chromosomal mutations *[*S83L in *gyrA* and S80L in *parC], aac(6')-Ib-cr* and overexpression of pump genes, particularly, adeB was detected in fluoroquinolone-resistant *A. baumannii*. Specific mutations were detected within *adeRS*, responsible for *adeB* overexpression. In contrast to baumannii, *gyrA* mutations in fluoroquinolone-resistant non-baumannii were either S83L or S83F or S83Y while *parC* could not be amplified. *aac (6')-Ib-cr* was detected in low proportion. None of the pump genes, found in *A. baumannii*, was present in non-baumannii, though presence of efflux pump inhibitors decreased MIC values.

Differences in chromosomal mutations and expression of efflux pumps was noted in the two groups. To the best of our knowledge, this is the first study elucidating significant differences in fluoroquinolone resistance mechanisms between *A. baumannii* and non-baumannii. This indicates that therapeutic strategies may be considered separately for these two groups.

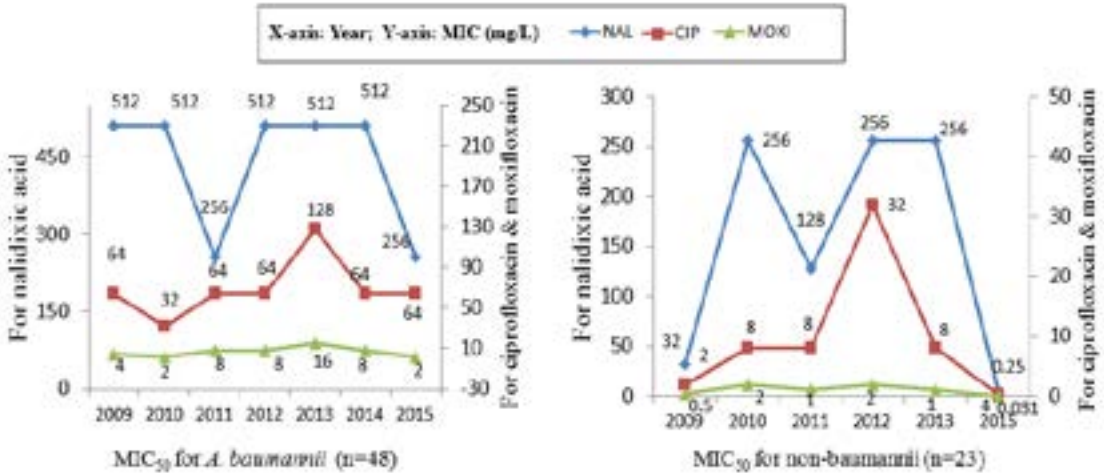

Fig11. Distribution of MIC_{50} (2009-2015) for 1st generation (nalidixic acid), 2nd generation (ciprofloxacin) and 4th generation (moxifloxacin) fluoroquinolones among 48 *Acinetobacter baumannii* and 23 non-baumannii determined by broth microdilution method.

H. Koley (Principal Investigator)

Alginate chitosan nano formulations of OmpA- *a Shigella* subunit vaccine

Co-investigators: P. Mukherjee, M. K. Chakraborti

Previous studies on outer membrane vesicles of *Shigella* revealed the presence of outer membrane protein A (OmpA) in the vesicles. OMPs are novel vaccine candidates since they are usually copious and are in direct contact with host immune response. Among them, OmpA is an abundant protein found in the bacterial outermembrane and is highly conserved among all the species of *Shigella* and throughout evolution. OmpA is also a chief immunogenic protein of *Shigella* and plays a structural role in the integrity of the bacterial cell surface. It is composed of two domains: an N-terminal membrane embedded domain of 170 amino acid residues, serving as a membrane anchor; and C- terminal 155 residues domain, which is located in the periplasmic space and has been proposed to interact specifically with the peptidoglycan layer. It has already been known that OmpA of E.coli stimulates dendritic activation and secretion of cytokines, which are indispensible to boost the immune response during infection. Outer membrane proteins are key molecules in the interface between the cell and its environment. It is important in maintaining integrity of the outer membrane and stimulates a strong antibody response. Hence, in our present study, we expressed and purified recombinant OmpA protein after cloning and used it as a subunit vaccine candidate. Needle free approach oral immunization seems to be the easiest for children, thus we coated this protein with chitosan-alginate micro particle by ionotropic gelation method in order to increase bioavailability which crosses the stomach acid barrier in this immunization procedure.

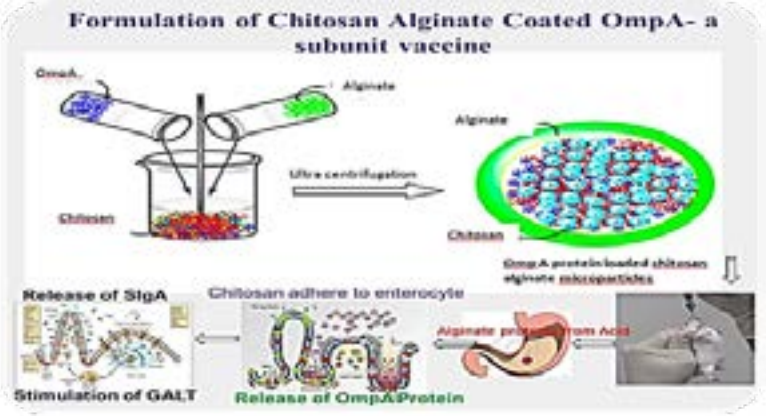

Fig:12 Schematic abstract of formulation of chitosan alginate coated OmoA – subunit vaccine

Morphology andstructural characterization of micro particles by DLS (Fig13 E and F) and electron microscopy (Fig13 A, B, C and D) reveals the mean diameter was about550nm. The rapid charge inversion of OmpA loaded chitosan alginate micro particles (from +33 mv to -20.78 mv) was observed during the coating procedure which indicated the presence of alginate layer on the chitosan micro particles surfaces.

Loading efficiency was 65% and acidic degradation shows efficient protection of OmpA by chitosan alginate micro particle. In our experimental animal model, oral immunization of mice with the OmpA coated chitosan-alginate micro particle induces strong protective immunity revealed by serum immunoglobulin response (Figure 13 G). Serum Immunoglobulin response was significantly higher in CAOP compare to only OmpA immunized group upto 120 days post immunization. Control mice maintains a basal level titre. Secretory IgA was also found in higher level for chitosan alginate OmpA group. Thus our chitosan alginate OmpA nanoformulation was able to induce serum immunoglobulin as well as secretory IgA for proection against Shigellosis (as depicted in schematic diagram of Fig 12).

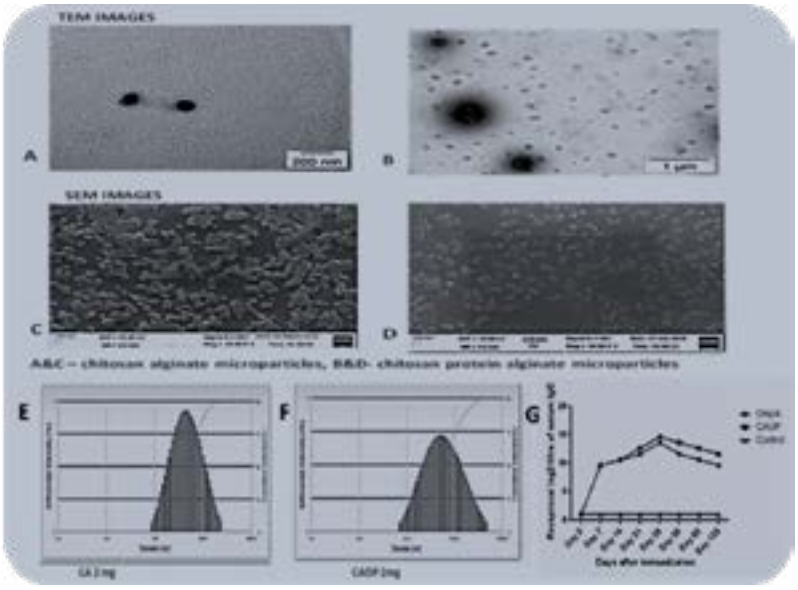

Fig 13: A and C: Morphological Characterization of chitosan alginate blank microparticles by TEM and SEM reveals homogeneous particles more or less attached with each other. B and D: Characterization of chitosan alginate microparticles with OmpA by TEM and SEM also depicts homogeneous particles. DLS data of chitosan alginate blank microparticles (E) and chitosan alginate microparticles with OmpA (F) reveals intensity distribution of particle which is within the range of 50nm to 500nm and 100nm to 1000nm respectively. Serum immunoglobulin response (G) reveals significantly higher titre in CAOP compare to only OmpA immunized group upto 120 days post immunization.

Awards/ Honours Received

S. Dutta

- Awarded Prof. S.C Seal Memorial Oration 2017 at the 60th State Conference of Indian Public Health Association (West Bengal Branch) on 6th May, 2017 at NICED, Kolkata
- Received Life Time Achievement Award 2017 of Indian Association of Applied Microbiologists 2017 at the 15th National Conference of IAAM held on 22nd -23rd September, 2017 at Vivekanandha College of Arts & Science for Women, Elayamalayam, Tiruchengode Taluk, Namakkal Dist. Tamil Nadu
- Awarded Dr. Y.S. Narayana Rao Oration Award for research work in the field of Microbiology for the Year 2014 received on 11th October, 2017 at ICMR hqrs. New Delhi
- Elected as Fellow of West Bengal Academy of Science & Technology (WAST) for 2017

A. Palit

- Member, Water purification sub-committee (FAD 14: 2), Bureau of Indian Standards, Ministry of Consumer affairs, Food and Public distribution, GOI, 2010-11.
- Member, Drinking Water sectional Committee, FAD 25, Bureau of Indian Standards, Ministry of Consumer affairs, Food and Public distribution, GOI, 2010-11.
- Member, Water purification system sectional committee, MHD 22, Bureau of Indian Standards, Ministry of Consumer affairs, Food and Public distribution, GOI, 2010-11.

S. Basu

- Acted as reviewer for Journal of Antimicrobial Chemotherapy , Journal of Medical Microbiology, Indian journal of Medical Research, Arab Journal of Gastroenterology

H. Koley

- Received PCT number of invention entitled 'Alginate chitosan nano formulations of OmpA- a *Shigella* subunit vaccine', PCT/IN2017/000094 on 9th November, 2017.

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

S. Dutta

- Participated in the Smart India Hackathon 2017 held on 1-2 April, 2017 at the Guru Nanak Institute of Technology, Sodepur and acted as nodal person from ICMR-NICED.
- Delivered a talk on “Antimicrobial resistance: Today’s challenges and opportunities for future research” at the seminar on antimicrobial resistance organized by NIPER-Kolkata on 17th April, 2017.
- Attended a workshop on “Signals and Systems for Life Sciences” held at IIT, Kharagpur on 23rd April, 2017.
- Attended VRDL-PI's meeting at the National Institute of Virology, Pune on 28th April, 2017 to discuss the challenges faced at VRDL.
- Attended the 60th State Conference of Indian Public Health Association (West Bengal Branch) as Chief Guest and delivered Prof. S.C Seal Memorial Oration 2017 on “Antimicrobial resistance: Today’s challenges and action plan for control” on 6th May, 2017 at NICED
- Participated in the Selection Committee meeting for the post of Accounts Officer, NICED held at ICMR-NICED on 16 May, 2017.
- Attended the Investigator's meeting for the project "National Surveillance System for Enteric Fever in India (Tier 1)" at the Pride Plaza Aerocity, New Delhi on 19-20th May, 2017.
- Attended the 7th Annual CME on “Tropical and infectious diseases” organized by Society of Tropical Medicine and Infectious Diseases in India at Hyatt Regency on 11th June, 2017.
- Attended the 1st meeting of National Steering Committee (NSC) as a Member under Technology Need Assessment (TNA) - Climate Change project of TIFAC - Health sector held on 28th June, 2017 at Technology Information, Forecasting & Assessment Council (TIFAC), New Delhi
- Attended the 2nd meeting of National Steering Committee (NSC) for health sector as a Member under Technology Need Assessment (TNA) - Climate Change Project of TIFAC held on 21st July, 2017 at Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi.
- Attended the Joint meeting of the project investigators along with the Steering Group for the “Etiology of Childhood Pneumonia in India” – ICMR task force study held on 2nd August, 2017 at National Institute of Pathology, Delhi.
- Attended the Expert group meeting to review the concept proposal on “Interchangeability study of rotavirus vaccine” held on 8th August, 2017 at NIE, Chennai organized by NICED.
- Attended the Meeting to discuss and formalize medical supplies as humanitarian assistance to the Republic of Yemen under the Chairmanship of Dr. Jagdish Prasad, Director General of Health Services at the Resource Centre, Nirman Bhawan, New Delhi on 16th August, 2017 to decide on the content and quantum of medical supplies to be provided to the Republic of Yemen
- As an Expert attended the Expert Group meeting for development of the Proposal on "Portable device for early stage and cost-effective diagnosis of typhoid in 6 hours" held on 18th August, 2017 at CSIR Headquarters, New Delhi
- Delivered a talk on “Feacal contamination of drinking water and its impact on diarrhoeal diseases” at the Brain Storming on Safe Water and Sanitation to be organized by The National Academy of Sciences, India (NASI) during 14-17 September, 2017 at NASI, Allahabad.
- Attended the North Zone Regional Consultation for Drafting State Health Action Plan for Climate Change & Human Health under the Chairmanship of Dr. Vishwa Mohan Katoch on 19-20th September, 2017 at Nirman Bhawan, New Delhi
- Nominated by Executive Committee of Indian Association of Applied Microbiologists, the Life Time Achievement Award for 2017 was conferred at the 15th National Conference of IAAM held on 22-23 Sept. 2017 at Vivekanandha College of Arts & Science for Women, Elayamalayam,

Namakkal Dist. Tamil Nadu. Attended the conference and delivered a talk on "Enteric vaccines: steps towards prevention of enteric diseases".

- Attended the First Annual Asia Pacific Meeting on Rotavirus and Rotavirus Vaccines, New Delhi, India held on 12-13 October 2017
- Attended as Guest of Honour the 76th CSIR Foundation Day Celebration at CSIR-IICB on 17th October, 2017
- Attended the First Meeting of Technical Working Group (TWG) to finalize the draft laboratory policy and strategic action plans prepared by NCDC on 23rd and 24th October, 2017 at Maidens Hotel, New Delhi
- Attended the National Conference on Virology with special reference to Virus Research Diagnostic Laboratories in India held on 26-27 October, 2017 at NIV, Pune and delivered an invited lecture on "Viral etiological agents other than group a rotaviruses associated with watery diarrhoea in Kolkata, India"
- Invited to Chair a session on "Diarrhoeal Disease Surveillance" at the 14th Asian Conference on Diarrhoeal Disease & Nutrition (ASCODD) and delivered a talk on "Enteric fever: current challenges and future perspectives" held during 30 October - 01 November, 2017 in Kochi, India
- Participated in the Hilleman Lab Science Day Workshop held on 2nd November, 2017 at The Imperial Hotel, New Delhi
- Attended the 4th Scientific Advisory Committee meeting of National Institute of Pharmaceutical Education and Research (NIPER)-Kolkata as a Member, held on 4th November, 2017 at Vivekananda Conf. Hall, Chunilal Bhawan, Kolkata.
- Attended the 3rd B.K. Bachhawat Memorial Lecture and Symposium on Chemical Biology Research at Dr. JC Ray Auditorium, IICB held on 13th November, 2017
- Visited the study site to Cadila, Ahmedabad to evaluate progress of the BIPP supported project entitled "Multivalenet Leishmania Vaccine Development" by Cadila Pharmaceuticals Ltd., Ahmedabad on 29th Nov. 2017
- Participated in the Media Training Workshop of ICMR-East held during 5-6th December, 2017 at ICMR-NICED, Kolkata
- Participated as Guest of Honour at the 86th Foundation Day of All India Institute of Hygiene and Public Health, Kolkata held on 5th January, 2018.
- Attended the NSSEFI Investigators meeting held on 23-24th January, 2018 at THSTI, Faridabad
- Delivered a talk on "Antimicrobial resistance: challenges and opportunities" at the International Conference on Antimicrobial Resistance (AMR) was jointly organized by NIPER and ICMR-NICED, Kolkata during 16-17 February, 2018 at NICED-II building, Kolkata
- Participated in the 52nd US-Japan Joint Panel Conference on Cholera and Other Bacterial Enteric Infections at Hat Yai, Thailand held during Feb 20-24 2018 and presented "Rapid diagnosis of cholera in outbreak situation: where do we stand?".

R. K. Nandy

- Acted as Joint Organizing Secretary for 'International Conference on Anti-Microbial Resistance (AMR)' organized jointly by NIPER and ICMR-NICED, Kolkata during 16-17th February, 2018 at NICED-II building, Kolkata.
- Poster presentation on 'Dysfunctional glyoxylate cycle attenuates *Vibrio cholerae* virulence' in 52nd US-Japan Joint Panel Conference on Cholera and Other Bacterial Enteric Infections held at Hat Yai, Thailand during 20th -24th February, 2018.

A. K. Mukhopadhyay

- Delivered a talk on "Antimicrobial peptide Polymyxin B: Altering the biotype attributes of *Vibrio cholerae* O1" in the 14th 'Asian Conference on Diarrhoeal Diseases and Nutrition, ASCODD held in Kochi, India from 30th October to 1st November, 2017.
- Invited by the Center for Global Safe WASH at the Emory University to attend an International Advisory Board Meeting for the SaniPath-Typhoid study between 28th February and 2nd March, 2018 at Emory University in Atlanta, Georgia, USA.
- Invited at the 52nd US-Japan Joint Panel Conference on Cholera and Other Bacterial Enteric Infections and also to deliver a talk on "Reconnaissance of Indian El Tor *vibrios* reveal incessant genomic changes" based on his research work during 20th -24th February, 2018 in Hat Yai, Thailand.

S. Basu

- 'Delivered an invited talk on 'The NDM story unfolds: lessons from the crib and beyond'. International conference on Antimicrobial resistance, held in Kolkata, India during 16th -17th February, 2018.
- 'International conference on Antimicrobial resistance, Kolkata, India', 16th -17th February, 2018. Incidence of bla_{NDM-1} in neonatal septicemic *Klebsiella pneumoniae* belonging to different sequence types (ST347, ST29 and ST2558) from North-eastern region of India. Subhankar Mukherjee, Anik Bhattacharjee, Sharmi Naha, Sanjib Kumar Debbarma, Tapan Majumdar, Sulagna Basu.
- 'International conference on Antimicrobial resistance, Kolkata, India', 16th -17th February, 2018. Plasmid mediated fluoroquinolone resistance in bla_{NDM-1} carrying Enterobacteriaceae isolates causing neonatal sepsis. Shravani Mitra, Sharmi Naha, Suchandra Mukherjee, Sulagna Basu.
- 'International Conference on Anti-Microbial resistance (AMR), Kolkata, India' 16th-17th February, 2018. (Received 2nd prize in poster & oral presentation). Moxifloxacin resistance in septicaemic *Acinetobacter baumannii* isolates from India: role of chromosomal mutations and efflux pumps". Roy S, Chatterjee S, Saha B, Chattopadhyay P and Basu S.
- 'Microbiology in the New Millennium: from Molecules to Communities, Kolkata, India', 27th -29th October, 2017. A comparative study between *Acinetobacter baumannii* and other genospecies of *Acinetobacter*s with respect to fluoroquinolone resistance mechanisms. Subhasree Roy, Somdatta Chatterjee and Sulagna Basu.
- 'Microbiology in the New Millennium: from Molecules to Communities, Kolkata, India', 27th -29th October, 2017. KPC-2 Producing Klebsiella pneumonia in a Neonatal Unit: Clonal Isolates with Differences in Colistin Resistance. Sharmi Naha, Subhankar Mukherjee, Sulagna Basu.
- 'MICROBE', New Orleans, Louisiana, USA, 2nd -5th June, 2017. *Acinetobacter baumannii* transfers bla_{NDM-1} gene via outer membrane vesicles. S. Chatterjee, A. Mondal, S. Mitra, S. Basu. Student Travel award and outstanding poster award from American Society of Microbiology was received by Somdatta Chatterjee.

H. Koley

- Invited Lecture on "*Shigella* Vaccine" on the occasion of MSD-Hilleman Laboratory Science day workshop on 2nd Nov 2017 at Imperial Hotel, New Delhi.
- Invited lecture at "Asian Society of Diarrhoeal Disease and Nutrition" conference (ASCODD) at Kochi between 30th October, 2017 to 1st November, 2017.

BIOCHEMISTRY

The Division of Biochemistry primarily focuses on in-depth understanding of the molecular mechanisms of host pathogen interaction using biochemical approaches. The molecules of interest are *Vibrio cholerae* chitinases, chitin-binding proteins, their regulators and colonization factors of enterotoxigenic *Escherichia coli* (ETEC). Researchers of this division address molecular characterization of these microbial proteins in relation to structure and pathogenesis of enteric diseases and host response. Knowledge generated aids ina greater understanding of the complexity of bacterial pathogenesis in the host. A recent aspect is broadly directed towards understanding of host pathogen interaction and its therapeutic approach. Disease develops as a result of a complex cascade of events from autophagic disruption to inflammation when infected by a pathogen. Investigating the molecular mechanism behind pathogenesis will help researchers to develop novel therapeutics. Natural inhibitors from plant sources will be targeted to inhibit the regulatory networks behind pathogenesis. Further, information gathered is being applied to establish molecular tools for detection of virulence markers in pathogenic strains during infection and to combat cholera and gastric diseases using pharmacological sources as inhibitors.

Scientists:

Dr. N.S.Chatterjee, Scientist F

Dr. S.Bhattacharya, Scientist B (Since 1st November, 2017)

Pre-Doctoral and Fellow:

Mr. Debjyoti Bhakat, SRF

Mr. Suman Das, SRF

Ms. Priyanka Basak, JRF

PhD Awarded:

Dr. Sudipto Mandal received Ph D. from the University of Calcutta

Title of the thesis: A study on effect and response of GbpA, a chitin-binding protein of *Vibrio cholerae* on intestinal cells during pathogenesis.

N. S. Chatterjee (Principal Investigator)

Studies on *Vibrio cholerae* adherence and survival in gut and environment

Vibrio cholerae O1, a cause of epidemic diarrheal diseases, normally resides in aquatic environment associated with the chitinous exoskeletons of zooplankton and utilizes chitin as the sole nutrient source by chitin utilization pathway. Presently, our studies are directed towards the understanding of this chitin utilization pathway of *V. cholerae* in environmental survival, horizontal gene transfer and pathogenesis. Chitin utilization pathway requires two factors, chitin binding protein and chitinases. The chitinases and the chitin utilization pathway are regulated by a two-component sensor histidine kinase ChiS (VCA0622) in *V. cholerae*. *V. cholerae* normally resides on the chitinous exoskeleton of crustacean shells in the aquatic region. Type 6 Secretion System (T6SS) in *V. cholerae* is a predatory killing device induced by chitin. This system promotes competitive advantage to *V. cholerae* in a polymicrobial community of the aquatic region under nutrient poor conditions. *V. cholerae* chitin sensing is known to be initiated by the activation of ChiS in presence of GlcNAc2 residues generated by the action of chitinases on chitin. Results showed that ChiS depletion or inactivation resulted in impaired bacterial killing and reduction in expression of T6SS genes. This effect of ChiS inactivation was due to reduced translation of tfoX that is known to be one of the regulators of T6SS. Active ChiS positively affected T6SS mediated natural transformation as well as expression of natural competence genes in *V. cholerae*. ChiS depletion or inactivation also resulted in poor growth and reduced colonization on insoluble chitin. Therefore, this study shows that *V. cholerae* colonization on chitinous surface activates ChiS which promotes T6SS dependent bacterial killing and horizontal gene transfer via upregulation of TfoX (Fig 14). Hence, it is proposed that ChiS plays an important role in *V. cholera* survival in a polymicrobial community under nutrient poor conditions.

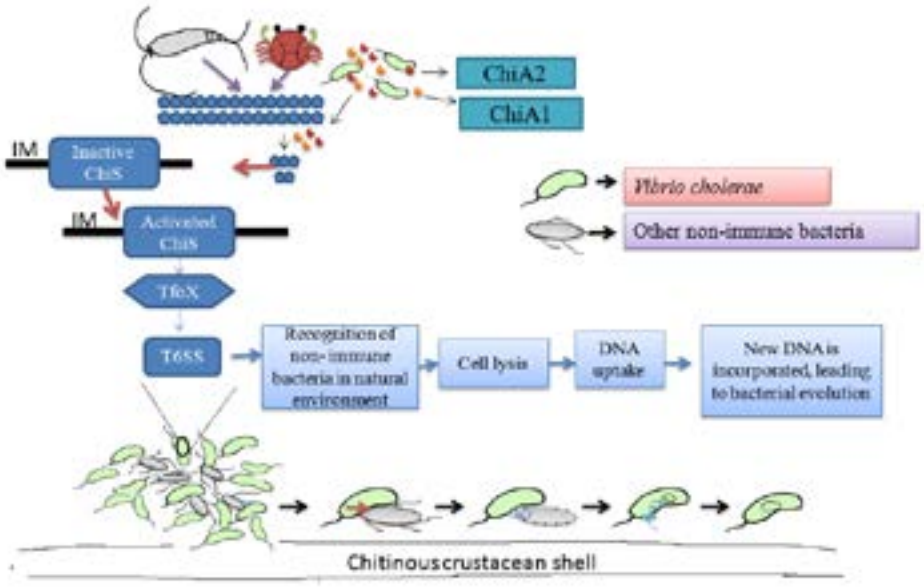

Fig 14: Schematic diagram showing that ChiS controls T6SS in *V. cholera* and helps it to survive under harsh environmental conditions in marine region. ChiSalso promotes T6SS induced DNA uptake and horizontal gene transfer

Molecular characterization of enterotoxigenic *Escherichia coli* colonization factors

Enterotoxigenic *Escherichia coli* (ETEC) infection is the leading cause of infantile diarrhea in developing countries and an important etiologic agent for traveler's diarrhea. Colonization factors (CF) play the important role in initiating the disease and had been the major vaccine targets. However, vaccines against CFAs had poorly performed which may be due to neglecting the other non-classical virulence genes. During this period of investigation, we aim to understand the distribution of enterotoxins, colonization factor and non-classical virulence factor profiles of clinical ETEC isolates between 2008 and 2014 from two Kolkata

hospitals. We used PCR for this genotyping study using gene specific primers against 2 enterotoxin genes, 11 common colonization factor genes and 5 common non-classical virulence factors (Table 7). All the ETEC strains were positive for enterotoxin genes. So far, among the 350 tested ETEC strains, 61% strains possessed *est+elt* genes followed by 25% *est* and 14% *elt* (Fig 15). Among 56% colonization factor positive ETEC strains, CS21 (37%) and CS6 (36%) were the prevalent ones, followed by the non-classical virulence factor genes that were present in 59% of the ETEC strains. Among non-classical virulence factors, EatA was the most prevalent (65%) followed by EtpA (51%). There were 29% strains negative for any colonization factors or the non-classical virulence factors. A pattern existed between CS6, EatA and the toxins. The heat-stable toxin gene *est* with or without *elt*, CS6 with or without classical colonization factor CS5 and with or without non-classical virulence factor EatA were present in 24% of clinical ETEC strains analyzed. CS21 has emerged as another predominant classical colonization factor but it had diverse combination with classical colonization factors and non-classical virulence factors. Understanding the prevalence of ETEC virulence factors would help in tracking ETEC globally and would help in suggesting the proper multivalent ETEC vaccine.

Table 7: List of virulence factors studied

Toxin	Classical colonization factors (CF)	Other virulence factors (NCVF)
elt (heat labile toxin) est (heat stable toxin)	CFA/I CS1, CS2, CS3, CS4, CS5, CS6, CS8(CFA/III), CS14, CS17, CS21	Eat A, EtpA, Tia, TibA, LeoA

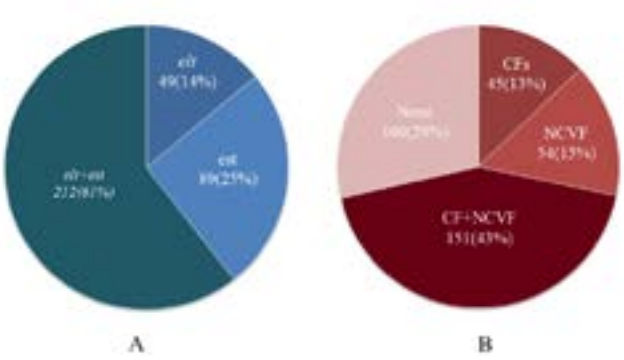

Fig 15: Distribution of toxin genes (A) and virulence factor genes (B) ETEC clinical strains isolated during the study period from individuals with diarrhea (n=350).

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

N. S. Chatterjee

- Participated at the Workshop on Biosafety and Risk Management under the Global Health Security program at New-Delhi organized by Integrated Quality Laboratory Services (IQLS), France in collaboration with Centers for Disease Control and Prevention (CDC), Global Disease Detection Center, Delhi, India during 9th -13th October, 2017.
- Attended the "ICMR Technical Committee" Meeting at ICMR Head Quarters, New Delhi on 22nd January, 2018.
- Attended the "ICMR Experts Committee" Meeting at ICMR Head Quarters, New Delhi on 5th February, 2018.

BIOINFORMATICS

Bioinformatics is an interdisciplinary field mainly involving molecular biology and genetics, computer science, mathematics, and statistics. Data intensive, large-scale biological problems are addressed from a computational point of view. With the availability of large number of genome sequences in public domain bioinformatics methods have been used to understand features, function, structure, or evolution of the genome sequences. Our thrust area is the analysis of genome sequences of human pathogens. Analysis of sequence data involves DNA and protein sequences for clues regarding function, identification of homologs, multiple sequence alignment, searching sequence patterns, and evolutionary analyses. We also perform analysis and prediction of protein structures (secondary and tertiary) and the associated problems regarding function, and structural alignment. Biological networks such as gene regulatory networks, metabolic pathways, and protein-protein interaction networks are usually modeled as graphs and graph theoretic approaches are used to solve associated problems such as construction and analysis of large-scale networks.

Scientist:

Dr. S.Basak, Scientist C (Since 6th December, 2017)

CLINICAL MEDICINE

The Division of Clinical Medicine carries out both hospital-based surveillance studies and translational research. Continued, hospital-based diarrheal disease surveillance is carried out for the past two decades. Under the surveillance study conducted at the ID & BG Hospital, Beliaghata, every 5th hospitalized patient of any age group is enrolled for five days a week. Another study is going on among children less than 12 years of age attending the OPD of B C Roy Postgraduate Institute of Pediatric sciences, Kolkata where again every 5th patient is enrolled. A second study carried out at the same hospital surveys for enteric fever by blood culture and Widal tests. Scientists from the Division worked as nodal persons in the activities related to dissemination of scientific knowledge and awareness programs at Science Fairs organized by Central Calcutta Science & Cultural organization for youth at New Barrackpore on 24th -17th August, 2017 and the National Fair on "Innovation in Science and Technology for Make-in-India" at Sonarpur on 14th -17th December, 2017.

Scientists:

Dr. Santasabuj Das, Scientist E
Dr. Abhik Sinha, Scientist C
Dr. Pallabi Indwar, Scientist B

Staff:

Mr. A. Pal, Technical Officer
Mr. K. G. Saha, Laboratory Assistant
Mr. S. Turi, Laboratory Assistant
Mr. A. Pramanik, MTS (general)

Post Doctoral Fellow

Dr. Ayan Lahiri – Research Associate (CSIR project)
Dr Shreya Dasgupta – ICMR Centenary Postdoctoral Fellow
Dr. Jayadev Joshi – Scientist II (ICMR project)

Pre-Doctoral Fellow

Ms. Pujarini Datta - SRF (DST-INSPIRE) (Thesis submitted)
Mr. Asim Biswas - SRF (CSIR) (Thesis submitted)
Mr. Sayan Das - SRF (CSIR) (Thesis submitted)
Ms. Rimi Chowdhuri - Technical Assistant (OUP3/4) (Thesis submitted)
Mr. Rahul Shubhra Mondal – Scientist I (ICMR project) (Thesis submitted)
Mr. Krishnendu Das – JRF (ICMR)
Ms. Suparna Chakraborty – JRF (DST-INSPIRE)

Ph D. Awarded:

Dr. Bhupesh Kumar Thakur received Ph D. from Department of Biotechnology, University of Calcutta

Title of Thesis: Studies on the regulation of innate immune responses at the intestinal mucosal epithelium and its relevance to gut homeostasis.

Dr. Atri Ta received Ph D. from Department of Biotechnology, University of Calcutta

Title of Thesis: Development of Novel Therapeutics against Enteric Infections.

S. Das (Principal Investigator)

Host-pathogen interactions in human Salmonella infection

Stringent response (SR) is a bacterial adaptive response mediated by hyperphosphorylated GTP/GDP derived molecules, called (p)ppGpp (also known as small alarmones) whose metabolism is governed by RelA and SpoT in Gram negative bacteria under conditions of nutritional scarcity and other physico-chemical stresses. Additionally, (p)ppGpp plays crucial roles in modulation of virulence and latency in several pathogens. *Salmonella* Typhi is a professional intracellular pathogen and the phagosomal niche is a hostile environment where the bacteria face nutrient starvation and multiple other stresses. We found that chromosomal deletion of RelA and SpoT generated a (p)ppGpp^0 *S.* Typhi strain, which failed to grow on nutritionally deficient or toxic media. Ty2ΔRelAΔSpoT was severely attenuated in swarming motility and biofilm formation and had significantly diminished capsule expression, all of which constitute critical virulence related traits of *S.* Typhi. Mice orally challenged with (p)ppGpp^0 *S.* Typhi showed no mortality in contrast to 100% death of mice similarly infected with the same dose of the isogenic wild type strain (Fig 16).

We have shown that gold nanoparticle tagged antimicrobial peptide (VARGWKRKCPLFGKGG), calledAu-VG16KRKP is non-cytotoxic to eukaryotic cells, but exhibits strong bacteriolytic activity against *S. lmonella* Typhi in culture. Au-VG16KRKP can penetrate host epithelial and macrophage cells and interacts with LPS of intracellular *S.* Typhi under in *vitro* and in *vivo* conditions. Treatment of mice with Au-VG16KRKP post-infection with *S.* Typhi resulted in reduced intracellular bacterial recovery and highly enhanced protection against *S.* Typhi challenge.

We have shown induction of humoral and cell mediated immune responses against *S.* Typhi after immunization of mice with a candidate subunit vaccine, rT2544. Our results showed induction of antibody dependent cellular cytotoxicity (ADCC). Immunized mice had significant percentages of T2544-specific antibody secreting cells (ASCs) in spleen, mesenteric lymph nodes (MLN) and Peyer's Patches (PP) and Cytotoxic T lymphotyes (CTL) in the spleen capable of destroying cells displaying T2544 antigen, in addition to T2544-specific memory B and T lymphocytes.

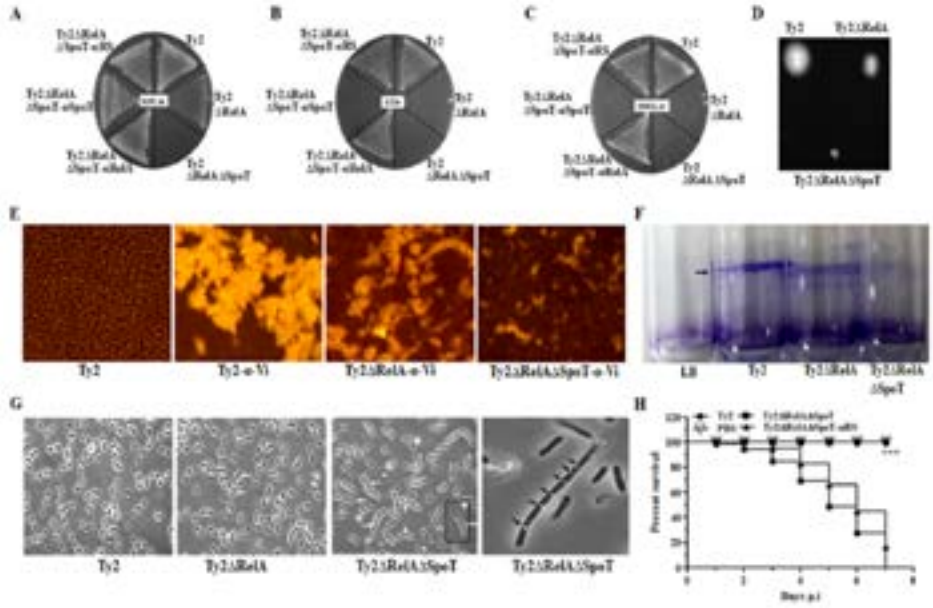

Fig 16: Functional analyses of (p)ppGpp^0 and complemented *S.* Typhi strains. A-C. Growth of indicated *S.* Typhi strains on nutrient starved minimal media containing 0.1% arabinose. As shown the (p)ppGpp^0 Ty2ΔRelAΔSpoT strain fails to grow on auxotrophic M9M (with Cysteine supplementation, since Ty2 is Δ*cys*), AT and SMGL media, while complemented strains rescue the growth defect. D. Motility agar plate showing swarming zone of strains as indicated. E. Dark field images showing agglutinated zones of indicated *S.* Typhi wild type and SR mutant strains with *Salmonella* specific αVi antiserum. Yellow coloured areas represent zone of agglutination and black rods indicate free bacteria. F. Biofilm formation as crystal violet stained ring in glass tubes, indicated by black arrow. LB without bacterial

inoculation was used as control. G. Phase contrast images showing morphology of indicated *S.* Typhi strains. White arrows indicate elongated morphology phenotype and black arrows indicate multiple nuclei within an elongated bacterium. H. Kaplan-Meier plot of cumulative mortality after 6-8 weeks old iron overloaded BALB/c mice (N=7) were orally infected with 10 x LD_{50} dose of indicated *S.* Typhi strains. 1% arabinose was used for induction. Significance calculated against Ty2. ***P<0.001 by log-rank comparison test.

Butyrate-induced regulation of intestinal homeostasis

Dietary fiber-derived short chain fatty acids, especially butyrate was shown to protect against colorectal cancer (CRC) development in numerous studies. To identify the most crucial genes,which are regulated by butyrate and may function as prognostic biomarkers of CRC, we constructed protein-protein interaction network (PPIN) with the differentially expressed genes from a whole genome microarray after butyrate treatment of HT-29 colon carcinoma cell line. We extracted thehub genes from the PPIN, which also participated in the APC-TP53 network (Fig 17). The idea behind this approach was that the common hub genes of butyrate and APC-TP53 networks could be critical for cell differentiation, and as a result,for colorectal cancer(CRC) prognosisdue to butyrate-induced relaxation of the perturbation caused by APC and TP53 mutations in HT-29 cells. Logistic Regression analysis of the mRNA expression profile of the common hub genesfrom seven large CRC cohorts showed strong evidence for the association of the commonhubs with CRC recurrence. We identified five novel biomarkers that increase the predictive value of theTNM staging for CRC recurrence and validated them against the TCGA-COAD (The Cancer Genome Atlas- Colon Adenocarcinoma) database.

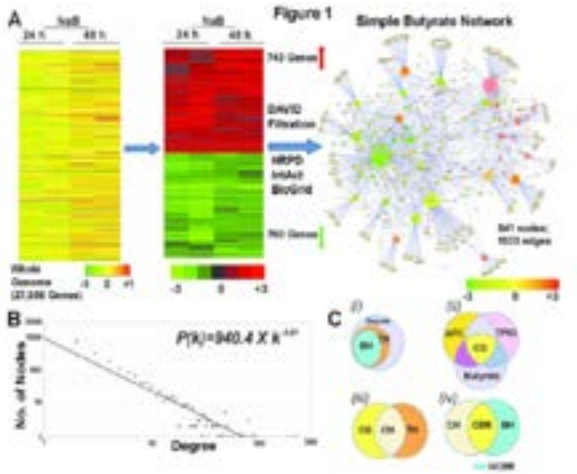

Fig17. (A) Construction of Butyrate network. The coloured circles represent node. Yellow nodes represent unaltered expression of the genes. Green nodes are downregulated, whereas the reds are up-regulated by butyrate (NaB) treatment. The blue edge connecting two nodes indicates the interaction between two proteins. Size of nodes is correlated with their number of interactions. (B) Butyrate Network Follows Power law. (C)Venn diagrams to identify common butyrate-regulated (CBR genes). BH-butyrate hubs, TH-total hubs, CH-common hubs.

Computational predictions of host-pathogen interactions and their validation

We developed a computational method to identify small RNAs (sRNA) in bacteria using machine learning approaches. The primary sequence and secondary structure features of experimentally-validated sRNAs of *Salmonella*Typhimurium LT2 (SLT2) were used to build the optimal model. We found that a tri-nucleotide composition feature of sRNAs achieved an accuracy of 88.35% for SLT2. We also validated the model on experimentally-detected sRNAs of *E. coli* and *Salmonella*Typhi. The proposed model was robust and attained an accuracy of 81.25% and 88.82% for *E. coli* K-12 and *S.* Typhi Ty2, respectively. We confirmed that this method significantly improved the identification of sRNAs in bacteria. Furthermore, using this model we identified sRNAs from complete genomes of SLT2, *S.* Typhi Ty2 and E. coli K-12 with sensitivities of 89.09%, 83.33% and 67.39%, respectively. A webserver was developed for the prediction of bacterial adhesion proteins (Fig 18).

Using statistical analysis, we describeddifferent sequence- and structure-related features whichdifferentiate bacterial sRNAs from other RNAs, such as tRNAs, rRNAs and mRNAs.We found that sRNAs differed significantly from other RNAs in terms of G+C composition, normalized minimum free energy of folding, motif frequency and other RNA-folding parameters. Based on selected features, we developed a predictive model using machine learning algorithm to classify the above four classes of RNAs. Our model displayed an overall predictive accuracy of 89.5%.

Fig18: Webserver for bacterial adhesion proteins prediction.

Clinical Research

Hospital-based Surveillance System for Diarrhoeal Diseases

Principal Investigator: S. Dutta

Co-Investigators: A. K. Mukhopadhyay, M. Chawla-Sarkar, S. Ganguly, S.S. Das, A.K. Deb

Hospital-based surveillance is ongoing since 1996 among the in-patients at I.D. & B.G. Hospital (IDH) and the outpatients of diarrhoea treatment unit (DTU) of Dr.B.C.Roy Post-Graduate Institute of Paediatric Sciences (BCRPGIPS), Kolkata. Of the 22,499 diarrhoea patients admitted at IDH during January to December 2017, 1,239 (5.5%) were enrolled under the surveillance, with an equal gender distribution (Male: 49.9%, Female: 50.1%). About a quarter [318 (25.7%)] were aged <5 years. During the same period, a total of 9,235 children attended the DTU of BCRPGIPS, of whom 1665 (18%) were enrolled. Majority [1,622 (97.4%)] were in <5 years age group with 62.2% being male.

Among the diarrhoea cases in BCRPGIPS, 89.1% had watery, 2.4% had semisolid and 8.5% had bloody stools. At IDH, 70.9%, 25.8 % and 3.3% had watery, semisolid and bloody stools, respectively on admission. Almost all diarrhoea cases enrolled at IDH were dehydrated at the time of admission (some: 90.6%, severe: 9.3 %). Vomiting was the main associated symptom (~86%) and about a quarter of the IDH patients also had fever. However, at BCRPGIPS, vomiting and fever affected patients were 49.7% and 34.7%, respectively.

In IDH, overall rotavirus isolation was 10.7% which comprised of 42.4% among the <5 years children whereas at BCRPGIPS, it was only 31%. In IDH, 9.4% cases were positive for *V. cholerae* O1, which remained susceptible to most of the fluoroquinolones, but highly resistant to co-trimoxazole, nalidixic acid and streptomycin. *V. cholerae* O1 strains isolated from both IDH and BCRPGIPS were susceptible to ampicillin as well as azithromycin (Fig 19). Multidrug resistant campylobacters were also found. Most of the *Shigella* strains were highly resistant to fluoroquinolones, but susceptible to azithromycin and ceftriaxone (Fig 20). The continued surveillance of diarrhoeal patients helps to determine appropriate management of diarrhoea in hospitals and also supports basic research at ICMR-NICED.

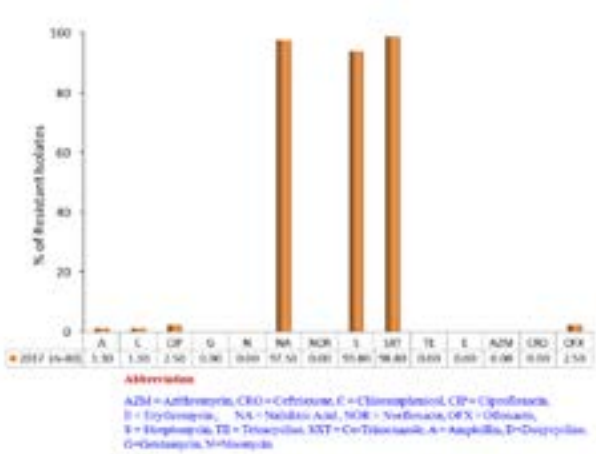

Fig19: *V.cholerae O1* Antimicrobial Resistance

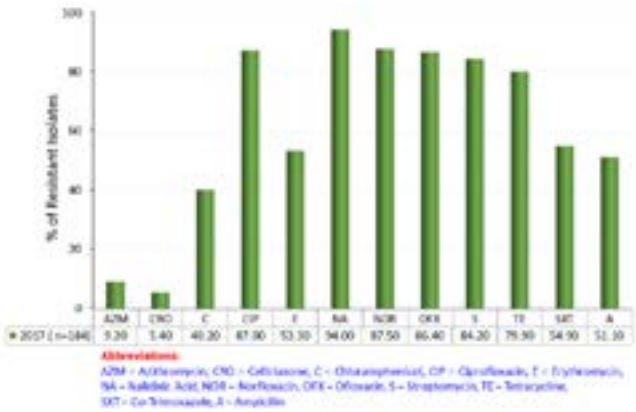

Fig20: Shigella antibiotic resistance

Awards/ Honours Received

A. Sinha

- Invited as a guest speaker in AIIMS, New Delhi to speak on Geriatric Mental Health Workforce on 16th December,2017 .

Conferences/ Seminars/ Workshops/ Meetings/ Trainings Attended/ Organised

S. Das

- Delivered a lecture on Vaccines and Immunotherapy on World Immunology Day, 2018 at CSIR-IICB, Kolkata.
- Delivered a lecture on "Type three secretion system independent epithelial invasion of *Salmonella* Typhi via T2942-Met Interaction"at the 52nd US-Japan Joint Panel Conference on Cholera and Other Bacterial Enteric Infections held at Hat Yai, Thailand during 20th -24th February, 2018.
- Delivered invited lecture on "Immune mechanisms in NASH: what all could be done to study" at Indian Institute of Liver and Digestive Sciences, Sonarpur, West Bengal on 6th February, 2018.
- Delivered invited lecture on "Modulating mucosal immune response to control intestinal infections and inflammation" at Indo-German Cooperation in Health Research Workshop on AMR at ICMR HQ on 18th -19th January, 2018.
- Rahul Shubhra Mandal, Ph.D. student presented a poster at "The EMBO Meeting" held at Hydelberg, Germany from 12th – 14th November, 2017.
- Jaidev Joshi, Scientist II presented a poster at "The EMBO Meeting" held at Hydelberg, Germany from 12th -14th November, 2017.
- Organized a 3-day workshop on 'Statistical principles and applications for biological data analysis' held at NICED Kolkata on 20th – 22nd September, 2017, attended by 20 participants.
- Taught 'Host-Pathogen Interactions' to the M.Sc Microbiology (4th Semester) students of the University of Calcutta.

A. Sinha

- MOHFW and WHO Meet for Development of National Action Plan for Viral hepatitis in New Delhi, 12th -13th October,2017
- National Round Table Meet on Viral Hepatitis organized by Liver Foundation on 9th September,2017

ELECTRON MICROSCOPY

The Division of Electron Microscopy focuses on ultrastructural studies at high resolution to understand the molecular mechanism of disease.There are one transmission electron microscope (TEM) and one scanning electron microscope (SEM) in this division used mainly for research and diagnosis. The techniques routinely used are negative staining analysis, Kleinschmidt's protein monolayer technique of DNA, partial denaturation mapping and heteroduplex analysis of DNA, protein-free spreading methods of DNA and RNA, immunoelectron microscopy, ferritin labeling, ultramicrotomy of cells and tissues to visualize ultrastructural changes, cryo-electron microscopy and three-dimensional image reconstruction technique, cryo-electron tomography and sub-tomogram averaging for in situ structure determination, scanning electron microscopy to obtain information about the surface topography and composition of cells, tissues and nanoparticles, atomic force microscopy for imaging the structure of DNA, RNA, protein-nucleic acid complexes, chromosomes, cellular membranes, cells or tissues.

Scientist:

Dr. M.Dutta, Scientist C

Staff:

Mrs. A. Sarbajna, Sr. Technical Officer (1)
Mr. S. Kumar, Laboratory Assistant
Mr. B. R. Mallick, Laboratory Attendant-2

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

M. Dutta

- Opening symposium and Inauguration of National CryoEM facility, January 24-25, 2018, InStem-NCBS Campus, Bangalore, organized by InStem-NCBS. Status of participation: Chaired a session.

EPIDEMIOLOGY & DATA MANAGEMENT

Epidemiology

The Division of Epidemiology at ICMR-NICED maintained its strive for addressing public health concerns at national and sub-national levels through community-based research in urban slums, rural areas, and even in hard-to-reach Sundarbans area of West Bengal. The scientists of this Division also contributed in the nation's effort in controlling HIV situation, especially in the North-Eastern States of the country.

Among the studies that have been completed during this period include a study to estimate the age-specific sero-prevalence of dengue as well as chikungunya and Japanese encephalitis viruses in India. The study encompassed fifteen states that were selected randomly from five geographic regions. From West Bengal, a total of 761 blood samples were collected from four selected districts, which were tested at the laboratory of ICMR-NIE, Chennai.

Another study titled "A Survey of What Information Research Participants Would Like to Know in Informed Consent Forms in Biomedical Research" was conducted to identify the necessary elements and the extent of information to be provided in the ICFs. As part of this multi-centric study, ICMR-NICED collected information from 152 participants that suggested that the research participants considered the benefit and risk associated with their participation to be more important than the general nature or technical details of the research. The study provided important insights to better address the challenges of determining the extent of information that is required in the ICFs.

Among the currently ongoing research projects, one study, initiated in October 2017 in Kolkata urban slums, intends to estimate the burden of culture confirmed typhoid fever in the community along with determining the incidence of acute febrile illness and its associated treatment practices in such communities. ICMR-NICED is a part of the four centres in India. Fever surveillance under this study, which is being carried out in four sites in the country, involves 6017subjects aged between six months and fourteen years.

Another study in Kolkata urban slums is being conducted among elderly population aged ≥60 years to estimate the burden of Acute Respiratory Tract Infection (ARI), associated influenza and other respiratory viruses infections as well as the risk factors underlying these viral infections and associated hospitalizations. This study also aims to estimate the economic burden due to influenza and other respiratory viruses infections as well as the effect of influenza infection on frailty and cognition among the elderly.This is a multi-centric study and one thousand and thirteen elderly subjects have been enrolled.

A research project titled "Rates of early initiation of breast feeding (EIBF) and exclusive breast feeding (EBF) up to 42 days of post-partum period and factors associated with failure to early initiation of breast feeding in rural West Bengal" is ongoing in a rural community of Hooghly district of West Bengal. The primary objectives of this study are to estimate proportion of newborns put on early breast feeding after birth and to estimate proportion of infants exclusively breast fed up to 42 days' post-partum period. The secondary objectives are to determine the factors associated with failure of early initiation of breast feeding, early interruption of exclusive breast feeding at 42 days' postpartum period and to estimate proportion of exclusively breast fed infant up to six months of age. So far, 249 mothers and their newborns have been recruited under this study and the work is under progress.

In the coastal Sundarbans region of West Bengal, ICMR-NICED has undertaken a study to delineate the role of climate variability on occurrence of diarrheal diseases, adjusted for the effects of relevant non-climate factors and to determine the linkage between temporal changes in water quality and occurrence of diarrheal diseases, including diarrheal outbreaks. To achieve its goal, the study is being carried out in a population of approximately 50,000 villagers in two geographically and demographically different panchayat areas. It will collect and analyze four major domains of information from appropriate sources - (a) data on relevant non-climate variables from various documents, (b) existing disease (diarrhea) data from the integrated disease surveillance programme (IDSP) as well as disease data through prospective diarrhea surveillance, (c) socio-demographic survey of study households, and (d) seasonal water quality data.

Data Management

The Division of Data Management aspires to undertake a formal orchestration of people, processes and technology to enable ICMR-NICED to leverage data as an organizational asset.This division primarily focuses on good data management practices in compliance with Good Clinical Practices (GCP) to produce the reliable, complete and accurate data from the various health research projects of this institute. The activities of the division spans the entire spectrum of research activities – from research study design to data quality assurance, data management, analysis and finally, publication in peer-reviewed journals.

The division plays a crucial role in managing the database created for undertaking the diarrheal disease surveillance which is currently being conducted at the Infectious Diseases Hospital (IDH), Kolkata, and Dr. B.C. Roy Post Graduate Institute of Paediatric Sciences, Kolkata (Fig 21). This surveillance, which has been running for two decades, helps to identify the patterns of etiologic agents responsible for causing diarrhoea, and to delineate the antimicrobial resistance patterns of the various bacterial pathogens, specifically *Vibrio cholerae*, *Shigella spp.* and *Escherichia coli*.This vital information is communicated on a weekly basis to the IDH authorities, and relevant Departments of the State Government, Kolkata Municipal Corporation (KMC), and the Integrated Disease Surveillance Program (IDSP), enabling evidence-based response from physicians and policymakers alike.

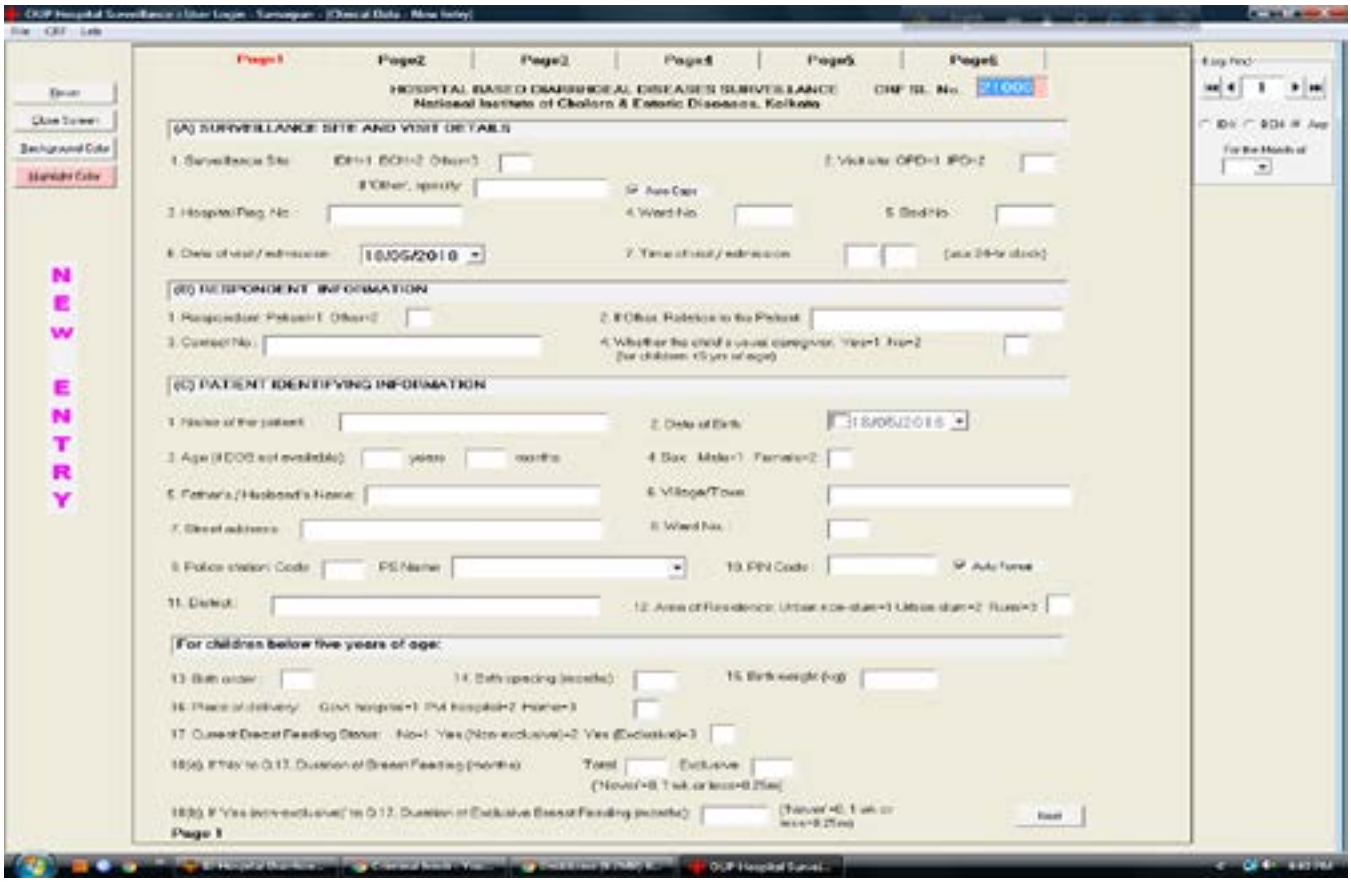

Fig 21: Example of data entry format for the diarrheal disease surveillance

The division also provides data management support, including activities related to data entry and verification, maintenance of data management systems, and data quality assurance for various studies being undertaken in the institute. The division has made invaluable contributions to data management for collaborative projects like National Surveillance System for Enteric Fever in India (NSSEFI); A multi-centric study to estimate the seroprevalence of dengue virus infection in India; Establishing a network of population-based influenza surveillance platform for elderly persons in India (INSPIRE-I); Strengthening/ Promoting evidence-based advocacy for influenza prevention and control in India (INSPIRE-II).

Activities related to paperless data collection using tablet or mobile devices, which transmit the data online to a secure server have also been initiated at the division (Fig 22). This has expanded the Institute's capacity to undertake large, multi-centre, collaborative studies where remote data capture and online transmission methods are adopted to streamline data management, improve data quality, and minimize data loss.

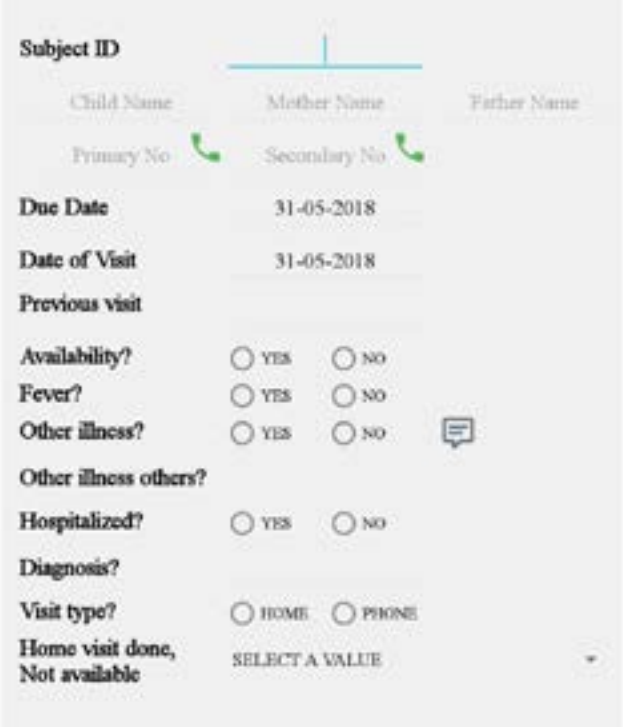

Fig 22: Interface for paperless data collection for the NSSEFI study

In keeping with the ICMR's strategic pillars, the division is also dedicated to building the capacity for health research in the state and the region. It has organized two workshops, which have seen enthusiastic participation from health researchers, from a wide variety of backgrounds. The workshop on research methods and biostatistics (July, 2017) was attended by 38 participants, hailing from different parts of the country. The workshop on systematic review and meta-analysis in healthcare, organized in collaboration with the Division of Epidemiology, trained 21 participants from across the country in undertaking systematic evidence synthesis – which contributes to yet another strategic pillar of ICMR. The division is now considering scaling up these activities on a regular basis to contribute to the building of health research capacity in the region.

The division continues to render statistical assistance for clinical, epidemiological, and laboratory research, as well as support to PhD students conducting thesis work in a wide variety of subjects.

The division will pursue the ideal of creating a milieu of excellence in data governance in the Institute in order to

a) enable informed evidence-based decision-making
b) reduce operational friction in conducting research projects
c) protect the needs and rights of data stakeholders
d) train healthcare researchers in research methods, epidemiology and basics of biostatistics methods
e) build frameworks enabling implementation of standardized, repeatable data management actions with verifiable accuracy
f) reduce costs and
g) improve transparency of data management

Scientists:

Dr. B. Manna, Scientist F (till 30.11.2017)
Dr. K. Sarkar, Scientist F (till 18.12.2017)
Dr. S. Panda, Scientist F (till 19.12.2017)
Dr. A. K. Deb, Scientist E
Dr. S. Kanungo, Scientist E
Dr. F. Debnath, Scientist C
Dr. P. Chatterjee, Scientist B

Staff:

Mr. R. L. Saha, Sr. Technical Officer (2)
Mr. S. Shil, Sr. Technical Officer (1)
Mr. C. Mandal, Sr. Technical Officer (1)
Mr. A. Chakraborty, Technical Assistant

K. Sarkar (Principal Investigator)

Strengthening/promoting evidence-based advocacy for influenza prevention and control in India

Co-Principal Investigator: S. Kanungo

Co-Investigators: A. Chakrabarti, B.Manna

Respiratory viruses like influenza virus and RSV are associated with large number of acute respiratory infections (ARI) among elderly population. However, there is paucity of data on burden of influenza among the elderly in India. Preliminary estimates, from a national sample survey of deaths (2010-13) in India found that influenza-associated annual excess respiratory mortality rate ranged from 3.4-4.8 deaths per 100,000 populations, resulting in estimated 41,169-58,121 influenza-associated excess respiratory deaths each year in India.However, due to lack of information on epidemiology of influenza and other respiratory viruses among elderly population, the programme is silent on interventions including immunization against influenza in this age group.

This study aims to estimate the burden, risk factor, economic burden of ARI and associated influenza and other respiratory viruses infections as well as to estimate the effect of influenza infection on frailty and cognition among a cohort of elderly (≥60 years) at four study sites in India. Ward-58, one of the administrative ward in Kolkata Municipal Corporation, was selected as NICED study area. One thousand and thirteen elderly subjects were enrolled from the study area. Enrollment initiation date was on 04 Sep 2017 and ended on 25th Sep 2017. Baseline household information was collected from each enrolled. The surveillance (dry run) was initiated on 04thDec 2017 and ended on 29th Dec 2017. Sample collection started from 01st Jan 2018.Till date (10th April 2018) 89 nasal and oro-pharyngeal swabs were collected from 498 Acute Respiratory tract infection cases. The surveillance is conducted through active surveillance, using tablets in the field (Fig.23). All the household and individual information are captured through ODK system (Open Data Kit) in the tablets and are transferred to the local server and uploaded in the central data repository. Dashboard is maintained to monitor the surveillance

Fig 23: Use of Tablets in field level

S. Panda (Principal Investigator)

Quality of life of children living with HIV

Support for children living with HIV (CLH) in India mostly focuses on biologic aspects of the disease. However analysis of a recently completed study revealed that the health related quality of life of CLH in West Bengal was poorer compared to that in socio-demographically comparable group. Based on this finding, the concerned Scientist of ICMR-NICED, facilitating this study, highlighted the need for development of culturally and developmentally appropriate psychosocial intervention for CLH who are yet to receive adequate program coverage in the country.

Initiative to develop policy brief & capacity building

Development of policy briefs was undertaken by Indian Council of Medical Research (ICMR), New Delhi as a central endeavor. Dr Samiran Panda from ICMR-NICED took part in one of the workshops organized under this initiative at the National Institute of Malaria Research (NIMR), during 24th-25th July, 2017. Subsequently he worked with 4 other scientists (Dr Pranab Chatterjee, Dr Alok K Deb, Dr Suman Kanungo and Dr Shanta Dutta) to initially conduct a systematic review based on which a policy brief with considerations around use of oral cholera vaccine in India was developed. The document is now in public domain and available on ICMR website.

A. K. Deb (Principal Investigator)

The interplay of climate and non-climate factors in determining the risks and predicting outbreaks of waterborne diseases

Project Coordinator: S. Dutta;

Co-Principal Investigator: A. Palit

Co-Investigator: F. Debnath, A. De

The objectives of this project are: (a) to improve our understanding of the role of climate variability on occurrence of diarrheal diseases, adjusted for the effects of relevant non-climate factors, (b) to determine the linkage between temporal changes in water quality and occurrence of diarrheal diseases, including diarrheal outbreaks, and (c) to develop a composite index for generating early warning for diarrheal outbreaks. The study, being conducted in two village panchayat areas in the Sundarbans area of South 24-Parganas district, will use four data collection processes - (a) data on relevant non-climate variables from various documents, (b) existing disease (diarrhea) data from the integrated disease surveillance programme (IDSP), (c) baseline survey of study households, and (d) prospective diarrhea surveillance within the study population. Trained study staffs recruited from the local communities have been engaged for conducting baseline survey as well as collection of diarrhea surveillance data. Trained laboratory staff along with these field staff are collecting and testing seasonal water samples (Fig.24) from pre-selected sources identified through a hand-sketched map of water sources in the study areas. Information on relevant non-climate factors are being collected through appropriate online as well as offline sources. However, for convenience, collection of all climate data from Regional Meteorological Department and extraction of IDSP data will be done towards the end of the study. All information are being entered into a study-specific database designed using Epi-Info (ver 7.2.2) software.

Fig.24: Water specimen collection from the study area

S. Kanungo (Principal Investigator)

A Survey of What Information Research Participants Would Like to Know in Informed Consent Forms in Biomedical Research

An ICF is mandatory and essential in most clinical studies as it is a primary source for disclosure of information and documentation of participants' consent in clinical research. The current practice shows that most ICFs in clinical research have been lengthened over time which could undermine the validity of consent obtained since potential participants are less likely to thoroughly read and understand the information provided. Therefore, empirical data are needed to inform investigators/ researchers related to the type and extent of information research participants need considering their diverse socioeconomic backgrounds and cultural settings affecting their decision on participation in research.

At the international level, this survey was conducted at seven FERCAP member countries- India, Indonesia, Malaysia, Philippines, Sri Lanka, Taiwan and Thailand. At the national level four centres -i) NICED (Kolkata), ii) NIRT (Chennai), iii) NIRRH (Mumbai), iv) SGPGI (Lucknow) were selected as study setting. The objective of this study was to identify the elements and the extent of information in informed consent form (ICF) that research participants in biomedical and health research would like to know.

A total of 152 participants were included by NICED and data was collected through an anonymous, self-administered, structured, paper-based questionnaire.Overall, the respondents wanted to know most of the 37 elements depicted in the questionnaire as ICF content required, rated as 'moderate to very important'. A few elements were considered 'slightly important' or 'lower' by the participants. The acceptable number of pages in the ICF that most of the research participants preferred to read was 4-6 pages. A few respondents commented, suggesting additional information needs. The majority of these comments showed their demand on treatment facilities (Table 8).

Table 8: Summary of the scientific outcomes of FERCAP study at the national level

Domains	Major findings
Elements considered most important in ICF	The respondents gave maximum concern to the items related to risk and benefit in ICF which included elements of' Possible benefit to you', 'Major foreseeable risk factors'and 'Common side effects of the interventions'. Other items which were given more importance were'Compensation policies and treatment available to you in the event of research-related injury', 'Relevant information about research interventions' and Anticipated benefits to the society'.
Page length of iCF	An approximately 3 to 6-page-long ICF seems to be acceptable to general population in India.
Respondents' information needs on ICF elements based on their socioeconomic backgrounds and nature of research.	Female participants gave more importance to many elements of ICF than male participants and few elements also differed significantly with education level and occupation. The participants involved in experimental research were more concerned for many elements than those involved in observational research.

National Surveillance System for Enteric Fever in India (Tier-1)

Principal Investigator: S. Dutta

Co-Principal Investigator: S. Kanungo

Co-Investigators: B. Manna, P. Chatterjee

The study is designed to estimate the burden of culture confirmed typhoid fever in the community and to

describe the incidence of acute febrile illness and its associated treatment practices in the community. The study had been initiated in Urban/semi urban populations in four states in various locations of India (Tamil Nadu, Maharashtra, Delhi and West Bengal). Each site had enrolled minimum of 6000 children and follow them up for 24 months. In Kolkata, the study is conducted in Wards 58 and 59 of Kolkata Municipal Corporation area. Two thousand children were enrolled in each age group of 6 months-4 year, 5 – 9 years and 10 -13 years respectively. Consenting and enrolment was started on 6th Nov-2017 and completed on 28th Dec 2017.Through a combination of weekly fever surveillance (Pic 1) and self-reporting of febrile episodes by the primary care givers to the Community health workers, fever cases are identified. Fever episodes are followed up daily until the end of the episode by dedicated Community Health Workers (CHW). Any febrile episode meeting the criteria for suspected typhoid fever(a fever of three or more consecutive days) are encouraged to report at the fields clinic where study physician evaluate and draw blood sample (Pic 2) for culture as per protocol. The culture confirmed typhoid cases are followed up at day 28 of the fever onset and 2-5 ml blood are drawn to look for the immune markers of disease. Some medicines like antipyretic and antibiotic are provided free of costs from the clinic, as per prescription by the study physician. Data are collected through electronic data capturing system (EDSS) at the site level.

Pic 1 : Regular surveillance with tablet at the household level

Pic 2 : Clinical activity at the community level

A multi-centric study to estimate the sero-prevalance of dengue, chikungunya and Japanese encephalitis virus infection in India.

Principal Investigator: S. Dutta

Co-Investigators: S. Kanungo, P. Chandra Sadhukhan

The study was designed to estimate the age-specific sero-prevalence of dengue virus infection and to estimate the sero-prevalence of chikungunya and Japanese encephalitis virus in India. In India, very little information is available about dengue sero- prevalence. Hence, a nationwide cross- sectional survey among individuals aged 5-45 years was conducted to estimate the age-specific sero-prevalence. For the purpose of the survey, the country was divided into five geographic regions – North, Northeast, East, West and South and three states were selected randomly from each geographic region. From each of the selected states, four districts were selected by probability proportional to population size, linear systematic sampling (PPSLSS) method and from each selected district, two clusters from rural areas and two clusters from urban areas were selected by Simple Random Sampling (SRS) method. From the selected cluster, one Census Enumeration Block (CEB) was selected in each area by Simple Random Sampling (SRS). Overall, 7920 persons (5 geographic regions X 3 states X 4 districts X 4 clusters X 3 age groups X 11 persons) was surveyed throughout India. After obtaining written informed consent and assent, the selected person or parent (in case of children) from four selected districts of West Bengal i.e Paschim Medinipur, Bankura, Burdawan and Dakshin Dinajpur were interviewed to collect information about socio-demographic details and past history of dengue fever and followed by bleeding. Consenting and bleeding was initiated on 10th Oct 2017 and ended on 16thDec 2017. Three to five ml of blood sample was collected from 761 subjects in West-Bengal (Table 9). Sera was separated and transported to NIE, Chennai for laboratory investigations. All the data were captured at the filed level through tablets and were transferred to central data repository from the field level

Table: 9 District wise Blood collection status

District	Number of blood sample collected (5yrs-8yrs)	Number of blood sample collected (9yrs-17yrs)	Number of blood sample collected (18yrs-45yrs)
Paschim Medinipur	57	60	59
Bankura	64	64	66
Burdawan	66	64	60
Dakshin Dinajpur	63	68	70
Total	250	256	255

F. Debnath (Principal Investigator)

Rates of early initiation of breast feeding (EIBF) and exclusive breast feeding (EBF) up to 42 days of post-partum period and factors associated with failure to early initiation of breast feeding in rural West Bengal

This is an ongoing intramural research project. The primary objectives of this study are to estimate proportion of newborns put on early breast feeding after birth and to estimate proportion of infants exclusively breast fed up to 42 days' post-partum period. The secondary objectives are, to determine the factors associated with failure of early initiation of breast feeding, to determine the factors associated with early interruption of exclusive breast feeding at 42 days' postpartum period, to estimate proportion of exclusively breast fed infant up to six months of age among those who will be exclusively breast fed up to 42 days' post-partum period. We opted a cohort study design for this purpose. We are conducting this study in Dhaniakhali Block of Hooghli District, where we need to recruit 319 newborns, assuming 38.3% of them are put on early initiation of breast feeding, odds ratio of two, 80% of power, 95% confidence interval and accounting for 10% of non-response. After obtaining all necessary approvals, we have started recruiting study participants who delivered at Dhaniakhali Rural Hospital. So far, we have recruited 249 mothers & their newborns in our study. The work is under progress. We are collecting information on sociodemographic, knowledge and attitude regarding breast feeding, delivery related issues, newborns' information, information related to EIBF & EBF using semi structured questionnaire (Table10). Post recruitment every infant is visited every week up to 42 days' post-partum period to collect information on EBF. Another visit is being paid one weak prior completing six months to collect information on EBF till that period, but this visit will only be paid to those who remained to be exclusively breast fed up to 42 days' post-partum period.

Pic 3: Interviewing one of our study participants at Dhanikhali block of Hooghli District.

Pic 4: Interviewing one of our study participants at Dhanikhali block of Hooghli District.

Pic 5: Project team members at Gurap HSC, Dhaniakhali block, Hooghli district

Table 10: Baseline characteristics of the participants, Dhaniakhali, Hooghli district, 2017-18 (N=169)

Characteristics		n	%
Age	≤22	89	53
	>23	80	47
Parity	Primipara	80	53
Religion	Hindu	152	90
Caste	ST	62	37
	SC	78	46
Educational qualification of the mother	Up to primary	98	58
	Illiterate	23	14
Educational qualification of the father	Up to primary	111	66
	Illiterate	25	15
Socioeconomic status	Lower	154	91
Family type	Joint family	80	49
Families where father of the child is the major earner		59	36
BMI	<18.5Kg/m^2	22	13
	23-27.5 &>27.5 Kg/m^2	42	25

P. Chatterjee (Principal Investigator)

Identifying Strategic Priority Areas for the Control of Enteric Infections in West Bengal (SPACEWeB)

Co-Investigator: S. Kanungo

The aim of the proposed study is to provide policymakers and research funding agencies with a structured understanding of the enteropathogens affecting West Bengal, and a mapping of the existing knowledge gaps and the priority research areas needed to address the prevention and control of the priority agents.

The specific objectives of the study are to identify a prioritized list of enteric infectious diseases which are of public health importance in West Bengal; and to identify the knowledge gaps and a prioritized list of research options needed to address these options.

The SPACEWeB team adopted the methodology developed by the Child Health and Nutrition Research Initiative (CHNRI). The CHNRI approach has been adopted and validated in multiple settings including the context of zoonotic diseases in India; diarrhoea in multiple countries, including several low- and middle-income nations; and mental health issues.

The project will lead to the identification of a prioritized list of enteric pathogens, with respect to their public health importance and mechanisms for prevention and control. Further, this project will also identify gaps in the existing knowledge about the optimal methods for prevention and control of these priority pathogens. The study adopts the modified CHNRI methodology, which will further help us to identify a list of priority research options which can be undertaken to address the vital gaps in the existing knowledge.

In line with the recommendations of the SAC, the investigator undertook methodological training in priority setting as well as scoping literature review activities. The steps that have been completed in the current project include

a) Training in the methodology of scoping literature review

b) Training in the process of priority setting using the CHNRI methodology

c) Scoping review comprising of search strategy set up, initial literature searches, initial list of 283 publications, both from peer reviewed and grey sources and details of the publications included in the scoping review, following the PRISMA flow (Fig 25)

d) Process of stakeholder mapping has been initiated; the included stakeholders will be invited to be a part of the consortium conducting the work on priority setting (Fig 26)

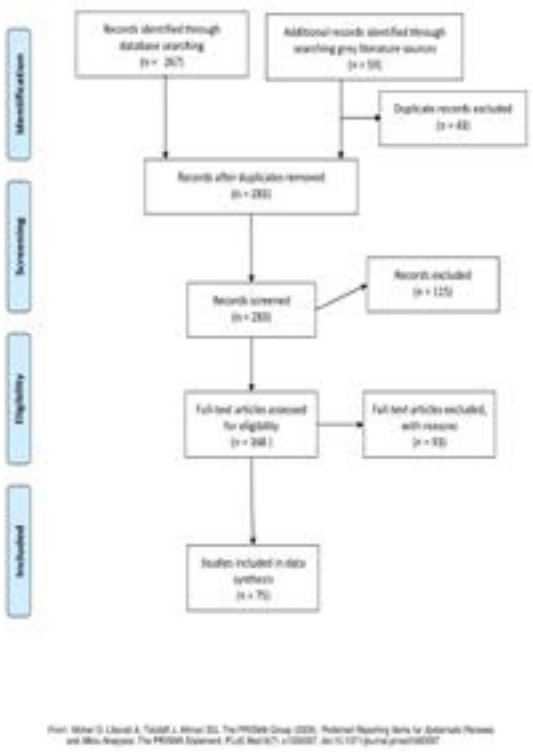

Fig 25 : PRISMA flowchart of publications included for the scoping review

Fig 26 : Study progress Gantt Chart

Eco-Bio-Social Determinants of Dengue in an Urban Agglomeration of Kolkata, West Bengal

Co-Investigators: R. Gupta, F. Debnath

The overall aim of the study is to aid in the development of targeted interventions for the control of dengue in an outbreak prone, highly endemic urban focus of the metropolitan city of Kolkata. The specific objectives to that end are to estimate the incidence of dengue in a highly endemic, outbreak prone urban focus in Kolkata, West Bengal and to identify the eco-bio-social determinants associated with the occurrence of dengue in a highly endemic, outbreak prone urban focus in Kolkata, West Bengal

Dengue has re-emerged as a public health scourge in urban India. However, little is known about its eco-epidemiology in the urban Indian milieu. Further, accurate estimates of the burden of dengue, specifically, its incidence and clinical outcome in highly vulnerable populations residing in densely populated urban agglomerates remains elusive.

We propose to estimate the burden of dengue infection (incidence) in Baranagar, which has been struck by dengue outbreaks multiple times in recent years, using a facility-based surveillance combined with healthcare utilization surveys at the baseline. Further, we propose to employ a mixed methods appraisal of the recruited cases, to explore the eco-bio-social risk factors predisposing to dengue infection.

This study is likely to uncover eco-epidemiological factors contributing to the persistence and propagation of dengue in urban India, and thus, help in developing an evidence-informed approach to prevention and control of dengue in high risk, densely populated, outbreak prone, urban foci.

Awards/ Honours Received

P. Chatterjee

- Conferred the Fellowship of the Royal Society of Public Health, United Kingdom, in January 2018

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

K. Sarkar

- One training course was organised to train nurses and field workers on collection of data using hand held devices

S. Panda

- Resource person in the workshop organized by the National AIDS Control Organization (NACO) and titled "Operational Research & Ethics in HIV/AIDS'' during 30th January – 2nd February, 2017 and also guided a follow on endeavor to finalize the draft research protocols in a workshop organized during 16th -17th October, 2017.

A. Deb

- Acted as the faculty for hands-on training in the workshop on Research Methodology & Biostatistics organized by and held at ICMR-NICED during 18th -20th July, 2017
- Participated as a resource person in the workshop on Epidemiological Investigation for Rising HIV Epidemic in Select North Eastern States, held at Regional Institute of Medical Sciences, Imphal during 12th -14th February, 2018
- Acted as a faculty in the workshop on "Systematic Review and Meta-Analysis in Healthcare," organized at ICMR- NICED, Kolkata from 7th to 9th March, 2018.

S. Kanungo

- Attended 10th International Conference on Typhoid and Other Invasive Salmonelloses ,held on 4th -6th April, 2017 in Kampala, Uganda
- Oral Presentation titled "Oral Cholera Vaccines: From Experience to Evidence in Controlling Cholera in Endemic Areas at the 14th International Conference on Diarrheal Disease & Nutrition (ASCODD), held 30th October 2017 to 1st November, 2017 at Kochi
- Attended as delegate in the 62nd Annual Conference of Indian Public Health Association, held from 9th -11th February 2018, at King George Medical University, Lucknow.
- Presented Poster titled "Can Single Dose Based Oral Cholera Vaccine (OCV) Campaigns Combat

Cholera Outbreaks in India? Evidence Synthesis for Policy Responses at the 52nd Joint Panel on Cholera and Other Bacterial Enteric Infection, held from 20th -24th February, 2018 at Prince of Songkla, Hat Yai, Thailand

- As a faculty in Workshop on Basics of Research Methodology and Biostatistics, organized by ICMR-National Institute of Cholera and Enteric Diseases from 18th -20th July, 2017.
- As a faculty in the Workshop on Systematic Review and Meta-Analysis organized by ICMR- National Institute of Cholera and Enteric Diseases from 7th -9th March, 2018

F. Debnath

- Member of the organizing committee on "International Conference on Anti-Microbial Resistance (AMR)" 16th -17th February 2018 at ICMR-NICED and this was a joint initiative of ICMR-NICED & NIPER, Kolkata.
- Attended the "SIDCER Survey" in September'17 as a participant and the training was organised by TATA Medical Centre, Kolkata.
- Participated in the "ECHO India immersion training" organised by ECHO India, New Delhi at New Delhi during March 2018.
- Organized workshop on "Research Methodology and Biostatistics" at ICMR-NICED during 18th -20th July, 2017 along with the other colleagues of Epidemiology division.
- Organized workshop on Systematic Review and Meta-analysis in Healthcare during 7th -9th March 2018 at ICMR-NICED.

P. Chatterjee

- Member of the Organizing Committee of the International Conference on Antimicrobial Resistance, which was organized by ICMR-NICED and NIPER, Kolkata jointly, at the premises of ICMR-NICED on 16th -17th February, 2018.
- Attended the 52nd Joint Panel Conference on Cholera and Other Bacterial Enteric Infections at The 60th Anniversary of His Majesty the King's Accession to the Throne International Convention Center, Hat Yai, Songkhla, Thailand, between 20th -24th February, 2018. Presented a poster titled "Cholera Outbreaks in India (2009-2017): Identifying Hotspots and Trends for Informed Policy Responses"
- Organized and took a session on "Reference Management" at the Workshop on Research Methodology and Biostatistics, held on 18th -20th July, 2017, at ICMR – National Institute of Cholera and Enteric Diseases, Kolkata.
- Iinvited faculty at the Workshop on Reference Management using Mendeley, held on 6th September, 2017, at the College of Medicine and Sagore Dutta Hospital, Kolkata.
- Participated in the Media Training Workshop, held on 5th -6th December, 2017, at ICMR – National Institute of Cholera and Enteric Diseases, Kolkata, which was organized by ICMR HQ, Global Health Strategies through the ICMR Communications Unit; nominated at the Nodal Communications Officer for ICMR-NICED.
- Attended the Public Health Dynamics Workshop 2018, held on 5th -7th March, 2018, at ICMR HQ, Delhi, organized by the Public Health Dynamics Laboratory of University of Pittsburgh and ICMR HQ.
- Organized and took sessions in the Workshop on Systematic Review and Meta-Analysis in Healthcare held on 7th -9th March, 2018, at ICMR – National Institute of Cholera and Enteric Diseases, Kolkata.

IMMUNOLOGY

A large symbiotic ecosystem resides in our gut called microbiome. The gut microbiome is established just after birthand is now considered to be the new biomarker of human health. Small imbalances caused by any disease can disturb the equilibrium between the microbiome and the host. In such situations the microbiota can become an amplifier of various pathological effects. These microbial populations in our gut calibrates the host innate and adaptive immune responses. The network of various interactions characterizes the interdependence between the gut microbiome and the host immune system. These 2 systems regulate one another orchestrating the host physiology.

We focus to understand the paradigms of interactions between the microbiome and our immune system by evaluating the mechanism that are involved in their crosstalk or identify the key factors which leads to the survival of the nonself commensal bacteria within the gut. We also study to decipher the complex relationship between the microbiome and the enteric pathogen in a goal to develop therapeutics either for removing the disease causing enteric bacteria or by boosting the beneficial bacteria.

Scientist:
Dr. T. Biswas, Scientist G (till 31st January, 2018)
Dr. M. Bhaumik, Scientist C

Staff:
Mr. S. K. Shaw, Technician B
Mr. N. C. Mondal, Laboratory Assistant

Pre-Doctoral Fellow:
Mr. Mainak Chakraborty (CSIR-JRF)

T. Biswas (Principal Investigator)

Porin-induced immunopotentiation of B cells: Ultimate role of an adjuvant

Toll-like receptor (TLR) agonists act by themselves as adjuvants for antibody (Ab) responses and thus are investigated as adjuvants for vaccines. Porins, the major outer membrane proteins of Gram-negative bacteria, are primarily TLR2 ligands and are robustly immunogenic. They are known for augmenting the humoral response of otherwise poorly immunogenic substances like polysaccharides and peptides.

Since convalescing Abs to porin of *Shigella dysenteriae* type 1 were found in patients recovering from shigellosis, it prompted us to purify the molecule to homogeneity and characterize it as an adjuvant. Porin, not only display immunomodulatory role in stimulating TLR mediated signaling but also coordinates innate signaling with adaptive immune response. Thus its role in driving systemic immunity would be the hallmark of a successful adjuvant. We found that porin activated splenic follicular zone (FO) B cells via TLR2 & 6 up-regulation followed by expression of activation markers CD69, CD40 along with co-stimulatory molecule CD86. This TLR mediated signaling suggests that resting FO B cells can be activated for effective priming of T cells via co-stimulation and Ag presentation. These B cells produced TLR2 dependent cytokines in response to porin since IFN-g, TNF-α and IL-12 production could be abrogated by the TLR siRNAs (Fig 27) validating the central role of TLRs in mediating proinflammatory response.

B cells have a fundamental role in Ab formation through production and sustenance of immunity against pathogens. Next we investigated whether these B-2 cells give rise to plasma cells. Immunized mice B-2 cells showed elevated expression of germinal center marker GL7 with CD138/syndecan-1, the plasma cell marker. CD138+ porin immunized cells showed specifically IgG2a and IgG3 expression.

Our work shows adjuvant action of the protein delineates the complex immune pathway leading to plasma cell formation and Ab production, thus explaining how adjuvants provide heightened immunity.

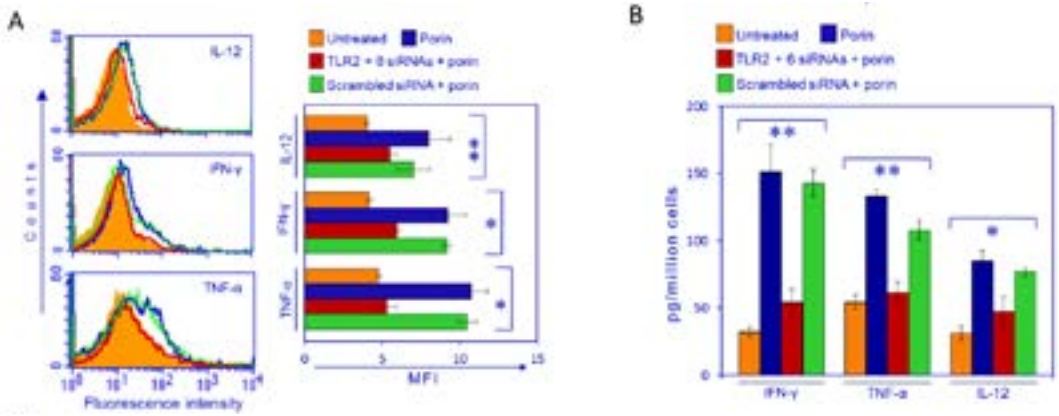

Fig 27: (A) Intracellular expression and (B) release of proinflammatory cytokines.

PARASITOLOGY

Parasites cause serious health problem across the globe with special emphasis in developing countries due to lack of proper resources and sanitation. The situation is further complicated by the emergence of drug resistant newer clones. Progress in controlling, eliminating or eradicating parasitic infections is a key part of the International health agenda. Keeping this in mind this Division of National Institute of Cholera and Enteric Diseases (NICED) is conducting various research programmes on *Entamoeba histolytica*, the causative agent for ameobiasis, and major enteropathogens like *Giardia lamblia*, Cryptosporidium, other coccidians and protists and different Soil Transmitted Helminths (STH) which are major health concerns in India.

The main research objective is the study of host-parasite relationships at large. A special emphasis is given to ectoparasites of cattle, vector borne diseases of large and small animals and increasing understanding of human parasitic diseases like Giardiasis, Amoebiasis, Cryptosporidiasis etc. can serve as the basic foundation for further development in screening, diagnosis and therapeutics research. The division has a long tradition of research on the biology of major diarrhoea causing parasites at its transcriptomics, proteomics and metabolomics level along with the molecular epidemiological studies. More recently, the lab has been implicated with the monitoring of Soil Transmitted Helminthes (STH) of the school children between 5-12 years and STH prevalence mapping in North Eastern states of India.

As per the directives from Ministry of Health and Family Welfare this division has initiated State-wide prevalence surveys of STH in technical cooperation and partnership with WHO, DtWi, State Governments for school aged children. An expert core committee has been formed under Ministry of Health and Family Welfare, Government of India, for nationwide strategy planning, development of guidelines, prevalence survey, mapping and deworming procedure where again the division of Parasitology of NICED, ICMR is one of the member. Depending upon the burden children can be included in regular deworming program. It helps in decreasing DALY rates, morbidity, decreased malnutrition and growth.

Modified Kato Katz technique for rapid identification of soil transmitted helminths (STH) has been introduced by our lab. It is low cost and highly effective. Identification of STH (soil transmitted helminthes) made easier and very cost effective. No need to make local labs for rapid identification within 1 hour of sample collection. The division has developed new diagnostic approach for better microscopy and molecular detection. Identification of parasites made easier and highly specific with Triple Feces Test (TFT technique).

The division has also been involved in the quality control assay program in partnership with AIIMS, New Delhi, KMC, Manipal, PGIMER, Chandigarh, SGPGI, Lucknow and CMC Vellore for parasite identification.

With the use of transcriptomics, proteomics and metabolomics the Parasitology division at NICED has already undertaken intervention strategies for controlling the diseases caused by these human pathogens. The strategies include: 1) prevention of host-parasite interaction, 2) identifying new genes and proteins, specific for the parasite that can be potential target sites for drug development, 3) targeting sub-cellular organelle, mitosome for anti-giardial drug design, 4) developing metabolite-based therapeutic agents derived from indigenous plants, 5) structure-function relationship of important enzymes like arginine deiminase/phospholipase B 6) protein kinases in relation to cell signaling, 7) programmed cell death in *Giardia*, 8) development of diagnostics, 9) stress survival and regulation of virulence gene expression in *Giardia lamblia*, 10) role of diverse intra and extracellular small signalling molecules in expression of genes essential for growth, survival in Giardia,11) genetic mapping of STR loci of *E. histolytica* genome to understand rapid emergence of new pathogenic clones 12) comparative genomics of *Entamoeba histolytica.*

The division has standardized PCR and ELISA based detection procedure of major parasites and also for simultaneous detection of three parasites namely Giardia, Cryptosporidium and Entamoeba. The Division of Parasitology was able high resolution genotyping based identification of strains with probable hidden pathogenicity. The division has developed a new high resolution genotyping of *Entamoeba histolytica* to assess its virulence and pathogenecity. They have also able to identify the enormous genetic diversity and different pathogenic markers and association of *Entamoeba histolytica* genetic patterns with disease

outcome by high resolution Multilocus sequence typing system (MLST) in Kolkata. Besides that they have assessed helminth burden among different age groups in West Bengal with special emphasis on children of low socio economic class and evaluated a new TriCombo ELISA kit (Techlab) for the simultaneous identification of *E histolytica, G lamblia* and *Cryptosporidium* directly from stool samples. The division has arranged several seminar and workshop for the training on parasite identification and biosafety issues of the local laboratories and teach how to handle stool samples and all the details about medical parasitology. This division serves as a resource in training on the identification of parasites by microscopy, PCR and ELISA. The division has contributed the knowledge about enteric parasites and STH including the epidemiology, trends of STH and school health issues, biology, clinical features, diagnosis, treatment, prevention and control.

Scientist:
Dr. S. Ganguly, Scientist E

Staff:
Mr. S. L. P.Singh, Technician B

Pre-doctoral Fellows:
Ms.Rituparna Sarkar (SRF)
Mr.Sanjib Kumar Sardar (JRF)
Mr.Maimoon Maruf (JRF)
Ms.Ajanta Ghosal (JRF)

S. Ganguly (Principal Investigator)

Genetic variations of Giardia lamblia

Co-Principal Investigator: Y. Saito Nakano, Senior Research Scientist, Division of Parasitology, NIID, Japan, Prof. T. Nozaki, Director, Department of Biomedical Chemistry, School of International Health, Graduate School of Medicine, The University of Tokyo, Japan

Despite different possible advantages for colonisation in human gut, *Giardiatrophozoites* are expected to be challenged by the high oxygen concentration present in the proximal small intestine. There are different genetic variations in Giardia for defence against this ROS burst and differential expression of pathogenic characters and functionally relatedto survival and pathogenisity inside the human gut with high oxidative stress. Therefore, the objective of the study is to elucidate how the associated genes differently expressed at high oxidative stress in different genetic variants of Giardia. ELISA, FITC ANNEXINE V Staining, Cloning and expression, Real Time PCR, Western Blot methods have been applied to examine gene expression at high oxidative stress.

The study revealed that some genes like heat shock proteins, NADH oxidase, pyruvate ferredoxin oxidoreductase etc. are always up-regulated during oxidative stress. On contrary nitroreductase is much more upregulated in metronidazole stress than in H_2O_2 stress. NADH oxidase, NADH ferredoxinoxidoreductase, pyruvate ferredoxinoxidoreductase, thioredoxinoxidoreductase, nitoreductase, arginine deiminase, alcohol dehydrogenase etc. have been found to make a good network for oxidative stress management. The results also indicate that pyruvate and related α-keto acids improve the survival of cultured trophozoites exposed to H_2O_2 stress. Further studies confirmed that the parasite cells are not dying through necrosis but via a programmed cell death mechanism. Our study also indicates a unique enzyme Phospholipase B (PLB) is present which leads the formation of Arachidonic acid and Prostaglandin which in turn initiates the apoptotic death (Fig 28).

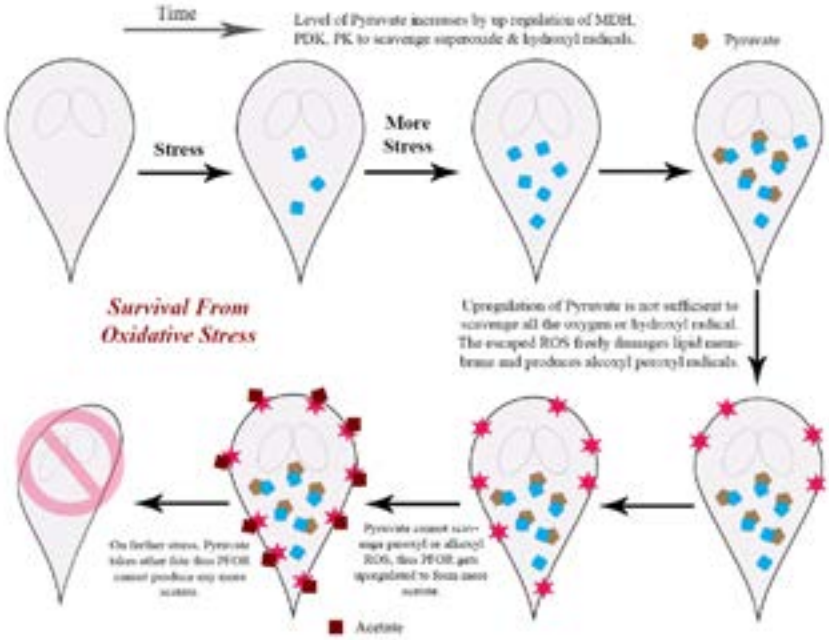

Fig 28: Oxidative stress induced death of Giardia

This study in *Giardia* and similar early branching eukaryotes (EBE) mayshed some new ideas in Evolutionary Biology. However, this is only the start of an intensive research period that will see *Giardia* spp. being used as model systems to understand genome function and evolution, gene expression, cell biology and intestinal immune responses. The genomes of several *G. intestinalis* isolates from different assemblages are being sequenced currently, and this will make it possible to develop methods for transfection, gene knockouts, functional genomics and gene expression studies. This will rapidly turn the diplomonads into a model system representing a branch of eukaryotic diversity that is currently very poorly studied.

Awards/ Honours Received

S. Ganguly

- Selected as advisory committee member of Department of Microbiology at Saint Xaviers University, Kolkata (Autonomous).
- Govt. of India expert committee member under Ministry of Health and Family Welfare, Government of India for conducting STH Mapping and deworming program in India.

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

S. Ganguly

- Invited participation and oral presentation in "Microbiology in the new millennium – from molecules to communities" organized by Bose Institute, Kolkata from 27th -29th October, 2017
- Participated in Asian Conference on Diarrhoeal Diseases and Nutrition (ASCODD), 2017 held in Kochi, India from 30th October – 1st November, 2017 and presented his work.
- Invited participation in "Indo-US Workshop on "Genomics and Bioinformatics to explore human microbial ecology in health and diseases" held at Translational Health Science and Technology Institute (THSTI), Faridabad, India from 6th -8th September, 2017.
- Invited participation in a short term training on "Drug efficacy against enteric protozoa" to present the results on the joint research project on the enteric protozoan infections and training on axenization of local isolates and their drug efficacy at Dept. of Parasitology in the National Institute of Infectious Diseases (NIID), Tokyo during 13th -15th December, 2017.
- Invited participation as an expert and judge in Smart India Hackathon 2017 held in GNIT, Panihati, Sodepur, Kolkata from 31st March to 1st April, 2017.
- Participated in a training course on quality management system and internal audit training as per ISO 15189:2012 and NABL 112 requirements held in B M Birla heart research centre Kolkata from 24th -27th April, 2017.
- Participated in Indo-US Workshop on "National Family Health Survey (NHFS) Data Analysis" organized by CDC, US and PHFI India and held at Public Health Foundation of India (PHFI), India from 11th -13th September, 2017.

PATHOPHYSIOLOGY

The major projects in this division are related to microbial proteases and their role in pathogenesis and tumor regression. The major protease secreted by *V. cholerae* is hemagglutinin protease (HAP) which is a 35 kDa metalloprotease. We reported for the first time that HAP is secreted in both its matured (45 kDa) and processed form (35 kDa) form. Functionally both these forms are different, the 45 kDa form showed cell distending effect on HeLa cells and increase in intestinal short-circuit current in *in-vito* Ussing's chamber model. The 35 kDa form showed cell rounding effect on HeLa cells, decrease in intestinal short-circuit current and hemorrhagic response in rabbit ileal loop (RIL) (Infection and Immunity 2006). Besides HAP the other protease repored in *V. cholerae* is PrtV (Vibro cholerae portease). We identified a novel serine protease (VesC) in a ΔhapAΔprtV *V. cholerae* strain and showed its role in hemorrhagic fluid accumulation in RIL assay (PloS ONE, 2010). HAP has been shown to be secreted by type II secretion system. We were the first to report that proteases in *V. cholerae* can be also be secreted by outer membrane vesicles (OMVs) (Infection and Immunity, 2016).

Proteases have been reported to regresses tumor growth in cancer models. HAP regressed tumor growth in EAC (breast cancer) in solid tumor and intraperitoneum mice model. HAP induced the intrinsic pathway of apoptosis (Apoptosis 2016). HAP cleaved PAR1 receptor which is reported clinical studies to be expressed more in cancer cells than in normal tissues (Apoptosis 2016). Recently we have identified the cleavage site of HAP on PAR1 and synthesized activating peptide which can induce apoptosis in cancer cells. This novel activating peptide is a pro-apoptotic peptide and has been shown to kill cancer cells and has been patented (Patent no: 201811003707).

We have also been working on SPATE autotransported proteases in neonatal septicemic *E. coli* (NSEC). Our studies suggest that SPATEs may play a role in pathogenesis of neonatal sepsis (EJCM&ID, 2014). We have identified, cloned and purified a novel metalloprotease, YghJ from NSEC and have shown that it induces proinflammatory response (Int J Med Microb, 2016) and also induces hemorrhagic response in mice ileal loop assay (Microbial Pathogenesis 2017). The molecular signaling mechanism of YghJ through TLR2 has also been recently reported by us (Infection and Immunity, 2018).

Scientist:
Dr. A. Pal

Staff:
Mr.B. Roy, Technician (2)

Post-doctoral students:
Dr T. Ray (DBT Women's Scientist)
Dr R. Tapadar Ghosh (ICMR Postdoctoral fellow)
Dr. T. Paul (DST-SERB Research Associateship)

Predoctoral Fellows:
Ms. Paramita Sarkar (SRF -DST INSPIRE)
Mr. Joydeep Aoun (SRF-ICMR)
Ms.Tultul Saha (SRF-UGC)
Mr. Dwiprohi Kar (SRF-CSIR).
Mr. Nanda Singh (JRF-CSIR)

A. Pal (Principal Investigator)

Molecular targeting therapy of breast cancer by PAR1 mediated apoptosis through a novel pro-apoptotic peptide

In our earlier study we have shown anti tumor activity of hemagglutinin protease (HAP) secreted by *V. cholerae*. One µg of HAP showed potent anti tumor activity when injected into the solid tumors in Swiss albino mice. Weekly administration of this dose is able to significantly diminish a large tumor volume within 3 weeks and increases the survival rate of cancerous mice. HAP caused PAR1 activation that triggered intrinsic pathways of apoptosis. HAP induced a new PAR1 cleavage site "PFISEDASGY" but the exact "tethered ligand" that binds intramolecularly to trigger transmembrane signaling was unknown.

From the HAP mediated PAR1 cleavage site we designed a novel pro-apoptotic peptide "PFISED" that binds specifically to PAR1 and caused PAR1 activation (Fig 29). The peptide showed apoptosis in human and mouse cancer cells where as in the same peptide concentration normal human fibroblast cells (MRC-5) and normal mouse peritoneal macrophage cells remain unaltered. Treatment with this peptide enhanced the survival kinetics of EAC induced mice (Fig 29). This peptide induced over expression and activation of PAR1 mediated its downstream MAP kinase and NFkB signaling pathways. These signaling pathways enhanced the cellular ROS level to kill malignant cells.This novel pro-apoptotic peptide can selectively kill malignant cells via its specific target receptor PAR1 which is over expressed in the malignant cells and can be used as a molecular target therapy for cancer treatment.

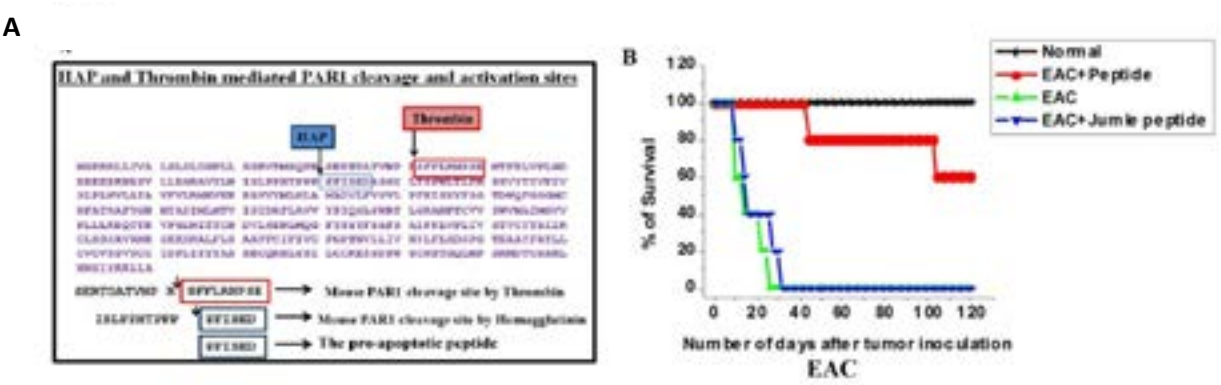

Fig 29: Design of the pro-apoptotic peptide "PFISED" and its effect on the survival kinetics of EAC induced mice intraperitoneal mice model. (A)Schematic diagram of the design and synthesis of pro-apoptotic peptide "PFISED" (B) The pro-apoptotic peptide "PFISED" treatment enhanced the survival rate of EAC induced intraperitoneal mice model mice.

TLR2 dependent proinflammotory cytokine secretion by SslE (YghJ), a cell associated and secreted lipoprotein of neonatal septicemic *E. coli*

Sepsis being systemic inflammatory response of host against an infection involves release of a series of endogenous mediators such as proinflammatory cytokines. Except bacterial LPS, no other factor of neonatal septicemic *E. coli* (NSEC) has yet been identified for stimulating proinflammatory response in host. We have identified SslE (YghJ), a cell associated and secreted lipoprotein having metalloprotease domain from a NSEC isolate, cloned, purified and showed that rSslE stimulated secretion of various proinflammatory cytokines such as IL-1α, IL-1β and TNF-α in RAW 264.7 cells in a TLR2/TLR1 dependant manner involving both NFκB and MAPKs (Fig 30). Moreover, SslE triggered production of other proinflammatory hallmarks (ROS, NO, proinflammatory chemokines such as MIP-1α, MIP-1β & RANTES) and increased expression of MHC II and co-stimulatory molecules like CD80, CD86 on mouse macrophages (Fig 30). We further validated our findings in HEK293 cells. Increased expression of TLR2 was found in SslE stimulated HEK-TLR2 cells

compared to HEK-TLR4 cells as determined by immunoblot, flow cytometry and immunofluorescence. Moreover, immunoblot showed that immobilized SslE pulled down TLR2 but not vector control and TLR4 and finally stimulated IL-8 secretion with activation of NFκB and different MAPKs in HEK-TLR2 cells compared to HEK-TLR4 and HEK-vector cells.

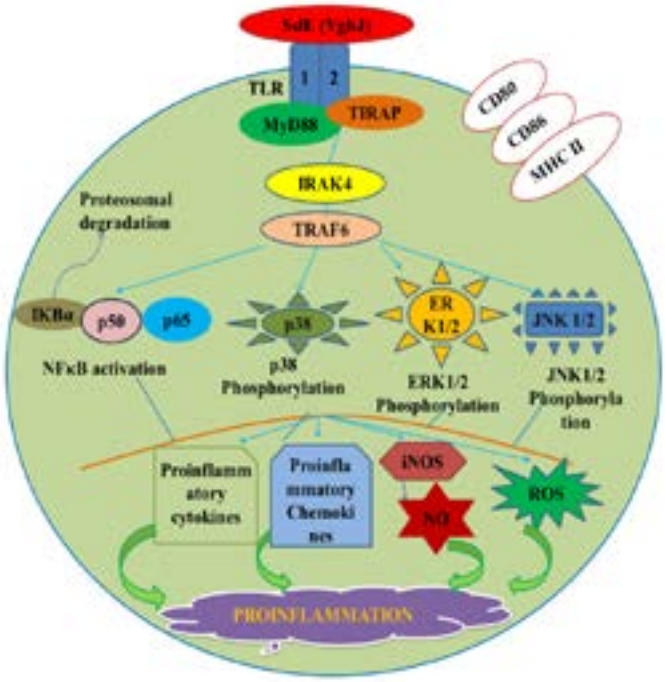

Fig 30: SslE (YghJ) induced proinflammation in mouse macrophages is TLR2/TLR1 mediated with the involvement of NFκB and MAP kinase signaling pathways.

M. H. Kazi (Principal Investigator)

Zinc Deficiency and Gut Epithelial Health: Effect on epithelial ion transport and tight junction function

There is growing interest in dietary factors, in particular micronutrients, from the perspective of disease pathogenesis and potential for treatment. Diarrheal disease in infants has been long linked with abnormal lower concentration of serum zinc, however the underlying mechanism by which zinc deficiency causes diarrhea remains elusive. Currently we are investigating the impact of zinc deficiency on the host, particularly of intestinal tight junction (TJ) integrity and proteins that are involved in intestinal absorption and secretion along with the pathogenesis of enteric infection. We have used human colonic T84 cells to study barrier function and *Shigella* to test susceptibility of intestinal infection due to zinc deficiency. T84 grown onto transwell inserts in Zinc deficient media showed a low transepithelial electrical resistance (TEER) compare to Zn sufficient media (1014 ± 165 Ω.cm^2 vs 3663 ± 293 Ω.cm^2) in confluent T84 monolayers (Fig 31). We are furthermore looking into the correlation between TEER and paracellular ionic conductance. Bacterial translocation studies has shown significant increase in apico-basolateral transmigration of *S. flexneri* post infection across T84 monolayers. We are also looking at the electrophysiological aspects involving the ion transporters CFTR and CaCC in Zn deficient cells, which may further lead to altered Cl^- secretion leading to perturbed transport mechanism.

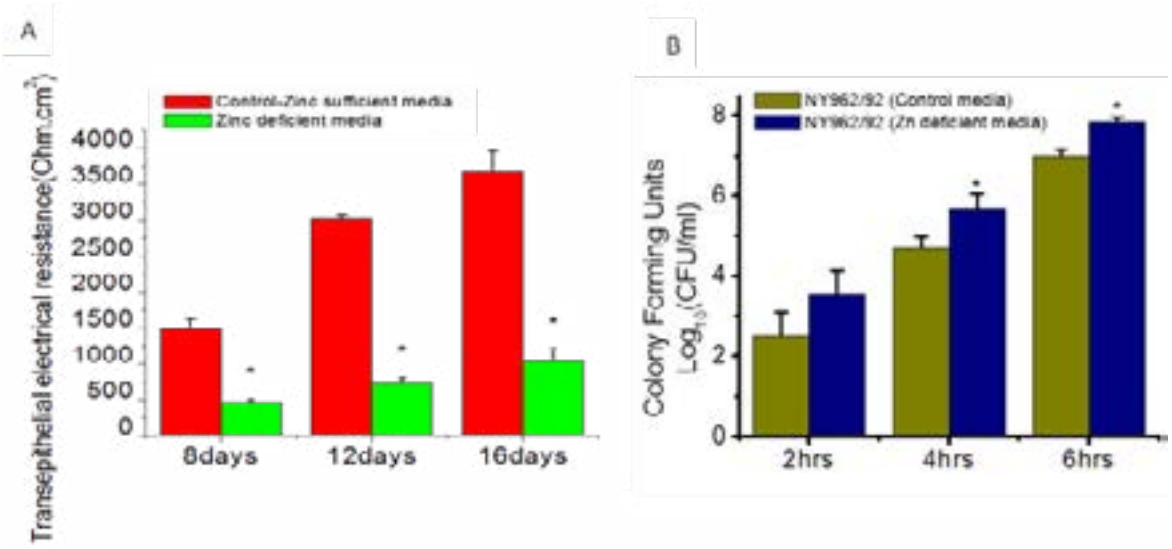

Fig 31: Perturbed barrier function in Zinc deficient T84 monolayers.(A) Representative time course of Transepithelial electrical resistance (TER) in T84 monolayers, cells were grown in normal and zinc deficient media for comparative resistance studies.(B) Apical-to-basolateral bacterial translocation assay of *Shigella flexneri* was performed with polarized T84 cells in Zinc deficient and sufficient media for 2hrs, 4hrs and 6hrs. The basolateral media was collected after 2hrs, 4hrs and 6 hrs were plated to obtain bacterial counts. Data are plotted are means ± SEM, N = 4-6 independent experiments.

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

A. Pal

- Elected as Recorder of the Section of Medical Sciences (including Physiology for 2016-17 and 2017-18) in the 104th and 105th Session of Indian Science Congress.
- Attended the 105th Science Congress at Manipur from 3rd to 7th January, 2018
- Nominated as a government representative for the Renewal of registration and reconstitution of the Institutional Animal Ethical Committee for CPCSED, New Delhi

VIROLOGY

Host-virus interactions studies are being carried out in the state of art virology lab facility. Development of graphene nano-support for enzyme aiming stability and activity enhancement is another thrust area. Studies on molecular diversity of diarrhoeagenic viruses, Influenza and HIV helps in evidence driven public health response for the country.

Basic laboratory research:

- Basic and functional aspects of host-rotavirus interaction employing proteomics and genomics to identify host cellular proteins required for viral replication and pathogenesis.
- Role of virus encoded non-structural proteins in the host cell during rotavirus infection.
- Host-influenza virus interactions to realize sequential phenomenon of virus assembly and budding in host cell with central focus on the various signalling involve in virus budding.
- Role of PB1-N40 protein in influenza virus on viral polymerase complex.
- Immobilization of lipase on graphene oxide for increased stability and activity.

Research having national public health intervention implications:

- Emergence of HIV drug resistance mutations among ART and Transmitted resistance mutation among ART naïve PLHIVs.
- Use of dry blood spot sample for HIV viral load estimation and for HIV genotyping
- Investigation to identify the drivers of HIV epidemic among north eastern Indian states

Surveillance studies:

- Molecular characterization to identify and characterize the genotypes of different enteric viruses among the patients with acute gastroenteritis. This generates knowledge on genetic diversity, emergence of new variant strains and phylogenetic nature of the circulating enteric viruses with focus on Group A Rotavirus, Caliciviruses viz. Norovirus and Sapovirus, Astrovirus, and Adenovirus.
- HIV surveillance, one of the largest and most robust in the world, is being implemented by National AIDS Control Organization with the involvement of premier national public health institutes. ICMR-NICED has been generating timely and critical epidemiological evidence on the level and trends in HIV prevalence across various population groups from east & north-eastern states of the country for planning appropriate interventions strategy under NACO program.
- Community based surveillance for monitoring and managing influenza pandemics and to understand the key epidemiological, virological and clinical features of the pandemic as well as the incidence and the seasonal pattern of influenza among the elderly population in India has been implemented in collaboration with CDC-AIIMS to understand current circulating strain among the elderly and to formulate the vaccine strain in future. Isolation of influenza virus from the referral samples is ongoing in tissue culture with an objective to characterize and study on host-virus interactions.

Public Health Support Providing Laboratory Diagnosis

- For effective patient management of acute Influenza infections,timely diagnosis is essential. Virology Division, ICMR-NICED has been acting as Nodal lab for diagnosis of Influenza Viruses (Influenza A/H1N1) in West Bengal since 2009. Genetic characterization strains are done to monitor variation, antiviral resistance and mutations in antigenic epitopes.
- Immunological and Molecular diagnosis of HIV from serum/plasm and dry blood samples is being done at National HIV Reference lab and Molecular HIV lab to assure best international quality

standard for individuals at different level of HIV risk, babies born to HIV infected mother, PLHIV on ART for viral load estimation to assess treatment effectiveness and HIV drug resistance mutations for evidence driven treatment options.

Public Health Support for Quality Diagnostics

As a member of Consortium of National Reference Labs, ICMR-NICED has been involved in evaluating performance of HIV, HBV & HCV diagnostic kits for procurement by Govt. agencies including NACO to ensure best international standard. These kits are used in all Govt health programs including blood banks.

Human Resource Development

- Providing advanced training for implementation of national public health programs for east and N-E India for laboratory diagnosis of diarrhoea viruses, Influenza and HIV and for surveillance of Influenza and HIV.
- Post graduate trainees from different Universities and Institutions across the country are trained in advanced molecular and immunological techniques.
- Doctoral and Post-Doctoral students are involved in latest cutting edge research programs.
- To ensure best laboratory practice, staff and students receive continuous Good Clinical Lab training to ensure highest international standards in research and public health programs.
- Training to laboratory technicians, postgraduate and doctoral students, so as to improve the human resource capable of studying viral diseases of national importance across the country. The research programs include intramural projects and extramural projects with national and international funding and collaborating scientists. The current programs are associated with ICMR, NACO, DBT, DST-Serb, CDC-Atlanta, Okayama University-Japan.

Scientists:

Dr. T. Krishnan,	Scientist F
Dr. M. K.Saha,	Scientist F
Dr. M. Chawla-Sarkar,	Scientist E
Dr. A. K. Chakrabarti,	Scientist D

Staff:

Dr. S.C.Bhunia.	Senior Technical Officer (2)
Dr. S.K.Sadhukhan.	Senior Technical Officer (1)
Mr. S. Omesh	Technical Officer-A
Ms. M. Mallik	Technical Officer
Ms. P. Bhaumik	Technical Officer
Mr. K. Sen	Technical Assistant
Ms. P. De	Technical Assistant
Md. M. Hossain	Senior Technician (1)
Ms. C. Das	Laboratory Assistant

Ramanujam Fellow Scientist:

Dr Anupam Mukherjee DST

Project Scientists:

Dr. Subrata Biswas	Project Coordinator NACO
Ms. Srijita Nandi	Research Officer NACO
Dr. Nalok Dutta	Research Officer NACO

Pre-Doctoral Fellows:

Ms. Arpita Mukherjee	UGC-SRF
Mr. Upayan Patra	ICMR-SRF
Ms. Anindita Benerjee	DST Women Scientist
Ms. Urbi Mukherjee	UGC-SRF
Mr. Rakesh Sarkar	UGC-JRF
Mr. Mahadeb Lo	CSIR-JRF
Mr. Devendra NathTewari	UGC-JRF
Mr. Partha Pratim Mondal	UGC-JRF

T. Krishnan (Principal Investigator)

Detection of emerging viruses among acute gastroenteritis cases in Kolkata, India

Co-PI: S. Das, P. Indwar, Supdt. Infectious Diseases and Beliaghata General Hospita, Kolkata and Supdt. Dr B.C. Roy Postgraduate Institute of Pediatric Sciences, Kolkata

Viral gastroenteritis is an important disease and etiological agents besides Group A rotavirus are associated with acute watery diarrhoea cases in Kolkata and other parts of the world.

The objective of the study was to study genome profiles characteristic of non Group A rotavirus and other emerging diarrhoeagenic viral pathogens.

In the methodolofy, faecal specimens of acute watery diarrhoea cases received in Division of Virology, ICMR-NICED were screened by agarose gel electrophoresis, followed by ethidium bromide staining. The molecular biology grade RNA was extracted by different methods and studied for yield and purity before it was used for next generation sequencing experiments.

The results showed characteristic electropherotype pattern of eleven segmented genomic dsRNA enabled the differentiation of Group B rotavirus (Segments 1,2,3,4 - 5,6,7,8 - 9,10,11) or Group C rotavirus (1,2,3,4 - 5,6,7 – 8,9 - 10,11) from Group A rotavirus [Segments 1,2,3,4 - 5,6 – 7,8,9 - 10,11).

The characteristic electropherotype of trisegmented genome showed 1st genomic segment of <3302 bp; the 2nd segment >1356 bp and the 3rd segment of approx. >1074 bp in the agarose gel. indicating the emergence of a different etiological agent associated with viral gastroenteritis as shown in Fig 32.

The emerging etiological agent was detected among diarrhoea cases of different age groups viz. children below 5 years, older children aged between 5 to 12 years, adolescents and among adults with symptoms of moderate dehydration. Vomiting / abdominal pain and /or fever during the diarrhoeal episode.

The nature of the faecal specimen varied from watery, loose stool or bloody mucoid stool in the positive cases.

The emerging etiological agent was detected as sole pathogen or with co-infection of other enteric pathogens viz. virus / bacteria and / or parasite. Next generation sequencing experiments showed it was an unknown virus associated with diarrhoea from different age groups in Kolkata, India.

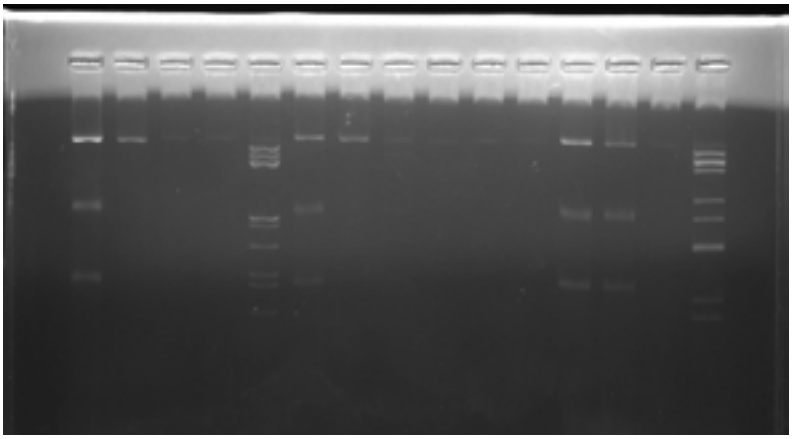

Fig 32 : Agarose gel showing the 3 genomic segments of emerging virus in lanes 1, 6, 12 and 13 respectively (a) approx . <3302 bp (b) approx. >1357 bp and (c) approx >1074 bp The size for each of the 11 genomic segments of Rotavirus shown in lane 15 were used as reference : 3302; 2687; 2592; 2362; 1581; 1357; 1062; 1059; 1074; 751; 666 (base pairs) respectively.

M. K. Saha (Principal Investigator)

HIV drug resistance among ART naïve adults in Kolkata.

Evidence on HIV drug resistance (HIVDR) mutation in India, particularly from eastern part of the country is essential for effective planning for recent massive scale up of ART for people living with HIV (PLHIV). Analysis of genotyping data from consecutive 47 ART naïve consenting PLHIV to find out HIVDR mutations comparing with Stanford database revealed mutations associated with protease inhibitors (PI), nucleoside reverse transcriptase inhibitors (NRTI), and nonnucleoside reverse transcriptase inhibitors (NNRTI) from plasma of study participants in HIV-1 pol gene sequences revealed complete absence of major and minor HIVDR mutations (Fig 33). Only mutations found were accessory ones. All the samples were detected as HIV 1 subtype C.

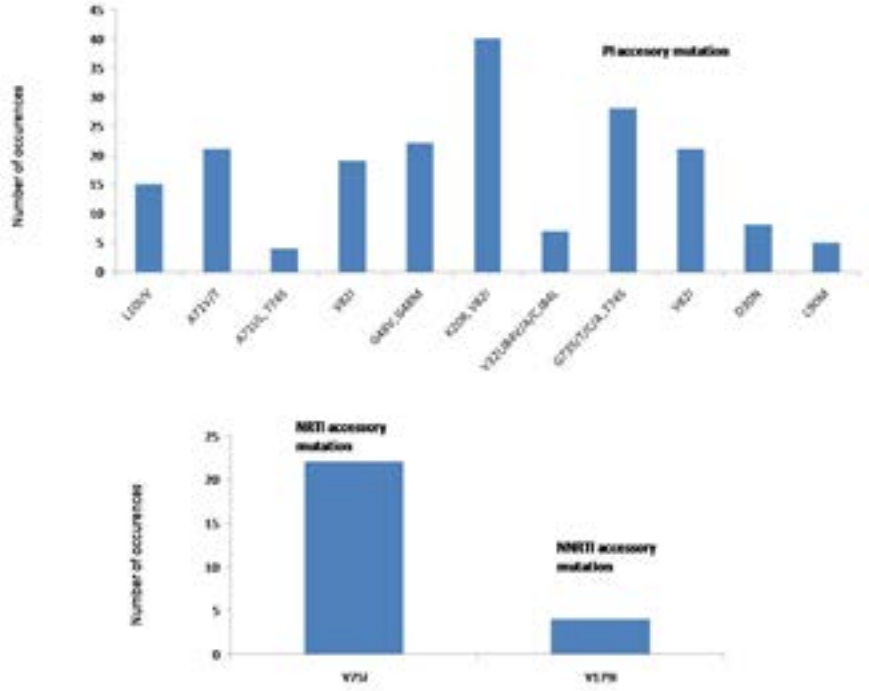

Fig: 33: HIV drug resistance mutation pattern observed

The PI accessory drug resistance mutations detected in the protease gene were L101/V, A71V/T, A71I/L, T74S, V82I, G48V, G48M, K20R, V82I, V32I, I84V/A/C, I84L, G73S/T/C/A, T74S, V82I, D30N and L90M, whereas in the RT gene V75I and V179I were detected.Absence of HIV drug resistance mutations, major or minor, in this study population indicate potential greater chance of first line ART success in this part of the country.

Immobilization of lipase on graphene oxide for increased activity and stability.

Protein adsorption capacity of graphene oxide (GO) is much higher than of other large surface area carbonaceous materials. Structure and physicochemical properties of GO are having potential beneficial for enzymatic activity modifications. A purified lipase from *Brevibacillusborstelensis* NLIP05 immobilized on GO exhibited remarkable increase in thermostability (at 95°C) over a broadalkaline pH range (pH 7-12) compared to the free enzyme.

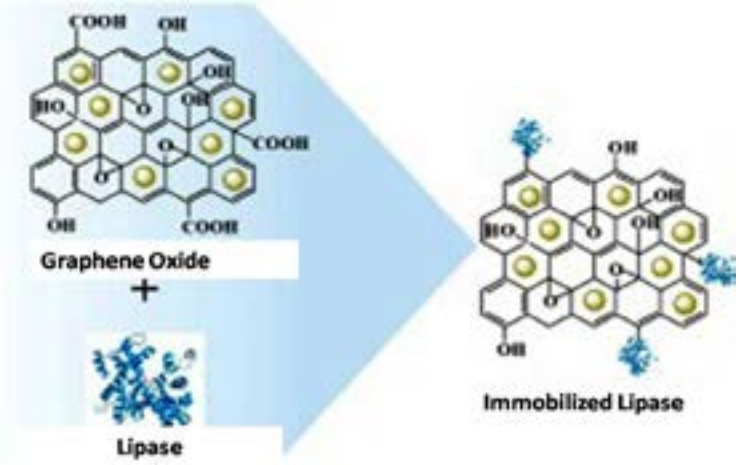

Fig 34: Immobilization of lipase on grapheme oxide

Thermodynamic analysis of the GO-lip showed decreases in K_m and activation energy (E_a) with increased V_{max} and deactivationenergy (E_d) at both 45°C and 95°C.The decrease in decay constant (k) coupled with the increase in $t_{1/2}$ value with temperature increase were salient features of the GO-lip system that conferred structural stability to the enzyme at higher temperature indicating chaperone like activity. Immobilized lipase ongraphene oxide nano-support (Fig 34) has the potential for varied biological applications in the form of active pharmaceutical substances, synthetic building blocks and effective synthesis of surfactants.

HIV and Syphilis among ANC attendees in Meghalaya, India

Scanty and inconclusive evidence of socio-demographic factors in the acquisition of HIV and syphilis infection among antenatal clinic (ANC) attendees of north-eastern India among ANC attendees of Meghalaya, a state of north-eastern India is a major challenge for infection control planning. A record-based cross-sectional study using data from National HIV Sentinel Surveillance on trend of HIV and syphilis infection among pregnant women aged 15-49 years attending selected sentinel ANC sites in Khasi and Jaintia hills district of Meghalaya from 2012 to 2017 using SAS 9.3.2 for descriptive and logistic regression analyses of the anonymous data was conducted.

Fig 35: Trend of HIV and Syphilis among ANC attendees in Meghalaya 2012 - 2017

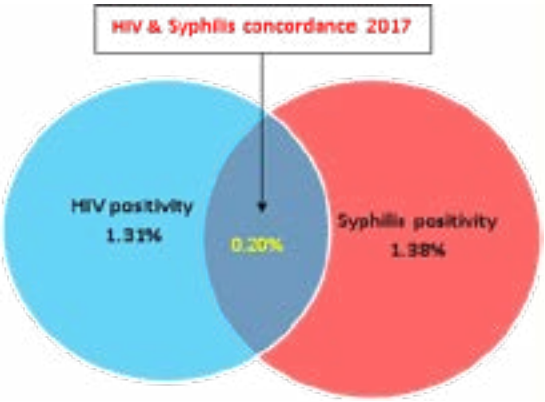

Fig 36: HIV and Syphilis among ANC attendees in Meghalaya

HIV prevalence was 0.50% in 2012 and increases to 1.31% in 2017 in Khasi and Jaintia hills district. The percentage positivity of syphilis also increased from 0.50% to 1.38% from 2012 to 2017 (Fig 35). Women who lived in Jaintia hills district area had higher HIV prevalence rates (2.38%) than women from Khasi hills area (0.25%) (Fig 36).

M. Chawla Sarkar (Investigator)

Surveillance and molecular characterization of Group A Rotavirus among children reporting with acute gastroenteritis

As part of the Institutional diarrhoeal disease surveillance and ICMR funded extramural project, rotavirus surveillance is conducted by NICED to assess the prevalence of Rotavirus infection among hospitalized children and to monitor circulating strains in the region. This surveillance has also contributed to the national network which provided baseline information as rotavirus vaccine has been introduced in national immunization program in India. Vast diversity in the rotavirus genotypes and rapid emergence of novel types due to recombination in developing countries raise concern, thus comparison of pre-vaccination data with the post vaccine scenario is important for determining vaccine efficacy. A total of 536 and 793 samples (<5y) were tested during April 2017-Jan 2018 from ID & BG Hospital (IDBG) and Dr.B.C. Roy Post-Graduate Institute of Paediatric Sciences. Of 536 samples from IDBG, 186 (34%); 68 (12.6%); 38 (7.0%) and 24 (4.4%) were positive for rotavirus, adenovirus, astrovirus and norovirus respectively. In BCH, of 793 samples, 191 (24%) were rotavirus positive and 63 (7.9%) were adenovirus positive (Fig 37). Maximum infection rate was observed in 6-12 months age-group. Genetic characterization of positive strains revealed predominance of G3P[8] (67%) during this period, while other genotypes like G9; G1; G2 and G12 were observed at low frequency. Emergence and circulation of G3P[8] strains in Eastern India has been observed after more than a decade (Fig 38).

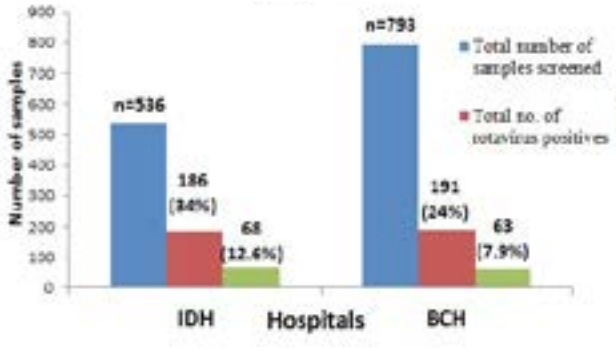

Fig 37: Distribution of sample tested and Rotavirus positives in ID-BG Hospital (IDH) & BC Roy Hospital (BCH), Kolkata

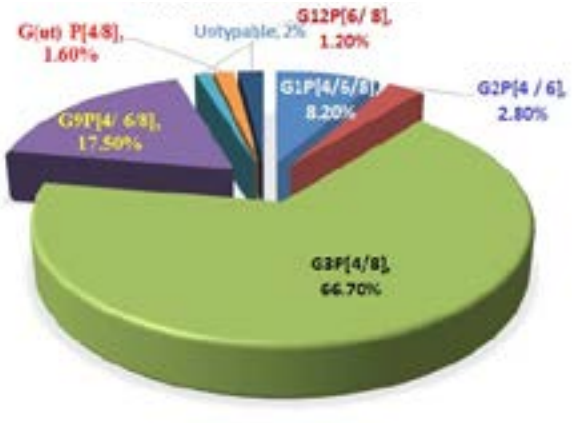

Fig 38: Circulating genotypes (G-P types) of group A Rotavirus in Kolkata

Identification of Host Determinants which modulate Rotavirus Infection and to assess their small molecule inhibitors as anti-viral candidates

Dynamic equilibrium between mitochondrial fission and mitochondrial fusion serves as an important quality control system within cells ensuring cellular vitality and homeostasis. Viruses often target mitochondrial dynamics as a part of their obligatory cellular reprogramming. The present study was undertaken to assess the status and regulation of mitochondrial dynamics during rotavirus infection. Distinct fragmentation of mitochondrial syncytia was observed during late hours of RV (SA11, Wa, A5-13) infection (Fig 39). RV nonstructural protein 4 (NSP4) was identified as the viral trigger for disrupted mitochondrial morphology. Severance of mitochondrial interconnections was found to be a dynamin-related protein 1 (Drp1)-dependent process resulting synergistically from augmented mitochondrial fission and attenuated mitochondrial fusion. Cyclin-dependent kinase 1 was subsequently identified as the cellular kinase responsible for fission-

active Ser616 phosphorylation of Drp1. In addition to its positive role in mitochondrial fission, Drp1 also resulted in mitochondrial translocation of E3-ubiquitin ligase Parkin leading to degradation of mitochondrial fusion protein Mitofusin 1(Fig 40). Interestingly, RV-NSP4 was found to interact with and be involved in recruiting fission-active pool of Serine 616 phosphoDrp1 (Ser616 pDrp1) to mitochondria independent of accessory adaptors Mitochondrial fission factor (Mff) and Fission protein 1 (Fis1). Inhibition of either Drp1 or Ser616 pDrp1 using specific small molecule inhibitor Mdivi-1, resulted in significant decrease in RV-NSP4-induced intrinsic apoptotic pathway as assessed by significantly reduced cytochrome C release into cytosol and caspase 3 and caspase 9 cleavage. In presence of Mdivi-1, RV replication was not affected but the release of virus particles from cells was significantly inhibited. Overall, this study underscores an efficient strategy utilised by RV to couple apoptosis to mitochondrial fission facilitating dissemination of viral progeny.

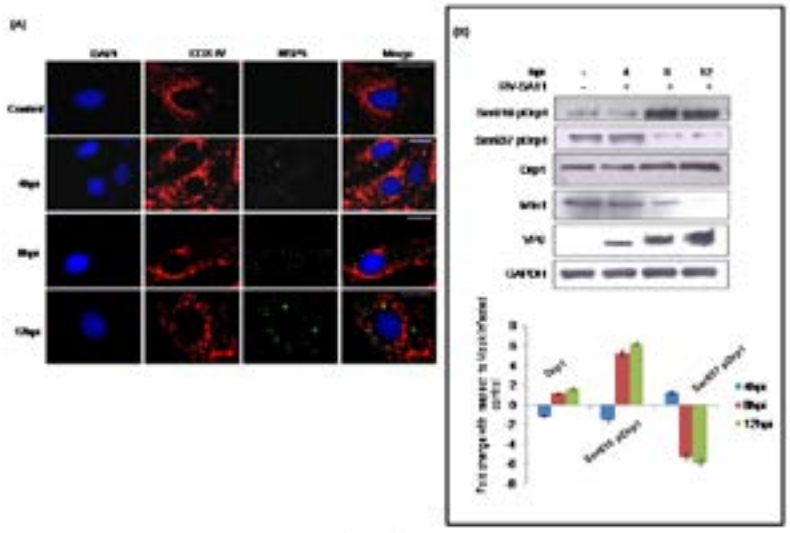

Fig 39: Rotavirus infection induces fragmentation of mitochondrial syncytia (A) Immunofluorescence microscopy revealed acute shortening of mitochondrial lengths in MA104 cells during late hours of RV-SA11 infection. (B) Western blot analysis of whole cell lysates prepared from RV-SA11 infected cells (4-14hpi) revealed increased expression level of Ser616 pDrp1 and decreased expression levels of Mfn1, Ser637 pDrp1 during late hours of infection compared to mock infected control.

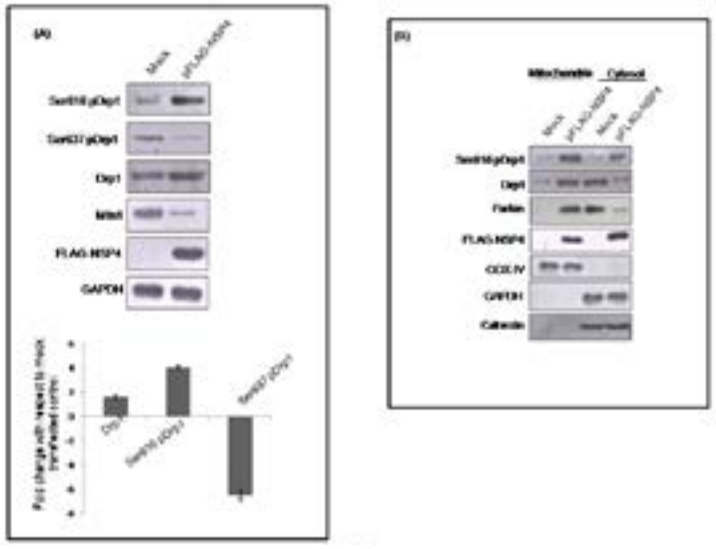

Fig40: Rotaviral protein NSP4 promotes Drp1-dependent mitochondrial fission. (A) Western blot analysis of whole cell lysates prepared from MA104 cells either transfected with pFLAG-NSP4 or pFLAG-CMV revealed tilted ratio of fission-active Ser616 pDrp1 and fission-inactive Ser637 pDrp1 in favour of mitochondrial fission in PFLAG-NSP4 over expressing cells. (B) Mitochondrial translocation of Ser616 pDrp1 and parkin were also evident in MA104 cells overexpressing pFLAG-NSP4.

Hospital based Surveillance for Respiratory Viruses in Outpatient and Inpatients seeking treatment for acute respiratory illness.

Hospital based surveillance for panel of respiratory viruses was initiated in Sagore Dutta Medical College and Hospital in Kolkata as part of a Multi-centric study co-ordinated by NIV Pune in 2016. During this period (Oct 2016-Sept 2017), a total of 1059 nasal/throat swabs were collected from both OPD (ARI n=903) and In-patient wards (SARI n=156). Average collection was 21samples/week. Maximum patients fulfilling the inclusion criteria belonged to <5 yr of age (56%) followed by 5-60y age group (39%).

Of 1059 samples, 451 (42%) were positive for one or more viruses. In both ARI and SARI cases, Influenza A, adenovirus, human meta-pneumovirus (HMPV) and rhinovirus were common. Co-infection/ mixed infection were predominantly identified (8.9%) among ARI cases from children <5y of age. Among In-patients, co-infections were significantly less (3%) Fig 41.

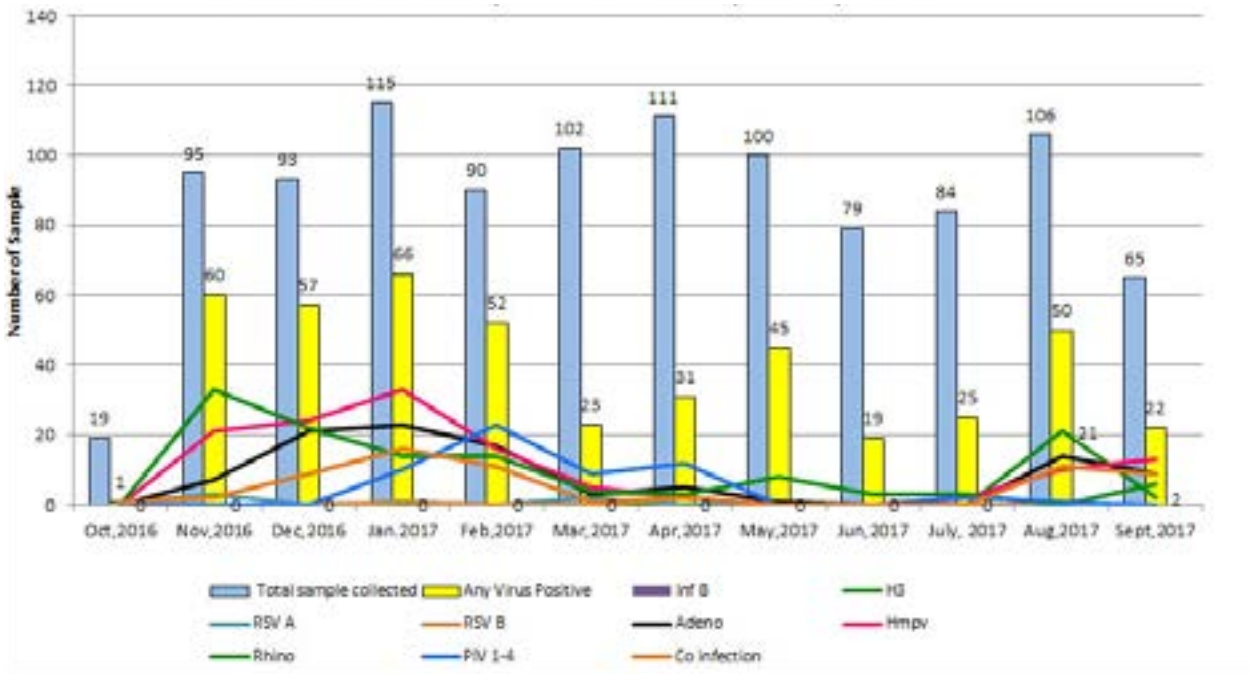

Fig 41: Distribution of respiratory viruses identified in patients coming to a healthcare facility with acute respiratory infection

A. K. Chakrabarti (Principal Investigator)

Functional evaluation of the role of PB1-N40 Protein of influenza virus in apoptosis and inflammation

Influenza A virus is encompassed by an envelope and the genome consists of eight segmented, negative-sense viral RNA (vRNAs). The PA, PB1, and PB2 are polymerase enzymes and upon binding to NP, it produces ribonucleoprotein (RNP) complex. RNP further helps in RNA transcription, and replication. With the help of viral RNA-dependent RNA polymerase,replication of vRNA is catalyzed in the nucleus and the newly synthesized VKNA also interacts with the trimeric complex of three subunits; PB1-PB2-PA. Initially, to form this trimeric complex, PB1 and PA interacts in the cytoplasm and then moves to nucleus, while PB2 enters in nucleus, independently as a monomer and interacts with PB1 and PA complex, as a result functional unit of PA-PB1-PB2 is formed. The PB1 protein act as a linker in this trimeric complex because the N-terminal end of PB1 is attached with PA and C-terminal end is attached with PB2 (Fig 42). Recent ribosomal scanning and chemical mapping reveals two internal ORFs in PB1 segment and these codes two alternative polypeptide; PB1-F2 and PB1-N40 (Fig 43). The PB1-F2 protein acts as a pro-apoptotic factor whereas the function of PBI N40 remains unclear. We have initiated a study on how PB1-N40 protein interacts with other viral proteins and its effect on host cell. PB1 and PB1 genes from influenza A H1N1 has been cloned in expression vector. Expression and characterization study is underway in this aspect.

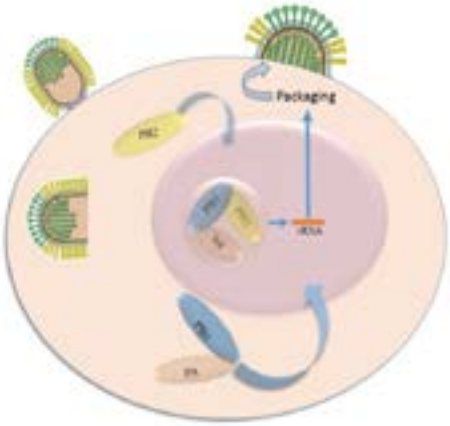

Fig42: Influenza A virus ploymerase comples formation

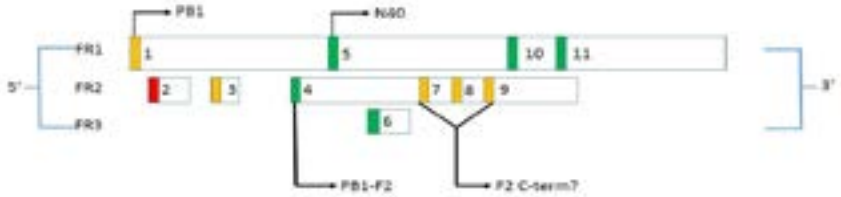

Fig43: Expression of multiple protein species from IAV PB1 segment. ORF's in the three reading frames are indicated by colored boxes. AUG codons are color coded according to the relative strength of the Kozak consensus (green=strong, amber=intermediate, red= weak), and those that initiate identified polypeptides are indicated in arrow.

Nationwide screening of phage types of *V. cholera* O1 and O139

Vibrio Phage Reference Laboratory of ICMR-NICED is involved in study on bacteriophages of *V.cholerae* and phage typing of *V.cholerae* strains. As a National centre we receive strains from medical colleges and hospitals from all the cholera endemic zones of India for biotyping, serotyping and phage typing study. *V. cholerae* strains isolated from clinical samples and environmental samples of different states were sent to the Vibrio Phage Reference Laboratory for phage typing study. A total of 304 strains received by us were confirmed as *V.cholerae* O1 biotype El Tor (Table 11). Most of the isolates belonged to serotype Ogawa and few were found as serotype Inaba. Phage typing was performed using a panel of typing phages available with us at Phage Reference Laboratory. Using the conventional scheme of Basu and Mukherjee the strains were discriminated into two different types, Type 2 and Type 4 but twelve different types were observed when the new phage typing scheme was used. Among the several types phage type 27 was the major type.

Table 11: Biotype, Serotype and Phage type of *V. cholerae* strains received during the year 2017-18

State	No of Strains	Biotype		Serotype		Basu & Mukherjee type		New Phage type											
		Classical	Eltor	Ogawa	Inaba	T2	T4	27	26	25	24	23	22	20	15	7	5	3	4
Gujarat	219		219	209	10	201	18	131	23	11	9	10	8	6	6	4	3	5	3
Maharashtra	46	-	46	42	4	41	5	28	9	7	-	2	-	-	-	-	-	-	-
Andhra Pradesh	19	-	19	16	3	17	2	15	1	2	-	-	-	1	-	-	-	-	-
West Bengal	20	-	20	20	-	20		15	4	-	1	-	-	-	-	-	-	-	-
Grand Total	**304**	**-**	**304**	**287**	**17**	**279**	**25**	**189**	**37**	**20**	**10**	**12**	**8**	**7**	**6**	**4**	**3**	**5**	**3**
Total %	**100**	**-**	**100**	**94.4**	**5.6**	**91.78**	**8.22**	**62.17**	**12.17**	**6.57**	**3.28**	**3.94**	**2.63**	**2.30**	**1.97**	**1.31**	**0.98**	**1.64**	**0.98**

Awards/ Honours Received

T. Krishnan

- Editorial Board Member of Journal of Medicine and Health Research for a term of three years.
- Academic Editor of British Journal of Pharmaceutical Research, a peer reviewed international journal since May 2017 for a term of four years

M. K. Saha

- NABL Accreditation (Quality Council of India), ICMR-NICED Laboratory.
- Member, Sectional Committee, Immuno-Biological Diagnostic Kits, Bureau of Indian Standards. New Delhi, Govt of India. Since 2010.
- Member, Expert Committee, Strengthening of Quality Control Testing Procedure of Immuno Diagnostic Kit Laboratory (IKDL), National Institute of Biologicals, N Delhi, Govt. of India.
- Member, Technical Resource Group, Laboratory Services, NACO, N Delhi,
- Member, Technical Expert Committee for strengthening of scientific activities of Molecular Diagnostic Laboratory, National Institute of Biologicals, New Delhi.
- Member, National Working Group on HIV Estimation-2017, NACO, N Delhi.
- External Expert, Institutional Biosafety Committee, National Institute of Biomedical Genomics, Kalyani, DBT, Govt of India.
- Chair & Judge. National Conference " Clinical Virology- A distinct entity at the frontiers of health care" Student session, Golden jubilee Celebration of Clinical Virology Department, CMC, Vellore, 21st and 22nd July, 2017.
- Member, Judges panel, Debate Competition, Muralidhar Girls' Collage, Kolkata, on 22nd December 2017.

A. K. Chakrabarti

- Acted as Reviewer for journals like PlosOne, Scientific Reports, Future Virology
- Editorial board member World Journal of Respirology
- Editorial board member SciFed Journal of Flu Science
- External examiner in the Department of Microbiology North Bengal University.

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

T. Krishnan

- Presented a Poster entitled: Detection of an emerging etiological agent of viral diarrhoea with three segmented genomic RNA profile in Kolkata, India at the International Congress of Virology [IUMS 2017] held in Singapore from 17th – 21st July 2017.
- Group A, Group B, Group C Rotavirus associated viral gastroenteritis among different age groups in Kolkata, India under the Theme16 :Virology and Vaccine Development---VVD as Poster VVD.1 during the Society of Biological Chemists (India) Annual Meeting held in Jawaharlal Nehru University, New Delhi from 16th November -19th November 2017.

M. K. Saha

- Participated as external expert for performance evaluation of HIV Viral Load Lab, Regional Institute of Medical Sciences, Imphal, Manipur, on 6th April. 2017.
- Participated as National Working Group member for "Expert Consultation cum Capacity Building workshop" on 19th June 2017, NIMS, ICMR, N Delhi on HIV Surveillance.
- Expert Committee member, Strengthening of Quality Control Testing Procedure of Immuno Diagnostic Kit Laboratory, meeting on 6th July 2017, National Institute of Biologicals, New Delhi, Govt of India.
- National Working Group member for "Expert Consultation cum Capacity Building workshop" during 16th -19th Aug 2017, AIIMS, N .Delhi on HIV Surveillance.
- Conducted consultative meeting & Workshop for *Protocol Development for Epidemiological Investigation into the Drivers of HIV epidemic in Select North-Eastern States* during 26th -28th October 2017, ICMR-NICED, Kolkata.
- Expert consultation and review for Biosafety, National Institute of Bio-Medical Genomics, Kalyani, 13th November, 2017.
- Conducted Post HIV Surveillance dissemination meeting for the states under Regional Institute at ICMR-NICED and at RIMS, Imphal, on 17th November, 2017 at NICED, Kolkata.
- Conducted workshop for Epidemiological Investigation into the Drivers of HIV epidemic in Select North-Eastern States on 18th November, 2017, ICMR-NICED, Kolkata.
- Attended project presentation program for DBT, Govt of India North-East Twining program on 12th December 2017 at New Delhi.
- Conducted training for Investigation into the Drivers of HIV epidemic on 16th December, 2017 at Agartala, Tripura.
- Attended National Working Group meeting for "HIV Estimation 2017" on 12th January 2018 , NIMS, ICMR, N Delhi.
- Conducted Data Analysis Workshop for Investigation into the Drivers of HIV epidemic during 12th -14th February 2018 at Regional Institute of Medical Sciences, Imphal, Manipur
- Attended Technical Resource Group HIV "Surveillance and Estimation" at NACO, New Delhi, on 21st February 2018
- Participated in the launch of National HIV Viral Load estimation program at New Delhi on 26th February, 2018.
- Participated in the NACO-UNAIDS "Expert Consultation Meeting on Newer Methods of HIV Surveillance and Estimation in India" at New Delhi on 21st -24th March, 2018.

M. Chawla Sarkar

- Rotavirus NSP4 triggers Drp1-dependent disruption of mitochondrial network which initiates intrinsic apoptotic cascade. Arpita Mukherjee, Upayan Patra, Rahul Bhowmick, Mamta Chawla-Sarkar. 20th International Conference of European Society of Clinical Virology. 13th-16th September, 2017 at Stresa Convention Centre, Italy. (Poster Presentation).
- Emerging G3 rotaviruses in Eastern India revealed intergenogroup recombination and changes in antigenic epitopes during 2014-2016. A Banerjee, B Manna, S Dutta, M Chawla-Sarkar. 20th International Conference of European Society of Clinical Virology. 13th-16th September 2017 at Stresa Convention Centre, Italy. (Oral Presentation).
- Cellular microRNAs: The key players in Rotavirus induced cellular signaling. M Chawla Sarkar. Modern Trends in Microbiology, 21st -22nd September 2017, St Xaviers College, Kolkata, India. (Invited Lecture).
- Pro-viral role of cellular heat shock proteins during Rotavirus infection: Exploring drug repurposing to harness novel antiviral therapeutics. M Chawla Sarkar 14th Asian Conference on Diarrhoeal Disease and Nutrition (ASCODD), 30th October-1st November, 2017, Kochi, Kerala, India. (Invited Lecture).
- Andrographolide exerts anti-rotaviral potency in vitro by inducing cytoprotective enzyme heme oxygenase-1. U Patra, U Mukhopadhyay, A Mukherjee and M Chawla Sarkar. Asian Conference on Diarrhoeal Disease and Nutrition. 30th October- 1st November, 2017 at Kochi. (Poster Presentation).
- Therapeutic potentials of synthetic microRNA analogs: Novel ways to control Rotavirus infection. U. Mukhopadhyay, S. Chanda, U. Patra, A. Mukherjee, A Mukherjee and M Chawla Sarkar. Asian Conference on Diarrhoeal Disease and Nutrition. 30th October- 1st November, 2017 at Kochi, Kerala. (Poster Presentation).
- Genetic diversity among group A rotavirus strains from children hospitalized with gastroenteritis in West Bengal. S Mitra, M K Nayak, N Ganguly, C Ghosh, P Niyogi, S Dutta, S Panda and M Chawla Sarkar. Asian Conference on Diarrhoeal Disease and Nutrition. 30th October - 1st November, 2017 at Kochi. (Poster Presentation).
- OMICS goes Viral: Coupling Host-Rotavirus interactions to Drug Repurposing for designing antiviral therapeutics. M Chawla Sarkar. International Seminar on Advances in Biological Techniques, 2nd - 4th November, 2017 at Raja Peary Mohan College, Uttarpara, WB, India. (Invited Lecture).
- 2nd Hands on training workshop on "Laboratory Diagnosis of Emerging Viral Diseases" organized by Regional Virus Research and Diagnostic Laboratory, at ICMR-NICED on 27th -28th February 2018; Resource Person.

A. K. Chakrabarti

- Attended INSPIRE Laboratory Training workshop from 11th to 13th September, 2017 at Department of Microbiology at AIIMS, New Delhi.
- Participated and provided training on viral detection by Real Time RT-PCR on "2nd hands-on Workshop on Laboratory Diagnosis of Emerging Viral Diseases during 27th – 28th February, 2018 at ICMR-NICED.
- Delivered oral presentation and provided hands on training on "Cell Culture Techniques" during 27th -28th February, 2018 at ICMR-NICED.
- Participated in a Research protocol review meeting with the CDC-AIIMS team to formulate the work strategy on a project entitled "Indian Network of population-based Surveillance Platforms for Influenza and other Respiratory viruses among Elderly (INSPIRE) during 12th -14th March, 2018.

ICMR-NICED VIRUS LABORATORY

Molecular characterization of HCV to understand its diversity in Eastern and North-Eastern India with special reference to high risk groups population

ICMR-NICED Virus laboratory is actively associated with blood borne viral hepatitis (HBV and HCV) study for long time in Eastern and North-Eastern India. In view of WHO Viral Hepatitis Elimination Programme 2030, ICMR-NICED is emphasizing on viral hepatitis and its associated illness on public health importance. One of the major focus is molecular epidemiology and host virus interaction of HCV infection among chronic and high risk population like, multitransfuse thalassemia, hemophilia, heamodialysis patients and person who inject drugs (PWIDs) as they are the major HCV reservoir of this blood borne disease and risk factor for spreading this virus. Direct acting antivirals (DAAs) are available for HCV treatment but till date they are HCV genotype specific, so HCV genotype detection is one of the most importance parameter for it treatment. Recently, a recombinant HCV strain of HCV genotype 3a/1a was isolated from an PWIDs in Kolkata for the first time from this region and HCV drug resistant is also noticed by this Division.In HCV infection, 20-30% individuals spontaneously resolve this virus, thus host-virus interaction and host immunomodulation is very importance in HCV chronicity and disease progression.

Surveillance of Dengue virus serotypesin Eastern India

ICMR-NICED is an Apex Referral Laboratory designated by National Vector Borne Disease Control Programmein Eastern Region. This Division is actively associated with arboviral research and gives full support for the detection of dengue, Japanese Encephalitis and Chikungunya throughout the year in this region. ICMR-NICED is also the Referral Laboratory for Dengue serotyping recognized by Govt. of West Bengal for this state and this division receives dengue NS1 positive blood samples from all over the state, including Sikkim for dengue serotyping. All four dengue serotypes are co-circulated in this region but in recent year, a rapid change in dengue serotypes pattern is observed and causes severe dengue outbreak in this region every year. Since this region belongs to dengue endemic region, continuous monitoring of dengue serotypes is needed all over the year.Rapid differential detection of different arboviruses at febrile phase is urgently needed and this Division is currently working on it. This division is also associated with dengue sero surveillance conducted by ICMR.

Understanding the incidence, pattern of infectivity and frequency of HCMV infection in eastern India

The ICMR-NICED is actively involved to understand the epidemiological prevalence pattern, physiological/ clinical characteristics and molecular phylogeny of Human cytomegalovirus among the infected patients of Eastern region. This division is also engaged in developing new serological and molecular methods for the rapid detection of this virus from patient samples. They are trying to identify the different socio-demographic and clinical parameters associated with the HCMV infectivity pattern and has also made some critical advancements towards understanding the mechanism of infection at the molecular level.

Ethnomedicinal Research:"Traditional to Translation"

ICMR-NICED Virus laboratory is engaged in 'national policy translation research' including the scientific validation of selected traditional medicines of diverse marginalized communities of India. The work includes survey, documentation of unknown information, sample collection, processing, extraction, standardization and *in vitro* bioactivity testing based on usage to validate the claim. The isolation of pathogenic Herpes Simplex Virus, their identification and characterization is another area of work. Once a new activity observed, the extract is subjected to rigorous testing in different models with collaboration and then isolation of active components with its mode and molecular mechanism of action. So far these works help to gather knowledge on use of traditional medicines in viral infections, established significant activities of few Ethnomedicines to be used in primary health care through safety and efficacy studies. These works not only help to sustain the livelihood of the respective communities but also generate revenue along with the conservation of important gene pool.

Scientists:
Dr. D. Chattopadhyay, Scientist- F (on lien)
Dr. N. Chakraborty, Scientist- E
Dr. P. C. Sadhukhan, Scientist - D

Staff:
Mr. A. Mitra, Sr. Technician (2)
Mr. B. Ganguly, Technician (1)
Mr. R. Bhakta, Driver-cum-Mechanic, (Gr.-II)
Mr. S. Mullick, U.D.C
Mr. B. Mitra, Laboratory Assistant
Mr. R. Hela, Laboratory Assistant

Post-Doctoral Fellow:
Dr. Agniswar Sarkar, PDF (UGC)
Dr.Priyanka Bhowmik, NPDF (DST-SERB)

Pre-Doctoral Fellow:
Ms. Dipanwita Das, SRF (DST-INSPIRE)
Mr. Aroni Chatterjee, SRF (UGC)
Mr. Sabbir Ansari, SRF (WB-DST)
Ms. Debanjali Gupta, JRF (ICMR)
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Ms. Apurba Das, JRF (DBT)
Ms. Ananya Das Mahapatra, JRF (DST-INSPIRE)
Mr. Rajendra Prasad Chatterjee, SRF (DBT)
Mr. Debsopan Roy, JRF (WB-DST)
Mr. Supradip Dutta, UGC-JRF
Mr. PreetamParija, JRF (WB-DST)

N. Chakraborty (Principal Investigator)

Study of CMV infection in Neonatal Hepatitis and its association with maternal CMV infection

Co-PI: S. K. Ghosh, Dr. BC Roy Post Graduate Institute of Pediatric Sciences, Kolkata; B. Basu, NRS Medical College, Kolkata

- **Congenital CMV infection prevalence and genotypic distribution of gB gene**

Cytomegalovirus (CMV) is a contributory element for congenital infection in neonates and often leads to neurological discrepancies and hearing loss. Infants born with symptomatic/asymptomatic congenital CMV infection (cCMV) are at major high risk globally. CMV-UL83 gene encodes the phosphoprotein pp65, which involves entry to infected cells immediately after adsorption and subsequently translocate to the cell nucleus. On the other hand, CMV-UL55 gene encodes a major envelope glycoprotein B (gB), which plays a key role in the virus entry and fusion. It also participates in cell-to-cell proliferation. The present study aimed to develop proper molecular diagnostics of cCMV infection through the characterization and sequencing of gB and UL83 genes, to determine the association of its genetic variation.

3ml blood was collected from 39 suspected newborns within 2 weeks after birth. Serum samples were tested for CMV-specific IgM using ELISA and molecular characterization of gB and UL83 gene was done by nested PCR (Fig 44).

46.15% (n=39) patients were positive for IgM. Among the samples collected, 53.84% was positive for the CMV gene (UL83 or gB) by PCR analysis. 28.20% patients were positive in both PCR and ELISA. 17.9% patients were found to be negative for CMV gene on PCR analysis however tested positive for IgM. The false positive reactions for virus-specific IgM occurred probably due to the presence of RF (Rheumatoid Factor). 25.6% samples were positive for CMV-specific genes but tested negative for IgM antibody. PCR analysis was conducted on two very significant CMV-specific genes UL83 and gB. UL83 gene was positive in 57.14% cases.

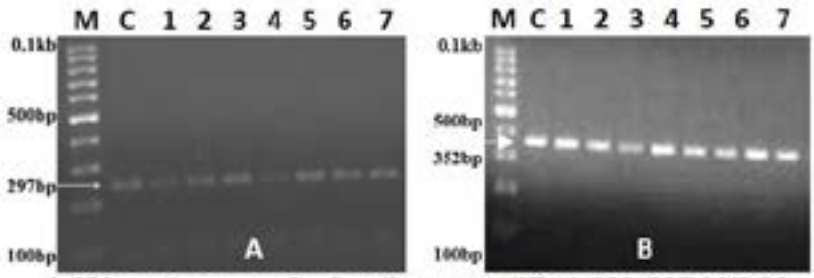


Fig 44 2.0% agarose gel showing amplified (A)-CMV-UL83 and (B)-CMV-gB gene. Lane M, 100bp marker; Lane C, Control strain ATCC-AD169.

gB gene was positive in 80.95% cases and 23.07% patients were positive for both gB and UL83 genes.Early detection of cCMV will thus help to minimize the morbidity and mortality of neonates and will lead to clarify the association of infection in neonatess acquired from maternal transmission.

Development of reagents for simple-immunochemical test for the detection of Chikungunya infection

Co-PI: S. Chatterjee

Chikungunya virus (CHIKV) is an enveloped, positive strand RNA virus belonging to the genus Alphavirus of the Togaviridae family. Infection with CHIKV results in chikungunya fever.

The Objectives here are to perform (1) Laboratory based confirmation of Chikungunya virus infections amongst the referred cases, admitted in the hospital with respective illness in the state of West Bengal. (2)

Relationship between age, sex, lifestyle, occupation, educational status, socio-economic status amongst the infected cases. (3) To characterize the circulating strains at molecular level to ascertain the prevalent type and to correlate the same with disease outcome.

Serum samples were tested for detection of IgM antibodies to CHIKV by ELISA method. RT-PCR was carried out for confirmation of CHIKV infection. Attempts were made to isolate CHIKV from 15 acute CHIKV RT-PCR positive samples in C6/36 mosquito cell line. Isolation was confirmed through RT-PCR.

Of 1139 collected samples, only 317 IgM samples were reactive to CHIKV antibody by ELISA method (27.8%), among which 173 samples were RT-PCR positive (15.1%). The study comprised of patients from all the socioeconomic classes with 39.9 % patients belonging to the lowest income group (<5000INR/month), 61.4% patients to the urban locality and 60.2 % patients were employed. 40.8% patients were illiterate and 63.3% patients lived in extremely unhygienic conditions. Maximum numbers of CHIKV positive cases observed in the age group of 0–10 years in both sexes due to weak immunity. Males and females have been almost equally affected. IgM seroprevalence was higher in patients from urban locality (38.2%) and those living under unhygienic conditions (35.6%). Patients with no educational exposure were found to be affected at a higher rate (34.1%). The maximum number of cases was found during July to November. (Table 12). The major cases were observed from the Kolkata, Howrah, North and South 24 Parganas, East and West Medinipur (Table.13). This study represents only the tip of the iceberg, in depth study on the virus and mosquito eradication is immensely necessary to combat the spread of the disease.

Table: 12

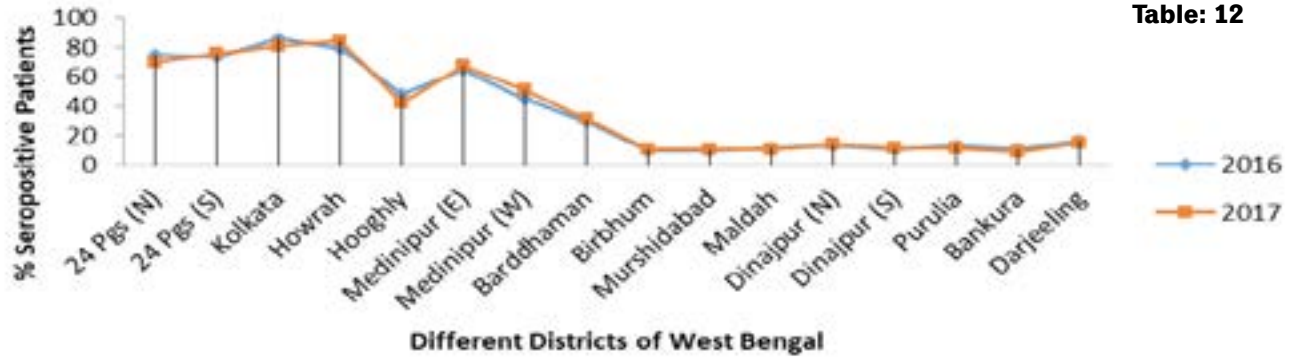


Table: 13

P. C. Sadhukhan (Principal Investigator)

Studies on genomic variation of hepatitis C virus in high risk group population in Eastern part of India

Co-Investigator: S.Panda, S. Ghosh, A. Konar, M. Bhattacharyya, P. Chaudhary

Genomic evolution is a continuous process for Hepatitis C virus (HCV), like other RNA viruses to evolve into new genotype and subtypes. So, it is very important to monitor viral genomic diversity and evolution of this virus on regular basis, especially within high risk group (HRG) population, like thalassemia, hemophilia, hemodialysis patients and PWID, as they are the major HCV reservoir of this blood borne disease and are risk factor in spreading this virus. In the era of genotype specific direct acting antivirals, if we know the molecular diversity of HCV in different population group, therapeutic intervention would be much easier for clinicians to tackle this disease.

During this period, we have received 391 HCV sero-reactive blood samples from different HRG population as well as from general population with chronic liver diseases from Eastern part of India. Demographic and clinical data were collected at the time of blood sample collection. Out of 391 HCV sero-reactive individuals, 279 (71.36%) were found to be HCV RNA positive. We observed that HCV RNA positivity varied in different HRG population groups, e.g, RNA positivity in thalassemia patients and PWIDs were 65.08% and 88.46% respectively, whereas in general population with chronic liver diseases, it was 70.83%. Our HCV genotype data showed that the distribution of HCV varied in different population groups; 3a (46.46%) was the major circulating strain in our study population followed by 3b (24.74%), 1c (9.09%), 1b (11.62%), 1a (7.58%), 4a (0.51%).We also observed that majority of thalassemia patients were infected with HCV genotype 3a (76.5%); 65.38% of hemodialysis patients were infected with HCV genotype (1c) whereas 81.25% of the general population with chronic liver diseases were infected with HCV genotype 3 (Fig.45). A total of 110 HCV RNA positive individuals with different genotypes were treated with Direct Acting Antivirals (DAAs), 4 of them were relapsed (3 of them were CLD patients and 1 was thalassemia patient) and belonged to genotype 3, the major genotype variant in India. Overall, we observed HRG population carrying new HCV subtypes and also HCV genomic diversity was more prominent within HRG population and DAA relapse cases were not uncommon in this region.

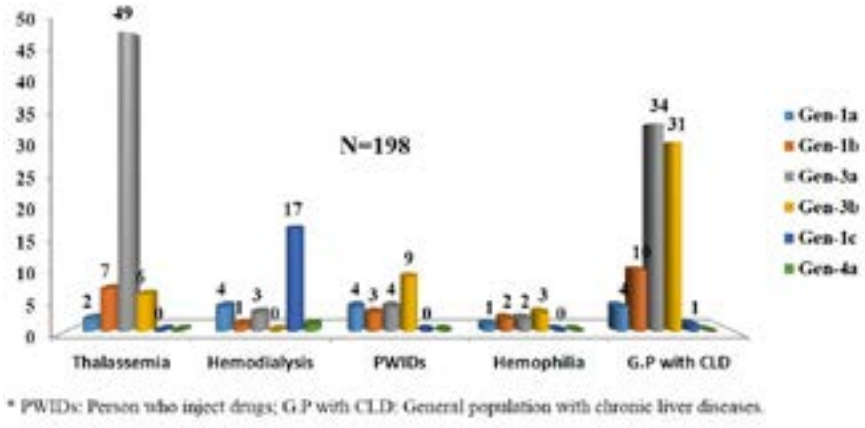


Fig. 45: HCV genotype distribution in different high risk group population In Eastern part of India

Studies on Circulating Serotypes in 2017 Dengue outbreak in West Bengal

Co-Investigators: S. Dutta

In 2017, from north to south, all the districts of West Bengal suffered from a massive dengue outbreak. We have processed more than 1000 dengue NS1 sero-positive blood samples received from all the district as well as Sub-divisional hospitals of West Bengal for dengue serotyping. We observed co-circulation of all the four dengue serotypes during the outbreak with different percentage in different parts of West Bengal. Overall, DENV2 was 73.44% followed

by DENV4 (14.73%), DENV1 (6.88%) and DENV3 (4.95%) (Fig.46). We have noticed a rapid change in dengue serotypes all over West Bengal in last few years where DENV3 serotype was the major circulatng strain in 2012 to 2015, but in 2016, DENV1 was the prevalent strain whereas DENV2 was in 2017.

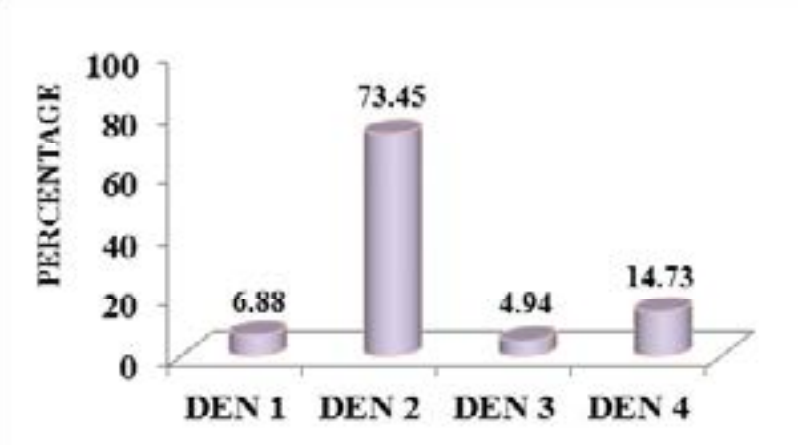


Fig. 46: Circulating Dengue Serotype in 2017 Dengue outbreak

Awards/ Honours Received

P. C. Sadhukhan

- Regular Reviewer of Journal for Hepatology, PLoS One, Journal of General Virology, Journal of hepatitis Research, Virus Diseases, Viral Immunology, Journal of Medical Virology, International Journal of Public Health and Epidemiology; International Journal of Tropical Diseases & Health, British Microbiology Research Journal, Indian Journal of Medical Microbiology, Indian Journal of Medical Research.

Conferences/ Seminars/ Workshops/ Meetings/Trainings Attended/ Organised

P. C. Sadhukhan

- Aritra Biswas, Debanjali Gupta, Rushna Firdaus, Prasanto Chowdhury, Maitreyee Bhattacharyya, Provash Chandra Sadhukhan. Host IL28B, TNF-alpha (-308 A/G) and IFN-gamma (+874 A/T) gene polymorphisms is associated with spontaneous viral clearance in HCV infected multitransfused thalassemic patient. 7th CME of Society of Tropical Medicine and Infectious diseases of India, 11th June, 2017, Kolkata.
- Debanjali Gupta, Aritra Biswas, Rushna Firdaus, Kallol Saha and Provash Chandra Sadhukhan. Genomic diversity of Hepatitis C virus among intravenous drug users in the District of Darjeeling, West Bengal. 7th CME of Society of Tropical Medicine and Infectious diseases of India, 11th June, 2017, Kolkata
- Delivered lecture for training workshop on "Laboratory Diagnosis of Emerging Viral Diseases" organized by Regional –VRDL, ICMR-NICED, on 27th & 28th March, 2018, Kolkata.
- Invited speaker for CME on Dengue Fever, Vivekananda Institute of Medical Sciences, Ramkrishna Mission Seva Pratishthan, Kolkata, 20th December, 2017.
- Attended meeting on "Policy Round Table: Hepatitis B and C prevention and care delivery in the North Eastern States of India" Sponsored by Tata Trusts and Liver Foundation of West Bengal, Kolkata. 10th September, 2017.
- Participated Investigators Meeting on proposed ICMR task Force project: "Assessment of Viral Hepatitis burden in Northeast India: A systematic study". 13th - 14th July, 2017, RMRC, Dibrugrah, Assam.
- Participated in 7th CME of Society of Tropical Medicine and Infectious Diseases in India, 11th June, 2017, Kolkata.

SERVICES PROVIDED BY THE INSTITUTE

Quality Assurance for HIV Testing

External Quality Assurance Scheme (EQAS) is one of the essential tools to assess the performance of the laboratory and their ability to generate accurate results. It is achieved by a series of processes that assure the most accurate and highest quality result. National Reference Laboratory (NRL) of ICMR-NICED is the proficiency testing provider for HIV antibody testing for the State Reference Labs (SRLs) of A&N, Assam, Jharkhand, Meghalaya, Mizoram and Orissa. The main activities of NRL of ICMR-NICED are as follows:

- Conducting Proficiency Testing for 12 SRLs and 432 ICTCs under these states.
- Confirmation of all indeterminate or discordant samples identified by attached 12 SRLs.

Referral service for confirmation of HIV testing results of the samples received from different SRLs and other organizations. (Pic 1)

- Quality Assurance for HSS Lab result (Retesting of all positive and 5% negative).
- Testing of HIV Dried Blood Spot samples for HIV Sentinel Surveillance for High Risk Group and Bridge Population (2017). (Table 1)

Pic 1: HSS Sample testing

Table 1: External Quality Assurance/ Confirmation of samples from SRLs/ NRLs

Name of States	Name of SRLs/ other organizations	Samples received	Concordant Result at NRL	Discordant Result at NRL
West Bengal	School of Tropical Medicine	04	04	00
Assam	Silchar Medical College & Hospital, Silchar	08	05	03

Referral Services: National Reference Lab, NICED has been entrusted with the responsibility of verifying results for samples sent by Hospitals. Samples tested, result communicated within the turnaround time, analyzed the root cause of discordance and trained the referring lab personnel for improvement and technical capacity building. Most of the samples are positive for HIV antibody indicating improvement of quality of the referring labs. (Table 2, Table 3, Table 4)

Table 2: Referral Service done for the institutions at NACO NRL, ICMR-NICED, Kolkata.

Source of Samples	No. of sample Tested	No. of sample Positive
Command Hospital, Kolkata	27	27

Table 3: HIV Sentinel Surveillance 2017 (ANC): Quality Assurance for SRLs under NACO NRL, NICED, Kolkata and other Testing Center (sample received from April 2017 to March 2018)

State	Name of SRL/Testing Centre	Samples sent by SRL		Samples rejected by NRL	Confirmed Result at NRL		Discordant
		HIV -ve	HIV +ve		HIV -ve	HIV +ve	
Jharkhand	Regional Institute of Medical Sciences, Ranchi, Jharkhand	201	05	00	201	05	00
	Patuliputra Medical College, Dhanbad, Jharkhand	120	05	00	120	05	00
	MGM Medical College, Jamshedpur, Jharkhand	125	03	00	125	03	00
Assam	Assam Medical College & Hospital, Dibrugarh, Assam	132	02	01	131	02	00
	Gauhati Medical College & Hospital, Guwahati, Assam	320	08	11	309	08	00
	Silchar Medical College & Hospital, Silchar, Assam.	74	07	00	74	07	00
Odisha	SCB Medical College, Cuttack, Odisha	260	21	00	260	21	00
	MKCG Medical College, Berhampur, Odisha	183	05	00	184	04	01
	VIMSAR, Burla, Odisha	202	10	00	202	10	00
A & N Islands	GB Pant Hospital, Port Blair, A & N Islands	85	01	00	85	01	00
Meghalaya	Tura Civil Hospital	44	00	00	44	00	00
	Pasteur Institute, Shillong	101	22	00	101	22	00
Manipur	RIMS, Imphal	127	11	00	127	11	00

Table 4: Testing Center data: HIV Sentinel Surveillance 2017 (HRG & Bridge population)

State	Total samples received	Total samples rejected	Total samples tested	Total HIV positive
Chhattisgarh	2501	13	2488	53
Meghalaya	701	03	698	15
Nagaland	3248	26	3222	69
Mizoram	1648	05	1643	35
Tripura	984	00	984	20
Total sample tested			9035	
Total HIV positive			192	

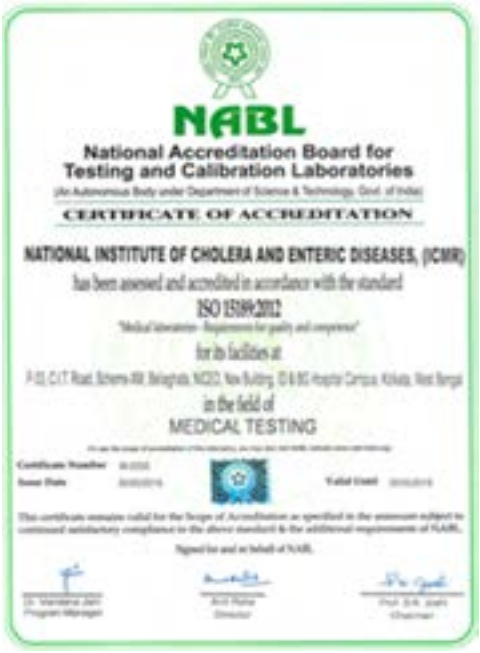
Proficiency testing program for NRLs conducted by Apex Lab (NARI, Pune): NACO-National Reference Laboratory of ICMR-NICED participated in the proficiency testing program conducted by Apex Laboratory, NARI, Pune twice in a year.

Proficiency testing program for SRLs and their attached ICTCs: NACO- National Reference Laboratory of ICMR-NICED conducted "Proficiency Testing Programme" for 12 State Reference Laboratory and their attached ICTCs. Collection of samples, preparation, characterization and validation of panel is the steps to be followed for whole activity.

Pic 2: Participants - EQAS Workshop

Training: NACO-NRL of ICMR-NICED conducted Training programs for Medical Officers, Lab/Program Supervisors and Medical Lab Technologists for HIV testing as and when requested by different organizations. Every year two workshops are organized for 12 State Reference Laboratories under NRL. (Pic 2)

NABL Accreditation: ICMR-NICED has expanded the scope of NABL accreditation in accordance with ISO 15189:2012 in the year 2016. This year HIV molecular assay (quantitative), parasitology and VRDL of ICMR-NICED have applied as expanded scope of NABL in the field of Medical Testing which undergoes the discipline of Microbiology and serology. (Pic 3)


NABL
National Accreditation Board for Testing and Calibration Laboratories
CERTIFICATE OF ACCREDITATION
NATIONAL INSTITUTE OF CHOLERA AND ENTERIC DISEASES, (ICMR)
has been assessed and accredited in accordance with the standard
ISO 15189:2012
for its facilities at
in the field of
MEDICAL TESTING

Pic 3: NABL Certificate

Diagnostic Kit Evaluation by Consortium of NRLs at ICMR-NICED

Anti-HIV antibody tests are performed for diagnosis of HIV infection, surveillance of HIV infection and screening blood to protect the blood recipient from transfusion transmitted infections (TTIs). The other routinely tested TTI infections are HBV and HCV. The evaluation of diagnostic kits for TTIs was an important aspect of obtaining good quality kits. Hence a Consortium of four NRLs was established in 2008 with the help of NACO which provides Quality Evaluation of ELISA and Rapid diagnostic kits for HIV, HBV and HCV. Quality assurance of HIV, HBV & HCV diagnostic kit is essential to combat against spread of these viruses. To ensure supply of quality kits for all public health facilities including blood banks, a robust mechanism has been developed by a Consortium of National Reference Labs following the uniform procedure countrywide to evaluate performance of commercial kits. Request for evaluation is routed through the consortium secretariat, NARI, Pune, and all the labs are assigned the task for evaluation in a predefined rotational basis to avoid any bias. (Pic 4 & Table 5)

Pic 4: Work in Progress at NRL Lab

Table 5: Kit Evaluation by Consortium of NRLs, ICMR-NICED, Kolkata

Type of Kit Evaluated	No. of Kit/ Batch Received	No. of Kit/ Batch Rejected	Reason for Rejection	No. of Kit/ Batch accepted and Evaluated	No. of Batches meet the required Sensitivity	No. of Batches meet the required Specificity	Total no. of batches complying with specification
HIV ELISA	10	00	NA	10	09	10	09
HIV RAPID	28	02	Temp on arrival at Lab beyond acceptable limit of 2-8° C	26	26	26	26
HBsAg ELISA	10	00	NA	10	10	10	10
HBsAg RAPID	01	00	NA	01	01	01	01
HCV ELISA	13	02	Temp on arrival at Lab beyond acceptable limit of 2-8° C	11	11	11	11
HCV RAPID	00	00	NA	00	NA	NA	NA
TOTAL	62	04	----------	58	57	58	57

Integrated Counseling & Testing Centre (ICTC)

HIV counseling and testing service is a key entry point to prevention of HIV infection and to treatment and care of people who are infected with HIV. When availing counselling and testing services, people can access accurate information about HIV prevention and care and undergo HIV test in a supportive and confidential environment. People who are found HIV negative are supported with information and counseling to reduce risks and remain HIV negative. People who are found HIV positive are provided psycho-social support and linked to treatment and care.

The main functions of the ICTC include:

- Conducting HIV diagnostic tests.
- Conducting VDRL test for High Risk Group (HRG).
- Providing basic information on modes of transmission and prevention of HIV for promoting behavioural change and reducing vulnerability.
- Providing psychosocial support to HIV positive people. (Pic 5)
- Link HIV positive people with other HIV prevention, care and treatment services.

Pic 5: ICTC activities

- Follow up counselling.
- Free condom distribution.
- Cross referrals to TB, STI, ART, TI-NGO etc. (Table 6)

Table 6: HIV testing details at ICTC (April 2017-March 2018)

Total Tested	Positive	Positivity	HRG Tested	Referred from RNTCP	Referred from Govt. Hospital
817	32	3.92%	260	123	368

High standards of testing are maintained at ICTC by using 3 test principles for diagnosing HIV. There are established external quality assurance scheme (EQAS) for ICTC through State Reference Laboratory. NICED ICTC secured 100% concordance result in EQAS.

From April 2017 to March 2018, total 817 persons were tested for HIV in ICTC. Among them, 32 (3.92%) were found HIV positive and linked to ART centre for pre ART registration and CD4 testing (Fig 1). 260 HRGs were tested for HIV during this period. Almost 90% of them were tested for syphilis.

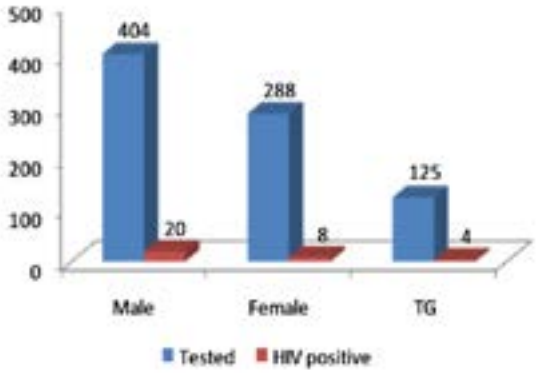


Fig 1: HIV positivity among ICTC clients

Early Infant Diagnosis

Molecular Diagnosis of HIV among babies born to HIV infected mothers using DBS employing state of art molecular assay for 14 states of East and North Eastern India were done. This is to ensure early initiation of ART for the infected babies and also to monitor effectiveness of current practice of PPTCT (Prevention of Parent to Child Transmission).

Molecular diagnosis of HIV among babies (up to 18 months) born to HIV infected mothers employing Dried Blood Spot (DBS) samples, is being done at ICMR-NICED Regional Reference Lab (RRL), for the first time in the country in such massive scale covering all the 14 eastern and North-Eastern states of India, to address the monumental challenge of implementing this Nationwide program. Evidence generated rationalized change of national ART regimen for preventing mother to

child HIV transmission as well as use of only DBS sample (removing whole blood sample test for confirmation) for molecular diagnosis of HIV.

NACO-conducted EID Program is the cornerstone in the efforts to significantly reduce HIV related morbidity and mortality in infants. The diagnosis of HIV infection in infants and children younger than 18 months is different from that in adults due to trans-placental transfer of maternal antibodies from mother to child during pregnancy, childbirth and breast feeding. Hence, HIV-1 TNA (Total Nucleic Acid) PCR testing is recommended for the babies less than 18 months of age.

ICMR-National Institute of Cholera and Enteric Diseases (NICED) is one of the 6 Regional Reference Laboratories (RRL) among AIIMS, ICMR-NICED, NITR, MUniv, NIMHANS & NARI, under NACO, performing RealTime HIV-1 Qualitative in vitro amplification assay for the qualitative detection of Human Immunodeficiency Virus Type 1 (HIV-1) nucleic acids from Dried Blood Spot (DBS) samples. In ICMR-NICED, EID program has been started from August, 2010 initially with three states, West Bengal, Orissa and Chhattisgarh. With gradual success of the program, other Eastern and North Eastern states (Jharkhand, Bihar, Assam, Manipur, Mizoram, Nagaland, Meghalaya, Arunachal Pradesh, Sikkim, Tripura, and Andaman & Nicobar Islands) were also included under ICMR-NICED-RRL (Molecular HIV Laboratory).

Presently, 1200 ICTCs are involved in collection of DBS samples in 14 states under NICED-RRL for DBS HIV-1 TNA PCR. A National Testing Algorithm comprising of two sections according to the age group of the child (Algorithm A: for infants < 6 months and Algorithm B: for child 6-18 months) have been followed for HIV exposed infants in this EID program for detection of HIV-1 DNA. All DBS HIV-1 PCR reactive/detected specimens are further confirmed by a 2nd Confirmatory HIV-1 PCR of the same sample.

A total of 2200 DBS samples were received from April 2016 to March 2017 at ICMR-NICED-Regional Reference Laboratory (Molecular HIV Lab) and among them 2161 samples were accepted for testing, according to sample acceptance criteria.

A total of 2365 DBS samples were tested for the period of 1st April, 2017 to 31st March, 2018 (The accepted samples can be tested in any month. Therefore, the number of samples accepted and tested in a month may not tally) and their status is depicted below. (Table 7 & Fig 2)

Table 7: Status of EID DBS samples received and tested (with HIV-1 positivity) at ICMR-NICED from April 2017 to March 2018

Name of States	No. of total DBS samplesaccepted	No. of total DBS samples tested	HIV-1 DNA detected in DBS
West Bengal	479	529	35
Orissa	247	271	34
Chhattisgarh	449	480	31
Bihar	368	424	37
Jharkhand	154	160	32
Mizoram	154	157	20
Assam	151	171	4
Manipur	55	57	13
Nagaland	93	104	0
Meghalaya	1	1	0
Arunachal Pradesh	6	7	0
Sikkim	3	3	0
Tripura	0	0	0
A & N Islands	1	1	0
TOTAL	2161	2365	186

N.B: *No.of samples 'tested' is more than no.of samples 'accepted', as samples of previous year were tested in this current period (year).*

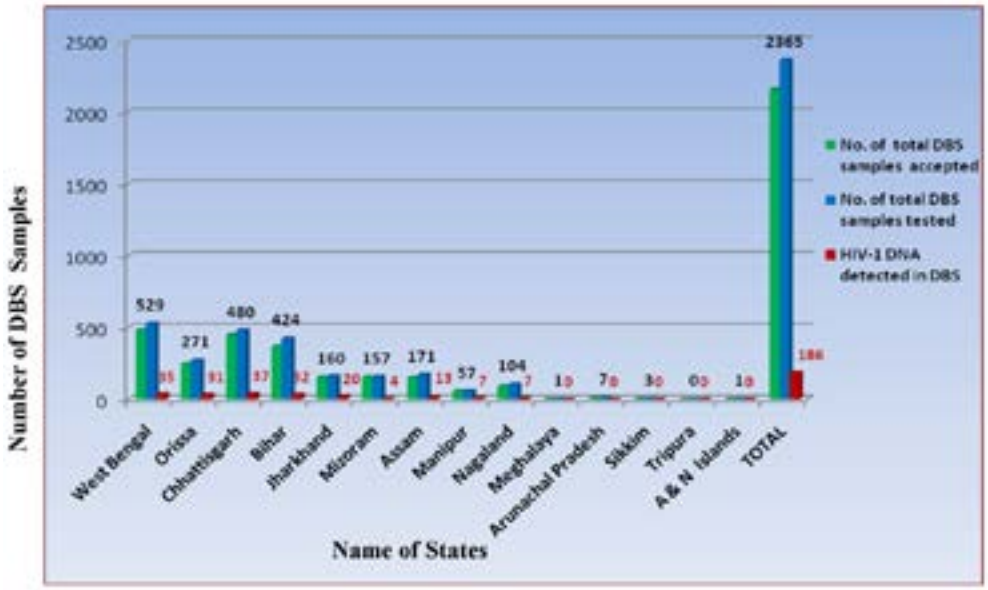


Fig 2: Status of EID DBS samples received and tested (with HIV-1 positivity)at ICMR- NICED from April 2016 to March 2017

Regional Institute (East) for HIV Surveillance

The activity of Regional Institute (East), ICMR-NICED, involves implementation of HIV Sentinel Surveillance (HSS) among Antenatal Clinic (ANC) attendees and High Risk Group (HRG) for the East and North Eastern states with the aims to monitor the (i) trends and prevalence of HIV infection, (ii) distribution and spread of HIV prevalence in different population subgroups and in different geographical areas and (iii) to identify emerging pockets of HIV epidemic in the country. RI (E) also has an important role in data entry and data management of HSS.

Major Activities of Regional Institute

Pic 6: Monitoring visit for HSS

- Technical support & guidance to State AIDS Control Society (SACS) in overall planning & implementation of HSS activities in eastern Indian states, facilitating smooth implementation of surveillance activities by liaising with concerned state authorities addressing specific problems at sentinel sites/ testing labs.
- Technical validation & approval of new site through review of relevant data & site visits.
- Conduct Regional Pre & Post-surveillance co-ordination & planning meetings, Regional Trainings and Workshops for HSS – ANC and HRG round.
- Technical & Supervisory support for state level training of site & lab personnel.
- Monitoring & Supervision during HSS (ANC and HRG round) through site visits by RI team members. (Pic6) Constitution of State Surveillance Teams (SST) and coordination of all their activities including Monitoring & Supervision by SST members.
- Ensuring timely reporting & corrective action at sites/testing labs during the round.
- Data Entry, matching, modifying, freezing & cleaning through SIMS.
- Concurrent data monitoring and initiation of corrective action, as required.
- Giving inputs to improve the software program.
- Analyze the data during survey period for better field work.
- Guide SACS in preparation of state surveillance reports after the round.
- Undertaking special epidemiological or operational studies and in-depth analyses during the inter-surveillance period to validate or strengthen surveillance findings.
- Technical review & approval of any other specific proposal from SACS related to HSS.
- Submission of report of activities undertaken during surveillance and analysis of the surveillance findings in the allocated states. (Table 8 & Table 9)

Table 8: ANC Sites in ICMR-NICED region for HSS 2017:

States	No. of Sites	Samples Allotted	No. of Testing lab
Andaman & Nicobar Islands	4	1600	1
Chhattisgarh	26	10400	3
Meghalaya	9	3600	2
Nagaland	13	5200	2
Sikkim	5	2000	1
West Bengal	23	9200	4

Table 9: HRG Sites in ICMR-NICED region for HSS 2017:

States	FSW	MSM	IDU	TG	LDT	SMM
Andaman & Nicobar Islands	0	0	0	0	0	0
Chhattisgarh	4	2	3	0	1	1
Meghalaya	1	0	2	0	0	0
Nagaland	1	1	10	0	1	0
Sikkim	1	0	2	0	0	0
West Bengal	7	3	4	1	3	1

Epidemiological Investigations

Pic 7: Participants of Consultation workshop for planning of epidemiological investigation

In view of the preliminary findings of sustained as well as emerging pockets of high HIV prevalence from HSS 2017, the National AIDS Control Organization (NACO), Ministry of Health & Family Welfare, Government of India intends to launch an epidemiological investigation into the States of Manipur, Mizoram, Nagaland, Meghalaya and Tripura. This investigation aims to define the location, behavioral and contextual factors that drive the HIV epidemic in these States. Regional Institute, ICMR-NICED leads the implementation of Epidemiological Investigations for the states of Nagaland, Meghalaya, Assam & Tripura.

The objectives of the investigation in the five selected States as mentioned above are as follows:

i. To understand the levels, trends and geographical spread of the HIV epidemic

ii. To determine the profiles of the HIV positive ICTC attendees

iii. To identify the contextual factors that may be driving the HIV epidemic

iv. To identify the individual behaviors influencing the HIV epidemic

v. To explore the role of environmental contextual factors contributing to the HIV epidemic (Pic 7)

Plasma Viral Load Assay for HIV

HIV Viral load assay, under NACO, is being conducted at ICMR-NICED – Molecular HIV Laboratory for East & N-E region, for ensuring efficacy of ART and taking evidence based decision for initiation of further

treatment. Quantitative measurement of HIV level in peripheral blood has greatly contributed to the understanding of the pathogenesis of HIV infection and has been shown to be an essential parameter in prognosis and management of HIV infected individuals. Decisions regarding initiation or changes in antiretroviral therapy are guided by monitoring plasma HIV RNA levels (viral load). The goal of antiretroviral therapy is to reduce the HIV virus in plasma to below detectable levels of available viral load tests. ICMR-NICED is one of the Laboratories under NACO that uses Abbott RealTime HIV-1 RNA assay which is an in vitro reverse transcription polymerase chain reaction (RT-PCR) assay for the quantization of HIV-1 in human plasma. ICMR-NICED Molecular HIV laboratory restarted HIV viral load assay for the patients under ART for monitoring effectiveness of on-going treatment as per national guidelines and also to assist in HIV drug resistance mutation assay. (Pic 8)

Presently, there are two linked centres, one in West Bengal and the other in Chhattisgarh, sending specimens to ICMR-NICED for HIV Viral Load test.

For the period of 1st April, 2017 to 31st March, 2018, 1009 Viral Load samples were received at ICMR-NICED, and a total of 984 samples were tested for HIV viral load from the particular period.

The status of the samples is depicted in the table and figure below. (Table 10 & Fig 3)

Pic 8: Activity at Molecular HIV Laboratory

Table 10: Status of HIV Viral Load Assay for patients under ART for the period of 1st April 2017to 31st March, 2018:

NO. OF SAMPLES		HIV-1 Viral Load Copy No. <400 copies	HIV-1 Viral Load Copy No. 400-10000	HIV-1 Viral Load Copy No. >10000	HIV-1 Viral Load NOT DETECTED
Received	Tested				
1009	984	165	136	295	388

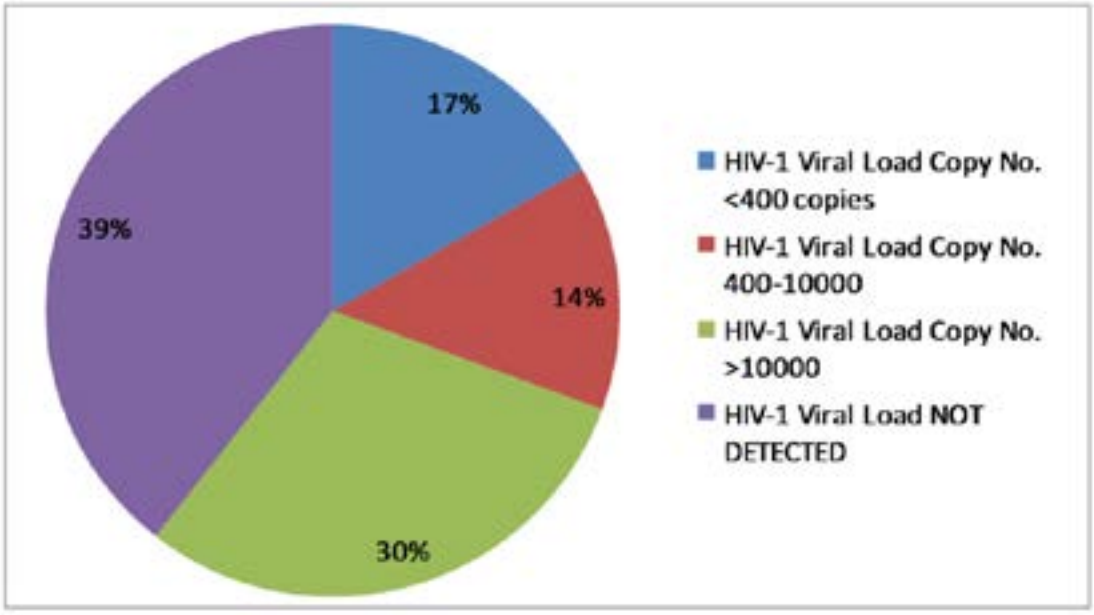


Fig 3: Status of HIV Viral Load Assay for patients under ART for the period of 1st April, 2017 to 31st March, 2018

Training and Workshop

- Workshop on External Quality Assurance Scheme (EQAS) & NABL Accreditation for State Referral Laboratories was held on 24th October, 2017 at ICMR-NICED. Technical Officer & M.T (Lab) from Assam, A & N Islands, Assam, Jharkhand, Meghalaya, Mizoram & Odisha participated in the training program. (Pic 9)

Pic 9: EQAS Workshop at NICED

- EQAS workshop & Panel sera distribution for SRLs was held at ICMR-NICED on 20th March, 2018. Technical Officer & M.T (Lab) from Assam, A & N Islands, Jharkhand, Meghalaya & Mizoram participated in the workshop.

- Post surveillance dissemination meeting for important findings and follow-up actions was organized at ICMR-NICED on 17th November, 2017 for Eastern and North Eastern region. Participating states were Andaman & Nicobar Islands, Chhattisgarh, Meghalaya, Nagaland, Sikkim & West Bengal for eastern region (ICMR-NICED) and Arunachal Pradesh, Assam, Manipur, Mizoram & Tripura for north-eastern region (RIMS). (Pic 10)

Pic 10: Post Surveillance meeting at NICED

- A three day consultation workshop for 'Development of Operational Framework for Investigation into Rising Epidemic in Select North-Eastern States' was held at ICMR-NICED during 26th – 28th October 2017. Representatives from NACO, RIMS, FHI360 and ICMR-NICED attended the workshop. An implementation plan along with data management plan for the epidemiological investigation was developed in the workshop.

Pic 11: Workshop for Investigation into the drivers of HIV Epidemic held at NICED

- Workshop for Investigation into the drivers of HIV Epidemic in Select North-Eastern States of India held at ICMR-NICED on 18th November 2017, attended by representatives from state AIDS control societies (Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura), Independent expert, NACO-New Delhi, CDC-India, FHI 360, AIIMS-New Delhi, PGIMER-Chandigarh, ICMR-NIE- Chennai, ICMR-NARI-Pune, ICMR-NIMS-New Delhi, NIHFW-New Delhi, NACO-North-Eastern Technical Support Unit-Guwahati, RIMS-Imphal and ICMR-NICED-Kolkata. (Pic 11)

Exposure visit of experts from WHO:

A visit of delegate from World Health Organization took place during 14th February 2018. WHO expert visited National HIV Reference Laboratory Regional Reference Laboratory for Early Infant Diagnosis of HIV and ICTC laboratory. (Pic 12)

Pic 12: Staff explaining activities of lab

NICED virology lab is a referral lab for H1N1/2009 testing in West Bengal since 2009. Service to the state is provided by testing clinical samples of referred Severe Acute Respiratory Illness cases from hospitals in Kolkata and surrounding districts. During 2017-18, 1427 referred cases (In-patients with severe respiratory illness) were tested, 232 were positive of Influenza A/pdm H1N1 (16.25%) and 16 were subtyped as H3N2 (≈1%). Reports were disseminated to the State Health Departments on daily basis.

The outpost at the OPD of Dr B. C. Roy Children's Hospital offered diagnostic service to suspected diarrhoeal diseases and typhoid fever patients (stool/ blood culture and sensitivity, molecular diagnostics, Widal test) and provide treatments while carrying out hospital-based surveillance.

Phage Typing : As a national center Vibrio Phage Reference Laboratory of ICMR-NICED receives *V. Cholerae* O1 strains from different cholera endemic area of India for biotyping, serotyping and phage typing study. A total of 304 strains isolated from clinical and environmental sources were received from different medical colleges and hospitals for this study were confirmed in Vibrio Phage Reference Laboratory and used for phage typing study. Existing sets of the typing phages were used for the typing phages *V. cholerae* O1 strains and the strains were discriminated into several different phage types. Reports of the result were communicated to the concerned authority in time.

Influenza Virus Diagnosis: Surveillance is extremely important to monitor the circulating strains and hence contributes to manage influenza pandemic. Globally, populations of older adults have been shown to have a high burden of influenza virus infection. Influenza virus and RSV are associated with large number of acute respiratory infections (ARI) among older adults. To determine the feasibility of influenza in a population of community-dwelling elderly populations, surveillance platforms for elderly persons in India has been formulated in collaboration with CDC-AIIMS. Virology laboratory of ICMR-NICED received samples from the above mentioned group and providing diagnosis for influenza virus among the older population. This surveillance will help to understand current circulating strain among the elderly and help to formulate the vaccine strain in future.

Additionally, referral samples from different hospitals from acute respiratory illness are being tested for detection of influenza A H1N1. Samples from other states were also included.

Dengue virus serotyping service to West Bengal State Health, Kolkata Municipal Corporation and NVBDCP as a service component.

Hepatitis C virus RNA detection, viral load estimation and genotyping services to Medical Colleges and Hospitals of Kolkata and District Hospital of West Bengal as a service component.

The Biomedical Informatics Center under the Division of Clinical Medicine (PI: Dr. Santasabuj Das) assisted the scientists and research scholars from NICED, other research institutes, regional medical colleges and universities in the analysis of microbial genomes, three dimensional structure of proteins as well as statistical analysis.

Training and support on parasite detection and isolation.

Field studies have been performed during last fiscal year from this division, in Chakdah, Nadia, West Bengal for investigation of presence of different enteric parasites by improper hand wash. And in Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, West Bengal for identification of different soil transmitted helminthes among school children.

Quality Control and Quality Assessment support facility in eastern India for parasitic detection.

Regional VRDL, ICMR-NICED :

Virus Research and Diagnostic Laboratory (VRDL) at ICMR-National Institute of Cholera and Enteric Diseases is a Regional laboratory under the auspice of Virus Research and Diagnostic Laboratory Network (VRDLN) since established under the Department of Health Research (DHR) to strengthen the infrastructure of viral diagnostics in India. On request of West Bengal State Health, VRDL, ICMR-NICED provides extensive laboratory support towards viral outbreak management. Furthermore, collaboration exists with Virus Diagnostic Laboratories (VDLs) and Public Health facilities in Bihar, Jharkhand and Sikkim to provide diagnostic/training/research support.

The Laboratory and Infrastructure

Though testing was initiated since July, 2015, the new laboratory of VRDL became functional since January, 2018. The new premises have a built-up area of 2850 sq. ft. (approx.)having state of the art laboratories for sample receiving, serology, molecular virology, realtime PCR, nucleic acid sequencing (tissue culture facility, -80°C freezers and BSL-3 laboratory (2000 sq. ft. approx.). There is also a fully furnished conference room, meeting room and data entry facility. An extension of the laboratory with a similar built-up area is under process in another wing of the same building. A total of 18 staff comprising 4 Research Scientists, 2 Research Assistants, 4 Laboratory Technicians, 2 Data Entry Operators and 6 Multi-Tasking Staff are recruited.

Pic 13: Instrument facility at the VRDL

Training of personnel

In February 2018, VRDL personnel have been trained on molecular detection of Influenza A (H1N1 Pdm 09) and antiviral susceptibility of Influenza A (H1N1pdm09) at ICMR-National Institute of Virology (NIV), Pune. In February 2018, data entry personnel has been trained at National Institute of Epidemiology (NIE), Chennai to operate online/offline data capture system.

Activities in routine Viral Diagnosis and Crisis Management Response

Since its inception, VRDL, ICMR-NICED has been consistently testing samples by immunoassays (antigen and antibody detection ELISAs) and molecular (conventional and real time PCR) tests. Active collaboration exists with 66 private hospitals (on request and support from State Health Department), 21 Government Hospitals in West Bengal, 1 Government Hospital in Jharkhand and Sikkim and also IDSP and NVBDCP of Govt. of India.

Dengue is the most prominent viral threat in this region. VRDL actively participated in screening samples from Kolkata and the adjoining districts of West Bengal during the outbreak. On request of the Govt. of West Bengal, Dengue serotyping has been undertaken on a significant number of samples as an apex referral lab of NVBDCP. During the pandemic H1N1 outbreak in 2017, Regional VRDL, ICMR-NICED played a prominent role in providing laboratory support for timely diagnosis. Other strains prevalent in this region

such as Influenza A H3N2, Influenza B (subtypes Yamagata and Victoria) were also screened. On request from DHR, haemagglutinin gene of 10 influenza strains were sequenced and the data was submitted to the VRDL technical evaluation team.

Zika surveillance

A continuous surveillance is necessary for Zika because of the symptomatic similarity with dengue fever and the concern of transmission from affected countries on the directive of MOHFW, Govt. of India. More than 1400 samples from patients suffering from acute febrile illness have been screened for Zika virus by PCR. However, till date, no positive cases have been reported.

Diagnostic services for other viruses

Investigation of other viruses such as Hepatitis A virus, Hepatitis E virus, Hepatitis B virus, Hepatitis C virus, Respiratory Syncytial Virus (A,B), Human Metapneumovirus (A1A2), Parainfluenza (1,2,3,4), Respiratory Adenovirus, Rhinovirus, Rotavirus and Enteric Adenovirus (40,41) have been initiated. Facility exists for diagnosis of other infectious diseases like Scrub Typhus. Both immunoassays and molecular tools are used for detection.

Record of Investigations Performed

A record of investigations performed at Regional VRDL, ICMR-NICED for the period of 2017-18 is summarized below.

Investigations Performed	Total Tested in 2017-18
Dengue NS1	7579
Dengue IgM	4902
Dengue Serotyping	1107
Chikungunya PCR	1155
Chikungunya IgM	372
Japanese Encephalitis IgM	12
Influenza A H1N1	1310
Zika PCR	1017

Training imparted on laboratory management of emerging viral diseases

As a regional centre, VRDL, ICMR-NICED is responsible for imparting training to healthcare professionals in this part of the country to build capacity to diagnose viral diseases. Regular hands-on-training workshops covering epidemiology, immunology and molecular diagnosis of emerging viral diseases, cell culture techniques, laboratory safety and quality assurance have been undertaken. Two such workshops have been successfully conducted in 2017-18 including 35 participants from the various state medical colleges of Bihar, Jharkhand and West Bengal.

Looking Forward

New frontiers are being explored, through research projects focussing on developing low cost nanoparticle based Point of Care Test for arbovirus infections and for finding the mechanism of peri-natal transmission of flavivirus infections.

As the country continues to have frequent epidemics due to various viral pathogens, both old and novel, timely diagnosis of these outbreaks become critical to mount appropriate public health responses. The Regional VRDL, ICMR-NICED, strives to fill the gaps in detection delay and inadequate outbreak data which significantly affect response time for interventions.

FLAGSHIP PROGRAMMES-SWACHH BHARAT CAMPAIGN

As part of the Swachhta Action Plan, several activities were organized by ICMR-NICED during the period April 2017 to March 2018. These included (a) regular Swachhta Awareness Programmes conducted among the students and teachers of various schools across Kolkata, (b) organization of voluntary cleanliness programmes and public seminars for the residents of urban slum communities, and (c) special programmes associated with observation of Swachhta Pakhwada. Highlights of these programmes are mentioned below:

*Swachh Bharat Activities in Schools by ICMR-NICED :*The members of the Health & Hygiene Committee of ICMR-NICED organized several awareness-generating interactive lectures around Kolkata throughout the year. In these events, emphasis was given on maintenance of personal hygiene including proper hand washing, environmental sanitation, keeping school premises clean, use of safe drinking water, food safety as well prevention and treatment of common ailments including diarrhea. The team members also demonstrated the six steps of hand washing with soap and water and distributed colored brochures in this regard. Each event also included an interactive question & answer session. Following is the list of schools that participated in this event during the concerned period.

Date	Venue	Participants
18/05/2017	Ultadanga United Boys' High School, Kolkata	26 students of Class IX and 2 teachers
23/06/2017	Ultadanga United Girls' High School, Kolkata	20 students of Classes V and IX
27/07/2017	New National School for Boys, Kankurgachhi, Kolkata	36 students of class X
22/09/2017	Deshbandhu Vidyapith (primary section), Narkeldanga North Road, Kolkata.	72 Class students of Classes III & IV
25/10/2017	Mitra Sangha Vidyayatan High School, Chaulpatty Road, Beliaghata, Kolkata	25 boys of Classes VI & IX and 9 teachers
15/11/2017	Ichhapur Girls' High School, 24 Parganas (N)	80 students of Classes IX & X along with the Headmistress and other teachers
17/11/2017	Janakalyan Siksha Mandir High School, Tangra, Kolkata	17 girl and 23 boy students of Standard IX and their teachers
18/01/2018	Tiljala Balika Vidlaya, Tiljala, Kolkata	35 students of Standard V to X along with their teachers
05/02/2018	Panchkari Radharani Adarsh Vidyalaya, Christopher Road, Kolkata	85 boy students and 3 Class teachers
16/02/2018	Sanat Roychowdhury Institute, Tangra, Kolkata	23 boy and 43 girl students of standard XI along with Headmaster and other teachers
23/03/2018	Shree Jawahar Hindi School, Beliaghata Main Road, Kolkata	9 girl and 7 boy students of Standard V and their teachers

Pic14: Swachhta Awareness Programme being conducted among school children.

Swachh Bharat Activities in communities by ICMR-NICED: During the period, ICMR-NICED organized five community-based programmes. The aim was to promote Swachhta-related awareness and practices such as keeping the environment clean and garbage-free, maintaining personal hygiene, understanding water and food safety issues, etc. Among the residents the community members also took part in voluntary cleanliness drives around their localities. Further, a drawing competition was also organized on the topic "Healthy Life from Clean Environment" for promoting hygiene and cleanliness within the locality through students of Class II to V, who were also residents of the locality.

There were 5 public seminars organized at the clubs and Non-Government Organizations in the localities. For promoting good health through clean environment, there were community based activities organized to identify areas to throw garbage and stop indiscriminate garbage disposal. To encourage and bring awareness on community cleanliness and personal hygiene with emphasis on hand washing a drawing competition was organized among children at the slum locality on 23rd October, 2017. Other community seminars included topics on personal hygiene, hand washing and diarrhoea management at the community level

Pic 15: Drawing Competion at the community with theme on Swaccha Bharat

Pic 16: Students taking part in the drawing competition on Healthy Life and Clean Environment

Pic 17: Raising awareness in mothers about handwashing and hygiene for health

Pic 18: Community-based awareness building activities for Swachh Bharat Abhiyan

Table:11

Sl no	Date	Venue	Cleaning Activities Undertaken
1	19/09/2017	ICMR-NICED Canteen	Dr. Abhik Sinha along with Dr. Samiran Panda organised a program on hand hygiene and food hygiene among all the staff members and scientists of the Institute.
2	17/10/2017	NICED premises	Cleaning activities were organized in the NICED premises. Broken slabs and stonechips dumped at the campus were cleaned.
3	17/11/2017	Janakalyan Siksha Mandir High School, Tangra	Dr. Abhik Sinha conducted an interactive session on water and food borne diseases. Steps of hand washing was demonstrated to the students.
4	20/12/2017	NICED-II Seminar Room	A training program on Bio-Medical Waste Management was held for all scientists, staff and research fellows of the institute. Dr. Sandipan Ganguly and Dr. Abhik Sinha organised the training program.
5	23/03/2018	Sri Jawahar Hindi High School	Dr. Abhik Sinha spoke on diarrhoeal diseases and water & food borne Viral Hepatitis and thereafter steps of handwashing were demonstrated and Health Education materials were distributed.

Pic 19: Mobilizing communities to attain cleanliness: Swachhta Abhiyan

Observation of Swachhta Pakhwada at ICMR-NICED: Swachhta Pakhwada was observed during 4th-17th October, 2017. During this fortnight, special cleanliness drives were undertaken within all three buildings of ICMR-NICED. Several maintenance activities, including replacement of broken marbles and slabs, cleaning of water tanks etc. were also conducted during this period. Initiatives were also taken for disposal of various types of garbage in identified garbage bins to maintain the campus clean and tidy.

Pic 20: Cleanliness activities within NICED premises and placement of garbage bins during observation of Swachhta Pakhwada

OUTBREAK INVESTIGATIONS

During the epidemic outbreaks (2017-18) microbial analysis and examination of samples of potable water sources from different parts of West Bengal were analyzed and the results were reported to the Govt. agencies. It has been a routine activity of the environmental laboratory of the division of Bacteriology.

Water samples were received from different PHCs of N. 24 Parganas, Nadia, Hooghly, Howrah, Kolkata and its adjoining areas. Results have been conveyed to the respective agencies with a copy of the same to State Health secretariat, Govt. of West Bengal. During the period under report, 66 samples had been received from various sources, of which 54 had been found to be culture positive (49 and 17 for the presence of faecal coliforms and *V.cholerae*) (Table 12).

Table 12. District wise distribution of the Outbreak Water Samples, their respective sources and organisms identified

Sl No.	District	No. of samples received	Source					Culture Positive	PCR positive
			Tap	Tube well	Drinking water	Pond	Others		
1.	North 24 Parganas	19	4	14	0	0	1	16	13
2.	Nadia	0	0	0	0	0	0	0	0
3.	Hooghly	23	1	10	7	4	1	20	14
4	Howrah	10	0	0	5	0	5	10	9
6	Kolkata	14	3	0	11	0	0	8	8
	Total	66	8	24	23	4	7	54	44

TRAINING & EXTENSION

The Division of Training & Extension is an important and integral part of the National Institute of Cholera and Enteric Diseases (NICED). The division was established with the aim to cater to various needs of a scientific institute. A scientific institute cannot prosper solely depending on its research activities alone. To prosper in a holistic manner, a research institute should also engage in several activities that include workshops, seminars, symposium and training to create a noble scientific work force. The Division of Training and Extension at NICED is bestowed upon with the responsibility of proper and successful management of the aforementioned activities.

The Division has conducted many seminars and workshops successfully and has also arranged for symposiums and undertaken training programmes to generate proper scientific workforce.

Among the many seminars and workshops held during the last year NACO workshops have been organized throughout the year. Also STH workshop was organized for training on identification of soil transmitted helminths. Seminars were organized by scientists and research scholars on weekly basis on different aspects of their latest research. On the occasion of observation of Swacch Bharat Campaign several lectures by eminent doctors and scientists were arranged. The division also arranged the Institutional Ethical Committee meetings and Scientific Advisory Committee meetings. Posters have been prepared and demonstrated in different State Govt. events on enteric diseases, diagnostics, treatment and prevention of NICED foundation day was observed and the prestigious Dr. S. C Pal oration lecture was successfully organized by this division in 2017. This year, the lecture was delivered by the Vice Chancellor of Amity University, Kolkata, Prof. D. J. Chattopadhyay. The division also arranged Science Day lecture. NICED is expanding with time and with it the Division of Training and Extension is also growing in responsibilities and duties. The division, as in the past, will engage with the activities of arranging scientific programmes and conduct them successfully. Newer facilities and infrastructures will be infused into this division and it will continue to be an important and integral part of NICED, conducting its responsibility successfully and helping NICED prosper in every field possible.

A. Important meetings held at ICMR-NICED

Scientific Advisory Committee Meeting 2017: The 45th Meeting of Scientific Advisory Committee (SAC) of the ICMR-NICED, Kolkata headed by Dr. Gagandeep Kang was held on 28th and 29th August, 2017

Scientific Advisory Committee meeting in progress

Institutional Ethics Committee Meeting: Institutional Ethics Committee of the ICMR-NICED, Kolkata was held on 20th January, 2018

Institutional Ethics Committee Meeting in progress

Animal Ethics Committee Meeting: The Institutional Animal Ethics Committee (IAEC) Meeting of the ICMR-NICED, Kolkata was held on 22ndDecember, 2017.

Institutional Animal Ethics Committee meeting in progress

Institutional Biosafety Committee Meeting: The Institutional Biosafety Committee Meeting of ICMR-NICED, Kolkata was held on 4th December, 2017.

B. Visit of Scientists/Scientific Staff/Academicians:

Lectures/Seminars delivered by invited scientists

- Prof. K. K. Datta, Former Director, National Institute of Communicable Diseases (NICD) and Academic Coordinator, NIPER-Kolkata, delivered a lecture on "Viral Haemorrhagic Fever - A Global Perspective" on 7th April, 2017 at the seminar room of NICED II building.
- Prof. Uchchal Kr. Bhadra, Principal, ID & BG Hospital, Kolkata delivered a talk on "Homage to Dr. B.C. Roy: Medicine in His Time and Now" on 2nd July, 2017 at the seminar room of NICED II building.
- Professor Huw Taylor, School of Environment & Technology, University of Brighton, United Kingdom delivered a talk on "Microbial Source Tracking: A Potential Health Protection Tool in India" at 3-00 p.m. on 4th August, 2017 (Friday) at the Seminar Room of NICED-II building.
- Dr. William C Summers, MD, Ph.D, Emeritus Faculty, Yale Combined Program in the Biological and Biomedical Sciences, USA delivered a talk on "Cholera and the Indian Bacteriophage Inquiry of 1926-36" at 3-00 p.m. on 25th August, 2017 (Friday) at the Seminar Room of NICED-II building.
- Dr. Deanna L. Gibson and Dr. Sanjay Ghosh, Associate Professors, University of British Columbia, Canada delivered a talk on "Early nutrition, gut microbiota and immunity" and "Dietary lipids and heart disease" respectively at 3.00 p.m. on 6th October, 2017 (Friday) at the Seminar Room of NICED-II building.
- Prof. Ashish S. Verma delivered a talk on "HIV, AIDS and Neuro-AIDS" on 1st December, 2017 at the Seminar Room of NICED-II building.
- Dr. Bhaswati Bandopadhyay, Associate Professor, Department of Virology, Calcutta School of Tropical Medicine delivered a presentation at the Annual Biosafety Training Program held at 3.00 p.m. on 8th December, 2017 (Friday) at Dr. B.C. Deb Auditorium, Dr. S.C. Pal Building.
- Dr. Ratna Roy, Professor of Pathology, Edward A. Doisy Research Center, St Louis University, USA delivered a talk on "Hepatitis C virus mediated liver pathogenesis: what do we know about the mechanism?" at 3.00 p.m. on 15th December, 2017 (Friday) at the Seminar Room of NICED-II building.
- Dr. Dominique Legros, Head, Cholera Infectious Hazard Management, WHO Health Emergencies Programme, Geneva delivered a talk on "Global Cholera Control" at 11.00 a.m. on 18th January, 2018 (Thursday) at the Seminar Room of NICED-II building.
- Dr. Prosanto Chowdhury, Consultant, Haemoglobinopathy and Thalassaemias, The Indian Institute of Child Health, Kolkata delivered a talk on "Deconstructing cell therapy-yesterday, today and tomorrow" at 3.00 p.m. on 2nd February, 2018 (Friday) at the Seminar Room of NICED-II building.
- Prof. Dhrubajyoti Chattopadhyay, Vice Chancellor, AMITY University, Kolkata delivered Dr. S. C. Pal Memorial Oration lecture entitled "Trojan horse in Chandipura virus infection" on 9th March, 2018.

Meetings attended by invited scientists

- CDC-IAMM visit to NICED to assess laboratory capacity of NICED under Lab Strengthening Program of NCDC on 8thJune, 2017.
- Dr. Jayanta Bhattacharya, THSTI to NICED for discussion on collaborative studies on "HIV/AIDS" on 23rdJune, 2017.
- Meeting with Mr. Masayuki Taga, Consul-General of Japan, Ms. Kanako Yoshizawa, Economic Advisor and Dr. Okamoto on 30thJune, 2017 at ICMR-NICED.

- Dr. Ravi Kumar, KIMSH&RC, Bangalore for discussion on Pneumonia project on 25thJuly, 2018
- Meeting with the team from Emory University for discussion on future collaborative research studies especially Environmental Typhoid surveillance on 31stJuly and 1stAugust, 2017
- Dr. Stephen Luby, Stanford University for discussion on environmental component of TCV introduction in NMMC area with NICED team on 10th August, 2017.
- Attended GSK meeting on Rota vaccine at JICA_NICED on 7th September, 2018.
- Meeting with Mr. Shimada, Yakult Foundation at JICA-NICED on 8th September, 2017.
- Meeting with Dr. Dominique Legros, WHO, Geneva,Kashmira Shah and Dr. DipikaSur regarding WHO GTFCC on 16th-18th January, 2018.
- ECHO India project development meeting on 25thJanuary, 2018.
- Meeting with Dr. R.K. Manchanda on 30th January, 2018.
- Meeting with Dr. Willy Urassa, Head, Scientist, Prequalification Team Diagnostics, Essential Medicines and Health Products, World Health Organization, Geneva, who visited ICMR-NICED lab on 14th -15th February, 2018, for inclusion of the lab as a WHO prequalified lab for evaluation of cholera RDT kit to detect presence of cholera bacilli in clinical samples.
- Participated in the meeting with the researchers of Japan Agency for Medical Research and Development (AMED) on 20th -21st March, 2018 at ICMR-NICED

C. Training/ Workshop/ Conferences held at NICED

Training on Kato Katz technique to identify and measure intensity of soil transmitted helminth infection

The Division of Parasitology, ICMR-NICED, conducted national level public health training on Kato Katz technique to identify and measure intensity of soil transmitted helminth infection. Prior to the field survey a training program for the field workers was conducted in NICED from 1st -5th May, 2017. The training conferred detailed information about the project, brief knowledge on infection and frequency, prevalence rate and kato-katz method, followed by basic lab-safety measures, how to handle stool samples and proper disposal. Hands on training was performed on Kato-Katz technique, identification of different STH egg [*Ascaris lumbricodes* (both fertilized and unfertilized), Trichuris trichura and Hookworm], egg enumeration and eggs per gram (EPG) calculation. The performance was assessed by the internal experts as well as by an external guest expert.

Theory class by external expert

Demonstration of stool handling

Preparation of slides by Kato-katz

Identification of STH under microscope

Training and workshop of BHMS students from National Institute of Homoeopathy: One-day training cum workshop was arranged in ICMR-NICED, Kolkata for the students of National Institute of Homeopathy, Kolkata on 20th June, 2017. About 80 final year students participated in this training program. The students were welcomed with an opening address delivered by the Director, NICED followed by a brief introductory lecture to the attendees. A series of educational lectures on bacterial, viral, parasitological etiological agents of diarrhea, were delivered by the scientists of the institute. Lectures on biosafety in the laboratory and on animal models were also delivered. Post-lunch session included laboratory visits and hands-on demonstration. Students were divided in groups and visited laboratories of Bacteriology, Parasitology, Virology and Animal House for practical demonstration of research techniques. The program ended with a concluding note by the Director.

Participants from BHMS along with NICED scientists

Hands-on training in progress

Training of trainers from Leprosy Mission: A two-day TOT workshop on "NIKUSTH" software was organized by Ministry of Health & Family Welfare & Directorate General of Health Services, Govt.of India at ICMR-NICED on 22nd-23rd June, 2017. Faculty members from Central Leprosy Teaching & Research Institute, Govt. of India; and higher officials from West Bengal Health Department, Medical officers of eastern region working in NLEP participated in this workshop. Consultants from ICMR HQ provided hands on training on the procedures of use of the mentioned software.

Officials of the workshop

Workshop in progress

Web of Science workshop: Web of Science Workshop was conducted at ICMR-NICED on 12th July, 2017. ICMR has provided Web of Science, a product of the International Scientific Institute (ISI) to some of the Institutes of ICMR, including NICED, in order to facilitate research work. The workshop was attended by the scientists and research fellows of the Institute. The resource person was Mr. Vishav Sharma of Clarivate Analytics. Mr. Sharma showcased the features of the Web of Science database that could effectively facilitate research work.

Workshop on Research Methodology and Biostatistics: ICMR-NICED organized a workshop on Research Methodology and Biostatistics from 18th to 20th July, 2017. A total of 38 participants attended the three-day workshop. Thirty-seven participants hailed from 11 States/Union Territories of India, and one was a visiting clinician from Australia. The workshop attendees came from a wide range of professional backgrounds: Dentistry, Statistics, Zoology, Biochemistry, Microbiology, Physiology, Bioinformatics, Pediatrics, Internal Medicine, Botany, Pharmacology, Public Health, Biotechnology, Ophthalmology and Physical Medicine & Rehabilitation. Dr. Arvind Pandey, ex-Director, ICMR-NIMS, was the sole external faculty and the rest of the faculty members were Scientists of ICMR-NICED.

The topics covered in this workshop aimed to develop the research skills in early career researchers. Topics covered in the workshop included: developing research questions; identifying study designs; developing statistical plans; good data practices and data management; introduction to the principles of qualitative research; development of research papers; and automated tools for management of references and bibliography.

The participants felt that the workshop was a helpful aid for their future research efforts. They expressed a desire to attend such future workshops, especially on topics related to sample size calculation, GCP and ethics, data analysis, and application of software/programs for public health research. They also expressed an appreciation for practical hands-on sessions, use of participatory approaches, and workbooks for practice exercises.

The workshop generated a lot of enthusiasm in the participants, who came together as an online fraternity following the workshop, in an effort to consolidate the learning objectives fulfilled in course of the three days. This was an important step towards fulfillment of the vision of ICMR to strengthen health research capacity within India.

Word-map of keywords expressed by participants when asked what sessions they preferred in the research methods and biostatistics workshop

Participant and Training Team Group Photo

Training workshop on the implementation of the eOffice system: A training workshop on the implementation of the eOffice system was organized at ICMR-National Institute of Cholera and Enteric Diseases (ICMR-NICED), Kolkata on 21st August, 2017. This was a guided demonstration of the eOffice system, followed by hands on practice by the participants to get acclimatized with the functioning of the system.The training process for the one-day workshop was facilitated by Dr. Manjeet Singh Chalga, Scientist B, and In-charge, eGovernance, ICMR Headquarters, New Delhi, and Mr. Sanjeev Kumar, Private Secretary, eGovernance, ICMR Headquarters, New Delhi. The training workshop was attended by 22 trainees from four ICMR institutes, in addition to the two trainers from ICMR HQ, New Delhi. The four institutes participating in the training workshop included: i) ICMR Virus Unit, Kolkata, ii) ICMR-RMRCNE, Dibrugarh, iii) ICMR-RMRIMS, Patna and iv) ICMR-NICED, Kolkata.The training workshop was broadly divided into two sections; in the first half, the facilitators demonstrated the system and its functions; in the second half, dummy accounts were given to participants of all four ICMR institutes so that the members present there could try hands-on the eOffice software and its different modules. The facilitators provided the participating members with soft copies of their training manual so that they could follow up on the demonstrated processes from their institutions after the training workshop was concluded.

Participants listening to the demonstration of the eOffice System

Dr. Manjeet Singh Chalga, Scientist B, and In-charge, eGovernance, ICMR Headquarters, New Delhi explaining the different functions in the eOffice system

Asian Conference on Diarrhoeal Diseases and Nutrition (ASCODD): NICED co-organized the Asian Conference on Diarrhoeal Diseases and Nutrition (ASCODD), 2017 held in Kochi, India from 30th October to 1st November, 2017. International participants from different countries participated in this program. Many scientists and students from NICED presented their work at the conference.

Participants from ICMR-NICED at the 14th ASCODD

Media Training Program and Workshop: A Media Training Program and Workshop was held at ICMR-NICED, on 5th-6th December, 2017 at ICMR-NICED. The Directors and designated Nodal Officers from several ICMR Institutes (ICMR-NICED, Kolkata; ICMRRMRI, Patna; ICMR-RMRC, Dibrugarh; ICMR-NIREH, Bhopal; ICMR-NCDIR, Bengaluru; ICMR-NIMR, Delhi; ICMR-RMRC, Port Blair; ICMR-NIN, Hyderabad; and ICMR HQ) attended this two-day interactive training program. Faculty members from GHS (Global Health Strategy, New Delhi) imparted training on media and communication skills to the participants.

Group activities for Directors of various ICMR Institutes on Day 1 of the two-day media training workshop

Group photo of participants in the Media Training workshop

Brainstorming Meeting on Programmatic Operationalization of Oral Cholera Vaccine in Cholera Hotspots in Kolkata: Following the deliberations at the National Technical Advisory Group on Immunization's (NTAGI) Standing Technical Sub-Committee (STSC) in November, 2016, it was decided to pursue a pilot demonstration of Oral Cholera Vaccine (OCV) delivery, using existing public health infrastructure, in cholera hotspots of Kolkata. In alignment with the suggestions from this meeting, ICMR-NICED undertook preparatory

steps to assess the policy environment for OCV implementation and identified the cholera hotspots based on reported case-loads from the IDSP database. A brainstorming meeting was held at ICMR-NICED during 16th -18th January 2018, which was co-chaired by Dr. Dominique Legros, Head, Cholera Infectious Hazard Management, WHO Health Emergencies Programme, WHO, Geneva and Dr. Shanta Dutta, Scientist G and Director, ICMR-NICED. In addition to the ICMR-NICED team (Dr. Asish K. Mukhopadhyay, Scientist E;Dr. Alok K. Deb, Scientist E; Dr. Suman Kanungo, Scientist E; Dr. Pranab Chatterjee, Scientist B), the meeting was also attended by Dr. Kashmira Date and Ms. Nedghie Adrien, Medical Epidemiologist, Centers for Disease Control and Prevention, Atlanta, Georgia; and Dr. Dipika Sur, Senior Consultant, Translational Health Science and Technology Institute, Faridabad.

In course of this meeting, the progress in identifying the policy drivers for OCV implementation and cholera hotspots in the Indian contexts were discussed. A concept note on OCV implementation using existing public health infrastructure of the Kolkata Municipal Corporation (KMC), developed by the ICMR-NICED team, was also tabled. Discussions were held under the supervision of Dr. Legros, Dr. Dutta and Dr. Date to further develop the idea and frame a protocol. Stakeholder mapping was also discussed in course of the meeting to identify potential funding and support sources, including technical, logistics and advocacy support from external agencies like CDC and WHO. A field trip was undertaken to visit the cholera susceptible areas in and around ICMR-NICED, where an ongoing passive surveillance has helped map the disease trends over the years. Particular niches, especially around the canal areas, were of great interest to the visiting team as it was also observed that the cases tended to originate more frequently from these locations.

A meeting was also organized with Mr. Atin Ghosh, Member, Mayor-in-Council (MMIC), Health, KMC to explore avenues for collaboration. The hon'ble MMIC was apprised of the cholera situation in the area and he expressed his willingness to collaborate with the ICMR-NICED team in undertaking the programmatic operationalization of OCV deployment once the logistics and procurements were arranged.

Subsequently, ICMR-NICED was invited to the NTAGI STSC meeting on 6th July, 2018, at the Department of Biotechnology, New Delhi, to present an update on the cholera disease burden and vaccine introduction plan in West Bengal. This meeting was attended by Dr. Suman Kanungo, Scientist E and Dr. Pranab Chatterjee, Scientist B, on behalf of Dr. Shanta Dutta, Director, ICMR-NICED. The progress on all fronts were presented to the STSC and the deliberations were conducted under the leadership of Dr. Balaram Bhargava, DG ICMR and Secreatry, DHR and Dr. Renu Swarup, Secretary, DBT.

Handing over of the OCV Policy Brief

From Left to Right: Dr. Kashmira Date, CDC; Ms. Nedghie Adrien, CDC; Dr. Dominique Legros, GTFCC, WHO; Dr. Shanta Dutta, ICMR-NICED; Dr. Dipika Sur, THSTI.

From Left to Right: Dr. Pranab Chatterjee, Dr. Kashmira Date, Ms. Nedghie Adrien, Dr. Dominique Legros, Dr. Shanta Dutta, Dr. Dipika Sur, Dr. Suman Kanungo, Dr. Alok K. Deb

International Conference on Anti-microbial Resistance (AMR): Antimicrobial resistance (AMR) is a serious public health threat concerning global health authorities and jeopardizing global health security. The problem of AMR is more grave and widespread in India, the largest consumer of antibiotics in the world. Easy access fosters irrational use of antibiotics in the human and animal health sectors, and promotes environmental contamination. In this context, an International Conference on Anti-microbial Resistance

was organized jointly by the National Institute of Pharmaceutical Education and Research (NIPER), Kolkata and ICMR-National Institute of Cholera and Enteric Diseases (ICMR-NICED), on 16th -17th February, 2018 at NICED-II building, ICMR-NICED. The two-day programme was inaugurated in the presence of Dr. V. Ravichandiran, Director NIPER and Dr. Shanta Dutta, ICMR-NICED. Dr. Ramanan Laxminarayan, Director & Senior Fellow, Environmental Institute, Center of Diseases, Dynamics, Economics & Policy; Dr. Simon L. Croft, Professor, Faculty of Infectious & Tropical Diseases, London School of Hygiene & Tropical Medicine; Dr. Richard Stabler, Director, AMR Center Associate Professor of Molecular, Bacteriology, London School of Hygiene & Tropical Medicine; Dr. V. M. Katoch, Former DG, ICMR, New Delhi; Dr. T. Ramamurthy, National Chair, THSTI Faridabad; and Dr. Anuj Sharma, Technical Officer, WHO Country Office for India were among the distinguished speakers. This meeting was attended by young students, researchers and faculty members from different institutes. In these two days, participants witnessed the exchange of various important ideas on AMR. It was a timely effort to address certain important issues of AMR, especially for understanding the current magnitude, determinants and drivers, challenges ahead, and strategies to reduce the AMR burden in India in the years to come. The conference concluded with a commitment to create 'a One health' solution for this important public health issue.

Inaugural ceremony of the "International Conference on Anti-microbial Resistance (AMR)" held at NICED II building during 16-17th February 2018.

Dr. Richard Stabler from London School of Hygiene and Tropical Medicine delivering lecture at the AMR conference

Dr. V.M. Katoch, former DG, ICMR, delivering lecture at the"International Conference on Anti-microbial Resistance (AMR)" at NICED II building during 16th -17th February 2018.

Winner of the poster presentation competition held during the "International Conference on Anti-microbial Resistance (AMR)" at NICED II building on 16th -17th February 2018, receiving award from the Director, ICMR-NICED.

"International Conference on Anti-microbial Resistance (AMR)" at NICED II building on 16th -17th February 2018

Hands-on Training Workshop on Laboratory Diagnosis of Emerging Viral Diseases: The 2nd Hands-on Training Workshop on Laboratory Diagnosis of Emerging Viral Diseases, sponsored by Department of Health Research (DHR), was conducted by Regional Virus Research and Diagnostic Laboratory (VRDL) at ICMR-NICED on 27th & 28th February, 2018. The workshop had a vision to train the health personnel for timely diagnosis of viral epidemics in this part of the country. Twenty invited participants from other VRDLs, VDLs and Medical Colleges from the states of Bihar, Jharkhand and West Bengal and twenty-one internal participants attended the training. Dr. Shanta Dutta, the Director, ICMR-NICED and the Chief Guest, Dr. Sagarmoy Ghosh, Associate Professor, University of Calcutta inaugurated the workshop. Dr. S.S. Das provided an overview of emerging viral infections. Dr. T. Krishnan highlighted on novel techniques and advances in viral detection. Hands-on training involved Dengue-NS1 ELISA, RNA isolation from serum and conventional RT-PCR for Dengue Virus, RNA isolation from throat swab and real time RT-PCR for H1N1 influenza virus. Dr. M.K. Saha held a session on Laboratory Safety, Quality Control and Quality Assurance. Dr. A. Chakrabarti presented an overview of cell culture techniques and its application followed by demonstration of cytopathic effects under microscope. The workshop enabled the participants to get an idea of the techniques followed in a viral diagnostic laboratory. Participants were satisfied with the academic content of the workshop and were enthusiastic about participatingin such training workshops in future.

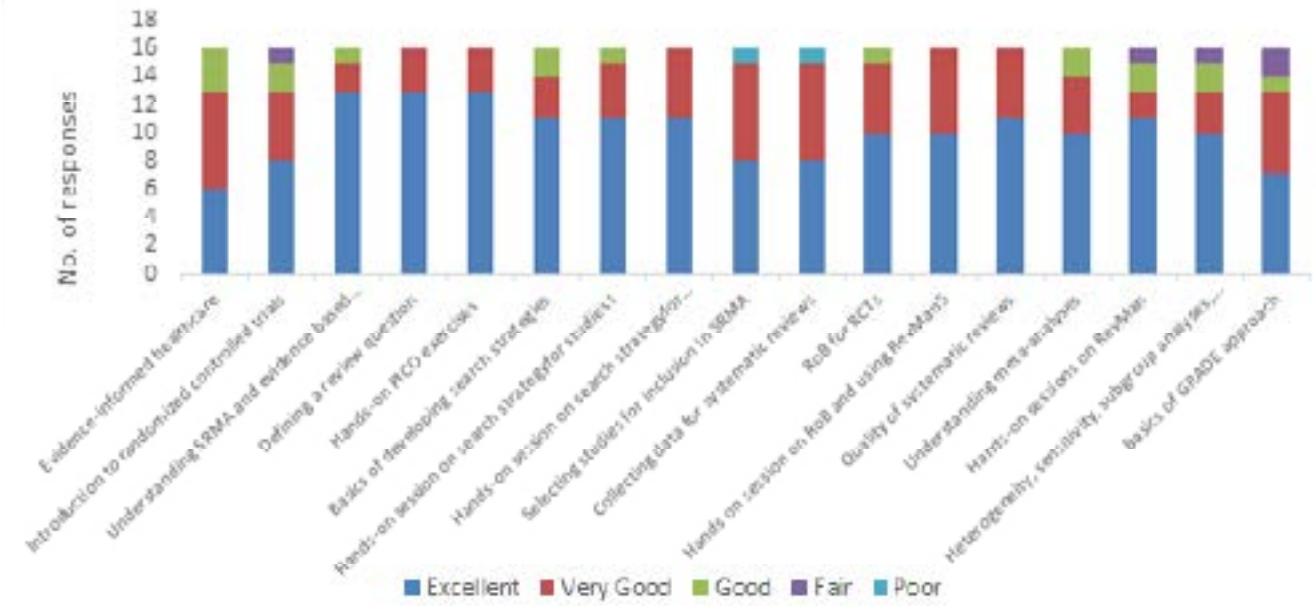
Pic: Participants and training team group photo

Workshop on Systematic Review and Meta-Analysis in Healthcare: A three-day workshop on systematic review and meta-analysis in healthcare was organized by ICMR – NICED as a part of its activities to build health research capacity in India from 7-9 March, 2018. The scientists concerned involved in organizing the

workshop were Dr. Falguni Debnath and Dr. Pranab Chatterjee. The main resource person of the workshop was Dr. Soumyadeep Bhaumik, George Institute of Global Health, India, an experienced public health consultant working on evidence synthesis through systematic review and meta-analytic approaches.

There was a great interest in the workshop, and 51 individuals pre-registered for screening. After screening, we selected 21 participants for the workshop. These 21 participants hailed from eight states/union territories: Assam, Bihar (2), Delhi (2), Karnataka (1), Maharashtra (5), Rajasthan (1), Uttar Pradesh (1), and West Bengal (8). A wide range of expertise was represented in the participants; there were interns, postgraduate trainees and teachers, doctoral and post-doctoral students, as well as experienced researchers and clinicians who wanted to know more about systematic reviews. The disciplines represented included: AYUSH/ Indian systems of medicine (1), Biochemistry (1), Community Medicine and Public Health (9), Dermatology (1), Entomology (1), Environmental Sciences (1), Medicine (1), Neonatology (1), Scientometrics (1) and Library sciences (1), Statistics (2) and Zoology (1).

The participants were thoroughly engaged in the three-day workshop, at the end of which they provided feedback about the quality of the various sessions. Most participants felt that the workshop sessions were excellent and were going to be helpful for their work in the future.



Reported perceptions of participants about the quality of workshop sessions

Participant and Training Team Group Photo

A. Other Events

Smart India Hackathon: Scientists of ICMR-NICED participated in the Grand Finale of Smart India Hackathon 2017 held during 1st and 2nd April, 2017 at the Guru Nanak Institute of Technology, Panihati, Sodepur where 45 teams had participated for digital solution of 28 medical problems, floated by ICMR, by developing software or mobile apps. After rigorous judging and mentoring, the designated judges selected the winner, 1st runner up and 2nd runner up from 8 shortlisted teams who were awarded by ICMR, Department of Health Research (DHR), Ministry of Health & Family Welfare, Govt. of India.

Observation of the World Health Day: The World Health Day was observed at the Institute on 7th April, 2017. Prof. K. K. Datta, Former Director, National Institute of Communicable Diseases (NICD) and Academic Coordinator, NIPER-Kolkata, delivered a lecture on "Viral Haemorrhagic Fever - A Global Perspective".

Prof. K. K. Datta delivering his lecture

Observation of Yoga Day: The 3rd International Yoga Day was observed on 21st June, 2017 for promotion of yoga among the staff towards making it a part and parcel of daily routine. After a brief introduction on the significance and utility of Yoga, all staff and students of NICED as well as delegates from Okayama University, Japan participated in a mass Yoga performance. This was followed by holding of Yoga workshop and demonstration of Yoga art by students of Arjuna awardee Yoga expert Mr. Pallab Das Gupta.

Scientists and staff of ICMR-NICED and representatives of Okayama University, Japan performing Yoga lessons

Artistic Yoga performance by students of Arjuna awardee Yoga expert Mr. Pallab Das Gupta

Observation of Doctors' day: Doctors' Day (July 1) was celebrated on 3rd July, 2017. On this occasion, Prof. Uchchal Kr. Bhadra, Principal, ID & BG Hospital, Kolkata delivered a talk on "Homage to Dr. B.C. Roy: Medicine in His Time and Now". Scientists, research scholars and staff of ICMR-NICED and ICMR Virus Unit attended the lecture.

Prof. Uchchal Kr. Bhadra delivering his talk

Indian National Exhibition cum Fair: As per the directives from DG, ICMR, ICMR-NICED has taken part in the Indian National Exhibition cum Fair 2017, organized by Bengal Human Resource Development Foundation at Dinabandhu Andrews College Park in Garia, Kolkata, from 17th-20th Aug, 2017. A stall was run by scientists and staff of ICMR-NICED, ICMR-ROHC and ICMR headquarters representative. Several posters, cut outs and banners were exhibited on this occasion along with short but informative handouts on Swachch Bharat initiatives of ICMR-NICED.

Participation in the 21st National Health Exhibition: ICMR-NICED participated in the 21st National Health Exhibition organized by Central Calcutta Science & Culture Organization for Youth Forum from 24th -27th August, 2017 at Agradut Krirangan, Kolkata. Posters were displayed from ICMR-NICED and ROHC, Kolkata under supervision of Dr. Chandrashekhar, Scientist G & Head, ITR from ICMR Hqrs. Dr. Santasabuj Das, Scientist - E was deputed to the exhibition as the Nodal Officer. Scientists and staff from ICMR-NICED also participated in the activities of showcasing IEC material and achievements of the institute.

Vigilance Awareness Week – 2017: Vigilance Awareness Week was observed at ICMR – National Institute of Cholera and Enteric Diseases, Kolkata from 30th October, 2017 to 4th November, 2017 keeping in view of the theme "My Vision - Corruption Free India". Banners containing the theme of the Vigilance Awareness Week 2017 in Hindi and English remained displayed throughout the week at prime locations in all the three buildings of ICMR - NICED. The commencement of the Vigilance Awareness Week Observation started at 11am on 30th October, 2017 taking the pledge with all scientists, staff of all ranks, and research fellows of the Institute taking The pledge. The pledge was administered in Hindi, English and Bengali.

A lecture competition was organized on 3rd November, 2017. The theme of the competition was "Corruption Free India – Hurdles and Avenues". The program was inaugurated by the Director of the Institute and delivered the welcome address. Her speech was followed by addresses given by the Administrative Officer and the Vigilance Officer. There were eleven participants who deliberated on different issues, hurdles and avenues to make India corruption free. This was followed by Prize Distribution Ceremony. First, second and third prize were given away to the winners by the Director of the Institute. All the participants received Certificate of Participation. Vote of thanks was delivered by Dr. Nabendu Chatterjee.

Dr. Shanta Dutta, Director ICMR-NICED delivering the welcome address

Oath is being read in Hindi, English and Bengali by senior scientists of ICMR-NICED

Oath is being taken by the staff of ICMR-NICED

One of the participants delivering speech at the lecture competition

Unity Day 2017: On 31st October, 2017 National Unity Day (or Rashtriya Ekta Diwas) was observed in the Institute by taking of the pledge at Dr. B.C. Deb Auditorium of ICMR – NICED. National Unity Day is the birthday (birth anniversary) of Sardar Vallabhbhai Patel, a famous personality for uniting India. Pledge was administered in Hindi, English, Bengali and all the scientists, staff of all ranks, students participated in this pledge taking ceremony.

Pledge is being taken by the scientists and staff of ICMR-NICED

Constitution Day 2017: The Constitution Day Observance took place at the Seminar Hall of NICED-II Building of ICMR – NICED on 24th November, 2017. Dr. Nabendu Sekhar Chatterjee, Scientist F welcomed all the scientists, staff and research fellows of the institute. In the beginning he briefly recollected Dr. B. R. Ambedkar's role and the significance of Constitution Day. Dr. Tapas Biswas, Scientist G read out the "Preamble" to all the staff present during the program. Then, Dr. Shanta Dutta, Director and Scientist-G delivered her speech. The program ended with the vote of thanks given by Dr. Nabendu Chatterjee.

Dr. Shanta Dutta, Director, delivering her speech

Dr. Tapas Biswas, Scientist G, read out the Preamble to the Indian Constitution

World AIDS Day: World AIDS Day was observed at ICMR-NICED, Kolkata on 1st December, 2017. Dr. Uchchal Kr. Bhadra, Principal, ID & BG Hospital graced the occasion as Chief Guest and Prof. Ashish S. Verma, Pro-Vice Chancellor, Jadavpur University, Kolkata was invited as speaker for the occasion. Following brief introductory speech by the Director, NICED, Prof. Bhadra delivered key note address as Chief Guest. Prof. Ashish S. Verma delivered talk on the topic "HIV, AIDS and Neuro-AIDS". All staff and students of ICMR-NICED actively participated in the program to increase the awareness about the disease. The program ended with the vote of thanks.

Welcome speech by Dr. Shanta Dutta, Director, ICMR-NICED

Prof. Ashish S. Verma delivering his talk

Jatiya Sanhati Utsav-O-Bharat Mela, 2017: Four scientists and ten staff members from ICMR-NICED actively participated and demonstrated at the 13th Jatiya Sanhati Utsav-O-Bharat Mela, 2017 held during 14th-18th December, 2017 at the Atul Krishna Roy Girls' School play ground (Sonarpur Samabay Samity Chandmari Math), Sonarpur, 700150 West Bengal.

Foundation day celebration of ICMR-NICED: The 56th Foundation Day of ICMR-NICED was celebrated on 9th March, 2018 in the auditorium at NICED-1 building in the presence of the Director, all staff and pensioners. Dr. Uchhal Bhadra, Principal, I.D. & B.G. Hospital graced the occasion as the chief guest and Prof. Dhrubajyoti Chattopadhyay, Vice Chancellor, AMITY University, Kolkata delivered the Dr. S. C. Pal Memorial Oration entitled "Trojan horse in Chandipura virus infection". NICED Staff completing 25 years of the service at NICED, were felicitated by the Director. This occasion was also celebrated by cultural programme organized by the students and staff of NICED. The programme ended on a happy note.

Inaugural song being performed by the staff and students of ICMR-NICED

Dignitaries lighting the lamp

Prof.Dhrubajyoti Chattopadhyay delivering the Dr. S. C. Pal oration

Hindi Divas Celebrations at NICED: ICMR-NICED celebrated the Hindi Divas on 6th March, 2018 at the Auditorium, NICED-I building for the promotion of Rajbhasha and for encouraging staff to use Hindi in their official routine work. Shri Priyankar Paliwal, Secretary, Kolkata Official Language Implementation Committee-2 (KOLTOLIC-2) graced the occasion as the chief guest. After a brief introduction on the history and significance of Hindi Divas by Dr. Shanta Dutta, Director NICED and Shri Paliwal, a lecture competition was organized on selected topics such as “Importance of women in development of a nation” or “Current education system and its impact on children”. Scientific, technical and administrative staff members participated enthusiastically and were awarded based on their performance. The program ended with the prize distribution ceremony.

EXTRAMURAL PROJECTS

Title	:	Studies on the molecular typing *S.* Typhi isolates of Kolkata its relevance in controlling the drug-resistant organisms
PI	:	Dr. S. Dutta
Finding Agency	:	WBDST
Duration	:	2014 to 2017

Title	:	A multi-centric study to estimate the sero-prevalence of dengue virus infection in India
PI	:	Dr. S. Dutta
Finding Agency	:	ICMR
Duration	:	2017 to 2018

Title	:	National Surveillance System for Enteric Fever in India
PI	:	Dr. S. Dutta
Finding Agency	:	BMGF through CMC, Vellore, India
Duration	:	2017 to 2020

Title	:	Seasonal dynamics of enteropathogenic bacteria in Gulf of Khambat, Gujrat: its impact on health of coastal population
PI	:	Dr. A. Palit
Finding Agency	:	Ministry Of Earth Science
Duration	:	2016-2019

Title	:	Strengthening/promoting evidence-based advocacy for influenza prevention and control in India
PI	:	Dr. K. Sarkar
Finding Agency	:	CDC, Atlanta through AIIMS, New Delhi
Duration	:	Nine month

Title	:	Apoptosis and molecular targeting therapy in cancer by microbial proteases
PI	:	Dr. A Pal
Finding Agency	:	DST-SERB
Duration	:	2017-2020

Title	:	Studies on a novel virulence factor YghJ in Gram negative pathogens causing neonatal septicaemia
PI	:	Dr. A Pal
Finding Agency	:	ICMR
Duration	:	2016-2018

Title	:	Targeting pro-apoptotic peptide for PAR1mediated programmed cell death in colon cancer cell
PI	:	Dr. A Pal
Finding Agency	:	DBT Women's Scientist
Duration	:	2017-2020

Title	:	External Quality Assurance for HIV testing
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2002 - 2019

Title	:	HIV Sentinel Surveillance
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2008-2019

Title	:	Evaluation of diagnostic kits for HIV, HBV and HCV
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2015 – 2020

Title	:	Molecular detection of HIV in infants and children under age of 18 months.
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2012 – 2019

Title	:	Counseling and Testing for HIV, Blood Borne Infections and STIs.
PI	:	Dr. M. K. Saha
Finding Agency	:	WBSAP&CS
Duration	:	2012 - 2019

Title	:	Molecular assay for HIV-1 Plasma Viral Load.
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2015 - 2019

Title	:	Molecular characterization of HIV for drug resistance mutations among infant using dried blood spot sample
PI	:	Dr. M. K. Saha
Finding Agency	:	ICMR
Duration	:	2015 - 2018

Title	:	Evaluation of impact of antiretroviral therapy under National AIDS Control Program in India.
PI	:	Dr. M. K. Saha
Finding Agency	:	National AIDS Control Organization
Duration	:	2017-19

Title	:	Molecular diversity of Hepatitis C virus in a tertiary care hospital of Manipur, India.
PI	:	Dr. M. K. Saha
Finding Agency	:	DBT, Govt. of India
Duration	:	2018-21

Title	:	Regulation of the colonization factor CS6 of enterotoxigenic *Escherichia coli* in pathogenesis
PI	:	Dr. N. S. Chatterjee
Finding Agency	:	DBT, Govt. of India
Duration	:	2017-2020

Title	:	The interplay of climate and non-climate factors in determining the risks and predicting outbreaks of waterborne diseases
Project Coordinator	:	Dr. S. Dutta
PI	:	Dr. A. K. Deb
Co-PI	:	Dr. A. Palit
Co-I	:	Dr. F. Debnath, Dr. A. De
Finding Agency	:	Department of Science & Technology, Govt. of India
Duration	:	Three years (2018 – 2020)

Title	:	Etiology of childhood pneumonia in India: An ICMR task force study
Project Coordinator	:	Dr. S. Dutta
PI	:	Dr. A. K. Deb
Co-PI	:	Dr. S. Kanungo
Co-I	:	Dr. A.K. Mukhopadhyay, Dr. M. Chawla Sarkar
Finding Agency	:	Indian Council of Medical Research
Duration	:	Two years (2018 – 2019)

Title	:	Retrospective analysis on the evolutionary aspects of *Vibrio cholerae*
PI	:	Dr. A. K. Mukhopadhyay
Co-I	:	Dr. M. Morita
Finding Agency	:	NIID, Japan
Duration	:	2013-2018

Title	:	Studies on blood group antigen binding adhesin (babA) gene in relation to *Helicobacter pylori* mediated diseases outcome in India
PI	:	Dr. A. K. Mukhopadhyay
Finding Agency	:	CSIR, Govt. of India
Duration	:	2015-2018

Title	:	Changing pattern of the *Vibrio cholerae* strains in India along with the antimicrobial resistance and its relationship with pathogenesis for better management of cholera
PI	:	Dr. A. K. Mukhopadhyay
Co-I	:	Dr. H. Koley and Dr. S. Das
Finding Agency	:	AMED, Japan
Duration	:	2015-2020

Title	:	Role of *Helicobacter pylori* Tumour Necrosis Factor Alpha inducing protein (Tip Alpha) in causing gastro duodenal diseases including gastric cancer
PI	:	Dr. A. K. Mukhopadhyay
Co-I	:	Dr. R. Das (Amity University)
Finding Agency	:	ICMR
Duration	:	2017-2020

Title	:	Exploratory study to standardize PCR tests on paraffin sections to detect *Helicobacter pylori* and compare with other detection tests.
PI	:	Dr. A. K. Mukhopadhyay
Collaborator:	:	Dr. R. Sukanya (NCDIR, Bengaluru)
Finding Agency	:	ICMR
Duration	:	2017-2019
	:	
Title	:	Evaluation of available rapid diagnostic tests for cholera
PI	:	Dr. A. K. Mukhopadhyay
Finding Agency	:	BMGF through THSTI
Duration	:	2016-2018

Title	:	Deciphering the Mechanisms of Invasion by *Salmonella* Invasins
PI	:	Dr. S. Das
Finding Agency	:	Department of Science and Technology
Duration	:	Three years/ 2017-2020

Title	:	Biomedical Informatics Center of ICMR, 2nd Phase of Task-force Project (IRIS ID: 2013-1551G).
PI	:	Dr. S. Das
Finding Agency	:	Indian Council of Medical Research
Duration	:	Five years/ 2013-2018

Title	:	Studies on therapeutic peptides against human *Salmonella* infections as drugs and vaccine adjuvants (OUP-4)
PI	:	Dr. S. Das
Finding Agency	:	Japan Initiative for Global Research Network on Infectious Diseases (J-GRID) of the Japan Agency for Medical Research and Development (AMED) (OUP3-4)
Duration	:	Five years/ 2015-2020

Title	:	Studies on immune responses elicited by candidate peptide vaccines and polysaccharide-peptide conjugate vaccines against *Salmonella enterica* serovars Typhi and Paratyphi infections (27(0308)/14/EMR-II)
PI	:	Dr. S. Das
Finding Agency	:	Council of Scientific and Industrial Research, Government of India
Duration	:	Three years/ 2015-2017

Title	:	Designing inhibitors of interactions between bacterial Leucine-rich Repeat (LRR)-containing effector proteins with E3 ubiquitin ligase activities and their host targets as novel anti-infective agent (Medical Innovation Fund)
PI	:	Dr. S. Das
Funding Agency	:	Indian Council of Medical Research
Duration	:	Two years/ 2015-2017

Title	:	Study of mechanism of probiotic action in persistent diarrhea in children caused by enteroaggregative E.coli – using a mouse model (GIA/49/2014-DHR)
PI	:	Dr. S. Das
Funding Agency	:	Department of Health Research, Government of India
Duration	:	Three years/ 2014-2017

Title	:	Genetic variations of Giardia lamblia
PI	:	Dr. S. Ganguly
Funding Agency	:	NIID, Japan
Duration	:	Three years (2016-2018)

Title	:	An approach to identify the environmental drivers modulating rotavirus seasonality
PI	:	Dr. M. Chawla Sarkar
Co-PI	:	Dr R.K. Nandy, Dr. A. Deb
Funding Agency	:	ICMR
Duration	:	3 years (2017- ongoing)

Title	:	Screening of small molecules with antiviral activity as adjunct therapy for viral diarrhea
PI	:	Dr. M. Chawla Sarkar
Co-PI	:	Dr. H. Koley
Funding Agency	:	Okayama University
Duration	:	3 years / 2015-2018

Title	:	Enhancing Biorisk mitigation awareness in public health community and creating laboratory networks for enhanced diagnostic capabilities to deal with surveillance and outbreaks of high-risk group viral pathogens causing viral hemorrhagic fevers and respiratory infections.
PI	:	Dr. M. Chawla Sarkar
Co-PI	:	Dr. S. Panda, Dr. A. Deb
Funding Agency	:	CDC, USA
Duration	:	Two years/ 2015-2017

Title	:	Coupling virus-host interaction to host subcellular quantitative proteomics: An unbiased integrated approach to decipher host determinants for rotaviral infection
PI	:	Dr. M. Chawla Sarkar
Co-PI	:	Dr. N. S. Chatterjee
Funding Agency	:	WB-DST
Duration	:	Three years /2018-2021

Title	:	Acquired mechanisms of quinolone resistance in carbapenem–resistant Enterobacteriacae : relevance in neonatal healthcare
PI	:	Dr. S. Basu
Funding Agency	:	DST, West Bengal
Duration	:	2015-2018

Title	:	Assessing drug resistance in Enterobactericae causing neonatal sepsis in North-East India: resistance mechanisms and transmission
Co-PI	:	Dr. S. Basu
Funding Agency	:	ICMR
Duration	:	2015-2018

Title	:	Burden of antibiotic resistance in neonates from developing societies, (BARNARDS)
PI	:	Dr. S. Basu, (PI , Indian counterpart)
Funding Agency	:	Cardiff University, Bill and Melinda Gates Project
Duration	:	2017-2018

Title	:	Development and evaluation of a heat killed multi-serotype oral Shigella vaccine
PI	:	Dr. H. Koley
Funding Agency	:	Okayama University, Japan
Duration	:	Four years/ 2015 to 2019

Title	:	Development of a universal Shigella vaccine based on virulence gene expression
PI	:	Dr. H. Koley
Funding Agency	:	NIID, Japan
Duration	:	Six years/ 2012-2018

Title	:	Studies on immunogenicity and protective efficacy of multi-serotype OMVs of circulating *Salmonella* strains in chicken model
PI	:	Dr. H. Koley
Funding Agency	:	DST, Kolkata
Duration	:	Three years/ 2017-2020

Title	:	Development of Nanoparticle or Microparticle Adjuvanted Subunit Oral Vaccine against Poultry Salmonellosis
PI	:	Dr. H. Koley
Funding Agency	:	DBT New Delhi
Duration	:	3 years/ 2017-2019

Title	:	Vaccination and protection studies for a targeted Nanoparticulate oral vaccine against shigellosis
PI	:	Dr. H. Koley
Funding Agency	:	DBT, New Delhi
Duration	:	One and half year/ 2018 -2019

Title	:	A Survey of What Information Research Participants Would Like to Know in Informed Consent Forms in Biomedical Research
PI	:	Dr. S. Kanungo
Funding Agency	:	Indian Council of Medical Research
Duration	:	Ten Months (Aug 2017- June 2018)

Title	:	Strengthening/promoting evidence-based advocacy for influenza prevention and control in India
PI	:	Dr. S. Kanungo
Funding Agency	:	All India Institute of Medical Sciences
Duration	:	Three years/ 2016-2019

Title	:	Study of CMV infection in Neonatal Hepatitis and its association with maternal CMV infection
PI	:	Dr. N. Chakraborty
Funding Agency	:	University Grants Commission (UGC), Govt. of India
Duration	:	5 years/ 2015 to 2019

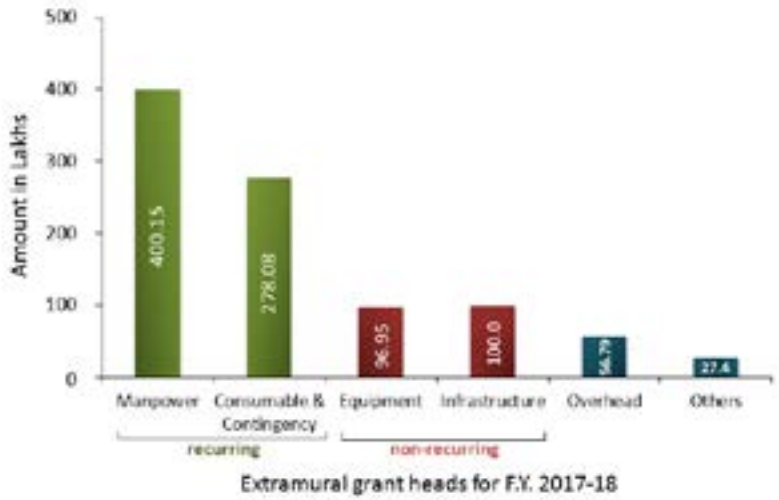
Title	:	Strategy to study screening of anti-CMV (Cytomegalovirus) compounds from some medicinal and edible mushrooms
PI	:	Dr. N. Chakraborty
Funding Agency	:	WBDST
Duration	:	3 years/ 2018 to 2020

Title	:	Development of reagents for simple-immunochemical test for the detection of Chikungunya infection
PI	:	Dr. N. Chakraborty
Funding Agency	:	DBT, New Delhi
Duration	:	3 years/ 2015 to 2017

Title	:	Studies on genomic variations of hepatitis C virus among multi-transfused thalassemic patient in West Bengal
PI	:	Dr. P Ch. Sadhukhan
Co-I	:	Prof. M. Bhattacharyya
Funding Agency	:	West Bengal DST
Duration	:	2015-2018

Title	:	Development of rapid, sensitive one-tube duplex RT-PCR assay for specific and differential diagnosis of Chikungunya and Dengue
PI	:	Dr. P. Ch. Sadhukhan
Funding Agency	:	ICMR
Duration	:	2017-2019

Title	:	Treatment Expenditure in Under Five Pneumonia patients :Search for Expenditure Areas which can be prevented /reduced
PI	:	Dr. A. Sinha
Funding Agency	:	University of Calcutta
Duration	:	1 year (2018-19)



Extramural grant heads for F.Y. 2017-18

PUBLICATIONS

1. Ali M, Kim DR, Kanungo S, Sur D, Manna B, Digilio L, Dutta S, Marks F, Bhattacharya SK, Clemens J. Use of oral cholera vaccine as a vaccine probe to define the geographical dimensions of person-to-person transmission of cholera. Int J Infect Dis. 2018 Jan; 66:90-95.

2. Banerjee A, De P, Manna B, Chawla-Sarkar M. Molecular characterization of enteric adenovirus genotypes 40 and 41 identified in children with acute gastroenteritis in Kolkata, India during 2013-2014. J Med Virol. 2017 Apr; 89(4):606-614.

3. Banerjee S, Bhattacharyya P, Mitra S, Kundu S, Panda S, Chatterjee IB. Anti-p-benzoquinone antibody level as a prospective biomarker to identify smokers at risk for COPD. Int J Chron Obstruct Pulmon Dis. 2017 Jun 21;12:1847-1856.

4. Barik A, Das S. A comparative study of sequence- and structure-based features of small RNAs and other RNAs of bacteria. RNA Biol. 2018 Jan;15(1):95-103.

5. Barman RK, Mukhopadhyay A, Das S. An improved method for identification of small non-coding RNAs in bacteria using support vector machine. Sci Rep. 2017 Apr; 7:46070.

6. Biswas A, Firdaus R, Gupta D, Ghosh M, Saha M, Chowdhury P, Bhattacharya D, Bhattacharyya M, Sadhukhan PC. Interferon λ3 Gene (IL28B) is associated with spontaneous or treatment induced viral clearance in HCV infected multitransfused thalassemic patients. Transfusion. 2017 Jun; 57(6):1376-1384.

7. Biswas A, Gupta D, Saha K, Sarkar K, Firdaus R, Sadhukhan PC. Emerging new HCV strains among intravenous drug users and their route of transmission in the north eastern state of Mizoram, India. Mol Phylogenet Evol. 2017 Nov;116: 239-247.

8. Chatterjee RP, Chatterjee A, Chakraborty N, Chatterjee S.A Seroepidemiological insight into the current into the current status and rapid dissemination of Chikungunya virus infection in West Bengal-A two years' retrospective study. Int J Sci Res.2017 Sep; 6(9):289-291.

9. Chatterjee A, Thakur I, Ansari S, Chatterjee RP, Sarkar R, Guha SK, Chakraborty N. A Comparative Insight into the Incidence of Steven Johnson Syndrome/Toxic Epidermal Necrolysis among the Immunocompromized Patient Populace of Eastern India with a Distinctive Emphasis on the Possible Association of Human Cytomegalovirus. J AIDS Clin Res.2017 Jun; 8(6).1000706.

10. Chatterjee P, Bhaumik S, Chauhan AS, Kakkar M. Protocol for developing a Database of Zoonotic disease Research in India (DoZooRI). BMJ open.2017Dec; 7(12):e017825.

11. Chatterjee P, Chauhan AS, Joseph J, Kakkar M. One Health/EcoHealth capacity building programs in South and South East Asia: a mixed method rapid systematic review. Hum Resour Health. 2017 Sep; 15(1):72.

12. Chatterjee S, Mondal A, Mitra S, Basu S. *Acinetobacter baumannii* transfers bla_{NDM-1} gene via outer membrane vesicles. J Antimicrob Chemother. 2017 Aug; 72(8):2201-2207.

13. Chattopadhyay D, Ojha D, Mukherjee H, Bag P, Vaidya SP, Dutta S. Validation of a traditional preparation against multi-drug resistant *Salmonella* Typhi and its protective efficacy in *S.* Typhimurium infected mice. Biomed Pharmacother.2018 Mar; 99:286-289.

14. Chowdhury R, Ilyas H, Ghosh A, Ali H, Ghorai A, Midya A, Jana NR, Das S, Bhunia A. Multivalent Gold nanoparticle–Peptide Conjugates for Targeting Intracellular Bacterial Infections. Nanoscale. 2017 Sep; 9(37):14074-14093.

15. Das A, Detels R, Afifi AA, Javanbakht M, Sorvillo FJ, Panda S. Health-related quality of life (HRQoL) and its correlates among community-recruited children living with HIV and uninfected children born to HIV-infected parents in West Bengal, India. Qual Life Res. 2017 Aug;26(8):2171-2180.

16. Das G, Das S, Dutta S, Ghosh I. In silico identification and characterization of stress and virulence associated repeats in *Salmonella*. Genomics. 2018 Jan; 110(1):23-34.

17. Das S, Chowdhury R, Ghosh S, Das S. A recombinant protein of *Salmonella* Typhi induces humoral and cell-mediated immune responses including memory responses. Vaccine. 2017 Aug; 35(35 Pt B):4523-4531.

18. Das S, Ghosh AN. Preliminary Characterization of El Tor Vibriophage M4. Intervirology. 2018 Mar; 60(4):149-155.

19. Das S, Samajpati S, Roy I, Sankar S, Gaind R, Deb M, Kulkarni R, Paul DK, Dutta S. Molecular Subtyping of *Salmonella enterica* Serovar Typhi by Pulsed-Field Gel Electrophoresis and Multiple-Locus Variable-Number Tandem-Repeat Analysis in India: Their Association with Antimicrobial Resistance Profiles. Jpn J Infect Dis. 2017 Sep; 70(5):536-543.

20. Dasgupta N, Thakur BK, Ta A, Das S, Banik G, Das S. Polo-like kinase 1 expression is suppressed by CCAAT/enhancer-binding protein α to mediate colon carcinoma cell differentiation and apoptosis. Biochim Biophys Acta. 2017 Jul; 1861(7):1777-1787.

21. De R, Ramamurthy T, Sarkar BL, Mukhopadhyay AK, Pazhani GP, Sarkar S, Dutta S, Nair GB. Retrospective genomic analysis of *Vibrio cholerae* O1 El Tor strains from different places in India reveals the presence of ctxB-7 allele found in Haitian isolates. Epidemiol Infect. 2017 Aug; 145(11):2212-2220.

22. Debnath F, Bhatnagar T, Sundaramoorthy L,Ponnaiah M. Competency of peripheral health workers in detection & management of common syndromic conditions under surveillance, North 24 Parganas, West Bengal, India, 2016: A cross-sectional study. Glob Health Epidemiol Genom. 2017 Oct 11; 2 :e15.

23. Debnath F, Mukhopadhyay AK, Choudhury G, Saha RN, Dutta S. An Outbreak of Foodborne infection caused by Shigella sonnei in West Bengal, India. Jpn J Infect Dis. 2018 Mar; 71(2):162-166.

24. Debnath F, Ponnaiah M, Acharya P. Dengue fever in a municipality of West Bengal, India, 2015:An outbreak investigation. Indian J Public Health.2017 Oct-Dec; 61(4):239-242.

25. Deen J, Lopez AL, Kanungo S, Wang XY, Anh DD, Tapia M, Grais RF. Improving rotavirus vaccine coverage: Can newer-generation and locally produced vaccines help? Hum Vaccin Immunother. 2018 Feb; 14(2):495-499.

26. Doan YH, Suzuki Y, Fujii Y, Haga K, Fujimoto A, Takai-Todaka R, Someya Y, Nayak MK, Mukherjee A, Imamura D, Shinoda S, Chawla-Sarkar M, Katayama K. Complex reassortment events of unusual G9P[4] rotavirus strains in India between 2011 and 2013. Infect Genet Evol. 2017 Oct; 54:417-428.

27. Dutta N, Nandi S, Guha S K, Saha M K. Emergence of HIV drug-resistant mutations in East Indian population after failure of first-line antiretroviral therapy. HIV AIDS Rev. 2017Nov; 16(4): 258-264.

28. Ganguly S, Barkataki S, Karmakar S, Sanga P, Boopathi K, Kanagasabai K, Kamaraj P, Chowdhury P, Sarkar R, Raj D, James L, Dutta S, Sehgal R, Jha P, Murhekar M. High prevalence of soil-transmitted helminth infections among primary school children, Uttar Pradesh, India. Infect Dis Poverty. 2017 Oct; 6(1):139.

29. Ganguly S, Malhotra A, Chowdhuri M, Ghosa A, Sardar SK, Okamoto K, Dutta S, Bhattacharya SK. Intractable Seizure in a Case of Primary Amoebic Meningoencephalitis caused by the Free Living Amoeba Naegleria Fowleri. Arch Parasitol 2017Nov; 1(3):114.

30. Ghosh K, De S, Mukherjee S, Das S, Ghosh AN, Sengupta SB. Withaferin A induced impaired autophagy and unfolded protein response in human breast cancer cell-lines MCF-7 and MDA-MB-231. Toxicol In Vitro. 2017 Oct; 44:330-338.

31. Ghosh P, Kumar D, Chowdhury G, Singh P, Samanta P, Dutta S, Ramamurthy T, Sharma NC, Sinha P, Prasad Y, Shinoda S, Mukhopadhyay AK. Characterization of *Vibrio cholerae* O1 strains that trace the origin of Haitian-like genetic traits. Infect Genet Evol. 2017 Oct; 54:47-53.

32. Halder M, Mookerjee S, Batabyal P, Palit A. Waterborne outbreaks in Diarrhoea endemic foci of India: a longitudinal exploration and its implications. Environ Monit Assess. 2018 Feb; 190(3):172.

33. Halder M, Mookerjee S, Batabyal P, Palit A. Environmental *Vibrio cholerae* non O1/ non O139 from the Gangetic delta: a diarrheal disease purview. Int J Environ Health Res. 2017 Aug; 27(4):241-251.

34. Howlader DR, Koley H, Maiti S, Bhaumik U, Mukherjee P, Dutta S. A brief review on the immunological scenario and recent developmental status of vaccines against enteric fever. Vaccine. 2017 Nov; 35(47):6359-6366.

35. Jana S, Patel D, Patel S, Upadhyay K, Thadani J, Mandal R, Das S, Devkar R. Anthocyanin rich extract of Brassica oleracea L. alleviates experimentally induced myocardial infarction. PLoS One. 2017 Aug; 12(8):e0182137.

36. Kanungo S, Chatterjee P. Oral cholera vaccines: exploring the farrago of evidence. Lancet Infect Dis. 2017 Oct; 17(10):1012-1013.

37. Karmakar S, Dutta S, Ganguly S. Surveillance of enteric parasites in an infectious diseases hospital, Kolkata, India. Am J Biotech Bioinfo.2017; 1:5.DOI: 10.28933/ajobb-2017-09-2805.

38. Kulkarni PS, Desai S, Tewari T, Kawade A, Goyal N, Garg BS, Kumar D, Kanungo S, Kamat V, Kang G, Bavdekar A, Babji S, Juvekar S, Manna B, Dutta S, Angurana R, Dewan D, Dharmadhikari A, Zade JK, Dhere RM, Fix A, Power M, Uprety V, Parulekar V, Cho I, Chandola TR, Kedia VK, Raut A, Flores J; SII BRV-PV author group. A randomized Phase III clinical trial to assess the efficacy of a bovine-human reassortant pentavalent rotavirus vaccine in Indian infants. Vaccine. 2017 Oct; 35(45):6228-6237.

39. Kumar P, Bag S, Ghosh TS, Dey P, Dayal M, Saha B, Verma J, Pant A, Saxena S, Desigamani A, Rana P, Kumar D, Sharma NC, Hanpude P, Maiti TK, Mukhopadhyay AK, Bhadra RK, Nair GB, Ramamurthy T, Das B. Molecular Insights into Antimicrobial Resistance Traits of Multidrug Resistant Enteric Pathogens isolated from India. Sci Rep. 2017 Oct; 7(1):14468.

40. Kumar R, Dutta S, Pal D. Microbiological quality assessment and detection of fecal *Escherichia coli* (Coliform) in foods of animal origin sold in the open markets of Kolkata City in India. Ind J Comp Microbiol, Immunol Infect Dis.2017July; 38(1):22-25.

41. Mandal RS, Panda S, Das S. In silico prediction of drug resistance due to S247R mutation of Influenza H1N1 neuraminidase protein. J Biomol Struct Dyn. 2018 Mar; 36(4):966-980.

42. Mitobe J, Sinha R, Mitra S, Nag D, Saito N, Shimuta K, Koizumi N, Koley H. An attenuated Shigella mutant lacking the RNA-binding protein Hfq provides cross protection against Shigella strains of broad serotype. PLoS Negl Trop Dis.2017 Jul; 11(7):e0005728.

43. Mukherjee P, Dutta S, Mukhopadhyay AK. Development and evaluation of a PCR assay for rapid detection of azithromycin resistant Campylobacter isolated from diarrhoeal patients in Kolkata, India. Gut Pathog. 2017 Jun; 9:37.

44. Mukherjee SK, Mandal RS, Das S, Mukherjee M. Effect of non-**β**-lactams on stable variants of inhibitor-resistant TEM **β**-lactamase in uropathogenic *Escherichia coli*: implication for alternative therapy. J Appl Microbiol. 2018 Mar; 124(3):667-681.

45. Naser IB, Hoque MM, Abdullah A, Bari SMN, Ghosh AN, Faruque SM. Environmental bacteriophages active on biofilms and planktonic forms of toxigenic *Vibrio cholerae*: Potential relevance in cholera epidemiology. PLoS One. 2017 Jul; 12(7):e0180838.

46. Nayak MK, De P, Manna B, Dutta S, Bhadra UK, Chawla-Sarkar M. Species A rotaviruses isolated from hospitalized patients over 5 years of age in Kolkata, India, in 2012/13. Arch Virol. 2018 Mar; 163(3):745-750.

47. Nayak U, Kanungo S, Zhang D, Ross Colgate E, Carmolli MP, Dey A, Alam M, Manna B, Nandy RK, Kim DR, Paul DK, Choudhury S, Sahoo S, Harris WS, Wierzba TF, Ahmed T, Kirkpatrick BD, Haque R, Petri WA Jr, Mychaleckyj JC. Influence of maternal and socioeconomic factors on breast milk fatty acid composition in urban, low-income families. Matern Child Nutr. 2017 Oct; 13(4) doi: 10.1111/mcn.12423. Epub 2017 Feb 15.

48. Panda S, Swaminathan S, Hyder KA, Christophel EM, Pendse RN, Sreenivas AN, Laksono SJ, Srivastava R, Nair GB, Aditama TY, Singhasivanon P, Thapa AB, Sarkar SK. Drug resistance in malaria, tuberculosis, and HIV in South East Asia: biology, programme, and policy considerations. BMJ. 2017 Sep 5;358:j3545.

49. Patil S, Shetty P, Kulkarni R, Ajantha G, Kalabhavi A, Patil D, Hosamani M, Jain P, Chakraborti AK, Shubhada C. Antibiogram and Serotyping of *Vibrio cholerae* O1 Isolates from a Tertiary Care Centre in South India. JPAM. 2017 June.DOI: http://dx.doi.org/10.22207/JPAM.11.2.46

50. Raj D, Chowdhury P, Sarkar R, Saito-Nakano Y, Okamoto K, Nozaki T, Dutta S, Ganguly S. Pyruvate protects Giardia trophozoites from cysteine-ascorbate deprived medium induced cytotoxicity. Korean J Parasitol. 2018 Feb; 56(1):1-9.

51. Rajpara N, Nair M, Chowdhury G, Mukhopadhyay AK, Ramamurthy T, Niyogi SK, Bhardwaj AK. Molecular analysis of multidrug resistance in clinical isolates of Shigella spp. from 2001-2010 in Kolkata, India: role of integrons, plasmids, and topoisomerase mutations. Infect Drug Resist. 2018 Jan; 11:87-102.

52. Sarma N, Chakraborty S, Dutta A, Sadhukhan PC. Hand, Foot and Mouth Disease in West Bengal, India: A Preliminary Report on Clinicovirological Trend over 3 Successive Years (2013-2015). Indian J Dermatology.2017 Sep-Oct; 62(5):486-490.

53. Sen K, Lu J, Mukherjee P, Berglund T, Varughese E, Mukhopadhyay AK. Campylobacter jejuni Colonization in the Crow Gut Involves Many Deletions within the Cytolethal Distending Toxin Gene Cluster. Appl Environ Microbiol. 2018 Mar; 84(6). pii: e01893-17.

54. Singh R, Khatri P, Srivastava N, Jain S, Brahmachari V, Mukhopadhyay AK, Mazumder S. Fluoride exposure abates pro-inflammatory response and induces in vivo apoptosis rendering zebrafish (Danio rerio) susceptible to bacterial infections. Fish Shellfish Immunol.2017 Apr; 63:314-321.

55. Sinha A, Kanungo S, Kim DR, Manna B, Song M, Park JY, Haldar B, Sharma P, Mallick AH, Kim SA, Babji S, Sur D, Kang G, Ali M, Petri WA Jr, Wierzba TF, Czerkinsky C, Nandy RK, Dey A. Antibody secreting B cells and plasma antibody response to rotavirus vaccination in infants from Kolkata India. Heliyon. 2018 Feb; 4(1):e00519.

56. Sinha R, Howlader DR, Ta A, Mitra S, Das S, Koley H. Retinoic acid pre-treatment down regulates *V. cholerae* outer membrane vesicles induced acute inflammation and enhances mucosal immunity. Vaccine. 2017 Jun; 35(28):3534-3547.

57. Ta A, Thakur BK, Dutta P, Sinha R, Koley H, Das S. Double-stranded RNA induces cathelicidin expression in the intestinal epithelial cells through phosphatidylinositol 3-kinase-protein kinase Cζ-Sp1 pathway and ameliorates shigellosis in mice. Cell Signal. 2017 Jul; 35:140-153.

58. Tapader R, Bose D, Pal A. YghJ the secreted metalloprotease of pathogenic E. coli induces hemorrhagic fluid accumulation in mice ileal loop. Microb Pathog. 2017 Apr; 105:96-99.

59. Weill FX, Domman D, Njamkepo E, Tarr C, Rauzier J, Fawal N, Keddy KH, Salje H, Moore S, Mukhopadhyay AK, Bercion R, Luquero FJ, Ngandjio A, Dosso M, Monakhova E, Garin B, Bouchier C, Pazzani C, Mutreja A, Grunow R, Sidikou F, Bonte L, Breurec S, Damian M, Njanpop-Lafourcade BM, Sapriel G, Page AL, Hamze M, Henkens M, Chowdhury G, Mengel M, Koeck JL, Fournier JM, Dougan G, Grimont PAD, Parkhill J, Holt KE, Piarroux R, Ramamurthy T, Quilici ML, Thomson NR. Genomic history of the seventh pandemic of cholera in Africa. Science. 2017 Nov; 358(6364):785-789.

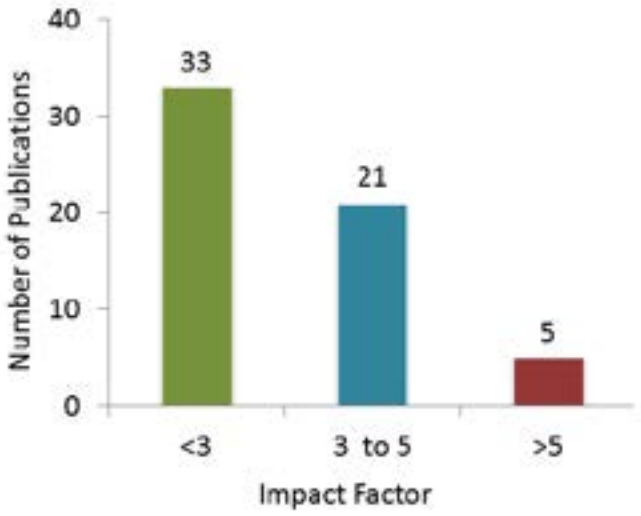
60. Yadav JP, Das SC, Dhaka P, Vijay D, Kumar M, Mukhopadhyay AK, Chowdhury G, Chauhan P, Singh R, Dhama K, Malik SVS, Kumar A. Molecular characterization and antimicrobial resistance profile of Clostridium perfringens type A isolates from humans, animals, fish and their environment. Anaerobe. 2017 Oct; 47:120-124.

Book Chapters:

Mandal RS, Das S.2017. In Silico Approaches Toward Combating Antibiotic Resistance. In Arora G, sajid A, Kalia VC (eds), Drug Resistance in Bacteria, Fungi, Malaria, and Cancer. Springer, pp.577-593.

Policy Brief:

Panda S, Chatterjee P, Deb AK, Kanungo S, Dutta S. Oral Cholera Vaccines - Worth a Shot? [Policy Brief]. Indian Council of Medical Research, New Delhi, November 2017.



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Dr. Bhaskar Saha Scientist 'G' National Centre for Cell Science NCCS Complex, Pune University Campus Ganeshkhind, Pune- 411 007	Member
Prof. Debashis Bhattaharya Director of Medical Education Dept. of Hlth & FW, Govt. of W.B. Swasthya Bhavan GN 29, Sector V, Salt Lake City, Kolkata - 700 091	Special Invitee
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Prof. Subir Kumar Dutta Scientific Research Laboratory 2, Ram Chandra Das Road, Kolkata-700013	Member
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Dr. P. Dutta Former Emeritus Medical Scientist (ICMR) ICMR-NICED, Kolkata	Member Secretary

Institutional Animal Ethics Committee:

Dr. Tapas Biswas, NICED, Scientist, Biological discipline	Chairman
Dr. M.K. Chakraborty, NICED, Scientist Member Biological Scientist	Member
Dr Santa Sabuj Das, NICED Scientist Member, Biological discipline	Member
Dr. Gautam Prasad Sarkhel, Veterinarian, Uttranyan , Block D, Flat 2C, 40 Dum Dum Road, Kolkata 74	Member
Prof Antony Gomes, Dept. of Physiology, Calcutta University, Main Nominee, CPCSEA	Member
Dr. Capt. Kamal Kanti Dutta, Natritam (NGO) Link Nominee CPCSEA	Member
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Dr. Hemanta Koley, NICED	Member Secretary

Institutional Biosafety Committee (IBSC)

Dr. Amit Pal, Scientist-F	Chairman
Dr. Nabendu Sekhar Chatterjee, Scientist-F	Member Secretary
Dr. Asis Kr. Mukhopadhyay, Scientist-E	Member
Dr. Mamta Chawla Sarkar, Scientist-E	Member
Dr. Suman Kanungo, Scientist-E	Medical/Biosafety Officer
Dr. Rupak Bhadra, Chief Scientist, CSIR-IICB, Kolkata	External Expert
Dr. Parminal Karmakar, Professor Dept. of Life Science and Biotechnology, Jadavpur University, Kolkata	DBT Nominee

Right to Information Act (RTI)

Till 28th December, 2017

Dr. Samiran Panda, Scientist-F	Appellate Authority
Dr. Ranjan Kr. Nandy, Scientist-E	CPIO (Central Public Information Officer)
Mr. T.K. Saha, Administrative Officer	CPIO
Mr. Shyamal Kr. Das, Private Secretary	CPIO
Mr. Gopal Das, Assistant	Coordinator

From 29th December, 2017

Dr. Ranjan Kr. Nandy, Scientist-E	Appellate Authority
Dr. Sulagna Basu, Scientist-E	CPIO (Central Public Information Officer)
Administrative Officer	CPIO
Mr. Shyamal Kr. Das, Private Secretary	CPIO
Mr. Avijit Chakraborty, Technical Assistant	Coordinator

Official Language Implementation Committee

Till 28th January, 2018

Dr. Anup Palit, Scientist-F	Chairperson
Dr. Mamta Chawla Sarkar, Scientist-E	Member
Mr. T.K. Saha, Administrative Officer	Liaison Officer
Mr. Sunil Bernard, Private Secretary	Member
Mr. Pradip Bose, Assistant	Member
Mr. Vishwanath Besra, Assistant	Member
Mr. Sudhir Omesh, TO-A	Member

From 29th January, 2018

Dr. Mamta Chawla Sarkar, Scientist-E	Chairperson
Dr. Falguni Debnath, Scientist-C	Member
Dr. Pallavi Indwar, Scientist-B	Member
Administrative Officer	Liaison Officer
Ms. Arpita Sarbajna, Sr.TO (1)	Member
Mr. Sunil Bernard, Private Secretary	Member
Mr. Sudhir Omesh, TO-A	Member
Mr. Vishwanath Besra, Assistant	Member

SC/ST cell

Till 26th February, 2018

Dr. Malay Kr. Saha, Scientist 'F'	Chairperson/Liaison Officer
Dr. Amit Pal, Scientist 'F'	Member
Mr. Pradip Bhadra, Section Officer	Member
Ms. Arpita Sarbajna, TO-A	Member
Mr. Vishwanath Besra, Assistant	Member

From 27th February, 2018

Dr. Malay Kr. Saha, Scientist 'F'	Chairperson/Liaison Officer
Dr. Amit Pal, Scientist 'F' & AO (Addl.Charge)	Member
Dr. Pallavi Indwar, Scientist 'B'	Member
Ms. Arpita Sarbajna, Sr. TO (1)	Member
Mr. Vishwanath Besra, Assistant	Member

Grievance Cell

Till 8th February, 2018

Dr. Tapas Biswas, Scientist-G	Chairperson
Dr. Sulagna Basu, Scientist-E	Member
Mr. T.K. Saha, Administrative Officer	Member
Mr. Pradip Kr. Bose, Assistant	Member Secretary
Mr. Vishwanath Besra, Assistant	Member
Mr. Somesh Chandra Bhunia, TO-A	Member
Mr. Sudhir Omesh, TO-A	Member

From 9th February, 2018

Dr. Sulagna Basu, Scientist-E	Chairperson
Dr. Suman Kanungo, Scientist-E	Member
Administrative Officer, NICED	Member
Mr. Pradip Kr. Bose, Section Officer	Member Secretary
Mr. Vishwanath Besra, Assistant	Member
Mr. Somesh Chandra Bhunia, Sr.TO-2	Member
Mr. Sudhir Omesh, TO-A	Member

Internal Complaints Committee of ICMR-NICED for Sexual Harassment of Women at Workplace

From 7th September, 2016

Dr. Triveni Krishnan, Scientist-F	Chairperson
Dr. Mamta Chawla Sarkar, Scientist-E	Member
Dr. Sulagna Basu, Scientist-E	Member
Mr. Tapan Kr. Saha, Admin. Officer	Member
Smt. Arpita Sarbajna, Technical Officer-A	Member

Library Committee

Till 18th December, 2017

Dr. Shanta Dutta, Scientist-G	Chairperson
Dr. Kamalesh Sarkar, Scientist-F	Working Chairperson
Dr. N.S. Chatterjee, Scientist-E	Member
Dr. Mamta Chawla Sarkar, Scientist-E	Coordinator
Dr. Suman Kanungo, Scientist-C	Member
Administrative Officer	Member
Mrs. Saheli Samanta, ALIO	Member

From 19th December, 2017

Dr. Shanta Dutta, Director & Scientist-G	Chairperson
Dr. N.S. Chatterjee, Scientist-F	Working Chairperson
Dr. Mamta Chawla Sarkar, Scientist-E	Coordinator
Dr. Suman Kanungo, Scientist-E	Member
Dr. Moumita Bhowmick, Scientist-C	Member
Administrative Officer	Member
Mrs. Saheli Samanta, Sr.Technical Officer-2	Member

Purchase Committee

Till 31st January, 2018

Dr. Tapas Biswas, Scientist-G & AO (Addl. Charge)	Chairperson
Dr. Byomkesh Manna, Scientist-F& ACO (Addl. Charge)	Member
Dr. Amit Pal, Scientist-F	Member
Dr. Malay Kr. Saha, Scientist-F	Member
Dr. Ranjan Kr. Nandy, Scientist-E	Member
Dr. Pallavi Indwar, Scientist-B	Member
Mr. Gopal Ch. Das, Store-in-Charge	Member

From 1st February, 2018

Dr. Amit Pal, Scientist-F	Chairperson
Dr. Malay Kr. Saha, Scientist-F	Member
Dr. Alok Kr. Deb, Scientist-E	Member
Dr. Ranjan Kr. Nandy, Scientist-E	Member
Dr. Sandipan Ganguly, Scientist-E	Member
Administrative Officer	Member
Mr. Gopal Ch. Das, Store-in-Charge	Member

Web Committee

Dr. Shanta Dutta, Director & Scientist-G	Chairperson
Dr. Ranjan Kumar Nandy, Scientist-E	Co-opt Member
Dr. Sandipan Ganguly, Scientist-E	Co-opt Member
Mr. Sunil Bernard, Private Secretary	Member
Mrs. Saheli Samanta, ALIO	Coordinator

Staff List:

Director's Secretariat

Shri S. Bernard, Private Secretary
Shri S. Sen, Personal Assistant
Shri N. G. Sutradhar, Laboratory Assistant

Office of the Administrative Officer

Dr. T. Biswas, Administrative Officer (Additional Charge) (till 31.01.2018)
Dr. A. Pal, Administrative Officer (Additional Charge)
Shri S. K. Das, Private Secretary

Smt. R. Jaiswal, Upper Division Clerk
Shri O. Lal, Laboratory Assistant
Shri J. Malakar, Laboratory Assistant
Shri Kh. I. Singh, MTS (General)

Accounts Section
Dr. A. Palit, Accounts Officer (Additional Charge) (w.e.f. 01.12.2017)
Shri P. Kumar Bose, Section Officer (w.e.f.01.02.2018)
Shri D. Kumar Gayen, Upper Division Clerk
Shri P. Guha, Upper Division Clerk

Personnel Section
Shri S. Ghosh, Assistant (till 31.01.2018)
Shri P. Bhadra, Section Officer (w.e.f.01.02.2018)
Shri R. Chowdhury, Assistant
Shri A. Chakraborty, TA
Shri R. Hela, Lab. Assistant

Establishment Section
Dr. S. Kumar Sadhukhan, Sr. Technical Officer (1) (w.e.f.16.08.2017)
Shri P. Bhadra, Section Officer (upto 31.01.2018)
Shri A. Chandra, Upper Division Clerk
Mrs.M. Bhattacharya, Lab. Attendant (2)

Cash Section
Shri C. Kumar Naskar, Assistant.
Shri R. Biswas, UDC

Store Section
Shri G. Chandra Das, Assistant
Shri G. Kundu, UDC
Shri K. Sharma, UDC
Shri S. Banerjee, Assistant (upto April,2017)
Shri T. Kumar Paul, Lab. Assistant

Pension Section
Shri V. Besra, Assistant
Shri S. Bandyopadhyay, Assistant (Till February,2018)

Despatch Section
Shri G. CharanTudu, Lab. Assistant
Shri A. Kumar Roy, Lab. Assistant
Shri A. Banerjee, Technician (1)

Library
Smt. S. Samanta, Sr. Technical Officer (2)
Shri T. Pal, Sr. Technical Officer (1)
Shri M. Chakraborty, Technical Assistant (Till 31/05/2017)
Shri B. Roy, Laboratory. Assistant

Media Section
Dr. A. Palit, Scientist G, IC (Addl.)
Shri A. K. Saha, Technician-B
Shri K. Roy, Laboratory Assistant
Shri K. Ghosal, Lab. Assistant
Shri S. Mondal, Laboratory Attendant- 2(Technical)
Shri V. K. Singh, Lab. Assistant

Vehicle Section
Shri D. K. Saha, Sr. Technician (3) (Till 31/01/2018)
Shri S. K. Das, Sr. Technician (3) (Till 31/10/2017)
Shri D. K. Chowdhury, Sr. Technician (2)
Shri H. P. Das, Sr. Technician (2)
Shri M. Ali Khan, Sr. Technician (3) (Till 31/01/2018)
Shri A. K. Dutta, Driver (Grade II)
Shri S. Das, Driver (Grade II)
Shri S. K. Ghosh, Driver (Ordinary Grade)
Shri D. Dey, Driver (Ordinary Grade)

Maintenance, Instruments & Equipment Section
Shri P. K. Ghoshal, Principal Technical Officer
Shri A. R. Das, Care Taker
Shri S. K. Dey, Technical Assistant
Shri A. K. Dey, Technician `B' (retired on 31.12.2017)
Shri K. Dey, Senior Technician-I
Shri S. Kumar Routh, Laboratory Assistant
Shri B. Mandi, Laboratory Assistant
Shri B. Das, Laboratory Assistant
Shri S. Mullick, Laboratory Assistant
Shri M. Dosad, Laboratory Assistant (passed away on 23rd January, 2018)
Shri S. Hazra, Laboratory Assistant
Shri A. Das, Laboratory Assistant
Shri B. Moshi, Laboratory Assistant
Ms. B. Hela, Laboratory Assistant
Shri D.Turi, Laboratory Assistant
Shri A. Seal, MTS (General)
Shri S. Maiti, MTS (General)

Training & Extension
Shri A. Jana, Technician `B'
Shri S. Adhikary, Laboratory Assistant

Department of Animal House
Shri K.C. Paramanik, Senior Technical Officer-I
Shri K.C. Tudu, Technical Assistant
Shri S. Hari, Laboratory Assistant
Shri P. Turi, Laboratory Assistant
Shri R. Hazra, Laboratory Assistant
Shri S. Balmiki, Laboratory Assistant

Scientists Associated with ICMR-NICED
Dr. A. Ghosh, J.C. Bose Distinguished Chair Professor,National Academy of Sciences, India
Dr. M. K. Chakrabarti, ICMR Emeritus Scientist
Dr. A. N. Ghosh, ICMR Emeritus Scientist
Dr. M. K. Bhattacharya, ICMR Emeritus Scientist
Dr. B. L. Sarkar, ICMR Emeritus Scientist
Dr. B. Manna, ICMR Emeritus Scientist

Employees transferred to/joined ICMR-NICED during 2017-18

	Name and designation	Division	Date of transfer/joining
1.	Dr. A. Sinha, Scientist C	Clinical Medicine	09.08.2017
2.	Dr. (Mrs.) S. Bhattacharya, Scientist B	Biochemistry	01.11.2017
3.	Dr. (Mrs.) M. Bhaumik (Ghosh), Scientist C	Immunology	06.11.2017
4.	Dr. (Mrs.) M. Dutta, Scientist C	Electron Microscopy	01.12.2017
5.	Dr. S. Basak, Scientist C	Bioinformatics	06.12.2017
6.	Mr. I. Mukherjee, Consultant (Accounts)	Administration	20.03.2018

Employees who left ICMR-NICED during 2017-18

	Name and designation	Division	Date of release
1.	Dr. K. Sarkar, Scientist F	Epidemiology	18.12.2017
2.	Dr. S. Panda, Scientist F	Epidemiology	19.12.2017

Retired Employees of the Institute during 2017-18

"Farewell dear friends"

	Name and designation	Division/ Section	Date of Retirement
1.	Mr. T. K. Saha, Admn. Officer	Administration	30.04.2017
2.	Mr. S. Banerjee, Assistant	Administration	30.04.2017
3.	Mr. M. Chakraborty, Tech. Assistant	Library	31.05.2017
4.	Mr. S. K. Das, Sr. Technician (3)	Vehicles	31.10.2017
5.	Dr. B. Manna, Scientist-F	Data Management	30.11.2017
6.	Mr. S. K. Bhowmik, Sr. Technical Officer (2)	Bacteriology	30.11.2017
7.	Mr. A. K. Dey, Technician-B	Maintenance	31.12.2017
8.	Dr. T. Biswas, Scientist-G	Immunology	31.01.2018
9.	Mr. S. Ghosh, Assistant	Personnel	31.01.2018
10.	Mr. D. K. Saha, Sr.Technician (3)	Vehicles	31.01.2018
11.	Mr. M. Ali Khan, Sr. Technician C	Vehicles	31.01.2018
12.	Mr. S. Bandyopadhyay, Assistant	Pension	28.02.2018

Obituary..our tribute and homage

"You will always be remembered…rest in eternal peace"

Mr. Meghlal Dosad, Laboratory Assistant, passed away on 23.01.2018

ICMR - National Institute of Cholera and Enteric Diseases

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