Evaluation of the West Nile Surveillance System for the State of Kansas

MPH Capstone Experience
Conducted at
Kansas Department of Health and Environment

Presented By
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Public Health Surveillance

- Ensure that problems of public health importance are being monitored efficiently and effectively and to insure that public health resources are being utilized to their fullest extent.

- Evaluating surveillance systems help improve the quality, efficiency, and usefulness of the program.
West Nile Virus

- Arboviral disease in the *Flaviviridae* family
- Member of the Japanese encephalitis virus antigenic complex
- Maintained in enzootic bird-mosquito-bird cycle
  - *Culex species*
West Nile Virus

- First isolated in 1937 from a febrile women in Uganda

- Implicated in sporadic outbreaks of encephalitis in humans and horses in Africa, the Middle East, western Asia, and Australia
  - Usually mild disease in children
Signs and Symptoms

- Asymptomatic Infections

- West Nile Fever (WNF)
  - Non-specific flu-like symptoms

- West Nile Neuroinvasive Disease (WNND)
  - WNF with development of neurological symptoms
WNV in the United States

- Entered New York City area in 1999
- Spread to all lower 48 states by 2005

- Has caused an estimated
  - 29,624 reported cases
    - 16,765 (56.6%) West Nile Fever
    - 12,088 (40.8%) West Nile Neuroinvasive Disease
    - 771 (2.6%) Clinically Unspecified
    - 1,161 (3.9%) Fatal
Surveillance

- Center for Disease Control and Prevention
  - Started to provide funding for state surveillance in 2000

- Original surveillance used to track spread of virus
  - Determine potential vectors, seasonality, geographic areas of high activity, and susceptible species.
Surveillance in Kansas

- 2001, Kansas Department of Health and Environment started statewide surveillance

  - Funded by the CDC’s Epidemiology Laboratory Capacity (ELC) grant

  - Included: Dead bird testing, mosquito pool collection, and reporting of human, equine and other animal cases
2009 Surveillance

- Passive human disease reporting
  - K.S.A. 65-118 and K.S.A. 65-128 all arboviral disease are reported within 7 days of diagnosis

- Mosquito pool collection and testing
  - 13 of 105 counties
  - May through late Fall
    - Collection by Kansas State University Entomology Department
    - Testing conducted at KDHE Laboratory
**WNV Surveillance**

- Positive human laboratory data submitted to KDHE
- All mosquito results submitted to KDHE
- All data entered into Kansas’s Electronic Disease Surveillance System (KS-EDSS)
- Shared with CDC through ArboNet
Materials and Methods

- CDC’s 2001 document: *Updated Guidelines for Evaluating Public Health Surveillance Systems*

- CDC’s 2003 document: *Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control*
Goals of Mosquito-based Surveillance

1) Use data on mosquito populations and virus infection rates to assess the threat of human disease;

2) Identify geographic areas of high risk;

3) Assess the need for and timing of interventions;

4) Identify larval habitats for targeted control;

5) Monitor the effectiveness of this type of surveillance and improve prevention and control measures; and

6) Develop a better understanding of transmission cycles and potential vector species.

(CDC Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control)
Engage the Stakeholders

- KDHE, Bureau of Surveillance and Epidemiology
- Dr. Ludek Zurek, KSU Entomology Department
  - Supervisor and coordinator for mosquito collection
- Dr. Roman Ganta, KSU Dept. Diagnostic Medicine/Pathobiology
  - Supervises virology laboratory and animal WNV testing
- Local Health Departments with positive mosquito pools
Describe Public Health Importance

- Human case data retrieved from KS-EDSS
  - January 1, 2002 to December 31, 2009

- Cases are classified as confirmed, probable or suspect for surveillance purposes
  - Only confirmed and probable cases included

- Exported to Microsoft Excel® spread sheets
  - Names and address excluded to protect privacy
Describe Public Health Importance

- Data separated into case classification and year

- Evaluated by clinical classification, age, and sex

- Cases from 2002-2009 were plotted on epi-curve by MMWR week
**Timeliness**

- Time between mosquito collection and reporting of test results to KDHE
  - 2008 and 2009

- Data analyzed to determine number of days between positive non-human case report dates and human case onset of illness dates in the same county
  - SAS 9.1.3
  - Avian, Animal, Mosquito
  - 2003-2009
Timeliness

- Onset dates for human illness and mosquito pool result dates were plotted by MMWR for 2003-2006 and 2008-2009

- No mosquito pools collected in 2007
Neighboring States

- Public health officials from Oklahoma, Nebraska, Missouri and Colorado were interviewed regarding their state’s WNV surveillance program

- Main focus on type of surveillance and sources of funding
  - Will surveillance be continued without ELC grant?
Results: Stakeholders

- KSU Entomology Department
  - Not gaining any new information from the data that is collected
  - As incidence goes down, more difficult to find the virus in mosquito populations

- KSU Virology Lab
  - Equine testing decreased with no positive in last few years

- Counties with positive mosquito pools
  - None indicated that they released PSAs or increased vector control measures
Results: Public Health Importance

- 890 human reports in EDSS
  - 153 confirmed
  - 142 probable

- 295 human cases since 2002
  - 194 (65.7%) WNND
  - 99 (33.6%) WNF
  - 2 (0.68%) were clinically unspecified
  - 13 (4.4%) Fatalities
Results: Public Health Importance

Human Cases and Fatalities in Kansas 2002-2009

Number of Cases or Fatalities

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases</th>
<th>Fatalities</th>
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<tbody>
<tr>
<td>2002</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>91</td>
<td>4</td>
</tr>
<tr>
<td>2004</td>
<td>43</td>
<td>2</td>
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<td>2005</td>
<td>25</td>
<td>1</td>
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<td>2007</td>
<td>40</td>
<td>2</td>
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<tr>
<td>2008</td>
<td>31</td>
<td>0</td>
</tr>
<tr>
<td>2009</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>
Results: Public Health Importance

- **Age**
  - Range 1 – 94 years
  - Median 52

- **Sex**
  - 59.2% Male
  - 39.8% Female
  - 1% unspecified
Results: Public Health Importance

Age Comparison for West Nile Fever and West Nile Neuroinvasive Disease 2002-2009

- Age Group:
  - <18
  - 18-35
  - 36-54
  - >55

- Number of Clinical Cases

- West Nile virus Fever
- West Nile Neuroinvasive Disease
Results: Public Health Importance

Human Cases by MMWR Week for 2002-2009
# Results: Timeliness

Days between mosquito pool collection and report date of test results

<table>
<thead>
<tr>
<th>Year</th>
<th>Range (days)</th>
<th>Median (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>6-87</td>
<td>22</td>
</tr>
<tr>
<td>2008</td>
<td>6-43</td>
<td>24</td>
</tr>
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</table>

Both years combined the range was 6-87 days with a median of 23 days
Results: Timeliness

- Time between positive non-human cases and positive human cases in the same county
  - 890 human reports in KS-EDSS
    - 456 had an onset of illness date
    - 288 were either confirmed or probable cases
  - 122 animal cases
  - 365 avian reports, 205 positives
  - 2992 mosquito pools, 115 positives
Results: Timeliness

- Animal Cases
  - Ranged from 49 days prior to 110 after human cases
  - Median 22.5 days after

- Avian Cases
  - Ranged from 60 days prior to 58 after human cases
  - Median 1 day after

- Mosquito Pools
  - Ranged from 36 days prior to 82 days after human cases
  - Median 24 days after
Results: Timeliness

Positive Human Cases and Positive Mosquito Pools by MMWR Week for 2003-2009*

* Excludes data from 2007 – Mosquito pool collection was not performed in 2007
Mosquito Pools and Human Cases in 2009

[Map showing mosquito pools and human cases in different counties with color-coded areas for testing, positives, and positive human cases.]
Results: Neighboring States

- Equine Cases reported in all 4 states
  - Required in 3 of 4 states

- Dead bird reporting in 2 of 4
  - Testing done in 1 of 4

- Mosquito pool testing in all 4 states
  - Number of counties tested
    - 27/93 (29%)
    - 19/64 (29.7%)
    - 4/77 (5.2%)
    - 14/114 (12.3%)
    - 13/105 (12.4%) – Kansas
Results: Neighboring States

- All funded by ELC grant
  - Only one state indicated that surveillance would continue if federal funding is cut – others were unsure at this time but not optimistic

Other thoughts

- Concerned about having to start surveillance again if another arbovirus enters the US
- National Pollutant Discharge Elimination System
  - Hard for cities to obtain permits without documented positive mosquito pools
Conclusion

- Mosquito based surveillance is not a useful tool for prediction of human illness

- Time between collection and reporting of results is prolonged

- Human cases can and have occurred and even peaked before mosquito activity is reported
Conclusion

- Animal and avian cases are not reliable sentinels for human infections
  - Vaccination of horses
  - Decrease in susceptible bird populations and/or herd immunity
Recommendations

- Discontinue mosquito pool testing
  - Not providing adequate public health data

- Move in the direction of public education and vector control
  - Update and maintain website
    - Maps last updated in 2006
  - Provide public service announcements to county extension offices and Master Gardener programs
  - Release timely statewide PSAs in late June and again in August about personal protection
  - Revamp avian and animal results from KSU
Closing Comments

- West Nile virus is now endemic in Kansas
  - We can stop looking for it and move to continuing education to the public

- Current methods will not detect other arboviral disease
  - Resources are now known and could be reinitiated if needed

- Education should include all vector diseases, not only WNV
In Addition

- Daily activities of State Health Department
- Press Releases
- Outbreak Investigation
  - H1N1
  - Food-borne
Thank You

- Dr. Ingrid Garrison, DVM, MPH, DACVPM
  - State Public Health Veterinarian and Environmental Health Officer

- Mr. Charlie Hunt, MPH
  - State Epidemiologist

- All the Ladies (and Dan) in the Bureau of Surveillance and Epidemiology
Get Outside! Play... just remember to apply a DEET-based repellent to exposed skin.

Ask an adult for help.

For more information visit www.ack.gov/westnile or www.deetonline.org.