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Rise of Malaria Patients in Rural and Urban Communities: A Comparative and Analytical Study in The District of Panipat, Haryana, India

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ABSTRACT

Malaria has afflicted the populace of India for several centuries and has singlehandedly been responsible for significant loss of lives and a great deal of human suffering. With diverse ecological and social conditions, spread of malaria via P. Falciparum and P. Vivax as the two major plasmodium species has resulted in the infection of millions of Indians and led to loss of lives in the tens of thousands. Adoption of Anti-malaria Treatment Policies (ATP), Intermittent Preventative Treatment (IPT) methods, introduction of Insecticides Treated Nets (ITN) and Anti Malaria Medication (AMM) has led to the reduction in number of malaria cases in India. Conversely to the national data, there has been an increase in cases of Malaria in the district of Panipat, Haryana over the last few years. To explore this increase in number of malaria cases, a total of 216 reported malaria patients residing in 21 different villages and urban areas were studied over the span of two years. Data was gathered in form of structured questionnaires and topographical inspections to generate a profile for every region. 3 regions out of 21 were found to harbor the majority of malaria cases due to their location on agrarian land and abundance of stagnant open water sources. A net total of 37% increase in malaria cases were registered between the years 2015 and 2016 in the district of Panipat, Haryana.

KEYWORDS P. Falciparum, P. Vivax, Intermittent Preventative Treatment, Drainage fascilities, Chloroquine

Introduction

Widespread of malaria affecting anywhere from 200 million to 500 million people worldwide has been one of the primary health concerns of the planet (WHO, 1997) (Bank, 1993). The fatal nature of malaria has consistently caused deaths of over 2 million people annually, majority of victims residing in Sub-Saharan Africa (SSA) (Snow RW C. M., 1999). India has long been known to harbor a considerable amount of malaria cases that reach upwards of 1.5 million in the year as recent as 2013 (Shiv Lal, 2000) (WHO, 2014) (Hay SI, 2010). Although data collected by National Vector Born Disease Control Program (NVBDCP) and World Health Organisation (WHO) seem to contradict each other in the number of registered malaria cases, a general consensus is regarding the death toll per year reaching over 1000. Plasmodium Falciparum (53%) and Plasmodium Vivax (47%) are the two species that contribute to spread of malaria in India (Sehgal PN, 1973) (Snow RW G. C., 2005). Except the northern region of India, nearly every other region is affected by malaria making it one of the few diseases that causes suffering on such a large geographic scale. Plasmodium Falciparum has a high probability of up to 90% in areas that are surrounded by dense forests which makes the state of Orissa contribute to 25% of total malaria cases in India (Bhattacharya PR, 1997) (Nandy A, 2003).

The widespread of malaria in India and its adverse effects on the quality of life of people has prompted the governments and various Non-Governmental Organisations (NGOs) to introduce various policies that overlook the spread of information and research to prevent the spread of malaria (Das NG, 1997) (Bhattacharya S, 2006). National Vector Born Disease Control Program (NVBDCP) has especially provided support to government to facilitate the adoption of new Anti-malaria Treatment Policies (ATP) and Intermittent Preventative Treatment (IPT) of malaria along with direct financial help by bearing a net total of cost of treatment of malaria in India (NVBDCP., 2002). This has helped in the reduction in number of cases of malaria from 1970s to 2000s (Herris VK, 2001).

This reduction in overall cases of malaria has been in stark contrast to the rise in number of cases in malaria in the northern state of Haryana over the past few years (Dhingra N et all, 2010) (Sinha, 2012). This is particularly evident in the eastern districts of Haryana that are situated next to the Yamuna River. Panipat is one such district with area of 1268 square kilometers and a population of 1,205,437 according to the 2011 census. Despite the presence of multiple health care centers, public health awareness programs and higher than national average literacy rate of 75.94 of Panipat, rise in the number of patients with malaria has become a strong concern for the government and populace. The number of malaria cases seems to occur in the fall season when the temperatures become suitable for the breeding of mosquitoes bearing the parasite. With qualitative and quantitative analysis of data gathered from local hospitals in the City of Panipat, a total of 216 cases from 21 rural and urban areas recorded in the year of 2015 and 2016 of malaria patients were examined as part of this study. All 216 cases took part in a questionnaire structured around the period of their contraction of malaria. Once this data was gathered, thorough topographical inspections of all 21 regions were done to identify the causes that aided in the spread of malaria.

The study aimed to explore the trend of rise in malaria cases in the district of Panipat from January 2015 and October 2016. Also examined in this study were the possible causes that lead to the change in number of malaria cases in the span on 20 months.

Methods

Area of Study

The study was conducted in the district of Panipat, located on the eastern frontiers of the state of Haryana. The district has a long standing history of handloom and textile industries that are majorly located on the borders of the city Panipat. The city is well connected to the neighboring villages via roads and maintains a healthy channel of transportation accessible at every hours of the day. The villages rely on farming as their main source of income and produce up to 3 cycles of crops every year. The river Yamuna crosses many villages and the city of Panipat before entering the Delhi which is located approximately 91 Kilometers to the east. Although the river Yamuna and its canals are used by the local population for business and agriculture, the majority of water needs are fulfilled by ac-

cessing the underground water supply via government distribution, tube wells and hand pumps.

Out of 87 villages and 3 major cities, a total of 20 villages and the city of Panipat were chosen for this study due to the vast diversification of population residing in this area. The economic conditions aided by a long established textile industry and fertile agrarian land have attracted immigrants from neighboring states, especially from Bihar and Uttar Pradesh in the last few decades (Jana, 2010). This has made the district of Panipat a multicultural core of people with various ethnic beliefs, religion and social norms. The district of Panipat now houses a population of over 1.2 million where many major Indian languages and local dialects are spoken and used as a mode of communication in trade and commerce.

Comparative Analysis

This study was carried out over a span of two years and lasted from January 2015 to October 2016. The data of malaria patients made available by three private and one government funded malaria testing facilities made up for 100% of recorded cases of malaria in the district of Panipat between the years 2015 and 2016. The city of Panipat and the following villages made up for all 20 villages chosen for the study: Bapoli, Ujha, Khotpura, Kabri, Dadlana, Sewah, Ugra Kheri, Samalkha, Atta, Pattikalyana, Naraina, Chulkana, Ahar, Seenk, Kawi, Matlauda, Rerkalan, Naultha, Israna, Mandi. During the period of January 2015 to October 2016, 223 cases of malaria were reported, out of which, 216 agreed to become a part of this study. Data for the remaining 7 was unavailable as the patients chose to keep their information private. The collection of this data began in November 2015 and was updated over the course of next year until the end of October 2016.

Design of Study

The exploratory nature of this study was aided by the adoption of qualitative and quantitative methods of data gathering and interpretation. The researcher was accompanied by two trained interviewers who were well versed in local culture, religion and dialects. The questionnaire was prepared in English, Hindi and Urdu and was presented as a survey to all 216 malaria infected participants. Rural areas consisted of a total of 27 participants who uneducated and required the translation of the questionnaire in local dialects as a means to obtain useful information. Two local doctors and a staff nurse from the district of Panipat were also part of this study and aided the researcher by providing their independent assessments on the malaria outbreak.

Quantitative Study

The topographical expanse of the District of Panipat was divided into urban and rural areas. The city of Panipat was chosen for the study of urban areas by further sub-dividing the city into three sections covering the north-east, city center and south west regions. A total of 20 villages were selected where 15 were chosen due to their proximity with the city of Panipat and the Yamuna Canal and 5 were chosen at random. An extensive questionnaire was presented to 216 malaria patients, aimed to understand their knowledge of malaria outbreak, prevention techniques including use of Insecticide-impregnated mosquito nets (IIPs) and knowledge on readily available malaria prevention and treatment methods (Sharma VP C. R., 1985) (Bhati PG, 1996). Simple mathematical models were created to compare the data and all the gathered information was analysed on Statistical Package for Social Sciences (SSPS) on Windows 95.

Qualitative Study

Individual discussions were carried out with every malaria patient residing in urban and rural areas. The aim was to understand the knowledge and awareness of malaria patients after their affliction with this disease (Hausmann Muela S, 1998). The questionnaire was deliberately written in format familiar to the individuals with non – science background and specific biomedical terms were avoided all together. The focus of the survey was on understanding the reasons of the spread of malaria as understood by malaria infected participants. Exploration of various malaria prevention techniques including use of mosquito nets and traditional healing methods were included in the questionnaire along with their familiarity with modern prevention techniques (Singh N, 1999). The questionnaires were shared with two local interpreters and three members of medical staff of this research. The data of 216 participants was analysed using ATLAS software with standard settings (ATLAS.ti, 1997).

Results

Description of Participants

All 216 participants who suffered from malaria came from a diverse background where 87.5% were literate. The age of the participants varied from 13 years to 70+ years (some participants were unsure of their age as they followed traditional Indian Hindu counting system) out of which 94 were females and made up 43.4% of total participants. 67 participants (31%) were martially single and 149 (69%) participants were in a monogamous relationship.

Comparative Study on spread of Malaria

Malaria treatment centers in the district of Panipat in the year 2015 received a total of 91 positive cases of patients suffering from Malaria. The first quarter of the year registered no cases of malaria anywhere in the district of Panipat. The second quarter saw a total of 10 cases of malaria and accounted for 11% of total cases received in the year 2015. The third quarter saw a further rise in number of malaria cases with a total of 64 and accounted for 70.3 % of total cases in the year 2015. The fourth quarter saw a decrease in number of cases as a total of 17 patients were registered with malaria accounted for 18.7% of total cases in the year 2015.

Table 1 depicts the spread of malaria in the year 2015 in all 21 chosen regions of Panipat district.

Region of Panipat district	First Quarter (Jan – Mar)	Second Quarter (Apr – Jun)	Third Quarter (Jul – Sep)	Fourth Quarter (Oct – Dec)	Total cases of malaria
Bapoli	0	0	15	1	16
Ujha	0	0	3	0	3
Khotpura	0	1	6	1	8
Kabri	0	0	1	0	1
Dadlana	0	2	4	0	6
Sewah	0	0	9	0	9
Ugra Kheri	0	2	10	1	13
Samalkha	0	1	1	2	4
Atta	0	0	0	1	1
Pattikalyana	0	0	0	4	4
Naraina	0	1	0	2	3
Chulkana	0	1	2	0	3
Ahar	0	0	2	2	4
Seenk	0	0	0	2	2
Kawi	0	0	1	0	1
Matlauda	0	0	1	0	1
Rerkalan	0	0	0	0	0
Naultha	0	0	0	0	0
Israna	0	0	0	0	0
Mandi	0	0	0	0	0
Panipat city	0	2	9	1	12

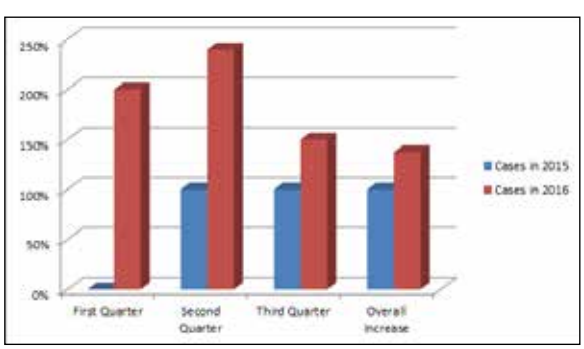
The year 2016 (ending in 31 October 2016) had a total of 125 positive malaria cases registered at Malaria treatment centers in the district of Panipat. The first quarter registered 2 cases and accounted for 1.6% of total cases in 2016. The second quarter registered 24 cases of malaria and accounted for 19.2% of total cases. The third quarter registered the highest amount of cases at 96 and accounted for 76.8% of all cases. No results were available for final quarter and but was estimated that at least 15 more cases will be registered in the final two months. For the validity of data, the estimated results from last quarter of 2016 will be excluded from this study.

Table 2 depicts the spread of malaria in the year 2016 in all 21 chosen regions of Panipat district.

Region of Panipat district	First Quarter (Jan – Mar)	Second Quarter (Apr – Jun)	Third Quarter (Jul – Sep)	Fourth Quarter (Oct only)	Total cases of malaria
Bapoli	0	4	35	0	39
Ujha	0	2	11	0	13
Khotpura	0	0	3	1	4
Kabri	0	1	1	0	2
Dadlana	0	1	2	0	3
Sewah	0	3	1	0	4
Ugra Kheri	0	6	11	0	17
Samalkha	0	2	3	1	6
Atta	1	1	4	0	6
Pattikalyana	0	0	1	0	1
Naraina	0	0	3	0	3
Chulkana	0	0	2	1	3
Ahar	0	0	2	0	2
Seenk	0	1	0	0	1
Kawi	0	1	0	0	1
Matlauda	0	0	3	0	3
Rerkalan	0	0	0	0	0
Naultha	0	0	0	0	0
Israna	0	0	0	0	0
Mandi	0	0	0	0	0
Panipat city	1	2	14	0	17

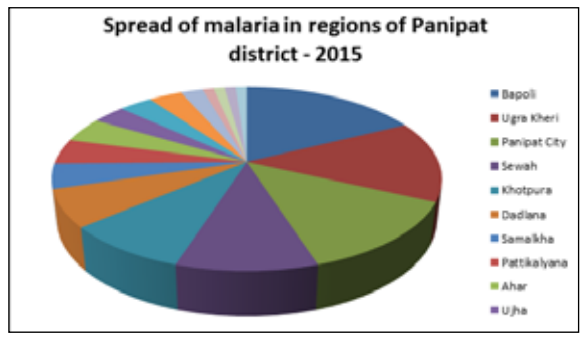
A comparison of the years 2015 and 2016 show that there has been an increase of 34 cases which accounts for a total rise in malaria cases in 2016 when compared to 2015 at 37.36%. Evaluation of malaria cases in the first quarter of both years shows that there has been a rise in malaria cases in the first quarter, a 140% rise in the second quarter and a 50% rise in the third quarter. Further analysis of data indicates that the highest numbers of malaria cases were registered in the months of August and September. Year 2015 had 26 registered cases in August and 32 cases in September whereas year 2016 had 50 registered cases in August and 27 cases in September. The month of February was the safest month of the year as no cases of Malaria were registered in both years.

Figure 1 shows the increase in total number of malaria cases in all 21 regions of Panipat district in the years 2015 and 2016 based on four yearly quarters.



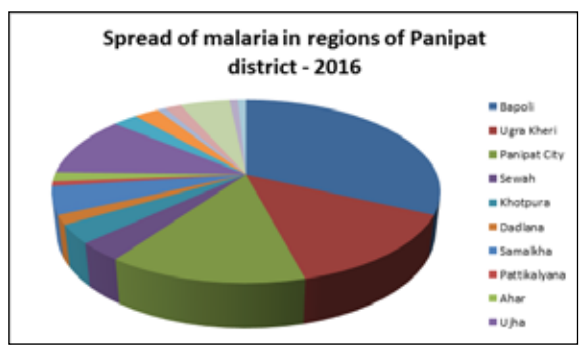
Out of 20 villages and one urban city as Panipat, it was found that highest number of registered malaria cases in 2015 originated from village Bapoli with a net total of 16 cases or 17.5%. Village Ugra Kheri had the second highest number at 13 cases amounting to 14.2% in 2015. Four villages of Rerkalan, Naultha, Israna and Mandi had no cases of malaria in 2015.

Figure 2 shows the comparative spread of malaria in all affected regions of Panipat district in the year 2015.



In the year 2016, the place with highest number of malaria cases was Bapoli with a net total of 39 making up for 31.2% of all cases in 2016. The place with second highest outbreak in 2016 was village Ugra Kheri and the city of Panipat, both harboring 17 cases each and making up for 13.6% of all cases individually. Once again, four villages of Rerkalan, Naultha, Israna and Mandi showed no cases of outbreak in 2016.

Figure 3 shows the comparative spread of malaria in all affected regions of Panipat district in the year 2016.



Awareness of Malaria in the District

Malaria has been present in the state of Haryana for many centuries and the populace of district Panipat is aware of the general symptoms and underlying causes of malaria. Even with three major languages spoken and understood by the people of district Panipat, the term malaria is always used to describe illness followed by the bite of a mosquito. Local government agencies and private organisations spread awareness through publishing information via print and electronic media. The prevalence of mobile data and cell phone usage allows the public to obtain information at a faster rate. This makes district Panipat unique in the fact that all 216 malaria infected participants were aware of the existence of malaria and the several ways in which it can be prevented or cured including the use of mosquito nets and visit to a general practitioner.

The symptoms of malaria were also well understood by most of the participants as 209 of them were well aware of general cleanliness of surroundings. Stagnant water which is often accumulated in small ponds, ditches and badly kept waste management facilities is a factor that 198 patients were aware of and described as the major cause of spread of malaria. Mismanaged sewage facilities and open drain pipes had a significant impact on the rise of malaria according to 185 participants. 87 participants were aware of land pollution caused by excessive construction by government and private industries. Failure to maintain a clean environment was stated by 85 participants who believed that they are to blame for the rise in outbreak of malaria. 35 participants stated that use of fertilizers that promote the breeding of drug resistant mosquitoes was the reason for surge in number of malaria cases. Environmental factors responsible for rise in malaria cases were supported by 16 participants and 4 participants correlated it to divine intervention.

Table 3 reports on the possible causes of spread of malaria as understood by 216 patients.

Causes of malaria as understood by participants	Possible mechanisms involved	Total number of participants	Percentage of total participants
General Cleanliness	Keeping houses clean and leaving no open water sources	209	96.75%
Stagnation of water	Accumulation of water in ponds used for animals, rain water in potholes	198	91.67%
Local sewage and drainage facilities	Facilities run by government to promote public health	185	85.64%
Unplanned construction	Carried out by individuals as well as government agencies	85	39.35%
Excessive use of fertilizers	Promotion of drug resistant mosquitoes carrying the parasite	35	16.20%
Environmental factors	Belief that climate change is responsible for this outbreak	16	7.40%
Divine intervention	Act of god or ancestral spirits causing the outbreak	4	1.85%

Prevention of Malaria Outbreak

The second half of the year is widely regarded by people as the time when the outbreak of malaria is at its highest chance. A variety of preventative measures were known to the participants that ranged from some traditional to modern methods. The use of mosquito coil was widely known by the participants and was their first act of prevention at the advent of second half of the year. A few participants in the remote villages also reported the burning of dry leaves during evening hours to combat the nuisance of mosquitoes in the area. Wide varieties of mosquito nets being produced locally in the district of Panipat were used by the participants and were especially favored by participants belonging to poor families. The participants in the city of Panipat reported the use of liquid based electrically operated mosquito coils. It was also reported that the municipal corporation would provide a monthly service of spreading mosquito repellants via large fog machines.

Treatment of Malaria

Use of anti malaria drugs that included a combination of chloroquine, asprin and paracetamol were provided at the private and government led malaria treatment centers. All 216 malaria patients reported the use of anti malaria drug as directed by their physicians. There were however, 12 cases in rural areas of Bapoli and Ugra Kheri where malaria patients took the drug as under the guidance of their local expert which might have led to incorrect dosage. Due to the consumption of correct anti malaria drugs, there were no reports of any fatality for past several years.

Discussion

Comparative Analysis

After several decades of drop in malaria cases in northern India, there has been a sudden rise in the past few years, especially in the regions adjacent to Yamuna Canal passing through eastern Haryana (Sharma VP U. H, 1985). This has lead to a total of 91 malaria cases being registered at the private and government funded aid organisations in the year of 2015. Abrupt patterns of rain and stagnant water sources have provided new breeding grounds for mosquitoes bearing the harmful parasite in the past year. This has led to an increase in the number of malaria cases to 125 in the year 2016. The months following heavy monsoon rains have always accounted for high cases of malaria and this was true for the months of August and September 2015 and 2016. The cold climate during the months of January and February offer harsh breeding conditions for mosquitoes and therefore had no cases of malaria registered for both years.

Three regions namely the city of Panipat and village Bapoli and Ugra Kheri were particularly prone to malaria outbreaks due to the presence of vast open water sources and inefficient drainage systems. The year 2016 especially saw the emergence of two ponds in the village of Bapoli and one pond in the village of Ugra Kheri. A close inspection of these areas indicated the presence of mosquito larvae in the months of August 2016 which are the likely cause of rise in malaria outbreaks in 2016 in these regions. The south western region of Panipat city in 2016 saw the emergence of large potholes near residential areas harboring a considerable size of population. As a result, the total number of malaria cases in these three regions increased significantly and had contributed to the total rise in number of malaria cases in 2016.

The villages of Samalkha and Atta also witnessed 140% increase in number of cases of malaria in the year 2016. These villages are not in close proximity to the Yamuna canal and are usually considered to the one of the driest regions of Panipat district. Although there are very few open water sources in these regions, the sewer and drainage system that operated efficiently until 2014 have since steadily underperformed leading to sewage spills in small areas. This resulted in spread of malaria not only in the monsoon season but throughout the second and third quarter of the year 2016.

The best example of the adoption of government policies and aid was observed in Rerkalan, Naultha, Israna and Mandi. Not only did these regions have a fully operational sewage and drainage systems, these areas also excelled in public awareness about the spread of malaria via print and electronic media. Economically these regions are far behind the city of Panipat and other larger villages, but more mosquito nets were being sold in these regions than any other region excluding Panipat city. Another factor contributing to these regions being free from malaria is the small population residing in each of the four villages.

The city of Panipat is spread out in an area of 64 and harbors 444, 524 people according to the 2011 census. This makes up for 36.8% of total population of Panipat district. The city possesses a robust infrastructure but its drainage and sewage system has been under a constant pressure due to its ever rising population. Industrial infrastructure of the city has constantly been attracting immigrants from neighboring states and lack of sewage expansion projects is responsible for the rise in malaria cases. No open water sources were found in the central sector of the city but 3 cases of stagnant water sources were observed in the north eastern and south western sectors. This has lead to a total increase of 5 cases in the year 2016 when compared to 2015 figures. Although this figure is extremely small compared to the population of the city, it still accounts for a total rise of 41.6 % in year 2016.

Prevention of Malaria

Due to the high literacy rate (87.5%) of the 216 participants of this study, general awareness regarding the prevention of malaria was known to every participant in one medium or another. The 20 rural villages knew about the causes of malaria its dependence on stagnant water sources. Participants knew that malaria was caused by the bite of a mosquito and knew of various precautionary measures that would protect them in future. As the participants in villages usually relied on the growing and rice and wheat as their primary for income which fell on the low end of earning spectrum, the villages relied on the use of mosquito repellant coils to not only save themselves from malaria but to also avoid the nuisance of being bitten by a mosquito. The elder populations in the villages

over 40 years were more prone on using mosquito nets than youths. The city of Panipat harbored people of high income households and therefore participants of city were aware of the causes of malaria and knew how to find more information in case of need. Almost all households utilized liquid mosquito repellants, body sprays and even hired private anti mosquito fog machines in areas where the municipal corporation could not reach.

Treatment of Malaria

The outbreak of malaria was dealt very swiftly by almost all participants. This involved a visit to their private or government employed general practitioner and receiving anti malaria drugs. A combination ofcholroquine, paracetamol and asprin were given to every participant by their respective doctors (Sharma VP, 1985) (Garg M, 1995). Almost all of the participants stated they finished the complete dosage of their medication with only a few exceptions. The participants in rural areas knew about the treatment of malaria and referred to it as 'malaria tablets' whereas around 40% of participants in the city of Panipat knew the correct name of anti malaria drugs and could identify them by their names. The spread of malaria in the district of Panipat has been on the rise for the past several years despite the efforts of government and private health organisations. With current sanitary and health system facing an ever increasing stress by the advent of new migrants, the district needs to redirect its resources in health sector and promote public awareness to prevent future escalation of malaria outbreaks.

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