Arboviral Disease Surveillance — Kansas, 2013

Background

West Nile virus is an arbovirus (arthropod-borne virus) most commonly spread by infected mosquitoes. West Nile virus was first identified in the United States in 1999 and spread throughout the United States. Natural transmission involves a mosquito-bird-mosquito cycle; animals such as humans and horses do not circulate enough virus to re-infect a blood-feeding mosquito, and thus are referred to as "dead-end" or "accidental" hosts. Several species of mosquitoes are responsible for transmission of arboviruses but *Culex* species are the primary vector for West Nile virus in the United States.

The incubation period for arboviral infections vary. The incubation period for West Nile virus ranges from 3 to 15 days with an average incubation period of approximately one week. Arboviral infections may be asymptomatic or may result in illness of variable severity. Approximately 80% of people who become infected with West Nile virus do not develop any symptoms[1]. About one in five people who are infected develop a fever with other symptoms such as headache, body aches, joint pains, vomiting, diarrhea, or rash[1]. Most people with 'West Nile virus Fever' recover completely but fatigue and weakness can last for weeks or months[1]. Less than 1% of people who are infected develop a serious neurological illness, such as encephalitis or meningitis, and approximately 10% of people who develop this kind of an infection will die[1].

From 1999 – 2012 there were a total of 39,557 cases and 1,668 deaths in the United States from West Nile virus[2]. During 2012 the United States experienced the second highest number of cases since 2002, with 5,674 confirmed and probable cases reported to the Centers for Disease Control and Prevention[2]. The number of cases declined sharply in 2013 with a 56.5% reduction in cases reported to CDC[2]. However, Kansas had a 63% increase in human cases.

The Kansas Department of Health and Environment (KDHE) began surveillance for West Nile virus (WNV) in 2001 and the first human case was reported in Kansas in 2003. This surveillance system has three main components: mosquito surveillance, human surveillance, and reporting the results to public health partners.

Methods

Mosquito Collection

Mosquito surveillance was conducted weekly from June 13 to October 24, 2013 by Dr. Christopher Rogers with the Kansas Biological Survey. Surveillance was conducted in Sedgwick County, where human cases have been reported most frequently in Kansas. The traps were placed where mosquito arbovirus transmission was most likely to occur. These areas are where large numbers of migratory birds, extensive mosquito habitats, and large human populations coincide.

An Encephalitis Vector Survey (EVS) trap, with dry ice as a carbon dioxide source, was used to collect mosquitoes. These traps typically attract mosquitoes that feed on humans or other mammals. An average of nine traps was set each week in Sedgwick County. The traps were placed at the designated location in the early evening and were collected the following morning. The contents of the traps were secured in a container and labeled with the address

and/or GPS coordinates of the location of the trap. The mosquitoes were transported to the Kansas Biological Survey (KBS) at the University of Kansas for identification.

Mosquito Identification

The KDHE contracted with the Kansas Biological Survey (KBS) to enumerate and identify mosquitoes to the species level. Mosquito counts of greater than 1,000 per trap were divided into a smaller subset for identification due to budget constraints. Those mosquitoes identified as potential West Nile virus vectors were submitted to the Kansas Health and Environmental Laboratories (KHEL) via the Douglas County Health Department courier for testing. Results from the enumeration and identification were entered on a Microsoft® Excel® spreadsheet and submitted by KBS to KDHE weekly via e-mail.

West Nile Virus Testing of Mosquitoes

The West Nile virus vector mosquitoes from each trap location were tested at the Kansas Health and Environmental Laboratories. Mosquitoes were divided into vials containing approximately 50 mosquitoes each and tested for West Nile virus by polymerase chain reaction (PCR). The results were entered in an Excel® spreadsheet and sent to KDHE. All results were posted to KDHE's website and reported to the ArboNET surveillance system. (ArboNET is a national arboviral surveillance system managed by the Centers for the Disease Control and Prevention (CDC) and state health departments.)

Human Case Surveillance

West Nile virus, and all other arboviral diseases, is a reportable disease in Kansas. It is a passive surveillance system; healthcare providers or laboratories are required to report cases to KDHE. Cases were classified according to the 2011 CDC case definition (Appendix A). Confirmed and probable cases are reported to CDC and are included as the case count (e.g. confirmed + probable = total number of cases). It is important to note that these definitions are used for case counts only and are not used for clinical diagnosis. In addition, the county in which the person resides is used as the location for surveillance purposes, although they may have been infected elsewhere. Prior to 2011 Kansas only reported confirmed cases therefore we are only able to compare case counts and rates of West Nile virus from 2011-2013.

The cases were entered into EpiTrax, Kansas' electronic disease surveillance system, and the corresponding local health department completed the investigation. The Arboviral Disease Investigation Guideline contains information to provide technical assistance with local surveillance and disease investigation. They contain not only disease-specific information, but also sample letters, reporting forms, sample communication sheets and other tools to assist the local public health department. Once the case investigation is complete, all confirmed and probable cases are reported to the ArboNET surveillance system and the results are posted to the ArboNET website. Information on human West Nile virus case counts and rates can be found in KDHE's annual publication, Reportable Infectious Diseases in Kansas.

We report the incidence rate (number of cases per 100,000 people) of West Nile virus neuroinvasive disease cases for Sedgwick County and compare it to the State of Kansas, the West North Central region (Iowa, Kansas Minnesota, Missouri, Nebraska, North Dakota, and South Dakota), and the United States. We limit our incidence rates to neuroinvasive disease

cases as reporting for these cases is believed to be more consistent and complete than for nonneuroinvase disease cases[3].

Animal Case Surveillance

West Nile virus infection of animals is not a reportable disease in Kansas. However, positive laboratory results are sent to KDHE as a courtesy from the Kansas Department of Agriculture's Division of Animal Health or the United States Department of Agriculture's Animal and Plant Health Inspection Service. West Nile virus cases in horses may serve as a sentinel of West Nile virus activity in Kansas. Kansas does not conduct surveillance of dead birds for West Nile virus.

Mosquito Control

Sedgwick County Health Department and the City of Wichita worked together in an effort to educate citizens, control mosquitoes, and decrease the risk of West Nile virus transmission in Sedgwick County. The Sedgwick County Health Department developed palm card highlighting the three 'D's of prevention; drain, dress, and DEET (Appendix B). Code Enforcement Officers with the Metropolitan Area Building and Construction Department (MABCD), handed out the West Nile virus palm cards to citizens as they conducted inspections throughout the city of Wichita and Sedgwick County. The Sedgwick County Extension Master Gardeners and Extension Agents also distributed the palm cards.

In response to dramatically increasing numbers of vector mosquitoes during the month of August, the City of Wichita deployed mosquito larvicide "dunks" to areas of standing water that were likely breeding locations for these mosquitoes based on surveillance data. The larvicide contained in the dunks is a type of bacteria, *Bacillus thuringiensis israelensis*, or Bti. When the Bti are eaten by mosquito larvae it prevents development into adult mosquitoes. It is non-toxic to other insects, fish, animals, and humans. One dunk treats approximately 100 square feet of water and lasts for 30 days.

Evaluation of Measures to Predict West Nile Virus Cases

The Vector Index (VI) is used to quantify potential risk of transmission of West Nile virus from mosquitoes to humans[4]. The VI requires three values to complete the calculation; female vector mosquito presence, vector species density, and vector species infection rate[4]. First, vector density is calculated by the number of female *Culex* (e.g. *C. erraticus, C. pipiens/quinquefasciatus, C. resturans, C. tarsalis*) mosquitoes divided by the number of trap nights each week. Second, the Infection Rate (maximum likelihood estimate of the proportion of WNV infected mosquitoes in pooled samples) is calculated by the number of WNV positive mosquitoes per 1,000 mosquitoes tested[5]. After these measures are obtained the Vector Index (VI) is calculated by multiplying the vector density by the infection rate. All potential WNV mosquito vector species were tested and each pool contained a variety of mosquito species. We estimated the number of *Culex* mosquitoes for each pool and calculated an infection rate and VI using this estimate.

Two- and three-week prevalence estimates of *Culex spp.* and Vector Index were calculated and compared to the number of human cases, both those that occurred in Sedgwick County and those that occurred throughout the entire state. The mean number of *Culex spp*. and Vector Index by two- and three-week prevalence was compared to human cases that occurred at weekly intervals 2, 3, and 4 weeks later.

The correlation between measures was calculated using Pearson's correlation coefficient (R) and a p-value of <0.05 was considered statistically significant.

Results

Mosquito Surveillance

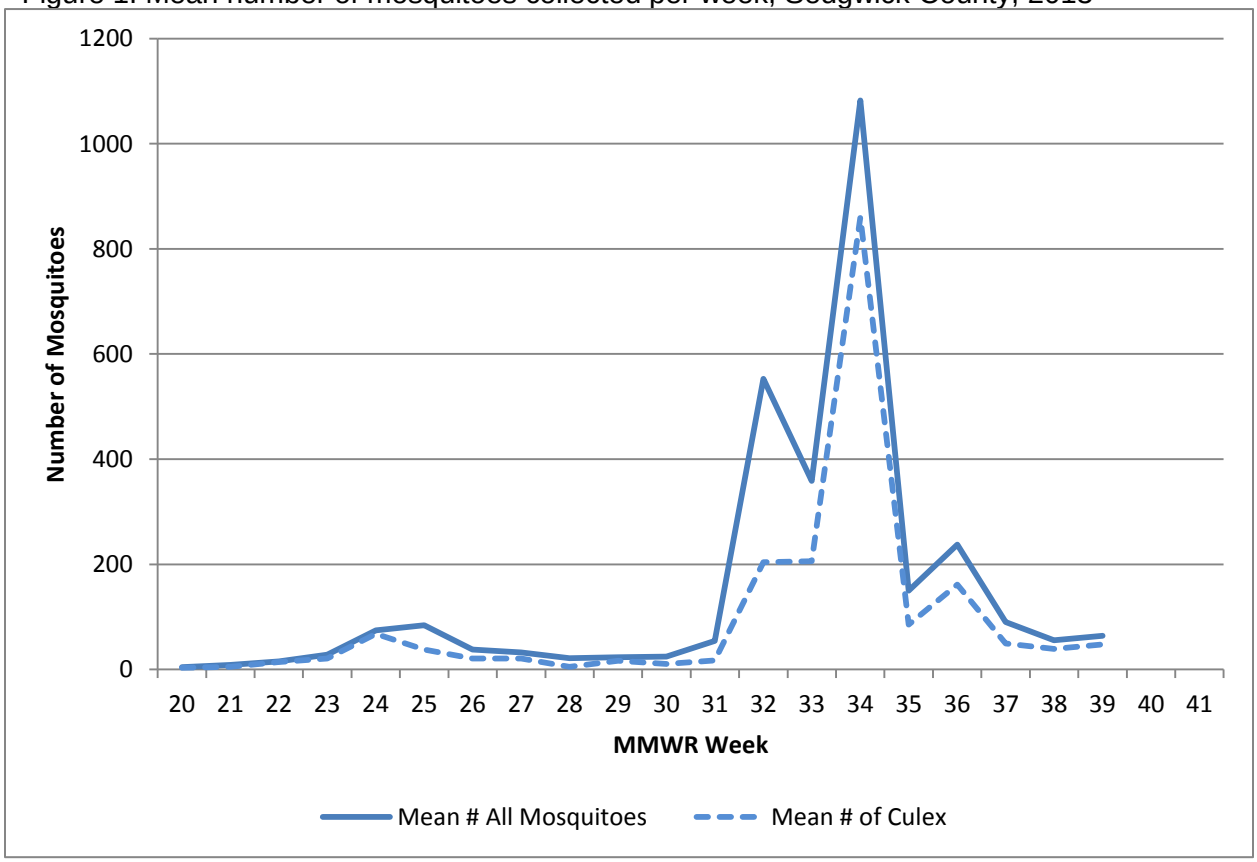
Mosquito Identification

Mosquito collection began on May 14 and continued weekly through September 24, 2013. All identified species (Table 1) have been previously documented in Kansas.

Mosquito Abundance

There was an average of nine trap nights per week during the twenty weeks of surveillance for a total of 179 trap nights. A trap night is calculated by taking the number of traps per night and multiplying it by the number of weeks of surveillance. The median number of mosquitoes collected each week was 495 (range 0 – 9740) and the median number of *Culex* mosquitoes was 100 (range 0 – 7744) (Figure 1). The mean number of *Culex* species (number of mosquitoes divided by the number of traps per week) per trap ranged from 3 – 860.

Figure 1. Mean number of mosquitoes collected per week, Sedgwick County, 2013



There were a total of 26,690 mosquitoes collected. *Culex tarsalis* (35%) *and Culex pipiens/quinquefasciatus* (27%) comprised the majority of mosquitoes collected (Table 1).

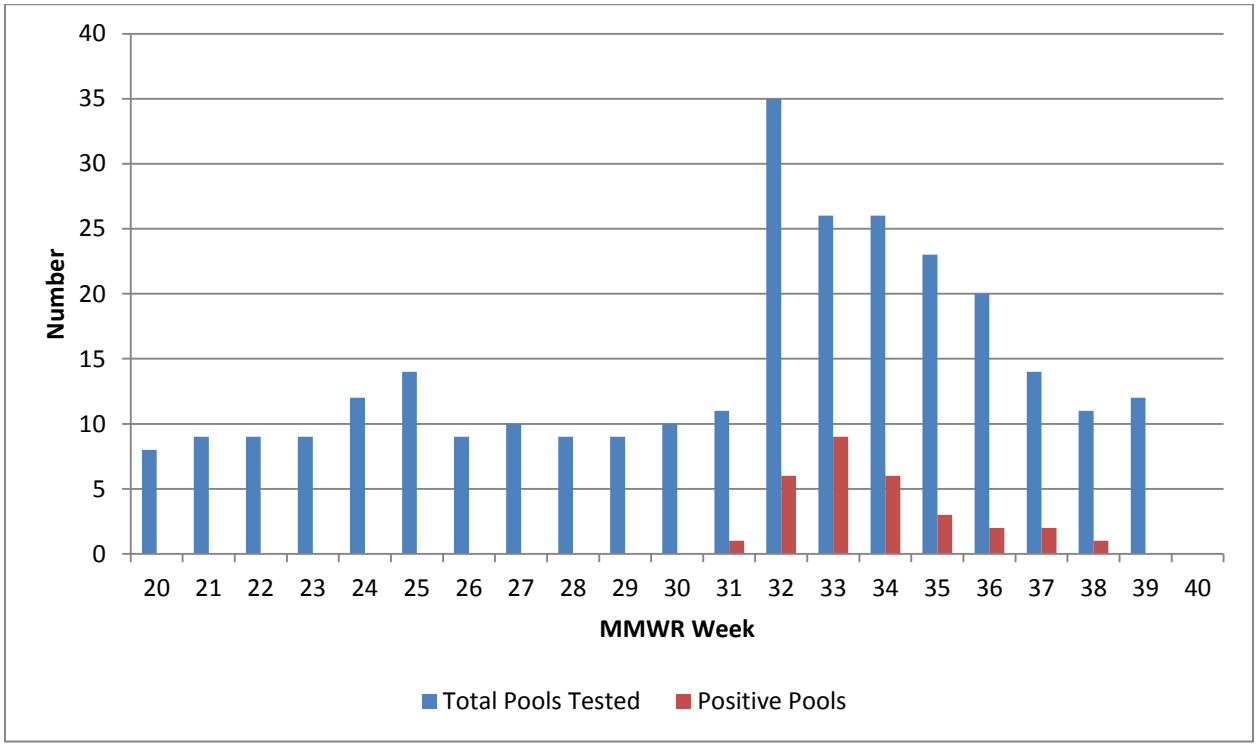
Table 1. Mosquito species collected, Sedgwick County, 2013

Mosquito Species	**Number**	**% Total**
Culex tarsalis	9458	35
Culex pipiens/quinquefasciatus	7317	27
Aedes vexans	6683	25
Anopheles quadrimaculatus	1010	4
Aedes albopictus	898	3
Ochlerotatus zoosophus	831	3
Anopheles punctipennis	110	0.4
Culex erraticus	96	0.4
Psorophora cyanescens	95	0.4
Ochlerotatus triseriatus	79	0.3
Psorophora discolor	32	0.1
Culex resturans	27	0.1
Culiseta inornata	17	<0.1
Psorophora columbiae	14	<0.1
Psorophora horrida	8	<0.1
Orthopodomyia signifera	8	<0.1
Psorophora ciliata	3	<0.1
Oclerotatus nigromaculis	3	<0.1
Total	**26690**	

Arboviral Testing

Mosquitoes were pooled for testing by location with up to 50 mosquitoes included per pool. Due to the excessive number of mosquitoes captured during MMWR weeks 33-36 only a subset of mosquitoes were tested. A total of 286 mosquito pools were tested for West Nile virus; 10.5% (30) tested positive for West Nile virus (Figure 2). The first WNV positive pool was collected on July 30th and the last WNV positive pool was collected on September 17th.

Figure 2. Number of West-Nile-virus-positive mosquito pools and total number of pools tested, Sedgwick County, 2013



Human Case Surveillance

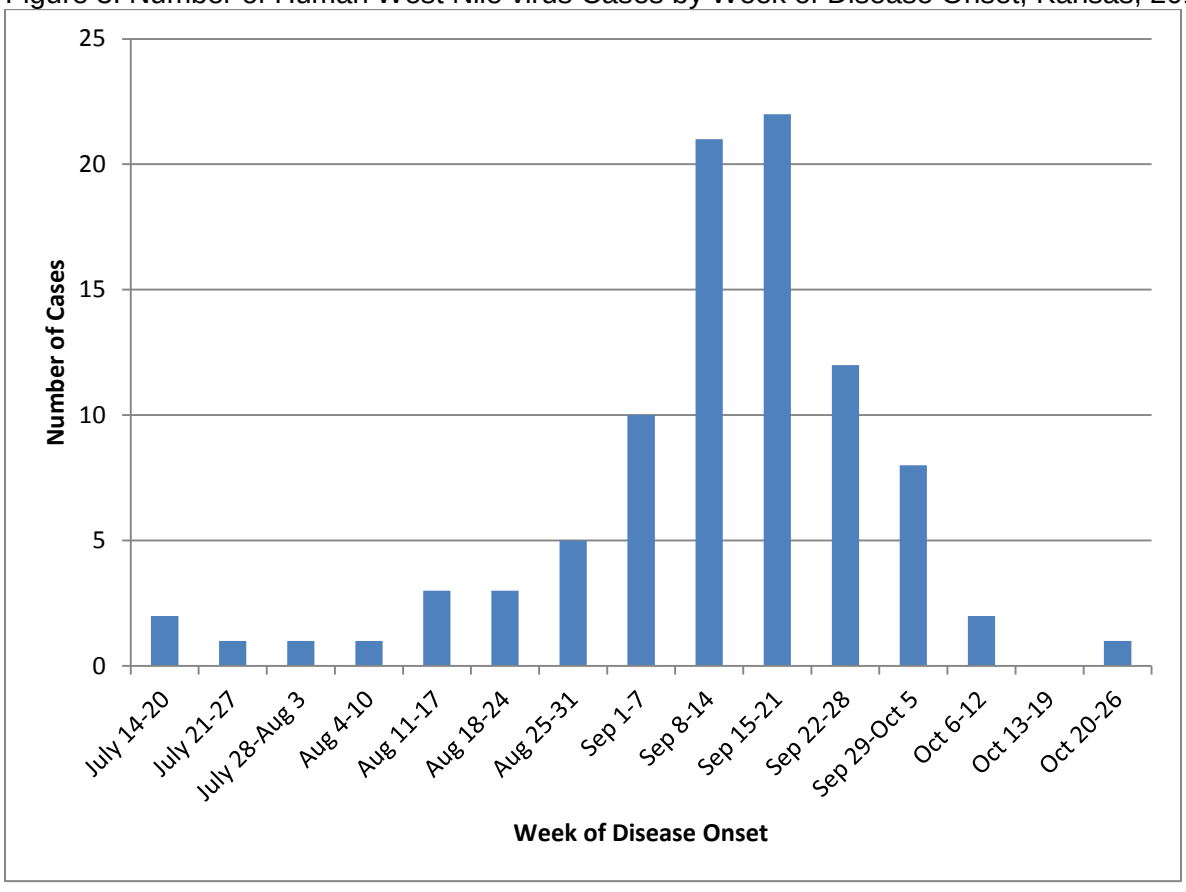
State of Kansas

A total of 92 human cases of West Nile virus were reported in the state of Kansas during 2013 (Table 2). This was a 62.5% increase in cases from 2012 (n= 56). There were five confirmed and 54 probable cases of non-neuroinvasive WNV and 33 probable cases of neuroinvasive WNV. There were no confirmed cases of neuroinvasive WNV. The median age was 59.5 years (range 12 – 85 years). Fifty-six cases (61%) were hospitalized. Eight (9%) deaths were reported. The earliest case became ill in July; the majority (72.8%) of cases had disease onset during September (Figure 3).

Table 2. Human West Nile virus case characteristics, Kansas, 2013 (n=92)

Age (years)		
Median	59.5	
Range	12-85	
	Number of Cases (%)	
Gender		
Male	63	(68)
Female	29	(32)
Month of Disease Onset		
July	3	(3)
August	13	(14)
September	67	(73)
October	9	(10)
Clinical Status		
Neuroinvasive disease	33	(36)
Non-neuroinvasive disease	59	(64)
Hospitalized	56	(61)
Died	8	(9)

Figure 3. Number of Human West Nile virus Cases by Week of Disease Onset, Kansas, 2013.



Sedgwick County

There were 11 cases of West Nile virus in Sedgwick County in 2013. Thirty-six percent (n=4) of these cases were neuroinvasive West Nile virus disease. This was a 60% decrease from the number of West Nile virus neuroinvasive cases reported in 2012. However, the neuroinvasive case rate increased 57% in the State of Kansas and 28% in the West North Central region (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota) (Table 3).

Table 3. West Nile virus neuroinvasive disease count and incidence rate* by year, 2011-2013

Region	**2011**		**2012**		**2013**	
	Count	*Rate*	*Count*	*Rate*	*Count*	*Rate*
Sedgwick County	0	N/A	10	1.98	4	0.79
Kansas	4	0.14	20	0.69	34	1.14
West North Central†	31	0.15	225	1.08	288	1.38
United States	1,267	0.16	2,873	0.92	486	0.44

**Number of cases per 100,000 population, based on July 1, 2013 U.S. Census population estimates.*
†U.S. Census region, West North Central includes; Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.

Animal Surveillance

Animal Case Surveillance

There were eight WNV-positive horses reported to KDHE during 2013. Horses in three counties (Saline, Butler, and McPherson) had specimens collected for WNV testing, and were likely symptomatic, prior to the first human case in each of those counties. Three counties (Sedgwick, Reno, and Leavenworth) reported specimens collected in horses after onset of symptoms in human cases (Table 4). The first horse reported with WNV in Sedgwick County, with a specimen collection on August 28, was symptomatic at the end of July. This was just a few days prior to the onset of symptoms in the first human case in Sedgwick County.

Table 4. Comparison of West-Nile-virus-positive horses with the illness onset date of the first human case per county, Kansas, 2013

County	**Date Specimen Collected from Horse with WNV**	**Symptom Onset Date of County's First Human WNV Case**
Saline	August 22	September 20
Butler	August 25	August 31
Sedgwick	August 28	August 1
Sedgwick	September 5	August 1
McPherson	September 9	October 10
Reno	September 13	August 9
Rooks	October 7	No human case
Leavenworth	October 21	September 23

Mosquito Control

The City of Wichita deployed 60 dunks within two different areas of standing water in the city on August 23 and August 27 and 45 dunks on August 28. On August 29 a total of 190 dunks were deployed in four additional locations. No adulticiding, or spraying for adult mosquitoes, was performed.

"Fight the Bite" educational campaign materials were developed and distributed in a variety of formats and locations. There were 210 posters distributed to City of Wichita facilities including swimming pools, city halls, and parks. There were 1,080 palm cards distributed by City of Wichita code enforcement personnel and storm water staff, Sedgwick County Extension Master Gardeners and local Extension Agents[6].

Evaluation of Measures to Predict West Nile Virus Cases

The mean number of *Culex* mosquitoes per week was calculated using two-week (current week and one week prior) and three-week (current week and two weeks prior) periods of mosquito surveillance data, and compared with the number of human cases, both for Sedgwick County and the state of Kansas, two to four weeks later. There is a strong correlation (R=0.82) between the two-week mean *Culex* prevalence and human cases occurring in Sedgwick County three weeks later. There was also a strong correlation between the two-week mean *Culex* prevalence and human cases occurring throughout the entire state of Kansas three (R=0.65) and four weeks (R=0.95) later. There was a strong correlation between the three-week mean *Culex* prevalence and human cases occurring in Sedgwick County three weeks (R = 0.61) and four weeks (R = 0.77) later. There was also a strong correlation between the three-week mean Culex prevalence and human cases occurring throughout the entire state of Kansas three (R=0.53) and four (R=0.86) weeks later.

We calculated a Vector Index (VI) for those weeks with a WNV positive mosquito pool (MMWR weeks 31-38). The highest VI, 6.6, occurred during week 34 (Table 5). We calculated a two-week (current week and one week prior) and three-week (current week and two weeks prior) VI and compared with the number of human cases, both for Sedgwick County and the state of Kansas, two to four weeks later. There was a weak correlation between the two-week VI and human cases occurring in Sedgwick County two (R = 0.49) and three (R = 0.40) weeks later; however, there was a strong correlation between the two-week VI and human cases occurring throughout the entire state of cases three (R = 0.93) and four (R = 0.63) weeks later. There was a strong correlation (R = 0.78) between the three-week VI and human cases occurring in Sedgwick County two weeks later and human cases occurring throughout the entire state of Kansas two (R = 0.91) and three (R = 0.86) weeks later.

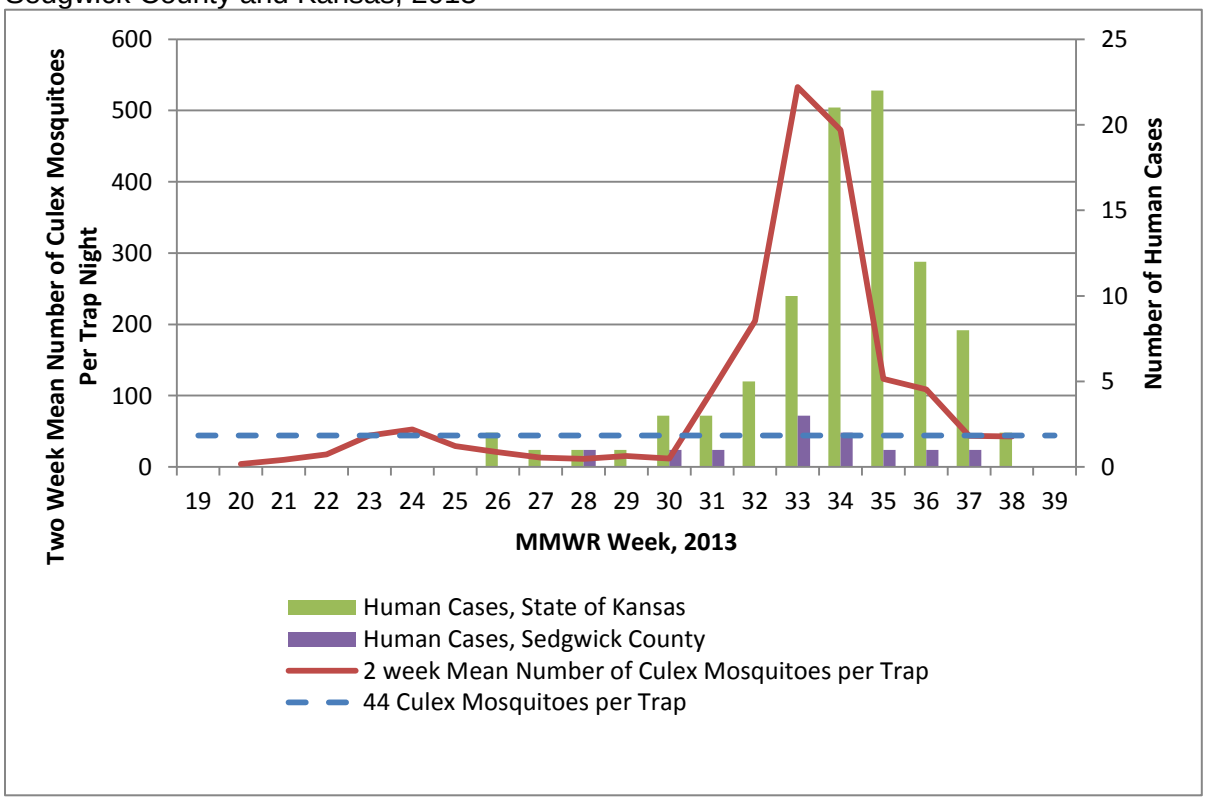
We evaluated the moving two- and three-week *Culex* mosquito prevalence estimate to determine if there was a number at which the mean number of *Culex* mosquitoes could be used to guide mitigation actions. 82% (9/11) of cases occurred three weeks later in Sedgwick County and 89% (81/91) of cases occurred three weeks later throughout the state of Kansas when the two-week mean number of *Culex* mosquitoes per trap was $\geq$44 (Figure 5). There did not appear to be a clear cutoff between the Vector Index values.

Table 5. Vector Index, Sedgwick County, Kansas, 2013*

MMWR Week	Mean Number of *Culex* Mosquitoes	Infection Rate for *Culex* mosquitoes (MLE/1,000)	Vector Index
31	17	9.17	0.16
32	204	0.55	0.11
33	206	5.21	1.07
34	860	7.7	6.63
35	85	4.11	0.35
36	162	3.57	0.58
37	49	5.35	0.26
38	39	2.82	0.11

**No West Nile virus positive mosquitos in MMWR weeks 20-30 and 39.*

Figure 5. Two-Week Mean Culex Mosqutio Prevalence and Human Cases Three Weeks Later, Sedgwick County and Kansas, 2013



Discussion

We changed our mosquito surveillance methodology in 2013 to increase the number of mosquito traps in the county where the highest number of human cases had been reported each year (Sedgwick County). This allowed us to concentrate the number of surveillance sites in a highly populated area, increase the amount of data collected, and attempt to quantify an action level at which mosquito control efforts should occur for public health officials.

There have been several recent peer-reviewed papers that evaluate the utility of mosquito surveillance data to attempt to quantify a measure or measures that can be used to predict human West Nile virus transmission from mosquitoes to humans[7-9]. Although the Vector Index is considered the gold-standard it relies on the outcome of test results from mosquitoes for West Nile virus (or other arboviruses) which can cause, at a minimum, a one to two week delay for prediction of human cases[8]. Due to the extremely high volume of mosquitoes collected during the peak of the season in Sedgwick County, late August through early September, the test results were not available until October and November. This significant and unavoidable delay in West Nile virus testing of mosquitoes rendered the Vector Index measure useless as a tool to predict human cases of West Nile virus and direct mosquito control efforts.

Therefore, we evaluated the utility of the mean number of *Culex* mosquitoes per trap, as the results are consistently available within three business days of collection. Bolling et al conclude that abundance of *Culex tarsalis* females were strongly associated with weekly numbers of West Nile virus disease cases with onset 4-7 weeks later[8]. Drs. Kilpatrick and Pape state that use of a two- or three-week moving window of vector index would alleviate substantial week-to-week variation of the risk index[7]. We applied their methodology to evaluate the utility of a two- and three-week mean *Culex* prevalence per trap night measure to predict human cases. The majority of cases occurred in Sedgwick County and the entire state three weeks after the two-week mean *Culex* prevalence was $\geq$44 *Culex* mosquitoes per trap night. This information can guide Sedgwick County and the City of Wichita officials on the location(s) to concentrate mosquito mitigation efforts and to focus public health messaging to residents of Sedgwick County. In addition, this information can also be used to alert all people in the state of Kansas when the risk of West Nile virus transmission may be increased.

There were at least three limitations of our study. First, we do not know the exact location where case-patients were infected. For the purpose of this study we assume that the case-patient was infected in their county of residence. This may under or overestimate the number of cases in Sedgwick County. Second, we were only able to evaluate one year of data as the sampling methodology changed between 2012 and 2013. Third, we had to estimate the number of *Culex* females per mosquito pool tested for West Nile virus for weeks 33-36 due to the abundance of mosquitoes collected; this may cause the Vector Index to be lower or higher than it actually was.

West Nile virus has been endemic in Kansas since 2003, with annual cases declining until the nationwide outbreak in 2012. From 2012-2013 the number of neuroinvasive West Nile virus cases decreased 83% in the United States; however, Kansas had a 70% *increase* in cases. While Sedgwick County has reported the highest number of cases of neuroinvasive disease in the state, there was a substantial (60%) *decrease* of the number of cases reported from 2012-2013. We believe that this is due, in part, to the targeted larvicidal treatment of mosquito breeding sites identified through adult mosquito surveillance efforts. We are unable to quantify this outcome as we did not perform mosquito larval surveillance.

Outbreaks of arboviruses, such as West Nile virus, are difficult to predict due to the variety of factors that can influence transmission of this disease including weather (e.g. precipitation and temperature, animal and human host abundance, and human behaviors (e.g. use of repellent, outdoor activity, etc.)[8].

People should take the following precautions to protect against West Nile virus:

- When you are outdoors, use insect repellent containing an EPA-registered active ingredient on skin and clothing, including DEET, picaridin, oil of lemon eucalyptus, or IR3535. Follow the directions on the package.
- Many mosquitoes are most active at dusk and dawn. Be sure to use insect repellent and wear long sleeves and pants at these times or consider staying indoors during these hours.
- Make sure you have good screens on your windows and doors to keep mosquitoes out.
- Get rid of mosquito breeding sites by emptying standing water from flower pots, buckets and barrels. Change the water in pet dishes and replace the water in bird baths weekly. Drill holes in tire swings so water drains out. Keep children's wading pools empty and on their sides when they aren't being used.

References

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Appendix A: West Nile virus surveillance case definition, 2013

CLINICAL CRITERIA FOR SURVEILLANCE PURPOSES

Neuroinvasive disease

- Fever (≥100.4°F or 38°C) as reported by the patient or a health-care provider, ***AND***
- Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician, ***AND***
- Absence of a more likely clinical explanation.

Non-neuroinvasive disease

- Fever (≥100.4°F or 38°C) as reported by the patient or a health-care provider, ***AND***
- Absence of neuroinvasive disease, ***AND***
- Absence of a more likely clinical explanation.

LABORATORY CRITERIA FOR SURVEILLANCE PURPOSES

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***
- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred, ***OR***
- Virus-specific IgM antibodies in CSF or serum.

SURVEILLANCE CASE DEFINITIONS

- *Confirmed:*

  Neuroinvasive disease

  A case that meets the above clinical criteria for neuroinvasive disease and one or more the following laboratory criteria for a confirmed case:

  - Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
  - Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
  - Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***

- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and one or more of the following laboratory criteria for a confirmed case:

- Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, ***OR***
- Four-fold or greater change in virus-specific quantitative antibody titers in paired sera, ***OR***
- Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen, ***OR***
- Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.

- *Probable:*

Neuroinvasive disease

A case that meets the above clinical criteria for neuroinvasive disease and the following laboratory criteria:

- Virus-specific IgM antibodies in CSF or serum but with no other testing.

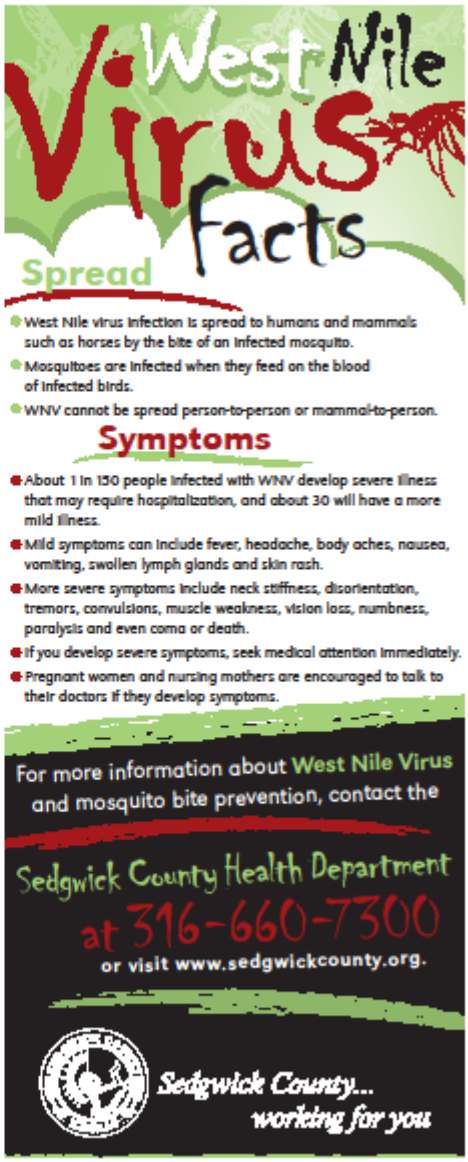
Non-neuroinvasive disease

A case that meets the above clinical criteria for non-neuroinvasive disease and the laboratory criteria for a probable case:

- Virus-specific IgM antibodies in CSF or serum but with no other testing.

Appendix B: Sedgwick County Health Department, ‘Fight the Bite’ Palm Card


Fight the BITE!
Mosquitoes are annoying.
They can also cause serious health problems.
These tiny insects spread diseases like West Nile Virus to humans and heartworms to our pets.
The best way to avoid bites from these little suckers is to follow the three Ds:
DRAIN
Eliminate standing water; mosquitoes need water to breed. Check pots, gutters, tires, tarps, wagons, wheelbarrows – anything that holds water. Change any standing water in wading pools, pet dishes and bird baths several times a week. And, use mosquito dunks or mosquito-eating fish in ponds and stagnant water.
DEET
Use insect repellents that contain DEET. DEET offers the best protection against mosquito bites. Follow product label directions. Avoid over-application.
DRESS
Wear long, loose-fitting clothing when outdoors, especially at dawn and dusk hours, which is when mosquitoes are most active.


West Nile Virus Facts
Spread
West Nile virus infection is spread to humans and mammals such as horses by the bite of an infected mosquito.
Mosquitoes are infected when they feed on the blood of infected birds.
WNV cannot be spread person-to-person or mammal-to-person.
Symptoms
About 1 in 130 people infected with WNV develop severe illness that may require hospitalization, and about 30 will have a more mild illness.
Mild symptoms can include fever, headache, body aches, nausea, vomiting, swollen lymph glands and skin rash.
More severe symptoms include neck stiffness, disorientation, tremors, convulsions, muscle weakness, vision loss, numbness, paralysis and even coma or death.
If you develop severe symptoms, seek medical attention immediately.
Pregnant women and nursing mothers are encouraged to talk to their doctors if they develop symptoms.
For more information about West Nile Virus and mosquito bite prevention, contact the
Sedgwick County Health Department
at 316-660-7300
or visit www.sedgwickcounty.org.
Sedgwick County... working for you

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Our Mission

To protect and improve the health and environment of all Kansans