Arboviral Disease Surveillance — Kansas, 2016

Kansas
Department of Health and Environment
Division of Public Health

Contents

Background

Arboviruses (arthropod-borne virus) are commonly spread to humans through the bites of infected mosquitoes, ticks, sand flies, or midges. This report focuses on those arboviruses transmitted by mosquitoes. West Nile virus (WNV) is the leading cause of domestically acquired arboviral disease in the United States and Kansas[1]. 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 – 2016 there were a total of 46,086 cases and 2,017 deaths in the United States from West Nile virus[2]. During 2012, the United States experienced an outbreak of West Nile virus that resulted in the second highest number of cases since 2002, with 5,674 cases reported to the Centers for Disease Control and Prevention[2]. However, Kansas did not experience a dramatic increase in cases until the following year. In 2013, Kansas had 92 human cases of WNV; a 63% increase from cases the previous year. Although the number of WNV neuroinvasive disease cases declined in 2014, the incidence rate (number of cases per 100,000 population) for Kansas remained higher than the incidence rate for the United States until 2015[3].

The Kansas Department of Health and Environment (KDHE) began surveillance for West Nile virus in 2001 with a grant from the Centers of Disease Control and Prevention (CDC). The first WNV positive mosquito specimens were collected on July 23, 2002; the first equine case and human case had onset of WNV on August 6 and August 8, 2002 respectively [4]. This surveillance system has three main components: mosquito surveillance, human surveillance, and reporting the results to public health partners.

In May 2015, an emerging arboviral disease, Zika virus, was reported in the Americas for the first time[5]. By early 2016 this included local transmission of the disease in Puerto Rico. Although most Zika virus infections do not result in disease or result in mild illness (e.g. fever, rash, joint pain, and conjunctivitis), infection was linked to infants with birth defects and Guillain-Barré syndrome[5]. It is the first mosquito-borne illness to cause microcephaly and the first infectious cause of microcephaly to be identified in more than 50 years.

Zika virus is primarily transmitted by the *Aedes aegypti* mosquito; however, it is also transmitted from mother to fetus in utero, from person to person through sexual intercourse, and via blood transfusions. This mosquito can also transmit dengue and chikungunya viruses. The *Aedes aegypti* mosquito has been found in Kansas; however, the range of the mosquito was not well-defined in our state. In 2016, the Kansas Biological Survey (KBS) conducted an *Aedes aegypti* and *Aedes albopictus* survey to determine the range of these mosquitoes in Kansas.

Methods

Mosquito Collection

Mosquito surveillance for WNV was conducted weekly from May 17 to October 25, 2016 by Dr. Christopher Rogers with KBS. Surveillance was conducted in Sedgwick County, where human cases have historically been reported most frequently in Kansas. Mosquito surveillance has been conducted solely in Sedgwick County since 2013. 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; our primary mosquito of interest was *Culex* species. Nine traps were 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 GPS coordinates of the location of the trap. The mosquitoes were transported to KBS at the University of Kansas for identification.

BG-Sentinel traps, with BG-Lure as an attractant, was used to survey for *Aedes aegypti* and *Aedes albopictus* mosquitoes. The survey began in the easternmost counties in the state. Traps were moved west county by county until no *Aedes aegypti* or *Aedes albopictus* mosquitoes were found in two consecutive counties. One historical report stated *Aedes albopictus* had been found in Morton County in the southwest corner of the state, therefore, Morton County was included in the survey.

Mosquito Identification

The KDHE contracted with 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. Mosquitoes of the genus *Culex (Culex spp.)*, the most common WNV vector, were submitted to the Kansas Health and Environmental Laboratories (KHEL) for testing. Results from the enumeration and identification were entered in a Microsoft® Excel® spreadsheet and submitted by KBS to KDHE weekly via e-mail.

West Nile Virus Testing of Mosquitoes

Culex spp. were tested at the Kansas Health and Environmental Laboratories. Mosquitoes were divided into homogenizer vials by date and trap location containing up to 50 mosquitoes each and tested for West Nile virus by reverse transcription polymerase chain reaction (RT-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 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 most recent 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 to be 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 case's 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 WNV from 2011 to present.

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 WNV case counts and rates can be found in KDHE's annual publication, Reportable Infectious Diseases in Kansas.

The incidence rate (number of cases per 100,000 people) of WNV neuroinvasive disease cases for Sedgwick County was compared to the State of Kansas, the West North Central region (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota), and the United States. Incidence rates were limited to neuroinvasive disease cases as reporting for these cases is believed to be more consistent and complete than for non-neuroinvasive disease cases[6].

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 and the United States Department of Agriculture's Animal and Plant Health Inspection Service. Horses may serve as a sentinel of WNV activity in Kansas. Kansas does not conduct surveillance of dead birds for WNV.

Mosquito Control

The Sedgwick County Health Department, City of Wichita, Sedgwick County Extension Office, and McConnell Air Force Base worked together to educate citizens, control mosquitoes, and decrease the risk of WNV transmission in Sedgwick County. The Sedgwick County Health Department developed a 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), distributed the WNV palm cards to citizens as they conducted inspections throughout the city of Wichita and Sedgwick County. The Sedgwick County Extension Master Gardeners, Extension Agents, and the 22nd Medical Group Public Health staff at McConnell Air Force Base also distributed the palm cards. The following list contains examples of the public locations where the posters were displayed; neighborhood City Halls, libraries, swimming pools, recreation centers, golf courses, and city park restrooms.

The City of Wichita deployed mosquito larvicide "dunks" to areas of standing water that were likely breeding locations for mosquitoes based on surveillance data. The 'dunks' were deployed in areas when the mosquito counts were *Culex spp.* $\geq$20 per trap. 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 their 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 up to 30 days.

Measures to Predict West Nile Virus Cases

There have been several peer-reviewed manuscripts that have evaluated 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[7]. KDHE evaluated the utility of the Vector Index in 2013, when 10.5% of our vials were positive for WNV, revealed no correlation between the VI and human cases in Kansas[10]. It does not appear that the VI is a useful measure to predict human cases of WNV in Kansas[10]. KDHE has not calculated VI since the 2013 study due to the low proportion WNV positive mosquitoes. The use of the VI may be re-evaluated when subsequent years of data are available.

Evaluation of surveillance data from 2013 & 2014 revealed a strong correlation between the two-week mean *Culex spp.* prevalence and human cases that occurred in Sedgwick County, and the entire state of Kansas, two and three weeks later[3]. The majority of cases occurred in Sedgwick County, and the entire state, two weeks after the two-week mean *Culex spp.* prevalence was ≥44 *Culex* mosquitoes per trap night[3]. Based on this information we issued a statewide press release to warn the public of an increased risk for WNV transmission when the *Culex spp.* prevalence met or exceeded this threshold.

We calculated the two-week mean *Culex spp*. prevalence and compared it to the number of human cases that occurred in Sedgwick County and throughout the entire state from 2013-2016. The two-week mean is calculated by counting the number female *Culex spp.* per trap for the current week of surveillance and the previous week and dividing by the number of traps during the same two weeks. The mean number of *Culex spp*. by two-week prevalence was compared to human cases that occurred at weekly intervals 0 - 6 weeks later. The correlation between the two 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 17, 2016 and continued weekly through October 25, 2016 for a total of 23 weeks of surveillance. All identified species (Table 1) have been previously documented in Kansas.

Table 1. Mosquito species collected, Sedgwick County, 2016.

Mosquito Species	Number	% Total
Aedes vexans	10,988	50
Anopheles quadrimaculatus	2,707	12
Culex tarsalis	1,984	9
Aedes albopictus	1,924	9
Culiseta inornata	892	4
Culex pipiens/quinquefasciatus	891	4
Psorophora cyanescens	838	4
Culex erraticus	351	2
Psorophora horrida	273	1
Ochlerotatus canadensis	221	1
Ochlerotatus triseriatus	201	0.9
Ochlerotatus trivittatus	128	0.6
Anopheles punctipennis	103	0.5
Psorophora ciliata	99	0.5
Psorophora columbiae	78	0.4
Psorophora ferox	70	0.3
Ochlerotatus zoosophus	16	0.1
Psorophora discolor	11	0.1
Culex restuans	7	<0.1
Anopheles punctulatus	4	<0.1
Anopheles barberi	2	<0.1
Orthopodomyia signifera	1	<0.1
Psorophora ciliophora	1	<0.1
Total	**21,790**	

Table 2. Mosquito species collected by year, Sedgwick County*.

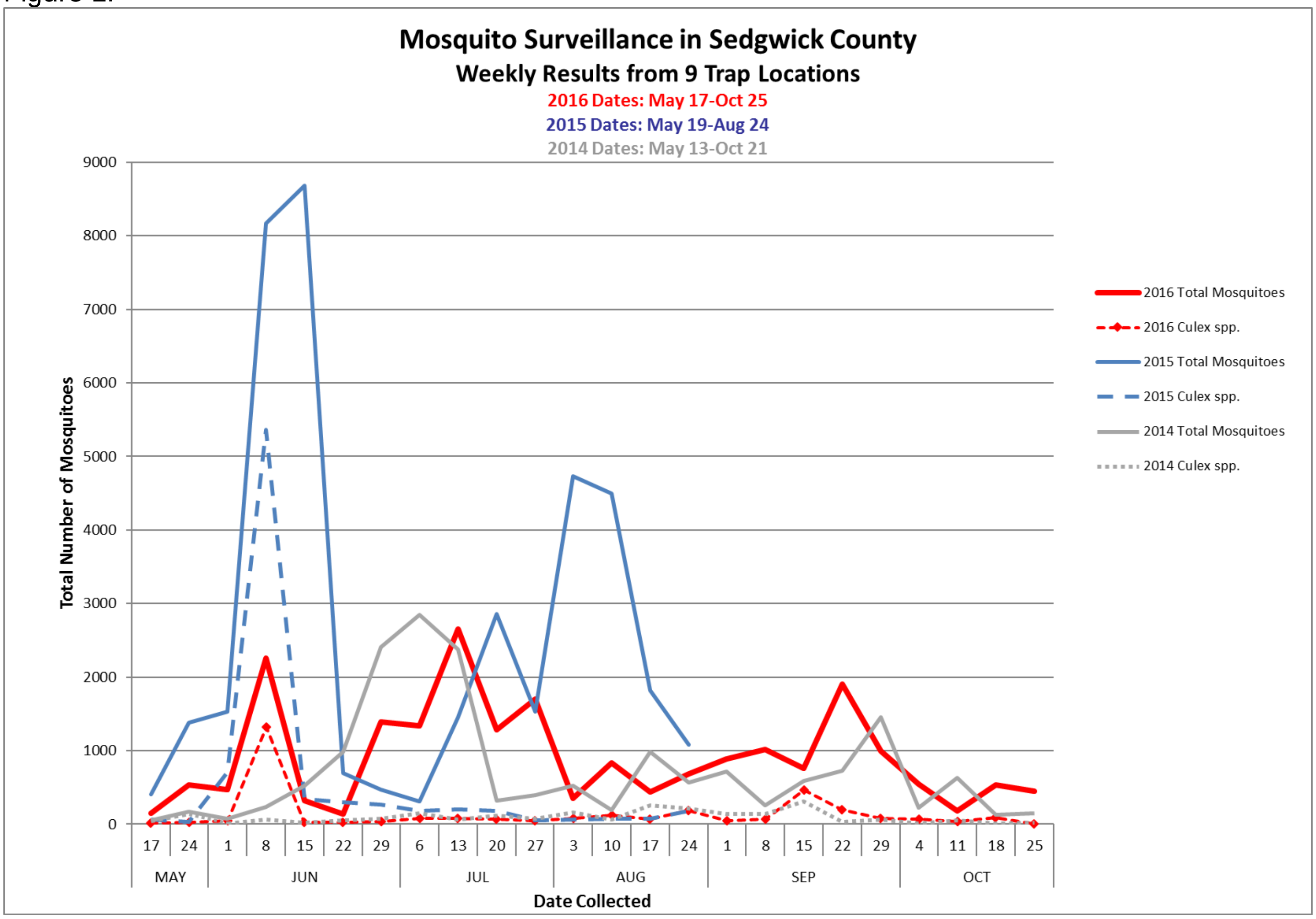
	2013		**2014**		**2015**		**2016**	
Mosquito Species	#	%	#	%	#	%	#	%
Aedes vexans	6,683	25	11,728	68	25,736	65	10,988	50
Culex tarsalis	9,458	35	1,425	8	6,698	17	1,984	9
Culex pipiens/quinquefasciatus	6,683	27	892	5	1,307	3	891	4

**The percent (%) of mosquito species was calculated by dividing the number (#) of that species by the total number of mosquitoes collected for the 2016 season.*

Mosquito Abundance

A trap night is calculated by taking the number of traps per week and multiplying it by the number of weeks of surveillance. There were nine trap nights per week during the 23 weeks of surveillance for a total of 207 trap nights. The median number of mosquitoes collected each week was 718 (range 134 – 2,652) and the median number of *Culex spp.* mosquitoes was 68 (range 0 – 1,325) (Figure 1). The mean number of *Culex spp.* per trap (number of mosquitoes divided by the number of traps per week) ranged from 0 – 147.

Figure 1.



There were 21,790 mosquitoes collected during 23 weeks of surveillance. The mosquito, *Aedes vexans*, a nuisance mosquito that does not transmit disease, comprised the majority (50%) of mosquitoes collected in 2016 (Table 1). *Culex tarsalis*, one of the primary vectors for WNV in Kansas, decreased in numbers by 108% compared to 2015 (Table 2).

Aedes Mosquito Survey

Seventy-seven percent (81/105) of Kansas counties were surveyed in 2016. *Aedes aegypti* were identified in 9 counties in eastern Kansas; Bourbon, Cherokee, Crawford, Douglas, Johnson, Labette, Linn, Miami, and Shawnee (Figure 2). *Aedes albopictus* were identified in 62 counties (Figure 3).

Figure 2. Range of *Aedes aegypti*, Kansas – 2016.

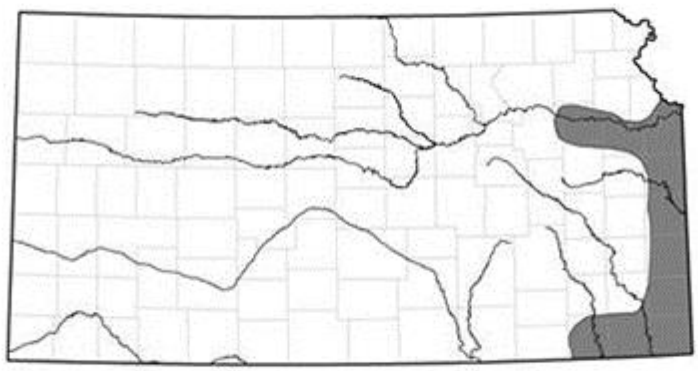
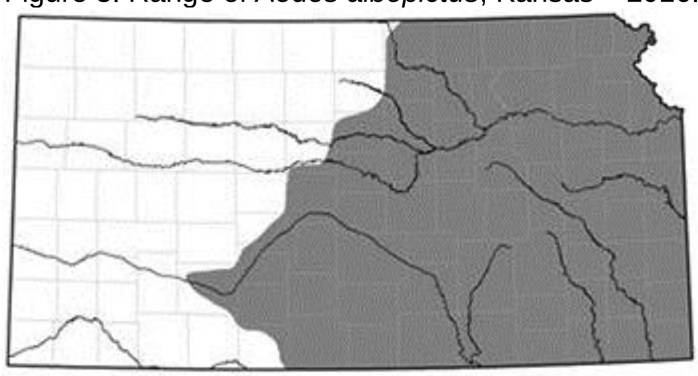


Figure 3. Range of *Aedes albopictus*, Kansas – 2016.



Arboviral Testing

A total of 149 vials were tested for WNV; only 2 vials tested positive (1.3%). Mosquitoes in the positive vials were collected on August 23rd and September 13th, 2016 in two different trap locations. This is a similar to past years where only 1 vial tested positive in 2015 (0.8%, 1/125) and in 2014 (0.7%, 1/143).

Human Case Surveillance

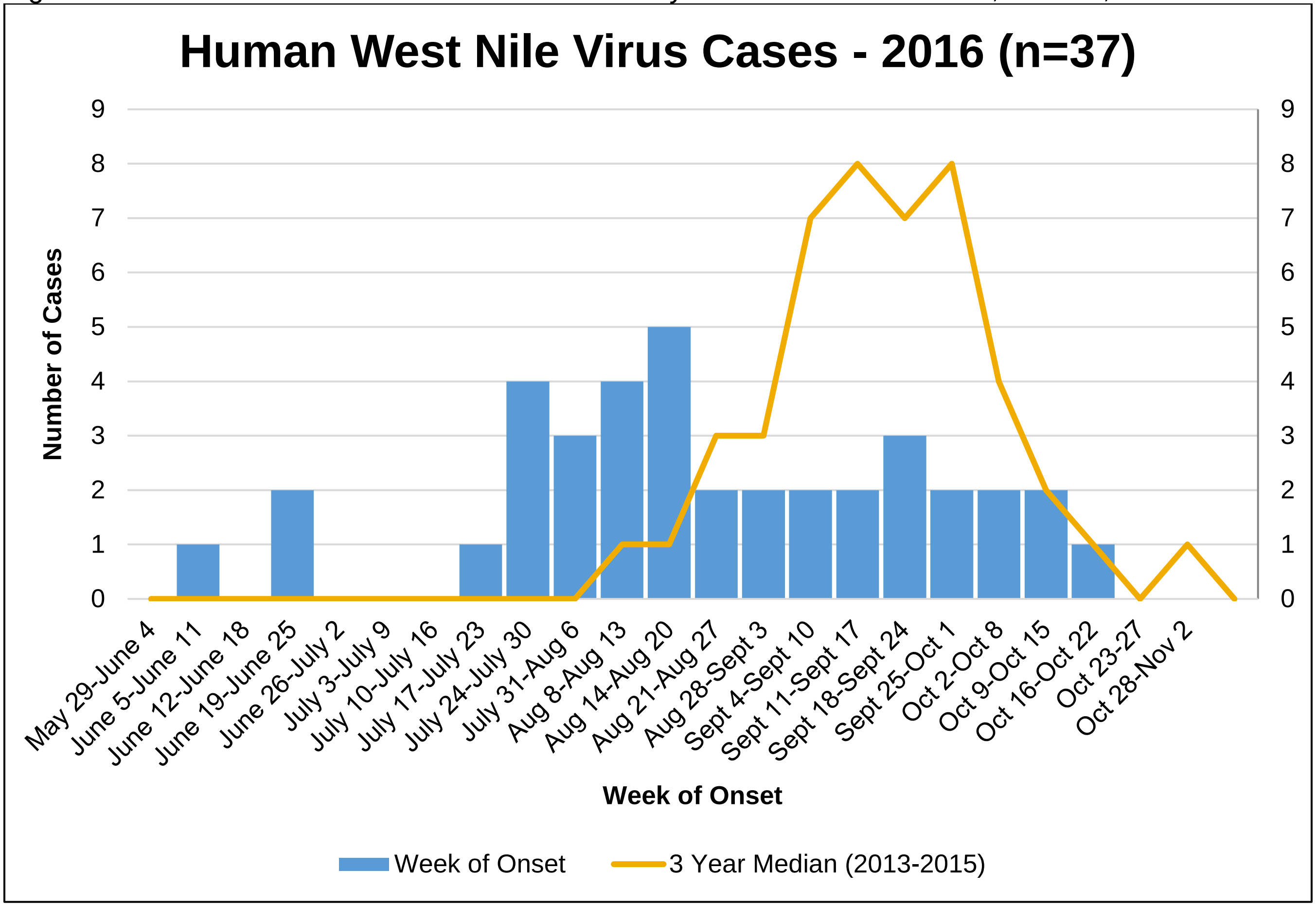
State of Kansas

A total of 37 human cases of WNV were reported in the state of Kansas in 2016 (Table 3). This was an increase of 3 cases from 2015 (N = 34). There were 20 cases of non-neuroinvasive WNV and 17 cases of neuroinvasive WNV. There was a 42% increase in the number of neuroinvasive disease cases compared to 2015 (Table 3). The earliest case became ill in June; the majority (59%) of cases had disease onset beginning in August or September (Figure 2). In the previous 3 years the majority (87%, three-year median) of cases had onset of disease in August and September. In 2016 19% of cases had disease onset in July; this is a substantial increase from the three-year median of 3%. The median age of case-patients was 59 years (range 26 – 88 years). Twenty-five cases (68%) were hospitalized. Five deaths (14% of total cases) were reported. In the United States, 5% of WNV cases resulted in death in 2016[2].

Table 3. Human West Nile virus case characteristics, Kansas, 2013-2016.

	2013	2014	2015	2016
Number of Cases	**92**	**54**	**34**	**37**
Age (years)				
Median	59.5	54	60	59
Range	12-85	10-78	26-82	26-88
		Number of Cases (%)		
Gender				
Male	63 (68)	32 (61)	21 (62)	28 (76)
Female	29 (32)	20 (39)	13 (38)	9 (24)
Month of Disease Onset				
June	0	0	2 (6)	3 (8)
July	3 (3)	1 (2)	3 (9)	7 (19)
August	13 (14)	23 (43)	12 (35)	13 (35)
September	67 (73)	27 (50)	15 (44)	9 (24)
October	9 (10)	3 (6)	2 (6)	5 (14)
Clinical Status				
Neuroinvasive disease	33 (36)	18 (33)	12 (35)	17 (46)
Non-neuroinvasive disease	59 (64)	38 (70)	22 (65)	20 (54)
Hospitalized	56 (61)	27 (52)	20 (59)	25 (68)
Died	8 (9)	0	2 (6)	5 (14)

Figure 2. Number of Human West Nile virus Cases by Week of Disease Onset, Kansas, 2016.



Peak cases occurred approximately one month earlier, late July and early August, than in previous years (Figure 2). This pattern occurred in Kansas and throughout the United States.

West Nile virus Neuroinvasive Disease

From 2015 to 2016 the neuroinvasive incidence rate increased in Sedgwick County (0.78 per 100,000), the State of Kansas (0.58 per 100,000), and the West North Central region (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota) (0.72 cases per 100,000). The incidence rate of WNV for Sedgwick County and Kansas was significantly higher than the incidence rate for the United States (0.35 per 100,000) in 2016.

There were four cases of neuroinvasive WNV disease in Sedgwick County in 2016 compared to 2 cases in 2015 (Table 4). The three-year median (2013-2015) for neuroinvasive disease in Sedgwick County was 2 cases. However, one of the four cases was likely infected in another country. If you remove this case from analysis, that decreased the rate of WNV in Sedgwick County from 0.78 to 0.58 cases per 100,000 people. The remaining three WNV neuroinvasive disease cases in Sedgwick County had onset of disease within two weeks of each other in late July and early August.

Table 4. West Nile virus neuroinvasive disease count and incidence rate* by year, 2013-2016.

Region	2012		2013		2014		2015		2016	
	Count	*Rate*	*Count*	*Rate*	*Count*	*Rate*	*Count*	*Rate*	*Count*	*Rate*
Sedgwick County	10	1.98	4	0.79	0	-	2	0.39	4	0.78
Kansas	21	0.74	34	1.17	18	0.62	12	0.41	17	0.58
West North Central†	226	1.08	288	1.38	104	0.50	82	0.39	174‡	0.82
United States	2,873	0.92	1,267	0.40	1,347	0.42	1,455	0.47	1,309‡	0.41

**Number of cases per 100,000 population, based on U.S. Census population estimates for July 1, 2016.*
†U.S. Census region, West North Central; Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.
‡ *Data from https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata/histatedate.html. Accessed December 7, 2017.*

Other Arboviral Diseases

In 2016 there were 25 cases of other arboviral diseases reported to the Kansas Department of Health and Environment. There was a significant decrease in the number of Chikungunya cases from 2015 (n = 11) to 2016 (n = 1) while dengue virus infections remained the same (n = 4). The decrease in Chikungunya cases is likely due to the emergence of Zika virus in areas with previously active Chikungunya transmission. There were 20 cases of Zika virus reported to KDHE.

All people reported with Chikungunya virus (n = 1), dengue virus (n = 4), and Zika virus (n = 20) acquired the disease outside of the United States in countries where these diseases were endemic. This was the first year that travel-associated Zika virus infection was reported in Kansas residents. All 20 Zika virus cases reported travel to countries in the Caribbean or Central America.

Animal Surveillance

Animal Case Surveillance

There were three WNV-positive animals were reported to KDHE in 2016.

Table 5. Animal cases of West Nile virus – Kansas, 2016.

Date of Specimen Collection	County	Animal
June 14	Riley	Red-tailed Hawk
August 1	Sedgwick	Horse
September 26	Sumner	Horse

Mosquito Control

The City of Wichita and Sedgwick County Health Department deployed 454 larvicide dunks within areas of standing water that were identified as likely mosquito breeding locations based on adult mosquito surveillance. The majority (53%) of the dunks were deployed in June (53%) and August (35%). No adulticiding (spraying for adult mosquitoes) was performed.

‘Fight the Bite’ educational campaign materials were developed and distributed in a variety of formats, including posters and palm cards. There was a total of 2,055 palm cards, 1,327 posters, and 425 door hangers distributed within Sedgwick County during 2016. This is a 52% increase from the number of ‘Fight the Bite’ educational materials distributed during 2015[3].

Measures to Predict West Nile Virus Cases

The two-week mean number of *Culex spp.* mosquitoes was calculated and compared with the weekly number of human cases, for Sedgwick County and the state from 2013 – 2016, zero to 6 weeks later. There was a weak correlation between the two-week mean *Culex spp.* prevalence and human cases in Sedgwick County two weeks (R = 0.47, p = <0.0001) and three weeks (R = 0.36, p = <0.0001) later. However, there was a strong correlation between the two-week mean *Culex spp.* prevalence and human cases throughout the entire state two weeks (R = 0.67), and three week (R = 0.60) weeks later.

We evaluated the moving two-week *Culex spp.* mosquito prevalence estimate to determine if the value used for public health alerts in 2016 (≥40 female *Culex spp.* per trap) should be modified. In Sedgwick County 43% (9/21) of human cases occurred 2 weeks after the two-week mean number of *Culex spp.* was ≥40 per trap. In Sedgwick County, 100% (21/21) human cases occurred after the two-week mean number of *Culex spp.* was ≥6 mosquitoes per trap (Table 6.)

Table 6. Two-week *Culex spp.* prevalence & human cases of WNV in Sedgwick County, 2013 – 2016.

Two-week *Culex spp.* Mosquito prevalence	**Number (%) of WNV Cases, 2 week lag**	
	Number	*Percent*
≥40	9	43
≥30	9	43
≥20	9	43
≥10	13	62
≥6	21	100

Throughout the state of Kansas 41% (82/202) and 40% (81/202) of the human cases occurred three weeks and four weeks after the two-week mean number of Culex spp. was ≥40 per trap. Eighty-six percent of human cases occurred after the two-week mean number of Culex spp. was lowered to ≥10 per trap (Table 7).

Table 7. Two-week *Culex spp.* prevalence and human cases of WNV in Kansas, 2013 – 2016.

Two-week *Culex spp.* Mosquito prevalence	**Number (%) of WNV Cases, 3 week lag**		**Number (%) of WNV Cases, 4 week lag**	
	Number	*Percent*	*Number*	*Percent*
≥40	82	41	81	40
≥30	90	45	83	41
≥20	119	60	115	57
≥10	171	86	173	86
≥6	195	98	195	97

Discussion

Although the case rate of WNV neuroinvasive disease in Sedgwick County (0.78 cases per 100,000 people) exceeded the state case rate (0.58 cases per 100,000) for the first time since 2012 the overall number and proportion of cases in Sedgwick County has decreased substantially. In 2012 Sedgwick County accounted for nearly half of all neuroinvasive WNV cases in the state (Table 4). Since focused mosquito surveillance, abatement, and education and outreach began in Sedgwick County in 2013 the case counts have decreased to a three-year median (2012-2015) of 2 cases per year. The proportion of neuroinvasive WNV cases has decreased substantially in Sedgwick County; from 47% of the state's neuroinvasive WNV cases in 2012 to 24% in 2016 with a record low of zero cases in 2014 (Table 4). This sustained decrease in neuroinvasive WNV disease cases in Sedgwick County is likely due to a combined effort of mosquito surveillance used to guide abatement efforts and outreach efforts to educate the public on how they can protect themselves from West Nile virus. The local media has been an invaluable partner in this effort as well.

We evaluated the moving two-week *Culex spp.* mosquito prevalence estimate to determine if the value was useful for predicting WNV infections in people and if the threshold used for public health alerts in 2016 (≥40 female *Culex spp.* per trap) should be modified. The surveillance data from 2013-2017 revealed only a weak correlation between the two-week mean *Culex spp.* and human cases that occurred two weeks (R = 0.47, p = <0.0001) and three weeks (R = 0.36, p = <0.0001) later in Sedgwick County. This was a decrease in correlation when compared to the 2013-2014 results; two-week lag (R = 0.82) and three-week lag (R = 0.64). This is likely due to the decrease in the number of cases of WNV in Sedgwick County. However there remained a strong correlation between the two-week mean *Culex spp.* and human cases throughout the state that occur 3 weeks (R = 0.67, p = <0.0001) and 4 weeks later (R = 0.60, p = <0.0001). It is important to note that only 41% (82/199) of cases occurred when the two-week mean *Culex spp.* count was ≥40 per trap however ~60% of cases occurred when the mean was lowered to ≥20 *Culex spp.* per trap at the three and four-week lag (Table 7). This is likely due to the decrease in the incidence of WNV cases reported to KDHE.

In the fall of 2016 we received reports of two fatal cases of neuroinvasive WNV in residents of Turon, Kansas. Turon, population 378, spans three counties (Pratt, Reno, and Stafford) in southcentral Kansas just west of Sedgwick County. Mosquito surveillance had last been conducted in Reno County in 2003, Stafford County in 2005, and Pratt County in 2009. Surveillance had been discontinued due to decreased funding for this program. Fortunately, we received additional funds for mosquito surveillance from CDC for 2017. We plan to conduct mosquito surveillance in Turon, and other locations in Reno County, to help guide mosquito abatement measures and provide education and outreach to citizens in order to prevent additional cases.

Outbreaks of arboviruses, such as WNV, 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.)[6]. For the 2017 mosquito surveillance season we plan to develop WNV risk levels to help citizens understand the risk of transmission of WNV and provide specific recommendations to prevent infection.

References

1. Centers for Disease Control and Prevention, Division of Vector-Borne Diseases. *West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control*. 4th Revision June 14, 2013. Morbidity and Mortality Weekly Reports. Accessed December 7, 2017. http://www.cdc.gov/westnile/resourcepages/pubs.html
2. Centers for Disease Control and Prevention. *West Nile virus disease cases and deaths reported to CDC by year and clinical presentation, 1999-2016*. Accessed December 7, 2017. http://www.cdc.gov/westnile/statsmaps/cummapsdata.html
3. Kansas Department of Health and Environment. *Arboviral Disease Surveillance – Kansas, 2014.* Accessed December 7, 2017. http://www.kdheks.gov/epi/arboviral_disease.htm
4. Kansas Department of Health and Environment. *Reportable Diseases in Kansas, 2002 Summary.* Accessed August 23, 2017. http://www.kdheks.gov/epi/annual_summary.htm
5. Hennessey M., Fischer M, Staples JE. *Zika Virus Spreads to New Areas – Region of the Americas, May 2015 – January 2016.* Morbidity Mortality Weekly Report. January 29, 2016/65(3);55-58.
6. Lindsey, N.P. Lehman, J.A., Staples, J.E., Fischer, M. *West Nile Virus and Other Arboviral Diseases – United States, 2014.* Morbidity and Mortality Weekly Report. Sept 4, 2015; 64(34):929-934.
7. Kilpatrick, A.M. Pape, J. *Predicting Human West Nile Virus Infections with Mosquito Surveillance Data*. American Journal of Epidemiology. 2013;178(5):829-835.
8. Bolling, B.G., Barker, C.M., Moore, C.G., Pape, W.J., Eisen, L. *Seasonal Patterns for Entomolgical Measures of Risk for Exposure to Culex Vectors and West Nile Virus in Relation to Human Disease Cases in Northeastern Colorado*. Journal of Medical Entomology. 2009;46(6):1519-1531.
9. Colborn, J.M., Smith, K.A., Townsend, J., Damian, D., Nasci, R.S., Mutebi, J-P. *West Nile Virus Outbreak in Phoenix, Arizona – 2010: Entomological Observations and Epidemiological Correlations*. Journal of the American Mosquito Control Association. 2013;29(2):123-132.
10. Kansas Department of Health and Environment. *Arboviral Disease Surveillance – Kansas, 2013.* Accessed August 17, 2016. http://www.kdheks.gov/epi/arboviral_disease.htm

Appendix A: West Nile virus surveillance case definition, 2016

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.

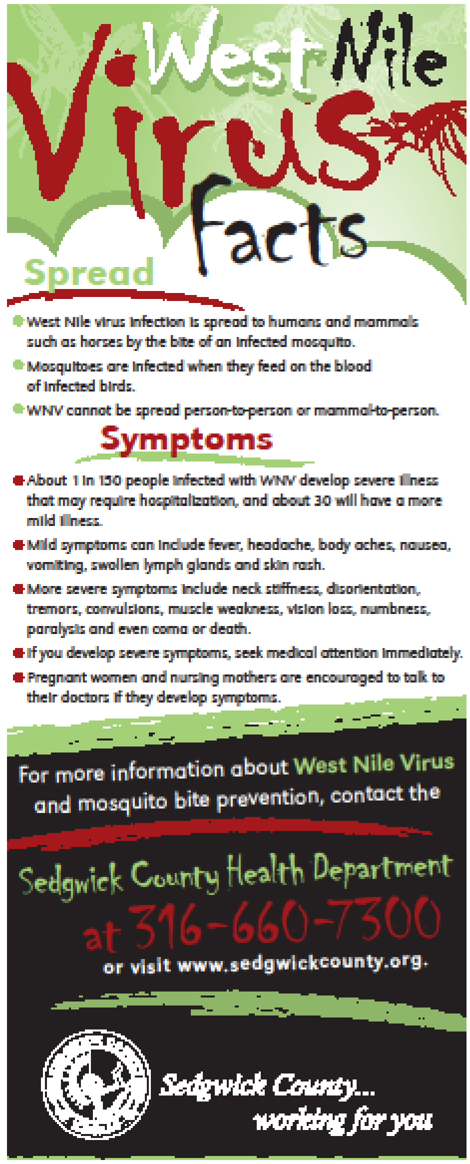
Non-neuroinvasive disease

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 150 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