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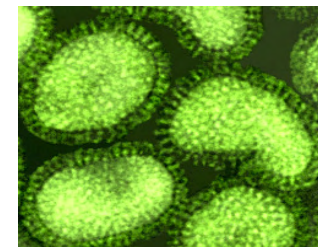
Epidemiology of 2009 H1N1 Influenza in Washington State

Communicable Disease Epidemiology
Washington State Department of Health



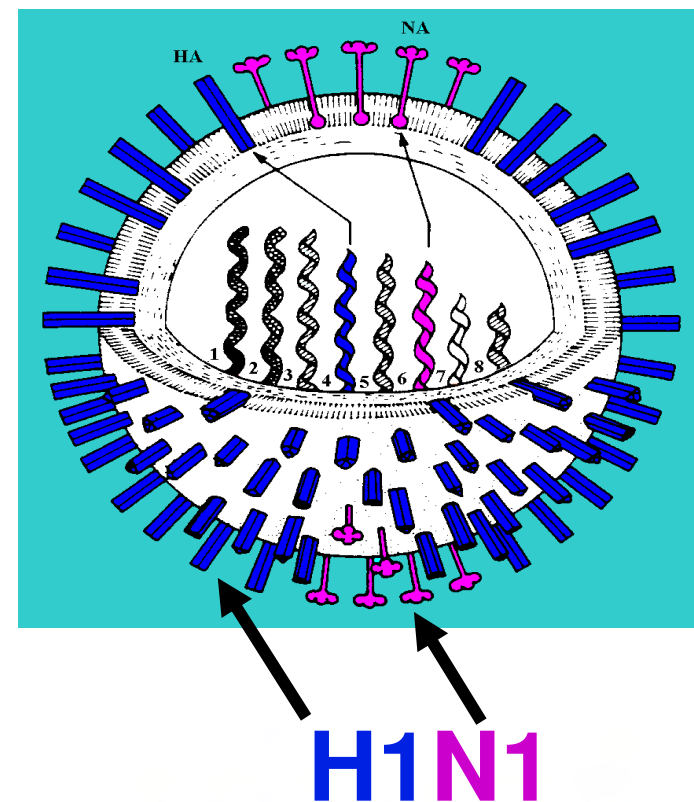
Overview

- Background of influenza
- Population-based surveillance for “swine flu”
 - Spring 2009 - initial response
 - Surveillance methods and epidemiology of cases
- Severity-based surveillance for “novel H1 influenza”
 - Summer 2009
 - Epidemiology of hospitalized and fatal cases
- Influenza surveillance
 - Fall/winter 2009 and onward
 - System components and strategy



Influenza

- Respiratory illness due to influenza virus
 - Infects nose, throat, and lungs
- 3 types of “flu” viruses: A, B, C
 - A and B commonly infect humans
 - Birds, pigs, and other mammals also infected
- Classified by viral proteins
 - H = hemagglutinin
 - N = neuraminidase
 - Similar but species-specific changes make them “human,” “avian,” or “swine” flu viruses
- Naming conventions
 - A/Human/California/01/ 2009 (H1N1)
 - A/Human/Fujian/411/2002 (H3N2)
 - B/Shanghai/361/2002



“Seasonal” vs. “Pandemic” Influenza

- Flu A viruses always changing (mutating, reassorting)
 - Interspecies segment reassortment (poultry, pigs, humans)
- Every year, virus proteins change a little (“drift”)
 - Cause “seasonal” flu epidemics each year
 - Fine tune the vaccine each year
- Rarely, flu A virus protein(s) change a lot (“shift”)
 - New (novel) virus is created
 - Spreads easily and sustainably among humans
 - Can cause severe disease in humans
 - Worldwide epidemic transmission (“pandemic”)
 - Requires new vaccine for a new virus

Pandemic Timeline: 2009 H1N1 virus

- March 24 – April 29 (5 weeks): >2,000 severe pneumonia cases reported to Mexico, 4.6% fatal
- April 24: MMWR reports 2 children in California with “swine” influenza A (H1N1)
- April – May: Increases of untypable (later “swine” H1N1) influenza cases across U.S.
- June 11: WHO declared a pandemic
- June: U.S. sees peak in novel H1N1



Spring 2009: Initial surveillance efforts in WA

- Outreach to local physicians
 - Test severely ill patients with fever; send to WA Public Health Laboratories (WA PHL) if rapid A +
 - Test those with influenza-like-illness (ILI) and travel to Mexico send to PHL if rapid A +
- ILI sentinel sites
 - Increase testing of patients with ILI, send all to PHL
- Commercial laboratories
 - Send all rapid A + to PHL
- Local health jurisdictions (LHJs) asked to complete case report forms for laboratory confirmed cases

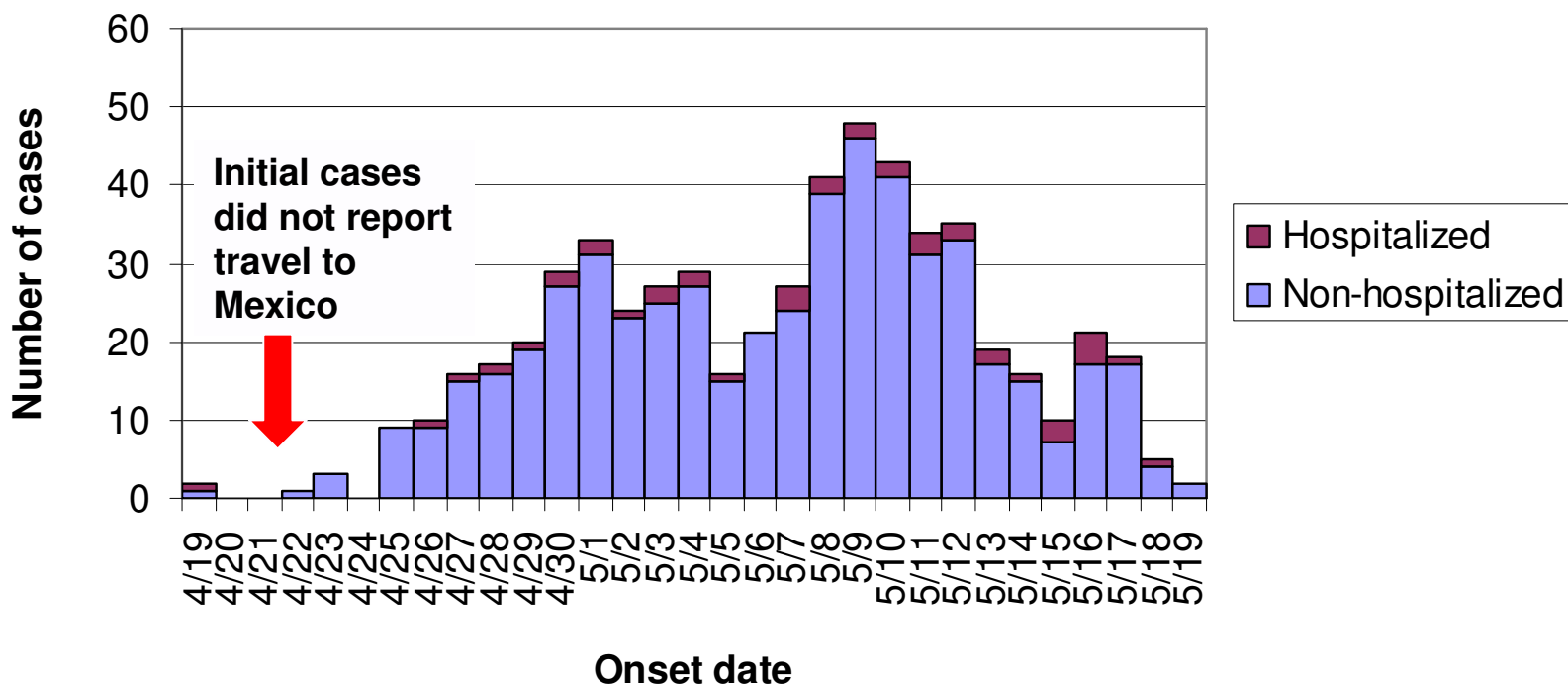
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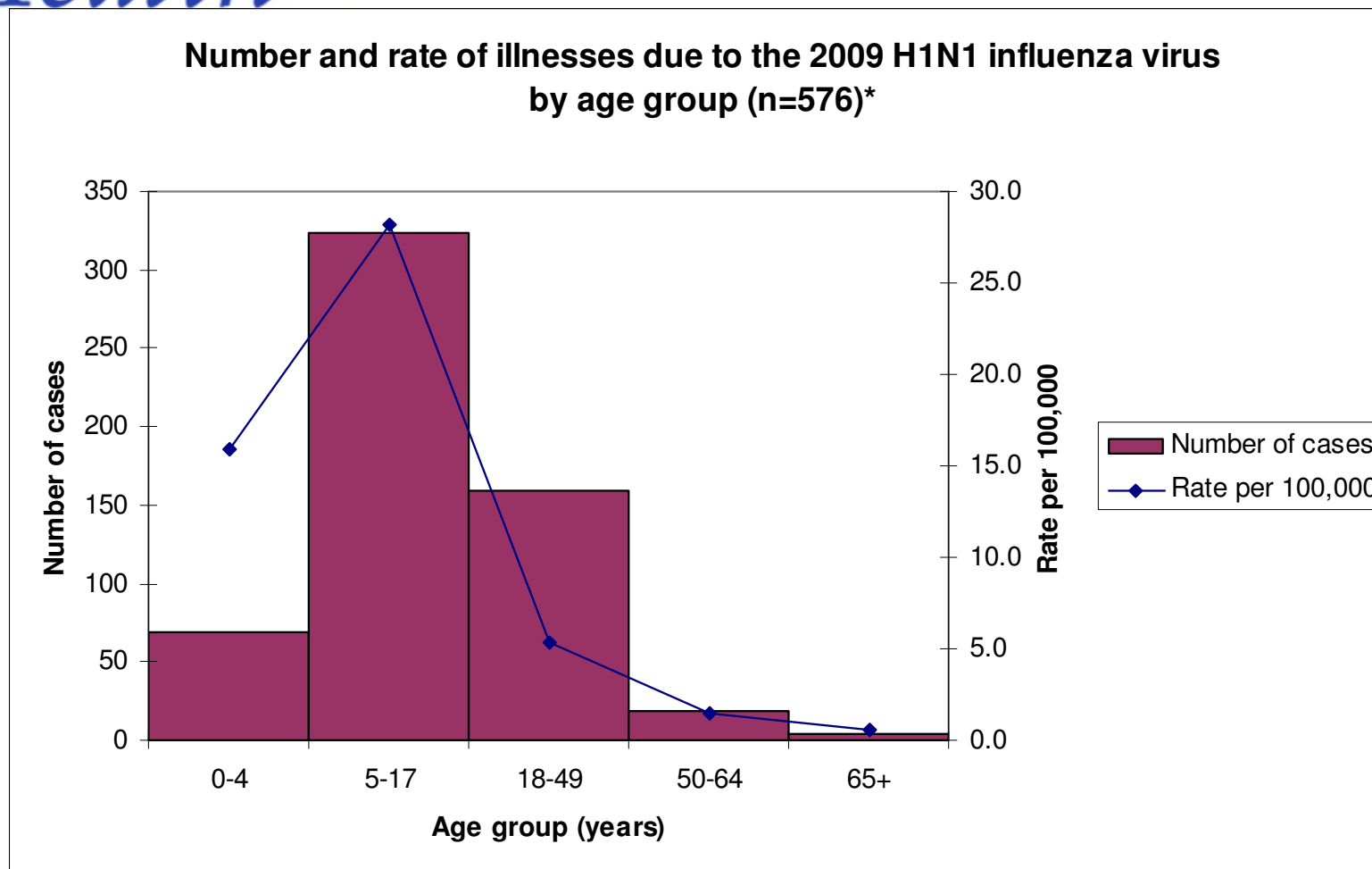
Epidemiology of initial 2009 H1N1 virus cases

- Conducted population-based surveillance for 2009 H1N1 virus in WA between April 26 and May 23, 2009
 - Not based on severity; accepted all flu A positives
 - 576 lab-confirmed cases reported in Washington
- Specimens were tested at
 - WA DOH Public Health Laboratories
 - Centers for Disease Control and Prevention (CDC)
 - Department of Defense Armstrong Laboratory, Texas
 - Other state public health laboratories

Number of illnesses due to the 2009 H1N1 influenza virus by onset date (n=576)*

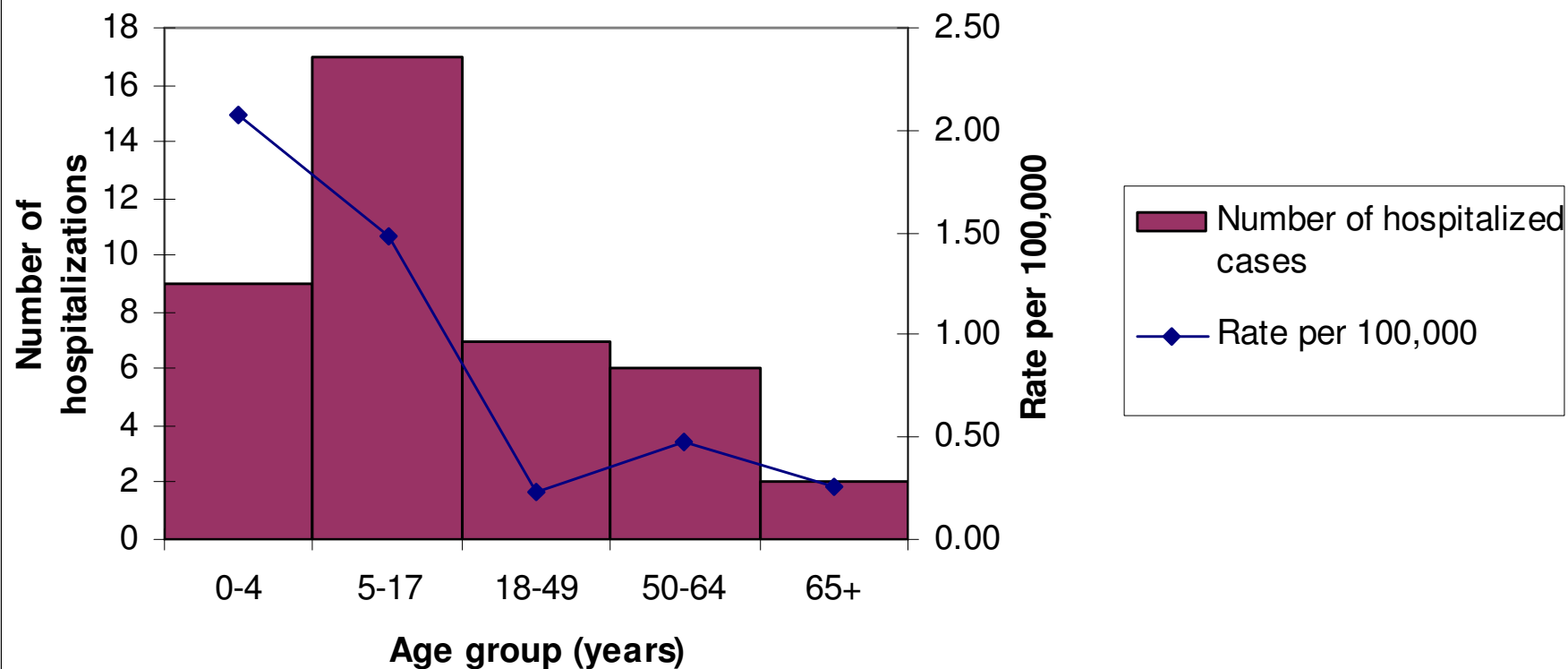


* Illness onset date unavailable for 34 cases; specimen collection date used instead.



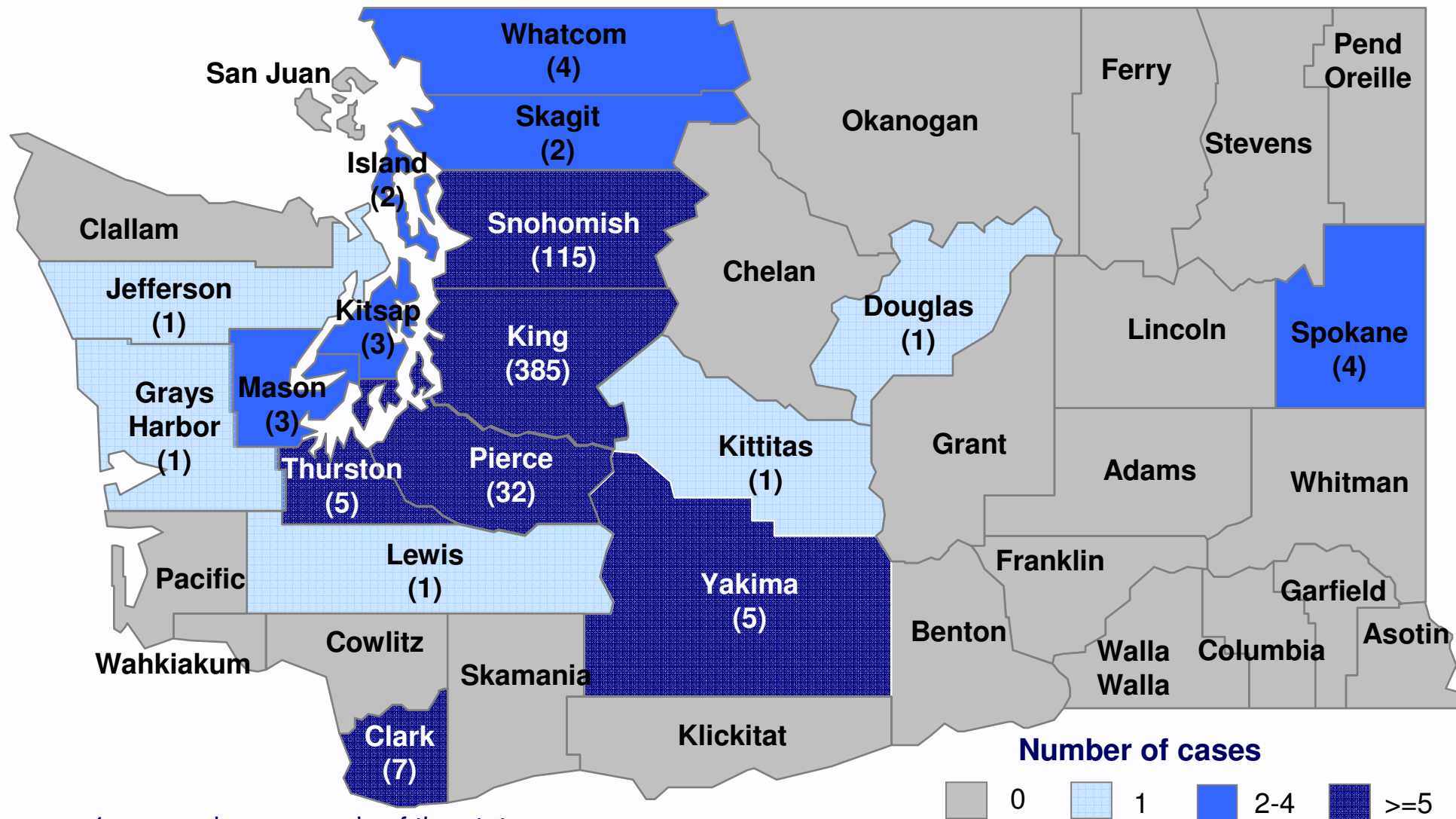
* Of 576 cases, 2 were missing age.

Number and rate of hospitalizations and deaths due to the 2009 H1N1 influenza virus by age group, Washington (n=41)



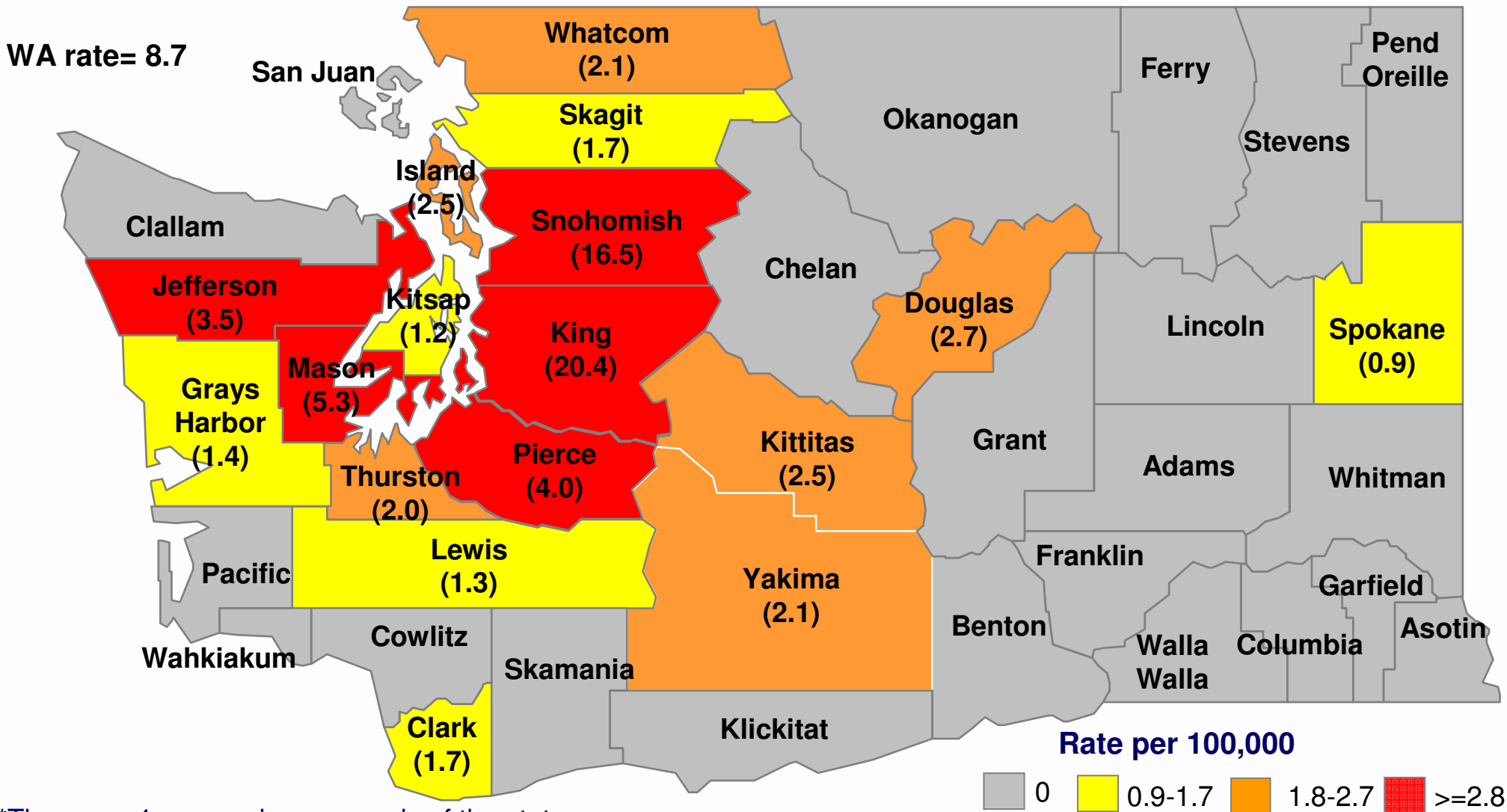


Number of confirmed illnesses due to 2009 H1N1 virus influenza by county of residence (n=576)*



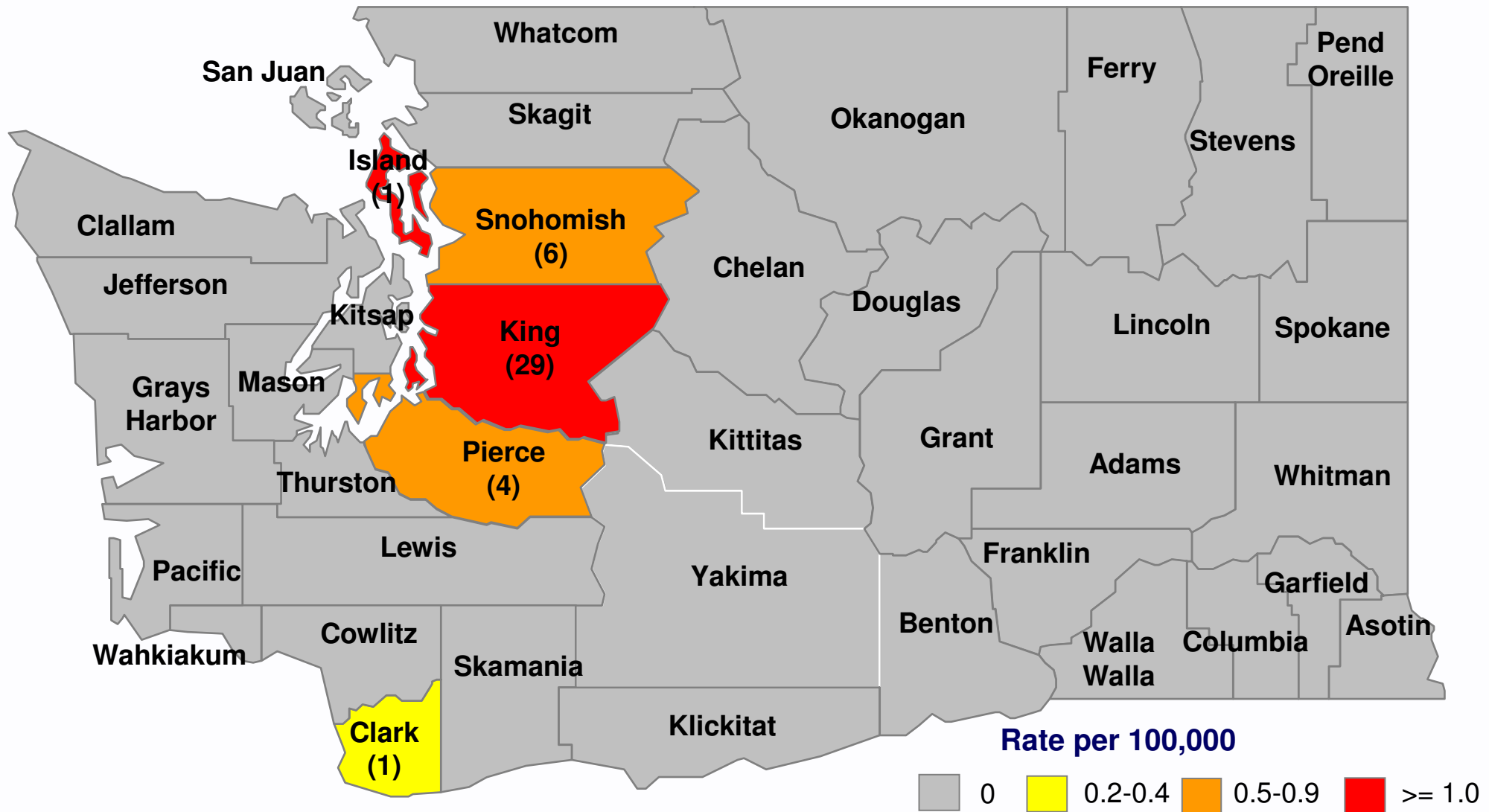
*There are 4 cases who are wards of the state.

Rate of confirmed illnesses due to 2009 H1N1 virus influenza by county of residence (n=576)*



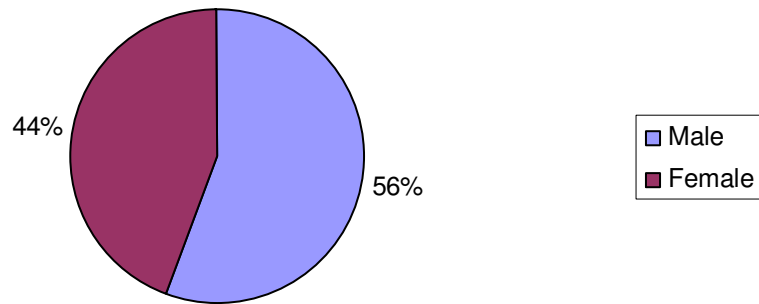
*There are 4 cases who are wards of the state.

Number and rate of hospitalizations due to 2009 H1N1 virus influenza by county of residence (n=41)

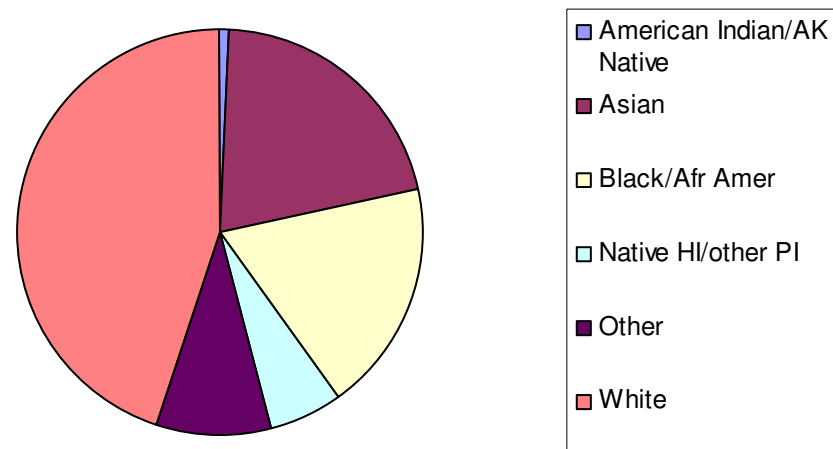


2009 H1N1 influenza virus cases by gender and race (n=576)*

Gender distribution of 2009 H1N1 virus cases, WA



Race distribution of 2009 H1N1 virus cases, WA



*1 case was missing information on gender, 318 (55%) cases were missing information on race

Symptoms of confirmed illnesses due to 2009 H1N1 virus influenza (n=576)

Symptom	Present	%
Fever	506 / 520	97%
Cough	473 / 510	93%
Sore throat	261 / 432	60%
Vomiting	121 / 444	27%
Diarrhea	104 / 436	24%

Symptoms of diarrhea and vomiting in confirmed cases of 2009 H1N1 virus influenza by age group (n=576)

Age group	Diarrhea			Vomiting		
	Present	%	P-value	Present	%	P-value
0-4	22 / 55	40%	0.033	15 / 56	27%	0.786
5-17	49 / 237	21%		70 / 246	29%	
18-49	31 / 125	25%		34 / 125	27%	
50-64	2 / 16	13%		2 / 15	13%	
65+	0 / 3	0%		0 / 2	0%	



Disposition of confirmed illnesses due to 2009 H1N1 virus influenza, WA (n=576)

Disposition	Present	%
Hospitalized	41 / 522	7.9%
Critical care	8 / 486	1.6%
Died	1 / 576	0.2%



Summary – Spring 2009

- Majority of cases did not travel to Mexico
 - Including initial cases
- Epicenter was in Puget Sound (western WA)
- Majority of cases <18 years old (predominantly 5-17 years)
 - Highest rate of hospitalizations in 0-4 year olds
- Higher than expected vomiting and diarrhea (vs. seasonal flu)
- Laboratory confirmation for all suspected cases was not sustainable long-term



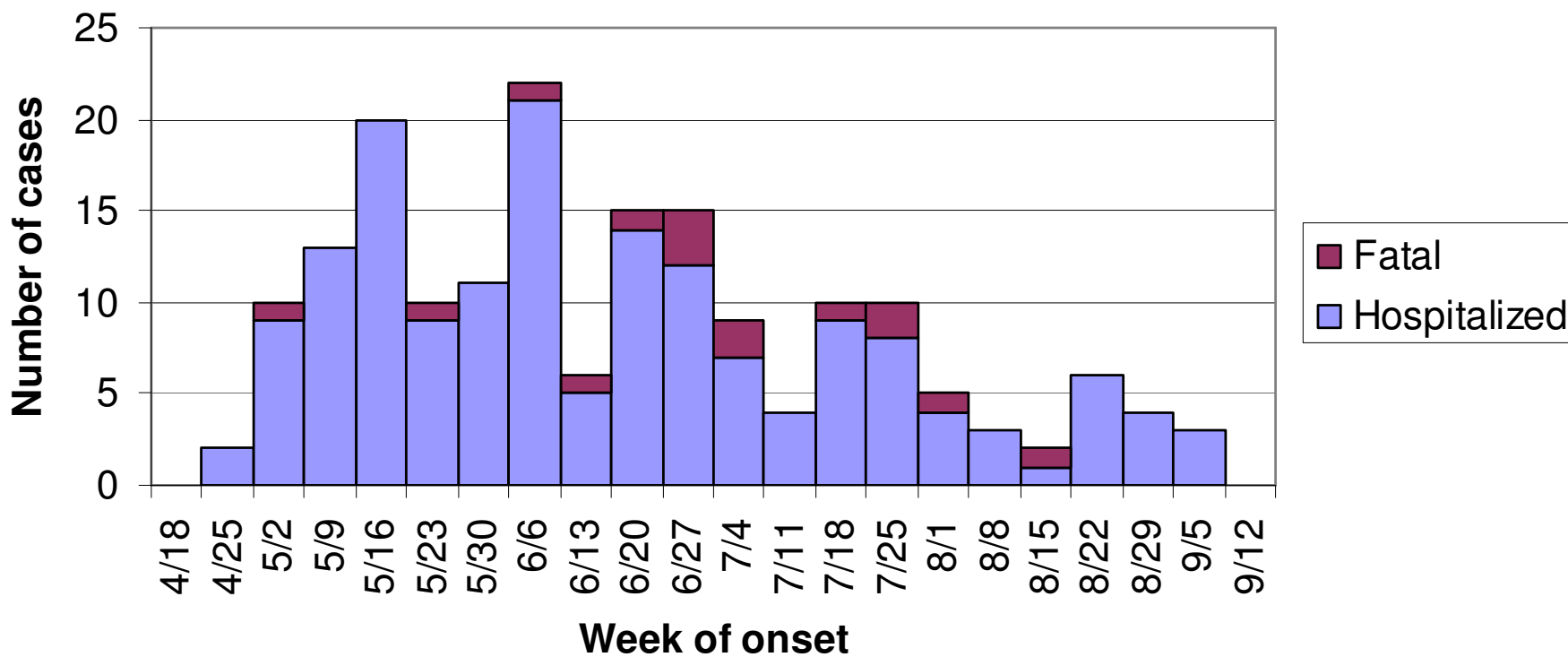
Change in surveillance – Summer 2009

- Previously, clinical syndrome or severity not used to screen before testing (4/26/09-5/23/09)
- Beginning the week of May 24, 2009, reporting criteria for 2009 H1N1 virus changed to:
 - Deceased and hospitalized persons with confirmed 2009 H1N1 infection (mandatory reporting)
 - Healthcare workers and pregnant women with confirmed 2009 H1N1 infection (voluntary reporting)

Hospitalized and fatal cases

- Includes all hospitalized and/or fatal cases reported to WA DOH 4/26 – 9/12 (n=183)
 - 16 fatal cases and 167 hospitalized
 - Data from case reports based on disease investigations by LHJs
- Epidemiology of hospitalized and fatal cases
- Analysis 1: comparison of hospitalized and fatal cases by age group (<18 years versus \geq 18 years)
- Analysis 2: comparison of hospitalized and fatal cases to non-hospitalized cases

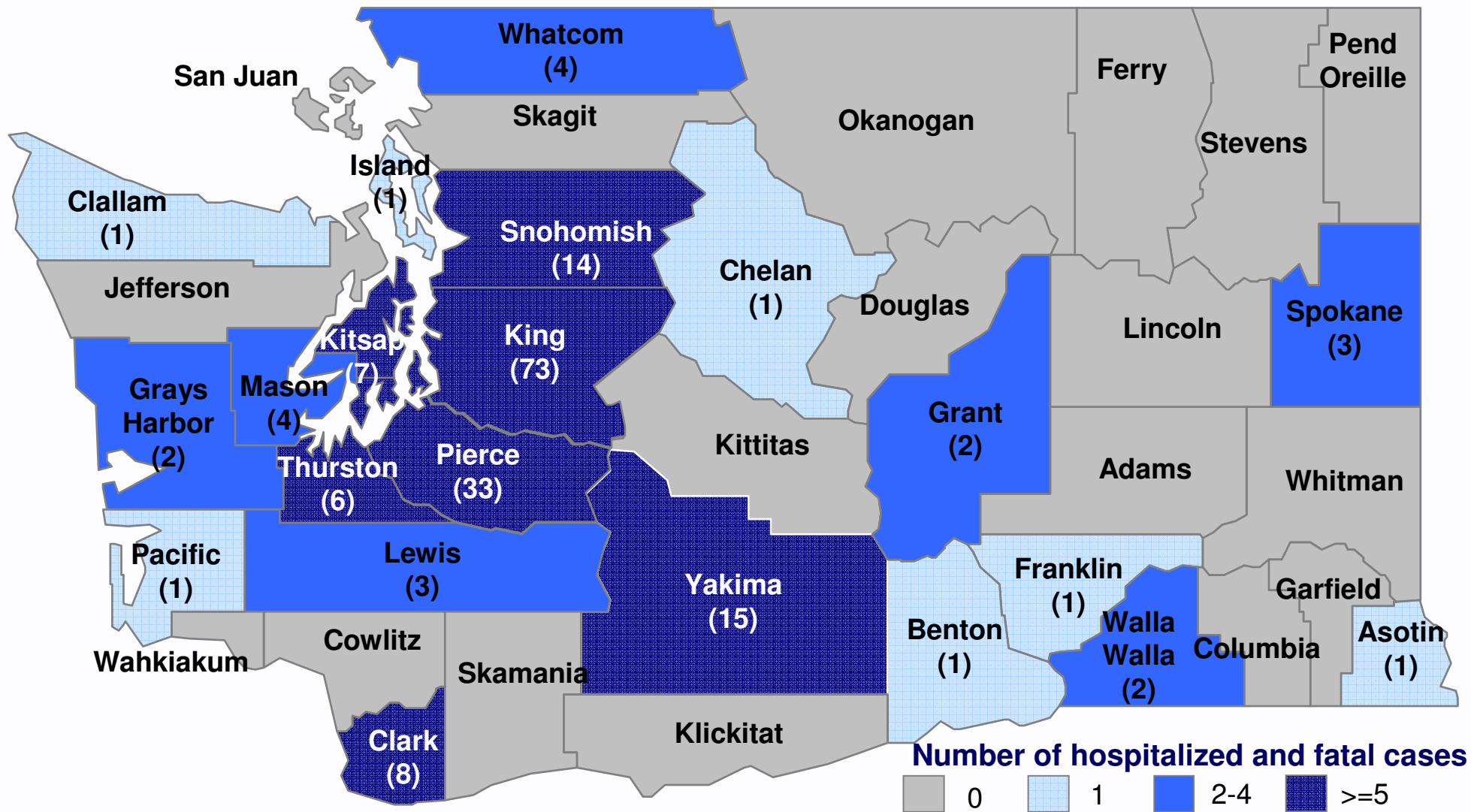
Number of hospitalized and fatal cases of 2009 H1N1 virus by week of onset, WA (n=183)*



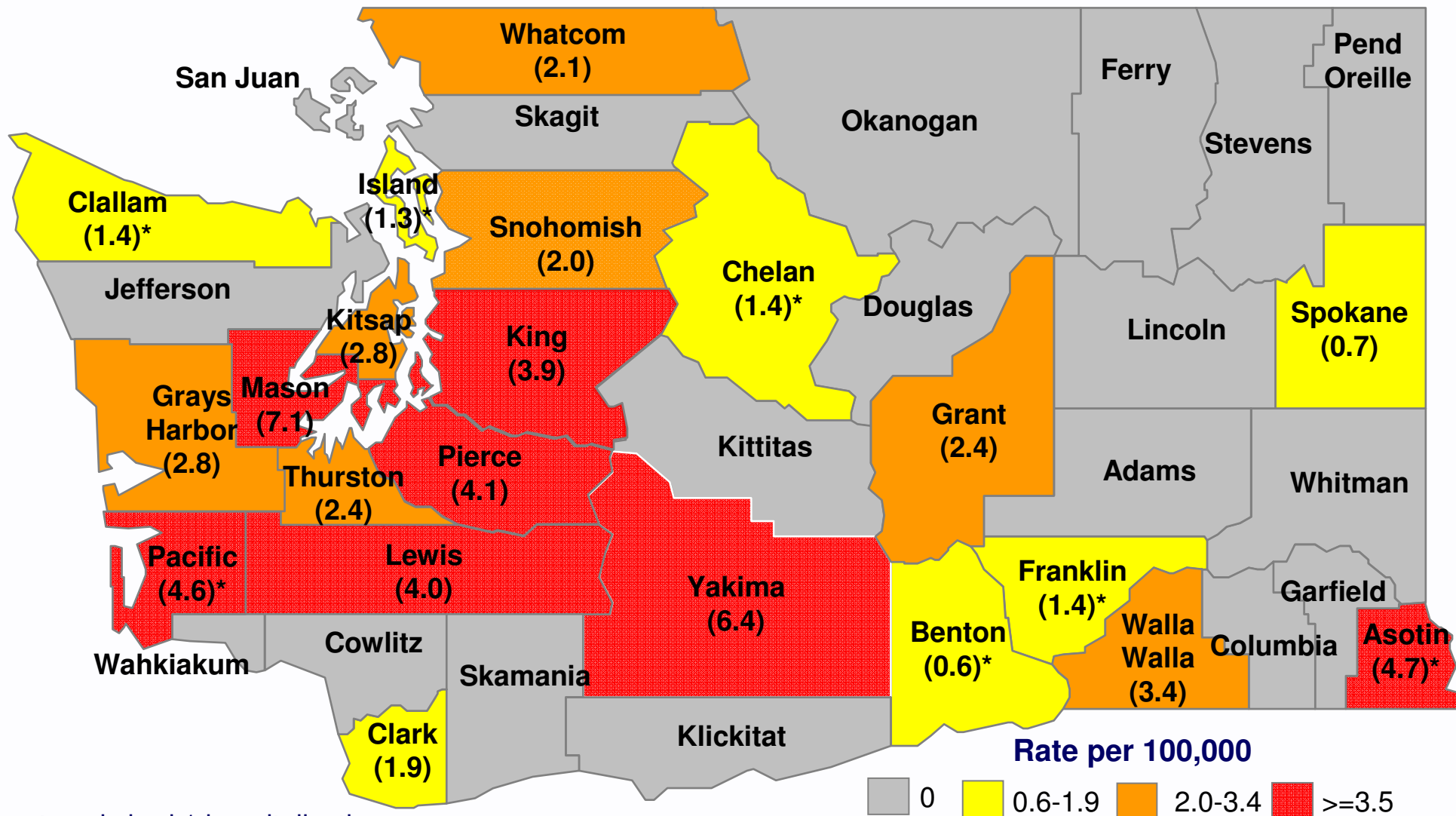
* 2 hospitalized cases and 1 fatal case did not have an onset date or collection date.

-Week of onset shown as week ending date.

Number of hospitalized and fatal cases due to 2009 H1N1 virus influenza by county of residence (n=183)

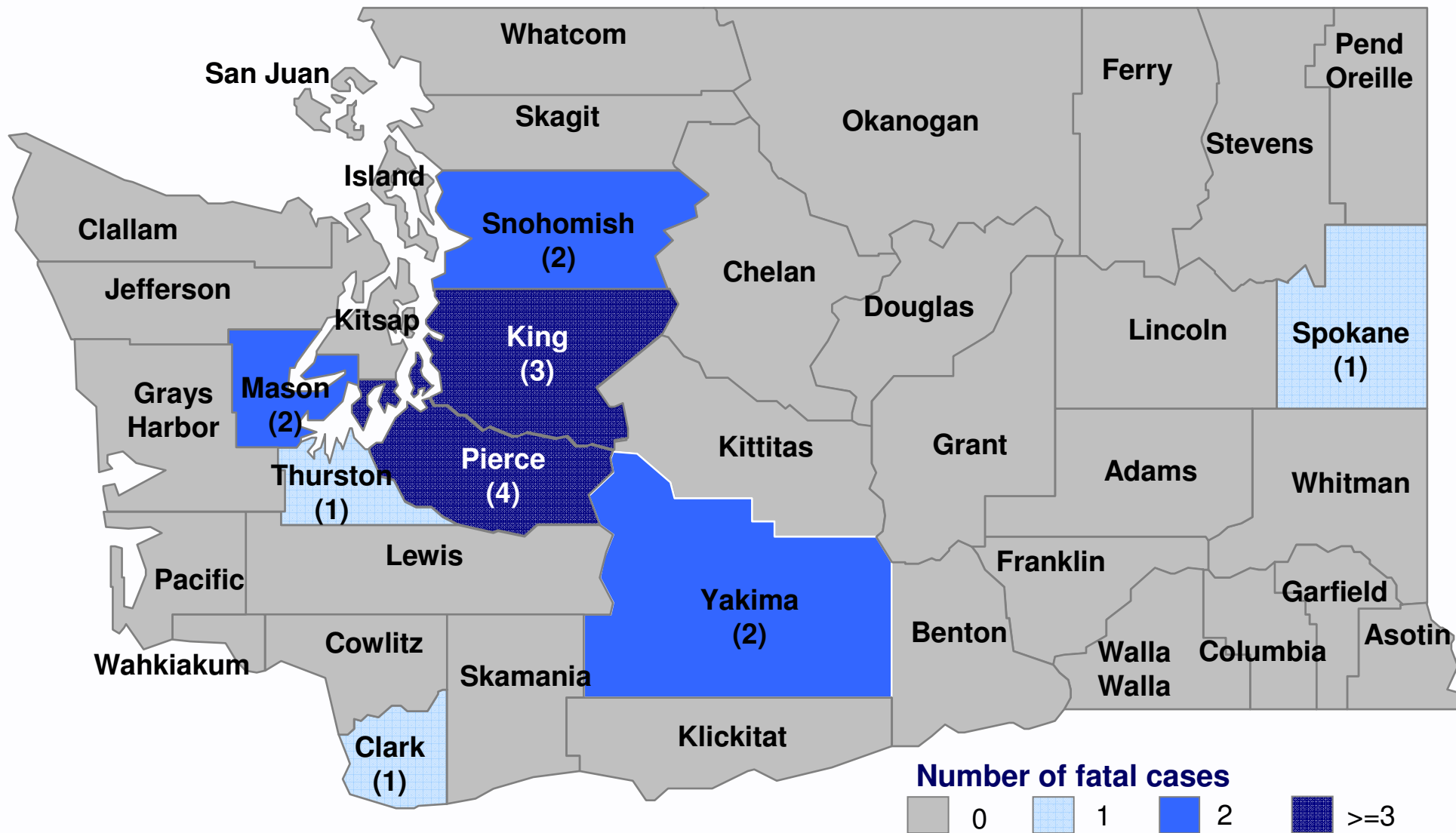


Rate of hospitalized and fatal cases due to 2009 H1N1 virus influenza by county of residence (n=183)

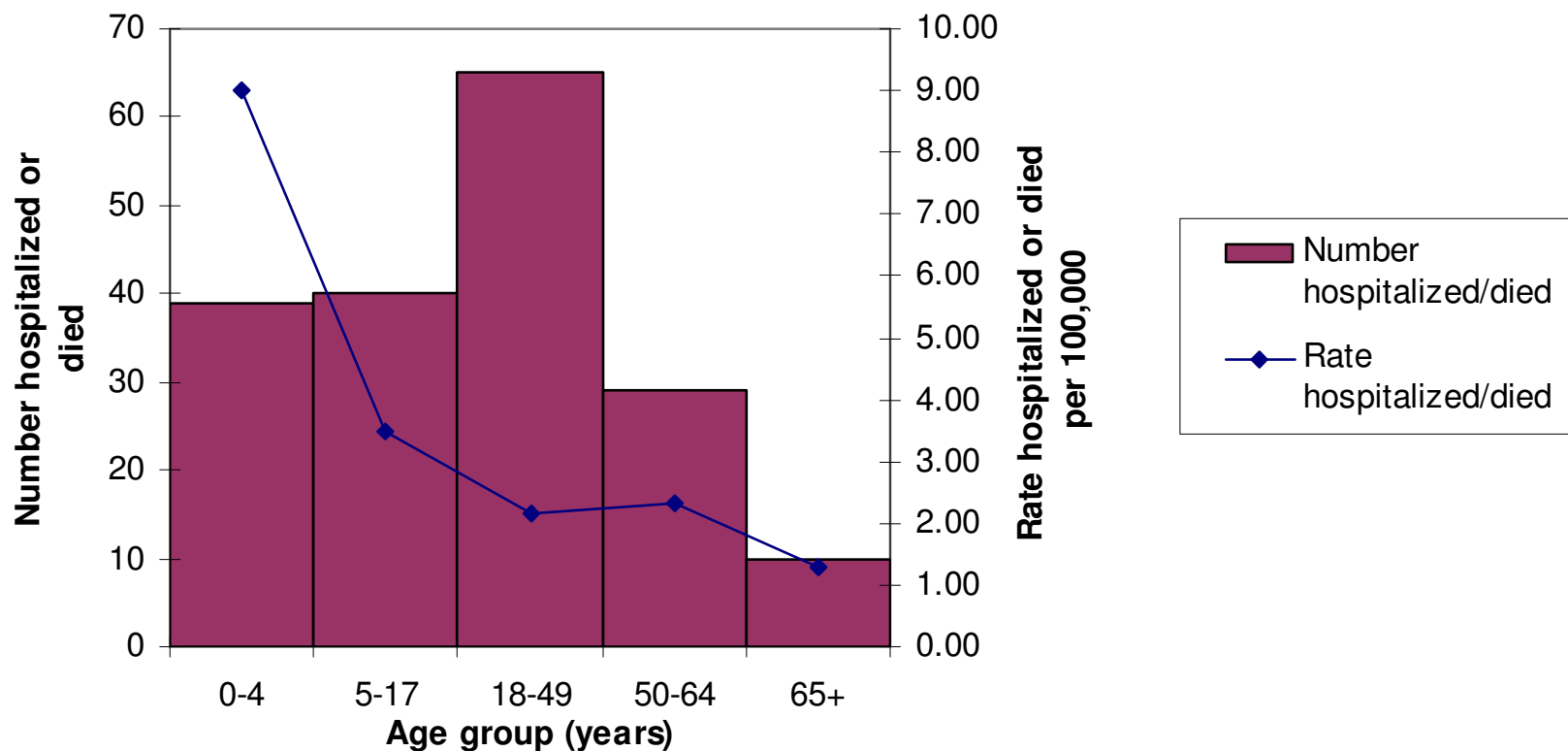


* County only had 1 hospitalization

Number of fatal cases of 2009 H1N1 virus influenza by county of residence (n=16)



**Number and rate of hospitalizations and deaths due to
2009 H1N1 virus by age group, WA (n=183)**





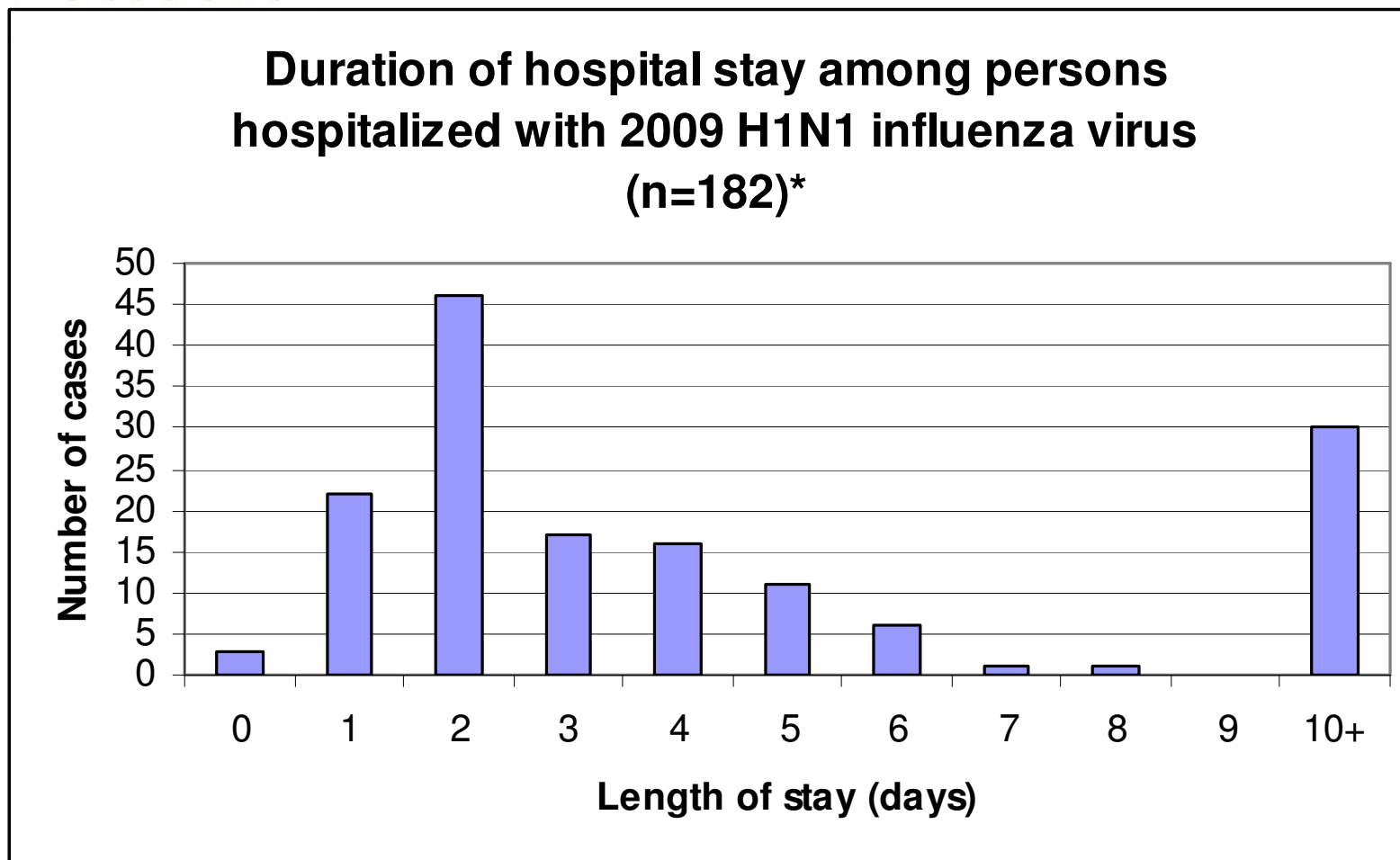
Symptoms of hospitalized and fatal cases of 2009 H1N1 influenza virus (n=183)

Symptoms	Present	%
Fever	161 / 170	95%
Cough	160 / 168	95%
Shortness of breath	86 / 119	72%
Sore throat	56 / 104	54%
Vomiting	59 / 144	41%
Diarrhea	36 / 137	26%



Clinical findings of hospitalized and fatal cases of 2009 H1N1 influenza virus (n=183)

Clinical condition	Present	%
Pneumonia	79 / 150	53%
Hypoxia	57 / 128	45%
ICU admission	57 / 168	34%
Mechanical ventilation	43 / 56	77%
Adult respiratory distress syndrome	29 / 42	69%
Fatal	16 / 183	8.7%



*29 cases had incomplete length of stay information



Hospitalized and fatal cases of 2009 H1N1 influenza virus by age and severity (n=183)*

Age Group	No critical care	Critical care/fatal	% severe
0-4	30	4	12%
5-17	29	8	22%
18-49	31	29	48%
50-64	13	16	55%
65+	6	2	25%
Total	109	59	35%

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* 15 cases were missing information on ICU status

Predisposing conditions in hospitalized and fatal cases of 2009 H1N1 influenza virus (n=183)

Condition	Present	%
Any predisposing condition	131 / 173	76%
Lung diseases/conditions	67 / 173	39%
Asthma	40 / 173	23%
Smoking	25 / 173	14%
Chronic lung disease	14 / 173	8%
Diabetes	24 / 173	14%
Heart disease	19 / 173	11%
Steroid therapy	14 / 173	8%
Pregnancy	10 / 158	6%
Alcohol or drug use	10 / 173	6%
Chemotherapy/cancer in last year	10 / 173	6%

Characteristics of pregnant hospitalized and fatal 2009 H1N1 influenza virus cases (n=10)

Age range (years)	16 – 43
Any predisposing conditions*	3 / 9 (33%)
Admitted to ICU	4 / 10 (40%)
Mechanical ventilator	4 / 4 (100%)
Adult respiratory distress syndrome	3 / 4 (75%)
Fatal	2 / 10 (20%)
<hr/>	
Trimester	First 1 / 10 (10%)
	Second 2 / 10 (20%)
	Third 7 / 10 (70%)

* Any pre-existing condition besides pregnancy

Characteristics of fatal 2009 H1N1 influenza virus cases (n=16)

Age range (years)		12 – 76
Age group	0 – 4 years	0
	5 – 17 years	1
	18 – 49 years	9
	50 – 64 years	4
	65+ years	2
Adult respiratory distress syndrome (%)		11 / 11 (100%)
Pregnancy (%)		2 / 16 (13%)
Predisposing condition (%)		15 / 16 (94%)
Median days from onset to death (range)*		15 (6 – 41)

88% of fatal cases
less than 65 years old

*Onset date or death date missing for 3 cases.



Summary of hospitalized/fatal cases of H1N1 virus

- 9% of hospitalized cases died
 - Seasonal flu estimate ~ 16%
- Highest rate of hospitalizations in 0-4 year olds
- Age group with highest number of hospitalized cases is 18-49 year olds
 - Shift from 5-17 year old age group being most frequently hospitalized in early cases
- 34% of hospitalizations required critical care
 - Age groups requiring critical care most frequently were 18-49 and 50-64 year olds
- Hospitalizations seen in Eastern and Western WA over the summer
- 76% of hospitalized cases had a predisposing condition

Analysis 1. Comparison of hospitalized and fatal cases of 2009 H1N1 virus by age group

- Includes all hospitalized and fatal cases reported to WA DOH 4/26 – 9/12
- Divided cases into two age groups
 - 0-17 years n= 79
 - 18+ years n= 104
- Chi-square tests used to assess associations
 - Fisher exact test used when expected cell count was <5

Symptoms of hospitalized and fatal cases of 2009 H1N1 virus by age group (n=183)

Symptoms	Age 0–17 (N=79)		Age 18+ (N=104)		p
	Present	%	Present	%	
Fever	70 / 75	93%	91 / 95	96%	0.510
Cough	67 / 73	92%	93 / 95	98%	0.079
Short of breath	23 / 45	51%	63 / 74	85%	<0.001
Sore throat	19 / 44	43%	37 / 60	62%	0.062
Vomiting	30 / 67	45%	29 / 77	38%	0.387
Diarrhea	12 / 62	19%	24 / 75	32%	0.094

Clinical findings in hospitalized and fatal cases of 2009 H1N1 influenza by age group (n=183)

Clinical condition	Age 0–17 (N=79)		Age 18+ (N=104)		p
	Present	%	Present	%	
Pneumonia	24 / 63	38%	55 / 87	63%	0.002
Hypoxia	13 / 48	27%	44 / 80	55%	0.002
ICU admission	12 / 71	17%	45 / 97	46%	<0.001
Mech. ventilation	5 / 12	42%	38 / 44	86%	0.003
ARDS	1 / 8	13%	28 / 34	82%	<0.001
Fatal	1 / 79	1%	15 / 104	14%	0.002

Predisposing conditions of hospitalized or fatal cases of 2009 H1N1 by age group (n=183)

Condition	Age 0–17 (N=79)		Age 18+ (N=104)		p
	Present	%	Present	%	
Any predisposing condition	45 / 75	60%	86 / 98	88%	<0.001
Lung diseases/conditions	25 / 75	33%	42 / 98	42%	0.203
Asthma	20 / 75	27%	20 / 98	20%	0.333
Smoking	1 / 75	1%	24 / 98	24%	<0.001
Chronic lung disease	5 / 75	7%	9 / 98	9%	0.548
Diabetes	1 / 75	1%	23 / 98	23%	<0.001
Heart disease	5 / 75	7%	14 / 98	14%	0.112
Steroid therapy	4 / 75	5%	10 / 98	10%	0.244
Pregnancy	2 / 74	3%	8 / 84	10%	0.105
Alcohol or drug use	0 / 75	0%	10 / 98	10%	0.004
Chemotherapy/cancer in last year	3 / 75	4%	7 / 98	7%	0.380



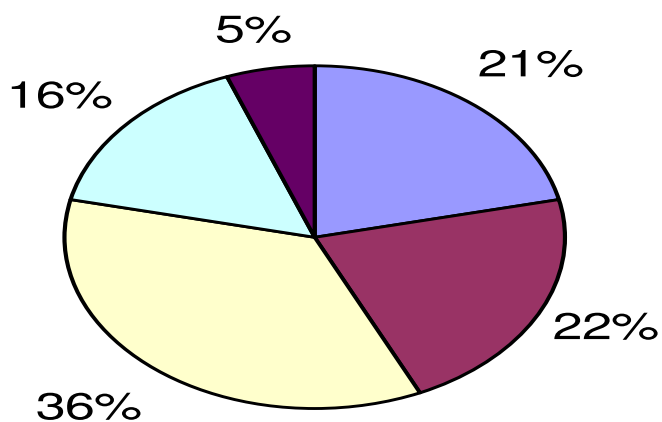
Key findings: Hospitalized and fatal cases of H1N1 virus by age group

- Adults were significantly more likely to
 - Have pneumonia
 - Have hypoxia
 - Be admitted to an ICU
 - Die

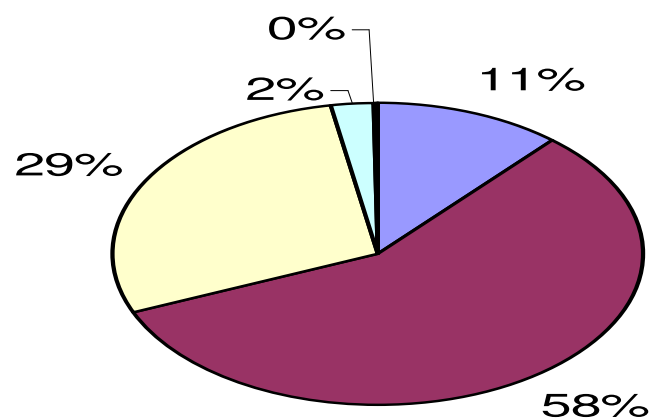
Analysis 2. Hospitalized and fatal cases compared to non-hospitalized cases of 2009 H1N1

- Includes all hospitalized and fatal cases reported to WA DOH 4/26 – 9/12 (n= 183)
- Of 576 cases reported 4/26 – 5/23:
 - 533 non-hospitalized persons with complete age information
 - Randomly selected 200 cases from 4 age groups at ratios proportional to the hospitalized population
- Chi-square tests used to look for associations
 - Fisher exact test used when expected cell count was <5

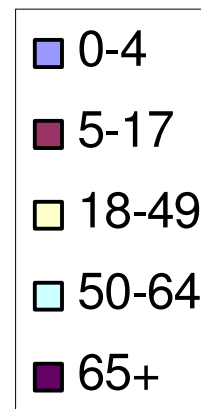
Age distribution of 2009 H1N1 cases: Hospitalized/fatal vs. non-hospitalized



Hospitalized and
fatal cases (n=183)



Non-hospitalized
cases (n=533)





Hospitalized/fatal and non-hospitalized cases of 2009 H1N1 by gender and race

	Hospitalized/Fatal (n=183)		Non-Hospitalized (n=200)		p
	Present	%	Present	%	
Male	78 / 176	44%	108 / 200	54%	0.061
Race					
White	58 / 113	51%	50 / 104	48%	
Black / African Am.	23 / 113	20%	20 / 104	19%	
Asian	16 / 113	14%	16 / 104	15%	
Native HI / Other PI	8 / 113	7%	4 / 104	4%	
Am. Indian / AK Native	5 / 113	4%	1 / 104	1%	
Other	3 / 113	3%	13 / 104	13%	

Symptoms of hospitalized/fatal and non-hospitalized 2009 H1N1 virus cases

Symptoms	Hospitalized/Fatal (n=183)		Non-hospitalized (n=200)		p
	Present	%	Present	%	
Fever	161 / 170	95%	194 / 199	97%	0.163
Cough	160 / 168	95%	180 / 196	92%	0.192
Sore throat	56 / 104	54%	91 / 161	57%	0.669
Vomiting	59 / 144	41%	42 / 173	24%	0.002
Diarrhea	36 / 137	26%	47 / 171	27%	0.812



Predisposing conditions among hospitalized/fatal and non-hospitalized 2009 H1N1 cases

Condition	Hospitalized/fatal (n=183)		Non-hospitalized (n=200)		p
	Present	%	Present	%	
Any predisposing condition	131 / 173	76%	46 / 195	24%	<0.001
Lung diseases/conditions	67 / 173	38%	29 / 195	15%	<0.001
Asthma	40 / 173	23%	22 / 195	11%	0.003
Smoking	25 / 173	14%	9 / 195	5%	0.001
Chronic lung disease	14 / 173	8%	0 / 195	0%	<0.001
Diabetes	24 / 173	14%	5 / 195	3%	<0.001
Heart disease	19 / 173	11%	0 / 195	0%	<0.001
Steroid therapy	14 / 173	8%	0 / 195	0%	<0.001
Alcohol or drug use	10 / 173	6%	5 / 195	3%	0.119
Chemotherapy/cancer in last yr.	10 / 173	6%	0 / 195	0%	<0.001

Influenza vaccination and treatment of hospitalized and fatal 2009 H1N1 cases compared to non-hospitalized cases

	Hospitalized/Fatal (n=183)		Non-hospitalized (n=200)		p
	Present	%	Present	%	
Received flu vaccine in last year	50 / 106	47%	67 / 147	46%	0.802
Treated with antivirals	126 / 163	77%	107 / 188	57%	<0.001



Key findings: Hospitalized/fatal cases compared to non-hospitalized cases of 2009 H1N1 virus

- Hospitalized and deceased persons were significantly more likely to:
 - Report vomiting
 - Receive antiviral treatment
- Hospitalized and deceased persons were significantly more likely to have a predisposing condition than non-hospitalized persons
 - Lung diseases/conditions (asthma, smoking, chronic lung disease)
 - Diabetes
 - Heart disease
 - Steroid therapy
 - Chemotherapy/cancer in last year

Limitations of surveillance data

- Change in surveillance strategies
 - Reporting and testing criteria
- Underreporting
 - Passive system
- Representativeness
 - More severe cases more likely to be reported
- Timeliness
- Incomplete case reports
 - Limits generalizability
 - Limits analyses