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Early detection of West Nile Virus mosquitoes and cases in Frisco and Dallas in 2019 using DNA &RNA testing and Climatic prediction with Math lab followed by Descriptive statistical analysis using R-programming

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Abstract*: *West Nile Virus is a mosquito borne disease that is initially caused in continental US that leads to neurological disease and death. There exists no vaccine or particular antiviral treatment for WNV.The mosquitoes become infected when they bite the infected birds. WNV is confined to the family Flaviviridae containing single stranded positive RNA with 11kb length. The purpose of this paper is to study WNV human cases and WNV positive mosquito traps in Frisco 75035 from Sep-Oct 2019. Also, the paper aims in explaining the current CDC data on WNV cases in detail using descriptive computer statistical analysis method. The data describes the current 2019 WNV neuro cases, WNV non-neuro cases, Death and presumptive viremic blood donors. According to (DSHS, 2019), there is no WNV cases reported yet in Frisco 2019 and one positive WNV case in Dallas county. According to CDC (2019), out of total 777, 98 were presumptive viremic blood donors, 504 was neuro-invasive cases, 273 were non-neuro-invasive cases, and 39 death was reported. Arizona and Colorado have the highest number of WNV Neuro invasive and Non-neuro-invasive cases of 132 and 60. This summary statistics reveals Neuro invasive cases have higher mean of 11.45 to non-neuro-invasive with 6.205. On the T-test it reveals at 95 % confidence level (P=0.007681) a significant difference in total cases versus the presumptive blood donors. It also represents more positive relationship on the scatter plots. According to Texas Department of state Health and Human Services (2019), reported human cases of reportable West Nile Disease of 19; out of which West Nile encephalitis is 15 and West Nile fever is 4. This shows that in Texas there is a drastic reduction of West Nile disease cases reported in 2019 related to good surveillance plans. This review summarizes descriptive statistical analysis of 2019 WNV cases which has shown a new increase in Presumptive viremic blood donors which is the hall mark of this review. Finally, the paper has completed a climatic niche prediction model using Math lab computer software for the future prediction of WNV positive mosquitoes using climatic conditions like high temperature, low temperature, humidity, rainfall, and precipitation.

Keywords* : *West Nile Virus, Dallas, Frisco, Neuro invasive, Viremic blood donor, Centre for Disease Control etc.

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I. INTRODUCTION

The diseases that are transmitted by mosquitoes comprise dengue, malaria, West Nile Virus, filariasis, Japanese encephalitis, yellow fever, Ross River fever etc. One of such disease that is now widely seen in Texas is the West Nile disease. Some of the infected birds will develop proliferated level of virus in the bloodstream and consequently the mosquitoes may become infected through biting such infected birds [1]. The infected mosquitoes could able to transmit the virus when it bites the horse, people and other mammals. There exists no evidence for the spread of the WNV from animals to person or from one person to another person with the exception in few cases which are tissue transplantation, blood transfusion, from mother to baby etc. This process describes the detection and analysis of viruses by circulating the various attributes in vectors from of data[2]. A combination of sequence of semi-automated process amplifies the detection of the virus as probability of the various attributes.

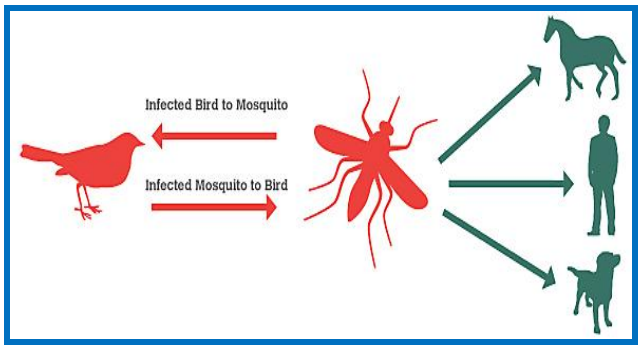

Fig. 1.Transmission cycle of WNV

- The figure 1 describes the transmission cycle of West Nile Virus.In general the surveillance of mosquitoes a technique for the estimation of the risk of transmission to people [3]. The precipitation and temperature variation plays a major role in detecting the infection rates of mosquitoes and WNV transmission [4]. Our study based on this analysis motivates the prediction of infection rates on the basis of appropriate weather conditions. Such weather conditions and patterns of meteorological occurrences is significant for disease transmission [5]. For example, low precipitation and

high temperature generally increases the WNV infection. The process is accomplished by Windows operating system in Mat lab R2015b software with Intel Pentium processor/4GB RAM. In this work, predictive models for the incorporation of weather could be utilized for providing early symptoms of WNV infection risk. The work at first assessed the capability of the existing model of WNV for predicting the infection in a particular area that is more susceptible followed by improving the model prediction through incorporating optimized weather factors affecting mosquito development. The interaction term usage between the temperature and precipitation enhanced the model performance. In specific, temperature is more specific than rainfall and hence the average temperature decreases the impact of low rainfall in increased infection rate.

A. Objectives

- To detect the existence of West Nile Virus with respect to data attributes.
- To analyze weather and GIS data for the prediction of WNV for the given time, location and species.
- To improve the detection performance with state of art methods.

B. Organization of the paper

Initial section in this paper gives the detailed preview of West Nile Virus in United States; Next section gives the survey of the existing literatures with reference to the evolution, causes and rapid diagnostic methods for WNV; The third section gives the glimpse of the methods that were considered base for the extension and implementation of the proposed methodologies; Fourth section includes the crucial area of our proposed methodology with reference to data analysis and interpretation; Fifth section gives the drawn conclusions with reference performance metrics and future directions; and Final section discusses the references for the used texts and referred works.

II. RELATED WORKS

The following section deals with the survey of existing works in WNV.

The research [6] indicated an evolutionary relation with attenuated Texas genotype and recommend further research in animal models and cell culture for confirming attenuated phenotype. The paper focused on the mosquito and avian and mosquito for obtaining more WNV isolates for the examination of WNV dissemination to other areas. [7] estimated the total number of WNV during 2012 arboviral season. It counted screened blood and confirmed positive viremic donations from north Texas during WNV. [8] performed RT-PCR on all the samples in which WNV positive in horsemeat collected in 2002 before and after outbreak. [9] stated that he West Nile Virus infection is mainly caused by the Culex mosquitoes they are the major vector carrying the virus. Animals like birds, horses, any vertebrate animal can get the disease and the mosquitoes who get infected transmit the virus to humans. Blood transfusions can also be a source of WNV infection as the person who is donating the blood has no evidence of the disease but its symptom come after the transfusion. WNV is seen in all continents in Africa, Europe, Middle East, Russia and Romania. The port of entry of WNV to USA was in 1999 New York epidemic it entered North America and was the major cause of transmission to neighboring countries and all states in America. Now the major cause of encephalitis and meningitis is WNV and is seen in all continents North America, South America, Asia, Europe Africa, and Australia. [10] The collaborative study conducted by National Institute of Allergy and Infectious disease and antiviral group has conducted clinical trials of WNV immunotherapy which is effective with Omr-IgG for the treatment of hospitalized patients infected with WNV. [11] predicted the vector borne disease using the weather forecast and data from the environmental database in future and take effective surveillance to prevent the epidemic. The time series study model conducted in Harris County in Texas shows WNV activity amplified at summer time; also it can be predicted by using Schmalhausen's law and with infection rates. As Texas has been affected by the epidemic in 2012 with total 1868 cases of WNV fever and WNV neuro-invasive disease it is highly vital to predict the mosquito productivity and the positive WNV cases. [10, 12] describes that most people who are infected with WNV don't demonstrate any clinical symptoms; however, about 1 in 50 people develop fever (WNF) and about 1 in 150 people develop fatal cases with neuro-invasive condition with potential for deficits and death. The neurological clinical presentation of WNV starts after two to six days with high fever, neck stiffness, stupor, coma, tremors, convulsions, vision loss, disorientation, muscle weakness, paralysis, and death. The elderly population, people over sixty years, and people with comorbidities are more commonly affected with WNV. The common diagnostic test to detect WNV are IgG antibodies in cerebrospinal (CSF) fluid and plaque-reduction neutralization tests. [13]offers a consensual perspective in regards to the connection between spatiotemporal analysis of county mosquito surveillance data and human cases of WNV. Like the past two works, the study proves that there is a predictive variability in mosquito distribution and human cases of WNV.[14] evaluated the ability of proactive control measures to maintain WNV risk indicators below those levels during weather conditions that would otherwise promote outbreak levels of WNV activity [15]described fine scale drivers of spatiotemporal variability of human WNV cases [13] explains that, "the remaining method of mosquito surveillance offers several advantages, allowing rapid measurements of vector mosquito population densities and infection rates and determinations of whether these are stable, increasing, or decreasing". [13]argues that the relation of mosquito abundance and infection data "measures and integrates WNV infected mosquitoes and WNV infected human cases into a vector index.

III. PROPOSED SYSTEM

The overall flow of the proposed system is depicted in the figure 2 that depicts the proposed flow of detecting WSN in

specified location which involves the various process such as input analysis, attribute analysis, descriptive analysis and predictive analysis.

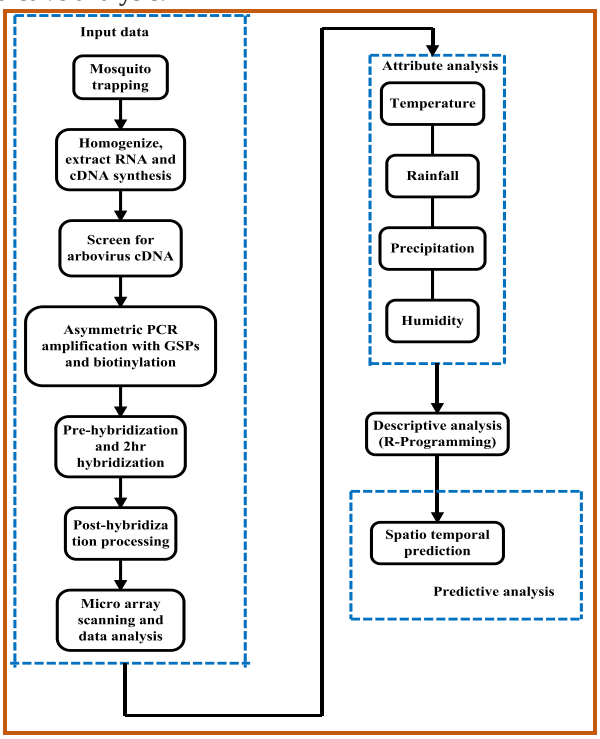

Fig. 2. Proposed flowchart for detecting WSN

A. Materials and methods

- **Mosquito traps:**

The accurate mosquito trapping is the most important to capture the efficiency of proposed model. There are several types of traps used in collection of mosquitos and it becomes the most necessary for analysis. These electric traps utilized with - UV light traps, Dyna trap, and CO2 traps were used which increases the efficiency of trapping. The BG-Sentinel traps (BGS) is utilized for collecting Aedes. This trapping methods are used for various mosquito attractants such as heat, water vapor, carbon dioxide, BG-lure, and it makes flexible tool for mosquito community research.

- **Study area and experimental design:**

The study was conducted from September 2019 to October 2019 in Frisco city and Dallas County. These localities chosen for experimental design. The Frisco city, Texas, a suburb 30 miles north of Dallas. The Dallas-Fort Worth area has attracted more and more corporate relocations, Frisco has absorbed more than its fair share of the growth and wealth that's come with them. The time series study model conducted in Harris County in Texas shows WNV activity amplified at summer time; also it can be predicted by using Schmalhausen's law and with infection rates. The southern mosquito Culex Quinquefasciatus is common in Texas and the main vector of WNV transmission and disease.

As Texas has been affected by the epidemic in 2012 with total 1868 cases of WNV fever and WNV neuro-invasive disease it is highly vital to predict the mosquito productivity and the positive WNV cases.

Fig. 3.Incidence of WNV in Frisco

For the current study of prevalence of WNV testing of mosquito we selected Frisco city (Figure 3) which is one of metropolitan city of Dallas. Frisco has elevation 640 feet, latitude 3309N and Longitude 09650W. According to Frisco Texas government site it has population in 2019 as 183,173. The zip code we selected is 75035 for the mosquito selection. This location is the heart of Frisco developing site with new building and some landfill areas close by. Light traps, Carbon dioxide baited traps, and nets were used to collect the mosquitoes from the site. They were run in the night daily from 6 PM till next day 6 AM whole night every day for three months period from August 2019 till October 2019. Mosquitoes caught in the traps were recorded daily and later randomly picked and morphologically identified by species Culex, Aedes or Anopheles. Later, as random date a sample was picked for the DNA testing for species identification and RNA testing for WNV, Chikungunya, and dengue. The day we tested the mosquito sample was on Oct 23 as it was after the rainfall more accurate prediction for a sample to be tested. Test was carried out in out laboratory in vector management with real time PCR. Finally, the Frisco health and department website was reviewed, and analyzed with our results for study and concluded that in Frisco area this year 2019 no West Nile human case was reported. But one case of Zika, three dengue cases and no chikungunya cases were reported in October 2019 arbovirus activity report. Also, the report in the lab stated that Aedes Aegypti and Aedes Albopictus is common this area which has a correlation with the cases of Dengue and Zika.

- **Incidence of WNV in Dallas County:**

The second study area is Dallas County as it is the more susceptible county for WNV infection mosquitoes and human cases.

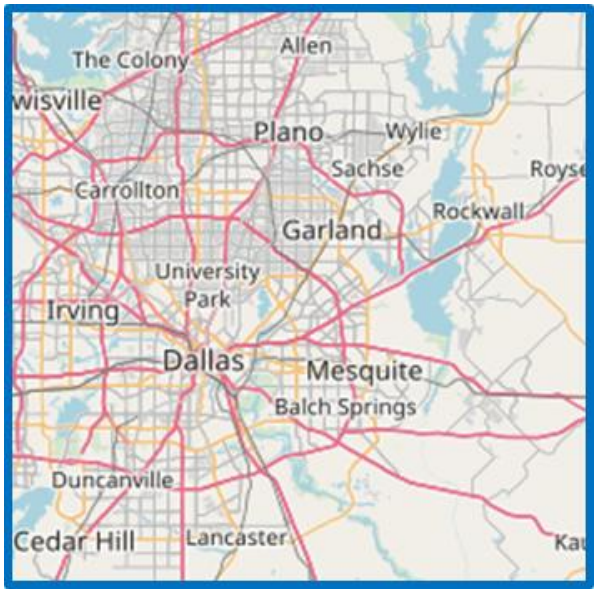

Fig. 4.Dallas city [16]

The spaciotemporal and ecological niche for the mosquito population in summertime is has more connection with the infection rates. Dallas County(Figure 4) information was collected in google report and the average weather and climate was collected from the geographical maps and data collection. The Dallas County has the weekly arboviral reports which reports the positive WNV mosquito traps, avian, and sentinel chicken. All the data was collected first and completed with a mean average data of climatic niche conditions that can cause these WNV positive mosquitoes to be more prominent in these areas. The train data set was completed and prediction model completed.

- **Statistical analysis of WNV cases in all states in US in 2019 using R- programming:**

For the current study we collected the data from Centers for Disease Control and Prevention (CDC) on West Nile Virus Disease cases by states 2019. The data is collected from all states of US on the Neuro-invasive disease cases and Non-Neuro-invasive disease cases. This research used R language for statistical computing and graphics. This R-progamming provides various statistical results in terms of linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, etc…

T-test:

T-test is used to determine whether the means of two groups are equal to each other. The assumption for the test is that both groups are sampled from normal distributions with equal variances. The null hypothesis is that the two means are equal and the alternative is that they are not.

DNA Analysis of WNV:

Broad spectrum of naturally present viral diversity is challenging and hence an efficient technique for the exploration of west nile virus is simultaneously detected from a broad spectrum. Most of the mosquito viral studies have been focused on the identification of well described, specific RNA arboviruses than the DNA viruses in the mosquitoes.For most of the selected viruses, capture probes were designed to multiple genes to increase the odds of detection, identification, and confirmation

The assays were performed in 12 hours. In general the the methodology for screening comprise PCR assay with consensus primers for gene level detection. The cDNA from the pool of mosquito that have been tested positively with screening assays must be continued with PCR amplification.

The selected samples were amplified with corresponding gene specific probe. For a reaction of 25 ml,the following composition is used: of distilled water)

Table I PCR Composition

Component	Quantity
cDNA	2ml
forward primer	1ml (10 mmol)
reverse primer	5ml (10 mmol)
biotin14-dCTP	3 ml (0.4 mmol)
Taq DNA	1 ml
Nuclease free water	13ml

PCR amplification was performed under default conditions and the amplicons were loaded in 2% agarose gel electrophoresis.

IV. RESULTS AND DISCUSSION

A. DATASET DESCRIPTION

The data were collected in Eighteen cities of Texas which are Addison, Carrolton, Coppell, Dallas, Garland, Glenn heights, Grand prairie, Highland park, Irving, Mesquite, Richardson, Seagoville, Unicorporated and University park. The infected mosquito of county and various parameters like average temperature, rainfall, precipitation and humidity were collected. Apart from that our study trapped the mosquitoes in Frisco city. The average temperature is the the air temperature recorded by an accurate thermometer in a provided time, day, month or year. The average rainfall is the the average amount of total rainfall received in a particular place and time period. The relative humidity is defined as the ratio of partial water vapor pressure to the water vapor pressure at equilibrium at a given temperature. The average precipitation is the condensed atmospheric water vapor which falls under gravity.

B. PERFORMANCE METRICS

- **Cumulative incidence**

The cumulative index is defined as the ratio of number of new WNV occurrence in a specified population to the total number of individuals at west Nile viral risk in the prescribed population.

- **Sensitivity**

Sensitivity is termed as the as the fraction of positives which are appropriately recognized or also named as true positive rate.

$$Sen = \frac{TP}{TP + FN}$$

- **Specificity**

Specificity is well-defined as which estimates the fraction of negatives that are appropriately recognized or also called as true negative rate.

$$Speci = \frac{TN}{TN + FP}$$

- **Accuracy**

Accuracy is defined as the nearness of a measured value to the known or standard value.

$$Acc = \frac{TP + TN}{P + N} \; or \; \frac{TP + TN}{TP + TN + FP + FN}$$

C. WNV TEST RESULTS

The 59 positive mosquito traps collected in Dallas city and 10 mosquito positive traps collected in Frisco city, the test results seemed to be negative for chikungunya disease virus and West Nile virus and positive for Aedes egypti species. The results predicted that the prevailing environment may be favorable for the proliferation of Aedes mosquito and hence proper remedial measures must be taken for the corresponding prevention. Also the investigation from the zoonotic species in the cities, where the WNV is more prevalent it is understood that the WNV have been spread from horse and sentinel chicken. Since vaccination status have been improved for the zoonotic disease, the paper strongly recommends appropriate vaccine provision for the animals for controlling the disease.

D. *PREDICTIVE ANALYSIS*

The following section deals with the predictive analysis of the proposed work.

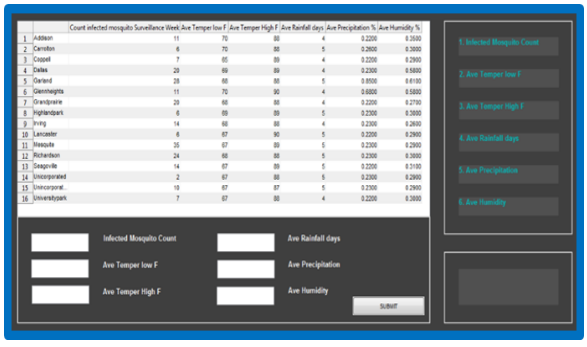

Fig. 5. Predictive model of WNV based on attributes

Figure 5 shows the detection of WNV as normal by using climatic niche prediction model based on various attributes in the form of matlab screenshot. The attributes are infected mosquito count, Ave temperature Low F, Ave temperature High F, Ave rainfall days, Ave precipitation and Ave humidity.

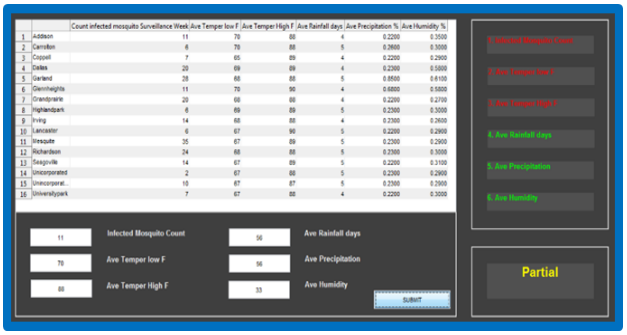

Fig. 6. Predictive model of WNV based on attributes

Figure 6 shows the detection of WNV that affects as partial by using climatic niche prediction model based on attributes in the form of matlab screenshot. The attributes are infected mosquito count, Ave temperature Low F, Ave temperature High F, Ave rainfall days, Ave precipitation and Ave humidity.

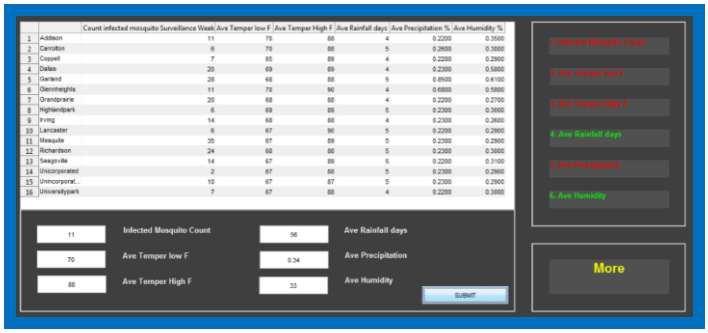

Fig. 7. Predictive model of WNV based on attributes

Figure 7 shows the detection of WNV that affects as more by using climatic niche prediction model based on attributes in the form of matlab screenshot. The attributes are infected mosquito count, Ave temperature Low F, Ave temperature High F, Ave rainfall days, Ave precipitation and Ave humidity.

Table II: Performance metrics of proposed system

Performance measures	Values
Accuracy	96.8750
Sensitivity	96.8421
Specificity	99.9668
NPV	99.9668
PPV	96.8421
TP	92
TN	9022

FP	3
FN	3

Table 2 describes the various performance measures of proposed work in terms of accuracy, sensitivity and specificity. The proposed method had the accuracy of 96.88%, sensitivity contains 96.84% and specificity defines 99.97%.

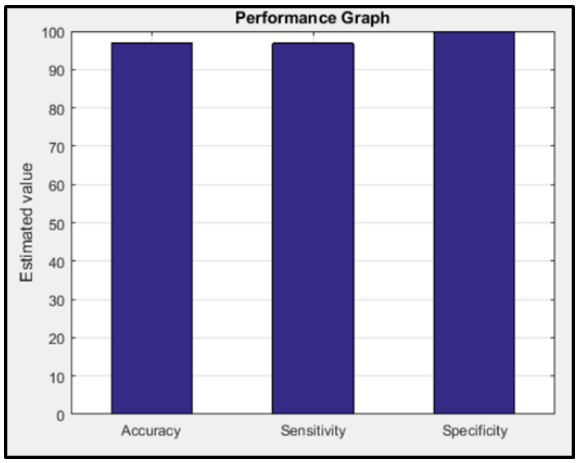

Fig. 8. Statistical analysis of proposed system

Figure 8 depicts the statistical analysis of proposed system with various performance measures such as accuracy, sensitivity and specificity.

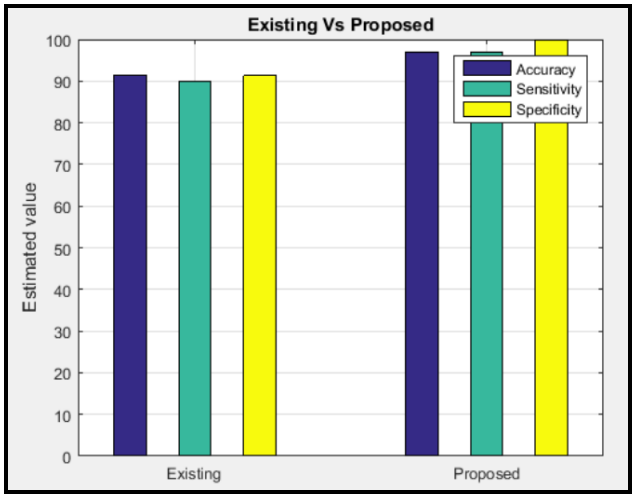

Fig. 9. Comparison of proposed method and existing methods

Figure 9 defines the comparison of proposed method and existing methods [17] with accuracy, sensitivity and specificity.

E. DESCRIPTIVE ANALYSIS

Table III: Summary statistics of WNV based on the states data

Cases	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum
Neuroinvasive Cases	0.00	1.00	3.00	11.45	9.00	132.00
Non-Neuroinvasive Cases	0.00	0.00	2.00	6.205	6.25	60.00
Total Cases	1.00	3.00	6.00	17.66	10.75	168.00
Mortality rate	0.00	0.00	0.00	0.8864	1.00	16.00
Presumptive Viremic Blood Donors	0.00	0.00	1.00	2.227	3.00	23.00

Table 3 describes the summary statistics of WNV based on the data. This statistical analysis provides neuroinvasive Cases, Non-Neuroinvasive Cases, Total Cases, Mortality rate, and Presumptive Viremic Blood Donors. From this analysis, the Neuro-invasive cases have a higher mean of 11.45 as compared to Non-Neuro-invasive cases with 6.205. The means for Total cases, Deaths and Presumptive Viremic Blood Donors are 17.66, 0.8864 and 2.2227 respectively. Arizona and Colorado have the highest number of Neuro-invasive cases and Non-Neuro-invasive cases of 132 and 60 respectively.

The t-test for Neuroinvasive and Non- Neuroinvasive Cases is shown 95% confidence level, there is no significant difference (p-value = 0.221) between the means of Neuroinvasive and Non- Neuroinvasive Cases. Therefore, we accept the null hypothesis and conclude that the two means are equal since the p-value is larger than 0.05. The maximum difference of the mean can be as low as -3.23 and as high as 13.73.The t-test for Total number of cases and the number of deaths can be shown 95% confidence level, there is a significant difference (p-value = 0.003886) between the means of Total number of Cases and the number of deaths. Hence we should reject the null hypothesis and conclude that the two means are not equal because the p-value is smaller than 0.05. The maximum difference of the mean can be as low as 5.69 and as high as 27.86.

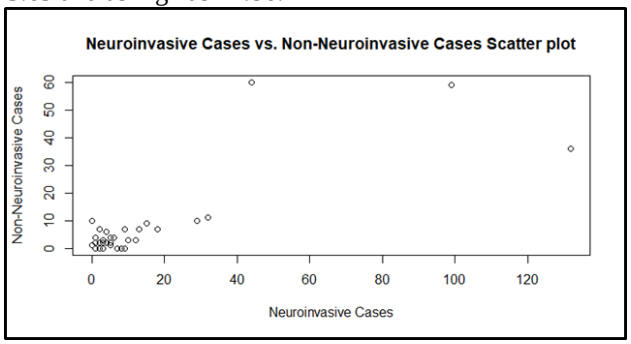

Fig. 10.Correlation analysis of Neuroinvasive against Neuroinvasive Cases

Figure 10 shows the correlation analysis of Neuroinvasive against Neuroinvasive Cases from all the states it is evident that the cases have a strong positive linear relationship. Also the Neuroinvasive and Neuroinvasive Cases have a correlation coefficient of 1 which is 100% linear relationship implying a strong positive linear relationship.

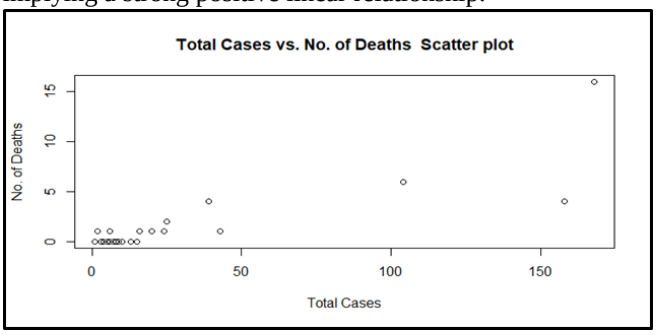

Fig. 11. Correlation analysis of total cases and no of mortality Cases

Figure11 shows the correlation analysis for total number of cases against the number of deaths that they also have a strong positive linear relationship. Also, the Total number of cases and the number of deaths has a correlation coefficient of 0.8645. This means that they have 86.45% linear relationship which is a strong positive linear relationship.

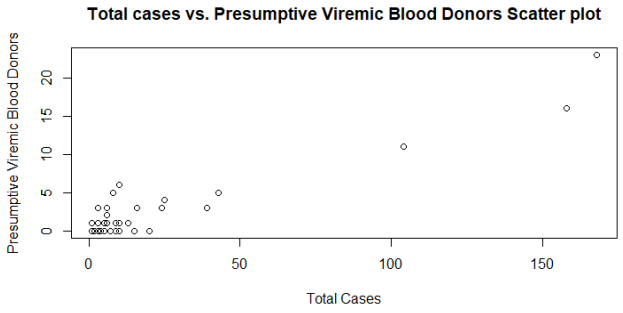

Fig. 12. Correlation analysis of Presumptive Viremic Blood Donors

Figure 12 describes the correlation analysis of total number of cases against Presumptive viremic blood donors also implies that they have a positive linear relationship. Also, the correlation coefficient of 0.941887 implies that the Total number of cases and Presumptive viremic blood donors have a 94.19% positive linear relationship.

V. DISCUSSION

After the descriptive statistical analysis from the data collected from CDC on West Nile Cases of 2019 it summarizes the Neuro-invasive, non-neuro-invasive, total cases in all, death, and the presumptive blood donors that has WNV positive cases. From this table we can say that the Neuro invasive cases have a higher mean of 11.45 as compared to Non-Neuro-invasive cases with 6.205. The means for Total cases, Deaths and Presumptive Viremic Blood Donors are 17.66, 0.8864 and 2.2227 respectively. Arizona and Colorado have the highest number of Neuro-invasive cases and Non-Neuro-invasive cases of 132 and 60 respectively. According to CDC (2019), out of total 777, 98 were presumptive viremic blood donors, 504 was neuro-invasive cases, 273 were non-neuro-invasive cases, and 39 death was reported. Arizona and Colorado have the highest number of WNV Neuro invasive and Non-neuro-invasive cases of 132 and 60. This summary statistics reveals Neuro invasive cases have higher mean of 11.45 to non-neuro-invasive with 6.205. On the T-test it reveals at 95 % confidence level (P=0.007681) a significant difference in total cases versus the presumptive blood donors. It also represents more positive relationship on the scatter plots. According to Texas Department of state Health and Human Services (2019), reported human cases of reportable West Nile Disease of 19; out of which West Nile encephalitis is 15 and West Nile fever is 4. This shows that in Texas there is a drastic reduction of West Nile disease cases reported in 2019 related to good surveillance plans. This review summarizes descriptive statistical analysis of 2019 WNV cases which has shown a new increase in Presumptive viremic blood donors which is the hall mark of this review.

VI. CONCLUSION

The study of West Nile Virus positive mosquito in Frisco zip 75035 is none and no WNV cases has yet been reported in the Frisco health department. The mosquito tested in the outside real time PCR lab for DNA testing concluded that they were Aedes Aegypti and RNA testing stated no WNV, Dengue and Chikungunya. Frisco area has three cases of Dengue and one case of Zika. This has led to conclusion that the health department should educate the residents in the area to be careful on spread of dengue and the Zika. The behaviors of the mosquitoes need more focus when studying on the incidence and prediction on WNV mosquitoes and human cases. The population of Frisco are safe of WNV positive mosquito and human cases. The Zoonotic departments have concluded that 29 total cases where 22 are West Nile Encephalitis and 9 are West Nile Fever. On the other hand in Dallas county the hot areas were selected for the study because they have West Nile Positive trap mosquitoes was selected to proceed with the study to predict the suitable climatic Niche Model which can help in predicting the positive trap mosquitoes in future. Dallas county has a positive human West Nile Virus case in zip code 75251 in Oct 2019. Also the surveillance reports stated that they had 35 positive WNV positive mosquito traps. One trap was containing Culex restuans in week 18. In the process we collected all weekly reports on the WNV positive mosquito trap from Dallas county website. The secondary data from the Dallas county cities were gathered from the website analyzed and focused on the increased breeding rate on the climatic factors. Later, using GIS climatic conditions were gathered which are suitable for the West Nile positive mosquitoes' favorable climatic factors to survive and breed. The statistics revealed that the month which had in increased positive WNV mosquito traps was from June 2019 till Sep 2019. After calculating the mean average, the data was gathered on main five climatic condition factors like high temperature, low temperature, precipitation, rainfall, and humidity.

The Math lab software was used to train the dataset which can help in creating the ecological Niche climatic model. After training the model it was tested with real data and it was able to predict the range that the mosquitoes with WNV is more active and favorable to cause the disease. This Mathlab prediction Model is very vital and can be implemented in planning future surveillance program which can be helpful early predication and diagnosis of diseases.

REFERENCES

1. R. Liu, J. Shuai, J. Wu, and H. Zhu, "Modeling spatial spread of West Nile virus and impact of directional dispersal of birds," *Mathematical Biosciences & Engineering*, vol. 3, p. 145, 2006.
2. L. Barzon, A. Papa, M. Pacenti, E. Franchin, E. Lavezzo, L. Squarzon, *et al.*, "Genome sequencing of West Nile Virus from human cases in Greece, 2012," *Viruses*, vol. 5, pp. 2311-2319, 2013.
3. L. Eisen, C. M. Barker, C. G. Moore, W. J. Pape, A. M. Winters, and N. Cheronis, "Irrigated agriculture is an important risk factor for West Nile virus disease in the hyperendemic Larimer-Boulder-Weld area of north central Colorado," *Journal of medical entomology*, vol. 47, pp. 939-951, 2010.
4. D. Lupulovic, M. A. Martín-Acebes, S. Lazic, J. Alonso-Padilla, A.-B. Blázquez, E. Escribano-Romero, *et al.*, "First serological evidence of West Nile virus activity in horses in Serbia," *Vector-Borne and zoonotic diseases*, vol. 11, pp. 1303-1305, 2011.
5. D. Martinez, K. O. Murray, M. Reyna, R. R. Arafat, R. Gorena, U. A. Shah, *et al.*, "West Nile virus outbreak in Houston and Harris county, Texas, USA, 2014," *Emerging infectious diseases*, vol. 23, p. 1372, 2017.
6. R. H. López, S. U. Soto, and J. C. Gallego-Gómez, "Evolutionary relationships of West Nile virus detected in mosquitoes from a migratory bird zone of Colombian Caribbean," *Virology journal*, vol. 12, p. 80, 2015.
7. D. T. Cervantes, S. Chen, L. J. Sutor, S. Stonecipher, N. Janoski, D. J. Wright, *et al.*, "West Nile virus infection incidence based on donated blood samples and neuroinvasive disease reports, Northern Texas, USA, 2012," *Emerging infectious diseases*, vol. 21, p. 681, 2015.
8. D. L. Miller, M. J. Mauel, C. Baldwin, G. Burtle, D. Ingram, and M. E. Hines, "West Nile virus in farmed alligators," *Emerging Infectious Diseases*, vol. 9, p. 794, 2003.
9. F. Bai, K.-F. Kong, J. Dai, F. Qian, L. Zhang, C. R. Brown, *et al.*, "A paradoxical role for neutrophils in the pathogenesis of West Nile virus," *Journal of Infectious Diseases*, vol. 202, pp. 1804-1812, 2010.
10. J. W. Gnann Jr, A. Agrawal, J. Hart, M. Buitrago, P. Carson, D. Hanfelt-Goade, *et al.*, "Lack of Efficacy of High-Titered Immunoglobulin in Patients with West Nile Virus Central Nervous System Disease," *Emerging infectious diseases*, vol. 25, p. 2064, 2019.
11. K. C. Poh, L. F. Chaves, M. Reyna-Nava, C. M. Roberts, C. Fredregill, R. Bueno Jr, *et al.*, "The influence of weather and weather variability on mosquito abundance and infection with West Nile virus in Harris County, Texas, USA," *Science of the Total Environment*, vol. 675, pp. 260-272, 2019.
12. E. McDonald, S. W. Martin, K. Landry, C. V. Gould, J. Lehman, M. Fischer, *et al.*, "West Nile virus and other domestic nationally notifiable arboviral diseases—United States, 2018," *American Journal of Transplantation*, vol. 19, pp. 2949-2954, 2019.
13. J. Voyles, A. M. Kilpatrick, J. P. Collins, M. C. Fisher, W. F. Frick, H. McCallum, *et al.*, "Moving beyond too little, too late: managing emerging infectious diseases in wild populations requires international policy and partnerships," *EcoHealth*, vol. 12, pp. 404-407, 2015.
14. R. S. Nasci and J.-P. Mutebi, "Reducing West Nile Virus Risk Through Vector Management," *Journal of medical entomology*, vol. 56, pp. 1516-1521, 2019.
15. S. Karki, W. M. Brown, J. Uelmen, M. O. Ruiz, and R. L. Smith, "The drivers of West Nile virus human illness: fine scale dynamic effects of weather, mosquito infection, social, and biological conditions," *bioRxiv*, 2019.
16. J. G. Ponsam and R. Srinivasan, "A survey on MANET security challenges, attacks and its countermeasures," *International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)*, vol. 3, pp. 274-279, 2014.
17. N. Komar, S. Langevin, S. Hinten, N. Nemeth, E. Edwards, D. Hettler, *et al.*, "Experimental infection of North American birds with the New York 1999 strain of West Nile virus," *Emerging infectious diseases*, vol. 9, p. 311, 2003.

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