2009 H1N1 Influenza in Washington State
A summary of the first year—April 2009–May 2010

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Executive Summary

In April 2009, the Centers for Disease Control and Prevention detected the emergence of the 2009 H1N1 influenza virus, a novel virus that subsequently caused the first influenza pandemic of the 21st century. During the first year of this virus' circulation, the Washington State Department of Health (DOH) and local health jurisdictions enhanced disease surveillance to determine the impact of the pandemic, the geographic spread of the virus in Washington, and risk factors for severe illness or death. This report describes the findings of that enhanced surveillance. Important highlights include:

- At a minimum, more than 1,650 hospitalizations and deaths in Washington State were due to this novel influenza virus. This number is likely an underestimate as it represents only the cases reported to DOH.
- The pandemic occurred in two waves; the first wave primarily affected western Washington residents and occurred from April through August 2009 while the second larger wave affected residents on both sides of the state and occurred from September through December 2009.
- During the first month of the pandemic, surveillance for all 2009 H1N1 cases showed that the attack rate was highest in those 5–24 years and the novel virus was less severe than anticipated.
- Pre-school aged children had the highest hospitalization rate throughout the entire pandemic.
- The second wave was associated with a markedly higher median age of hospitalized cases and fatal cases than was seen in the first wave.
- Most hospitalized and fatal cases had a medical condition recognized by the Advisory Committee on Immunization Practices (ACIP) that put them at higher risk for influenza complications. The most common medical conditions reported included asthma, chronic lung disease (excluding asthma), and diabetes.
- The proportion of hospitalized or fatal cases who received antiviral therapy increased slightly from 79% in the first wave to 88% in the second wave. Those receiving antiviral therapy within 2 days of symptom onset also increased slightly from the first to second wave from 43% to 55%. Fatal and critical cases received treatment later than did those with less severe disease.
- Compared to non-pregnant women and men of the same age, pregnant women were 8-11 times more likely to be hospitalized for 2009 H1N1 and 3-4 times more likely to be admitted to an intensive care unit for 2009 H1N1 influenza.
- Most hospitalized pregnant women were in their third trimester of pregnancy.

- Among pregnant women, those younger than 20 years of age, who were Hispanic, Black, or with Medicaid insurance had a higher rate of hospitalization compared to other pregnant women.
- Overall, 93% of hospitalized pregnant women received antiviral treatment. Of hospitalized pregnant women, 70% received antiviral treatment within 2 days of illness onset which was higher than other groups.
- Sustained nonpharmaceutical interventions (e.g., quarantine, isolation, school closure, or suspension of public gatherings) were not used in any Washington community.

Conclusions

The 2009 H1N1 influenza pandemic was less severe than initially anticipated. Still, younger age groups had higher flu-related morbidity and mortality than is typically seen with seasonal influenza. As with seasonal influenza, severe disease occurred in persons with specific underlying medical conditions, including pregnancy. During the first wave, the burden of disease was more pronounced in urban areas and among younger age groups; during the second wave, the incidence of disease increased in the less densely populated counties and also among older age groups. Overall however, the greatest morbidity from 2009 H1N1 influenza was borne by younger age groups.

To decrease the morbidity and mortality from influenza, healthcare providers must continue to educate persons with underlying medical conditions about their increased risk for complications and means to prevent severe disease, especially influenza vaccination. This education should occur before the influenza season begins. Influenza vaccination is the best way to prevent influenza. In 2010, the Centers for Disease Control and Prevention recommended that all persons 6 months of age and older receive influenza vaccine. To reduce the large impact of influenza on Washington health care systems, healthcare providers must make special efforts to vaccinate all eligible patients. In addition, new strategies must be developed to vaccinate persons who infrequently see their healthcare providers or do not have a “medical home.” In addition to improving vaccine coverage of their patients, healthcare providers must continue to provide timely antiviral treatment to persons with influenza-like illness (ILI) who are at higher risk of severe disease from influenza and those who present with more severe respiratory illness.

Finally, in 2009–2010, enhanced surveillance activities throughout state and local public health agencies improved the ability to monitor the impact of influenza virus and of vaccination efforts. Because influenza is one of the leading communicable disease causes of death and hospitalization, many of these enhanced efforts should continue as a standard for monitoring epidemic respiratory illness.

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Background

The first influenza pandemic of the 21st century began in North America in early 2009. A severe respiratory illness outbreak in Mexico in March 2009 was later determined to be caused by the novel 2009 H1N1 influenza A virus.[1] On April 21, 2009, the Centers for Disease Control and Prevention (CDC) reported two children from southern California infected with this novel virus. These children were not epidemiologically linked to each other and had not been in contact with pigs, suggesting that the virus was already circulating in humans in the region.[2] The virus was subsequently identified as a quadruple reassortant virus, containing genes from Eurasian swine, North American swine, avian and human influenza viruses[3-5] and contained an H1 subtype that had not circulated among humans in many years.

In Washington, the first cases of 2009 H1N1 influenza were identified in the week of April 27, 2009. The earliest known case became ill on April 19, 2009. Most of the initial cases had not traveled to Mexico or California, suggesting that community transmission occurred in Washington in early April.

Methods

Three different surveillance strategies, based on different surveillance goals, were used over the course of the pandemic.

April – May 2009 To determine the severity of the novel virus and the extent of transmission in Washington, the Department of Health (DOH) asked commercial laboratories in the state to forward influenza-positive samples to the Washington State Public Health Laboratories (WAPHL) for subtyping using CDC's reverse transcriptase-polymerase chain reaction (RT-PCR) test. In addition, healthcare providers were encouraged to test hospitalized patients with influenza-like illness (ILI) and respiratory failure for influenza. A case was defined as a Washington resident with 2009 H1N1 influenza confirmed by RT-PCR testing. Local health jurisdictions collected demographic and clinical data through medical record review and interviews using a standardized reporting form. Report forms were faxed to DOH Communicable Disease Epidemiology Section (CDES), entered into an Excel database, and analyzed by CDES staff.

June – August 2009 To estimate flu morbidity and mortality and determine risk factors for severe influenza due to the 2009 H1N1 virus, DOH and local health jurisdictions required healthcare providers and hospitals to report all hospitalized and fatal cases ("severe cases") of laboratory-confirmed 2009

H1N1 influenza. An emergency rule was adopted on June 11, 2009 which required reporting statewide. A case was defined as a Washington resident who was admitted to a hospital or who died with 2009 H1N1 confirmed by RT-PCR testing. Local health jurisdictions collected demographic and clinical data using a standardized reporting form (Appendix A). The form underwent minor modifications during the first pandemic wave.

September 2009 – May 2010 To estimate flu morbidity and mortality and determine risk factors for severe influenza, on September 19, 2009, a second emergency rule was adopted requiring healthcare providers and hospitals to report severe cases with laboratory-confirmed influenza of any type. This rule was renewed on January 15, 2010 and expired on May 15, 2010. A case was defined as a Washington resident who was admitted to a hospital or who died with influenza of any type confirmed by rapid antigen test, direct or indirect fluorescent antibody assay, virus culture or PCR. From September 2009 through May 2010, local health jurisdictions collected limited demographic and clinical data through medical record review using a standardized report form (Appendix B). Data were entered into the Public Health Issues Management System (PHIMS) and transmitted electronically to DOH.

Analysis Three groups were defined for analyses: all 2009 H1N1 cases reported to DOH during April - May 2009; all severe 2009 H1N1 cases with illness onset April through August 2009; and all severe influenza cases with illness onset September 2009 through May 2010. Persons with influenza B and "seasonal" H1N1 or H3N2 influenza A were excluded from analyses. Persons with influenza A of unknown subtype were presumed to have 2009 H1N1. High risk medical conditions associated with more severe or complicated influenza were defined by the Advisory Committee for Immunization Practices (ACIP); they include pregnancy, chronic pulmonary, hepatic, renal, or cardiovascular disease, cognitive, neurologic/neuromuscular, endocrine, metabolic, blood disorders, and immunosuppression.[6]

Population rates were calculated using Washington State Office of Financial Management population estimates for 2009.[7] Western Washington was defined as the region including Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, and Whatcom counties; all other counties were considered "eastern."

Pregnant Women Hospitalized with 2009 H1N1 Influenza DOH Maternal and Child Health Program staff obtained and reviewed the medical records of all pregnant women hospitalized with 2009 H1N1 influenza who were reported through PHIMS during April 2009 through January 2010. For this analysis,

hospitalization was defined as having at least one overnight stay. Because of the slightly different case definition and time period of case detection included for analysis, the number of pregnant women in this analysis is slightly different than that in other sections of the report. Rates were calculated using DOH estimates of live births per year.

Oseltamivir-resistant 2009 H1N1 Influenza CDC performed antiviral resistance testing for surveillance and to support clinical care. Antiviral resistance testing was performed using pyrosequencing to detect the H275Y mutation in the neuraminidase gene, a mutation which confers resistance to oseltamivir. The WAPHL sent to CDC a subset of influenza-positive specimens for antiviral resistance testing for surveillance purpose. In addition, antiviral resistance testing was performed for immunocompromised and critically ill patients with prolonged excretion of influenza virus despite antiviral therapy at the request of healthcare providers. All cases of oseltamivir-resistant 2009 H1N1 influenza were investigated by the local health jurisdictions in collaboration with DOH CDES staff.

Limitations Limitations of the surveillance data include underreporting of cases, bias in reporting with probable overrepresentation of severe cases, and incomplete case reports.

Results

For the purposes of this report, 2009 H1N1 influenza cases who sought medical care were categorized into four groups:

- Outpatient: Cases with influenza who were not hospitalized
- Severe: Cases with influenza who were admitted to a hospital or died
- Critical: Cases with influenza who were admitted to an intensive care unit or died
- Fatal: Cases with influenza who died

Overall From April 2009 through May 2010, 1,667 severe cases of 2009 H1N1 influenza were reported to DOH (Table 1) resulting in an annual rate of 24.7 severe influenza cases per 100,000. CDC estimates that only about 37% of 2009 H1N1 hospitalizations were reported.[8] Using a CDC-derived correction factor, there were likely more than 4,000 hospitalizations due to this novel virus in Washington. The county-specific rate of severe influenza ranged from 0 to 99 per 100,000 per year. Of 1,667 reported severe cases, 98 were fatal, a rate of 1.4 influenza deaths per 100,000 per year. No similarly derived rates for seasonal influenza are available for comparison.

Assuming that severe cases closely track ILI incidence, two distinct epidemic patterns occurred. Initially, there was a period of moderate epidemic transmission from April 2009 through August 2009 ("first wave") (Fig. 1), followed by a greatly enhanced epidemic transmission period from September 2009 through December 2009 ("second wave"). In addition to the distinctive temporal pattern, there appeared to be a marked geographic difference in transmission (Fig. 2). Transmission during the first wave occurred mainly in western Washington while transmission during the second wave occurred on both sides of the state but started and peaked roughly two weeks earlier in eastern Washington.

All Reported 2009 H1N1 Influenza Cases, April–May 2009 From April 27 to May 22, 2009, 576 lab-confirmed 2009 H1N1 cases were reported to DOH. Of those with complete data, 41(8%) were hospitalized, 8 (2%) required critical care, and 1 (0.2%) died. Among these cases, fever (97%), cough (93%), and sore throat (60%) were most commonly reported. Most reported cases were from counties along Puget Sound; the highest rates occurred in King and Snohomish Counties, with rates of 20.4 and 16.5 per 100,000, respectively (Fig. 3). The highest rates occurred in persons younger than 25 years of age (15.7 and 21.1/100,000 for age groups 0-4 and 5-24, respectively) and almost no infections were detected in the 65 years and older age group (Fig. 4).

Reported Severe 2009 H1N1 Influenza Cases, April–August, 2009 There were 188 severe 2009 H1N1 cases reported to DOH with illness onset from April 19–August 31, 2009. During this time, in general, western Washington counties had the highest number and rates of severe 2009 H1N1 influenza (Figs. 5 and 6). A notable exception was Yakima County in eastern Washington, which had 14 cases and an elevated rate of severe cases at 5.9/100,000.

As with total illnesses, severe cases were concentrated in the younger age groups. The median age of all severe influenza cases was 22 years old and the highest rate occurred in those 0 to 4 years of age (8.9/100,000)(Fig. 7). The vast majority of critical cases occurred in persons aged 5 to 64 years, with rates fairly similar across age groups 0 to 64 years (0.9-1.3/100,000)(Fig. 8). During this period, women made up the majority of severe cases (57%) but less than half of fatal cases (47%)(Table 2). Race and ethnicity data were not known for 29% of cases so these data should be interpreted cautiously. The most common underlying conditions among severe cases were asthma (23%), diabetes (15%), heart disease (10%) and immunosuppression (15%)(Table 3). Certain underlying conditions were more common in those 18 years and older than in younger persons, specifically, diabetes, heart disease, pregnancy, immunosuppression and kidney disease (Table 4).

Many hospitalized cases required intensive care. Overall, of 182 severe 2009 H1N1 influenza cases with known ICU status, 61 (34%) required ICU care. When compared by age group, persons 18 years or older were much more likely to be admitted to the ICU, require mechanical ventilation, develop acute respiratory distress syndrome (ARDS) and die from the illness (Table 5). In an additional analysis, multivariate analysis identified age 18–64 years and hospital admission more than 2 days after illness onset as independent risk factors for critical care illness or death among patients hospitalized during the first wave (Appendix C).

During the first five months of the pandemic in Washington, 17 (9%) severe 2009 H1N1 cases died, including 2 pregnant women. These fatal cases mainly occurred in the western part of the state in the counties along the Puget Sound (Fig. 9). The median age of these fatal cases was 39 years, and 88% were younger than 65 years (Table 6). Of the 17 fatal cases, 10 (59%) had an ACIP-defined condition other than age which put them at higher risk of complications from influenza. In addition, smoking was more common among the cases with more severe disease; of the 17 fatal cases, 4 (24%) were noted to be smokers compared to 8 (18%) of 44 non-fatal cases requiring critical care and 12 (10%) of 116 non-fatal hospitalized cases who did not require critical care (data not shown). Notably, the number of persons 65 years or older that died or required critical care was low during this phase of the pandemic (Table 6 and Fig. 8).

Receipt of antiviral treatment was reported for 174 (93%) of the severe cases; of these cases, 137 (79%) received antiviral treatment (Table 7). Timing of antiviral treatment was complete for only 72% of those who received antiviral treatment. Persons with critical or fatal illnesses received antiviral medication later than those with less severe disease. Among all severe cases, 43% received antiviral treatment within two days symptom onset compared to only 29% of critical care cases and 14% of fatal cases. According to CDC recommendations, certain groups at risk for severe influenza should receive prompt antiviral treatment.[9] During this first wave, among those with severe 2009 H1N1 influenza, 78% of pregnant women, 73% of asthmatics, but only 55% of children less than 2-years-old were treated with antiviral medication (Table 8). Among the 4 pregnant women with known timing of antiviral therapy, only 1 (25%) received antiviral medication within 2 days of onset of symptoms.

Known Severe 2009 H1N1 Cases, September 2009–April 2010 During the "second wave" of the pandemic, 1,492 severe influenza cases due to any influenza type were identified; 1480 (99%) were influenza A and 12 (<1%) were influenza B (Table 9). Nearly 100% of the subtyped influenza A specimens

were 2009 H1N1; only a single "seasonal" influenza A H1N1 was identified among 966 subtyped influenza A isolates (Table 9). All subsequent analyses are restricted to 1,479 hospitalized or fatal cases with 2009 H1N1 or influenza A of unknown subtype.

The five most urban and populous counties, Clark, King, Pierce, Snohomish, and Spokane, accounted for most of the severe influenza cases. However, though these counties comprise roughly 65% of Washington's population, they reported 62% of the severe cases and 58% of the fatal cases in the state (Figs. 10 & 11), slightly less than would have been expected. This is markedly different than what was seen during the first wave and suggests that this phase of the pandemic was penetrating more rural counties. In addition, unlike the first wave that more greatly affected western Washington, the rates of severe influenza cases were generally higher in eastern Washington counties (Fig. 12).

Similar to the first wave of the pandemic, the majority of hospitalized or fatal cases occurred in those younger than 65 years. However, the median age of hospitalized or fatal cases rose from 22 years in the first wave to 35 years in the second. The highest rate of severe cases was still in those 0 to 4 years of age (Fig. 13). The rate of critical influenza cases was highest for those 0 to 4 years of age and second highest for those 50 to 64 years old (Fig. 14). Unlike the first wave, the rate of critical influenza in those 65 years or older was much higher and more similar to that of persons aged 25 to 64 years. The majority of fatalities occurred in those older than 24 years of age. Fatality rates increased with age and were highest in those older than 49 years (Fig. 15).

Of the 1,479 severe influenza cases identified, 827 (56%) occurred in women (Table 10). Though men were hospitalized at a lower rate than women (19.6 vs. 25.0/100,000, respectively, data not shown), more fatal cases occurred in men (64%), a higher proportion compared to the first pandemic wave when 53% of the fatalities occurred in men. Race and ethnicity data were incomplete for 505 (34%) of cases so conclusions based on the data in this table should be made cautiously.

From September 2009 through April 2010, of 1,479 severe influenza cases, 81 (5%) died compared to 9% during the first wave (Table 11). The median age of fatal cases rose from 39 years during the first wave to 52 years in the second. Among fatal influenza cases, 76% had an ACIP-defined underlying medical condition other than age which put them at higher risk for complications from influenza. Of the 19 fatal cases who did not have an ACIP-defined underlying medical condition, 9 (47%) were obese, smoked or older than 64-years-old. Of three fatal cases in children 0 to 4 years of age, two infants under 1 year of age had one or more chronic conditions.

Fewer hospitalized cases required intensive care during the second wave. Of the 1,343 severe influenza cases with known ICU status, 350 (26%) were admitted to an ICU compared to 34% during the first wave (Table 12). As in the first wave, those 18 years and older were significantly more likely to be admitted to the ICU, require mechanical ventilation, develop acute respiratory distress syndrome or die from the illness.

The majority of severe cases had an associated ACIP-defined underlying condition (Table 13). The most common conditions were asthma (21%), chronic lung disease (other than asthma) (17%), diabetes (16%), heart disease (12%), immunosuppression (11%), and neurologic conditions (10%). Fatal cases were more likely than nonfatal cases to have chronic lung disease, diabetes, heart disease, or immunosuppression. Interestingly, asthma was less common among fatal cases than in survivors of severe influenza. In general, during the second pandemic wave, except for neurologic conditions which were more common in the younger group, underlying medical conditions were more common in those 18 years and older than in younger persons (Table 14). Among conditions not specified by ACIP as risk factors for complications, smoking, obesity and alcohol or drug abuse were all more common in critical and fatal cases than in other hospitalized persons (Table 13).

Overall, for the severe cases, receipt of antiviral medication within 2 days of illness onset improved during the second wave compared to the first wave. Antiviral treatment data were complete for 1204 (81%) of severe cases; of these, 1,062 (88%) were given antiviral treatment (Table 15). The proportion who received antiviral treatment was slightly better for critically ill (88%) than for fatal cases (83%). Timing of antiviral treatment was noted for 90% of those who received treatment. As in the first pandemic wave, persons with critical illnesses received antiviral medications later in their illness than those with less severe disease. Of hospitalized cases who did not require intensive care or die, 61% received antiviral treatment within two days of symptom onset compared to only 36% of critical cases and 30% of fatal cases. From the available data, the time between hospital admission and the first administered dose of antiviral medication could not be determined.

The use of antiviral therapy in pregnant women was markedly improved during this second wave. The proportion of severe influenza cases in pregnant women who received antiviral treatment increased from 78% in the first wave to 95% in the second wave (Table 16). Timeliness of antiviral treatment for pregnant women also improved during the second wave with 72% receiving treatment within 2 days of symptom onset compared to only 1 (25%) of 4 who received treatment within 2 days of symptom onset

during the first wave. A larger proportion of asthmatics, children younger than 2 years, and both children and adults with underlying conditions who had severe influenza illness due to 2009 H1N1 received antiviral treatment during the second pandemic wave compared to the proportion treated during the first wave.

Potential Vaccine Failure Two hospitalized patients were identified who developed PCR-confirmed 2009 H1N1 more than two weeks after receipt of H1N1 vaccine. Both these patients were pregnant women, one of whom was taking an immunosuppressive medication. In addition to these apparent vaccine failures in hospitalized pregnant women, one non-hospitalized pregnant woman was also identified who developed 2009 H1N1 more than two weeks after receipt of H1N1 vaccine.

Oseltamivir Resistance From April 2009 through April 2010, 8 cases of oseltamivir-resistant 2009 H1N1 influenza were detected in Washington.[10] All were tested at CDC using pyrosequencing and had the H275Y mutation in the neuraminidase gene. The median age of these patients was 37.5 years old (range 6 to 57 years old) and 7 (88%) required hospitalization. Seven (88%) were immunocompromised at illness onset and one patient without an underlying immunocompromising condition received steroids for the treatment of reactive airway disease while hospitalized for influenza. All were exposed to oseltamivir prior to developing the H275Y mutation; 7 received oseltamivir as treatment and 1 received oseltamivir as chemoprophylaxis. Seven were proven to be initially infected with the wild type strain.

Hospitalized and Fatal 2009 H1N1 Influenza Cases Among Pregnant Women From April 2009 through January 2010, 101 severe influenza cases in pregnant women were reported; 78 were confirmed to have 2009 H1N1, and 23 had an influenza A virus of unknown subtype presumed to be 2009 H1N1. Of the 101 cases, 11 (11%) required critical care and 2 (2%) died. Both deaths occurred during the first wave of the pandemic (Fig. 16).

Certain age, racial, and ethnic groups were more likely to be hospitalized (Tables 17 & 18). Compared to 25–29 year old pregnant women, 2009 H1N1 hospitalization rates were 2 and 3 times higher in 20–24 year old and 10–19 year old pregnant women, respectively. In addition, Hispanic and black pregnant women had higher rates of hospitalization than non-Hispanic white pregnant women, as did those on Medicaid insurance compared to those with other insurance. Most pregnant women were in their third trimester when hospitalized with influenza. Unlike the general population, only 29% of pregnant women had a medical condition besides pregnancy which put them at increased risk for influenza complications (Table 19).

Pregnant women with influenza were hospitalized at a high rate (Table 20). Pregnant females were 8 to 11 times more likely to be hospitalized and 3 to 4 times more likely to have critical illness from influenza than were males or non-pregnant females. Among hospitalized cases, 11% of pregnant females were admitted to an ICU compared to 34% of men 10 to 44 years old and 28% of non-pregnant women 10 to 44 years of old (data not shown) suggesting that pregnant women were being admitted conservatively.

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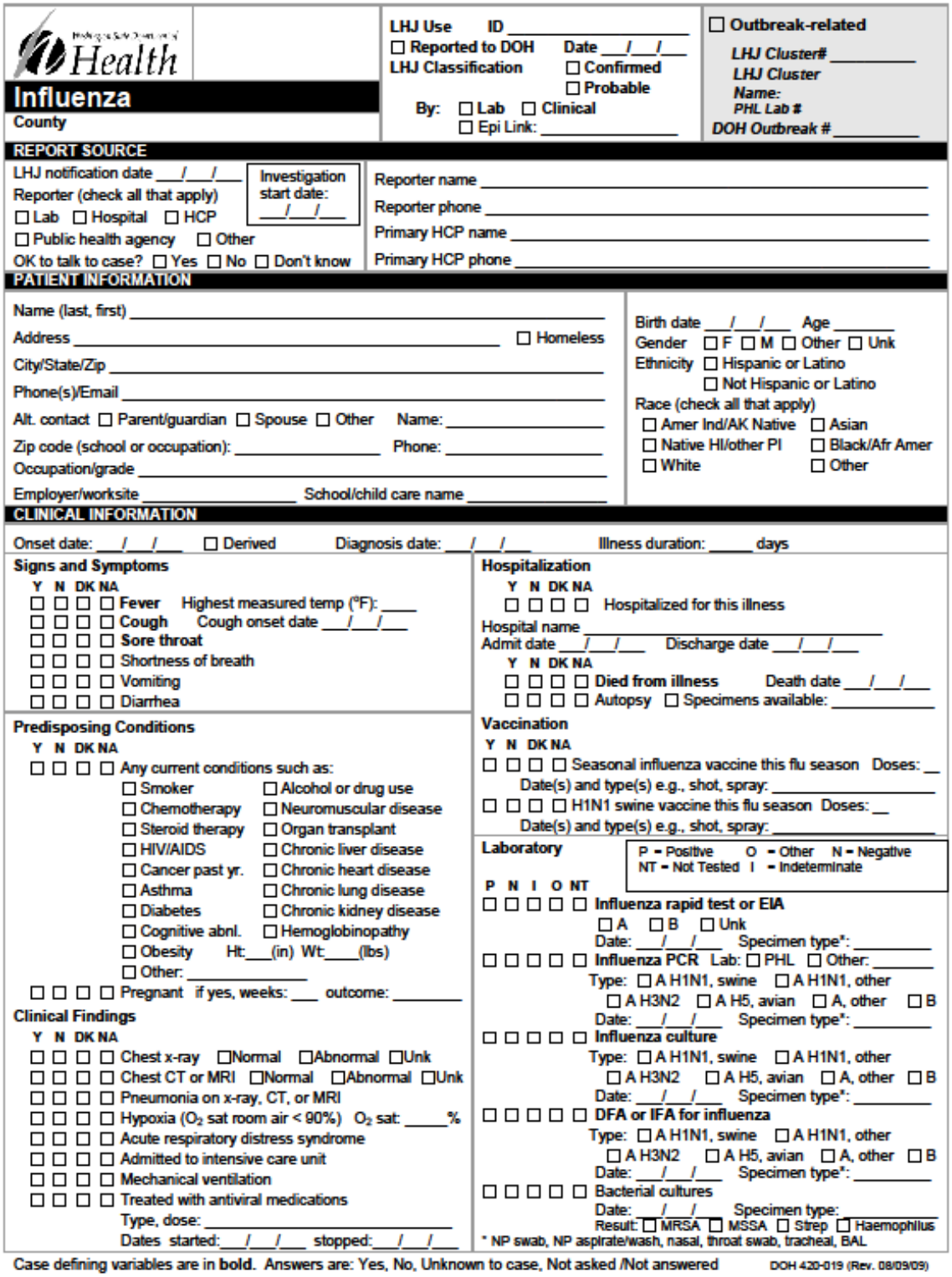
Appendix A: **Report form used by local health jurisdictions to collect demographic and clinical data from April-August 2009**



Health

Influenza

County

LHJ Use ID _____
☐ Reported to DOH Date ___/___/___
LHJ Classification ☐ Confirmed ☐ Probable
By: ☐ Lab ☐ Clinical ☐ Epi Link: _____

☐ Outbreak-related
LHJ Cluster# _____
LHJ Cluster Name:
PHL Lab #
DOH Outbreak # _____

REPORT SOURCE

LHJ notification date ___/___/___
Investigation start date: ___/___/___
Reporter (check all that apply)
☐ Lab ☐ Hospital ☐ HCP
☐ Public health agency ☐ Other
OK to talk to case? ☐ Yes ☐ No ☐ Don't know

Reporter name _____
Reporter phone _____
Primary HCP name _____
Primary HCP phone _____

PATIENT INFORMATION

Name (last, first) _____
Address _____ ☐ Homeless
City/State/Zip _____
Phone(s)/Email _____
Alt. contact ☐ Parent/guardian ☐ Spouse ☐ Other Name: _____
Zip code (school or occupation): _____ Phone: _____
Occupation/grade _____
Employer/worksite _____ School/child care name _____

Birth date ___/___/___ Age _____
Gender ☐ F ☐ M ☐ Other ☐ Unk
Ethnicity ☐ Hispanic or Latino ☐ Not Hispanic or Latino
Race (check all that apply)
☐ Amer Ind/AK Native ☐ Asian
☐ Native HI/other PI ☐ Black/Afr Amer
☐ White ☐ Other

CLINICAL INFORMATION

Onset date: ___/___/___ ☐ Derived Diagnosis date: ___/___/___ Illness duration: _____ days

Signs and Symptoms

Y N DK NA
☐ ☐ ☐ ☐ **Fever** Highest measured temp (°F): ____
☐ ☐ ☐ ☐ **Cough** Cough onset date ___/___/___
☐ ☐ ☐ ☐ **Sore throat**
☐ ☐ ☐ ☐ Shortness of breath
☐ ☐ ☐ ☐ Vomiting
☐ ☐ ☐ ☐ Diarrhea

Predisposing Conditions

Y N DK NA
☐ ☐ ☐ ☐ Any current conditions such as:
☐ Smoker ☐ Alcohol or drug use
☐ Chemotherapy ☐ Neuromuscular disease
☐ Steroid therapy ☐ Organ transplant
☐ HIV/AIDS ☐ Chronic liver disease
☐ Cancer past yr. ☐ Chronic heart disease
☐ Asthma ☐ Chronic lung disease
☐ Diabetes ☐ Chronic kidney disease
☐ Cognitive abnl. ☐ Hemoglobinopathy
☐ Obesity Ht:___(in) Wt:____(lbs)
☐ Other: _____
☐ ☐ ☐ ☐ Pregnant if yes, weeks: ___ outcome: _____

Clinical Findings

Y N DK NA
☐ ☐ ☐ ☐ Chest x-ray ☐Normal ☐Abnormal ☐Unk
☐ ☐ ☐ ☐ Chest CT or MRI ☐Normal ☐Abnormal ☐Unk
☐ ☐ ☐ ☐ Pneumonia on x-ray, CT, or MRI
☐ ☐ ☐ ☐ Hypoxia (O_2 sat room air < 90%) O_2 sat: _____%
☐ ☐ ☐ ☐ Acute respiratory distress syndrome
☐ ☐ ☐ ☐ Admitted to intensive care unit
☐ ☐ ☐ ☐ Mechanical ventilation
☐ ☐ ☐ ☐ Treated with antiviral medications
Type, dose: _____
Dates started:___/___/___ stopped:___/___/___

Hospitalization

Y N DK NA
☐ ☐ ☐ ☐ Hospitalized for this illness
Hospital name _____
Admit date ___/___/___ Discharge date ___/___/___
Y N DK NA
☐ ☐ ☐ ☐ **Died from illness** Death date ___/___/___
☐ ☐ ☐ ☐ Autopsy ☐ Specimens available: _____

Vaccination

Y N DK NA
☐ ☐ ☐ ☐ Seasonal influenza vaccine this flu season Doses: __
Date(s) and type(s) e.g., shot, spray: _____
☐ ☐ ☐ ☐ H1N1 swine vaccine this flu season Doses: __
Date(s) and type(s) e.g., shot, spray: _____

Laboratory

P = Positive O = Other N = Negative
NT = Not Tested I = Indeterminate

P N I O NT
☐ ☐ ☐ ☐ ☐ **Influenza rapid test or EIA**
☐ A ☐ B ☐ Unk
Date: ___/___/___ Specimen type*: _____
☐ ☐ ☐ ☐ ☐ **Influenza PCR** Lab: ☐ PHL ☐ Other: _____
Type: ☐ A H1N1, swine ☐ A H1N1, other
☐ A H3N2 ☐ A H5, avian ☐ A, other ☐ B
Date: ___/___/___ Specimen type*: _____
☐ ☐ ☐ ☐ ☐ **Influenza culture**
Type: ☐ A H1N1, swine ☐ A H1N1, other
☐ A H3N2 ☐ A H5, avian ☐ A, other ☐ B
Date: ___/___/___ Specimen type*: _____
☐ ☐ ☐ ☐ ☐ **DFA or IFA for influenza**
Type: ☐ A H1N1, swine ☐ A H1N1, other
☐ A H3N2 ☐ A H5, avian ☐ A, other ☐ B
Date: ___/___/___ Specimen type*: _____
☐ ☐ ☐ ☐ ☐ Bacterial cultures
Date: ___/___/___ Specimen type: _____
Result: ☐ MRSA ☐ MSSA ☐ Strep ☐ Haemophilus

* NP swab, NP aspirate/wash, nasal, throat swab, tracheal, BAL

Case defining variables are in **bold**. Answers are: Yes, No, Unknown to case, Not asked /Not answered

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INFECTION TIMELINE

Enter onset date (first sx) in heavy box. Count forward and backward to figure probable exposure and contagious periods

	Exposure period*		onset	Contagious period
Days from onset:	-7	-1		Contagious one day before symptoms to 24 hours after last symptom; longer in children.
Calendar dates:				

EXPOSURE (may be optional depending on circumstances of the case)

Y N DK NA

- ☐ ☐ ☐ ☐ Travel to an area with confirmed novel flu
- ☐ ☐ ☐ ☐ Travel out of the state, out of the country, or outside of usual routine
  - Out of: ☐ County ☐ State ☐ Country
  - Dates/Locations: _____
- ☐ ☐ ☐ ☐ Number people in household including case: ____
- ☐ ☐ ☐ ☐ Contact with pneumonia or influenza-like illness
- ☐ ☐ ☐ ☐ **Contact with confirmed human influenza case**
  - Type of contact: ☐ Household ☐ School / Child care ☐ Other: _____
  - Exposure was: ☐ Within about six feet of case ☐ Only touched items belonging to case
- ☐ ☐ ☐ ☐ Health care worker
- ☐ ☐ ☐ ☐ Handled suspected influenza lab samples

Y N DK NA

- ☐ ☐ ☐ ☐ Health care setting exposure
  - ☐ Lab ☐ Health care worker ☐ Patient
  - Setting: ☐ Hospital ☐ ER ☐ Outpatient ☐ Long term care ☐ Other _____
- ☐ ☐ ☐ ☐ Congregate living or employment
  - ☐ Barracks ☐ Corrections ☐ Long term care ☐ Dormitory ☐ Boarding school ☐ Camp ☐ Shelter ☐ Other: _____
- ☐ ☐ ☐ ☐ Other congregate or group exposure
  - ☐ School ☐ Child care ☐ Sports ☐ Shelter ☐ Other: _____
- ☐ ☐ ☐ ☐ Contact with confirmed or presumptive animal/bird novel influenza case Animal/bird: _____
- ☐ ☐ ☐ ☐ Poultry or farm animal exposure
  - Type: ☐ Poultry (chicken, duck, goose) ☐ Wild bird ☐ Swine, pig ☐ Other: _____
  - Animals were ☐ Healthy ☐ Sick ☐ Unk
  - Location of contact (e.g., farm, zoo) and address: _____

☐ **Patient could not be interviewed**
☐ **No risk factors or exposures could be identified**

Where did exposure probably occur? ☐ In WA (County: _____) ☐ US but not WA ☐ Not in US ☐ Unk

Exposure details: _____

PUBLIC HEALTH ISSUES

Y N DK NA

- ☐ ☐ ☐ ☐ Nosocomial infection suspected
- ☐ ☐ ☐ ☐ Work or volunteer in health care setting during contagious period
  - Facility name: _____
- ☐ ☐ ☐ ☐ Close contact works in health care setting

PUBLIC HEALTH ACTIONS

- ☐ Outbreak investigation
- ☐ Home isolation instructions given Date: ____/____/_____
- ☐ Contact quarantine instructions given
  - Number recommended for quarantine: _____
- ☐ Facility notified

NOTES

OPTIONAL TRAVEL WORKSHEET

Dates	Departure/arrival cities	Mode of travel (air, bus, etc.)	Number (e.g., flight)	Ill contacts

OPTIONAL HOUSEHOLD WORKSHEET

#	Name	Relationship*	Age (yrs)	Not ill	T>100F	Cough	Sore throat	Diarrhea	Onset
1									/ /
2									/ /
3									/ /
4									/ /
5									/ /

* 1=spouse, 2=mother, 3=father, 4=child, 5=sister, 6=brother, 7=cousin, 8=aunt, 9=uncle, 10=grandmother, 11=grandfather, 12=no relation, 19=other

Investigator _____ **Phone/email:** _____ **Investigation complete date** ___/___/___

Local health jurisdiction **Record complete date** / /

Case defining variables are in **bold**. Answers are: Yes, No, Unknown to case, Not asked /Not answered

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Appendix B: Report form used by local health jurisdictions to collect demographic and clinical data from September 2009-May 2010

Health

Influenza

County

Instructions: Please provide the information below on all hospitalized and deceased patients with laboratory-confirmed influenza infection. Minimum required fields are underlined in BOLD font.

REPORT SOURCE

Reporter type: ☐ Lab ☐ Hospital ☐ HCP ☐ Public health agency ☐ Other

Reporter name: _____

Reporter phone: _____

PATIENT INFORMATION

Name (last, first) _____

City/State/Zip _____

Phone Number _____

Medical Record #: _____

Birth date ___/___/___ Age _____

Gender ☐ F ☐ M ☐ Other ☐ Unk

Ethnicity ☐ Hispanic or Latino ☐ Unk ☐ Not Hispanic or Latino

Race (check all that apply) ☐ Unknown
☐ Amer Ind/AK Native ☐ Asian
☐ Native HI/other PI ☐ Black/Afr Amer
☐ White ☐ Other

CLINICAL INFORMATION

Onset date: ___/___/___ ☐ Derived

Predisposing Conditions

Y N DK NA

☐ ☐ ☐ ☐ Any current conditions such as:
- ☐ Smoker ☐ Alcohol or drug abuse
- ☐ Chemotherapy ☐ Neuromuscular disease
- ☐ Steroid therapy ☐ Organ transplant
- ☐ HIV/AIDS ☐ Chronic liver disease
- ☐ Cancer past yr. ☐ Chronic heart disease
- ☐ Asthma ☐ Chronic lung disease
- ☐ Diabetes ☐ Chronic kidney disease
- ☐ Cognitive abnl. ☐ Hemoglobinopathy
- ☐ Obesity Ht:___(in) Wt:____(lbs)
- ☐ Other: _____

☐ ☐ ☐ ☐ Pregnant if yes, weeks: _____
outcome: _____

Clinical Findings

Y N DK NA

☐ ☐ ☐ ☐ Acute respiratory distress syndrome
☐ ☐ ☐ ☐ Admitted to intensive care unit
☐ ☐ ☐ ☐ Mechanical ventilation
☐ ☐ ☐ ☐ Treated with antiviral medications
Type, dose: _____
Dates started: ___/___/___

Hospitalization

Y N DK NA

☐ ☐ ☐ ☐ Hospitalized for this illness
Hospital name _____
Admit date ___/___/___
☐ ☐ ☐ ☐ Died from illness Death date ___/___/___

Vaccination

Y N DK NA

☐ ☐ ☐ ☐ Seasonal influenza vaccine this flu season Doses: __
Date(s) and type(s) e.g., shot, spray: _____
☐ ☐ ☐ ☐ H1N1 swine vaccine this flu season Doses: __
Date(s) and type(s) e.g., shot, spray: _____

Laboratory

P = Positive N = Negative I = Indeterminate
O = Other NT = Not Tested

P N I O NT

☐ ☐ ☐ ☐ ☐ Blood cultures performed
Date: ___/___/___
Result: ☐ MRSA ☐ MSSA ☐ Strep ☐ Haemophilus ☐ Other

Influenza test results:

LHJ species/Organism: ☐ A ☐ B ☐ Unk ☐ Other

LHJ serotype/Serogroup:
- ☐ A 2009 H1N1 ☐ A H1
- ☐ A H3 ☐ A H1N1 (other)
- ☐ A H3N2 ☐ A H5, avian
- ☐ unknown ☐ A, unknown, but not 2009 H1N1
- ☐ other ☐ pending

Exposure

Y N DK NA

☐ ☐ ☐ ☐ Is the patient a healthcare worker?

NOTES

To be completed by local health jurisdiction:

LHJ notification date ___/___/___ Investigation start date: ___/___/___

Local health jurisdiction _____ Investigator _____ Investigation complete date ___/___/___

Answers are: Yes, No, Unknown to case, Not asked /Not answered

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Appendix C

This analysis included all non-hospitalized laboratory-confirmed 2009 H1N1 cases reported to DOH during 4/27/09–5/22/09 and all hospitalized and fatal laboratory-confirmed 2009 H1N1 cases reported to DOH during 4/27/09–9/18/09. Cases with incomplete data were excluded. Compared with non-hospitalized patients, a higher proportion of critical cases were adults and had a medical condition which put them at higher risk for influenza complications (Table 1).

Table 1: Characteristics of laboratory-confirmed 2009 H1N1 influenza cases* by hospitalization status for cases reported to DOH April 27, 2009–September 18, 2009

	Number of Cases (%)		
	Outpatient**	Hospitalized non-ICU/non-fatal	ICU/fatal
Total cases	477	123	61
Age			
0–17 years	326 (68)	68 (55)	12 (20)
18–49 years	137 (29)	34 (28)	30 (49)
50–64 years	12 (3)	14 (11)	16 (26)
≥65 years	2 (<1)	7 (6)	3 (5)
Gender			
Female	206 (43)	66 (54)	38 (62)
Time to hospital admission >2 days after symptom onset	NA	47 (38)	36 (59)
Any high risk ACIP-defined medical condition associated with severe influenza	89 (19)	74 (60)	42 (69)
Any chronic lung condition	68 (14)	37 (30)	21 (34)
Immunocompromised	2 (<1)	18 (15)	12 (20)
Diabetes	9 (2)	12 (10)	12 (20)
Chronic heart disease	4 (1)	14 (11)	5 (8)
Pregnant	4 (1)	6 (5)	4 (7)
Other ACIP high risk medical condition	7 (1)	12 (10)	8 (13)

* Includes cases with complete data
** Outpatients identified 4/27–5/22/09. Hospitalized, ICU, & fatal cases identified 4/27–9/18/09.

Table 2 shows the results of multivariable logistic regression analyses which assessed patient outcome in relation to age, gender, the presence of high risk medical conditions, and time from illness onset to

hospital admission. Analysis 1 compared hospitalized or fatal cases to non-hospitalized cases and analysis 2 compared ICU or fatal cases to hospitalized, non-ICU, non-fatal cases. Independent risk factors for hospitalization or death included age $\geq$ 18 years, female sex, and the presence of one or more high risk medical conditions. Among hospitalized patients, independent risk factors for ICU admission or death included age 18–64 years and hospital admission more than 2 days after illness onset.

Table 2: Risk Factors for severe outcome due to 2009 H1N1

	Analysis 1: Hospitalized or fatal cases compared to non-hospitalized cases	Analysis 2: ICU or fatal cases compared to hospitalized, non-ICU, non-fatal cases
	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Age 0–17 years	Referent	Referent
Age 18–49 years	1.60 (1.04-2.45)	4.44 (1.97-10.02)
Age 50–64 years	5.92 (2.71-12.91)	5.93 (2.24-15.65)
Age ≥65 years	13.09 (2.55-67.21)	2.53 (0.55-11.57)
Hospitalization >2 days after illness	Not applicable	2.17 (1.10-4.25)
Female	1.56 (1.05-2.33)	1.15 (0.57-2.32)
Any high risk medical condition associated with severe influenza	6.33 (4.26-9.39)	1.22 (0.59-2.52)