RESEARCH ARTICLE

POST-RENASCENCE ENVIRONMENTAL ADAPTATION OF SWINE-ORIGIN INFLUENZA VIRUS (S-OIV).

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Manuscript Info	*Abstract*
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Introduction:-

The three types of influenza viruses are A, B, and C. They belong to the Orthomyxoviridae family of single stranded RNA viruses. Type A viruses are sub-typed on the basis of two surface glycoproteins, hemagglutinin (HA), and neuraminidase (NA). Furthermore, the influenza A subtypes and the influenza B viruses are further classified into strains. Type A influenza viruses are further classified based on differences in the hemagglutinin (HA) and neuraminidase (NA) proteins found on the surfaces of the influenza viruses. There are 16 known HA subtypes and 9 known NA subtypes of influenza A viruses, which can recombine to create novel combinations of influenza.[1]
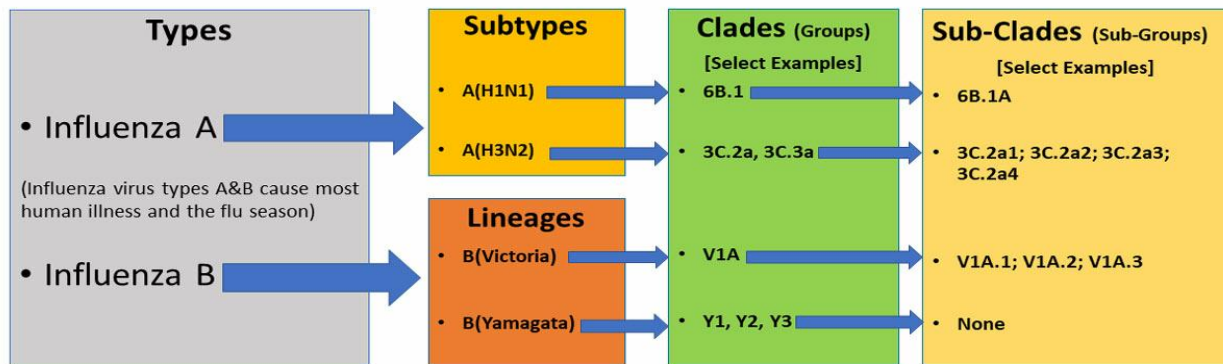
This graphic shows the two types of influenza viruses (A,B) that cause most human illness and that are responsible for the flu season each year. Influenza A viruses are further classified into subtypes, while influenza B viruses are further classified into two lineages: B/Yamagata and B/Victoria. Both influenza A and B viruses can be further classified into specific clades and sub-clades (which are sometimes called groups and sub-groups)

Influenza viruses are constantly changing. They can change in two different ways:

Antigenic drift are small changes (or mutations) in the genes of influenza viruses that can lead to changes in the surface proteins of the virus: HA and NA.

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Antigenic shift is an abrupt, major change in an influenza A virus, resulting in new HA and/or new HA and NA proteins in influenza viruses that infect humans.[2]

Material and Method:-

Retrospective study was conducted on all the suspected cases of Influenza A H1N1 (Swine Flu) from January 2014 to December 2018 in the Department of Microbiology, Government Medical College, Kota, Rajasthan, India.

We have included all suspected swine flu cases in our study irrespective of their categories (A, B or C) and age group.

As per the laboratory criteria for diagnosis of influenza specimen suggested by WHO, the RT-PCR protocol was adopted. The throat swabs were collected under all aseptic and universal precautions and kept in Viral Transport Medium and processed in a Biosafety level Class II type B3 cabinet. Real-time Reverse Transcriptase Polymerase Chain Reaction (rtRT-PCR) was done as per the CDC Protocol using StepOne by Applied Biosystems(AB).

A total of 7515 sample results data was collected in the study. A specially designed data collection form was used to collect some epidemiological data like age, sex, and month of the test performance during study period.

Data of average temperature and humidity were collected from National Centre for Disease Control, Ministry of Health and Family Welfare last updated on 3rd November,2019.[3]

This is a retrospective analysis of routine laboratory work, so an ethical consideration was not necessary.

Results:-

A total of 7515 samples were obtained during the study period. Out of which 1246 samples (16.58%) were tested positive for swine flu influenza H1N1 (Table 1).

Table 1:- Distribution of cases according to H1N1 positivity

Tested Samples	Positive	Negative
7515	1246	6269

Prevalence of swine flu positive cases was calculated for each year from 2014 to 2018 with its corresponding relative humidity and average temperature in our region.

With this data obtained we found out that the prevalence of swine flu positive cases in 2014 was 3.08% followed by the drastic change in the number of swine flu cases in the year 2015 with the prevalence of 18.57%. After renascence in the year 2015 the similar pattern was observed in 2017 and 2018 with an exception of the year 2016(Table 2).

Table 2:- Year-wise prevalence of swine flu w.r.t. average temperature and humidity

Year	Humidity (%)	Temperature(°C)	Prevalence(%)
2014	38.66	27.08	3.08
2015	37.66	27.67	18.57
2016	40.08	27.67	2.78
2017	36.66	27.75	17.21
2018	35.83	28.67	18.05

With the pattern of humidity and its respective prevalence we have noted that after the renascence virus was able to infect even at higher relative humidity which was against the previous pattern that swine flu virus exhibits its infection only at low humidity (Table 3).

Table 3:- Months of maximum prevalence

Year	Months	Prevalence(%)	Humidity(%)

2014	December	11.11	36
2015	February	23.85	33
2016	January	6.4	42
2017	August	27.36	65
2018	September	25.37	69

The climate of Rajasthan can be divided into four seasons: [4]
1. Summers (April to June)
2. Monsoon (Late June to September)
3. Post-Monsoon (October to November)
4. Winter (December to March)

With the data studied we found out that there was a trend of higher prevalence of swine flu positive cases in the months October to March in the year 2014, 2015 and 2016 which are broadly speaking considered as the cooler months as compared to the year 2017 and 2018 where the prevalence was higher in the months of relatively higher temperature i.e. April to September (Table 4).

Table 4:- Difference in prevalence (%) Oct-March vs Apr-Sept

|	Oct-March	Apr-Sept
2014	6	1.78
2015	18.79	17.15
2016	3.72	1.1
2017	7.03	21.58
2018	16.14	21.18

Discussion:-
2015 was the year of renascence for the swine flu virus which was studied worldwide in various other studies. We have also observed the revival of the virus infectivity after a dormant phase in the year 2014. Complete genome analysis was conducted by the National Institute of Virology, Pune on 6 virus strains from the 2015 outbreak indicates that the virus has not undergone any genetic changes that could have affected H1N1 virulence or resistance to Oseltamavir.[5]

Based on molecular analysis of isolates from Chennai and Pune, the dominant flu strain in India in the year 2017 was A/ Michigan/7/2009 (H1N1) pdm09 virus, replacing A/California/7/ 2009 (H1N1) pdm09 seen during 2016.[6]

Using the guinea pig as a model host, Lowen et al showed that aerosol spread of influenza virus is dependent upon both ambient relative humidity and temperature.[7]

After the renascence of 2015, there has been a similar pattern of high virus activity observed except in the year 2016 in Rajasthan (197 cases) which might be due to the change in the relative humidity (Graph:1). This low prevalence in the year 2016 was also found in the Delhi (193 cases), Uttar Pradesh (122 cases), and Gujarat (411 cases).[8]

Graph 1:- Year-wise comparison of Prevalence w.r.t Humidity and Temperature

Year-wise comparison of Prevalence w.r.t Humidity and Temperature
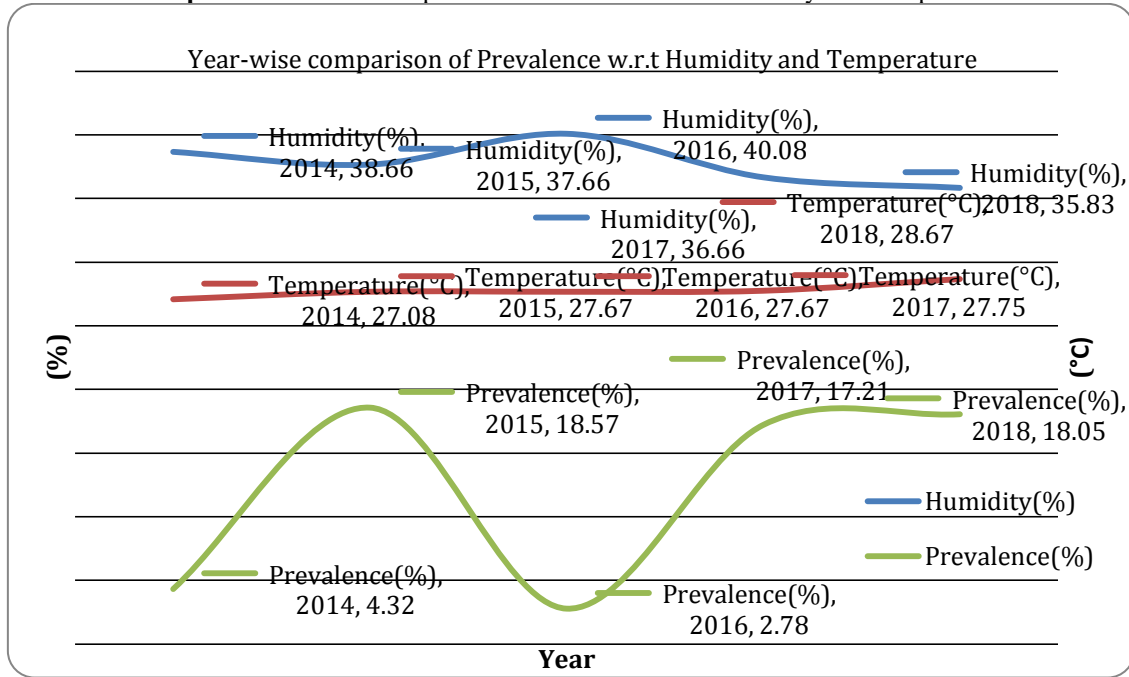
The peaks of the infection have changed, said Sanket Kulkarni, deputy director, National Centre for Disease Control(NCDC). "We found in 2017 that, much like earlier trends there were at least two seasons for the virus. One was January-March and second one was August-October. Earlier January-March season used to be what we call a 'major peak' and August-October would be a 'minor peak'. Now this has reversed", he said.

In our study we have also observed the same trend. With reference to Table:3, we have noted that the months of maximum prevalence in 2014(December), 2015(February) and 2016 (January) have a relative humidity of 36%, 33% and 42% respectively. On the contrary in 2017 (August) and 2018 (September) the months of maximum prevalence have relative humidity of 65% and 69% respectively (Graph:2). This sudden change in the months of maximum prevalence might be due to certain changes which virus would have acquired in the due course of time which has enabled its infectivity even at higher humidity.

**Graph 2:-** Months of maximum prevalence w.r.t humidity

Months of maximum prevalence w.r.t. humidity
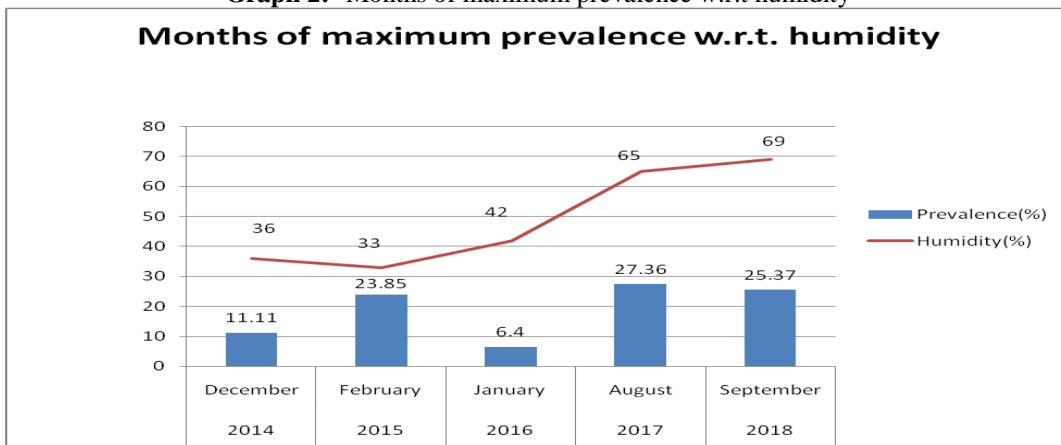
In 2017, A/ Michigan/7/2009 (H1N1) pdm09 virus came replacing the A/California/7/ 2009 (H1N1) pdm09 seen during 2016.[5] The new strain is capable of infecting at relatively higher temperature (Graph: 3).

Graph 3:- Prevalence w. r. t. temperature
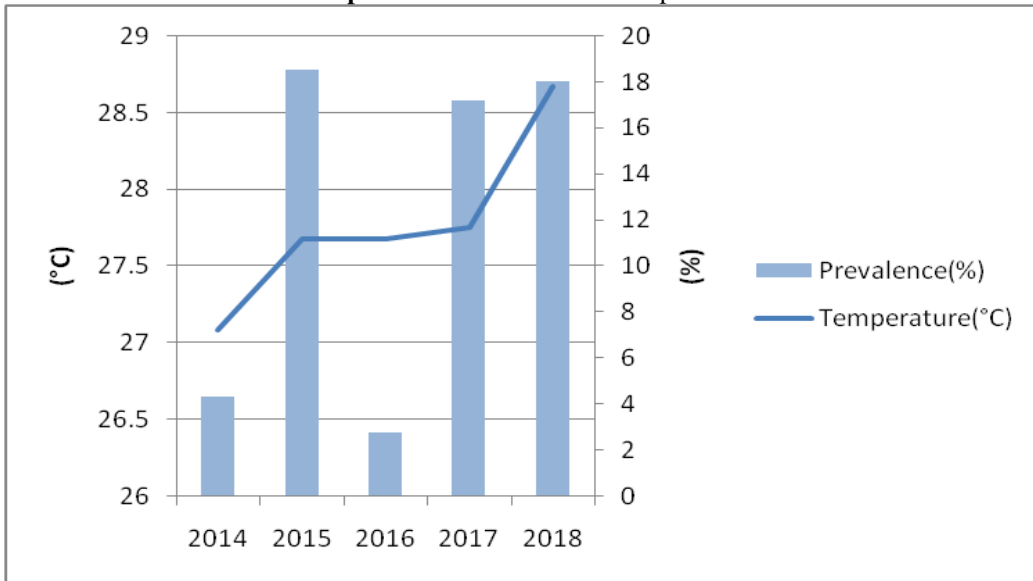
In tropical countries the swine flu virus previously had a predilection for winter season but after the Michigan strain it is observed that the prevalence of swine flu cases has also increased in summer months (GRAPH:4).

Graph 4:- Comparison of prevalence (%) Oct-March vs Apr-Sept
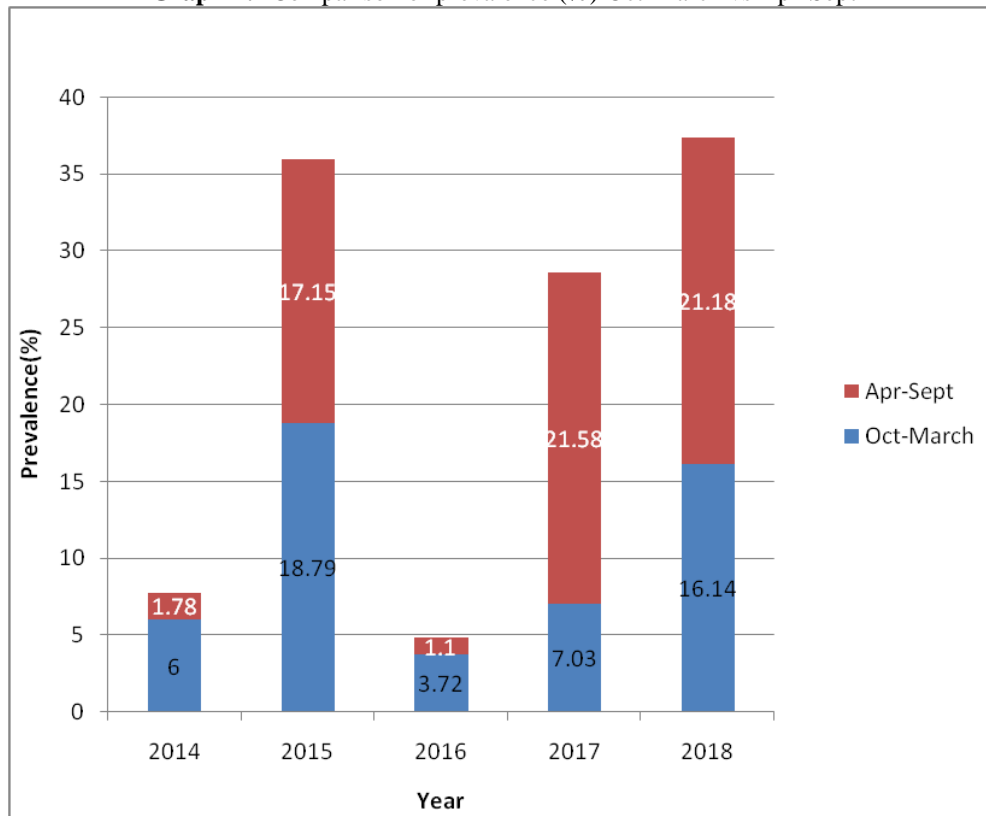
IDSP data show that the epidemiology of influenza A (H1N1) is changing in terms of geographical distribution, age and seasonality. The evolving situation and the associated risk factors need continued monitoring and investigation

with respect to the seasonal pattern of distribution of the disease, possibly linked with climatic conditions, seen during 2017. Understanding the genetic epidemiology of the virus in India would be helpful.

Conclusion:-
With our study we have tried to ascertain a relationship between the low prevalence in the year 2016 and the relatively higher humidity in that year. The cascade of swine flu infectivity is multi-factorial. The drastic change in the prevalence in the year 2017 and 2018 could be the ability of the virus to exhibit its infectivity even at different environmental conditions. For elaborative knowledge extensive researches must be carried out.

References:-
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