



**MANIPAL**  
ACADEMY of HIGHER EDUCATION

*(Deemed to be University under Section 3 of the UGC Act, 1956)*

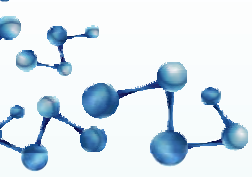
## Manipal Centre for Virus Research

Manipal, Udupi, Karnataka



ANNUAL REPORT OF  
**HOSPITAL BASED SURVEILLANCE OF  
ACUTE FEBRILE ILLNESS IN INDIA**

12 December, 2017



Project established under the Cooperative Agreement,  
Grant No: 5U01GH001051, awarded to Manipal Academy  
of Higher Education by Centers for Disease Control and  
Prevention (CDC), Atlanta, USA

Principal Investigator:


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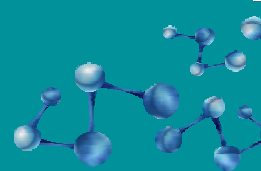
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## About MCVR, Manipal

Manipal Centre for Virus Research (MCVR), Manipal Academy of Higher Education was created on 1st May 2010 by upgrading the virology laboratory of the Department of Microbiology, Kasturba Medical College, Manipal into a university department.

Currently, MCVR houses the IDSP-Regional Reference Laboratory for Influenza Virus and the DHR/ICMR Virus Research and Diagnostic Laboratory- Grade I. MCVR is also the NVBDCP Apex Referral Laboratory for Dengue, Japanese Encephalitis and Chikungunya; all of which are Ministry of Health and Family Welfare (MoHFW), Government of India supported programmes. MCVR is also the referral laboratory for Zika testing in the country. The centre also enjoys an excellent working relationship with National, State and District Public health services.

MCVR has strong collaborations with International institutions like Centers for Disease Control and Prevention (CDC), Atlanta, USA, WHO Collaborating Centre for Influenza Reference and Research at the Victorian Infectious Diseases Reference Laboratory (VIDRL), Melbourne, Australia and The Public Health England (PHE), Colindale, UK.

MCVR has the uniqueness of hosting a public service programme on a private platform and in the short span of time, it has proven to be one of the best public-private partnership in the development of public health infrastructure in the country.

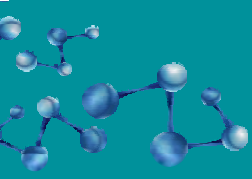
Apart from disease diagnostics, MCVR supports the state and national health services for outbreak investigation and disease surveillance activities. MCVR has been instrumental in confirming more than 150 viral outbreaks, MCVR team investigated around 30 outbreaks in various parts of the country including

Karnataka, Kerala, Goa, Uttar Pradesh and Odisha in the recent past. The AFI Surveillance project under the Global Health Security Agenda (GHSA) has been implemented in 27 Sentinel hospitals distributed across 10 states of India including Karnataka, Kerala, Assam, Goa, Gujarat, Maharashtra, Jharkhand, Tripura, Tamil Nadu and Odisha in close coordination and collaboration with the respective state health services.

Manipal Centre for Virus Research also offers Master of Science in Clinical Virology program, which is a unique focused competency based flexible postgraduate course intended to create a new cadre of virologists and conducts series of training programs in the field of practice oriented virology, biosafety and biosecurity to strengthen the manpower. The centre also runs short courses and training programmes, thereby contributing in creating a stronger public health cadre.

Research at MCVR focuses on translational virology which aims at transforming the department into a centre of excellence in diagnosis and research. Research includes community based epidemiologic studies, molecular epidemiology and development of viral diagnostic kits and devices.

Ever since its inception, Manipal Centre for Virus Research (MCVR) has been a stalwart in its endeavors to contribute to better public health. In the year 2013, in a bid to further the same, MCVR collaborated with Centers for Disease Control and Prevention (CDC), Atlanta and respective State Health Departments, initiating the Hospital Based Acute Febrile Illness (AFI) Surveillance in India, under the Global Health Security Agenda (GHSA).



Using the AFI Surveillance platform, MCVR began to contribute to the disease surveillance in the country by providing case based real time surveillance data. Acute Febrile Illness (AFI) is caused by a variety of infectious agents, including viruses, bacteria, and parasites some of which are amenable to therapeutic and/or preventative interventions. Advances in laboratory diagnostics have greatly enhanced understanding of the infectious aetiologies of Acute Febrile Illness (AFI).

However, significant gaps remain in the knowledge and understanding of burden, etiologic spectrum, and risk factors associated with AFI happening in India. The project was launched with an objective of bridging this gap and generating evidence for public health action.

Implemented first in the district of Shimoga, Karnataka in June 2014, the project has grown enormously with over 33 Sentinel hospitals currently under its wing. With its presence in over ten states of India including Karnataka, Kerala, Assam, Goa, Gujarat, Maharashtra, Jharkhand, Tripura, Tamil Nadu and Odisha; MCVR, MAHE continues to maintain close coordination and collaboration with the respective state health services.

This study aims to characterize the infectious causes of Acute Febrile Illness (AFI) among patients in District / Sub-District Hospitals / PHCs in India. It focuses on identifying pathogens including parasite (limited to malaria), bacterial, viral and other unknown causes of AFI. Clinical samples are tested for unknown pathogens by using serology and modern molecular diagnostic assays and also by PCR-sequence based pathogen discovery techniques.

Apart from the project's innate ability to detect various pathogens, its systematic yet highly efficient logistic system is also its highlight. Clinical samples are transported to MCVR on a daily basis under cold chain system. The results are communicated within 48 hours to the treating doctor under intimation to the State and District Health officials. This eliminates wastage of time in the diagnosis chain assisting rapid detection thereby helping with faster recovery.

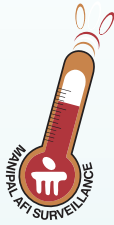
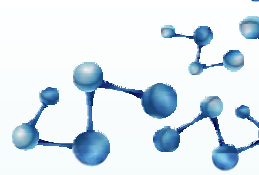
AFI surveillance project has recruited 27,586 cases until July 2017 and continues to generate valuable epidemiological data on infectious diseases in the country. This helps in taking evidence based public health action and generates evidence based health policy for the prevention and control of infectious diseases. It also aims to strengthen the public health laboratories by providing necessary equipment and protocols to enable onsite diagnosis of common diseases.

Further, it will help the public health infrastructure of the country in identifying emerging disease trends early which will, in turn, result in detection of outbreaks in the early stages and implementing effective control measures.

For more updates and latest developments, please engage with us

**@MCVRMU (twitter)**

**[www.thevirus.in](http://www.thevirus.in) (newsletter)**



## HOSPITAL BASED SURVEILLANCE OF ACUTE FEBRILE ILLNESS IN INDIA

Implemented first in the district of Shimoga, Karnataka in June 2014, the project has grown enormously with over 33 Sentinel hospitals currently under its wing. With its presence in over ten states of India including Karnataka, Kerala, Assam, Goa, Gujarat, Maharashtra, Jharkhand, Tripura, Tamil Nadu and Odisha.

This study aims to characterize the infectious causes of Acute Febrile Illness (AFI) among patients in District / Sub-District Hospitals / PHCs in India. It focuses on identifying pathogens including parasite (limited to malaria), bacterial, viral and other unknown causes of AFI.



### OBJECTIVE:

Determine the incidence and relative frequency of aetiologies of acute febrile illness (Influenza, Dengue, Chikungunya, Leptospirosis, Scrub typhus, Malaria, KFD, etc.) in children and adults admitted to selected hospitals in India.

**Duration of the Surveillance:** 5 years (2014-2019)

### Operational Case Definitions:

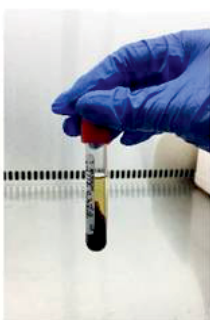
A case of Acute Febrile Illness is defined as, a sick case older than 5 years and younger than 65 years of age admitted to one of the participating hospitals with fever ( $\geq 38^{\circ}\text{C}$ ).

### Case recruitment and data collection

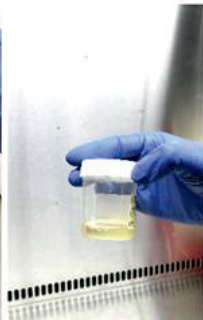
Eligible cases are identified with the help of the treating physician / paediatrician at the sentinel hospital and clinical history / clinical data will be obtained in a standard case report form by a study technician / nurse under supervision of the attending physician.

### Specimen Collection

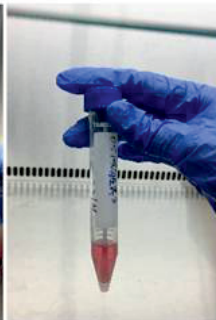
Various clinical samples including blood for serum, blood culture, urine, throat swab and stool sample (when required) and CSF (when collected by clinician as part of clinical management of the patient will be obtained to conduct various tests for the aetiology of AFI.



Blood for serum



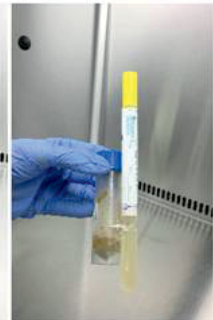
Urine



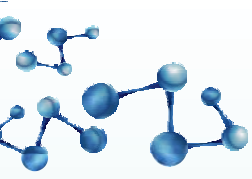
Throat swab in VTM



Blood culture



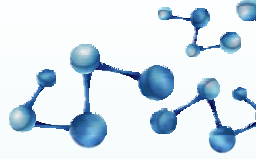
Stool



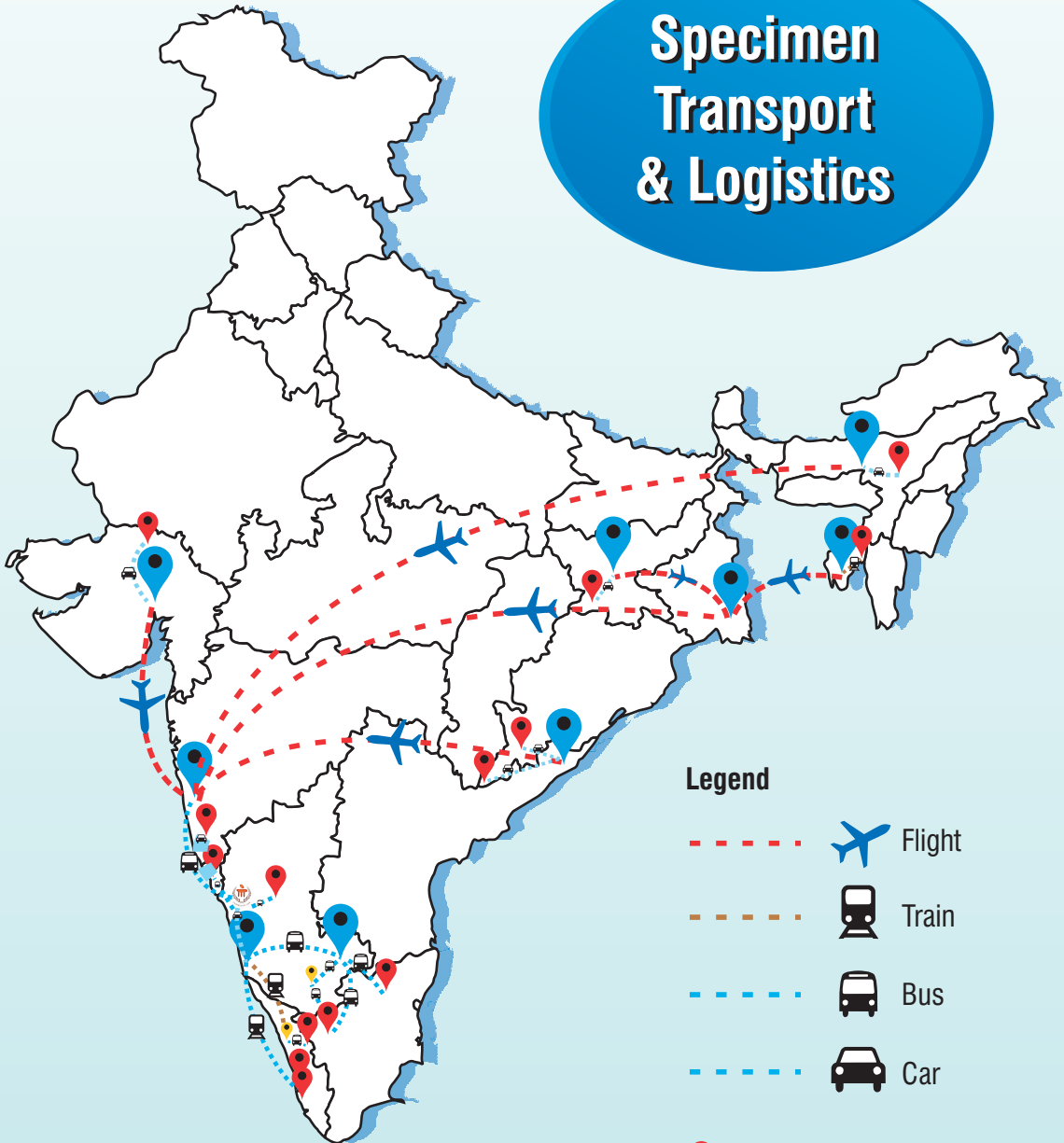
### Transport of samples

Samples from the sentinel sites are transported daily to the central laboratory at Manipal under cold chain. The transport process involves an integrated mode of road, rail and air routes. A dedicated logistic team works behind transporting, tracking and timely delivery of samples to the laboratory.





# Specimen Transport & Logistics

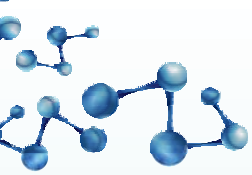


## Legend

- Flight
- Train
- Bus
- Car

- Major sentinel site
- Major Airport
- Major connecting cities

Map not to the scale  
Only for representation purpose

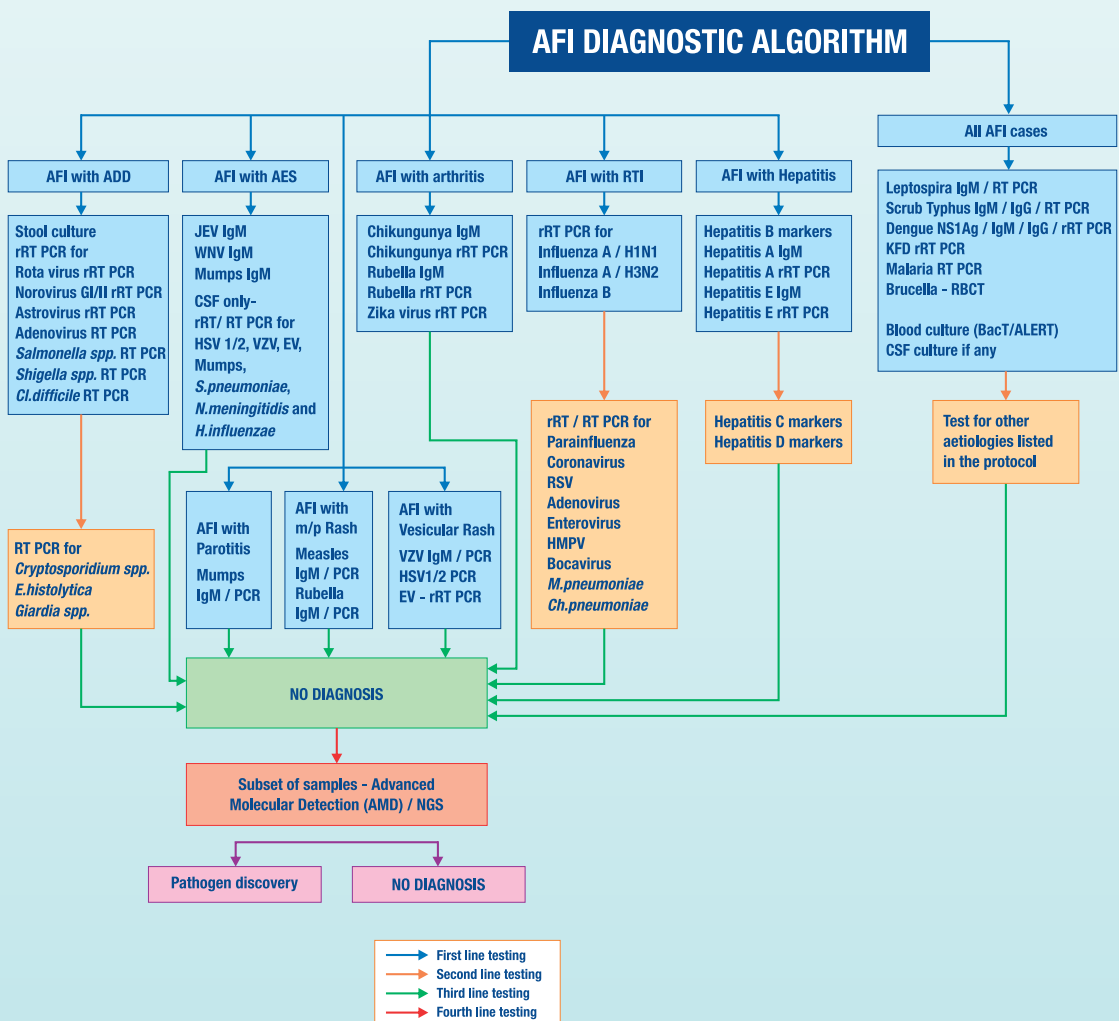


### Laboratory testing

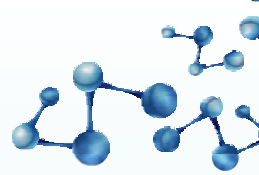
We use serology (ELISA), molecular diagnostic assays (Real Time PCR) and antigen detection assays for the laboratory diagnosis of AFI cases. Clinical samples may also be tested for unknown pathogens using PCR-sequence based pathogen discovery techniques.



The testing at MCVR involves an algorithm based on various syndromes of acute febrile illnesses.

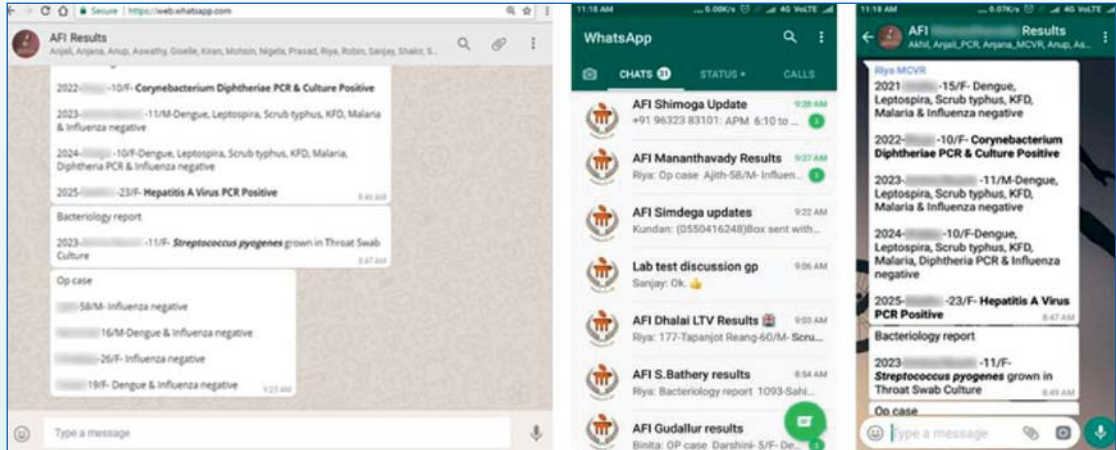






### Results communication

Results are communicated within 24 hours of sample processing to the concerned stakeholders. The treating physician gets an early report on Whatsapp, while an email with detailed patient information and epidemiologic information reaches the physician, district and state surveillance units by the next morning.

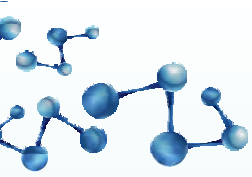


The emails has a line-list of the certified lab results of the day with details including the address, occupation and clinical symptoms.

<b>Manipal Centre For Virus Research, Manipal University, Manipal</b> Kamataka State, INDIA - 576104 , Tel: +91 820 2922718, virology@manipal.edu <b>MANIPAL AFI SURVEILLANCE LABORATORY REPORT</b> <span style="float: right;">Date: 09-06-2017</span>											
Line listing of cases tested at AFI Study Centre at District Hospital, Sonapur, Kamrup ( Metro) District of Assam											
SI No	Name of the BPHC	Name, Age & Sex	Address	Occupation	Clinical Symptoms.	Date of Onset	Hospitalization (Y/N)	Date of Hospitalization	Animal contact (Y/N)	Lab. test done	Outcome
5151938	DH Sonapur	Infu Begum, 19/F	[Redacted Address]	House-wife	Night sweats, Chills, Cough, Coryza, Headache	20-03-2017	Y	05-06-2017	Y	Dengue IgM ELISA, Leptospiira IgM ELISA, Scrub Typhus IgM ELISA, Coronavirus RT-PCR	Human Coronavirus OC43 PCR Positive
5151940	DH Sonapur	Sudip Kumar, 15/M	[Redacted Address]	Student	Headache, General weakness,	30-05-2017	Y	05-06-2017	Y	Dengue IgM ELISA, Leptospiira IgM ELISA, Scrub Typhus IgM ELISA	Leptospiira IgM Positive
5151942	DH Sonapur	Saba Bhowmik, 24/F	[Redacted Address]	House-wife	Night sweats, Chills, Headache, Retro orbital pain, Myalgia	19-03-2017	Y	06-06-2017	Y	Dengue IgM ELISA, Leptospiira IgM ELISA, Scrub Typhus IgM ELISA	Negative

\*Note: NEGATIVE results may not rule out infection

Dr. J. Ananthakumar  
Professor & Head  
Manipal Centre for Virus Research  
Manipal University  
Manipal - 576104



### Data Management

The data collected from the patients is entered on to an online database, which is maintained on MCVR servers. The data is regularly, checked, cleaned and prepared for analysis. A mobile based application is also being piloted to make data entry paper free



**MANIPAL UNIVERSITY** Hospital Based Surveillance of Acute Febrile Illness ( AFI ) in India Logout

Update Patient   Manage Report   Diagnosis Entry   Change Password   Export   Upload   Search   Dashboard   Deactivate Patient   Diagnosis Dashboard

**Patient Information**

Search for an existing patient   Study Id :

FORM Number: *	<input type="text"/>	Select Site: *	--Select--	Study ID: *	<input type="text"/>
Date of Recruitment: *	30/10/2017 dd/mm/yyyy	First Name: *	<input type="text"/>	Last Name:	<input type="text"/>
C/o:	<input type="text"/>	Contact No 1:	<input type="text"/>	Contact No 2:	<input type="text"/>
Address: *	<input type="text"/>	IP No:	<input type="text"/>	OP No:	<input type="text"/>
Aadhar Card No:	<input type="text"/>				

State: *	--Select--	District: *	--Select--	Taluka: *	--Select--
Tehsil:	<input type="text"/>	Pin Code:	<input type="text"/>	Post Office:	<input type="text"/>
Gram Panchayat:	<input type="text"/>	Village:	<input type="text"/>	Landmark:	<input type="text"/>
Age: *	<input type="text"/>	DOB:	dd/mm/yyyy	Gender: *	<input type="radio"/> Male <input type="radio"/> Female <input type="radio"/> Other
Marital Status: *	<input type="radio"/> Single <input type="radio"/> Married	If Married Female, Currently pregnant	<input type="radio"/> Yes <input type="radio"/> No	If Yes, Weeks	<input type="text"/>
Major Occupation: *	--Select--	Secondary Occupation1:	--Select--	Secondary Occupation2:	--Select--
Secondary occupation3:	--Select--	Other Occupation:	<input type="text"/>		

### Data sharing

The AFI data generated is shared with various stakeholders in a real time manner on daily and weekly basis.

### Daily data sharing

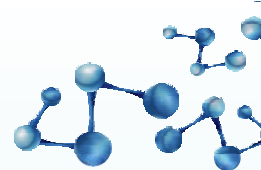
- Treating physicians
- District Medical Office/ District Health Office
- District Vector Borne Disease Control Office
- State Surveillance Unit
- State Vector Borne Disease Control Office
- Central Surveillance Unit

### Weekly data sharing (Monday)

- IDSP-NCDC
- ICMR
- NVBDCP
- DGHS
- Central Surveillance Unit
- GHSA Cell

### Weekly data sharing (Thursday)

- IDSP-NCDC
- Central Surveillance Unit
- State Surveillance Unit

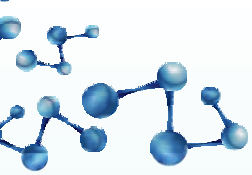


## Diagnostic and Research Laboratory Facilities

Manipal Centre for Virus Research is a BSL-2+ laboratory for research and diagnostics with primary focus on public health virology. The laboratory caters to real time laboratory supported surveillance needs of the region with a capacity to detect 100+ pathogens including bacteria, viruses and parasites with a turnaround time of 24 hours.

Given below is a table of the pathogens that can be detected at MCVR.

Viruses	Bacteria	Parasites
Adenovirus	Acinetobacter baumannii complex	Leishmania spp.
Chandipura virus	Aeromonas spp.	Plasmodium spp.
Chikungunya virus	Bacillus anthracis	Entamoeba histolytica
Crimean Congo Hemorrhagic Fever virus	Bordetella pertussis	Cryptosporidium spp.
Cytomegalovirus	Borrelia spp.	Giardia lamblia
Dengue virus	Brucella abortus	
Ebola Virus	Brucella melitensis	
Ebstein Barr Virus	Burkholderia cepacia	
Enteroviruses	Burkholderia pseudomallei	
Hantaviruses	Campylobacter spp.	
Hepatitis A virus	Chlamydia pneumoniae	
Hepatitis B virus	Chlamydia trachomatis	
Hepatitis C virus	Clostridium difficile	
Hepatitis D virus	Corynebacterium diphtheriae	
Hepatitis E virus	Coxiella burnetii	
Herpes Simplex Virus-1, 2	E. coli(EHEC,VTEC,EIEC,Escherichia coli O157)	
Human Astrovirus	Francisella tularensis	
Human Bocavirus	Group B Streptococcus	
Human Coronaviruses (NL63, OC43, 229E, HKU1)	Haemophilus influenzae	
Human Herpes Virus 6,7	Klebsiella pneumoniae	
Human Metapneumovirus	Legionella pneumoniae	
Human Papilloma Virus	Leptospira spp	
Influenza Virus A & B	Listeria monocytogenes	
Japanese Encephalitis Virus	Mycoplasma pneumoniae	
Kyasanur Forest Disease (KFD) Virus	Neisseria gonorrhoeae	
Measles Virus	Neisseria meningitidis	
MERS Corona Virus	Orientia tsutsugamushi	
Mumps Virus	Pseudomonas aeruginosa	
Nipah virus	Rickettsia rickettsii	
Norovirus G1 & G2	Rickettsia typhi	
Parainfluenza viruses 1,2,3,4	Salmonella enteritidis	
Parecho virus	Salmonella paratyphi A	
Parvo virus B19	Salmonella typhi	
Rabies Virus	Salmonella typhimurium	
Respiratory Syncytial Virus types A & B	Shigella boydii	
Rhino virus (pan)	Shigella dysenteriae	
Rift Valley Fever Virus	Shigella flexneri	
Rotavirus	Shigella sonnei	
Rubella Virus	Staphylococcus aureus	
Sapovirus	Streptococcus pneumoniae	
Varicella Zoster Virus	Streptococcus pyogenes	
West Nile Virus	Vibrio cholerae	
Zika Virus	Yersinia pestis	



The centre has classical, advanced as well as state of the art infectious disease diagnostic facilities including serology, molecular diagnostics as well as advanced molecular diagnostics.

### Serology

1. ELISA
2. Agglutination tests
3. Immunofluorescence Assay
4. Hemagglutination Assay and Hemagglutination Inhibition Assay
5. Plaque Reduction Neutralization Assay (PRNT)



Fig 1. ELISA reader

### Molecular Diagnostics

1. Conventional PCR
2. Real Time PCR
3. Multiplex PCR

### Pathogen discovery and tracking

- Next Generation Sequencing (NGS)
- Whole Genome Sequencing (WGS)
- Multiplex serology (Luminex)
- TaqMan Array



Fig. Real Time PCR machine

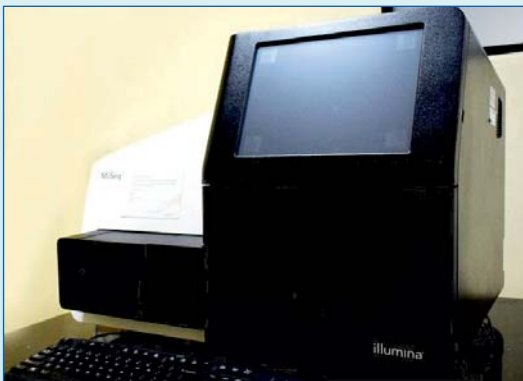


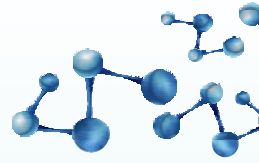
Fig. NGS platform (MiSeqDx Illumina)



Fig. Luminex platform



Fig. TaqMan Array Card



## Quality Assurance

MCVR has strong measures in place to ensure quality in its laboratory testing and other related procedures and protocols. Apart from Internal Quality Assurance (IQA) activities, MCVR is also a participant in various national and international External Quality Assurance (EQA) programs including:

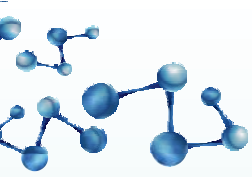
- Royal College of Pathologists of Australasia Quality Assurance Programs (RCPAQAP) – Australia
- College of American Pathologists (CAP) – USA
- Christian Medical College, Vellore (CMC) – India

MCVR also has inter laboratory proficiency testing with following national and international institutes of repute:

- National Institute of Virology (NIV), Pune
- National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore
- Centers for Disease Control and Prevention Atlanta (CDC), USA

EVALUATION ORIGINAL		ID2-B 2017 NAA, Respiratory		
Test Method	Specimen	Your Result	Intended Response	Your Grade
Influenza FAST-TRACK DIAG.	ID2-07	POSITIVE	POSITIVE	Good
Parainfluenza virus FAST-TRACK DIAG.	ID2-08	POSITIVE	POSITIVE	Good
Parainfluenza Subtype	ID2-08	TYPE 3		[26]
Respiratory syncytial FAST-TRACK DIAG.	ID2-09	POSITIVE	POSITIVE	Good
Adenovirus FAST-TRACK DIAG.	ID2-10	NEGATIVE	NEGATIVE	Good
Human metapneumovirus FAST-TRACK DIAG.	ID2-11	POSITIVE	POSITIVE	Good
Rhinovirus FAST-TRACK DIAG.	ID2-12	POSITIVE		[26]

Fig. Screenshot from CAP EQA report



## Key Findings

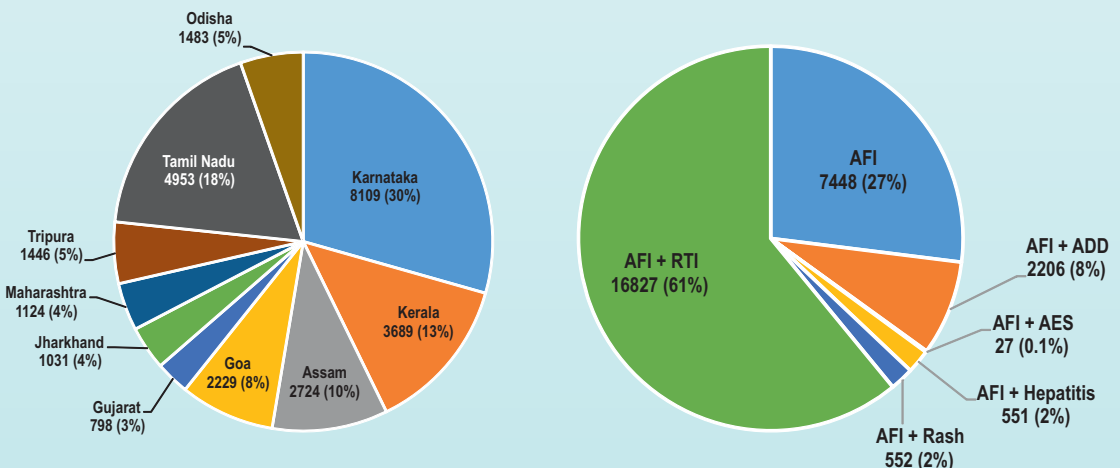
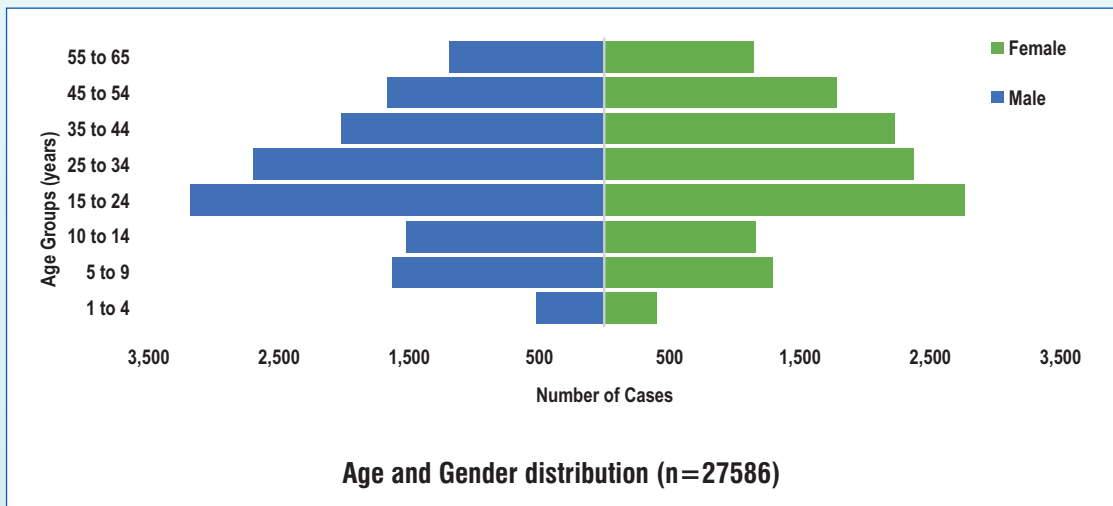
AFI surveillance project has recruited 27,586 cases until July 2017 and continues to generate valuable epidemiological data on infectious diseases in the country. The preliminary data provides great insights to the incidence of infectious disease in various parts of the country.

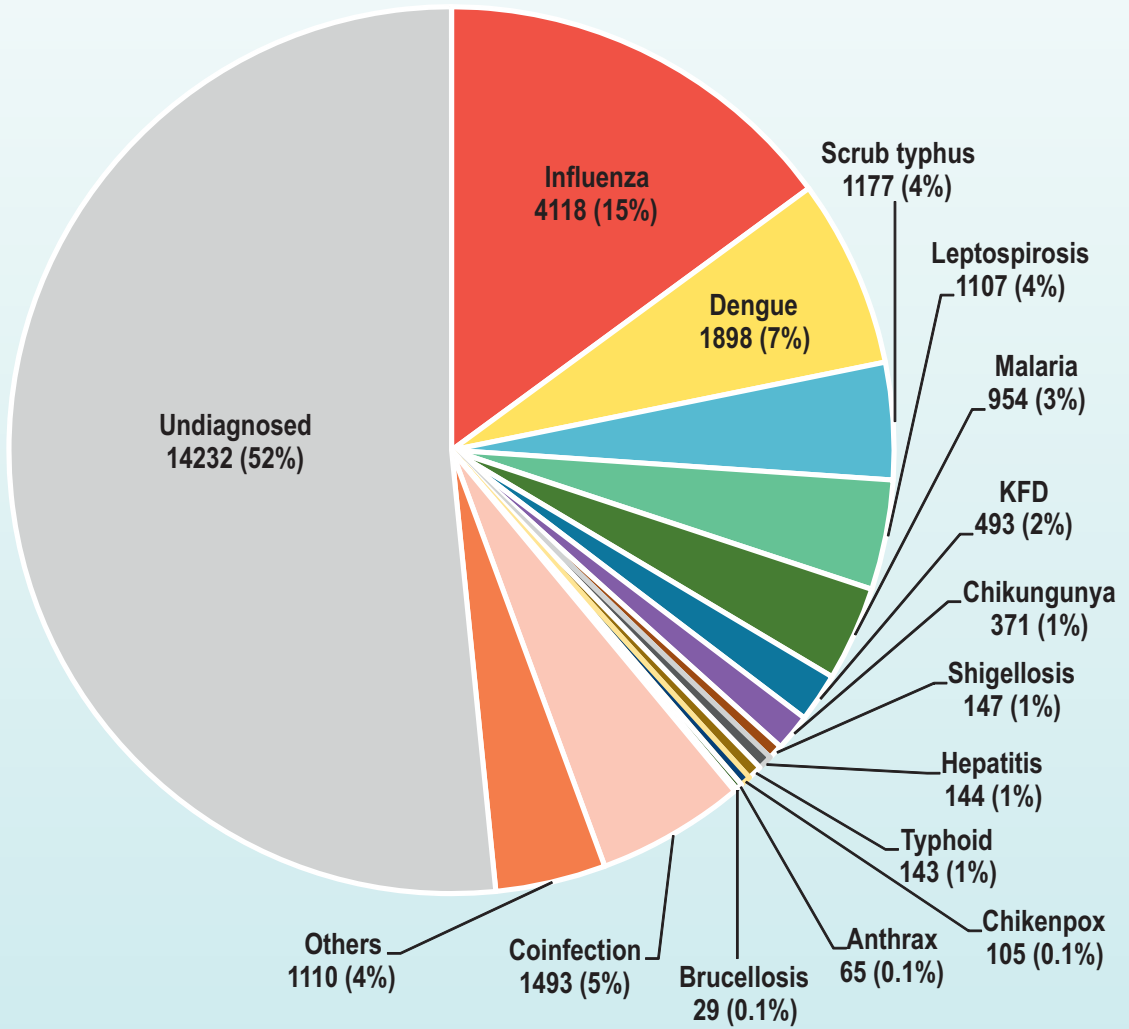
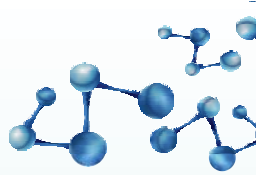
### Total number of cases recruited: 27586

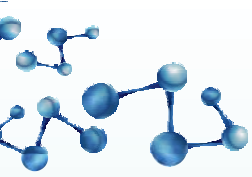
Median age (range) : 27 (1-65) years

Male (n %) : 14415 (52%)

### Demographic details of AFI cases recruited from Jun 2014 - July 2017 (n=27586)

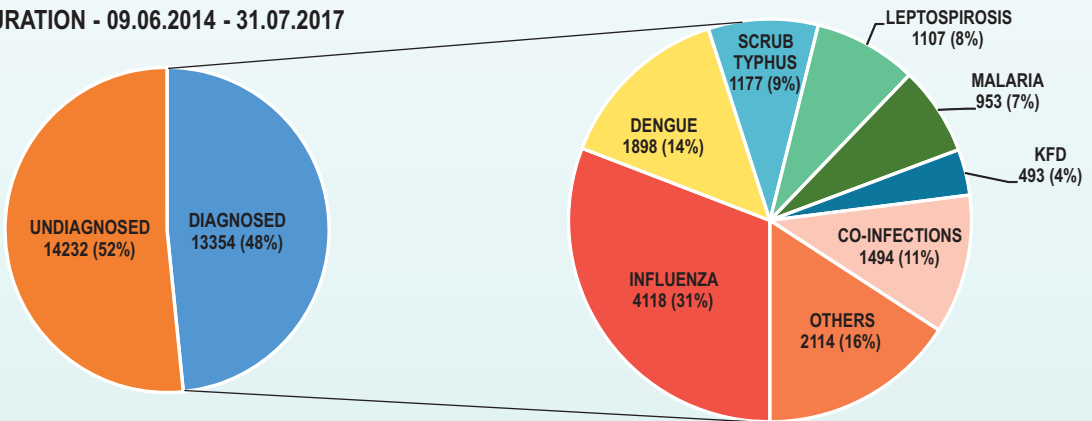




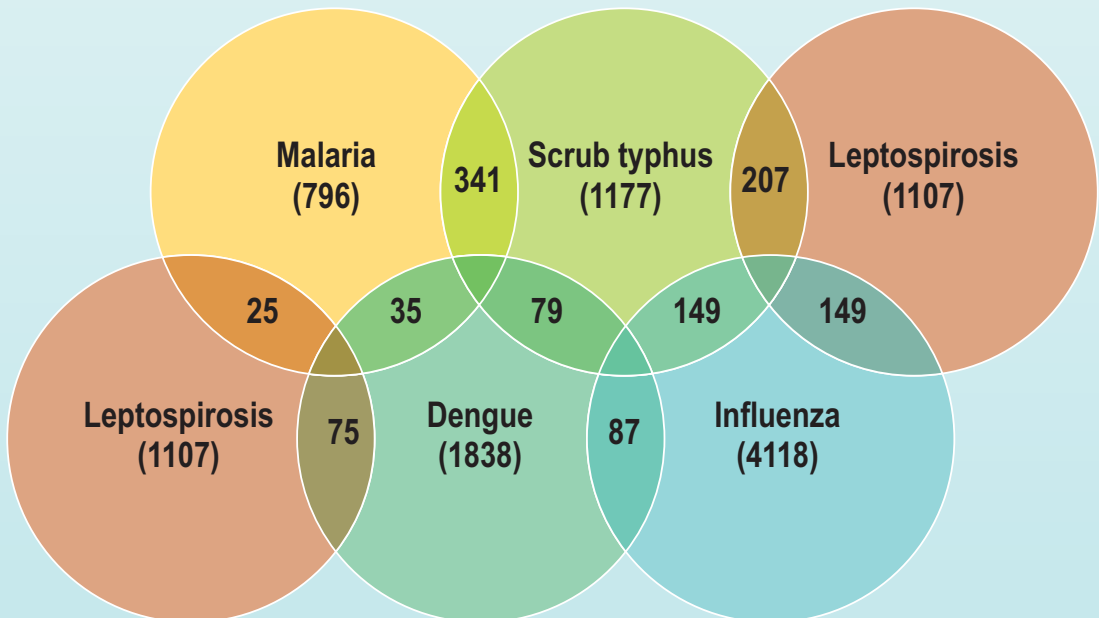


## Major 6 pathogens

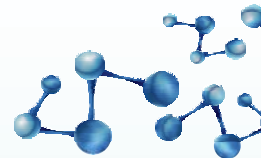
OVERALL AFI ETIOLOGY  
TOTAL CASES RECRUITED = 27586  
DURATION - 09.06.2014 - 31.07.2017



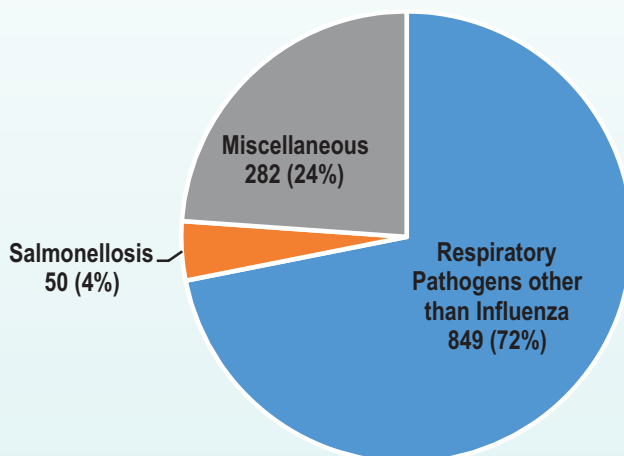
## Coinfections in Acute Febrile Illness





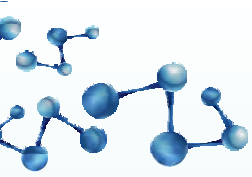


### Other Etiologies



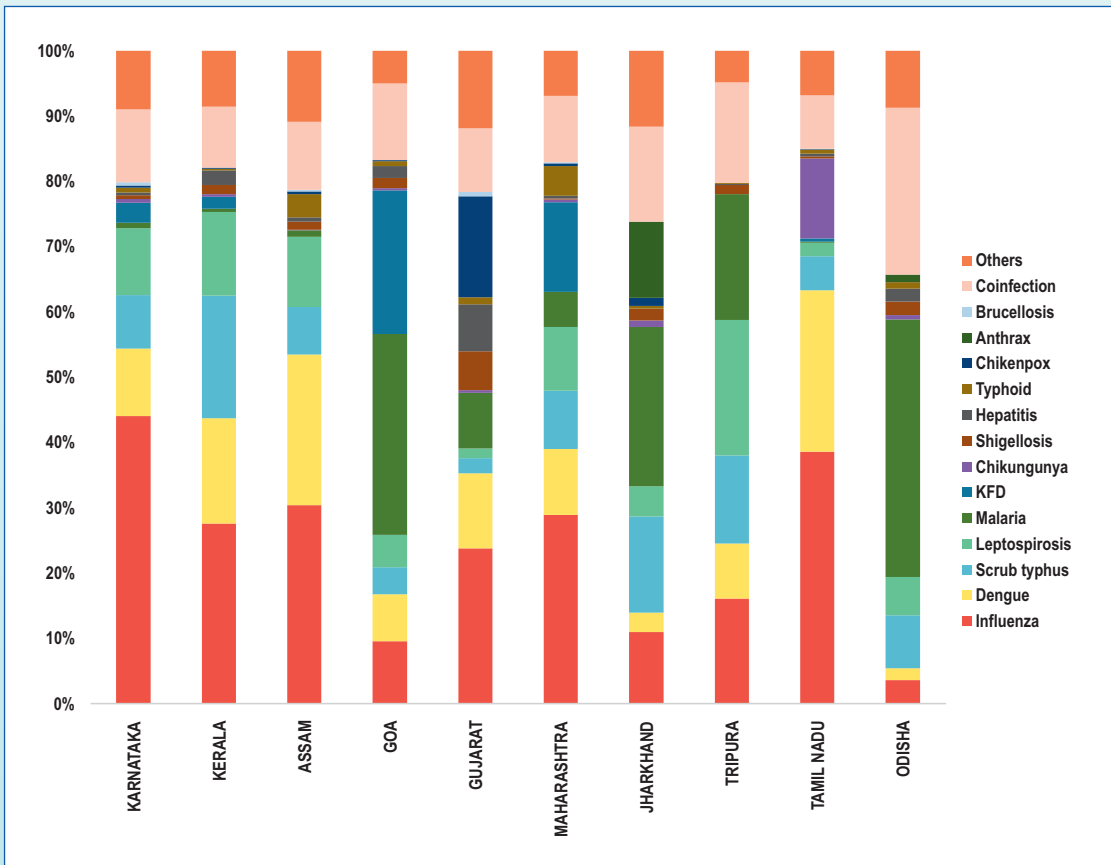
Other etiology	N(%)
Rhinovirus	179(1.3%)
Adenovirus	142(1.1%)
Coronavirus	124(0.9%)
Parainfluenza	117(0.9%)
Enterovirus	99(0.7%)
Varicella Zoster Virus	90(0.7%)
Measles	79(0.6%)
Hepatitis A virus	76(0.6%)
Mumps	73(0.5%)
RSV A/B	61(0.5%)
Shigella Flexioneri	52(0.4%)
Human metapneumovirus	51(0.4%)
Salmonella typhimurium	44(0.3%)
Shigella	44(0.3%)
Salmonella paratyphi	43(0.3%)
Staphylococcus pyogens	43(0.3%)
Rotavirus	36(0.3%)
Hepatitis B virus	28(0.2%)
Shigella sonnei	24(0.2%)

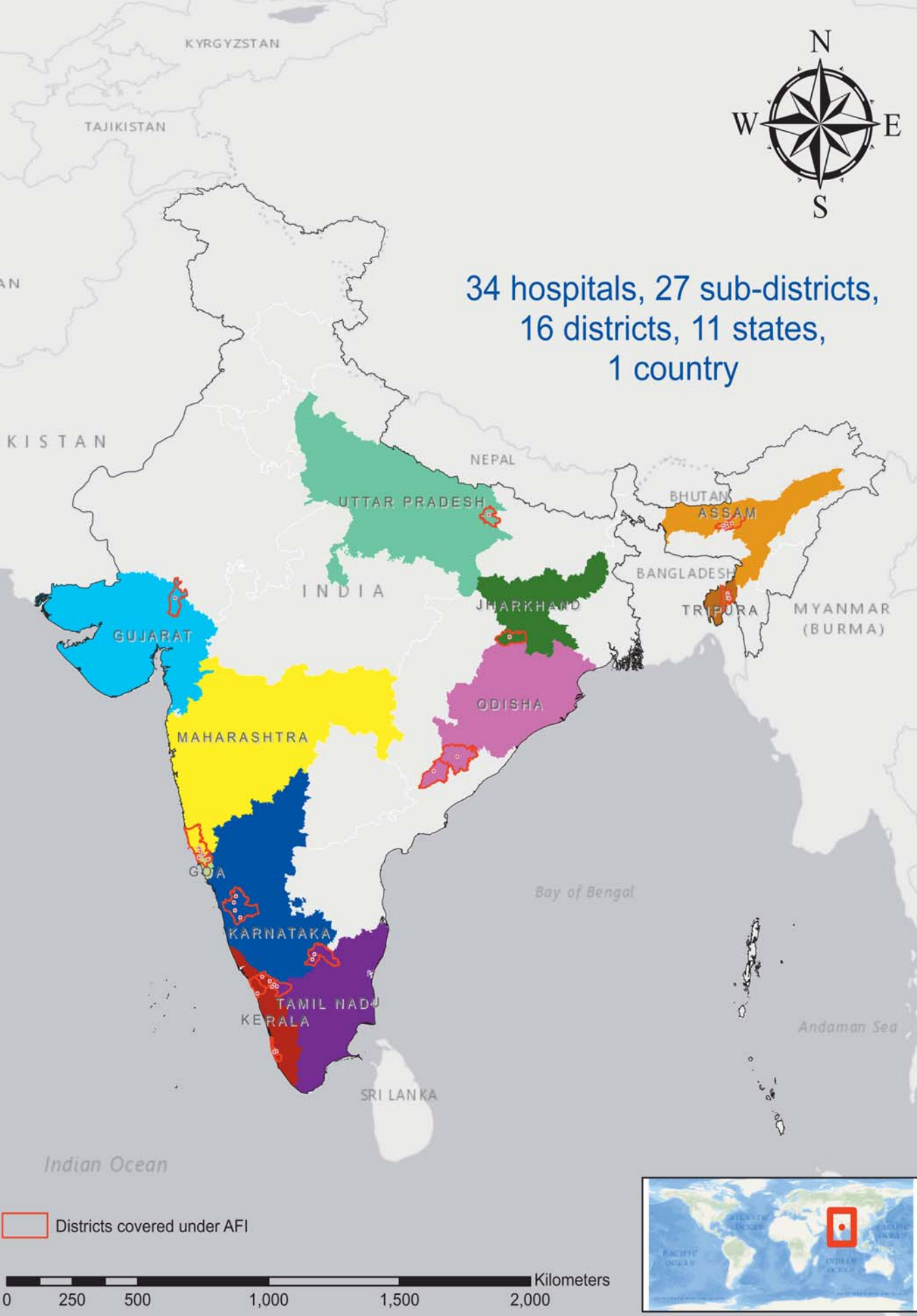
Other etiology	N(%)
Norovirus G2	22(0.2%)
Hepatitis E virus	19(0.1%)
Rubella	18(0.1%)
Staphylococcus aureus	15(0.1%)
Mycoplasma pneumoniae	14(0.1%)
Norovirus G1	14(0.1%)
HSV-1	12(0.1%)
Corynebacteriumdiphtheriae	11(0.1%)
E Coli 0157	8(0.1%)
Salmonella enteritidis	6(0.0%)
Astrovirus	4(0.0%)
S. pneumoniae	4(0.0%)
Human Bocavirus	3(0.0%)
Shigellaboydii	2(0.0%)
Parechovirus	1(0.0%)
Shigelladysenteriae	1(0.0%)
Vibrio Cholerae	1(0.0%)
Grand Total	1560(11.7%)



### Statewise Etiologies

Location (Date of Initiation)	Cases Recruited	Diagnosed	Undiagnosed	Diagnosed Percentage
Karnataka (June 2014)	8109	3835	4274	47.3 %
Kerala (Jan 2015)	3689	1751	1938	47.5 %
Assam (Oct 2015)	2724	1329	1395	48.8 %
Goa (Dec 2015)	2229	1186	1043	53.2 %
Gujarat (March 2016)	798	471	327	59.0 %
Jharkhand (May 2016)	1031	496	535	48.1 %
Maharashtra (April 2016)	1124	503	621	44.8 %
Tripura (June 2016)	1446	572	874	39.6 %
Tamil Nadu (July 2016)	4953	2616	2337	52.8 %
Odisha (Sept 2016)	1483	595	888	40.1 %
<b>TOTAL</b>	<b>27586</b>	<b>13354</b>	<b>14232</b>	<b>48.4 %</b>





34 hospitals, 27 sub-districts,  
16 districts, 11 states,  
1 country

 Districts covered under AFI

0 250 500 1,000 1,500 2,000 Kilometers



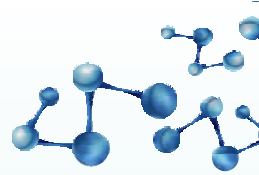
# ASSAM



Assam is a state in northeastern India known for its wildlife, archaeological sites and tea plantations. Agriculture is the primary occupation of most of the people. The symbiotic relationship with the forest is evident in the region. The culture of the local people has evolved due to the cultural assimilation of different ethnocultural groups. The AFI Surveillance has five sentinel hospitals across two districts including Kamrup Metro (M) and Morigaon.

## Kamrup Metro

The AFI Surveillance covers four sentinel sites in Kamrup(M) district of Assam. The population of Kamrup(M) is 1,253,938. Recruitment of cases from District Hospital Sonapur commenced on 28 October 2015. This hospital caters a large population of patients from two adjacent districts. Recruitment of cases from Panikhaiti Mini PHC started on 22 February 2016; while recruitment from the Urban State Dispensary Satgaon began on 15 March 2016. Tamulkuchi State Dispensary, located in the state border of Meghalaya and Assam, is the fourth sentinel hospital from where recruitment started on 17 June 2016.

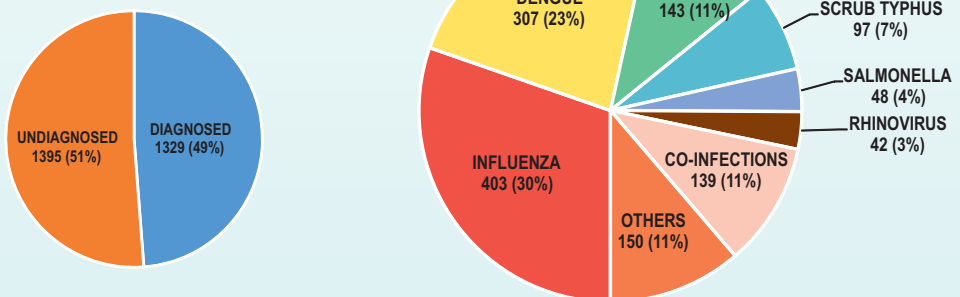


## Morigaon District

Jhargaon Block PHC, located in Morigaon district, is the fifth sentinel hospital in Assam. The population of Morigaon is 957,423. The recruitment of cases in this 10 bedded Block Public Health Centre started on 18th June 2016.

A total of 2724 cases were recruited from Assam as of 31 July 2017; out of which, 1329 (49%) cases could be provided with a definitive diagnosis. Major etiologies included Influenza 403 (30%), Dengue 307 (23%), Leptospirosis 143 (11%), Scrub Typhus 97 (7%), Salmonella 48 (4%) and Rhinovirus 42 (3%). Co-infections with more than one pathogen account for 139 (10%) cases.

**AFI ETIOLOGY, ASSAM**  
TOTAL CASES RECRUITED = 2724  
DURATION - 28.10.2015 - 31.07.2017



## DH Sonapur

As of 31 July 2017, the site has recruited 2202 cases of acute febrile illness, of which 1085 (49%) were having positive results for different aetiologies. Major etiologies included Influenza 314 (29%), Dengue 276 (25%), Leptospirosis 114 (11%), Scrub Typhus 65 (6%), Salmonella 39 (4%) and Rhinovirus 31 (3%). Co-infection accounted for 118 (11%) cases.

## PHC Panikhaiti

As of 31 July 2017, the site has recruited 77 cases of acute febrile illness, of which 32 (42%) were having positive results for different aetiologies. Major etiologies included Influenza 7 (22%), Rhinovirus 5 (16%), Dengue 4 (13%), Scrub Typhus 4 (13%), Leptospirosis 3 (9%) and Salmonella 3 (9%). Co-infection accounted for 2 (6%) cases.

## USD Satgaon

As of 31 July 2017, the site has recruited 90 cases of acute febrile illness, of which 37 (41%) were having positive results for different aetiologies. Major

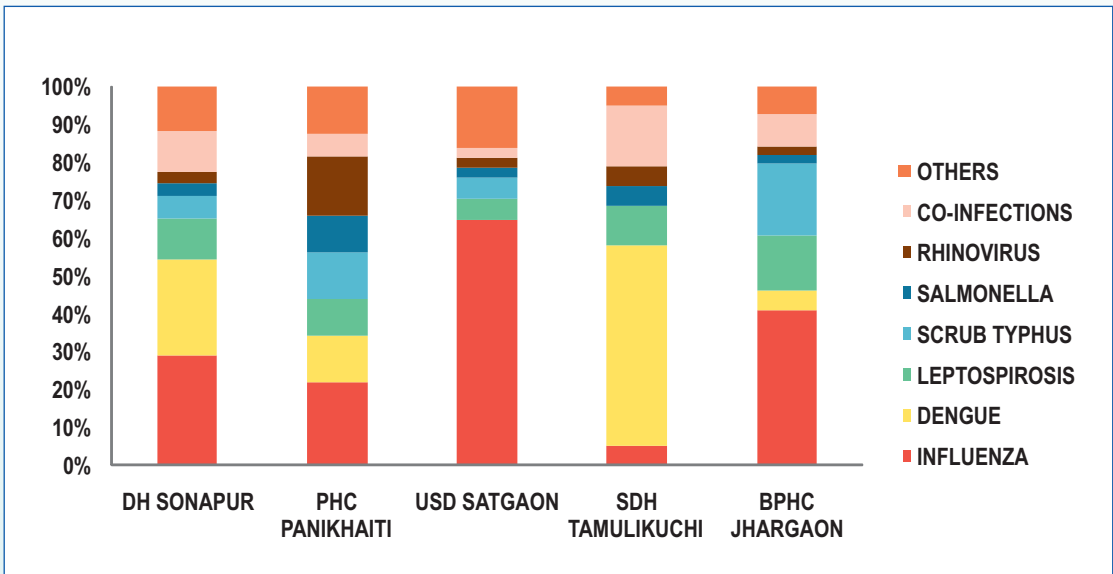
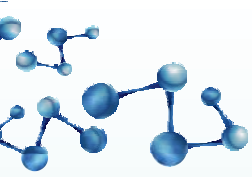
etiologies included Influenza 24 (65%), Leptospirosis 2 (5%), Scrub Typhus 2 (5%), Salmonella 1 (3%) and Rhinovirus 1 (3%). Co-infection accounted for 1 (3%) case.

## SDH Tamulikuchi

As of 31 July 2017, the site has recruited 56 cases of acute febrile illness, of which 38 (68%) were having positive results for different aetiologies. Major etiologies included Dengue 20 (53%), Leptospirosis 4 (11%), Influenza 2 (5%), Salmonella 2 (5%) and Rhinovirus 2 (5%). Co-infection accounted for 6 (16%) cases.

## BPHC Jhargaon

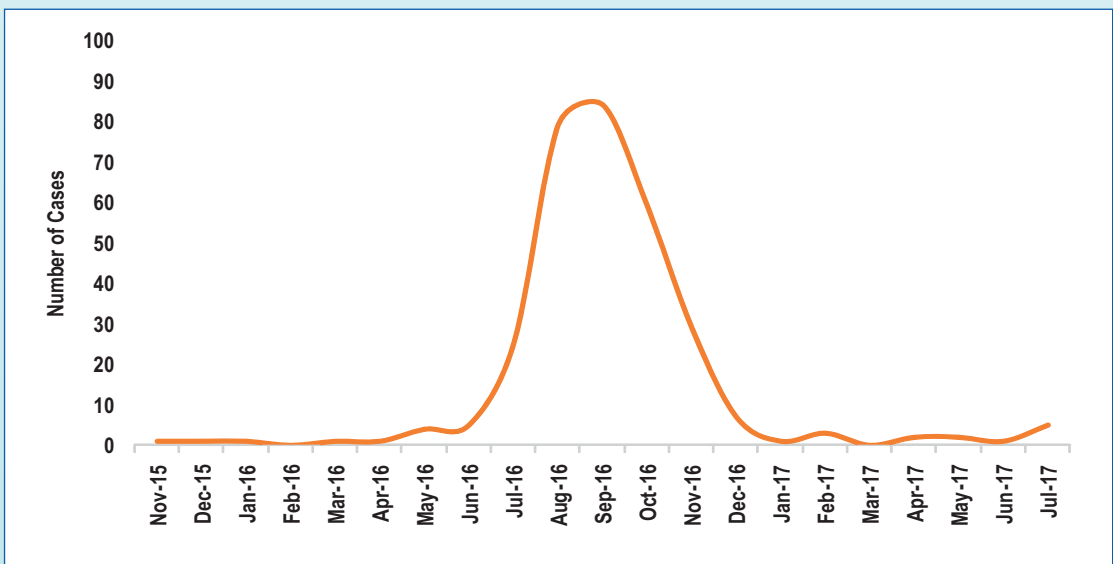
As of 31 July 2017, the site has recruited 299 cases of acute febrile illness, of which 137 (46%) were having positive results for different aetiologies. Major etiologies included Influenza 56 (41%), Scrub Typhus 26 (19%), Leptospirosis 20 (15%), Dengue 7 (5%), Salmonella 3 (2%) and Rhinovirus 3 (2%). Co-infection accounted for 12 (9%) cases.



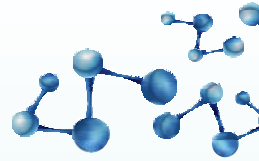
Distribution of Lab Confirmed AFI etiologies in Assam

**DENGUE:**

Dengue is a mosquito-borne viral infection of global public health concern. The disease is widely distributed in almost all states/UTs in India. The northeastern (NE) region is also a vulnerable spot for carrying dengue virus infection. Aedes mosquitoes, which are the vectors of dengue, are widely prevalent in the area. Out of the eight NE states, Assam shares significant numbers of dengue cases in every year. Dengue cases were not reported in the State till 2009. During 2010 dengue emerged in an epidemic form in Assam and 237 cases reported with two death as per the annual reports of NVBDCP. A total of 341 laboratory confirmed dengue cases were reported by Manipal Centre for Virus Research, during October 2015 to July 2017 from the four sentinel hospital of Assam.

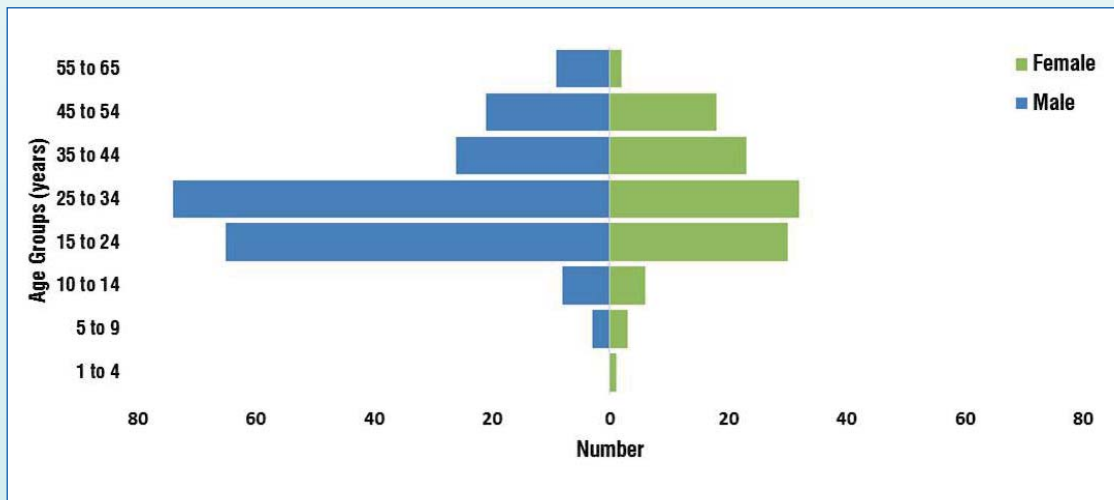


Trend of Dengue in Kamrup (M) district of Assam

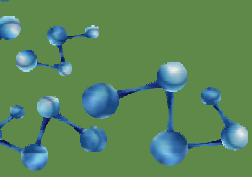


Out of the 341 positive cases, 307 cases are reported from District Hospital Sonapur, 21 cases from Tamulikuchi State Dispensary, 4 cases from Panikhaiti PHC and 9 cases from Jhargaon Block PHC. Majority of cases are reported from Kamrup(M) district during the post-monsoon months in September to December. However, dengue cases are observed from March onwards, and it followed year-round cycle. The district also shares a long interstate boundary with Meghalaya. Hence, the dengue virus infection is more amongst the inhabitant of border areas, and thus there may be every possibility of spreading the dengue virus infection in the entire district. The number of dengue cases increases from the month of August and reached peak during October to November in every year. Out of the 307 positive dengue

cases reported from District Hospital Sonapur, most are from the villages around the NH37 area which divides Assam and Meghalaya. The most affected villages are from Amerigog Panchayat of Sonapur Block in Kamrup(M). Fever was the most common clinical feature in almost all cases. The other most common presenting features were headache, retro-orbital pain, rash and myalgia. A total of 50.44% (172/341) cases having dengue infection belonged to 21–35 years of age groups followed by 26.39% belonging to 36–50 age group and 20.23% to 13–20 years age group.



**Age and Gender distribution of Dengue in Kamrup (M) district of Assam**



# GOA

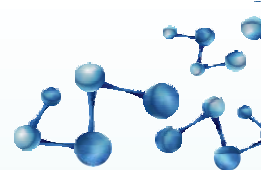


Goa state is located in the coastal region of Western part of India. It is bounded by Maharashtra to the north and Karnataka to the east and south, with the Arabian Sea forming its Western coast. It is India's smallest state by area and the fourth smallest by population. A large number of international and domestic tourists visit Goa each year for its beaches, temples, churches and world heritage architecture. Goa, being in the tropical zone and near the Arabian Sea, has a hot and humid climate for most of the year. The month of May is usually the hottest and the monsoon rains arrive by early June which lasts until late September. The Western Ghats with its rich flora and fauna, form most of eastern Goa, which has been internationally recognised as one of the biodiversity hotspots of the world.

North Goa is one among the two districts of Goa covering the entire northern part of Goa state. The district has an area of 1736 km<sup>2</sup> and is bounded by Sindhudurg district of Maharashtra state to the north and by Belgaum district of Karnataka to the east, by South Goa District to the south, and by the Arabian Sea to the west. The district is divided into three subdivisions – Panjim, Mapusa and Bicholim. The district has five taluks namely Tiswadi (Panjim), Bardez (Mapusa), Pernem, Bicholim and Sattari (Valpoi). The total population of North Goa district is 818008 and comprises of 194 villages. Sattaritaluka has the highest number of villages (77).

The AFI Surveillance has two sentinel sites in Goa, namely Community Health Centre, Valpoi and District

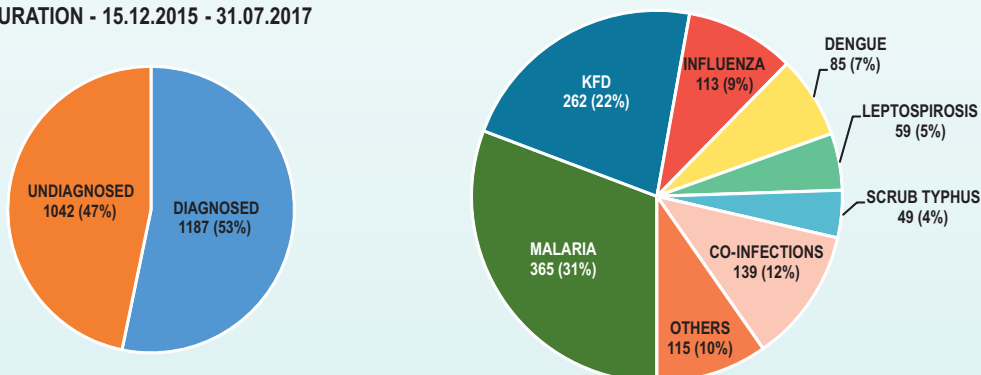




Hospital, Mapusa. A total of 2229 cases were recruited from these as of 31 July, 2017; out of which, 1187 (53%) cases could be provided with a definitive diagnosis.

Malaria 309 (26%) and KFD 262 (22%) are the major etiologies reported from Goa sites. Influenza 113 (10%), Dengue 85 (7%), Leptospirosis 59 (5%) and Scrub Typhus 49 (4%) are the other major diseases reported from Goa. Co-infections with more than one pathogen account for 195 (16%) cases.

**AFI ETIOLOGY, GOA**  
TOTAL CASES RECRUITED = 2229  
DURATION - 15.12.2015 - 31.07.2017



### Community Health Centre, Valpoi

Community Health Centre (CHC), Valpoi located in the Sattaritaluka of North Goa district was the first sentinel site for AFI Surveillance in Goa. Case enrollment at CHC Valpoi was started on 15th December 2015.

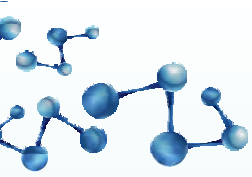
The Western Ghats form the eastern part of Sattaritaluka with most of the villages situated in proximity to the dense forests and Mhadei wildlife sanctuary. Most of the population visiting the CHC Valpoi are from the surrounding villages of Sattaritaluka and Valpoi town. Majority of the population live in close proximity to the forest. Major occupation involves cashew plantations, distributed along the periphery of the forest.

As of 31 July, 2017 the site has recruited 1110 cases of acute febrile illness, of which 534 (48%) were having positive results for different aetiologies. The major aetiologies reported were KFD 223 (42%), Influenza 79 (15%), Malaria 35 (7%), Scrub typhus 35 (7%), Dengue 27 (5%) and Leptospirosis 18 (3%). Co-infections accounted for 61 (11%). Other aetiologies include Adenovirus, Chikungunya,

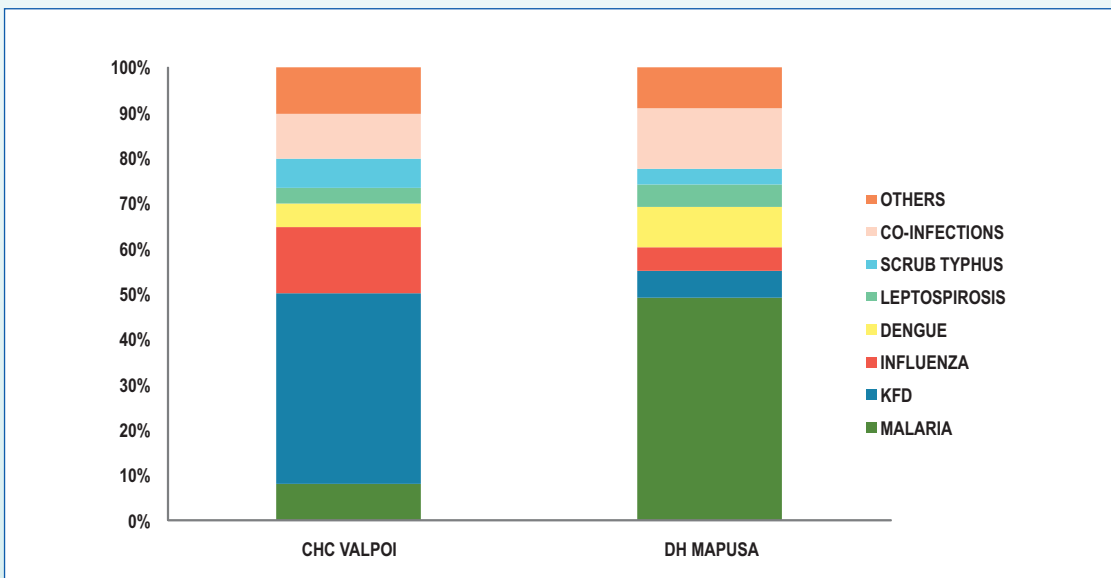
Coronavirus, Enterovirus, HSV-1, Human metapneumovirus, Norovirus G1, G2, Parainfluenza 1 & 3, Rhinovirus, Rotavirus, RSV, Salmonella species, Shigella species, Staphylococcus aureus. Major outbreaks of KFD and Shigellosis were detected in Sattaritaluka through the continuous vigilance of the AFI site in Valpoi CHC.

### District Hospital, Mapusa

District Hospital (DH), Mapusa is the second AFI sentinel surveillance site in Goa. The hospital, better known as Azilo Hospital is situated at Mapusa which is a subdivision of North Goa district. The site serves the population of Bardez and Pernem taluks and urban population of Mapusa. Migrants from different states like Bihar, UP, Orissa, Jharkhand, Maharashtra and Karnataka who work as manual labourers visit Mapusa. Approximately 40% of the cases visiting Mapusa site are migrants. It is the first referral unit for all the PHCs of the surrounding taluks. Many cases are also referred from the PHCs of Dodamarg taluk of Sindhudurg district of Maharashtra.



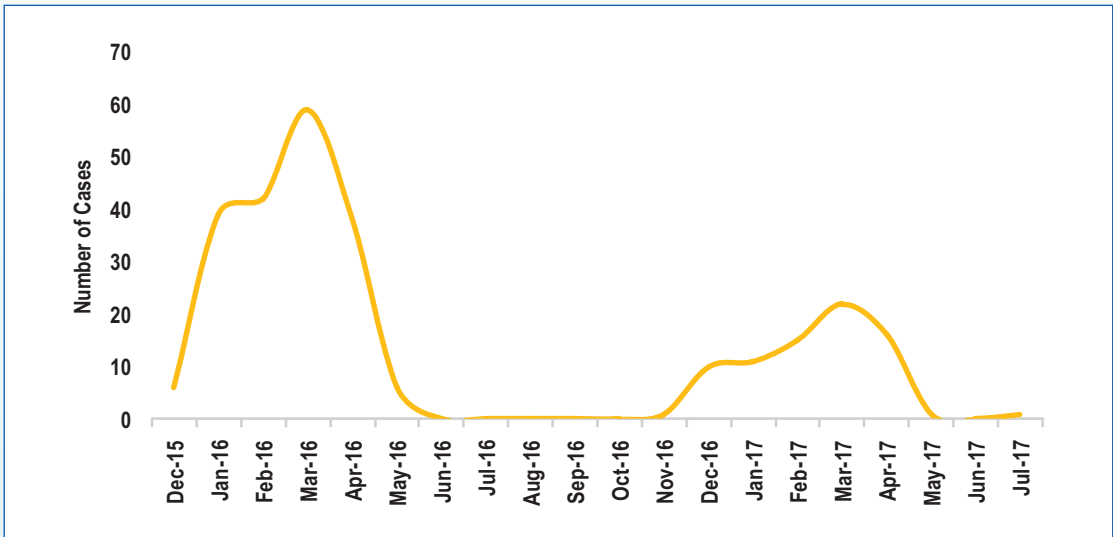
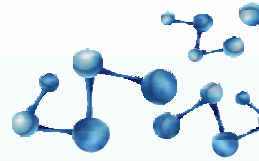
The AFI sentinel site was started on 18 December, 2015. We have recruited 1119 AFI cases until 31 July, 2017 out of which 653 cases were positive for different aetiologies. The site's case positivity rate of 58% has been consistent throughout this period. The major aetiologies reported were Malaria 274 (42 %), Dengue 58 (9%), Kyasanur Forest Disease 39 (6%), Influenza 34 (5%), Leptospirosis 31 (5%) and Scrub typhus 24 (4%). Co-infections accounted for 134 (21%). The site has reported as many as 22 different aetiologies namely Adenovirus, Chikungunya, Hepatitis A,B& E virus, Herpes simplex virus-1, Human metapneumovirus, measles, mumps, mycoplasma pneumonia, Norovirus G1, Rhinovirus, Rotavirus, RSV, Rubella, Salmonella species, Shigella species.



**Distribution of Lab Confirmed AFI etiologies in Goa**

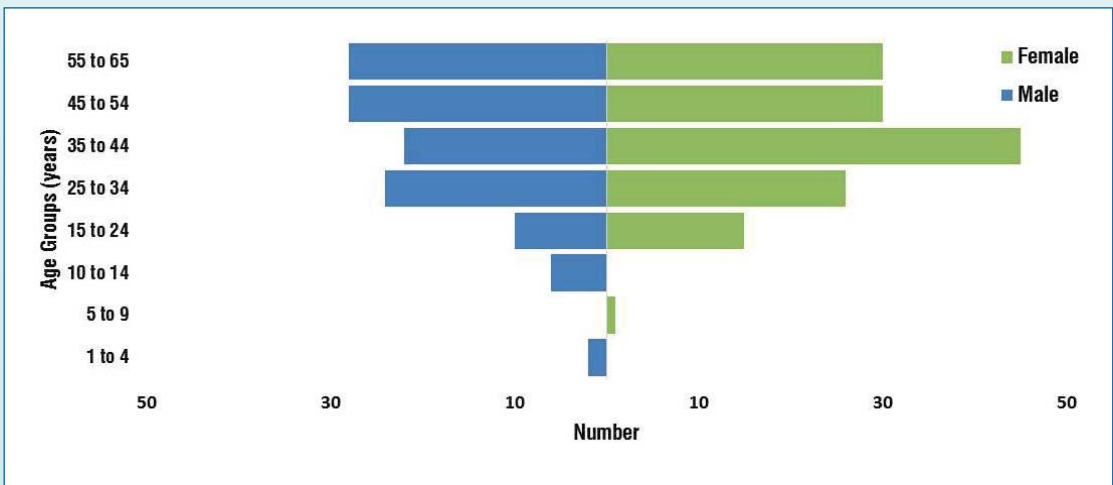
### **Kyasanur Forest Disease (KFD) in Goa**

During February 2015, Pali, a small village of Sattaritaluka, North Goa reported several cases of fever with diarrhoea, myalgia and severe prostration. On request of the Goa health department, MCVR investigated the outbreak and identified the transmitting agent as KFDV. This was the first time KFD was detected in Sattari, North Goa region. Subsequently, in December 2015, AFI sentinel site was started in CHC Valpoi. Since then KFD cases are being reported every year during November to June months which coincides with the cashew harvesting season. In 2016, 193 KFD cases were reported with its peak during January to April. Also during the year 2017, a total of 66 KFD cases were reported with the peak months being January to April.

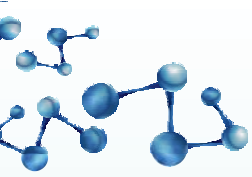


**KFD Cases from Valpoi, Goa, 2015 to 2017**

Around 20 villages of Sattaritaluka were affected. Both the gender were equally affected (males: 55%). People of age group 35 to 44 years were most affected compared to other age groups (25%)

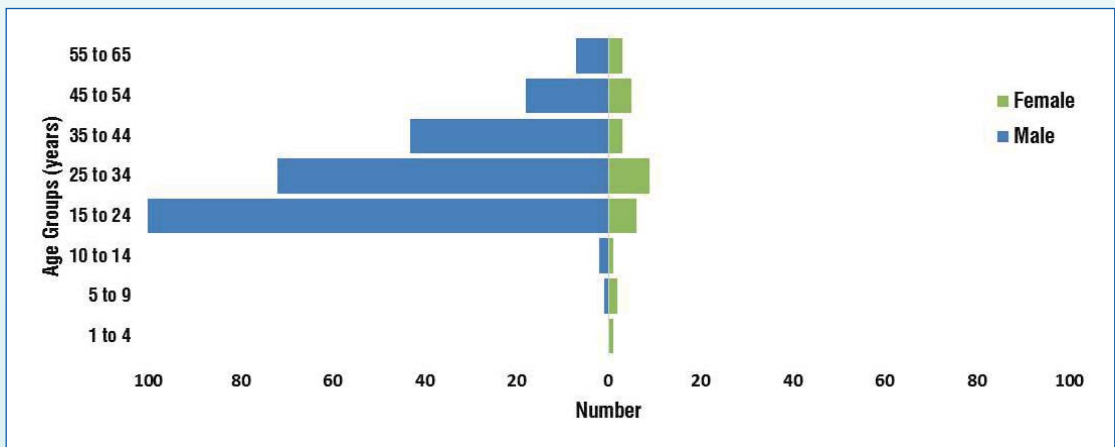


**Age and Gender distribution of KFD Cases from Valpoi, Goa, 2015 to 2017**

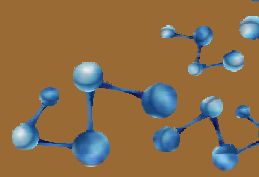


### Malaria in Mapusa, Goa

Malaria has mostly dominated the infectious disease burden of Mapusa. The AFI sentinel site at Mapusa has detected 274 cases of malaria during December 2015 to July 2017. Three different species of malaria has been reported; Plasmodium vivax (48%), Plasmodium falciparum (20%) and Plasmodium ovale (1%). Among the malaria cases, 2% of cases are mixed malaria. Majority of the cases are reported from the urban population of Mapusasubdivision. The disease is reported throughout the year with its peak from May to December. Males (87.73%) are more affected. The age group affected 15 to 44 years were mostaffected compared to other age groups (37%).



Age and Gender distribution of Malaria Cases from Mapusa, Goa, 2015 to 2017

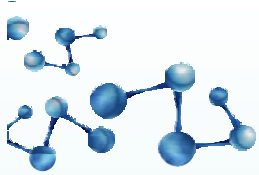


## GUJARAT

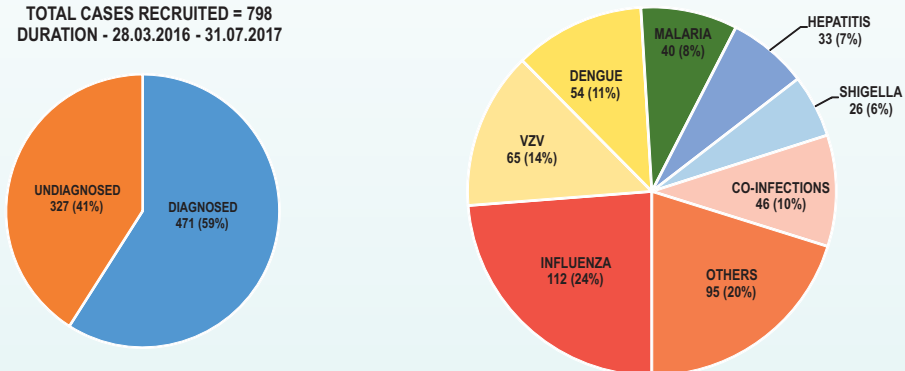


Idar also known as mountain city, is located at the southern end of the Aravalli mountain range with a semi-arid climate, having highest temperature in Gujarat state during summer. It is situated in north part of Gujarat, 80km away from Rajasthan and 130km from Ahmedabad.

Referral and Community Health Centre (CHC) Idar is the AFI sentinel site in Gujarat. Case recruitment from the site was initiated on 29 March, 2016. Located at the end of the city, CHC Idar is surrounded by mountains from three sides.



AFI ETIOLOGY, GUJARAT  
TOTAL CASES RECRUITED = 798  
DURATION - 28.03.2016 - 31.07.2017



As of July 2017, a total of 798 cases were recruited from CHC, Idar; out of which, 471 (59%) cases could be provided with a definitive diagnosis.

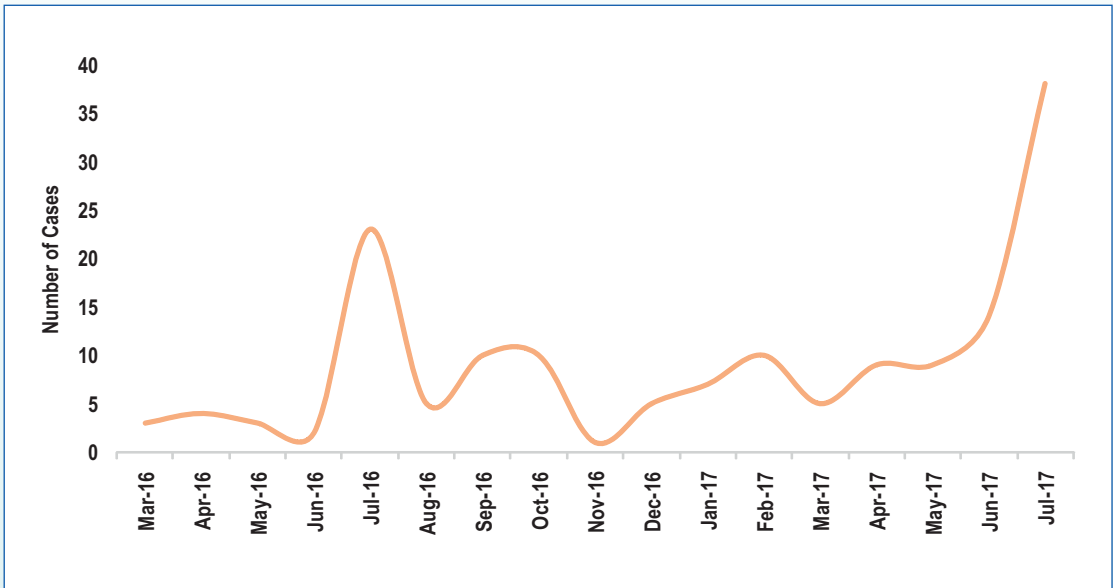
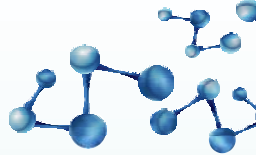
Influenza is the major aetiology reported from Gujarat with 112 (24%) cases. The other major diseases reported from Gujarat are VZV 65 (14%) and Dengue 54 (11%). Malaria 40 (8%), Hepatitis 33 (7%) and Shigella 26 (6%) are some of the other diseases that have been reported from Gujarat. Co-infections account to 46 (10%) cases.

#### Acute Diarrheal Disease in Idar, Gujarat

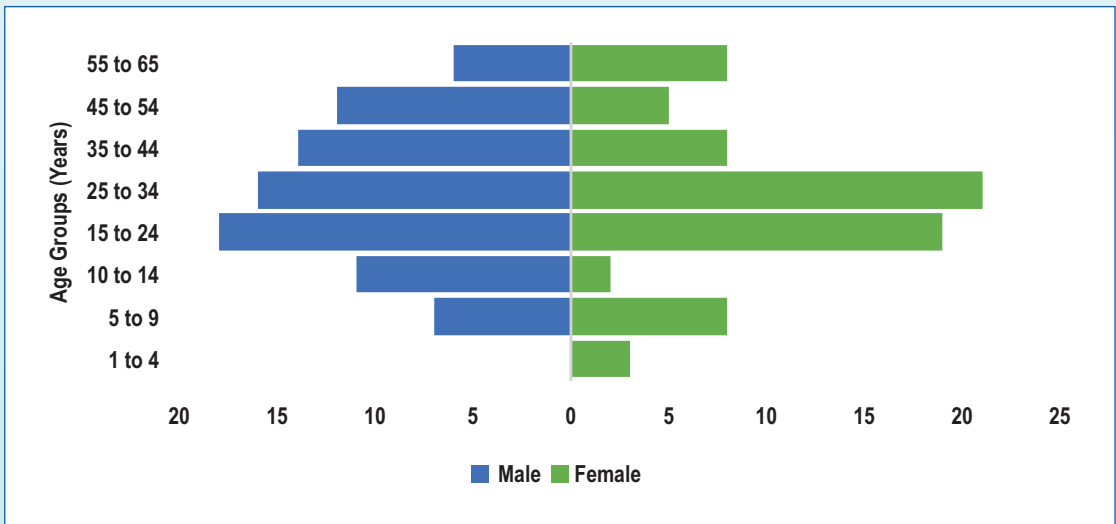
Diarrhea is the passage of loose, liquid or watery stools more than 3 times a day; Acute Diarrheal Disease (ADD) is a sudden onset of diarrhea, lasting for 3-7 days or 10-14 days. ADD is one the major complaints of patients getting admitted to CHC Idar. Data from AFI Surveillance suggests both bacterial as well as viral diarrheal pathogens as causative agents. The etiologies detected from Idar include Shigella spp, Salmonella typhimurium, Salmonella enteritidis,

Astrovirus, Rotavirus, Norovirus G1 & G2. ADD cases can be found throughout the whole year, with peaks during May-July.

Shigellosis is a type of diarrhea caused by a bacterial infection with Shigella. Symptoms usually start 1- 2 days after exposure and include diarrhea, fever, abdominal pain, and pain with passing stool; blood may be present in the stool. Shigellosis is caused by 4 specific types of Shigella, namely, *S.flexnerii*, *S.boydii*, *S.dysenteriae*, *S.sonnei*. Exposure to infected faeces typically spreads Shigellosis. It can occur via contaminated food, water, or hands. Among the other etiologies, Shigella spp. are the prominent ones causing ADD in the cases recruited at Idar sentinel site. All the 4 species known to cause ADD in humans have been detected from cases recruited from here. *Shigella flexnerii* is the most detected causative agent. *S.flexnerii* and *S.sonnei* infections were prevalent in all age groups, whereas *S.boydii* and *S.dysenteriae* were prevalent in old age and teenage age group respectively.



Seasonality of ADD Cases from Idar, Gujarat (Mar 16 to July 17)



Demographics of ADD Cases from Idar, Gujarat (Mar 16 to July 17)

## JHARKHAND



Acute Febrile Illness (AFI) surveillance was initiated in Simdega on 16May,2016. Sadar Hospital, Simdega, a 75-bedded district hospital, was selected as the sentinel site in Simdega. Simdega is located in the south-western part of Jharkhand, about 180 km from Ranchi in the east, 80 km from Rourkela, Odisha in the south. Sadar Hospital is located in the centre of Simdega town and is connected to the other villages via buses and auto rickshaws.

More than half of the population of Simdega belong to tribal communities. Farming and animal husbandry are the major occupations of the people.

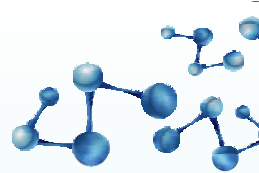
As of July 2017, a total of 1031 cases have been enrolled in the AFI programme, out of these 496 (48%) cases had laboratory confirmed diagnosis for different pathogens. Of these Malaria 92 (18%),

Scrub Typhus 73 (15%), Anthrax 58 (12%) and Influenza 54 (11%) are the major aetiologies reported from Jharkhand. Leptospirosis and Dengue represent 5% and 3% of the cases respectively. Co-infections account for 101 (20%) cases.

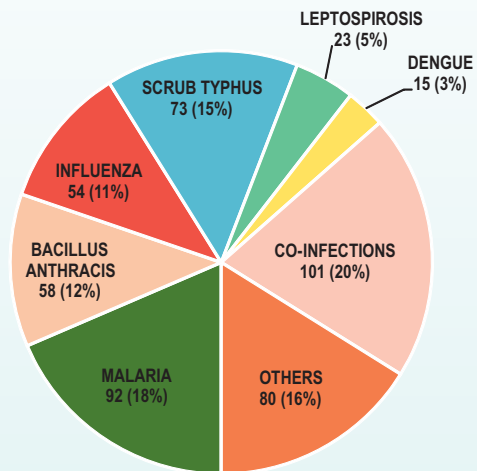
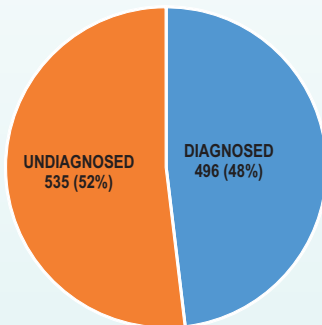
### **Anthrax in Simdega, Jharkhand**

Anthrax is primarily a disease of herbivores. Humans almost invariably contract the natural disease directly or indirectly from animals or animal products. The bacterium *Bacillus anthracis* causes anthrax. Naturally acquired human anthrax infection results from contact with infected animals, or occupational exposure to infected or contaminated animal products. The incidence of the natural disease depends on the level of exposure to affected animals. The clinical picture of anthrax includes cutaneous anthrax, gastrointestinal anthrax, inhalation anthrax and anthrax meningitis.





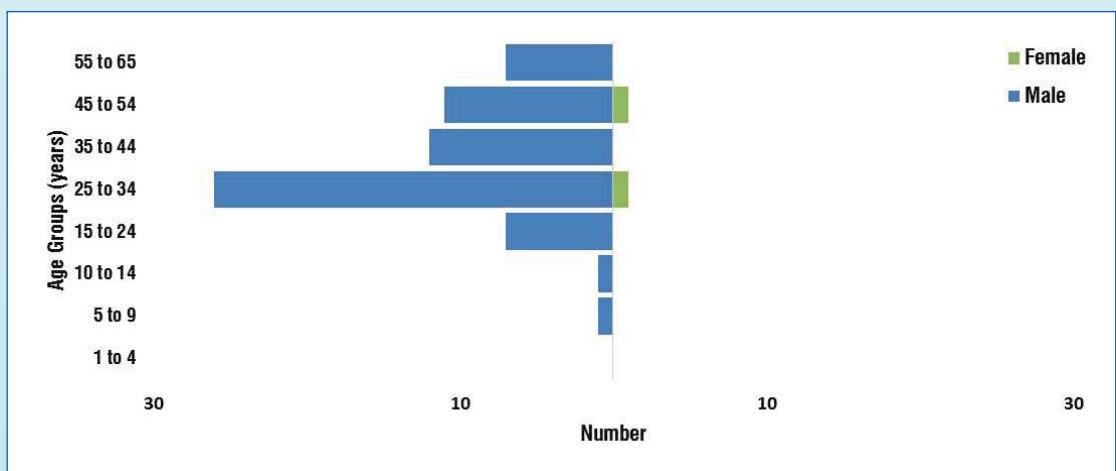
**AFI ETIOLOGY, JHARKHAND**  
**TOTAL CASES RECRUITED = 1031**  
**DURATION - 17.05.2016 - 31.07.2017**



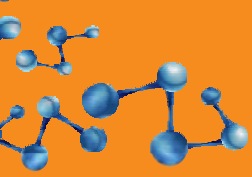
Since 2014, recurrent outbreaks of anthrax is being reported from several blocks of Simdega both in humans and animals. The trade of livestock between Odisha and Jharkhand, the practices including consumption of the meat of dead livestock in certain tribal communities pose major risks for anthrax in Simdega. People who are involved in butchering and handling raw meat are at higher risks, as cuts or skin abrasions that may be exposed allow the organism to infect the person. The district health officials usually get notified through local health workers about sudden or unusual death from their area.

Since May 2016, MCVR has been supporting the district through the AFI surveillance programme for

detection and confirmation of anthrax outbreaks in the district. The samples of suspected cases of anthrax are sent to the laboratory at Manipal for testing and confirmation by molecular as well as conventional techniques. A total number of 67 laboratory confirmed cases of anthrax had been reported during May 2016 to July 2017. All of the confirmed cases were in cutaneous form presentation where the wound with uneven edema or the typical presentation of eschar was seen mainly on hands and in some cases on the face and forehead. The AFI team at Simdega also supported anthrax outbreak investigations in Gumla district, Jharkhand as well as Deogarh, Odisha.



**Age and Gender distribution of Anthrax Cases**



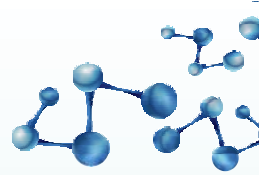
# KARNATAKA



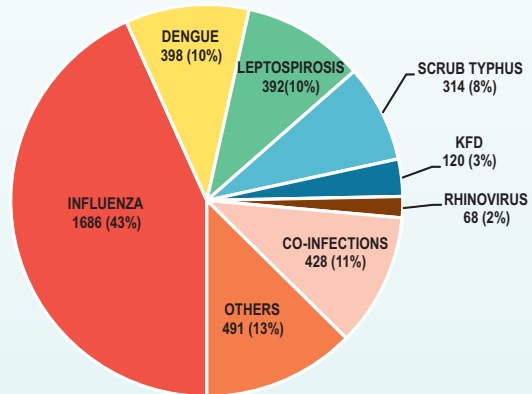
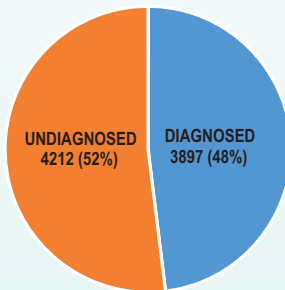
## Shimoga

Shimoga lies in the Malnad region of Western Ghats and has seven taluks under its jurisdiction, out of which AFI sites are housed in four of the Taluk Hospitals - Thirthahalli, Hosanagara, Sagara and Soraba. The population of Shimoga district is 1752753. The Acute Febrile Illness (AFI) Surveillance Project initiated in June 2014 with the launch of the study sites in Shimoga district, namely the Jayachamarajendra (JCH) Taluk hospital in Thirthahalli and Taluk hospital, Hosanagara. The project began with the recruitment of the first case in

JCH Hospital, Thirthahalli on 9th June 2014 and in Taluk Hospital in Hosanagara on 12th June 2014. Taking an average number of recruits in account the Taluk Hospital in Thirthahalli is the busiest of all the four and has a capacity of 100 beds which includes Male, Female, Pediatric and Maternity wards. Similarly, the Hosanagara Hospital holds 50 beds. After the successful operation in these two sites, two more AFI sites were launched in Sagar Taluk Hospital on 26th November 2015 and Soraba Taluk Hospital on 3rd December 2015, both of which have a capacity of 100 beds.



**AFI ETIOLOGY, KARNATAKA**  
**TOTAL CASES RECRUITED = 8109**  
**DURATION - 09.06.2014 - 31.07.2017**



A total of 8109 cases were recruited from Karnataka AFI sites till 31 July 2017; out of which definitive diagnosis could be provided to 3897 (48%) cases. Influenza is the majoretiology reported in the state of Karnataka. It accounts for 1686 (43%) cases reported. Dengue 398 (10%), Leptospirosis 392 (10%) and Scrub Typhus 314 (8%) are the other major etiologies reported from Karnataka AFI sites. KFD and Rhinovirus represent 120 (3%) and 68 (2%) cases respectively. 428 (11%) cases were co-infections.

### Thirthahalli

As of July 2017, a total number of 4,323 cases have been enrolled in the AFI programme, out of these 2,093 cases had laboratory confirmed diagnosis for different pathogens. Of these Influenza (44%), Dengue (9%), Leptospirosis (11%), Scrub typhus (9%), and KFD (6%) have topped the list followed by Rhinovirus (1%), Mumps (1%), Adenovirus (1%) and other pathogens (18%).

### Hosanagara

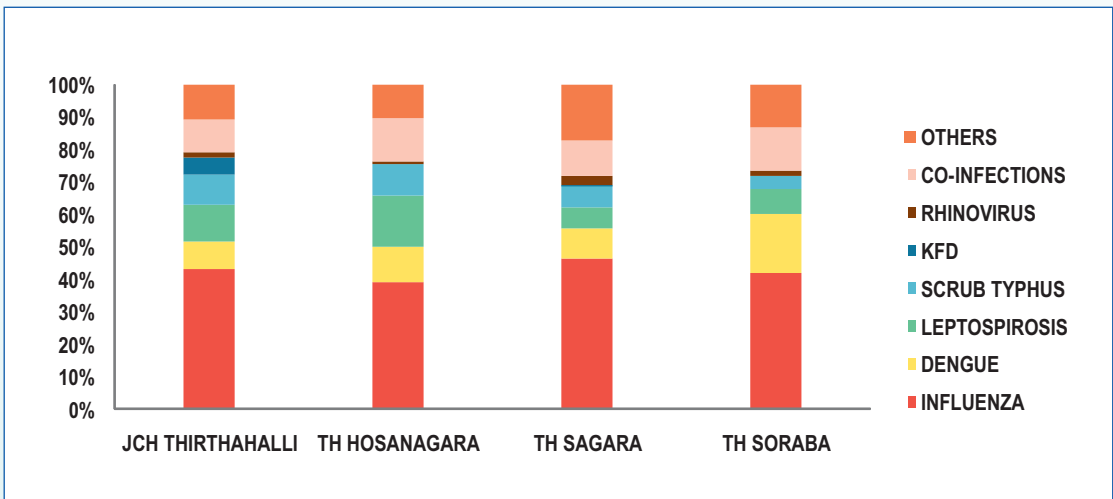
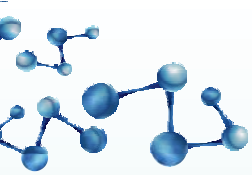
As of July 2017, a total number of 824 cases have been enrolled in the AFI programme, out of these 374 cases had laboratory confirmed diagnosis for different pathogens. Of these, Influenza (40%), Dengue (11%), Leptospirosis (16%) and Scrub typhus (10%) have topped the list followed by Rhinovirus (1%), Mumps (1%) and other pathogens (21%).

### Sagara

As of July 2017, a total number of 1,733 cases have been enrolled in the AFI programme, out of these 842 cases had laboratory confirmed diagnosis for different pathogens. Of these Influenza (47%), Dengue (9%), Leptospirosis (6%) and Scrub typhus (7%) have topped the list followed by Rhinovirus (3%), Mumps (2%), Adenovirus (1%), KFD (<1%) and other pathogens (25%).

### Soraba

As of July 2017, a total number of 1,229 cases have been enrolled in the AFI programme, out of these 526 cases had laboratory confirmed diagnosis for different pathogens. Of these Influenza (42%), Dengue (18%), Leptospirosis (8%) and Scrub typhus (4%) have topped the list followed by Rhinovirus (2%), Mumps (1%), Adenovirus (2%) and other pathogens (23%).

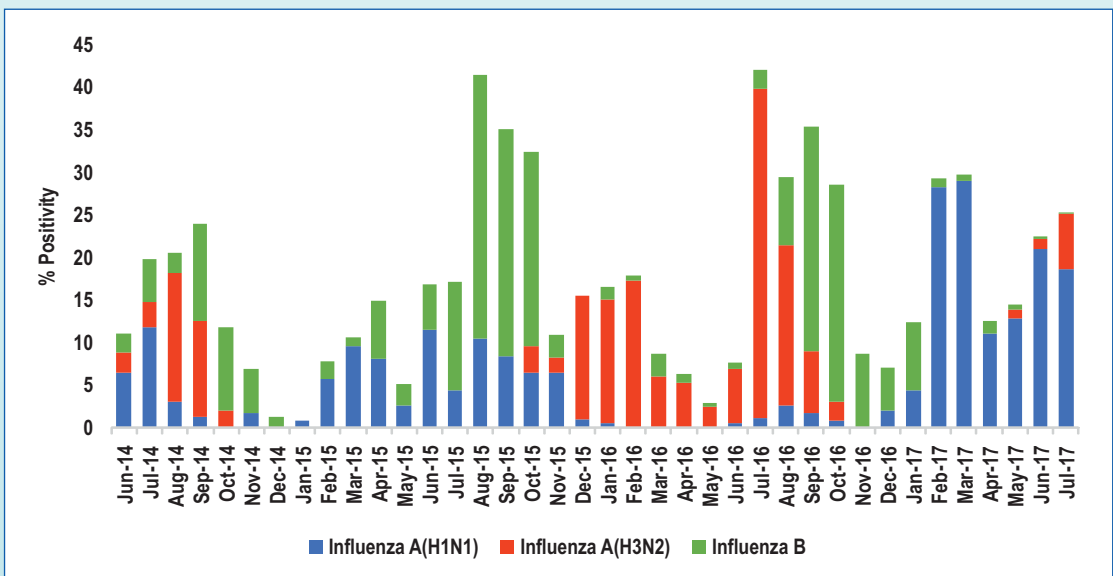


Distribution of Lab Confirmed AFI etiologies in Karnataka

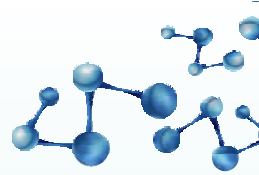
## Seasonality

### Influenza

Influenza makes it to a total of 44% of the total etiology in Shimoga. Influenza is a respiratory viral infection. JCH Thirthahalli got its first case diagnosed with AFI surveillance, and henceforth around 1686 cases have been diagnosed as Influenza. Below timeline shows a definite trend in the peak of Influenza cases and shows the prevalence of Influenza all the year.

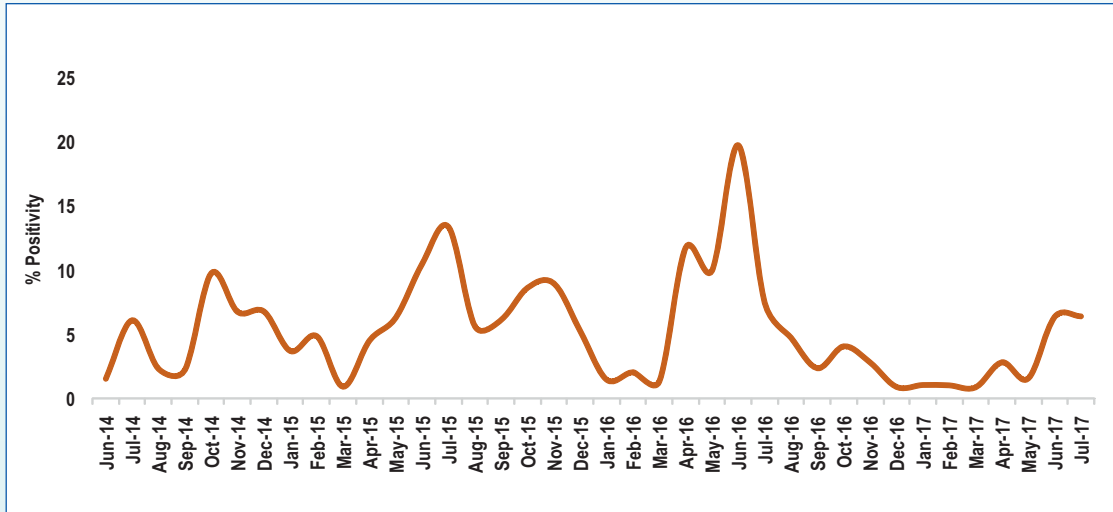


Percentage positivity of Influenza from June 2014 to July 2017



### Dengue

Dengue accounts for 18% of cases in Soraba district hospital and 9-11% in other three AFI sites. The below figure shows an increased incidence of dengue observed in the second half of each year (from May through December).

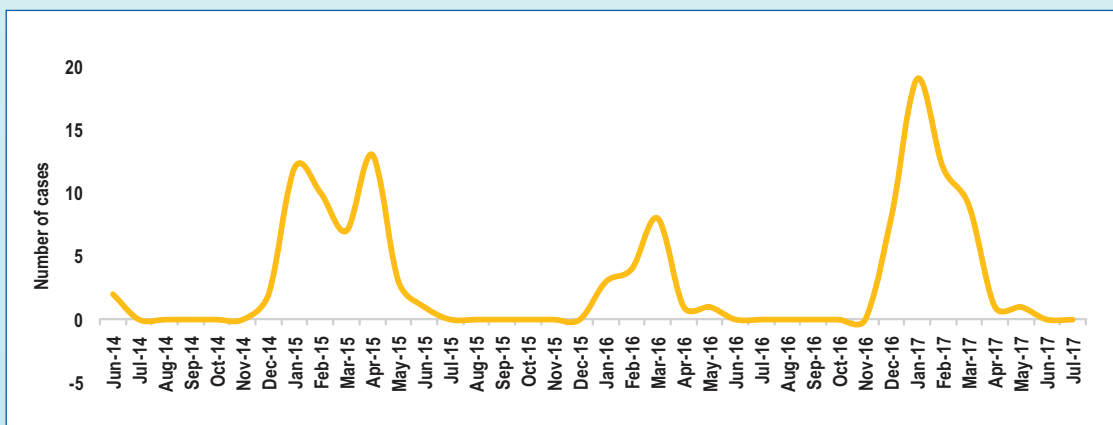


Percentage positivity of Dengue from June 2014 to July 2017

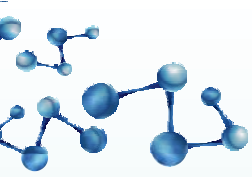
### KFD

KFDV was identified in 1957 when it was isolated from a sick monkey from the Kyasanur forest in Shimoga district of Karnataka state of India. KFD accounts for 6% of total cases in JCH Thirthahalli. KFD was historically limited to the western and central areas of Karnataka State, India until 2012.

Seasonality is a significant risk factor as more cases are reported during the dry season, from November through June. Clearing of forest area for cultivation causes changes in tick fauna and is considered as an important risk factor for outbreaks. The disease affects all ages in both sexes. However, it is common for young people who are more exposed to the forest. It is a seasonal disease usually from December to May.

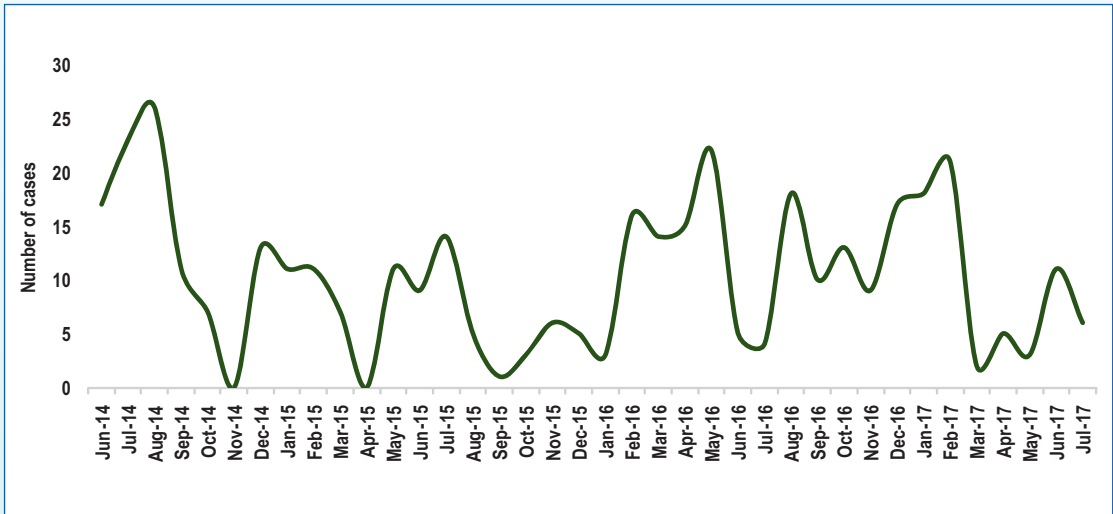


KFD positive cases from June 2014 to July 2017

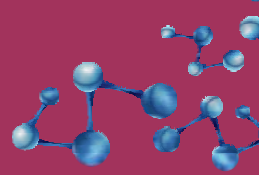


## Leptospirosis

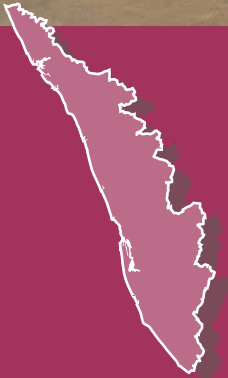
Leptospirosis is a common zoonotic disease with worldwide distribution affecting many mammalian species. Leptospirosis accounts for a total of 16%, 11%, 8% and 6% of cases in Hosanagara, Thirthahalli, Soraba and Sagara respectively.



Leptospirosis positive cases from June 2014 to July 2017

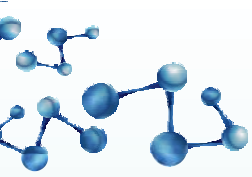


# KERALA

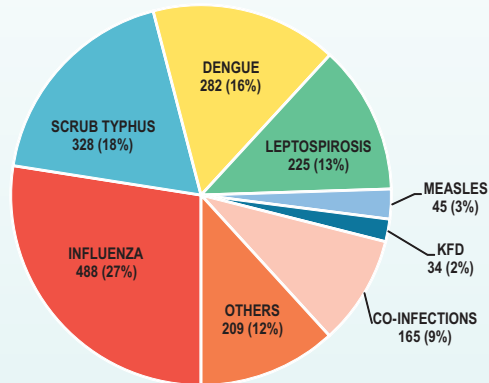
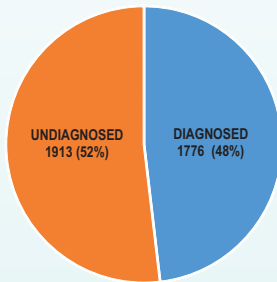


The Acute Febrile Illness (AFI) Surveillance Project in Kerala was initiated in Wayanad district. We have two study sites in Wayanad district, namely, Taluk Head Quarters Hospital, SulthanBathery and District Hospital, Mananthawady. The project was extended to Alappuzha district in July 2017. Alappuzha district has three study sites namely, Taluk Head Quarters Hospital, Pulinkunnu, Community Health Centre Veliyanad and Community Health Centre Champakkulam.

The total number of cases enrolled under the AFI surveillance in Kerala is 3689. Out of which, 1776 (48%) cases have been diagnosed positive. The majoretiology reported from the sites of Kerala is Influenza with 488 (27%) cases. Scrub Typhus 328 (18%), Dengue 282 (16%) and Leptospirosis 225 (13%) are the other major diseases reported from Kerala. Measles and KFD represent 3% and 2% of the cases respectively, Co-infections account for 165 (9%) cases.



**AFI ETIOLOGY, KERALA**  
**TOTAL CASES RECRUITED = 3689**  
**DURATION - 30.01.2015 - 31.07.2017**



### Wayanad

Wayanad is a district in the north-east part of Kerala state, stands on the southern top of the Deccan plateau and that span over a part of Western Ghats region with lofty ridges and rugged terrain interspersed with dense forest and deep valleys. This place has great importance as it is one of the leading tourist spots of South India and also has the largest population of aborigine people who belong to distinct tribes.

#### Taluk Head Quarters Hospital, SulthanBathery

The Acute Febrile Illness (AFI) Surveillance Project in Taluk Head Quarters Hospital SulthanBathery began with the recruitment of the first case on 30th January 2015. THQH SulthanBathery is a 57 bedded hospital which caters to the considerably large tribal community. The implementation of the project was so well timed that we were able to detect the very first cases of Kyasanur Forest Disease (KFD) in the district. Early detection of the KFD outbreak in Wayanad was helpful for district health administration in initiating preventive response mechanism efficiently.

As of July 2017, a total number of 1282 cases have been enrolled in the AFI project, out of these 643 (50%) cases had laboratory confirmed diagnosis for different pathogens. The major pathogens included Influenza 141 (22%), Scrub typhus 136 (21%), Dengue 100 (16%), Leptospirosis 70 (11%), KFD 30 (5%), Measles 22 (3%) and other etiologies accounted for 13%. Co-infection accounted for 63 (10%) cases.

### District Hospital, Mananthawady

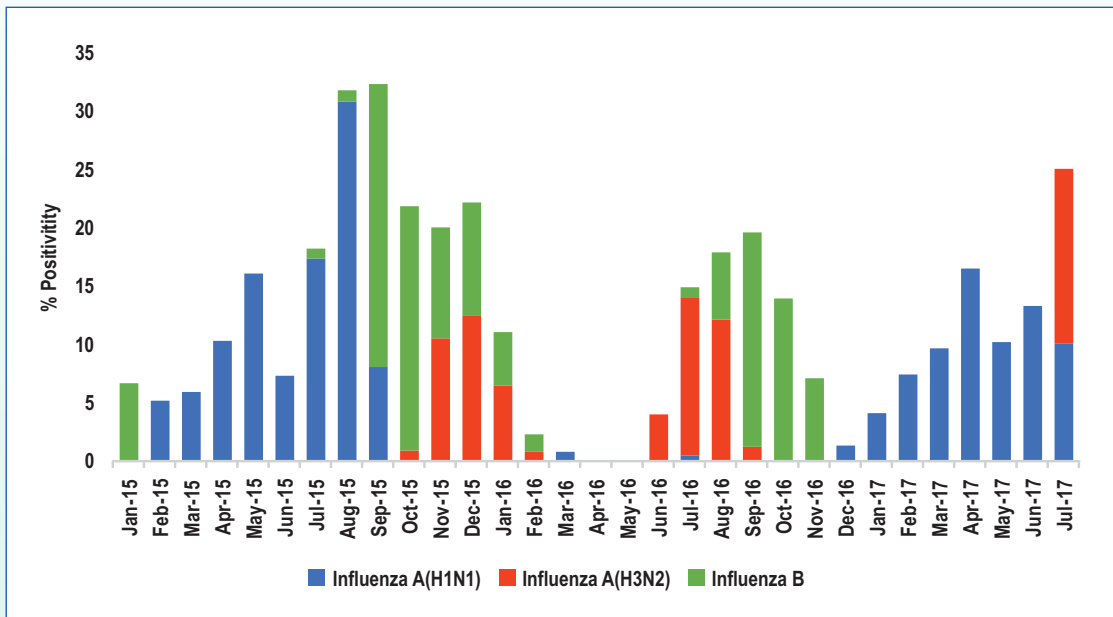
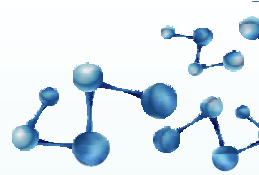
On successful implementation of AFI site in THQH SulthanBathery, and reviewing the results of the initial months, the project was extended to District Hospital Mananthawady from 14 June 2015. District Hospital Mananthawady is a 274 bedded hospital which includes General medicine, Pediatrics, Gynecology, Surgery, Orthopedics, ENT, Ophthalmology, Dermatology and Psychiatry ward.

As of July 2017, a total number of 2372 cases have been enrolled in the AFI project, out of these 1117 (47%) cases had laboratory confirmed diagnosis for different pathogens. The major pathogens included Influenza 334 (30%), Scrub typhus 192 (17%), Dengue 180 (16%), Leptospirosis 154 (14%), Measles 23 (2%) and other etiologies accounted for 11%. Co-infection accounted for 102 (9%) cases.

#### Influenza Seasonality

In Wayanad, Influenza is the major etiology accounting for 27% of the known etiology. A total of 470 patients were positive for Influenza (Influenza A (H1N1), Influenza A (H3N2) & Influenza B) out of 3654 fever patients enrolled in the study from January 2015 to July 2017. Among Influenza positive cases around two third was from the group aged between 25-54 years. Of Influenza positive cases 54% were females. There is a definitive increase from June to September which coincides with the monsoon season in Kerala. A significant finding of this study was that influenza cases are prevalent all around the year.

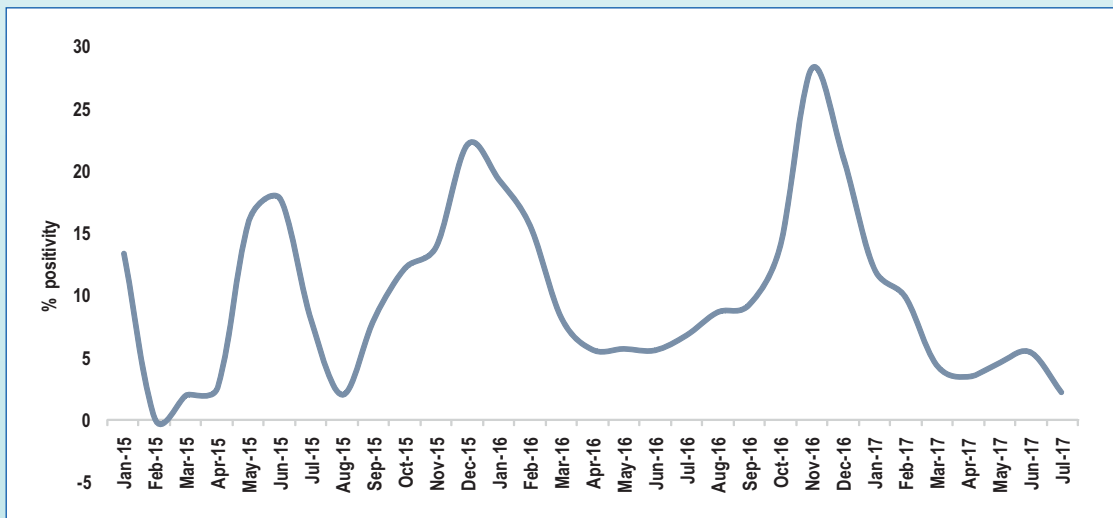




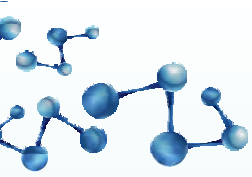
Percentage positivity of Influenza from Jan 2015 to July 2017

### Scrub typhus

In Wayanad Scrub typhus is one of the major etiologies causing hospitalisation. A total of 328 patients were positive for scrub typhus out of 3654 fever patients tested for infectious aetiology from January to July 2017. It accounts for 19% of the known etiology. Among scrub typhus, positive cases around 80% of the cases were from the group aged between 25-54 years. Of scrub typhus positive cases 62% were females. Graph below shows a definitive increase during September to March with cases being reported all around the year.



Percentage positivity of Scrub typhus from Jan 2015 to July 2017



### **Corynebacteriumdiphtheriae**

Diphtheria is a highly contagious communicable disease caused by toxin-producing strains of *Corynebacteriumdiphtheriae* and transmitted through respiratory droplets during close contact, primarily infecting the pharynx, tonsils and nose. Cardiovascular, neurological and renal complications resulting in death can occur weeks after acute infection. Diphtheria case fatality ratio (CFR) can be 10-50% depending on the severity of illness at presentation, vaccination status of the patient, timeliness of diphtheria antitoxin administration and the level of medical care available.

A total of 16 patients were positive for *Corynebacteriumdiphtheriae* out of 3654 fever patients tested for infectious aetiology from Wayanad from June 2014 to July 2017. Among *Corynebacteriumdiphtheriae* positive cases, one third was from the group aged between 9-18 years. Of *Corynebacteriumdiphtheriae* positive cases, 68% were females.

Increased surveillance in Wayanad has contributed in detecting the *Corynebacteriumdiphtheriae* at the early stage itself. Our AFI surveillance in Wayanad is a perfect example of sound public health practices wherein all the cases were detected at the earlier stage itself and referred to a medical college for diphtheria antitoxin treatment. Increased surveillance coupled with low level of vaccination among tribal communities would have contributed for more number of cases

### **Hepatitis A**

Hepatitis A virus (HAV) is an enterically transmitted virus that occurs primarily in Asia, Africa, and Central America. An improved understanding of the natural history of HAV infection has been achieved within the last decade. Several reservoirs and transmission modes have been identified. HAV infections are responsible for over 50% of acute viral hepatitis cases in areas like India. The average mortality rate is between 0.2%–4%.

Several outbreaks of HAV in small pockets of Padinjarathara, Muttill, Pulpalli and Kaniyampetta areas of Wayanad was detected using our AFI

surveillance in Wayanad. AFI surveillance combined with Infectious disease laboratory at THQH SulthanBathery were able to detect the cases within 24 hours of receipt of samples. This has helped the district health authorities to act fast and control the outbreaks at initial stages itself. This was an example of evidence based public health interventions. This also stressed the importance of role of laboratories in detecting outbreaks.

### **Alappuzha**

Alappuzha is a district in the southern part of Kerala state; it is a landmark between the broad Arabian sea and a network of rivers flowing into it. It is one of the leading tourist spots in India with its scenic beauty of the place with an unending stretch of paddy fields, small streams and canals with lush green coconut palms. It is fondly called as “The Venice of the East”.

### **Taluk Head Quarters Hospital, Pulinkunnu**

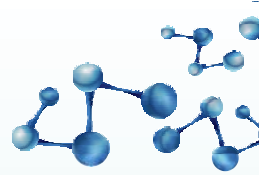
The Acute Febrile Illness (AFI) Surveillance Project in Alappuzha district was first started in Taluk Head Quarters Hospital Pulinkunnu with the recruitment of the first case on 20th July 2017. THQH Pulinkunnu is a 106 bedded hospital which includes Male, Female and paediatrics ward.

As on 31st July 2017, a total number of 20 cases have been enrolled in the AFI project, out of these 8 (40%) cases had laboratory confirmed diagnosis for different pathogens. The pathogens identified are Influenza (30%), Dengue (5%) and Leptospirosis (5%)

### **Community Health Centre, Veliyanad**

The Acute Febrile Illness (AFI) Surveillance Project in Community Health Centre Veliyanad started with the recruitment of the first case on 20th July 2017. CHC Veliyanad is a 30 bedded hospital with the Male and Female ward.

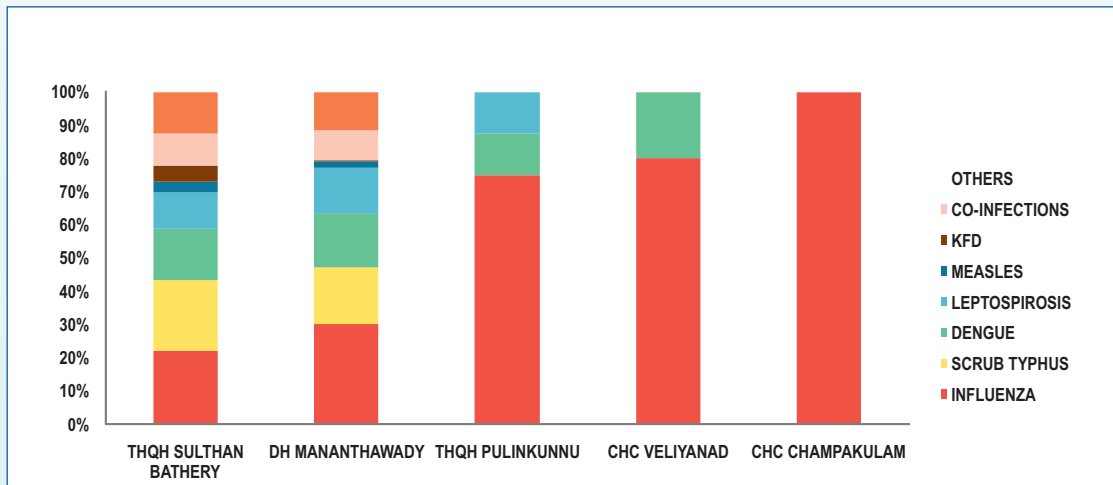
As on 31st July 2017, a total number of 10 cases have been enrolled in the AFI project, out of these 5 (50%) cases had laboratory confirmed diagnosis for different pathogens. The pathogens identified are Influenza (40%) and Dengue (10%).



### Community Health Centre, Champakulam

The Acute Febrile Illness (AFI) Surveillance Project in Community Health Centre Champakulam started with the recruitment of the first case on 26 July 2017. CHC Veliyanad is a 51 bedded hospital with the Male and Female ward.

As on 31st July 2017, a total number of 5 cases have been enrolled in the AFI project, out of these 3 (60%) cases had laboratory confirmed diagnosis and all the three were Influenza A (H3N2).



### Distribution of Lab Confirmed AFI etiologies in Kerala

As of July 2017, a total of 798 cases were recruited from CHC, Idar; out of which, 471 (59%) cases could be provided with a definitive diagnosis.

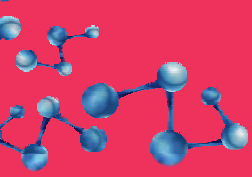
Influenza is the major aetiology reported from Gujarat with 112 (24%) cases. The other major diseases reported from Gujarat are VZV 65 (14%) and Dengue 54 (11%). Malaria 40 (8%), Hepatitis 33 (7%) and Shigella 26 (6%) are some of the other diseases that have been reported from Gujarat. Co-infections account to 46 (10%) cases.

#### Acute Diarrheal Disease in Idar, Gujarat

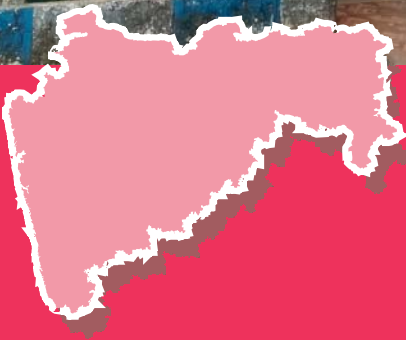
Diarrhea is the passage of loose, liquid or watery stools more than 3 times a day; Acute Diarrheal Disease (ADD) is a sudden onset of diarrhea, lasting for 3-7 days or 10-14 days. ADD is one the major complaints of patients getting admitted to CHC Idar. Data from AFI Surveillance suggests both bacterial as well as viral diarrheal pathogens as causative agents. The etiologies detected from Idar include Shigella spp, Salmonella typhimurium, Salmonella enteritidis,

Astrovirus, Rotavirus, Norovirus G1 & G2. ADD cases can be found throughout the whole year, with peaks during May-July.

Shigellosis is a type of diarrhea caused by a bacterial infection with Shigella. Symptoms usually start 1- 2 days after exposure and include diarrhea, fever, abdominal pain, and pain with passing stool; blood may be present in the stool. Shigellosis is caused by 4 specific types of Shigella, namely, S.flexnerii, S.boydii, S.dysenteriae, S.sonnei. Exposure to infected faeces typically spreads Shigellosis. It can occur via contaminated food, water, or hands. Among the other etiologies, Shigella spp. are the prominent ones causing ADD in the cases recruited at Idar sentinel site. All the 4 species known to cause ADD in humans have been detected from cases recruited from here. Shigella flexnerii is the most detected causative agent. S.flexnerii and S.sonnei infections were prevalent in all age groups, whereas S.boydii and S.dysenteriae were prevalent in old age and teenage age group respectively.



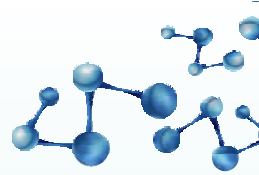
## MAHARASHTRA



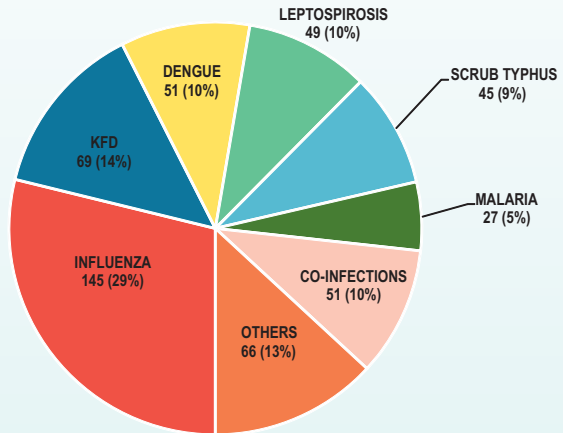
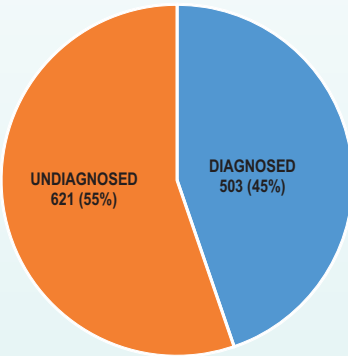
Sindhudurg district is located in the southern part of the greater tract known as the 'Konkan' which is historically famous for its long coastline and safe harbours. Sindhudurg district is spread over an area of around 5,207 sq. kms, with 8 towns, 8 tahsils and 748 villages. AFI Surveillance has 3 sentinel sites functioning Maharashtra.

From April 2016 to July 2017, 1124 cases have been

recruited by AFI sentinel sites in Maharashtra. Out of these cases, 503 (45%) cases have diagnosed positive. Influenza is the major etiology reported from Maharashtra sentinel sites with 145 (29%) cases. KFD 69 (14%), Dengue 51 (10%), Leptospirosis 49 (10), Scrub Typhus 45 (9%) and Malaria 27 (5%) are the other diseases reported from Maharashtra. Co-infections account for 51 (10%) cases.



**AFI ETIOLOGY, MAHARASHTRA**  
**TOTAL CASES RECRUITED = 1124**  
**DURATION - 05.04.2016 - 31.07.2017**



**Rural Hospital, Dodamarg**

Case recruitment for the project started at Rural Hospital (RH), Dodamarg on 5 April 2016. RH, Dodamarg is a 50-bedded facility with provisions for OPD services and laboratory. Dodamarg has 67 villages, covers a population of 53170.

From April 2016 to July 2017, 430 cases have been recruited at Rural Hospital (RH), Dodamarg sentinel site. Out of these cases, 164 (38%) cases have been diagnosed positive. Influenza and KFD were the major diseases reported from Dodamarg sentinel site with 41 (25%) and 27 (17%) cases. Leptospirosis 19 (12%), Dengue 16 (10%), Malaria 15 (9%) and Scrub Typhus 6 (4%) are the other diseases reported from Dodamarg. Co-infections account for 19 (12%) cases.

**Sub Divisional Hospital (SDH), Sawantwadi**

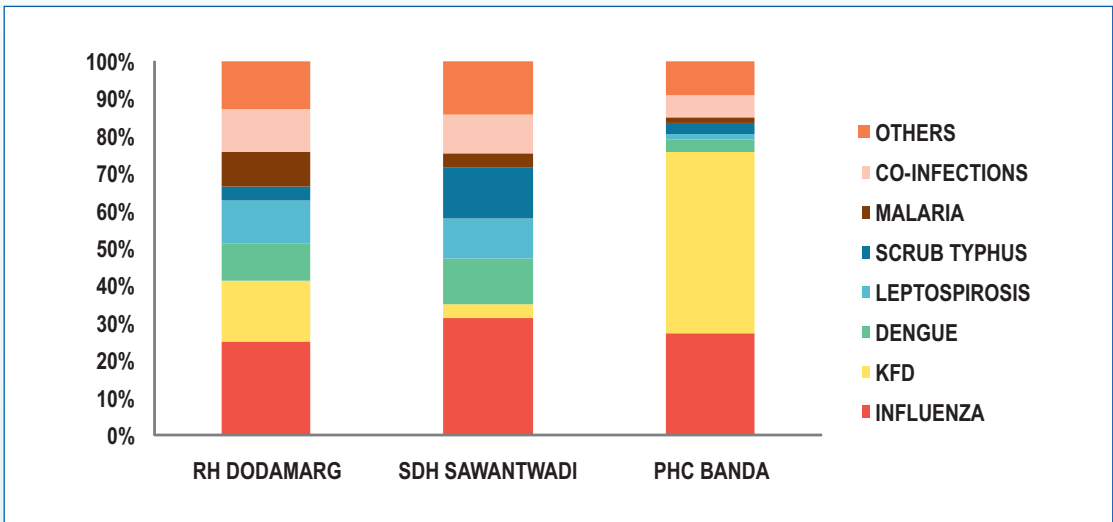
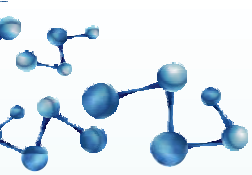
Sub Divisional Hospital (SDH), Sawantwadi is the second sentinel site in Maharashtra. The Sawantwadi SDH is a 300-bedded hospital with OP, IP facilities in addition to the laboratory facilities and an AYUSH clinic in the campus. Recruitment from Sawantwadi (SDH) began on 23 May 2016. Sawantwadi has 84 villages, covers a population of 133924.

Total 567 Cases have been recruited by Sub Divisional Hospital (SDH), Sawantwadi from March 2016 to July 2017. Out of these, 273 (48%) cases have been diagnosed positive. Influenza is the major disease reported from Sawantwadi sentinel site with 86 (32%) cases. Other diseases were Dengue 33 (12%), Leptospirosis 29 (11%), Scrub Typhus 37 (14%), Malaria 11 (4%), KFD 10 (4%) and Co-infections 28 (10%).

**Primary Health Centre, Banda**

Case recruitment from PHC Banda started on 12th March 2017. PHC Banda 15 bedded hospital with OP, IP and laboratory facilities. Banda comes under Sawantwaditaluka.

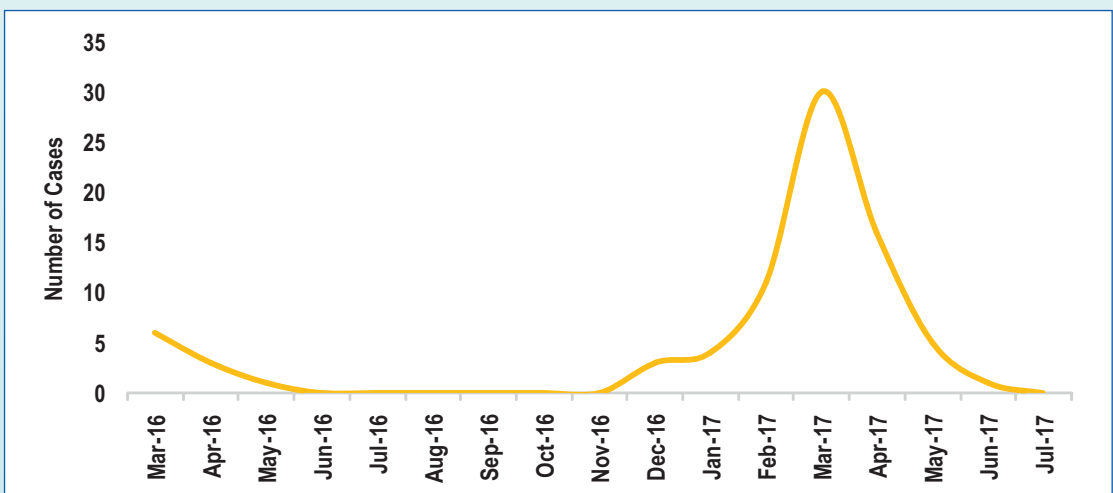
Total 127 cases have been recruited from March 2017 to July 2017. Out of these, 66 (52%) cases were diagnosed positive. KFD 32 (48%), Influenza 18 (27%), Dengue 2 (3%), Scrub Typhus 2 (3%), Leptospirosis 1 (2%) and Malaria 1 (2%) are the diseases reported from Banda. Co-infections accounts for 4 (6%) cases. KFD was the major disease reported from PHC Banda.



Distribution of Lab Confirmed AFI etiologies in Maharashtra

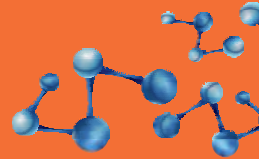
### KYASANUR FOREST DISEASE (KFD) in Maharashtra

Kyasanur forest disease (KFD) is a tick-borne viral haemorrhagic fever, caused by Kyasanur forest disease virus, transmitted by the bite of an infected tick nymphs (*Haemaphysalis spinigera*). KFD was not considered a prevalent disease in Maharashtra until recently.



KFD Cases, Maharashtra, 2016 to 2017

The AFI surveillance team at District Hospital, Mapusa (North Goa) sentinel site detected KFD infection in a case admitted at Goa. The case belonged to Ker village of Dodamarg. Following this, MCVR set up its AFI sentinel at Rural Hospital Dodamarg and the second one after Sawantwadi Sub-district hospital. In February 2017, KFD cases were detected from Banda area of Sawantwadi, following which a third sentinel site was setup at PHC, Banda. As of July 2017, 69 cases have been found positive for Kyasanur forest disease; Dodamarg 27 (39%), Sawantwadi 10 (14%) and Banda 32 (46%).



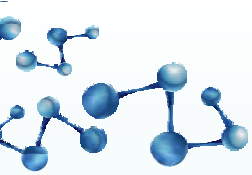
## ODISHA



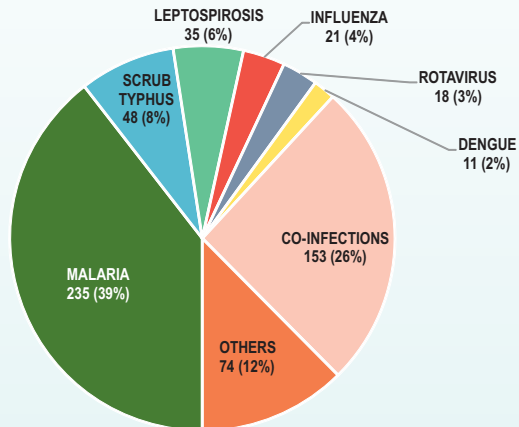
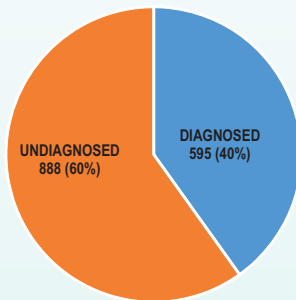
The AFI surveillance has two sentinel sites in Odisha. The sites are located in southern Odisha, along the Eastern Ghats. The ecological features along with its tropical climate characterised by high temperature, high humidity and medium to high rainfall provide the most favourable and conducive environment for breeding of vectors and development of vector-borne diseases along with other infectious diseases. The population is predominantly tribal belonging to Scheduled Tribes and Scheduled Castes.

Case recruitment began on 27 September 2016 at District Headquarter Hospital (DHH), Koraput later on it was extended to Malkangiri district hospital on 29th Nov 2016. Over the year, the project was able to diagnose a wide array of unknown viral and bacterial infections from this region.

Out of the total 1483 cases recruited under AFI surveillance in Odisha till July 2017, 595 (40%) cases were diagnosed positive. Malaria is the majoretiology reported from Odisha AFI sites with 184 (31%) cases. Scrub Typhus 48 (8%), Leptospirosis 35 (6%), Influenza 21 (4%), Rotavirus 18 (3%) and Dengue 11 (2%) are the other diseases reported from Odisha. Co-infections account for 204 (34%) cases.



**AFI ETIOLOGY, ODISHA**  
**TOTAL CASES RECRUITED = 1483**  
**DURATION - 27.09.2016 - 31.07.2017**



**DHH Koraput**

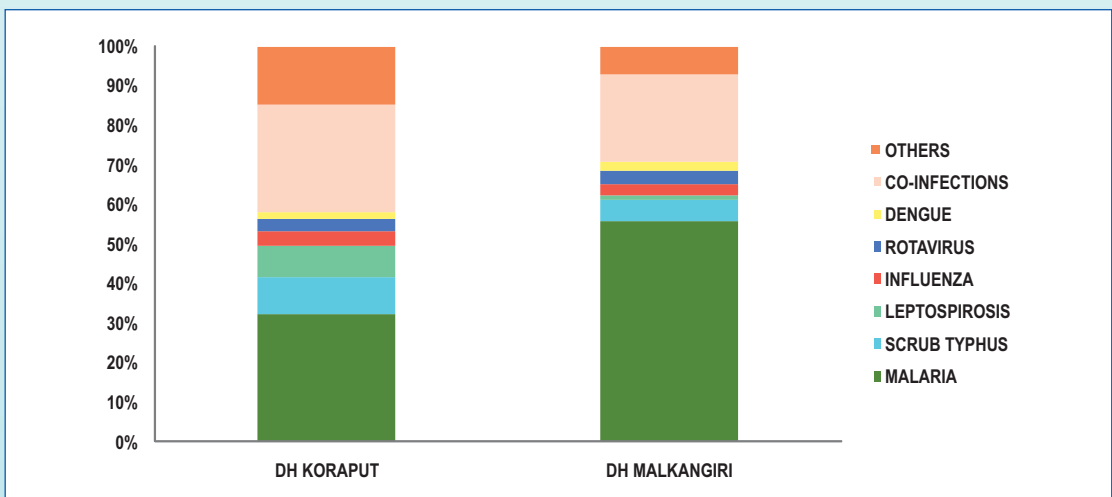
The Koraput District covers an area of 8807 sq km, bordering Chhattisgarh and Andhra Pradesh consisting total 13,79,647 population as per 2011 census. Of which 64.81% belongs to Scheduled Tribes and Schedule Castes. The Koraput tribal populations include – Bonda, Parija, Desua, Khoya, Dharua, Didaya, Bhumia, Santala, Juanga, Jatapa. The district has literacy rate 49.21 %. The District has got 2 subdivisions namely Koraput and Jeypore.

As of 31 July 2017, the site has recruited 1090 cases of acute febrile illness, of which 414 (38%) were having positive results for different etiologies. The major etiologies reported were Malaria 103 (25%), Scrub typhus 38 (9%), Leptospirosis 33 (8%), Influenza 16 (4%), Rotavirus 12 (3%) and Dengue 7 (2%). Co-infection accounted for 144 (35%).

**DHH Malkangiri**

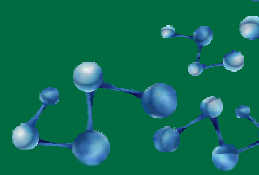
Malkangiri is the interior most district of Odisha sharing border with Chhattisgarh and Andhra Pradesh having an area of 5791 sq.km. The district is inhabited by tribes (60%), notable among who are Bondas, Koyas, Porajas and Didayis. The district has 7 Taluks, 1045 villages with 6,13,198 population. Case recruitment for the project started at DHH Malkangiri on 26 November 2016

As of 31 July 2017, the site has recruited 393 cases of acute febrile illness, of which 181 (46%) were having positive results for different aetiologies. The major aetiologies reported were Malaria 81 (45%), Scrub typhus 10 (6%), Influenza 5 (3%), Rotavirus 6 (3%), Dengue 4 (2%) and Leptospirosis 2 (1%). Co-infection accounted for 60 (33%) cases.

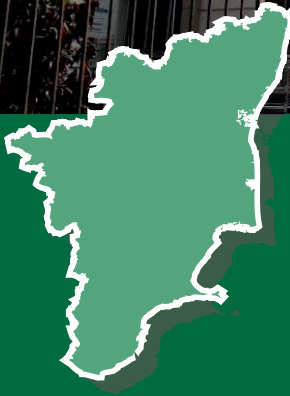


**Distribution of Lab Confirmed AFI etiologies in Odisha**



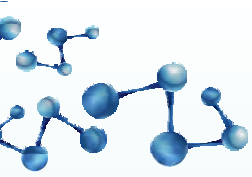


## TAMIL NADU

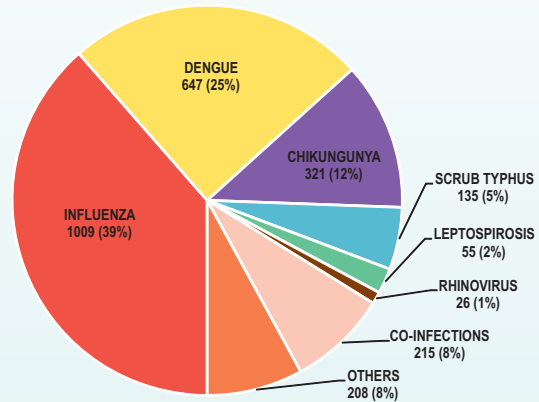
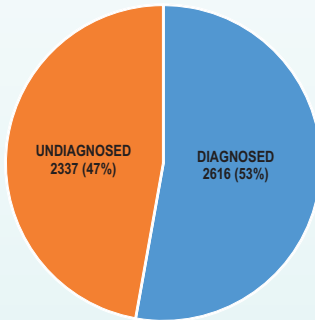


In July 2016, Manipal Center for Virus Research established Acute Febrile Illness surveillance platform in Krishnagiri and Nilgiris district with the aim of providing advanced laboratory diagnosis for fever cases. Currently, AFI sites are functional in 3 government hospitals in Nilgiris (GH Gudalur, GH Pandalur, and CHC Nellakottai) and 2 hospitals in Krishnagiri (GH Denkanikkottai and PHC Anchetty).

As of 31 July 2017, a total of 4953 cases were recruited from the state of Tamil Nadu; out of which 2616 (53%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 1009 (39%), Dengue 647 (25%), Chikungunya 321 (12%), Scrub typhus 135 (5%), Leptospirosis 55 (2%), Rhinovirus 26 (1%), and others 208 (8%). Co-infections for more than one pathogen account for 215 (8%) of the cases.



**AFI ETIOLOGY, TAMIL NADU**  
**TOTAL CASES RECRUITED = 4953**  
**DURATION - 01.07.2016 - 31.07.2017**



**Krishnagiri, Tamil Nadu**

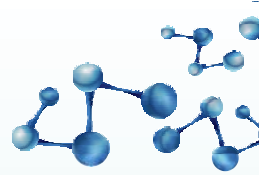
Krishnagiri district was formed as the 30th district of Tamil Nadu by carving out five taluks and ten blocks of the former Dharmapuri district. Krishnagiri district covers an area of 5143 sq.km bound by Vellore and Thiruvannamala districts to the East, the state of Karnataka to the west, state of Andhra Pradesh to the north and Dharmapuri district to the south. Krishnagiri is divided into 5 taluks; they are Hosur, Krishnagiri, Denkanikottai, Pochampalli, and Uthangarai with a population of 1879809 (Census 2011). Three languages namely Tamil, Telugu and Kannada are spoken in this district. Tribal communities called 'Irular' live in the forest areas of Denkanikottai, and they are skilled in tree climbing and honey collection. This district has an elevation of 300 to 1400 m above the mean sea level. The district has a hilly terrain, and the south Pennar river irrigates

the flatlands. Summer season is from March to June, rainy season between July to November, and winter prevails between December to February. The eastern part of the district experiences hot climate and the western part in contrast experiences cold climate. The annual average rainfall is 830 mm. Acute febrile illness sentinel site is functional at taluk government hospital of Denkanikottai.

As of 31 July 2017, a total of 3120 cases were recruited from the district of Krishnagiri; out of which 1796 (58%) could be provided with a definitive diagnosis. Major etiologies include Influenza 665 (37%), Dengue 493 (27%), Chikungunya 314 (17%), Scrub typhus 42 (2%), Leptospirosis 16 (1%), Rhinovirus 10 (1%), and others 103 (6%). Co-infections for more than one pathogen accounts for 153 (9%) of the cases.



**Distribution of Lab Confirmed AFI etiologies in Tamil Nadu**



### **Government Hospital Denkanikottai**

As of 31 July 2017, a total of 2405 cases were recruited from Government Hospital Denkanikottai; out of which 1416 (59%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 515 (36%), Dengue 382 (27%), Chikungunya 272 (19%), Scrub typhus 35 (3%), Leptospirosis 12 (1%), Rhinovirus 7 (1%), and others 76 (5%). Co-infections for more than one pathogen accounts for 117 (8%) of the cases.

### **PHC Anchetty**

As of 31 July 2017, a total of 715 cases were recruited from PHC Anchetty; out of which 380 (53%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 150 (40%), Dengue 111 (29%), Chikungunya 42 (11%), Scrub typhus 7 (2%), Leptospirosis 4 (1%), Rhinovirus 3 (1%), and others 27 (7%). Co-infections for more than one pathogen accounts for 36 (9%) of the cases.

### **The Nilgiris, Tamil Nadu**

Nilgiris is India's first biosphere in the Western Ghats, and because of its unique biodiversity, it has been declared one among the 14 hotspots in the world. These blue mountain ranges located at the tri-junction of Tamil Nadu, Kerala and Karnataka attract tourists from throughout India. This district is bound by Chamarajnagar district of Karnataka to the north, Wayanad, Malappuram and Palakkad districts of Kerala to the west, Coimbatore district of Tamil Nadu to the South and Erode district of Tamil Nadu to the east. The highest point in this district is Doddabetta (2,637 m). Apart from its rich bio-diversity, Nilgiris is home for more than 15 scheduled tribes including Toda, Kota, Kurumba, Irula, Paniyan, Kattunaicken (Nayaka), and Badaga constituting 4.5% of the district population. Nilgiris is administratively divided into 6 taluks; they are Coonoor, Kotagiri, Udhamandalam, Kundah, Gudalur, and Panthalur with a population of 735394 (Census 2011). The annual rainfall of the district is 1,920 mm. During summer the temperature reaches a maximum of 25 °C and a minimum of 10 °C. During winter the temperature maximum is 20 °C and the minimum 0 °C average. The economy is dependent majorly on the

tea and coffee industry. Acute febrile illness sentinel sites are functional in taluk government hospital of Gudalur and Panthalur.

As of July 31 2017, a total of 1833 cases were recruited from the district of Nilgiris; out of which 820 (45%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 344 (42%), Dengue 154 (19%), Scrub typhus 93 (11%), Leptospirosis 39 (5%), Rhinovirus 16 (2%), Chikungunya 7 (1%), and others 105 (13%). Co-infections for more than one pathogen accounts for 62 (7%) of the cases.

### **GH Gudalur**

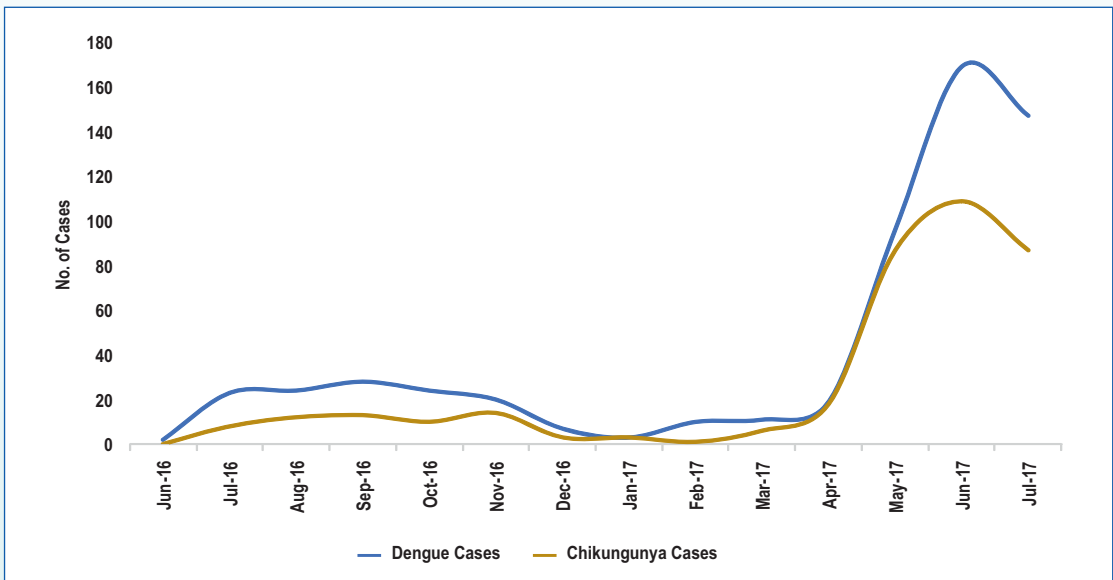
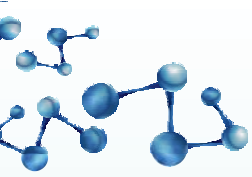
As of 31 July 2017, a total of 762 cases were recruited from GH Gudalur, Nilgiris; out of which 366 (48%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 148 (40%), Dengue 76 (21%), Scrub typhus 38 (10%), Leptospirosis 13 (4%), Rhinovirus 10 (3%), Chikungunya 3 (1%), and others 48 (13%). Co-infections for more than one pathogen accounts for 30 (8%) of the cases.

### **GH Pandalur**

As of 31 July 2017, a total of 751 cases were recruited from GH Pandalur, Nilgiris; out of which 312 (42%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 132 (42%), Dengue 64 (21%), Scrub typhus 41 (13%), Leptospirosis 19 (6%), Chikungunya 4 (1%), Rhinovirus 1 (0%), and others 33 (11%). Co-infections for more than one pathogen accounts for 18 (6%) of the cases.

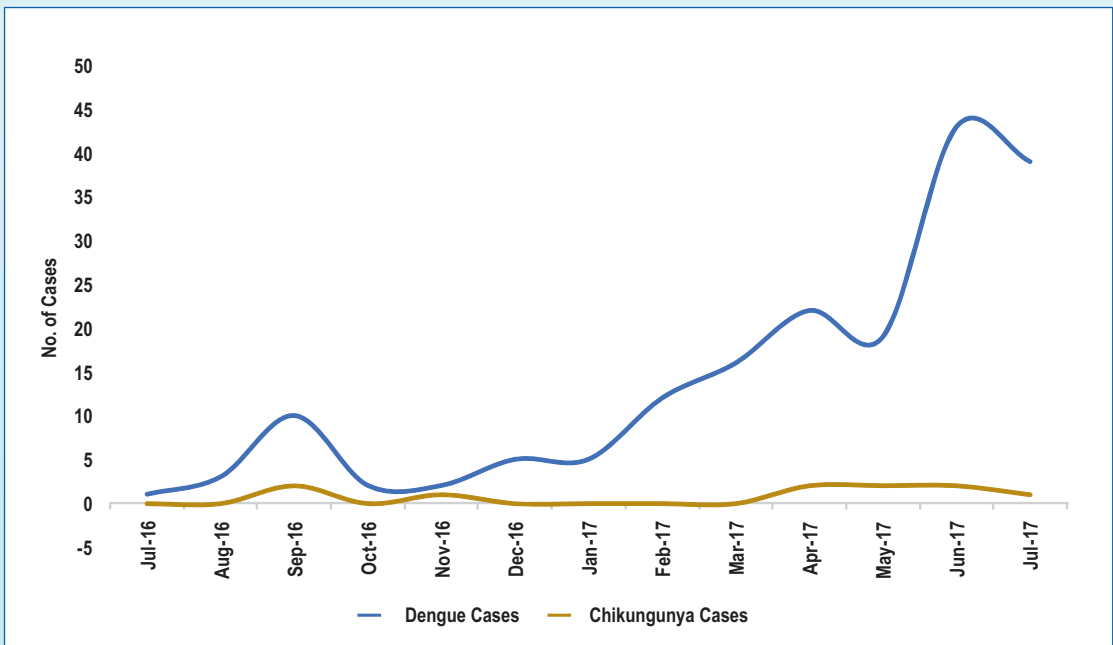
### **CHC Nellakottai**

As of 31 July 2017, a total of 320 cases were recruited from CHC Nellakottai, Nilgiris; out of which 142 (44%) could be provided with a definitive diagnosis. Major etiologies includes Influenza 64 (45%), Dengue 14 (10%), Scrub typhus 41 (10%), Leptospirosis 7 (5%), Rhinovirus 5 (3%), and others 24 (17%). Co-infections for more than one pathogen accounts for 14 (10%) of the cases.

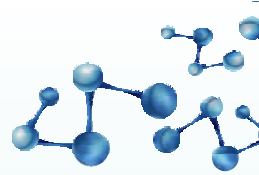


**Seasonal trend of Dengue and Chikungunya Cases from Krishnagiri**

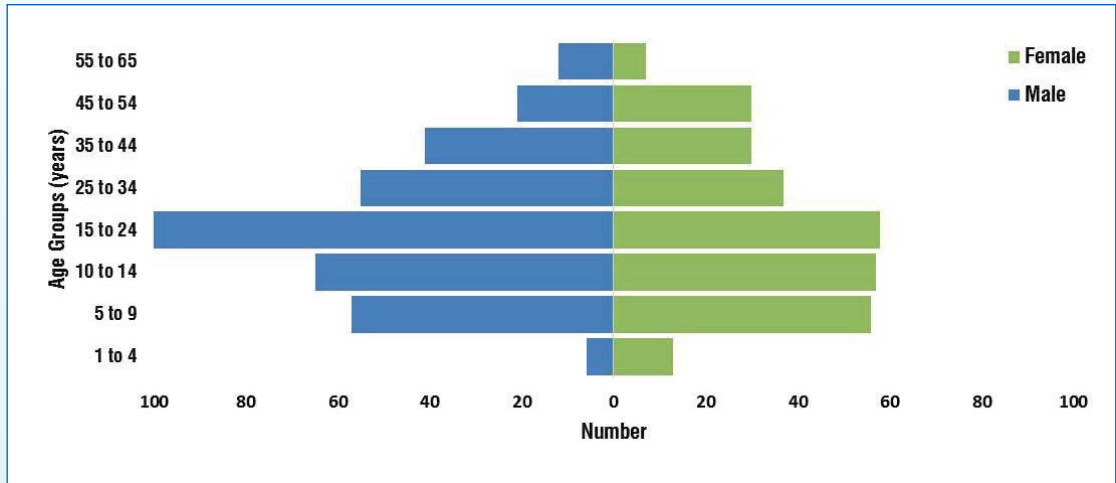
The figure shows the seasonal trend of dengue and chikungunya in Krishnagiri. The graph shows an increasing trend of dengue and chikungunya in the post-monsoon season from March, peaks in June and start to decline.



**Seasonal trend of Dengue and Chikungunya Cases from Nilgiris**

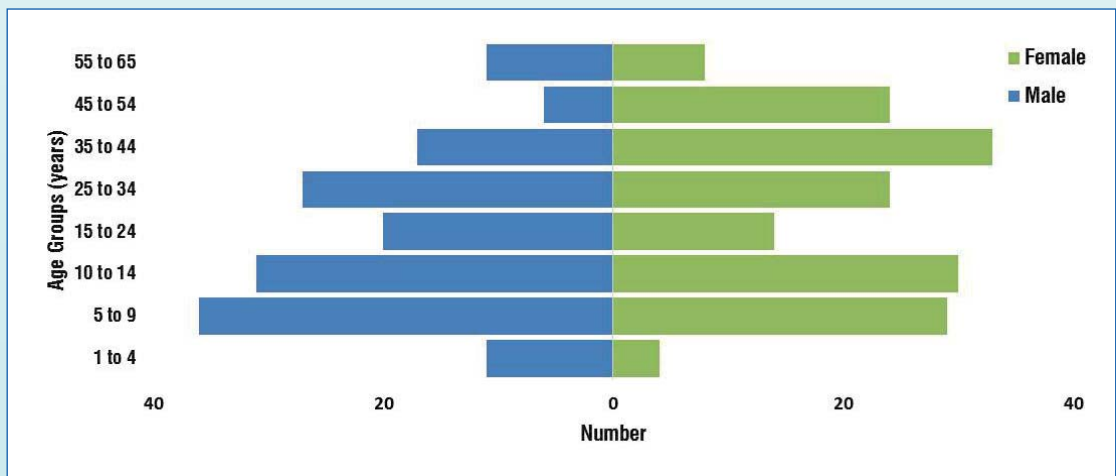


The figure shows the seasonal trend of Dengue and Chikungunya in Nilgiris. The district reported dengue activity throughout the year and peaked during June 2017.



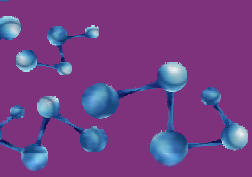
**Age and Gender distribution of Dengue Cases from Tamilnadu, 2016 to 2017**

The figure shows the age-wise and gender-wise distribution of dengue cases in Tamil Nadu. The majority (55%) of the cases were males and (45%) were females. Majority of the cases belong to the age group of 10 to 19 years.



**Age and Gender distribution of Chikungunya Cases from Tamilnadu, 2016 to 2017**

The figure shows the age-wise and gender-wise distribution of chikungunya cases reported in AFI sites of Tamil Nadu. 51% were females, and 49% were males. Majority of the cases belong to the age category of “10 to 19 years” followed by “2 to 9 years”.

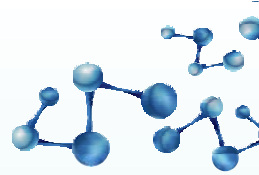


## TRIPURA

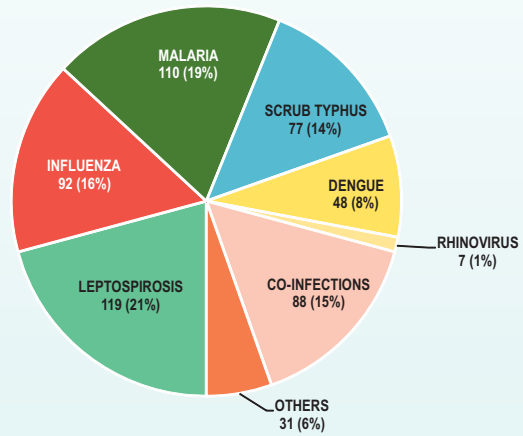
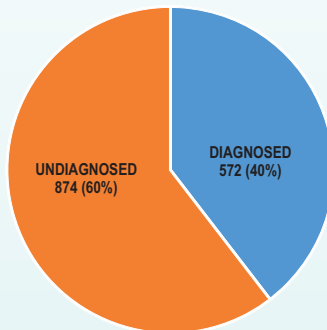


Dhalai District was formed in the year of 1995 by bifurcating North Tripura District and including part of Amarpur Sub-Division of the South Tripura District. The District is named after Dhalairiver which originates in the district. Located in the north-eastern part of Tripura, the district covers an area of about 2426 sq km. More than 70% area is forest covered; mostly undulating and hilly with small water streams, rivers and fertile valleys intervening. The District headquarter at Ambassa is located at a distance of about 85 km from the capital, Agartala. Bangladesh surrounds the district on the northern and southern sides.

The case recruitment for the AFI Surveillance started on the 6 June 2016 at Community Health Centre (CHC), Manu. CHC Manu is a 120-bedded hospital, which is a referral unit for the surrounding areas. We initiated recruitment from Sub Divisional Hospital (SDH), Chailenta on 21 June 2016 followed by Primary Health Centre (PHC), Chawmanu on 13 June 2016. The fourth sentinel site was set up in Primary Health Centre (PHC), Manikpur wherein the case recruitment was initiated on 15 June 2016. All the samples are collected and sorted in Manu, and from there it is handed over to the logistics partner who delivers it to us via Agartala, Kolkata & Bengaluru or Mumbai.



**AFI ETIOLOGY, TRIPURA**  
**TOTAL CASES RECRUITED = 1446**  
**DURATION - 06.06.2016 - 31.07.2017**



A total of 1446 cases have been recruited under the AFI surveillance in Tripura till 31 July 2017; out of which, 572 (40%) cases could be provided with a definitive diagnosis. Leptospirosis 119 (21%), Influenza 92 (16%), Malaria 90 (16%), Scrub Typhus 77 (14%) and Dengue 48 (8%) are the major aetiologies reported from Tripura. Co-infections account for 109 (19%) cases.

#### CHC Manu

As of 31 July 2017, the site has recruited 626 cases of acute febrile illness, of which 213 (34%) were having positive results for different aetiologies. The major aetiologies reported were Influenza 60 (28%), Leptospirosis 48 (23%), Scrub typhus 35 (16%), Malaria 17 (8%), Rhinovirus 4 (2%) and Dengue 4 (2%). Co-infection accounted for 30 (14%) cases.

#### SDH Longtarai

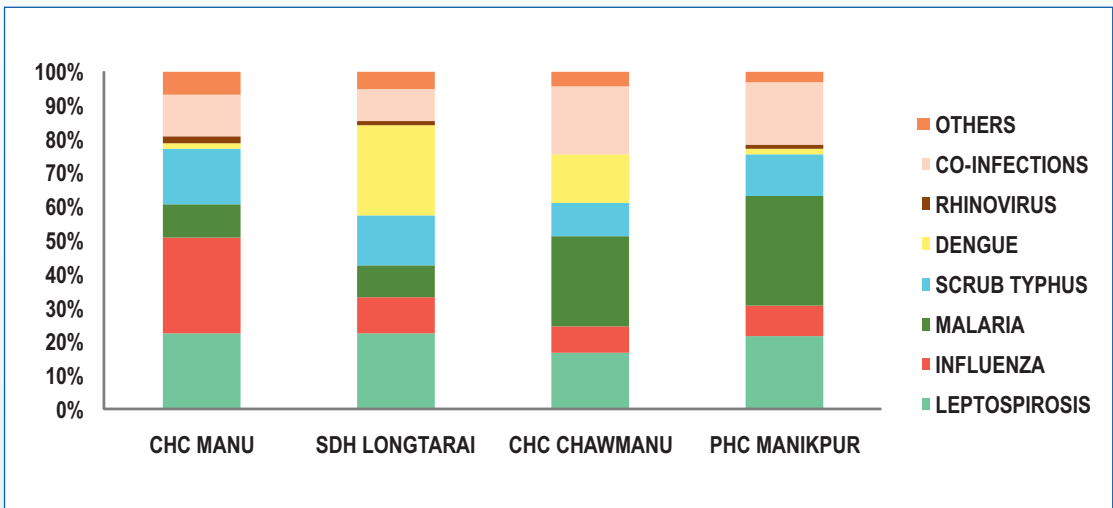
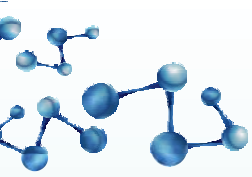
As of 31 July 2017, the site has recruited 301 cases of acute febrile illness, of which 75 (25%) were having positive results for different aetiologies. The major aetiologies reported were Dengue 20 (27%), Leptospirosis 17 (23%), Scrub typhus 11 (15%), Influenza 8 (11%) and Malaria 5 (7%). Co-infection accounted for 9 (12%) cases.

#### CHC Chawmanu

As of 31 July 2017, the site has recruited 291 cases of acute febrile illness, of which 154 (53%) were having positive results for different aetiologies. The major aetiologies reported were Malaria 31 (20%), Leptospirosis 26 (17%), Dengue 22 (14%), Scrub typhus 15 (10%) and Influenza 12 (8%). Co-infection accounted for 41 (27%) cases.

#### PHC Manikpur

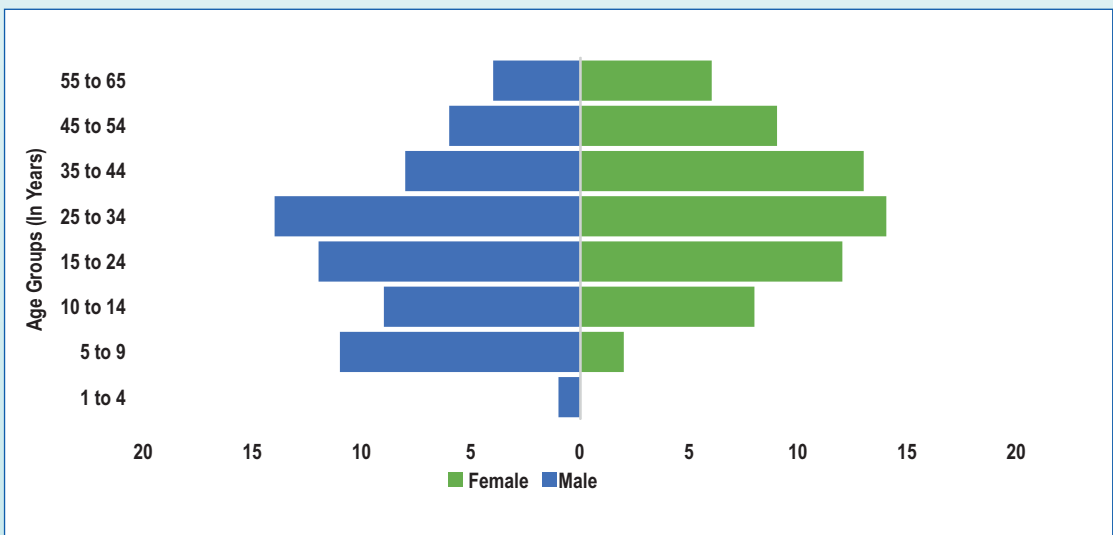
As of 31 July 2017, the site has recruited 228 cases of acute febrile illness, of which 130 (57%) were having positive results for different aetiologies. The major aetiologies reported were Malaria 37 (28%), Leptospirosis 28 (22%), Scrub typhus 16 (12%), Influenza 12 (9%) and Dengue 2 (2%). Co-infection accounted for 29 (22%) cases.



Distribution of Lab Confirmed AFI etiologies in Tripura

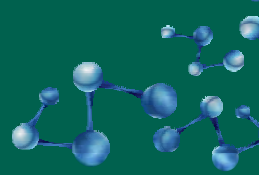
### Leptospirosis

During the period of June 2016 to July 2017, the 4 sites of Tripura has recruited 1446 cases of acute febrile illness, of which 572 (40%) were having positive results for various aetiologies. 119 (21%) were positive for leptospirosis. 51% were male and majority of the cases belong the age group of 25 to 34 years.



Age and Gender-wise distribution of Leptospirosis Cases from Tripura





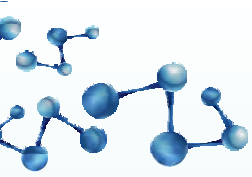
## UTTAR PRADESH



### Deoria

Deoria district has a population of 3,098,637 across 16 administrative blocks. Within Deoria district, there are 8 community health centres with 16 Primary Health Centers (PHC). Located on the eastern part of Uttar Pradesh, the District Hospital, Deoria caters to a predominantly rural population of the state. The AFI surveillance is proposed to be extended to Deoria district, which is already a site in the AES surveillance platform being conducted by NIMHANS, Bengaluru. This activity will be an amalgamation of the AES Platform and AFI Platforms and will be conducted by NIMHANS and MCVR jointly.

Deoria district hospital will be the primary sentinel site for AFI Surveillance in Uttar Pradesh. The platform will also be extended to one sub-district level facility in the district. The implementation of AFI surveillance in a region where acute encephalitis poses a major public health burden has the potential to more accurately characterize the etiologies of AFI in the area, and support identification of a broader range of pathogens that may lead to acute encephalitis. The sites are proposed to be functional as AFI surveillance sites in the first quarter of 2018.



## Influenza

Influenza is an acute respiratory illness caused by influenza viruses. Human influenza viruses such as the influenza A and B subtypes are responsible for the seasonal outbreaks every year. Acute febrile illness (AFI) surveillance network plays a crucial role in monitoring influenza activity and studying the circulating viruses in the country.

The tests and assays used by MCVR in influenza diagnostics include Influenza Real Time rt-PCR (CDC Protocol). Hemagglutination Assay and Hemagglutination Inhibition Assay is also used for typing of influenza virus.

AFI surveillance has identified 4115 cases of laboratory-confirmed Influenza since the beginning of the project in June 2014. Influenza cases were reported from Karnataka, Tamil Nadu, Kerala, Assam, Maharashtra, Goa, Gujarat, Tripura, Jharkhand, and Odisha. 1643 (39.93%) cases of influenza A (H1N1) pdm09, 1105 (26.85%) cases of influenza A (H3N2), and 1367 (33.22%) cases of influenza B were reported since June 2014.

The mean age of the affected influenza cases is  $25.83 \pm 16.57$  years. (Median: 23 years, IQR: 26 years). Mean age among Influenza A (H1N1) cases is  $27 \pm 17$  years. Mean age among Influenza A (H3N2) cases is  $30 \pm 16$  years. Mean age among Influenza B cases is  $20 \pm 14$  years.

**Figure 1.** Seasonality of Influenza, AFI Surveillance (June 2014 - July 2017)

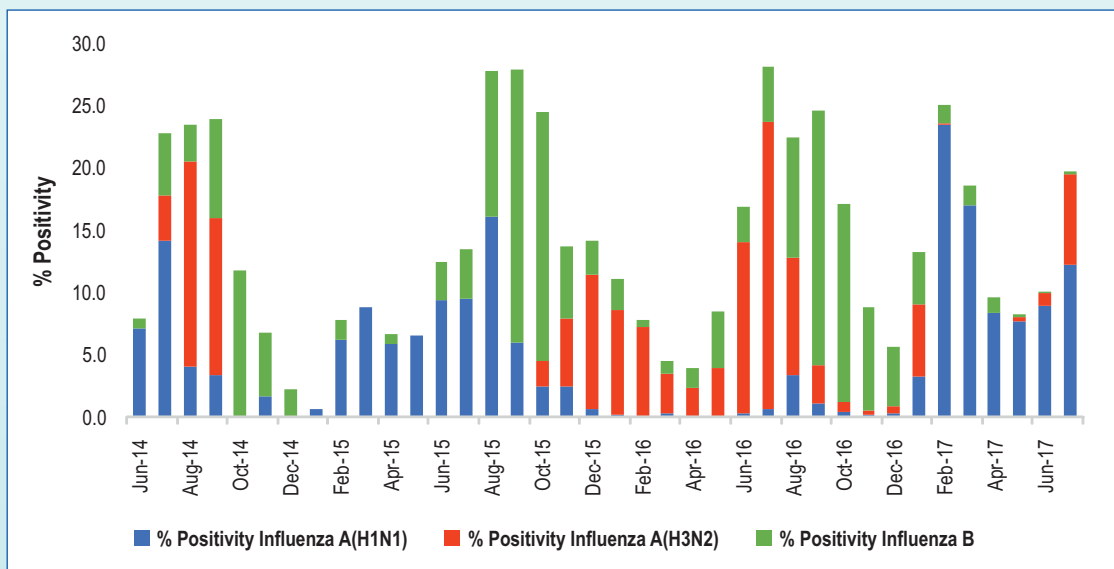
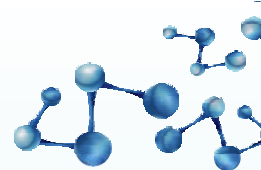
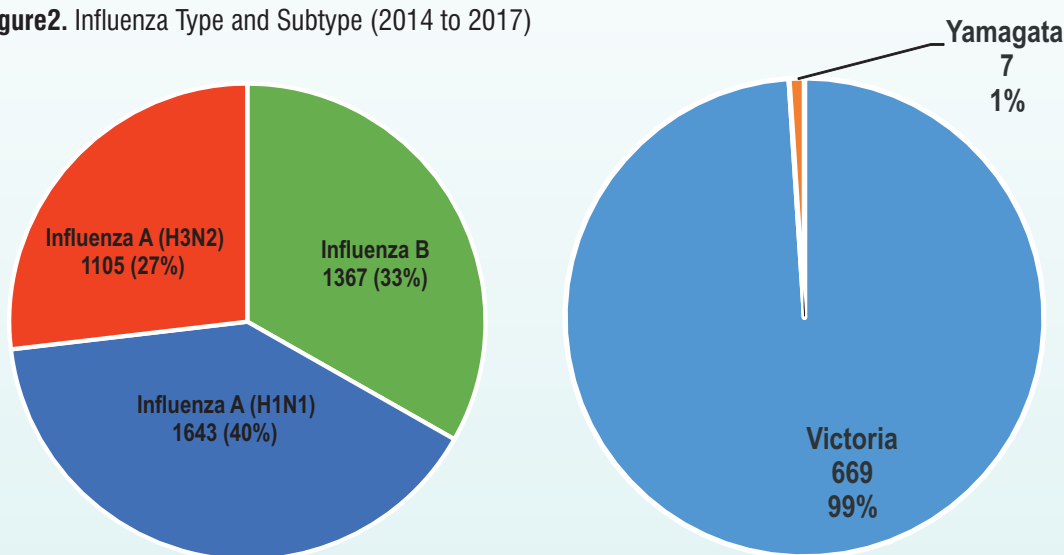


Figure 1 shows the seasonality of Influenza infection and the circulating virus types since June 2014. There is increasing trend of H1N1 activity since Dec 2016, peaks at March 2016, and declines in April 2017.

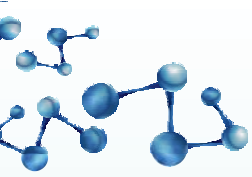
**Figure2.** Influenza Type and Subtype (2014 to 2017)

Among the circulating viruses, Influenza A (H1N1) pdm09 accounted for 40%, while 33% of the cases belonged to Influenza B; 27% of the cases belong to Influenza A (H3N2).

The circulating Influenza A (H1N1) pdm09 were Michiganlike strains. The predominant circulating Influenza B virus was Victoria lineage (99%).

**Table1.** State-wise circulating Influenza viruses

States	Influenza A (H1N1)	Influenza A (H3N2)	Influenza B	TOTAL
Assam	141 (35%)	132 (33%)	129 (32%)	402
Goa	20 (17%)	54 (46%)	43 (37%)	117
Gujarat	16 (14%)	39 (35%)	57 (51%)	112
Jharkhand	13 (25%)	24 (46%)	15 (29%)	52
Karnataka	688 (41%)	494 (29%)	504 (30%)	1686
Kerala	212 (45%)	139 (29%)	121 (26%)	472
Maharashtra	55 (39%)	42 (30%)	44 (31%)	141
Odisha	17 (77%)	2 (9%)	3 (14%)	22
Tamil Nadu	457 (45%)	138 (14%)	423 (42%)	1018
Tripura	24 (26%)	41 (44%)	28 (30%)	93
TOTAL	1643 (40%)	1105 (27%)	1367 (33%)	4115



**Figure3.** State-wise circulating Influenza viruses

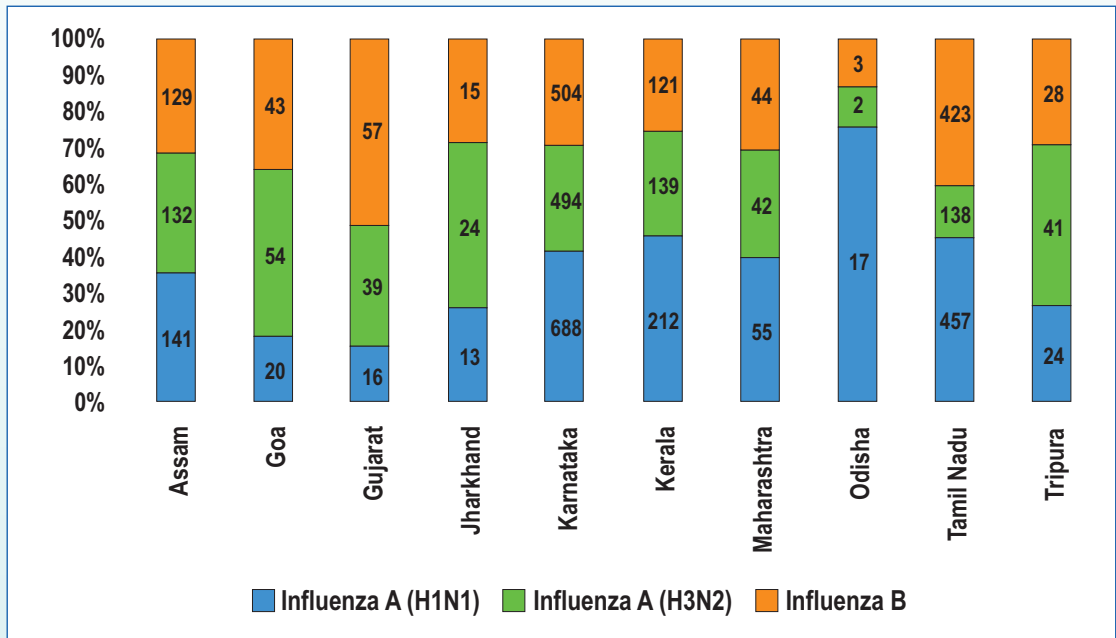


Figure 3 shows the state wise distribution of different Influenza viruses

**Figure 4.** Age and Gender-wise distribution of Influenza cases

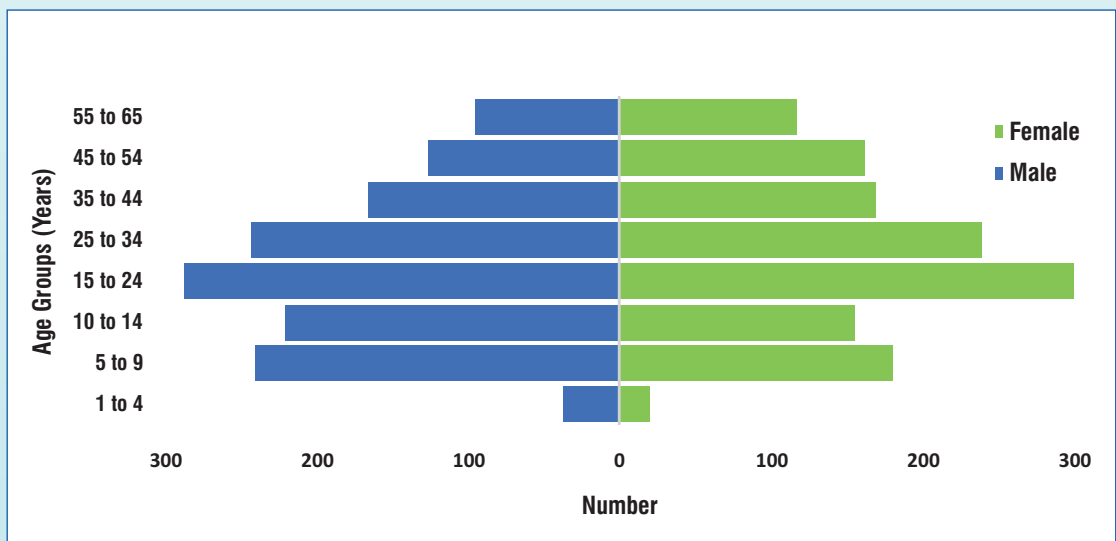
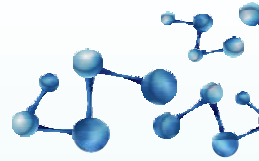


Figure 4 shows the age-wise and gender-wise distribution of Influenza cases. 51% were males and 49% were females. Majority of the cases belong to the age category of 10 to 20 years.



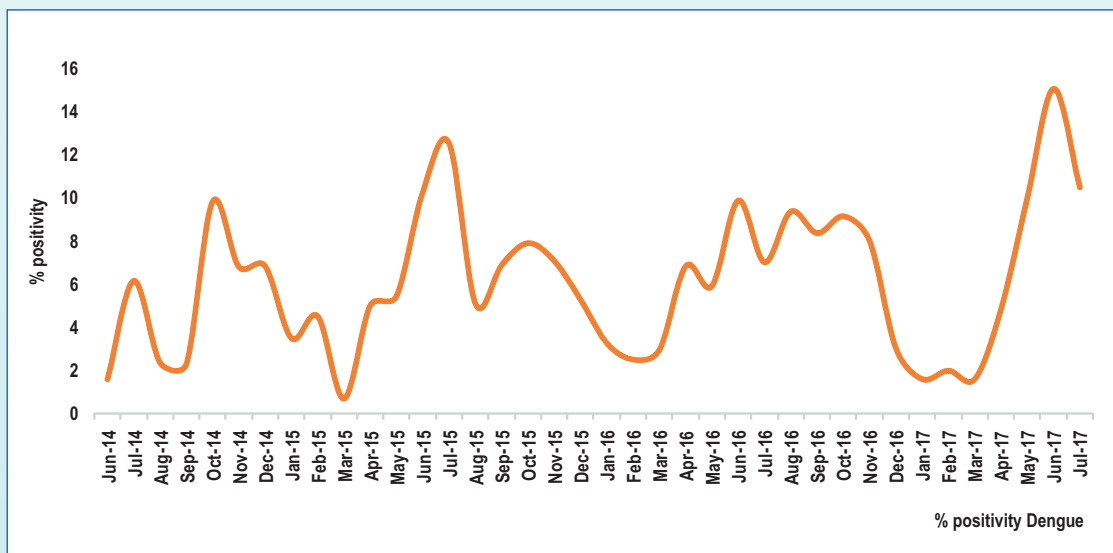
## Dengue

Dengue is the mosquito-borne viral disease transmitted by *Aedes* mosquitoes. Dengue is widespread in India with local variations in risk factors influenced by rainfall, temperature and unplanned rapid urbanisation. Dengue has been endemic in India for over two centuries as a benign and self-limiting disease. Most of the cases go undiagnosed and underreported. There are four distinct, but antigenically related, serotypes of the virus that cause dengue, namely, DENV-1, DENV-2, DENV-3 and DENV-4.

The tests and assays used by MCVR in Dengue diagnostics include Dengue IgM ELISA, Dengue IgG ELISA, Dengue NS1Ag ELISA (Panbio), Dengue Real Time PCR and Triplex PCR.

In the period of June 2014-July 2017, a total number of 1898 Dengue cases were recorded. The highest number of cases were from Tamil Nadu (647) followed by Karnataka (398), Assam (307) and Kerala (282). Case fatality rate is 0.1%.

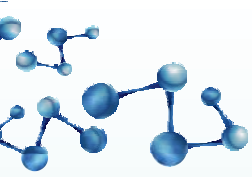
Out of 1898 cases, 1182 were males (62%) and 716 were females (38%) and majority of the cases belonged to the age group of 15 to 24 years (Figure 1). The mean age is 28 years (range 1-65 years). Similar to other countries from Asian continent (Sri Lanka, Malaysia and Singapore), there is a consistent pattern of excess in male cases in adolescent and adult males. In children below 5 years, females had comparatively higher dengue reporting rate.



Percentage positivity of Dengue from June 2014 to July 2017

### Dengue serotypes

Out of 810 positive cases which, 481 samples were serotyped. DENV-1 is the predominant serotype circulating in India in this period with 314 (65%) recorded cases. It is followed by DENV-3, 78(16%), DENV-2, 72(15%) and DENV-4, 17(4%).



# Scrub Typhus

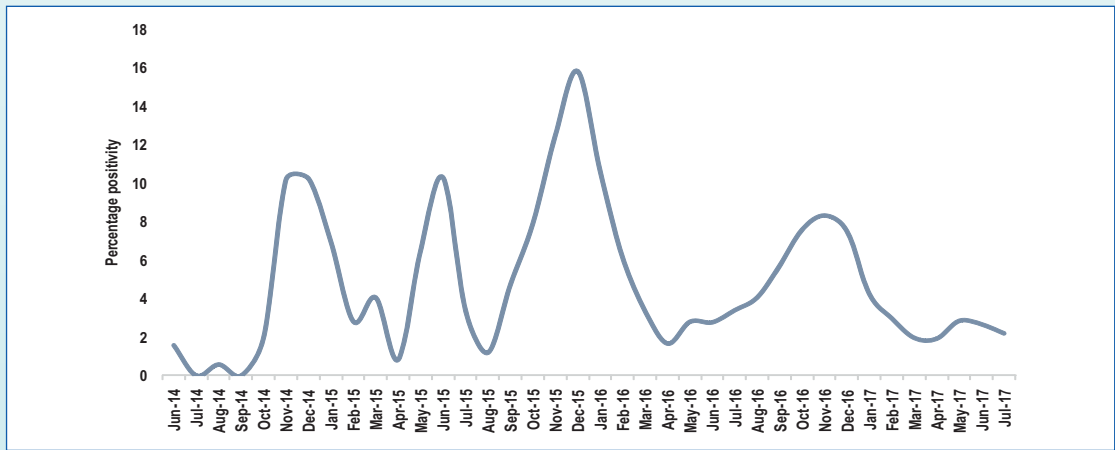
Scrub typhus is a rickettsial disease caused by the organism *Orientia tsutsugamushi*. The organism is transmitted through the bite of larval forms (chiggers) of trombiculid mites. It presents as either a non-specific febrile illness with constitutional symptoms such as fever, rash, myalgia and headache. Scrub typhus has been documented in India as early as 1932 and it has emerged as a major public health problem since the Second World War.

Trombiculid mites are the natural reservoirs of *O. tsutsugamushi* and transovarial and transstadial transmission maintains the infection among mites and their rodent hosts. While the mite larva feeds on small rodents, adult and nymphal stages are free-living in the soil, humans are accidental hosts and acquire the infection, when the infected mite larva bites. The transmission cycle of *O. tsutsugamushi* is very closely linked to the human-rodent-environment interface.

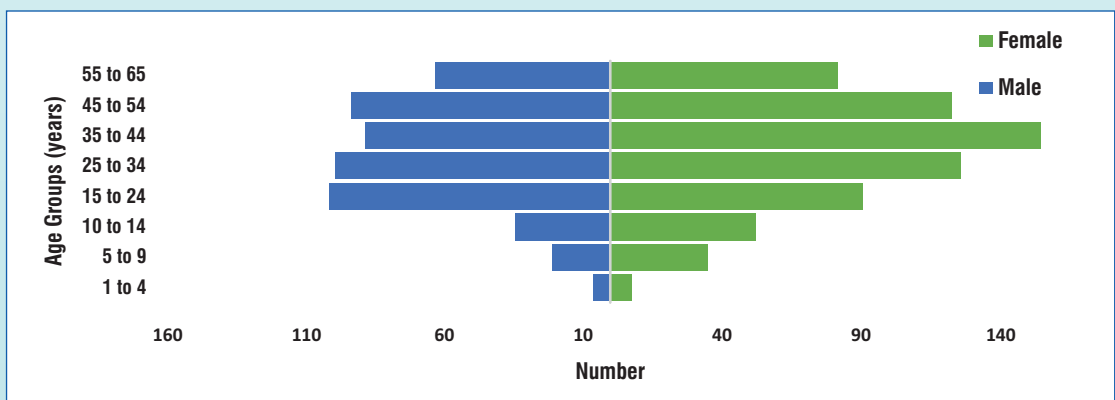
The tests and assays used by MCVR in Scrub Typhus diagnostics include Scrub Typhus IgM ELISA (InBios) and Scrub Typhus Uniplex Real-Time PCR.

The AFI Surveillance project provides great insights into the epidemiology of Scrub typhus, identifying it as one of the major etiologies causing hospitalisation. A total of 1177 (4.3%) patients were positive for scrub typhus out of 27,608 fever patients tested for infectious etiology from June 2014 to July 2017. Among scrub typhus positive cases, around one third were from the group aged between 25-54 years. Of scrub typhus positive cases, 60% were females. Also within the scrub typhus positive group, 436 (37%) cases had agriculture as their primary occupation (Table 1).

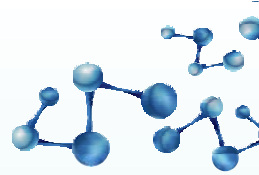
Out of 33 AFI surveillance sites from 10 states, Kerala (328 [28%]), Karnataka (314 [27%]) and Tamil Nadu (135 [11%]) contributed for 66% of Scrub typhus identified in the study.



Percentage positivity of Scrub typhus from June 2014 to July 2017



Age and Gender distribution of Scrub Typhus Cases



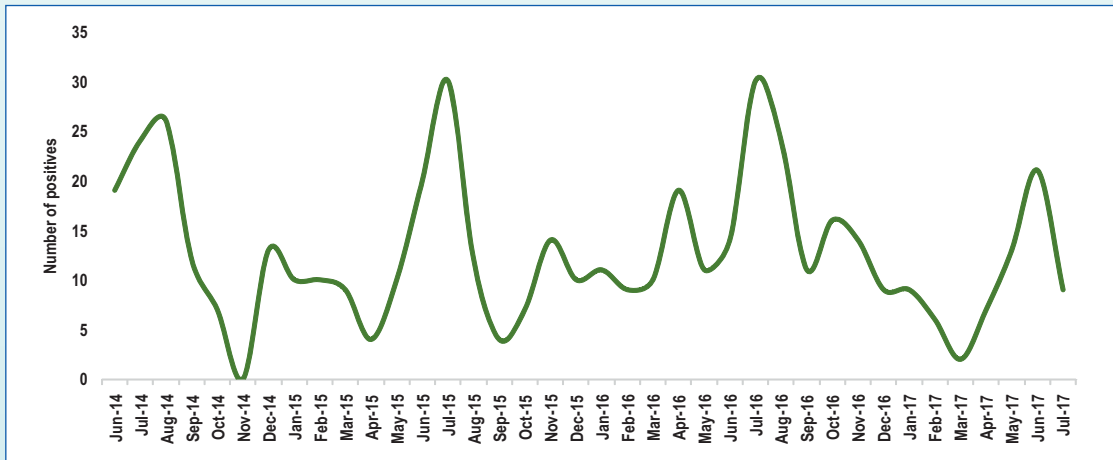
## Leptospirosis

Leptospirosis is a zoonosis of global distribution, caused by infection with pathogenic *Leptospira* species. The disease is emerging as a significant public health problem during the last decade or so due to a sudden upsurge in the number of reported cases and outbreaks.

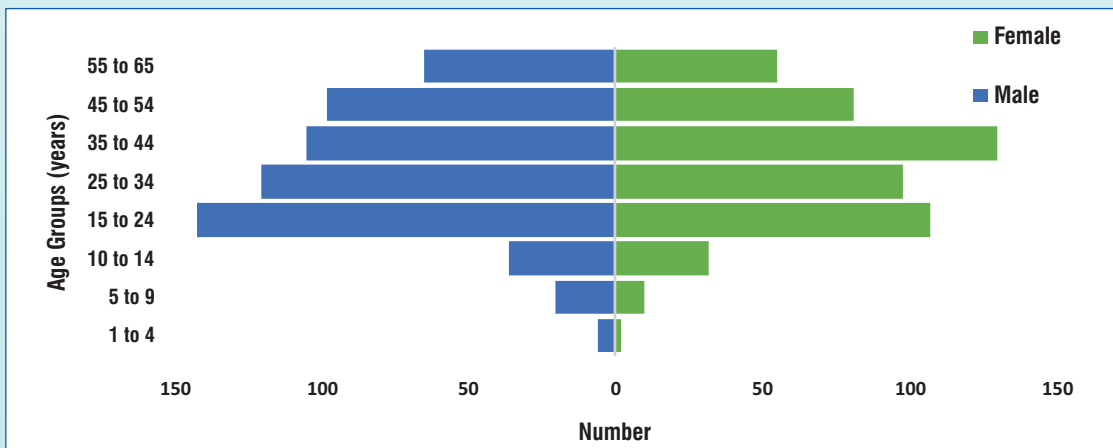
The tests and assays used by MCVR in leptospirosis diagnostics include *Leptospira* IgM ELISA (Panbio), *Leptospira* Uniplex Real-Time PCR (CDC protocol) and Microscopic Agglutination Test (MAT).

The prevalent *Leptospira* serovars identified at MCVR based on MAT include *L. georgia*, *L. bratislava*, *L. canicola* and *L. wolffi*.

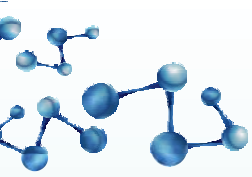
Leptospirosis account for 8.3% of the diagnosed cases in the current study. A total of 1107 lab confirmed cases of Leptospirosis were reported from June 2014 to 31st July 2017. Among these cases, 1096 were diagnosed by *Leptospira* IgM alone, while 7 cases were diagnosed by *Leptospira* PCR and 4 cases by *Leptospira* IgM & PCR. Most cases of Leptospirosis were reported from Karnataka (n=392) followed by Kerala (n=225), Assam and Tripura (n=143).



Seasonal trend of Leptospirosis (as of 31st July 2017)



Age and Gender distribution of Leptospirosis Cases

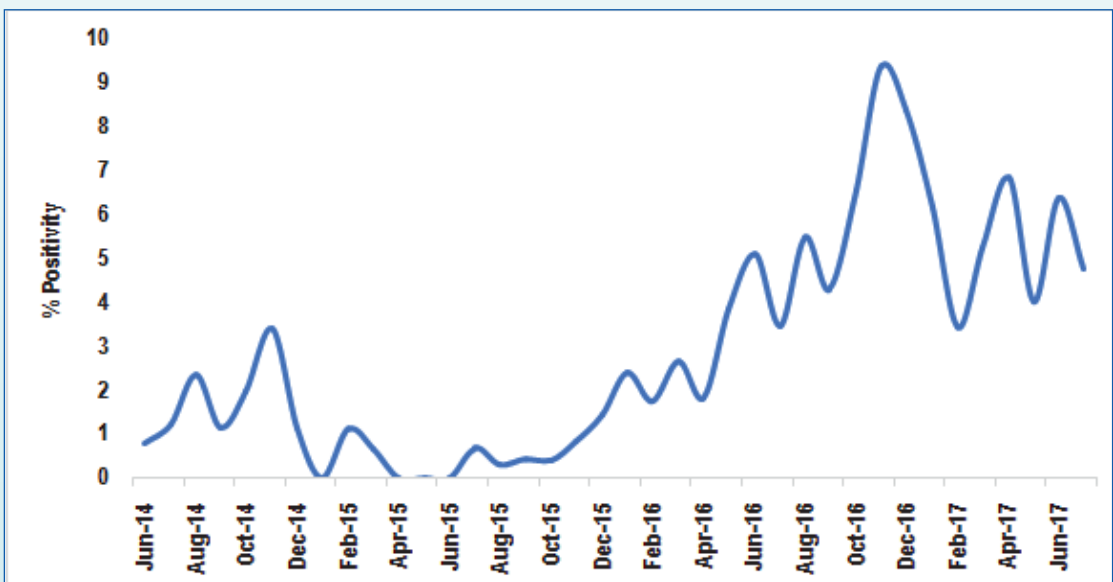


## Malaria

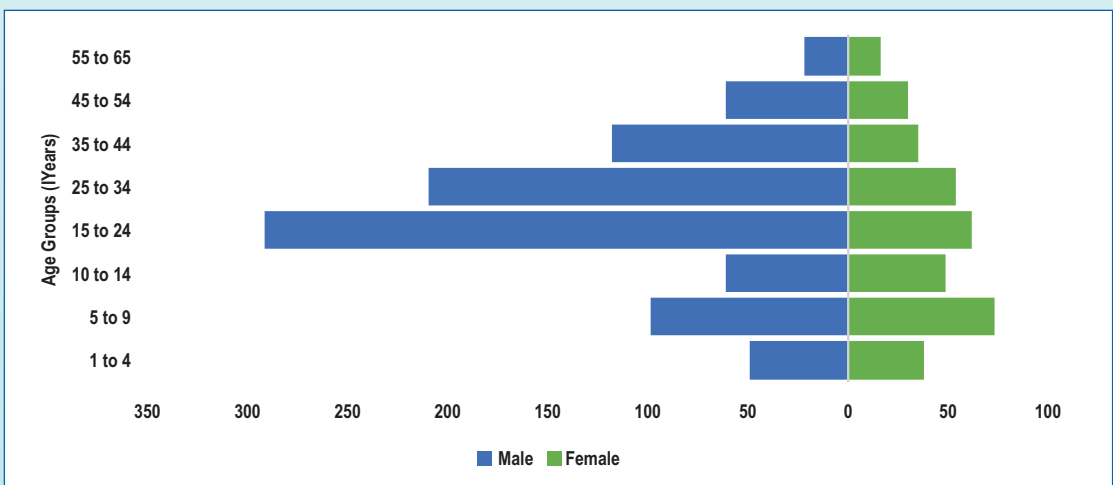
Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female *Anopheles* mosquitoes. It is preventable and curable. There are 5 parasite species that cause malaria in humans, and 2 of these species – *P. falciparum* and *P. vivax* – pose the greatest threat.

The tests and assays used by MCVR in Malarial diagnostics include Malaria card test (J. Mitra) and Malaria Uniplex Real-Time PCR.

Malaria account for 7.1% of the diagnosed cases in the current study. A total of 954 lab confirmed cases of Malaria were reported from June 2014 to 31st July 2017. Most cases of Leptospirosis were reported from Goa (n=365) followed by Odisha (n=235), Jharkhand (121) and Tripura (n=110).

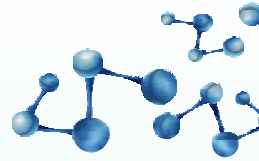


Seasonal trend of Malaria (Jun 2014 to July 2017)



Age and Gender-wise distribution of Malaria Cases (Jun 2014 to July 2017)





## Kyasanur Forest Disease

Kyasanur Forest Disease (KFD) is a tick-borne viral disease transmitted by Kyasanur Forest Disease Virus (KFDV) belonging to the family Flaviviridae and genus Flavivirus. KFD was first reported in March 1957 when there was an outbreak among people living near Kyasanur Forest of Sagara Taluk, Shimoga district, Karnataka state. Until recently, KFD was understood to be a disease confined to Shimoga district of Karnataka, but with the initiation of the AFI Surveillance, the disease has been documented in five states along the Western Ghats including Karnataka, Kerala, Goa, Maharashtra and Tamil Nadu. *Haemophysalis spinigera*, a tick, is the principal vector, while smaller animals like porcupines, rats,

squirrels, mice, shrews, cattle are the hosts while monkeys, Red faced Bonnet – *Macaca radiata* Black faced Langur – *Semnopithecus entellus* are amplifying hosts. Humans are accidental hosts.

KFD detection at MCVR is done by KFD Real Time PCR.

Among the total fever cases recruited, 493 (2%) of KFD cases identified. 56% were female and majority of them belong to age group of 35 to 44 years. Out of 33 AFI surveillance sites, Goa 261(54%), Karnataka 117(24%), Maharashtra 69(14%), Kerala 33 (7%), Tamil Nadu 13 (3%) contributed to the KFD identified in the study.

*Haemophysalis spinigera*

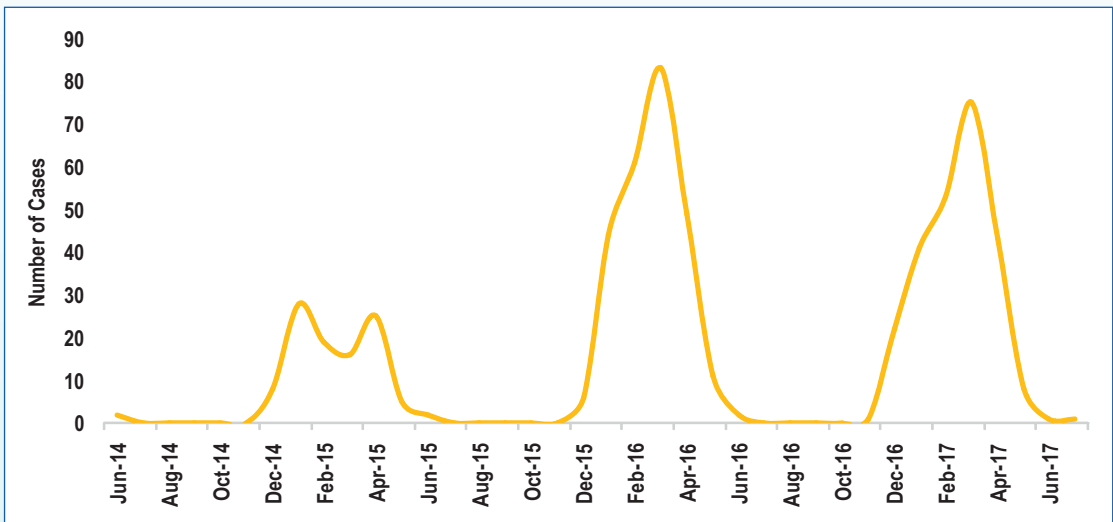
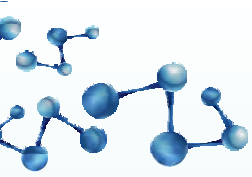


*Semnopithecus entellus*

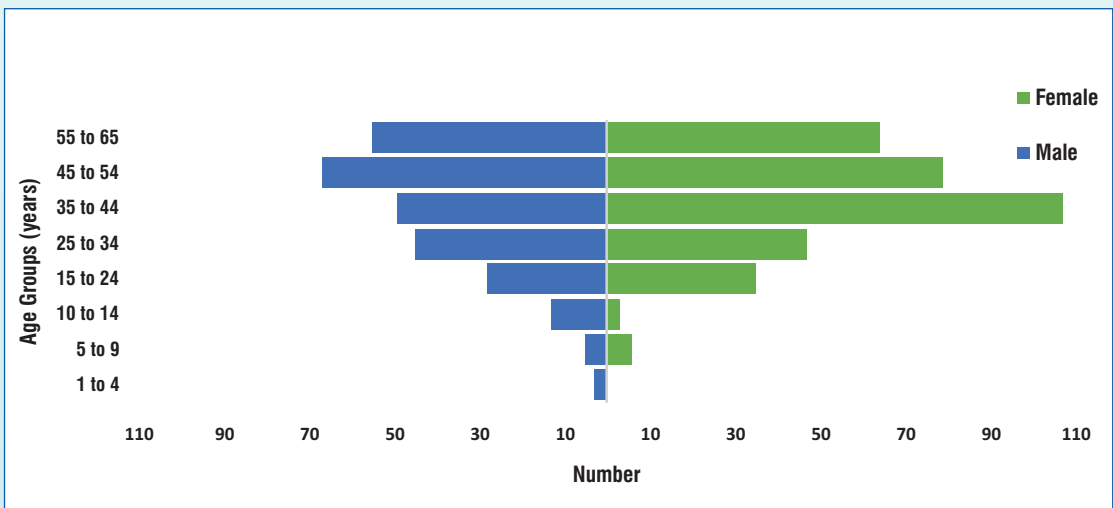


*Macaca radiata*

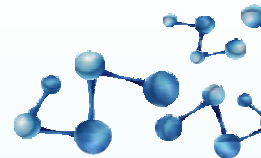




Seasonal trend of KFD ( Jun 2014 to July 2017)



Age and Gender-wise distribution of KFD Cases ( Jun 2014 to July 2017)



## Zika

Zika virus (ZIKAV) is an emerging mosquito-borne flavivirus, transmitted by the bite of an infected *Aedes* mosquito. Zika virus was first detected in 1947 from Uganda in monkeys, and later in 1952 from humans. As of early 2015, zika virus outbreaks have been reported from more than 65 countries. In 1952, Zika neutralizing antibodies were reported from patients in India. Considering the increasing international travel and wide prevalence of mosquito vector population, India is at high risk for Zika reintroduction and transmission.

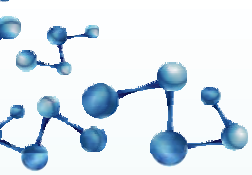
As of now four zika virus cases have been reported from India. On 15 May 2017, the Ministry of Health and Family Welfare-Government of India (MoHFW) reported first three cases of Zika virus from Bapunagar area, Ahmedabad District, Gujarat. Two months later, in July 2017, the AFI Surveillance platform detected the fourth case of zika virus from Krishnagiri district, Tamil Nadu.

Manipal Centre for Virus Research (MCVR) is a part of national zika virus surveillance in the country and contribute to more than 50% of the national data on Zika Surveillance since 2016.

MCVR follows the CDC's recommended real-time PCR assay for the detection of Zika virus in blood and urine samples.

- Triplex Real-time RT-PCR Assay. (Reference: CDC)
- UniplexrRT PCR – (Reference: Lanciotti RS, Kosoy OL, Laven JJ, Velez JO, Lambert AJ, Johnson AJ, Stanfield SM, Duffy MR. Genetic and serologic properties of Zika virus associated with an epidemic, Yap State, Micronesia, 2007, *Emerg Infect Dis* 2008; 8: 1232–1239)

Total AFI cases tested: 27, 586		
Age	1 to 65 years (Median: 29 years)	
Gender	Male (52%)	
Zika Positive cases : 1*		
State	No. of samples screened for ZIKV	Total tested positive for ZIKV
Karnataka	5635	0
Goa	2155	0
Gujarat	798	0
Jharkhand	1031	0
Tamil Nadu	4953	1
Kerala	2677	0
Assam	2643	0
Maharashtra	1124	0
Tripura	1146	0
Odisha	1483	0
*Indigenous case, no history of travel to ZIKV infected area, strain belongs to Asian lineage.		



## Testimonials

"My Health Ministry is committed in providing quality health care facilities to the people of Goa. We have given best facilities at the PHC, CHC and Rural dispensary to benefit rural population. Manipal Centre for Virus Research who has it's AFI unit at Valpoi has done a great job by supporting us to diagnose epidemics. Recently they diagnosed Shigellosis and Kyasanur Forest Disease also known as Monkey Fever. On behalf my department I thank MCVR and my good wishes for the annual review meeting on Acute Febrile Illnesses in India"

**Vishwajit P Rane**

Minister for Health, Government of Goa



Early diagnosis and treatment is the mantra of controlling communicable disease, this is what we achieved with help of MCVR's AFI Surveillance Platform. We are glad that patient's stay in hospital have decreased and unwanted referral to higher centre.

**Dr. Prabhakar Gujjarappa, JCH Thirthahalli**



Manipal Centre For Virus Research Acute Febrile Illness Surveillance Unit which is active at SDH Sawantwadi from last one year is of great help for us to diagnose fever patients within very short period and initiate the treatment promptly and correctly. It is really good work and we are thankful for it.

**Dr. Abhijit Chitari, SDH Sawantwadi**



Manipal Centre For Virus Research Acute Febrile Illness Surveillance Unit which is active at SDH Sawantwadi from last one year is of great help for us to diagnose fever patients within very short period and initiate the treatment promptly and correctly. It is really good work and we are thankful for it.

After establishing of the AFI Surveillance Unit at CHC Idar, Sabarkantha district, we are able to track the fever cases for better management and to understand the epidemiology of different diseases. We are also getting results in minimum time as sample are transported by air. It is also beneficial for the patients to get early treatment by timely diagnosis and for policy maker to take decision and allocate resources at right time and at right place to prevent further outbreak. We are very thankful to team MCVR headed by Dr. Arunkumar, for the support extended to Sabarkantha.

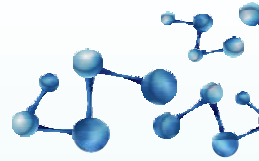
**Dr. Manish Fancy, CDMO Sabarkantha**



MCVR has been doing a great job by providing us with essential information in early detection of diseases. It has helped enormously in diagnosing patients with pyrexia of unknown origin (PUO). Detection of Dengue virus and Influenza B virus has been of special help in treating the patients in District Hospital Sonapur. We are indebted greatly to this project for diagnosing patients with acute febrile illness in the remote areas of our district which are generally not accessible to us.

**-Dr. Prarthana Goswami, District Hospital, Sonapur, Kamrup Metro**





The joint effort by Manipal Centre for Virus Research & District Medical Office in Wayanad district has resulted in identifying many outbreaks of diseases at a very early stage. It has also helped us to identify the correct causative agents of the outbreaks for the past many years. That has given us the options to control the outbreaks at a very early stage. Outbreaks are detected even before it is in a full bloom in the state so that we are able to control the number of cases that has occurred in each outbreak and also has been successful in preventing morbidity and mortality to a very large extent.



**-Dr. Jithesh V, District Medical Officer (Health), Wayanad.**

Thanks to MCVR, we are now able to get early diagnosis which helps us to treat and follow the patient. It also helps to undertake control measures at the earliest in the community.



**-Dr. Kathiravan, Block Medical Officer, Gudallur, Tamil Nadu**

Firstly, I express my heartfelt thanks for Manipal team. In the last month, my son was admitted in hospital and was severely ill. A member of Manipal team collected blood and other samples and because of that we got the result early and he received adequate treatment. My son is completely recovered now and I am feeling very happy. Again I express my heartfelt thanks for Manipal team



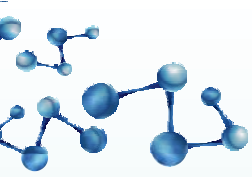
**Michael Raj (Patient's parent), Government Hospital- Gudalur, Tamil Nadu**

AFI study is helping the state surveillance by searching multiple etiologies at a time. Their fast reporting lets the public health system of the state to attend to diseases faster.



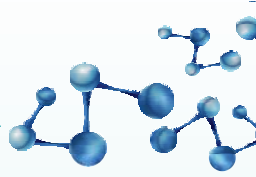
**Dr Pranab, Chatterjee**

Joint director, Directorate of Family Welfare And Preventive Medicine, Tripura.



## Impact of AFI Surveillance

1. Real-time laboratory confirmed infectious disease data at district/ state/ national level.
2. Real-time data for evidence based disease specific clinical management at sentinel hospitals leading to reduction in hospital stay and referrals to higher centres
3. Real-time data for evidence based public health response.
4. Redrew the boundaries of Kyasanur Forest Disease (KFD) in India and documented the burden of scrub typhus and influenza in rural India.
5. Early detection and laboratory confirmation of disease outbreaks such as KFD, Chikungunya, Dengue, Influenza, Anthrax etc.
6. Demonstrated that the availability of laboratory at or near community level changes the understanding the burden of infectious diseases and has a direct impact on disease control and case management.
7. Identified 6 major etiologies in the order of, influenza, dengue, scrub typhus, malaria, leptospirosis in all states, and KFD in states along the Western Ghats.
8. The data was also used for reprioritization of diseases by Integrated Disease Surveillance Program (IDSP) in a multisector exercise in 2016.
9. Established of a state of the art infectious disease laboratory at Manipal Centre for Virus Research (MCVR), Manipal and successfully transferred several technologies from CDC, Atlanta
10. Developed a unique workforce equipped with both laboratory and epidemiological skills, readily available for rapid deployment for disease outbreak investigation.



## Acknowledgements

- Ministry of Health and Family Welfare, Government of India
- Director General of Health Sciences
- Director General, Indian Council for Medical research (ICMR)
- Director, National Centre for Disease Control (NCDC)
- Director, National Vector Borne Disease Control Programme (NVBDCP)
- Global Health Security Agenda (GHSA) Cell
- Centers for Disease Control and prevention (CDC), Atlanta, USA
- GDD Centre in India and CDC India office
- State and District health officials of Karnataka, Kerala, Goa, Maharashtra, Assam, Gujrat, Jharkhand, Tamil Nadu, Tripura and Odisha
- National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru
- Manipal Academy of Higher Education (Deemed to be University)
- Team MCVR





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