Geospatial Mapping of Chikungunya and other Emerging Infections in Veterans Health Administration

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Emerging Infection Surveillance in VHA

- VHA Office of Public Health (OPH) conducts surveillance for emerging infections as well as annual influenza surveillance for situational awareness
- Healthcare Associated Infection and Influenza Surveillance System (HAIISS)
  - Inpatient and Outpatient Encounter data
  - Laboratory testing data
  - Pharmacy data
  - Telephone triage data
  - *Geospatial mapping capabilities*

Geospatial Mapping Capabilities in HAIISS

- ESRI Query Results Viewer (EQRV) is a custom interface between HAIISS biosurveillance system (ESSENCE) and ArcGIS
- ESSENCE utilizes ArcGIS Server 10 with web browser-based Arc GIS Flex Viewer that was customized for HAIISS by ESRI in 2011 with additional enhancements completed in 2014
- HAIISS surveillance data residing outside ESSENCE (e.g. lab data) visualized using MS MapPoint 2009

Recent Infections of Epidemiologic Significance

- Chikungunya (CHIKV) - 2014
- West Nile Virus (WNV) – 2012
- Pertussis/Whooping Cough – 2010-2014
- Dengue – 2009-2010
- Influenza (including H1N1 pandemic) – 2009 to present

Chikungunya (CHIKV)

- CHIKV is transmitted by mosquitoes and often occurs in large outbreaks with high attack rates
- Infections can be imported to new areas by travelers
- Symptoms can be severe and disabling: fever, joint pain & swelling, headache, muscle pain and rash
- December 2013: World Health Organization first report of local CHIKV transmission in Caribbean
- July 2014: First locally acquired case in the continental U.S. (Florida) & increasing cases in Puerto Rico

CHIKV Surveillance in VA

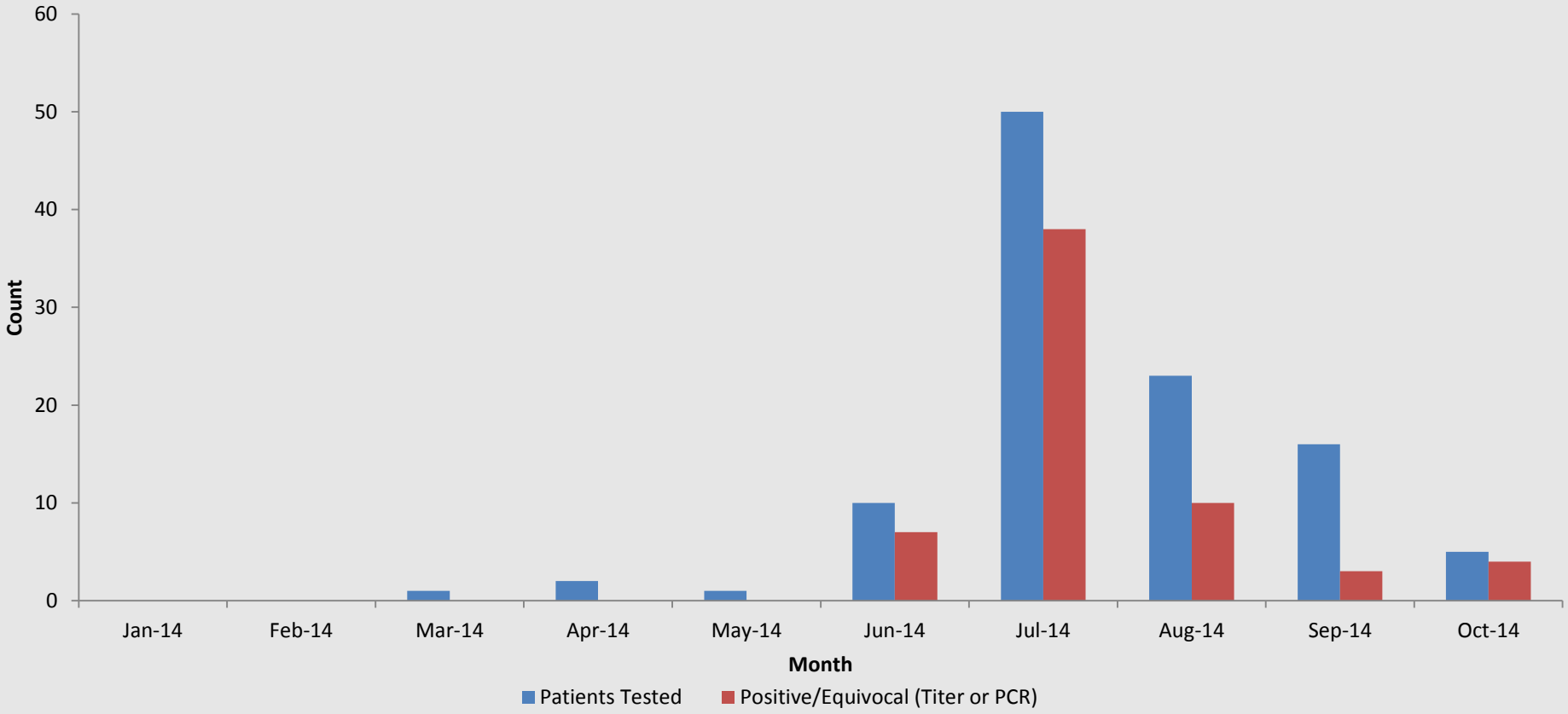
- OPH began producing bi-monthly surveillance reports starting in summer 2014
- Data sources included:
  - ESSENCE for ICD-9 coded outpatient, ED and inpatient encounters
  - Electronic lab data from HAIISS and VA Corporate Data Warehouse (CDW)
  - Facility reports (case reports from providers/Infection Preventionists and facility issue briefs)
- Geospatial mapping of cases provided a simple and effective means of communicating the location and distribution of cases being treated in our healthcare system

Overview – VA CHIKV cases

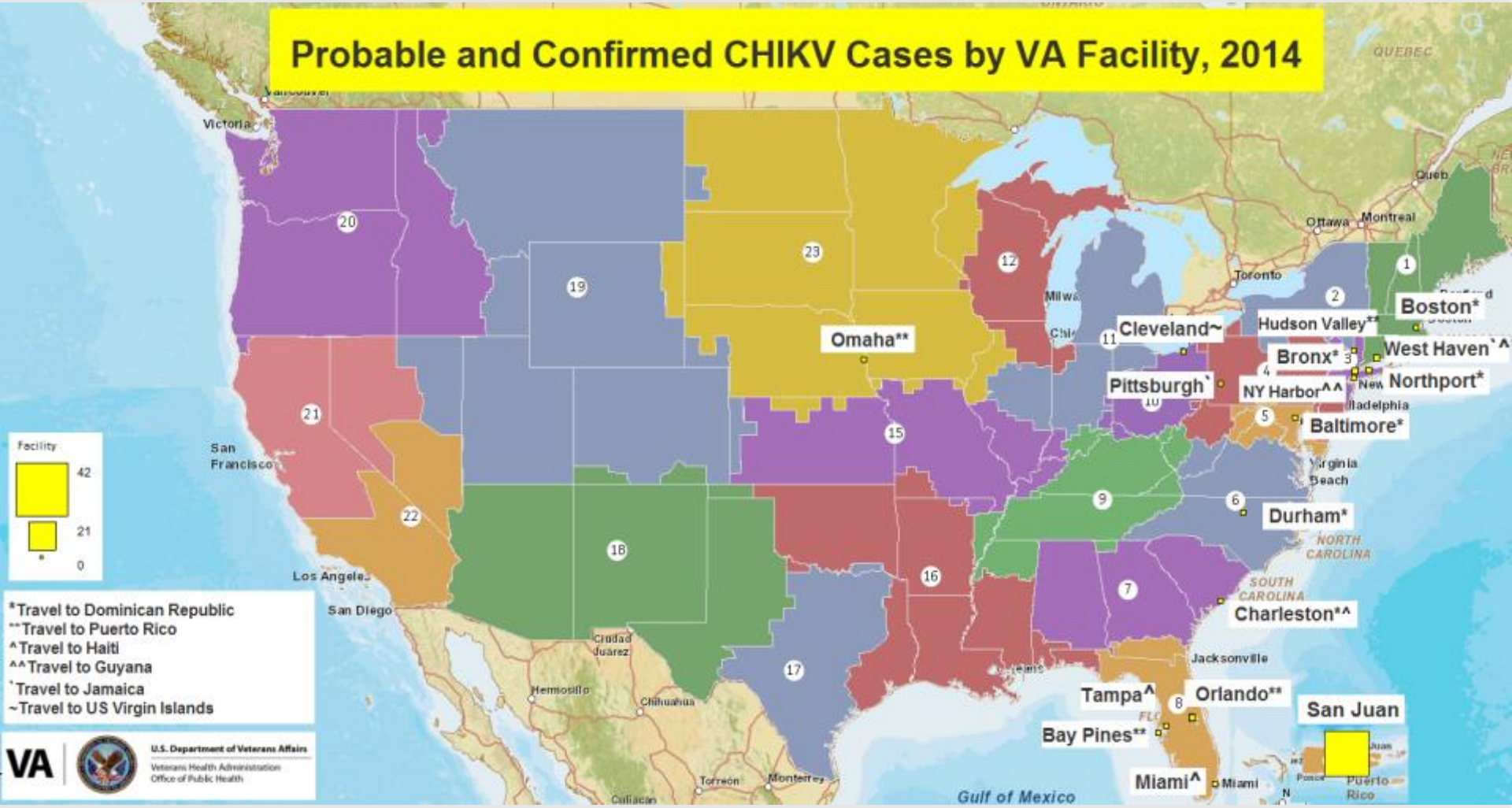
- Number of probable/confirmed cases for 2014: **62***
  - Probable cases: 1 (met clinical/epi criteria with equivocal lab results)
  - Laboratory-confirmed cases: 61
- All cases reported exposure outside the continental United States
  - Majority locally-acquired in or travel to Puerto Rico: 74%
  - Dominican Republic: 13%
  - Other (Haiti, Jamaica, Guyana, US Virgin Islands): 13%
- The percentage of laboratory specimens positive (or equivocal) for CHIKV: 57% (62/108)

Data limited to available and finalized laboratory reports. It does not include additional suspect cases in VA facilities for which CHIKV testing was not performed or results which are pending or require confirmation.

Monthly VA Chikungunya Laboratory Tests, 2014



Monthly VA CHIKV laboratory tests performed (blue) and positive tests (red).



Footnotes indicate the location of exposure for case(s) at each VA facility.

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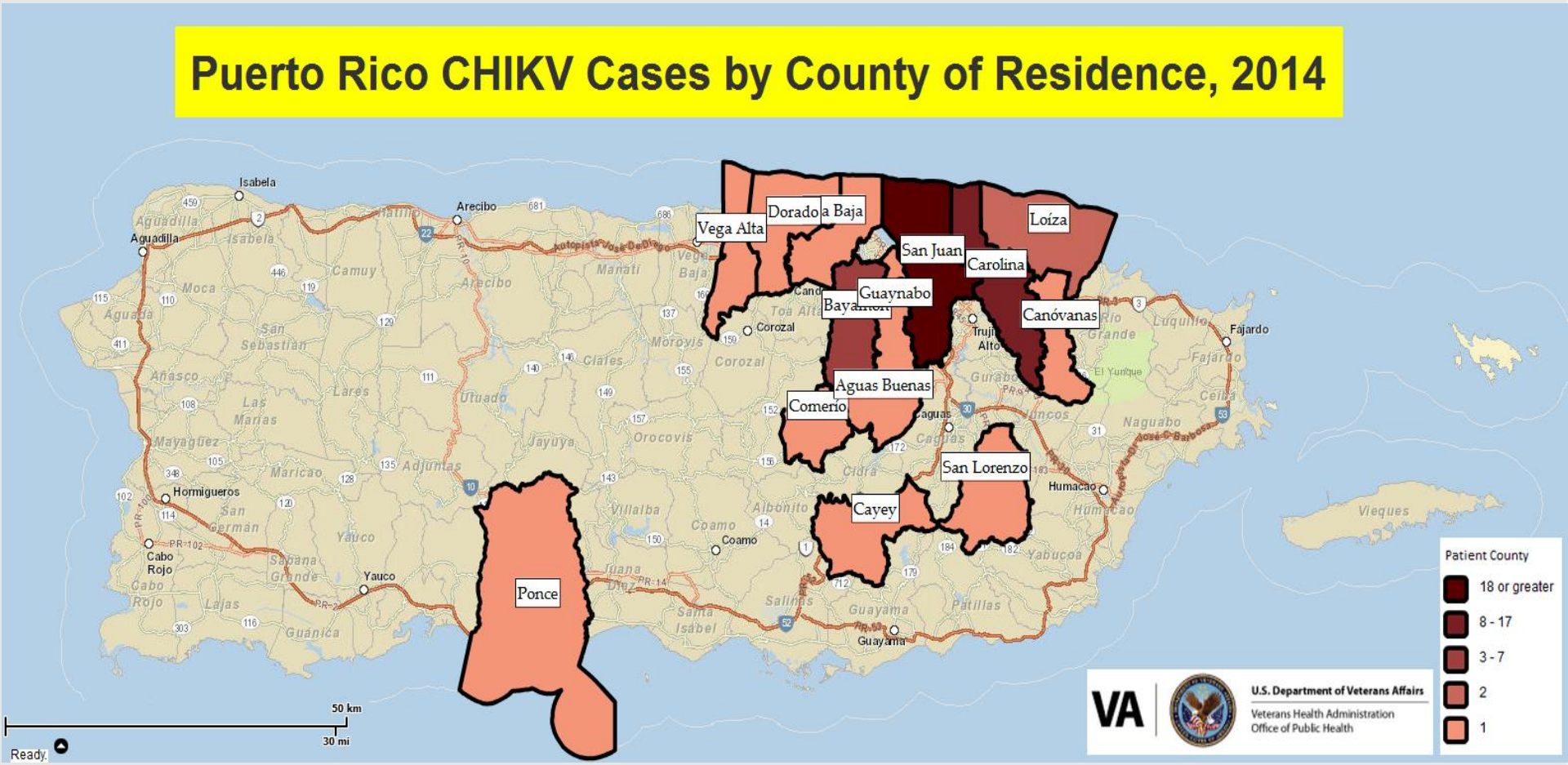
Puerto Rico CHIKV Cases by County of Residence, 2014



Note: It's possible that a patient's exposure occurred at a location other than their home residence.

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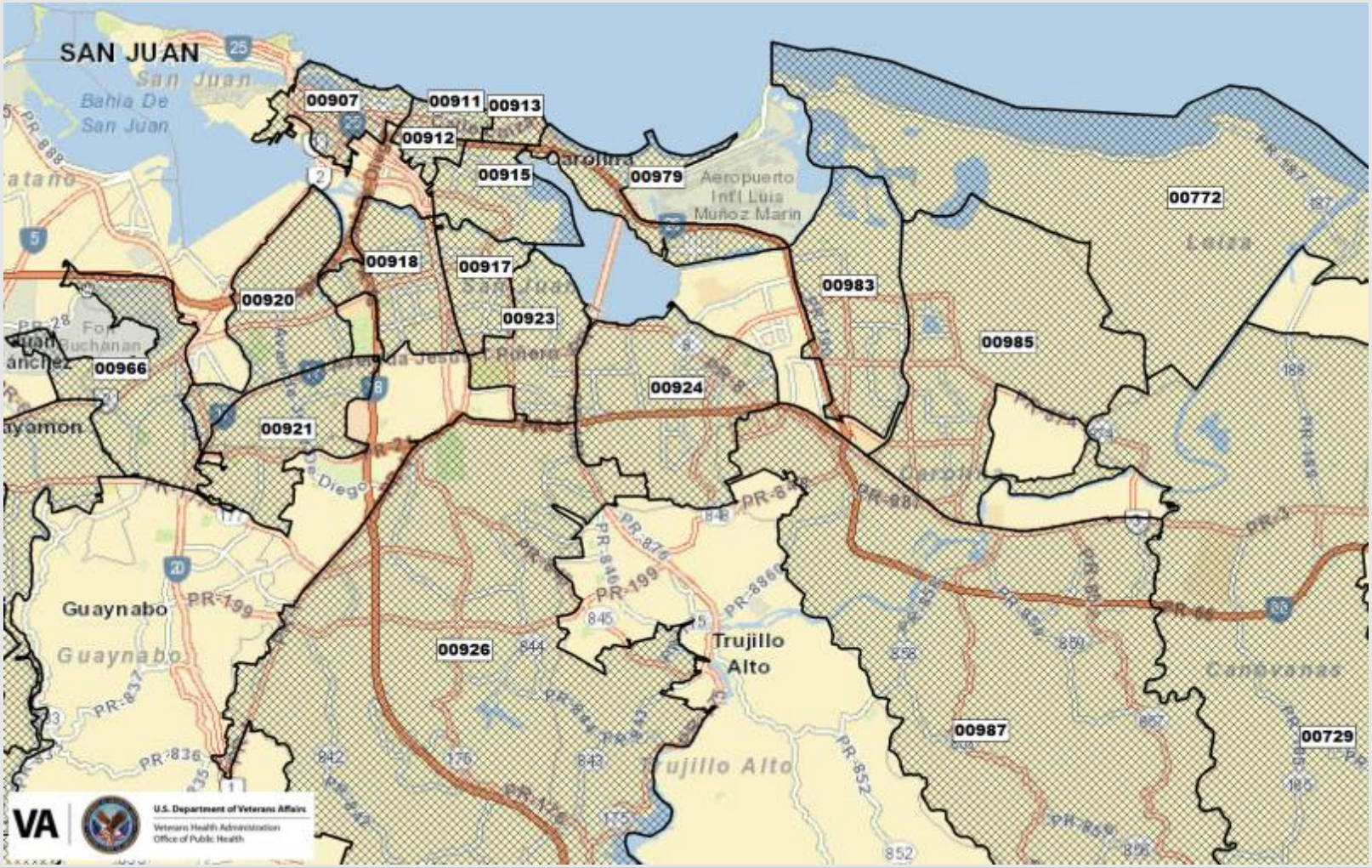
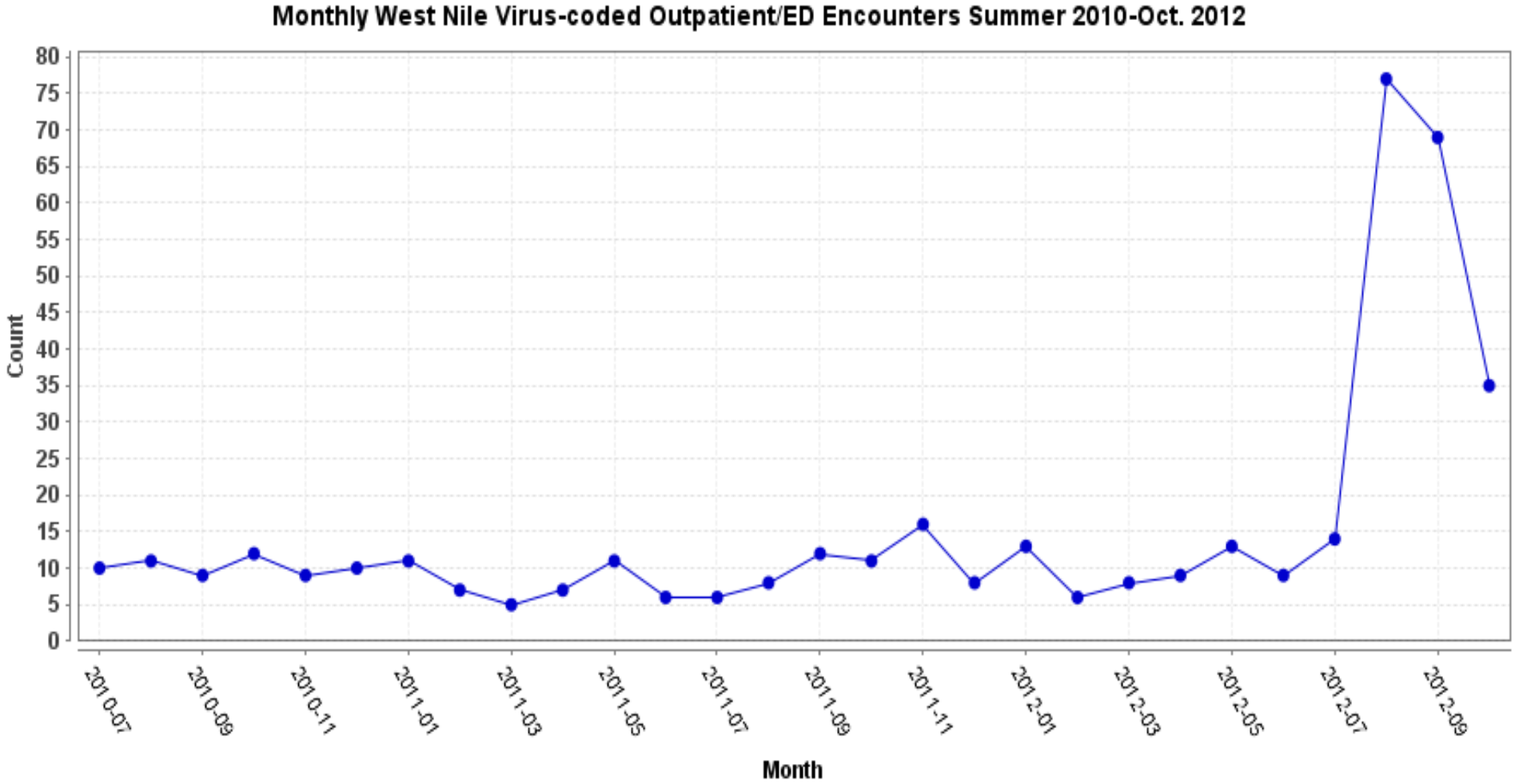
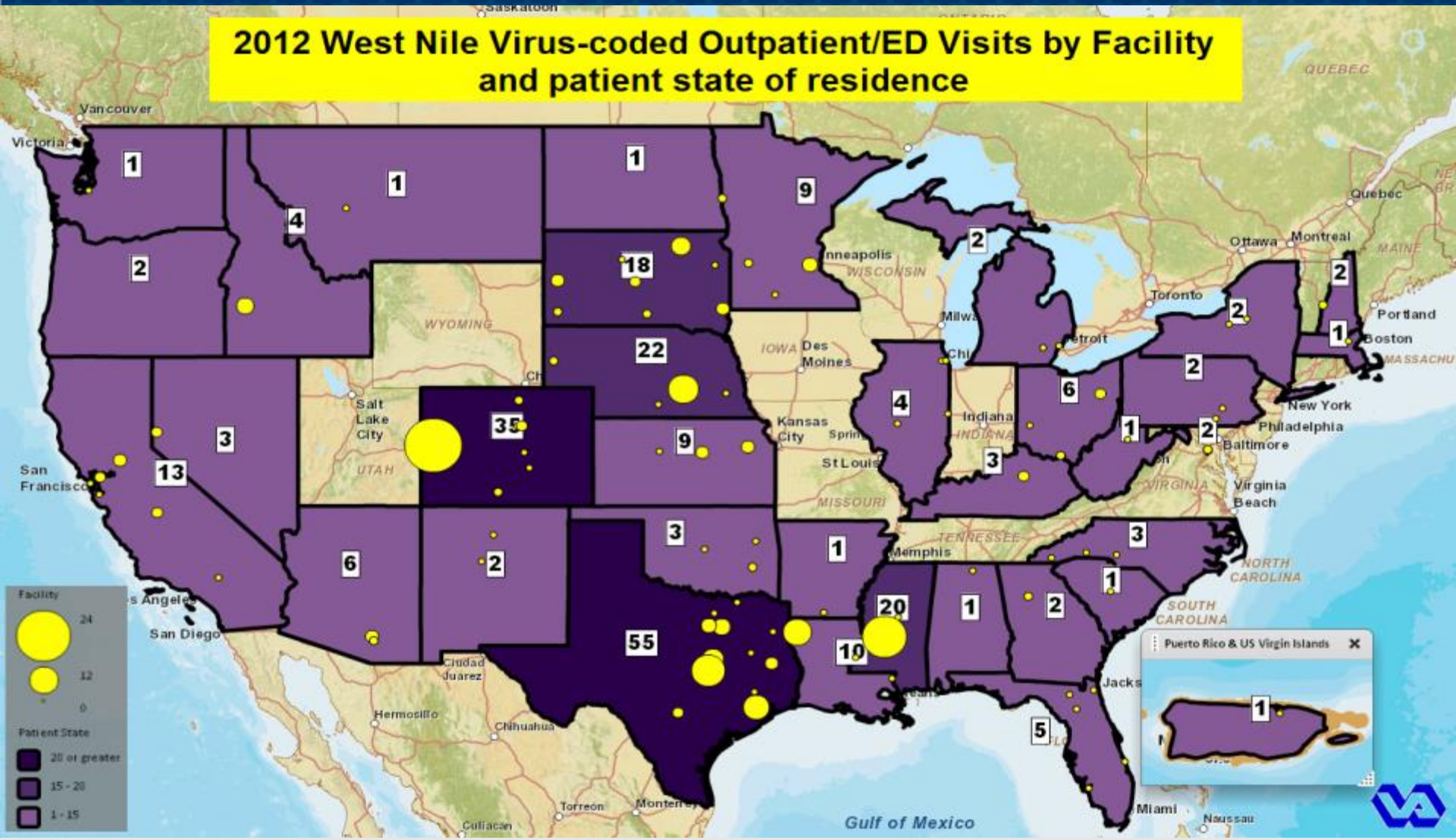
Detailed Street Map View of San Juan and Carolina Counties and Affected Zip Codes



West Nile Virus (WNV)

- Like CHIKV, WNV is a mosquito-borne illness causing symptoms such as fever & aches and in severe cases can cause meningitis, encephalitis and even death
- WNV first arrived in the U.S. in 1999 and has been detected in all lower 48 states
- Outbreaks occur every summer, but 2012 was the deadliest year on record in the U.S. for WNV with over 5,600 reported cases and 286 deaths
- People over age 50 and with underlying illnesses are most vulnerable, making VA's population at particular risk
- Starting in the summer of 2012 we produced regular surveillance reports which included maps of VA patient encounters with the WNV diagnosis code (ICD-9: 066.4)


Monthly West Nile Virus-coded Outpatient/ED Encounters Summer 2010-Oct. 2012
Count
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
2010-07
2010-09
2010-11
2011-01
2011-03
2011-05
2011-07
2011-09
2011-11
2012-01
2012-03
2012-05
2012-07
2012-09
Month



A total of 136 individuals with 281 outpatient/ED encounters coded for West Nile Virus Jan-Oct. 2012

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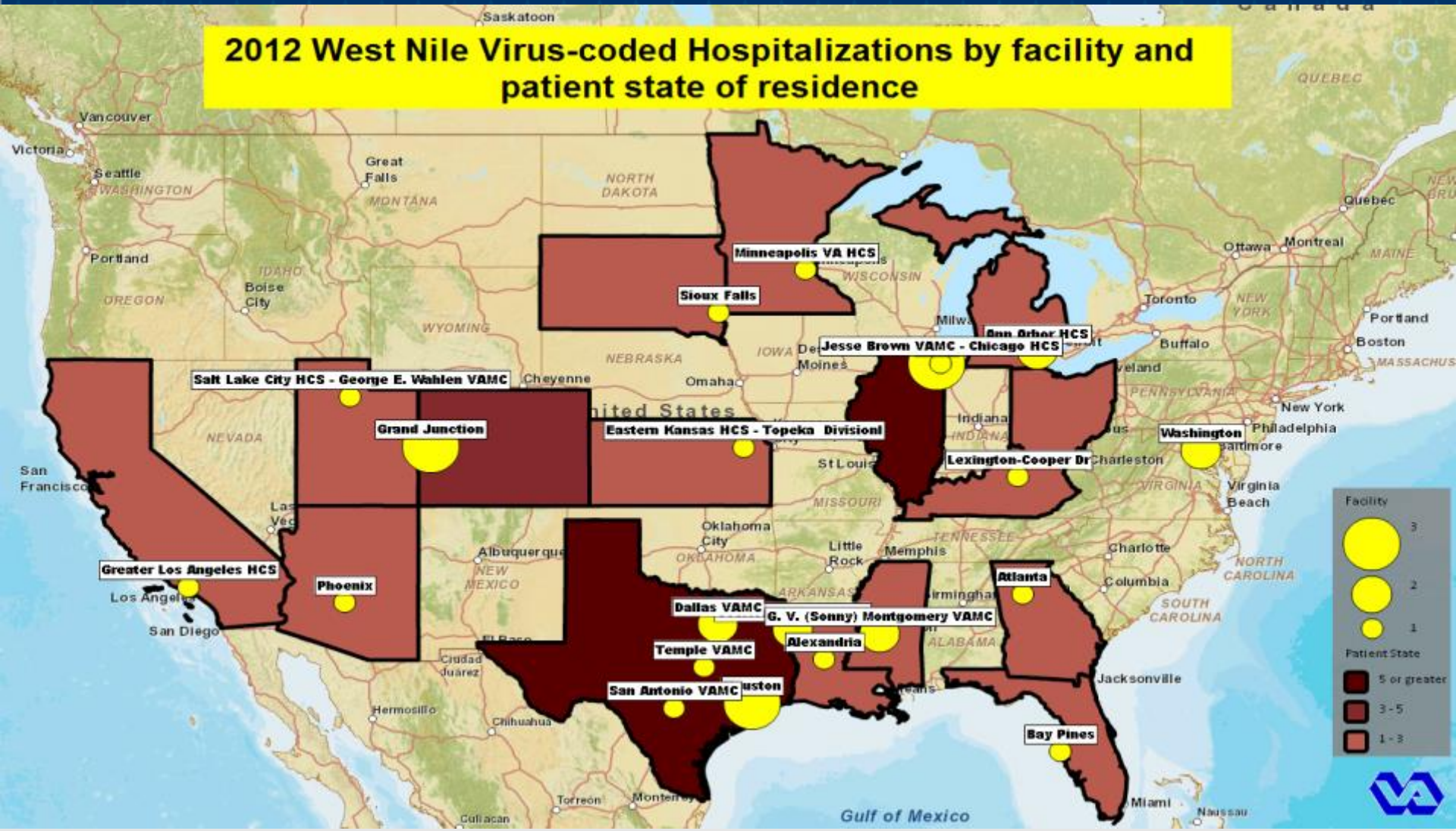
2012 West Nile Virus-coded Hospitalizations by facility and patient state of residence



From Jan-Oct. 2012, 35 hospitalizations among 32 individuals in 17 states were captured by HAIISS.

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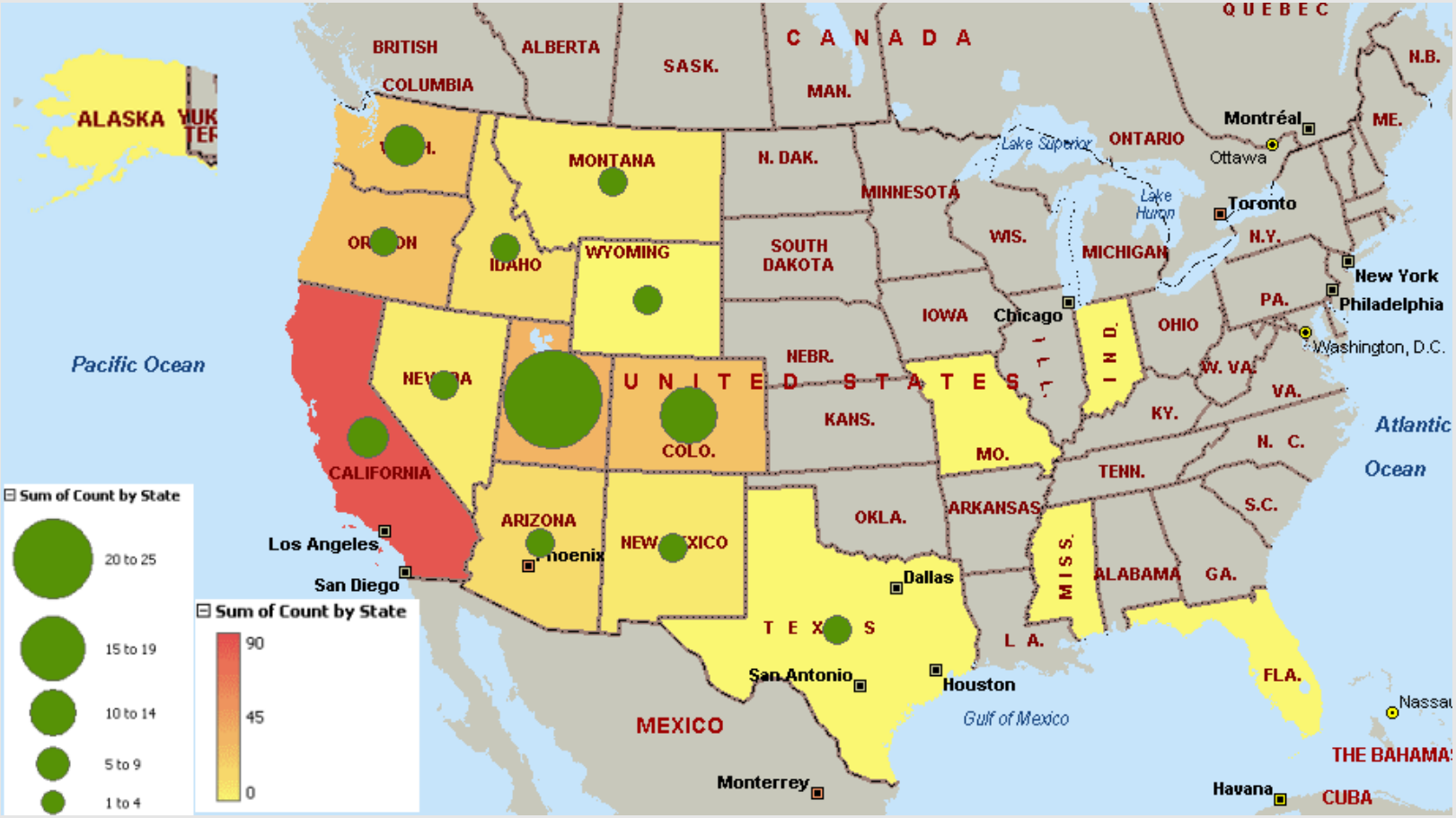
Pertussis/Whooping Cough

- Caused by *Bordetella pertussis*, a vaccine preventable bacterial infection
- Has been on the rise with most cases since 1955 reported in 2012 (48,277 or 15.4 per 100,000).
  - Particularly on the West Coast of the US
- Since 2005 recommended that people 19-64yo have a one time booster of Tdap. In 2010, broadened to include 65yo and older
- Since >20% cases happen in 20yo and older we evaluated pertussis in VA from 2010-2014
- Reviewed laboratory tests and diagnosis codes (ICD-9: 033.0, 033.8 or

	2010	2011	2012	2013	2014
VA Pertussis Cases	63	65	70	54	23

- 18% of cases were female, median age 55 (range 24-101), 10% were hospitalized, and 54% had a booster Tdap recorded in the medical record (regardless of whether vaccine was given prior to encounter)

Pertussis Cases 2010-2014



Yellow in IN, MO, MS and FL represent a patient with a home zip code in that state but were seen at a facility included in the analysis.

Map of 5-Year Cumulative Total Pertussis Cases by Patient Residence Zip Code (Red, Orange, Yellow) and by Positive Laboratory Testing by VA Facilities in the Identified States (Green Circles).

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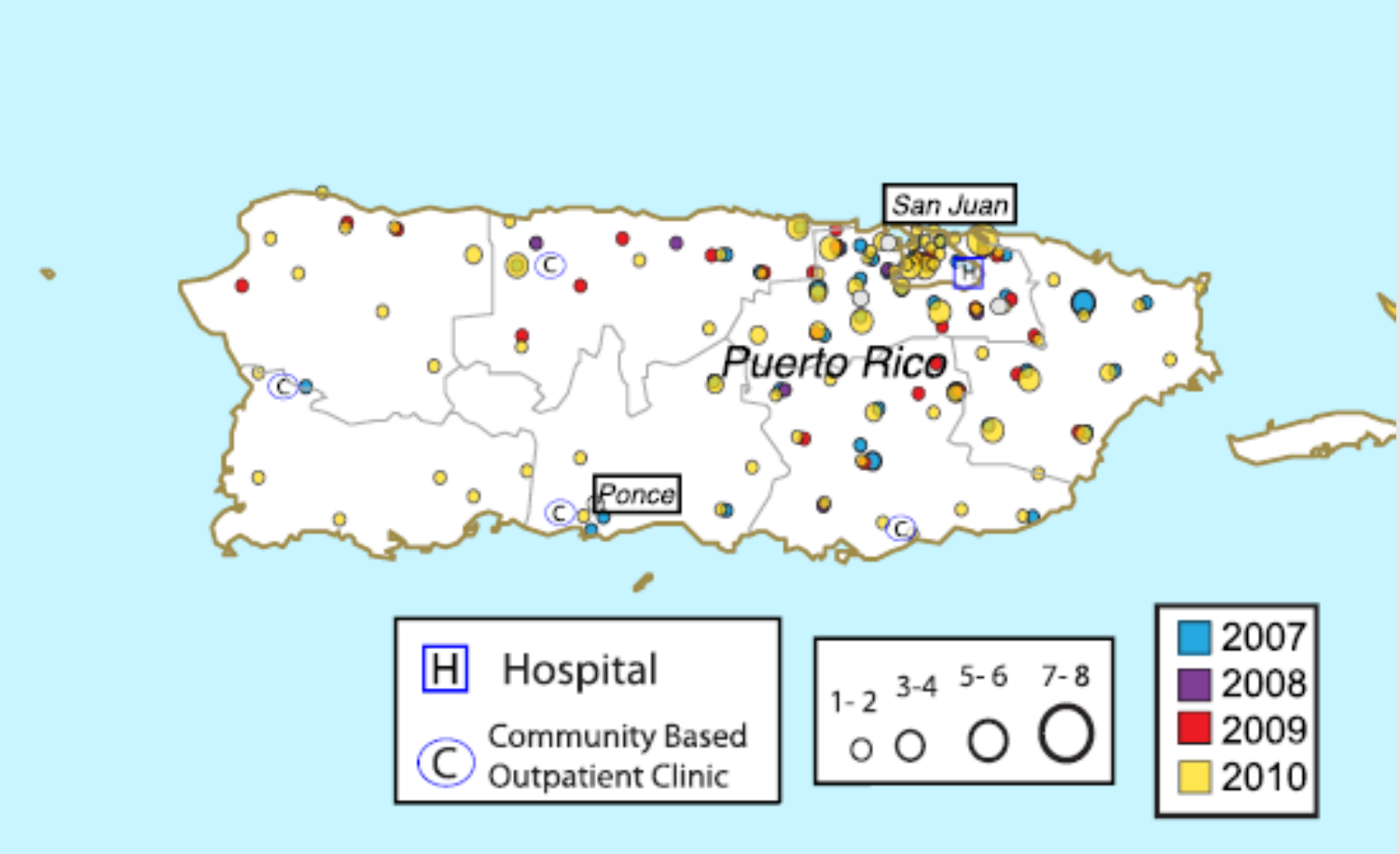
Dengue

- Another mosquito-borne illness infecting up to 400 million people worldwide annually causing mild constitutional symptoms to severe hemorrhagic illness
- Seen in tropical regions and endemic in Puerto Rico
  - Recently, epidemic years were 2007 and 2010
- Starting 2009, an outbreak of locally-acquired dengue in Key West, FL (no previous continental US outbreak outside Texas-Mexico border since 1946)
- In 2013, we published a summary of our surveillance from 2007-2010*, which included maps depicting location of VA cases
- In addition, dengue cases in relation to precipitation levels were mapped

VA Dengue Cases	2007	2008	2009	2010
Puerto Rico	65	13	30	180
Florida	0	2	7	12

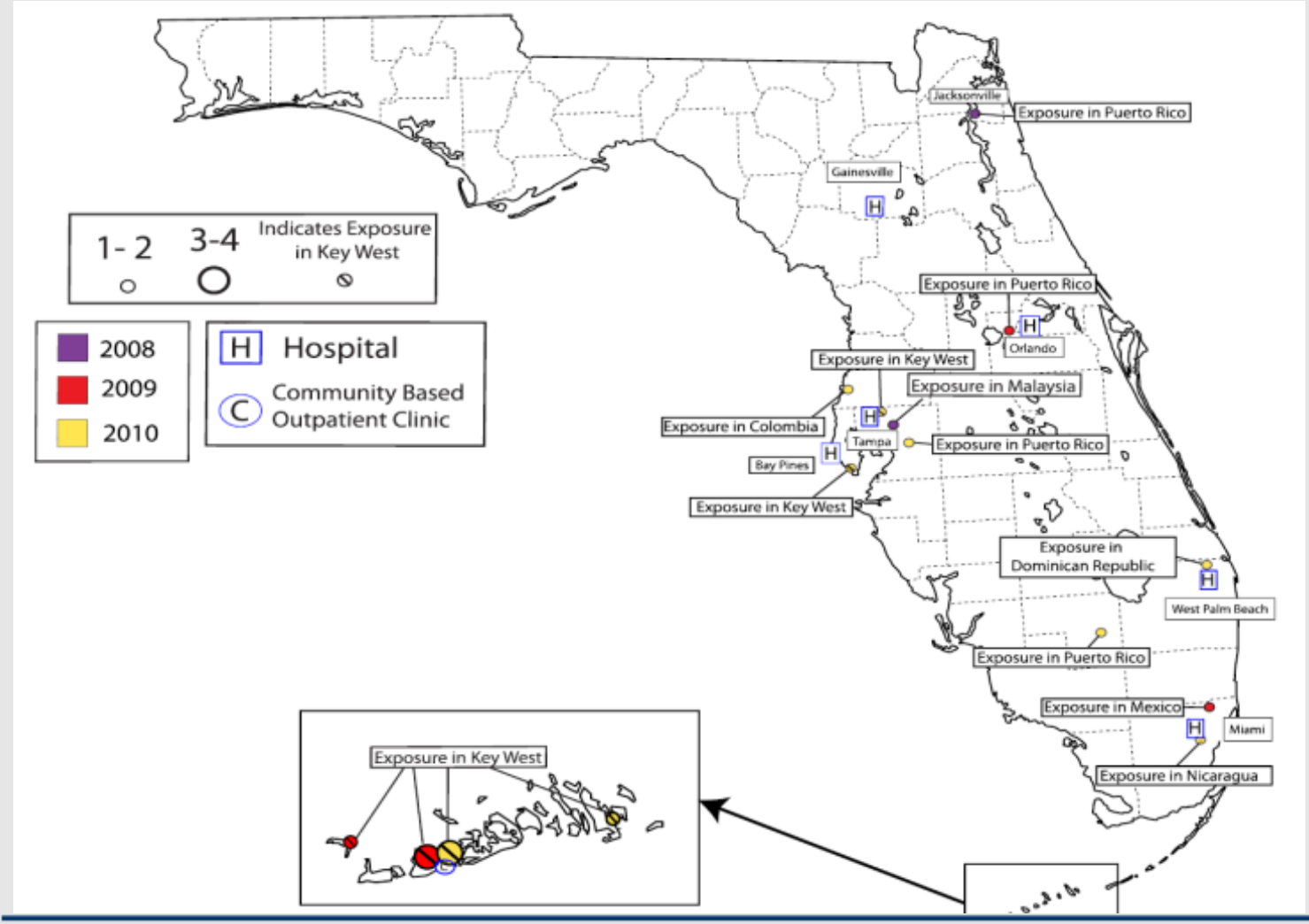
**Schirmer PL, Lucero-Obusan CA, et al. (2013) Dengue Surveillance in Veterans Affairs Healthcare Facilities, 2007-2010. PLoS Negl Trop Dis 7(3): e2040.*

Puerto Rico Dengue Cases, 2007-2010



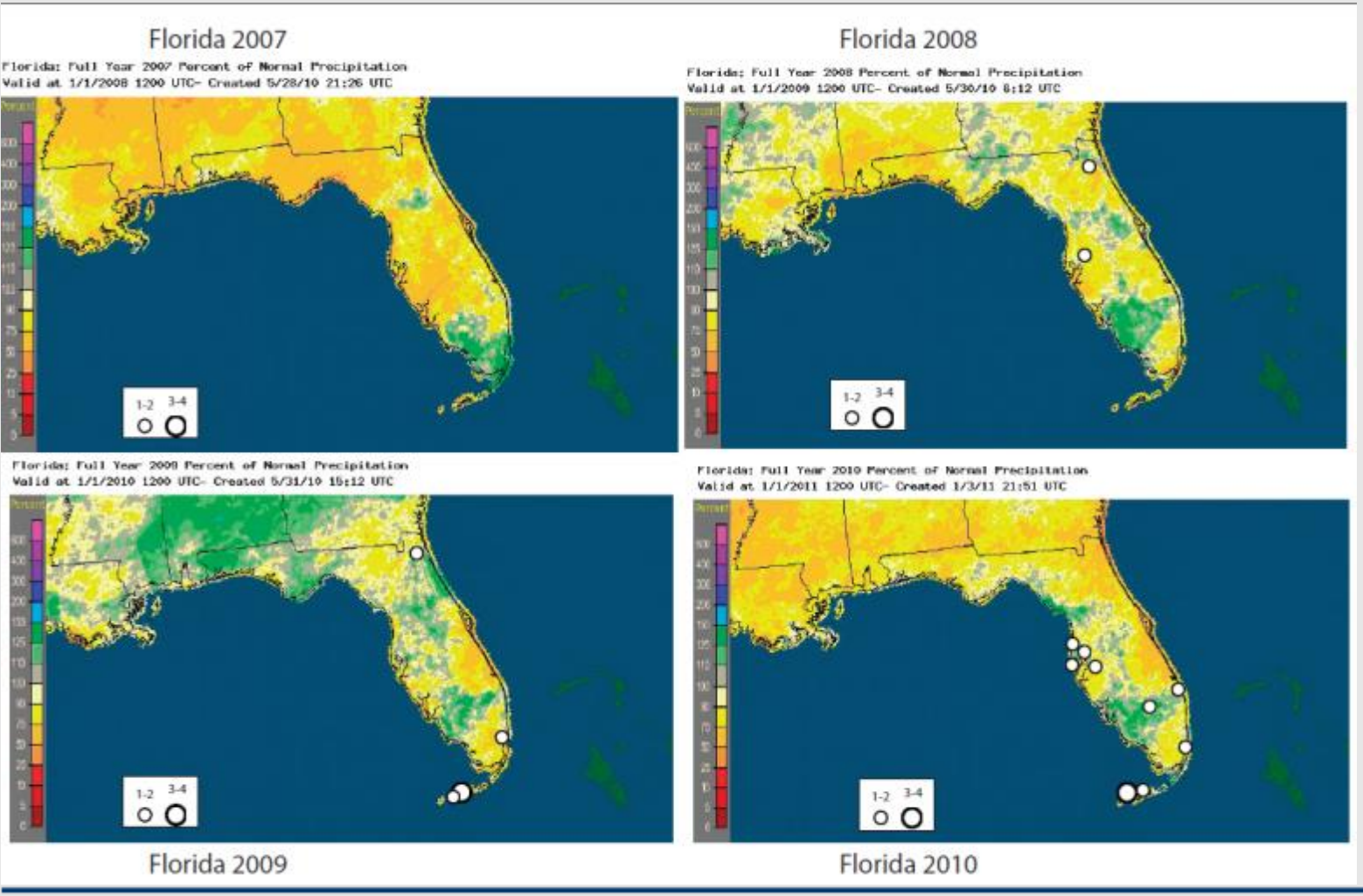
Cases presented to VA facilities in San Juan, Ponce, Mayaguez, and Arecibo

Florida Dengue Cases, 2008-2010



12 of 21 cases were acquired in Key West and 9 while traveling outside Florida in dengue endemic areas

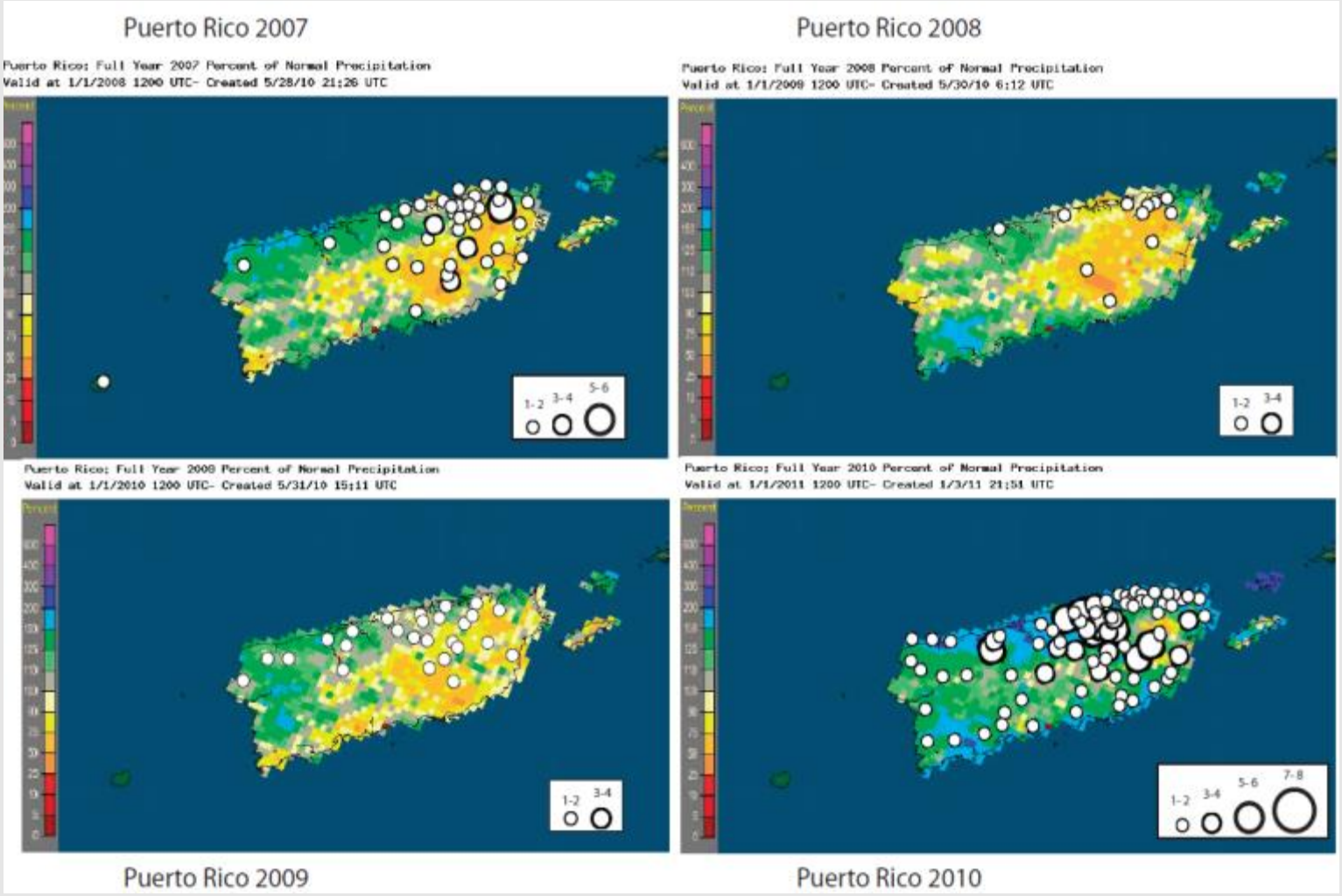
Dengue and Precipitation in Florida, 2007-2010



Location of VA Florida dengue cases (white circles) and percentage of precipitation based on the Advanced Hydrologic Prediction Service (water.weather.gov/precip)

No correlation with rainfall seen in FL

Dengue and Precipitation in Puerto Rico, 2007-2010

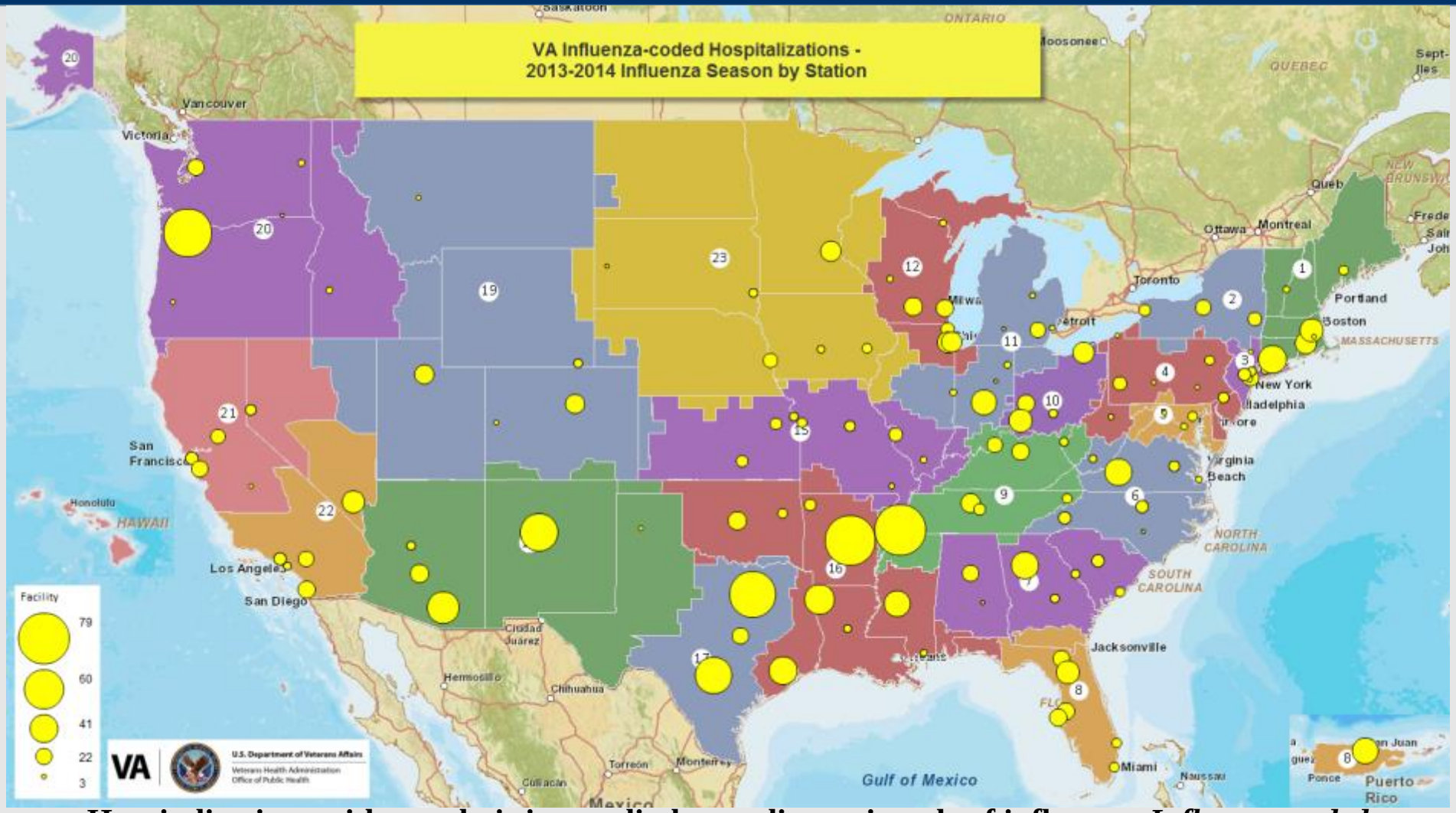


Location of VA Puerto Rico dengue cases (white circles) and percentage of precipitation based on the Advanced Hydrologic Prediction Service (water.weather.gov/precip)

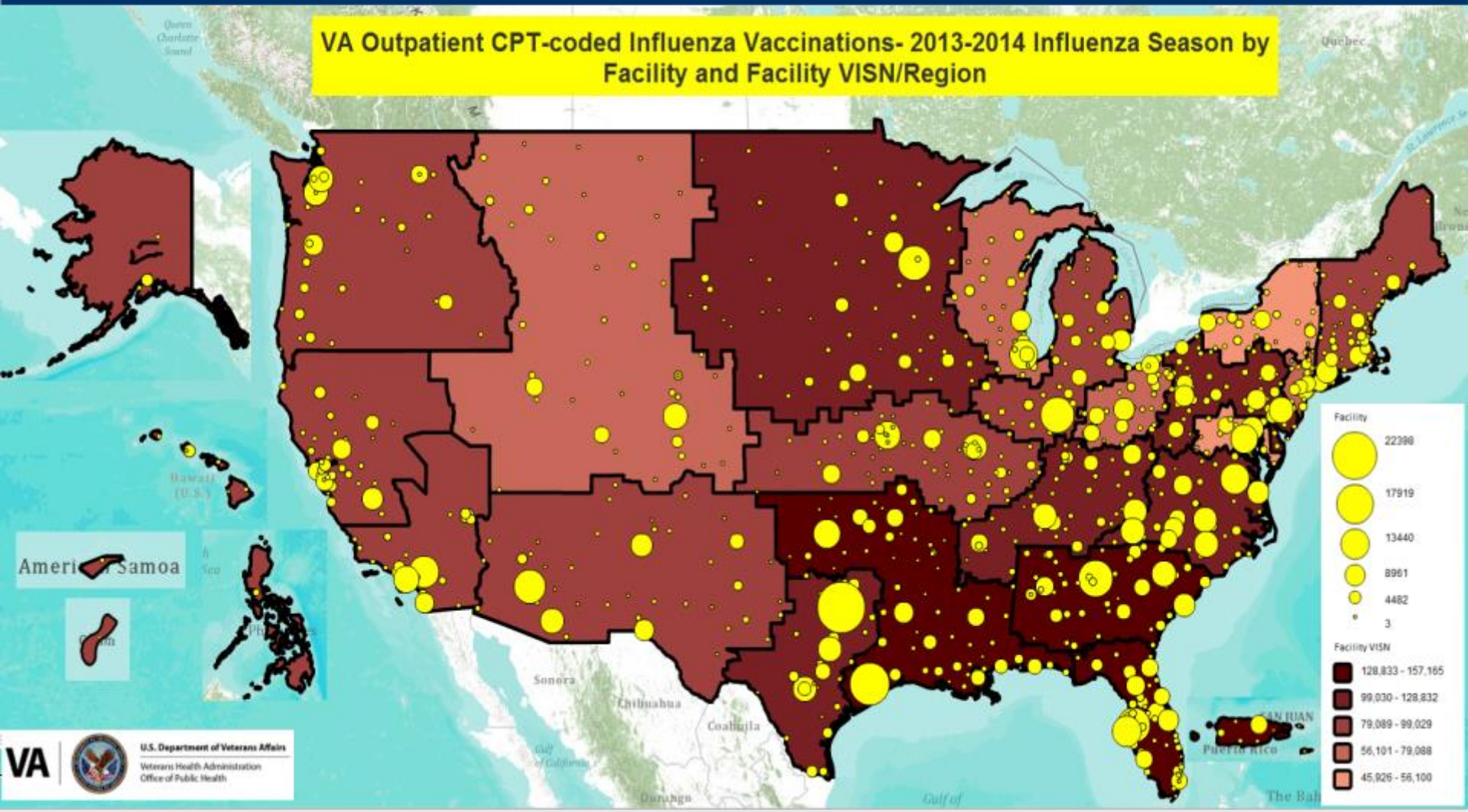
No correlation except in 2010 when rainfall 150-300% of normal

Influenza

- Influenza is associated with significant morbidity and mortality especially in the elderly population
- Since the 2009 H1N1 pandemic, we've monitored influenza and influenza-like illness (ILI) using HAIISS
- Geospatial mapping of influenza indicators is an important component of our weekly flu surveillance report
  - Hospitalizations
  - Vaccinations
  - Telephone triage calls
  - Positive laboratory tests



Hospitalizations with an admitting or discharge diagnosis code of influenza. ***Influenza-coded hospitalizations are not necessarily laboratory-confirmed.***



Over 1.9 million vaccines were recorded at VA facilities in all 50 states, US territories & Philippines.

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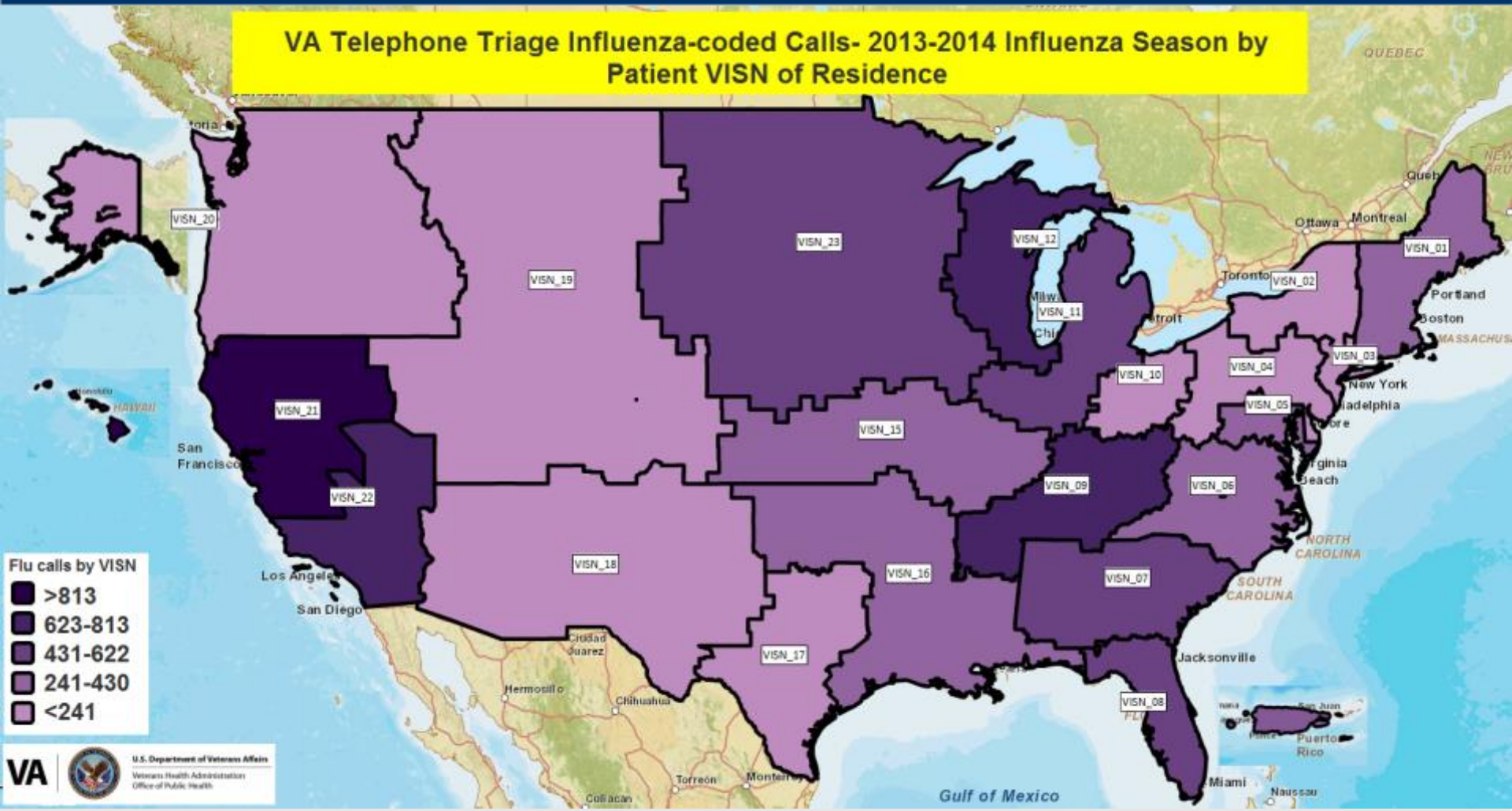
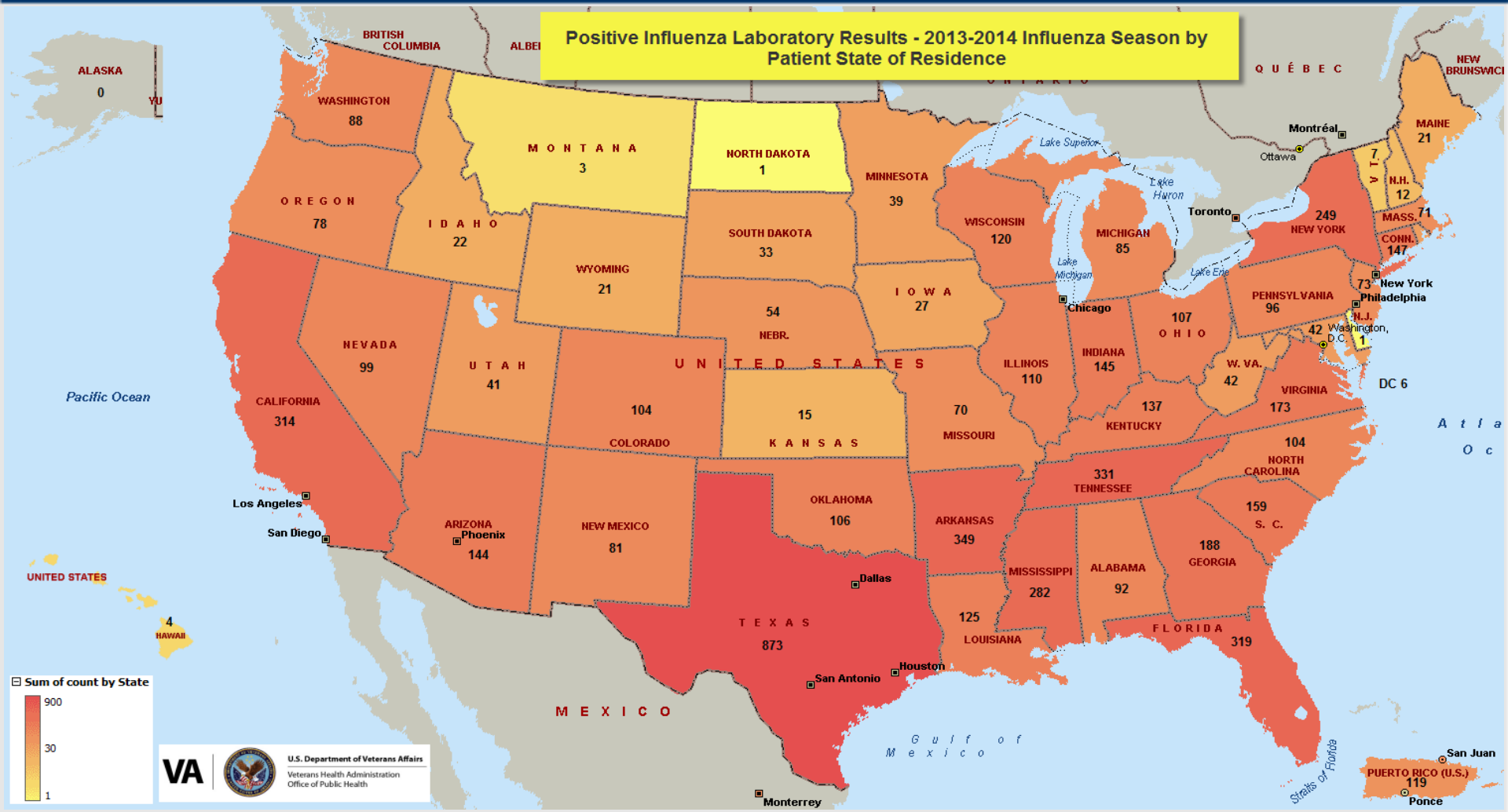


Influenza-coded telephone triage encounters by caller home VISN/VA Region. ***These calls do not necessarily represent confirmed influenza cases.***



Positive Influenza laboratory test results, by patient state of residence. ***Electronic lab data not currently available from all VA facilities.***

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