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Research Article

An Investigation into Outbreak of Malaria in Bareilly District of Uttar Pradesh, India

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A B S T R A C T

Uttar Pradesh is the largest state of India and is comprised of 75 revenue districts. It has vast area of 243,286 km² and 230 million population (199.81 million as per 2011 census) with population density of 828 persons per km². The topographical & environmental conditions including availability of rich irrigation facilities provide congenial conditions for development of different vectors transmitting various diseases. All the six Vector Borne Diseases (VBD) namely malaria, dengue, Chikungunya, Japanese Encephalitis (JE), Kala-azar & Lymphatic filariasis are prevalent in Uttar Pradesh and are now modifiable in the state since 2016. Among these, malaria, JE, dengue etc. are epidemic prone and claim lives during outbreak, if remained unattended in light of the NVBDCP operational guidelines. During July/ August, 2018, district Bareilly experienced outbreak of malaria, which claimed several lives according to various reports appeared in the media. A team of Officers from Regional Office for Health & Family Welfare (ROH & FW), Lucknow visited Bareilly district of UP during September, 2018 to assess the various factors responsible for the present outbreak and to guide & support the district health authorities for proper implementation of the various intervention measures to contain the outbreak. The detailed investigations revealed that the reasons for outbreak may be assigned to the excessive rainfall in the district, poor surveillance due to inadequate number of peripheral health workers, lack of laboratory facilities and improper monitoring & lack of timely actions. The screening of people for malaria with bivalent antigen based RDT kits reflected high malaria positivity both *Plasmodium vivax* (P.v.) & *Plasmodium falciparum* (P.f.) incidence but no fever related death was confirmed due to malaria.

Keywords: Malaria outbreak, *Plasmodium vivax*, *Plasmodium falciparum*, RDT Kits, Slide Positivity Rate, Annual Parasite Incidence

Introduction

Uttar Pradesh is the largest state of India and is comprised of 75 revenue districts. It has vast area of 243,286 km² and 230 million population (199.81 million as per 2011 census) with population density of 828 persons per km.² About two third population resides in rural areas and mainly depend on agricultural practices as the Indo - Gangetic plain is contributing a lot in the fertile agricultural region for the development of not only the state but India as

a whole. Since this area is traversed be a number of big & small rivers, provide good opportunity & facility for irrigation of the crop fields. The co-lateral outcome of the irrigation facility led to the public health problem as every third person suffered due to malaria with high mortality & morbidity prior to the independence. The National Malaria Control Programme (NMCP) was launched in 1953 with organized control efforts by performing Indoor Insecticidal Spray (IRS) inside the human dwellings with the help of only introduced insecticide DDT 50% wdp. This IRS tool success led to implement National Malaria Eradication Programme (NMEP) in 1958 by bringing the malaria incidence to 0.10 million in 1965, thereby eradicated the dreadful disease from almost major parts of India. The malaria free areas were handed over to the basic health services for maintaining the malaria free status in the area but the expectation reversed due to occurrence of local & focal outbreaks of malaria with high morbidity & mortality, thereby increasing the toll of malaria cases to 6.47 million in 1977. Thus, in order to overcome the resurgence of malaria cases, Modified Plan of Operation (MPO) was launched in 1977, the successful implementation of which brought down the malaria cases between 2-3 million but large scale malaria epidemics occurred again in 1994 in different parts of India,[2] led technical officers to think over this issue seriously. Various technical, operational, financial & administrative issues were experienced to contribute the resurgence of malaria.[3] In order to ensure effective implementation of the programme, National Vector Borne Disease Control Programme (erstwhile National Malaria Eradication Programme) on the basis of recommendations of group of experts, formulated the operational guidelines for malaria action programme in the country in 1995 and[1] Moreover, the process indicators were developed, which gave the details of various processes to be carried out at each level from primary health care to the top most level as well as assessment parameters to evaluate whether the implementation is going in right track or not,[3] when the disease has been planned for elimination from the country.[7,8]

Even with the availability of the strong implementing technical guidelines, outbreaks of malaria are still occurring in various parts of the country as well as state. District - Bareilly (28.3670º N, 79.4304ºE) reported high pyrexia and causalities through various media reports. The present paper reflects the efforts made to (a) Investigate the cause of the unprecedented incidence, (b) Suggest the appropriate intervention measures to contain the epidemic, and (c) indicate the correctional actions & necessary steps for future program implementation in more effective way in the district.

Methodology

In order to find out the facts and the ground realities of the incidence, the office of the Chief Medical Officer, District Malaria (VBD) Officer, District Hospital, Bareilly, District Surveillance Unit (IDSP), CHC - Majhgawan (28.3051º N,79.2761ºE), CHC-Bhamora (28.2090ºN,79.2983ºE) & CHC - Faridpur (28.2091º N, 79.5378ºE), and two worst affected villages - Dhakora under CHC-Majhgawan and village - Sendhi under CHC - Bhamora were visited to find out of the operational aspects of various activities including vector prevalence and control measures in the field areas of Bareilly district of Uttar Pradesh (Figure 1).

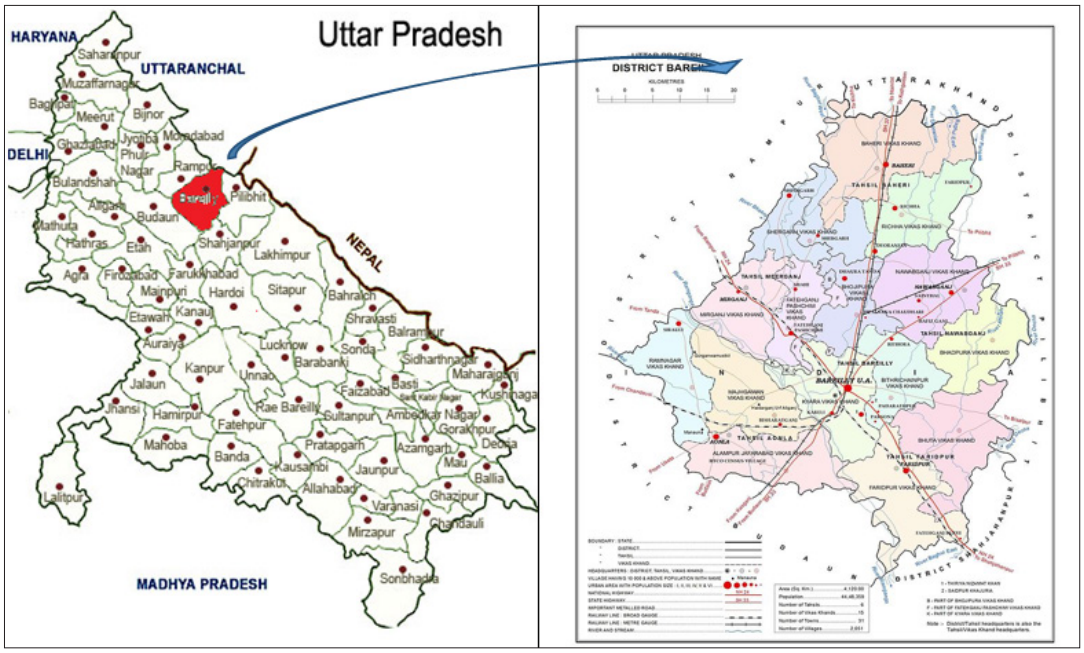

Figure 1.Map of District- Bareilly, Uttar Pradesh, India

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The office of District Malaria Officer/ VBD Officer was visited to find out and analyze the old record pertaining to malaria epidemiological situation of the district during past three years, the staff availability for implementing Vector Borne Disease Control Programme, the availability of logistic/ infra-structure in the district, the details of intervention measures undertaken by the district so far, the details of fever outbreak in the district & reasons of the same. The information on the details of deaths occurred in the district & death audit done by the authorities of PHCs, if the death considered due to malaria on prescribed format of National Vector Borne Disease Control Programme (NVBDCP) of Government of India & the vector prevalence in area and its role in the present outbreak was also gathered. The malaria epidemiological reports for the last three years, human resource details, intervention measures details were obtained from the District Malaria (VBD) office, Bareilly, Some other reports were obtained from CHC-Majhgawan, Bhamora & Faridpur and IDSP Unit Bareilly. Entomological surveillance was undertaken in village - Dhakora under CHC -Majhgawan and village - Sendhi under CHC-Bhamora. The data obtained were analyzed and findings are presented in this communication.

Result and Discussion

The details of the fever affected CHCs/PHCs depicting malaria incidence are reflected in Figure 2A, 2B & 3A, 3B. It is evident from the figures that the most malaria affected areas were CHC-Majhgawan, Aonla, Faridpur & Bhamora, as they contributed 75% of malaria positives by RDT kit, CHC - Majhgawan contributed highest (38.22%), followed by CHC - Bhamora (18.67%), Aonla (9.57%) & CHC-Faridpur (7.31%), of total malaria positives, whereas, Majhgawan, Aonla, & Bhamora contributed 87% of *Plasmodium falciparum,* malaria positives, Majhgawan was highest contributor (59.90%) followed by Bhamora (18.18%) & Aonla (9.14%).

The CHC-Majhgawan, which has reported the highest number of fever cases was visited. The area of Majhgawan CHC is located on banks of river Ramganga and reflected increased fever incidence, having no positivity for malaria in reports communicated from the CHC-Majhgawan laboratory, though the persons reflected clinical symptoms of malaria. This CHC has 239000 (approx.) population residing in 147 villages, out of which 122 villages (approx. 200000 population) were under the grip of fever. The CHC has 29 deaths related to fever, of which first death occurred in Village - Ballai on 30th August, 2018 & last death occurred village Dhamora on 25th September, 2018. The village was visited & enquired about the death. The death of a lady aged about 90 years was natural as informed by the villagers. However, the local media reported this death due to malaria.

The LT of CHC - Majhgawan, submitted a false report to district IDSP unit, Bareilly without preparing any blood smear from fever cases (Table 2), Moreover, when RDT kits were also not supplied to him equal to the number of tests performed by him from 2015 to 2018 (till the visit of the team). Only 100 RDT kits were supplied to him on 09-05-2015 and no replenishment was done thereafter. This discrepancy in the report submitted by CHC to district IDSP unit was a matter of serious concern and to be looked into by district and state health authorities, in order to avoid false reporting in future. The LT was imparted malaria orientation training at State Malaria (VBD) Head quarter, Lucknow conducted from January to March, 2018. The Superintendent of CHC was also not serious & vigilant for supervising the work of sub-ordinates and ability for holding the responsible position, because the technician was not performing the examination & accordingly not reporting malaria positives in L-Form of IDSP, when this CHC was most affected area of the district among all the CHCs/PHCs.

The CHC- Bhamora, was the next highest fever affected CHC, and with a population of about 2.50 lakh. This CHC has 174 villages, out of which 120 villages are in the grip of fever. However, no suspected death due to unidentified fever has been reported from any of the villages of this CHC, but IDSP list has included one fever associated death from one village.

The CHC - Faridpur is the highest fever affected CHC, and has about 3.00 lakh population. It was told that CHC area is in the grip of fever and two suspected death due to unidentified fever occurred in the villages of this CHC and IDSP list also includes two fever associated deaths. The death includes: (1) Mrs. Anita 22 year female w/o Mr. Rajesh R/o Rajan Paraspur expired on 27.8.208 on the way to hospital, got treatment in Ala Hazrat Hospital, Bareilly on 25-8-2018 & left hospital on 26-8-2018, (2) Ms. Khushaboo 19 year female, D/o Mr. Onkar R/O Pitampura and expired on 25-8-2018 in Global Hospital, Bareilly. She was treated in the hospital from 23rd to 25th August, 2018 in the hospital, (3) Another death of Mr. Radhey Shyam, 35 years/male occurred on 31-8-2018 due to jaundice. He got his treatment at private hospital. It is another CHC, where Laboratory Technician (LT), was working since 2007. He showed malaria positive blood slides and told that as per directions from higher authorities RDT kits were being used. The CHC was provided with two types of RDTs which are shown in Figure 4. He was asked to prepare & examine the blood smears of RDT positive patient. The technician has got malaria orientation training at State Malaria (VBD) Head Quarter, Lucknow conducted from January to March, 2018. On scrutiny of the laboratory register, it was found that no malaria microscopy was done by LT and only RDT were being used to diagnose malaria. It was found that till 11th Sep, 2018 only a few *Plasmodium vivax* cases has been detected by RDT, However, from 12th September, 2018

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onwards, a sharp rise in malaria cases were observed (both *Plasmodium falciparum* & *Plasmodium vivax*) as detected by RDT.

The District Male Hospital was also visited to know the status of the fever cases & prevalence of malaria cases. One pathologist is posted at district hospital laboratory, which is also designated as the Regional diagnostic laboratory. The report of malaria case screening is given below in table-1. The RDT kits of Oscar Medicare Pvt. Ltd., New Delhi & Malcard by J. Mitra & Co. Pvt. Ltd., New Delhi were used in the laboratory. Some malaria positive slides were shown with gametocyte stage of *Plasmodium falciparum* (Pf), conforming to the presence of disease reservoir as gametocytes take more time to develop, but no other stages of *Plasmodium falciparum* parasite were present in the laboratory.

District IDSP unit, Bareilly was also visited to find out the communication of early warning signals of fever different CHC/PHC of the district. The IDSP unit comprises of one Epidemiologist, one Data Manager, & one Data entry operator. The reports of CHC-Majhgawan, provided on L-Format, did not reflect any abnormality of any disease/ fever even in the report of 24th September, 2018. No case of P.f. has been shown since 25th June, 2018 (Table 2).

The unit also provided the list of 25 fever associated deaths (17 of Majhgawan, 03 of Ramnagar, 02 of Faridpur and, one each of Bhamora, Bhojipura & Kyara) and 21 non fever associated deaths (15 of Majhgawan, 04 of Ramnagar & 02 of Kyara). However, none of the deaths was conformed due to malaria and no death audit was carried out by the district health authorities in view of the clinical symptoms and as per guidelines laid by NVBDCP on the prescribed format.

Table 1.Report of Malaria case screening in District Male Hospital Bareilly

S. No.	Month	Blood smears examination		Examination by RDT		Remarks
		Number	Result	Number	Result	
1.	January, 2018	483	All Negative	10	All Negative	No malaria case found till 25th August, 2018 though there was considerable increase in fever incidence during July, 2018
2.	February, 2018	680	All Negative	18	All Negative	
3.	March, 2018	1307	All Negative	68	All Negative	
4.	April, 2018	1167	All Negative	44	All Negative	
5.	May, 2018	1109	All Negative	59	All Negative	
6.	June, 2018	1401	All Negative	50	All Negative	
7.	July, 2018	1582	All Negative	61	All Negative	
8.	August, 2018	732	All Negative	36	01 P.v. on 25-8-2018	
9.	September, 2018	401	All Negative	35	All Negative	
	Total	8862	All Negative	381	01 P.v. on 25-8-2018	

Table 2.Reporting on Form-L of IDSP from CHC-Majhgawan in District - Bareilly

S. No.	Date of reporting	Week of the report (Form-L)	No. of Samples tested	Result as malaria Positives	
				P.v.	P.f.
1.	25.06.2018	18-23.06.2018	137	03	00
2.	02.07.2018	25-30.06.2018	139	03	00
3.	09.07.2018	02-07.07.2018	239	02	00
4.	16.07.2018	09-14.07.2018	242	02	00
5.	23.07.2018	16-21.07.2018	142	02	00
6.	23.07.2018	23-28.07.2018	108	00	00
7.	13.08.2018	06-11.08.2018	212	03	00
8.	27.08.2018	20-25.08.2018	307	04	00
9.	03.09.2018	27.08-01.09.2018	311	03	00
10.	24.09.2018	17-22.09.2018	322	03	00

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It is evident from above table that based on the reports of CHC - Majhgawan submitted to the IDSP, Bareilly, that there were only a few P. vivax cases in the CHC - area, yet fever incidence with mortality was not worked out properly. The Medical Superintendent has never taken pain to cross check such reports when there were high incidence of fever cases. Even the district IDSP unit did not tried to explore possibilities the cause of fever, as RDT were indiscriminately being used reflecting high P.f. malaria positivity in the district. In spite of this, the IDSP Unit did not have any Early Warning Signal (EWS) to the district health authorities regarding abnormal increase in fever cases in absence of any authentic L-form.

The District Malaria (VBD) Officer, Bareilly, sent blood smears from January to August, 2018 for cross check of malaria positives to the Additional Director, Medical Health & Family Welfare, Bareilly (authority at Division for quality control of Blood smears) and received no discrepancy in the cross check of Blood smears (Table 3), The District Malaria (VBD) Officer, Bareilly, again sent 353 blood smears of Village - BehtaBujurg under CHC-Majhgawan (Worst affected CHC) of the district to Additional Director, Malaria/ VBD, U.P., Jawahar Bhawan, Lucknow on 07th September, 2018. The additional Director Malaria/VBD, U.P. through his letter dated 09th September, 2018 communicated the result of blood smears (Table 4), in which only two blood smears (No. 05 & 100) were declared as positive for *Plasmodium vivax* malaria, which reflected that there is no grave situation as far as malaria is concerned. Thus, The District Malaria (VBD) Officer at that time, tried to find out the possible cause of fever in Majhgawan area. It was also brought to the notice that the district is conducting anti-larval spray & fogging in rural areas right from non-transmission period of the disease.

Several teams visited District Bareilly from State Head Quarter (Dte. General of Medical & Health Services, UP) as well as from National Centre for Disease Control, GOI, Delhi during this period but none has verified death due to malaria on prescribed format of National Vector Borne Disease Control Programme.1 The team of Officers from State HQ, Lucknow directed the district authorities to conduct malaria case screening with the help of bivalent RDT. Many teams were also deployed to screen malaria cases by RDT. It is pertinent to mention here that the RDTs are not recommended in the programme, where malaria microscopy facilities are available. The state team must have arranged Laboratory Technicians (LT) during outbreak of fever for quality diagnosis by blood smear microscopy & prompt Radical Treatment (RT) The district has been indiscriminately using four (4) different make of antigen based bivalent RDTs supplied by various firms (Figure 4). Different types of RDTs reported different results, which might be due to their variation in their sensitivity and specificity.

Table 3.Cross check report of blood smears sent by District Malaria (VBD) Officer, Bareilly (Negative Blood Slides for malaria)

S. No.	No. Of CHC/PHC Reporting Units	Month of Blood smears	Digit No.	No. of Blood Smears Sent for cross check	To Whom sent	Handed over on date	Discrepancy observed	Remarks
1.	29	JAN, 2018	04	160	Additional Director, Medical, Health & Family Welfare, Bareilly. Division, Bareilly	02-02-2108	NIL	Majhgawan did not send B/S
2.	38	MAR, 2018	08	302		05-04-2108	NIL	Majhgawan did not send B/S
3.	33	APR, 2018	08	330		27-04-2108	NIL	Majhgawan did not send B/S
4.	35	MAY, 2018	02	391		31-05-2108	NIL	Majhgawan did not send B/S
5.	35	JUN, 2018	07	418		30-06-2108	NIL	Majhgawan did not send B/S
6.	40	JUL, 2018	01	479		02-08-2108	NIL	Majhgawan did not send B/S
7.	37	AUG, 2018	02	461		04-09-2108	NIL	Majhgawan did not send B/S
Total			2541			NIL		

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The CHC/PHC wise malaria epidemiological data of the district from 2015 to 2018 (up to August, 2018) is given in Table 5. It is evident from the table, that the malaria remained present throughout the duration but not a major public health problem, though some CHCs/PHCs reflected multifold increase in the malaria cases. The malignant form of malaria (*Plasmodium falciparum*) did not exhibit its presence in the district. The In-charge District Malaria (VBD) Officer informed that all CHC/PHC have been supplied the MF-7, MF-8 & MF-9 registers, in order to know the focus of disease parasite in villages but they were not updated due to lack of peripheral health workers.

Since the district is invaded by several rivers like Ram Ganga (tributary of holy river Ganga) and rivers of local importance. The adequate and excess rainfall during 2018 1329.70 mm as against normal rainfall of 1000 mm (approximately) might have possibly created congenial conditions for development of vector population to build up density above critical level required for active transmission of malaria. The entomological survey in dusk (Indoor resting Collection) was carried out by the team in village-Dhakora and Sendhi and the vector species encountered are mentioned in Table 6.

Table 4.Cross check report of blood smears sent by District Malaria (VBD) Officer, Bareilly (Negative Blood Slides for malaria)

S. No.	No. of CHC/PHC reporting units	Month of blood smears	Digit No.	No. of blood smears sent for cross check	To whom sent	Handed over on date	Discrepancy observed	Remarks
1.	CHC - Majhgawan (Vill. Behta Bujurg)	SEP, 2018	NA	353	Additional Director, Malaria/VBD, U.P., Jawahar Bhawan, Lucknow	07-09-2108	No discrepancy (Test Check of B/S)	Only two B/S (N0. 05 & 100) Declared *Plasmodium vivax* (P.v.) positive

Table 5.Malaria Epidemiological Situation of District Bareilly (from district health authority)

S. No.	Name of CHC/PHC	2015						2016					
		Popul-ation	B/S Exam.	Malaria Positives		SPR	API	Popul-ation	B/S Exam	Malaria Positives		SPR	API
				P.v.	P.f.					P.v.	P.f.		
1.	Kyara	273882	6487	5	0	0.08	0.018	276560	8232	14	0	0.17	0.051
2.	Bhamora	214504	5868	2	0	0.03	0.009	216649	7700	17	0	0.22	0.078
3.	Majhgawan	211519	7925	14	0	0.18	0.066	213634	6450	50	0	0.78	0.234
4.	Ramnagar	259355	5037	5	0	0.10	0.019	261951	7125	19	0	0.27	0.073
5.	Meerganj	177245	9638	23	0	0.24	0.130	179017	10444	45	0	0.43	0.251
6.	Fatehganj	227067	7472	36	0	0.48	0.159	229337	6402	38	0	0.59	0.166
7.	Bithri	360586	6433	1	0	0.02	0.003	364191	4209	2	0	0.05	0.005
8.	Bhojipura	206888	3222	13	0	0.40	0.063	208957	3038	11	0	0.36	0.053
9.	Mundia	226085	4290	14	0	0.33	0.062	228346	4810	24	0	0.50	0.105
10.	Shergarh	258733	6612	21	0	0.32	0.081	261320	6178	33	0	0.53	0.126
11.	Baheri	295846	3986	7	0	0.18	0.024	298804	4194	2	0	0.05	0.007
12.	Faridpur	257805	9780	16	0	0.16	0.062	260383	10916	46	0	0.42	0.177
13.	Kumandanda	183686	7140	1	0	0.01	0.005	185523	7683	5	0	0.07	0.027
14.	Nawabganj	302122	11872	0	0	0.00	0.000	305143	10457	11	0	0.11	0.036
15.	Dalelnagar	173952	5055	6	0	0.12	0.034	178583	6180	14	0	0.23	0.078
16.	Bareilly urb	1024012	7187	16	0	0.22	0.016	1034252	14777	64	0	0.43	0.062
Total	4653287	108004	180	0	0.17	0.039	4702650	118795	395	0	0.33	0.084	

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S. No.	Name of CHC/PHC	2017						2018 (upto August)					
		Popul-ation	B/S Exam.	Malaria Positives		SPR	API	Popul-ation	B/S Exam.	Malaria Positives		SPR	API
				P.v.	P.f.					P.v.	P.f.		
1.	Kyara	279326	6285	33	0	0.53	0.12	279326	3185	16	0	0.50	0.06
2.	Bhamora	218816	7771	13	0	0.17	0.06	218816	4607	8	0	0.17	0.04
3.	Majhgawan	215770	8988	49	0	0.55	0.23	215770	3734	37	0	0.99	0.17
4.	Ramnagar	264570	9318	47	0	0.50	0.18	264570	4664	32	0	0.69	0.12
5.	Meerganj	180808	5435	14	0	0.26	0.08	180808	2612	7	0	0.27	0.04
6.	Fatehganj	231630	4354	11	0	0.25	0.05	231630	1739	15	0	0.86	0.06
7.	Bithri	367833	1986	3	0	0.15	0.01	367833	966	1	0	0.10	0.00
8.	Bhojipura	214349	2046	2	0	0.10	0.01	214349	2527	6	0	0.24	0.03
9.	Mundia	230629	4264	13	0	0.30	0.06	230629	2100	3	0	0.14	0.01
10.	Shergarh	263933	3387	27	0	0.80	0.10	263933	1714	11	0	0.64	0.04
11.	Baheri	262986	3403	3	0	0.09	0.01	262986	1659	3	0	0.18	0.01
12.	Faridpur	301793	7698	22	0	0.29	0.07	301793	3797	41	0	1.08	0.14
13.	Kumandanda	187378	6621	5	0	0.08	0.03	187378	2944	5	0	0.17	0.03
14.	Nawabganj	308196	7884	5	0	0.06	0.02	308196	3633	5	0	0.14	0.02
15.	Dalelnagar	180368	4553	2	0	0.04	0.01	180368	2574	2	0	0.08	0.01
16.	Bareilly urb	1044594	11849	35	0	0.30	0.03	1044594	5512	21	0	0.38	0.02
Total	4752979	95842	284	0	0.30	0.06	4752979	47967	213	0	0.44	0.04	

Table 6.Differential Vector Density in District - Bareilly, Uttar Pradesh

S. No.	Name of CHC/ PHC	Majhgawan	Bhamora
1.	Name of Village	Dhakora	Sendhi
2.	Date of Collection	26.09.2018	27.09.2018
3.	Collection	Dusk	Dusk
4.	Time	18.00-19.00 Hrs.	18.00-19.00 Hrs.
5.	Site	Indoor	Indoor
S. No.	**Name of Mosquito/ Vector Species**	**Density (per man hour)**	
1.	Anopheles culicifacies	02.00	05.00
2.	Anopheles annularis	04.00	00
3.	Armigeres sp.	02.00	00
4.	Culex quinquefasciatus	06.00	02.00
5.	Culex vishnuiigp.	04.00	03.00
6.	Mansonia annulifera	02.00	00

It is apparent from Table 6, that the density of the malaria vector, Anopheles culicifacies was considerably high in CHC-Bhamora (Village-Sendhi) and above critical density required to transit malaria.

Though the District completed anti-larval spray in 1607 villages and fogging in 260 villages under campaign of prevention of communicable diseases right from non-transmission period, yet the vector density remained above critical level having no desired impact of anti-larval spray and fogging on the vector density, possibly due to the excessive rains.

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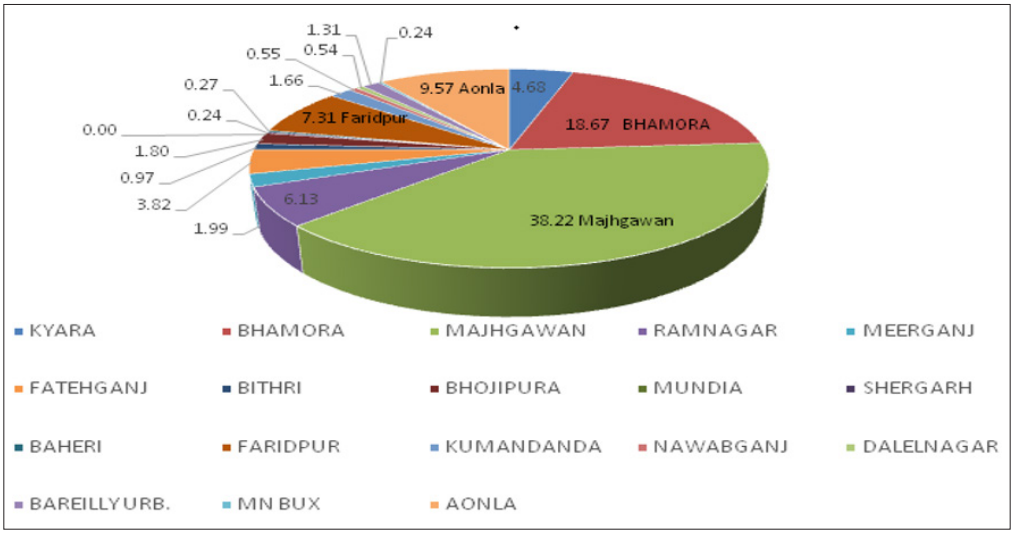

Figure 2(A).PHC wise malaria cases in Bareilly, UP

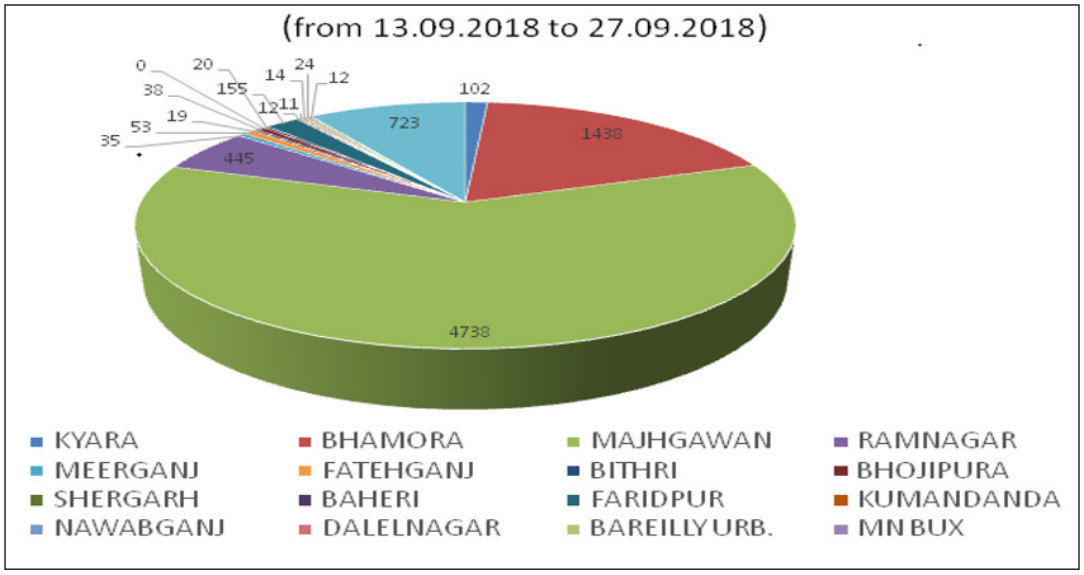

Figure 2(B).PHC wise p.f. malaria cases in Bareilly, UP

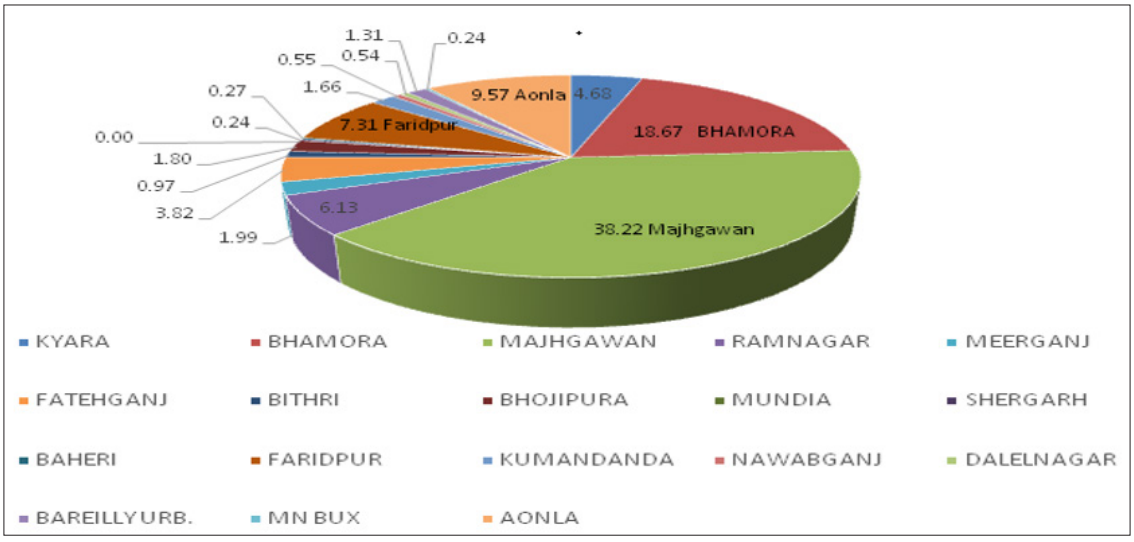

Figure 3(A).% contribution to malaria positives

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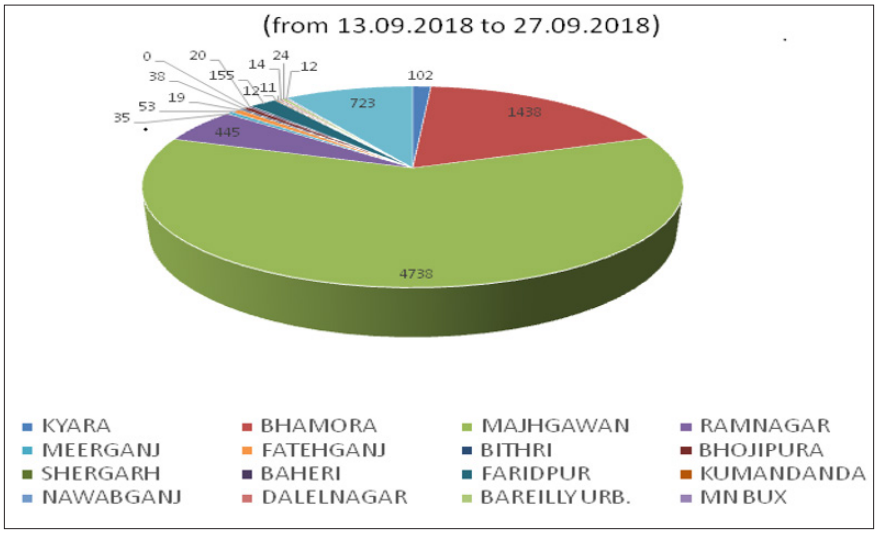

Figure 2(B).PHC wise *p.f.* malaria cases in Bareilly, UP

Figure 4.Different types of RDT kits used for screening of malaria cases in Bareilly districts during 2018

Table 7.Availability of Human Resource for surveillance at Village & CHC/PHC in Bareilly, Uttar Pradesh

S. No.	Name of CHC/ PHC	Basic Health Worker (Now MPW Male)			Health Inspectors (Now Health Supervisors)			Laboratory Technicians (L.Ts.)		
		S	P	V	S	P	V	S	P	V
1.	Bhamora	10	02	08	06	02	04	01	00	01
2.	Kyara	10	03	07	06	00	06	01	00	01
3.	Majhgawan	12	00	12	06	02	04	01	01	00
4.	Ramnagar	10	00	10	06	00	06	01	00	01
5.	Aonla	10	00	10	00	00	00	01	00	01
6.	Meerganj	10	02	08	06	00	06	01	00	01

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7.	Fatehganj	09	02	07	06	02	04	01	00	01
8.	Bithiri	15	00	15	06	01	05	01	00	01
9.	Bhojipura	10	01	09	06	01	05	01	00	01
10.	Mundia	11	00	11	06	00	06	01	00	01
11.	Shergarh	13	00	13	06	00	06	01	00	01
12.	Baheri	16	00	16	08	00	08	01	00	01
13.	Faridpur	12	00	12	06	00	06	01	01	00
14.	Kuwandanda	12	00	12	06	01	05	01	00	01
15.	Nawabganj	15	00	15	06	01	05	01	00	01
16.	Dalel Nagar	16	00	16	08	00	08	01	00	01
17.	Distt.HQ	00	00	00	00	00	00	01	01	00
Total	181	10	171	94	10	84	17	03	14	
Vacant Posts (%)	94.48	89.36	82.35							

S = Sanctioned, P= Posted, V= Vacant.

The district and CHC/ PHC authorities were asked to ensure preparation and examination of blood smears from all fever cases declared positive for P.f. & mixed cases by the RDTs for verification of the parasite prevalence & its potential role in the occurrence of the wide spread fever in the area. When RDTs are reflecting P.f. presence, there are many more chances of getting P.f. in blood smears. Some of the deaths occurred during the current fever outbreak, though not verified due to malaria, and may be attributed to the malaria keeping in view the prevalence of P.f. malaria cases detected through RDT, which reflects its presence. Treating malaria at an individual level is very simple; but it is very complex, when undertaken as a programme, because the disease transmission is governed by many biotic and a biotic factors related to the parasite, vector and host behavior in different environmental conditions. Chand G, et al.[4] attributed the malaria outbreak in Madhya Pradesh due to prevalence of rice cultivating ecosystem without any intervention measure like insecticidal spray, though qualified for undertaking intervention measures according to NVBDCP guidelines. Josh PL, et al.[5] attributed the malaria outbreak in Uttar Pradesh due to neglected surveillance. The present fever outbreak cannot be denied to be associated with malaria. The outbreak of the fever may be attributed to negligent disease & vector surveillance as well as poor quality of malaria microscopy. In absence of technical staff related to surveillance and diagnosis, as is evident from the Table 7, consequently, early detection & prompt treatment (EDPT) was severely affected and delayed, leading to the present outbreak.

On analyzing the data and assessing the situation in the district, the district authorities were asked to undertake space spray with pyrethrum (0.1% solution) to interrupt the transmission of malaria by killing the infected mosquito population followed by Indoor Residual spray with DDT50% wdp the insecticide available in the state, for which the State VBD Programme Officer was requested to divert the DDT 50% wdp from other district. According the DDT 50% wdp was diverted to the district without any delay. The district authorities started space spray with the pyrethrum (0.1% solution) in the highly affected 21 villages in CHC-Majhgawan, 11 villages of CHC-Bhamora, and CHC-Faridpur.

On the basis of the observations made during the course of the investigations, several gaps and lacunae were observed which includes: (a) The fever cases with standard case definitions based on laboratory diagnosis (microscopic) should have been given radical treatment & compliance of RT should have been ensured, (b) Blood smears should be collected simultaneously from all patient showing positivity by RDT kit in order to establish the specificity and sensitivity of these kits, (c) The quality control of laboratory diagnosis (microscopic) should be ensured at peripheral level, and (d) The Zonal entomological team based at Bareilly should be strengthened in terms of manpower & Infrastructure in order to conduct regular entomological surveillance to keep vigil on vector density & to suggest proper vector control measures. The state VBD programme authorities are advised to review the availability of technical staff related to surveillance and diagnosis of fever/malaria in other districts as well, in order to prevent any such outbreak or epidemic in future.

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Conflict of Interest: None

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