

The Quarterly

A Publication of the Communicable Disease Epidemiology & Immunization Section

Hantavirus in King County

Background Epidemiology

Until November 2016, thirteen years had gone by without a single reported case of locally-acquired hantavirus infection in King County. Then, within a six-month period, three cases of hantavirus pulmonary syndrome (HPS) – a severe, sometimes fatal respiratory disease – were confirmed. All three cases resided on the Eastside of Lake Washington and had exposure to rodents. None had traveled during their exposure period. Two of the patients survived; one died. No additional HPS cases have been identified since March 2017.

In Washington, deer mice are the only known reservoirs of Sin Nombre virus, the hantavirus that causes HPS. Deer mice are not found in urban areas and prefer wooded, semirural habitats or desert. Ecological studies have shown that periods of heavy rain are often associated with increases in deer mice populations. Heavy rains can drive deer mice to seek shelter indoors in closer proximity to humans and can spur the growth of grass seed, a food source for rodents. We hypothesize that our record-breaking winter rainfall may be a factor in this cluster of hantavirus cases, and although it is not possible to predict with any level of certainty, the risk of HPS may remain elevated in areas of King County for weeks to months.

Since the beginning of 2017, Public Health has received four false positive IgM laboratory reports in persons with mild, nonspecific illnesses and low-risk exposures to deer mice. These patients did not have complete blood cell count (CBC) findings consistent with HPS that would warrant hantavirus testing; some patients insisted

on testing despite the provider's recommendation that it was not needed. This article summarizes the key epidemiological risk factors, symptoms, and clinical findings associated with HPS.

Transmission

A person contracts HPS by breathing in hantavirus. This can happen when dust from dried rodent urine, saliva, and droppings that contain hantavirus are stirred up in the air. People can also get infected by touching rodent urine, droppings, or nesting materials that contain the virus, and then touching their eyes, nose, or mouth. This includes exposure to deer mice nests or droppings in homes and cabins as well as cars, trailers, or mobile homes where deer mice might be living. It is also possible to get HPS from a rodent bite. HPS caused by the Sin Nombre virus has not been shown to spread from person to person in the United States. Activities that put a person at higher risk of hantavirus infection include:

- Improperly cleaning up mouse and rat urine, droppings, and nests.
- Cleaning a shed or cabin that has been closed for some time, especially sweeping, vacuuming, and other activities that stir dust into the air.
- Working in areas where mice and rats may live (such as barns).
- Exposure to mouse nesting materials or droppings in a car, including possibly through the car cabin air filter, duct work, and vents

Symptoms

Symptoms of HPS begin one to eight weeks after in-

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Hantavirus, cont'd.

haling the virus, and typically start with three to five days of nonspecific febrile illness with other symptoms that may include myalgias, headaches, chills, dizziness, nausea, vomiting, and other gastrointestinal symptoms. Malaise, diarrhea, and lightheadedness are reported by about 50% of patients, and arthralgias, back pain, and abdominal pain are reported less frequently. With the onset of the cardio-pulmonary phase of HPS on approximately day seven of illness, patients may report shortness of breath and cough and may have an increased respiratory rate.

Clinical Findings

If a hantavirus infection is suspected, a CBC with platelet count and blood chemistry should be repeated every eight to twelve hours. A platelet count $<150,000$ units is seen during the prodromal period in 80-85% of cases, although it may be normal early in the prodrome. The white blood cell (WBC) count is usually elevated with a marked left shift in the absence of toxic granulations in neutrophils. The proportion of immature WBCs may be as high as 50% and circulating immunoblasts (often read as atypical lymphocytes) are frequently present, usually at the time of onset of pulmonary edema. A fall in the serum albumin and a rise in the hematocrit may indicate a fluid shift from circulation to lungs; elevated LFTs are often seen during the cardio-pulmonary phase.

Within 24 hours of initial evaluation, most patients develop some degree of hypotension and progressive evidence of pulmonary edema and hypoxia, usually requiring mechanical ventilation. The patients with fatal infections appear to have severe myocardial depression which can progress to sinus bradycardia with subsequent electromechanical dissociation, ventricular tachycardia or fibrillation.

Radiologic Findings

HPS has a characteristic radiological evolution, beginning with interstitial pulmonary edema, progressing to alveolar edema with severe bilateral involvement; pleural effusions are common. Cardiac silhouette size on chest radiographs is usually normal.

Approximately one-third of patients show evidence of pulmonary edema in the initial radiograph. Forty-eight hours after the initial radiograph, virtually all patients demonstrate interstitial edema and two-thirds have devel-

oped extensive bibasilar or perihilar airspace disease.

Differential Diagnoses (DDX)

The prodromal phase of HPS is nonspecific and clinically indistinguishable from numerous other viral infections. Often the only guide to the etiology of the patient's illness is a history of exposure to deer mice and the CBC findings of circulating immunoblasts and thrombocytopenia. Unlike other viral infections, HPS patients usually have concurrent left-shifted neutrophilia with circulating myelocytes. Lack of coryza aids the clinical distinction between HPS and influenza infection.

An echocardiogram also helps to distinguish patients with HPS from patients with ARDS as cardiac function is depressed to a much greater degree in the HPS patients and cardiac output does not respond to fluid challenge as it tends to with ARDS.

DDX in immunocompetent patients includes:

Leptospirosis, atypical pneumonia syndrome (Legionnaire's disease, mycoplasma, Q fever, chlamydia) septicemic plague, tularemia, coccidioidomycosis, and histoplasmosis. Non-infectious conditions such as Goodpasture's syndrome should also be considered.

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DDX in immunocompromised patients includes a broader range of viral and fungal pathogens.

Treatment

Treatment of patients with HPS remains supportive in nature. Patients should receive appropriate, broad-spectrum antibiotic therapy while awaiting confirmation of a diagnosis of HPS. Care during the initial stages of the disease should include antipyretics and analgesia as needed. If there is a high degree of suspicion of HPS, patients should immediately be transferred to an emergency department or intensive care unit (ICU) for close monitoring and care, preferably in a tertiary care center that has the capability to perform extra-corporeal membrane oxygenation (ECMO).

Testing

Testing for Sin Nombre virus IgM and IgG antibodies can be done commercially. Positive results will be confirmed through the Washington Public Health Laboratory. In patients with a compatible history of HPS, a positive serological test result, evidence of viral antigen in tissue by immunohistochemistry, or the presence of amplifiable viral RNA sequences in blood or tissue is considered diagnostic for HPS. Public Health can facilitate testing and should be notified of suspect cases. Epidemiologists are available 24/7 for consultation on hantavirus testing at 206-296-4774.

Resources:

CDC: <https://www.cdc.gov/hantavirus/technical/hps/index.html>

Public Health – Seattle & King County: <http://www.kingcounty.gov/depts/health/communicable-diseases/disease-control/hantavirus.aspx>

CDC: <https://www.cdc.gov/hantavirus/index.html>

Winning Strategies for Improving HPV Vaccination Coverage

Across the nation, HPV vaccination rates among adolescents trail far behind other immunizations recommended for the same age group, and King County is no exception. By the close of 2016, 57% of the County's 13-17 year-olds had initiated the HPV series and just 46% had received two or more doses¹, falling short of the Healthy People 2020 target of 80% coverage by the end of the decade². But several King County providers are doing their part to change that statistic, and in the process potentially preventing hundreds of cases of cervical, oropharyngeal, and other forms of cancer. To hear more about winning strategies for increasing coverage, we spoke with three practices that have demonstrated exceptional leadership.

Harborview Pediatrics

When the team at Harborview Pediatrics noticed their HPV vaccination rates were lagging, they made a solid commitment: vaccinate every patient at every opportunity. Dr. Ebel, lead pediatrician for Harborview's immunization quality improvement efforts, and her highly motivated team set out to reach adolescents least likely to schedule well child visits. That means vaccinating adolescents whenever they come in: for sprained ankles, asthma screenings, school physicals, or any other primary care. It also means reaching out to patients that face barriers accessing preventive health services, like the 80% of Harborview Pediatric patients that come from limited English proficient homes. Now, 92% of Harborview Pediatric's 13-17 year-olds have initiated the HPV series, and a full 80% are fully immunized against HPV.

Harborview's success is rooted in multiple strategies, including:

- **Checking the Washington Immunization Information System (WAIIS) before every adolescent visit.** This keeps both their EMR and WAIIS systems up-to-date, reduces missed opportunities, and prevents staff from administering unnecessary doses.

¹As of October 2016, the Advisory Committee on Immunization Practices (ACIP) recommends **2 doses of HPV** vaccine for adolescents starting the vaccination series before the 15th birthday. Three doses of HPV vaccine are recommended for those starting the series on or after the 15th birthday and for people with certain immunocompromising conditions.

² Office of Disease Prevention and Health Promotion [Internet]. Washington, DC. Healthypeople.gov; [cited 2017 May 30]. Available from: <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>

Increasing HPV Vaccination, cont'd.

- **Using WAIS's reminder-recall system** to identify patients behind on immunizations, and then calling to get them caught up.
- **Learning how to communicate effectively with families**, including those who are hesitant about vaccines. "Most families who refuse vaccination are not adamantly opposed and can change their minds," says Dr. Ebel. She emphasizes the importance of protecting a young woman's potential to have children later, or a young man's ability to protect his partner's fertility by not passing along HPV. She speaks from a personal perspective, noting that her own daughters and son are fully vaccinated. "I want the best for my patients just as though they were my kids." She also addresses and eases culturally specific concerns, for example the misperception that gelatin preservative in vaccines might conflict with some religious beliefs, by providing clear answers and creating a safe space for dialogue.
- **Involving all staff in planning and decision making**, and sometimes taking the lead from staff on the frontline, like the clinic's Medical Assistants. "If [the MAs] tacitly support vaccine deferral, all is lost. Our MAs have become extremely knowledgeable and passionate about the importance of vaccination and the key role they play as family educators." MAs huddle with physicians to prepare for each patient visit and review immunization needs.
- **"Measure, measure, measure,"** says Dr. Ebel. The pediatric team selected several vaccination indicators to measure the clinic's success, and together they review progress at every monthly staff meeting. When progress falls short, staff regroup and identify areas for improvement. When they are moving in the right direction, it's a chance to celebrate success.
- **Partnering with [School Based Health Centers \(SBHCs\)](#)**. SBHCs are located at a majority of public high schools in Seattle, as well as some middle and elementary schools. Just like a typical clinic, SBHCs provide a range of services, from primary care to mental health counseling to immunizations. For students that have a hard time returning to Harborview for follow-up HPV doses, SBHCs are the perfect way to close the treatment loop. Parents don't have to miss

work, students don't have to miss class, and services are all free! SBHC staff routinely updates WAIS so the Harborview team can always stay current on their patients' immunization profiles.

International Community Health Services (ICHS), Holly Park Medical Clinic

Preventive care is the bedrock of ICHS's model, and it shows in Holly Park's stellar immunization rates: an extraordinary 99% of 13-17 year-old patients have initiated the HPV series, and 95% of patients are completely immunized against HPV. As the state's largest community health center serving Asian, Native Hawaiian, and Pacific Islander communities, ICHS's primary population consists of immigrants, refugees, and patients with limited English proficiency. Approaching immunization work with cultural and linguistic competency is at the heart of ICHS's mission. We heard from Lysah Muongvang, ICHS Holly Park's Clinic Support Supervisor about what else is behind the clinic's success. Strategies include:

- **Starting the first HPV dose at nine years of age.** [Studies](#) have shown that HPV vaccine may produce a stronger immune response in younger adolescents. Vaccinating earlier also creates more opportunities to discuss vaccination with families and limits the chance that a child has already been exposed to the virus. ICHS Holly Park continues screening through young adulthood, up to 26 years of age.
- **Checking WAIS before every adolescent visit.** In addition, at every visit, staff conduct a detailed patient screening so no information gets missed.
- **Running monthly reminder-recall reports in WAIS** to identify patients due or overdue for vaccinations. Staff waste no time, immediately calling patients to set-up appointments, and addressing any language barriers with ICHS' multilingual staff, fluent in Vietnamese, Chinese, Laotian, Filipino, Cambodian, Somali and English.
- **Using existing appointments for vaccination.** Before scheduling immunization visits, staff always first check to see if patients have existing appointments elsewhere at the clinic, whether at the pharmacy, with a dentist, or with a health educator. Staff schedule vaccinations on the same day as pre-established appointments, limiting the need for patients to make multiple trips.
- **Subscribing to and regularly reading the WAIS**

Increasing HPV Vaccination, cont'd.

monthly newsletter. This ensures staff remain current on any upcoming changes or vaccine shortages and can adjust accordingly.

- **Taking a full-team approach.** ICHS's Vaccine Coordinator has been a strong organizing and motivating force, but staff operate as a multidisciplinary team. Everyone plays a role in improving vaccination rates and getting the message out that HPV vaccine is cancer prevention.

The Polyclinic – Madison Center

In the span of seven months, The Polyclinic – Madison Center catapulted their HPV initiation rates, more than doubling the rate among 11-12 year-olds (31% to 64%) and achieving a similarly impressive upswing among 13-14 year-olds (64% to 90%).

This kind of dramatic change doesn't happen on its own. It takes a leader like pediatrician Sherri Zorn, who identified the gap in coverage and then jumped on the opportunity to reach more patients. Key initiatives she has taken with her team of colleagues include:

- **Cleaning up the clinic's EMR and the WAIS.** Dr. Zorn started by removing names of former patients that had moved, instantly making the task of reaching all remaining patients far more manageable. She ran recall reports through WAIS and then verified patients in Polyclinic's EMR.
- **Calling patients overdue for vaccinations.** Recognizing that personal calls are sometimes a more powerful way to get a message out than robo calls, Dr. Zorn created a phone script and guided a small team of Patient Service Representatives (PSR) and Medical Assistants (MA) as they reached out to approximately 500 families with children due for HPV doses. The team held three separate calling campaigns over the course of four months, often pairing calls with reminders about routine annual check-ups. 99% of parents received the call positively, and staff members were able to schedule up to 50% of patients for appointments. Ensuring staff had protected time for calls when they wouldn't be interrupted was critical to Polyclinic's success.
- **Holding Saturday clinics.** In collaboration with other Polyclinic staff, Dr. Zorn led a Saturday drop-in HPV vaccine clinic to meet the needs of working families.

Polyclinic also began opening its weekly Saturday medical clinic for immunization-only appointments.

- **Articulating a strong cancer prevention message.** Dr. Zorn plants the seed as early as the kindergarten well-visit, telling the child with parents in ear-shot: "You're so lucky! When you turn 11, you'll get your next big-kid shots to protect you from whooping cough, certain types of cancer, and meningitis." Dr. Zorn and many of her colleagues consistently refer to HPV vaccine as the "anti-cancer vaccine."
- **Ensuring that all staff members are on board** with improving HPV coverage rates, from upper management to front-desk personnel, and that physicians offer a strong recommendation to each and every patient.

Could your practice use support as you work to improve HPV immunization coverage? Public Health – Seattle & King County is here to help! We can assist you in developing an action plan and implementing one or more quality improvement activities. If interested, write to the immunization program at vaccineinfo@kingcounty.gov.



Polyclinic Medical Assistant Amber Flynn administers an HPV vaccination to 11-year-old Bryan Henning.

2016-17 Influenza Season Summary

The 2016-2017 season was more severe than the previous five influenza seasons, with a larger number of reported laboratory-confirmed influenza deaths and more influenza outbreaks in long-term care facilities (LTCFs). Laboratory data from King County Public Health Laboratory, UW Virology Laboratory, and local hospital laboratories showed influenza A to be the predominant circulating strain. This is similar to national patterns reported by the [CDC](#). As of May 24, 2017, 83 laboratory-confirmed influenza-associated deaths were reported to Public Health (See Figure 1). Patients' ages ranged from 26-108 years (median=86 years); 93% were over age 65 years. Around half (53%) had evidence of recent influenza vaccination. Ninety percent of deaths were attributable to influenza A. Seven deaths were attributable to influenza B and one was not typed. All had contributing underlying conditions.

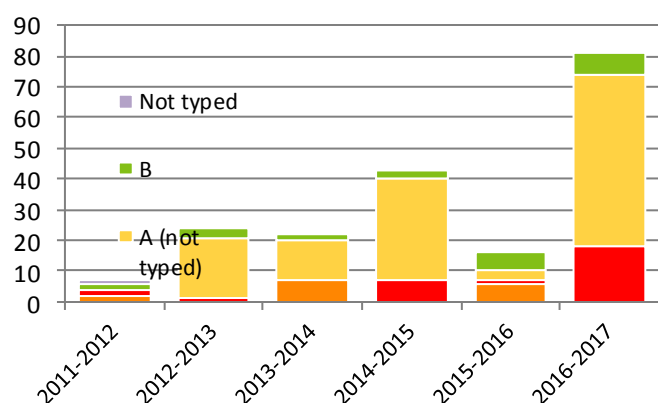


Figure 1. Laboratory-confirmed influenza deaths, by type and year.

Ninety-one outbreaks were reported from 81 LTCFs, all of which identified at least one laboratory-confirmed case of influenza. In the past five flu seasons, the number of LTCF outbreaks reported has ranged from six to 65 (See Figure 2). Nineteen LTCF outbreaks this season resulted in one or more deaths in residents. The majority of the outbreaks were attributable to influenza A.

Midway through the 2016-17 influenza season, CDC reported a preliminary [vaccine effectiveness estimate](#) of 48%. Effectiveness estimates range from 43% for influenza A (H3N2) to 73% for influenza B.

The latest influenza surveillance data for King County, updated weekly during the influenza season, can be found on the Public Health [website](#).

An Inside Look at Disease Investigation

Claire Brostrom-Smith doesn't wear a deerstalker cap or carry a magnifying glass, but as a Disease Investigator at Public Health - Seattle & King County, she's in constant detective mode, tracing the paths of her suspects and often stopping them in their tracks. Most culprits couldn't hold a candle to the ones Claire hunts down: disease-causing microbes, the most stealthy and ruthless villains of all.

Claire's most wanted list is long and heavily weighted with repeat offenders like norovirus, *Salmonella*, *E. Coli*, and *Campylobacter*, infamous for camouflaging themselves in crafty ways: a leaf of lettuce, a jar of peanut butter, a chicken drumstick served up at a holiday party. Take norovirus, a common source of foodborne illness. Since the start of 2017, noro has disguised itself in [raw oysters](#) and infected dozens of unsuspecting restaurant goers throughout King County.

Like most detectives, Claire can rarely predict exactly what her day will hold. The *Salmonella* investigation that begins her morning can quickly get eclipsed by a report of another disease. This past winter, King County's mump outbreak took center stage. A seeming constant stream of calls and faxes rolled in from health care providers reporting suspected mumps cases. Whether *Salmonella* or mumps, when a call or fax comes in about a [notifiable condition](#), Claire's mission is the same: figure out whether this is a true case of disease and, if so, limit its spread.

Her work typically begins with a series of interviews with the health care provider and, if possible, the patient to piece together a story. What symptoms is the patient experiencing? When did symptoms begin? Has he had close contact with anyone with similar symptoms? Has he traveled? Where, if at all, has he received medical care? If relevant, has the patient been vaccinated against the disease in question?

At the end of the interview, she'll classify the patient's likelihood of having the disease ("suspect," "probable," or "not a case"), factoring in his demographics to help determine his level of risk. When a patient's symptoms, exposures, and demographics don't match those typical for the disease, Claire can close the case and move on without lab testing. But when they do, lab tests are usually in order. Results can help Claire figure out whether more work needs to be done, like notify-

Disease Investigation, cont'd.

ing the patient's close contacts about a potential exposure, and following up with the patient's school or workplace to assist them in containing the spread of disease. If she's dealing with a vaccine preventable disease, like mumps, Claire and Public Health's Communicable Disease Epidemiology and Immunization Section may recommend that the school or workplace exclude those who are not immunized until the potential for infection ends.



Communicable Disease investigators like Claire Bostrom-Smith protect King County residents from the spread of diseases like salmonella and *E. Coli*.

For some suspect cases, Claire doesn't even need to wait for lab testing in order to take action; if a patient has certain key risk factors and his symptoms match those typical for the given disease, she'll classify him as "probable" and proceed as though he is a confirmed case. "Probable" and "confirmed" cases get reported to the WA State Department of Health (DOH) and the CDC so that resources can be channeled appropriately to identify and control the source of infection and educate the public.

Every once in a while Claire gets a call that throws her for a loop. Like the one this past November from a lab reporting a case of *Vibrio vulnificus*. If you haven't heard of this sometimes fatal bacterial infection, it's because there are typically fewer than 100 cases nationwide each

year. Of those, the vast majority originate in warm coastal waters, like the Gulf of Mexico, far from the chilly Pacific Northwest. With a little investigative work, Claire learned that although the affected woman had not recently traveled, just days before, she had prepared a dish with tilapia – a warm water fish – and sustained a cut during the cooking process. *V. vulnificus* found its way from the fish into her wound, causing pain and swelling and landing her in the hospital. Claire nailed down the location where the fish had been purchased – a market in Bellevue that carried several types of seafood. She partnered with Public Health's Environmental Health Division, DOH and the FDA to test samples of the market's seafood, fish tanks, and surroundings, figure out whether other seafood could have been contaminated, and ultimately, discard the market's seafood and properly clean and sterilize its tanks and equipment. No other cases were reported.

No one can say with certainty how many other cases of *V. vulnificus* there would have been without these interventions. But Claire and her colleagues in the Communicable Disease Epidemiology and Immunization Section always try to stay one step ahead of disease so that the public rarely needs to find out.

Zika Update

Since December 2015 as of time of publication, approximately 1050 King County residents have been screened for Zika. Public Health - Seattle & King County has identified 29 positive Zika disease cases, all of whom have lived in or traveled to regions with Zika transmission. The greatest number of cases have been travelers to Mexico (n=9), followed by Puerto Rico (n=4), Costa Rica (n=4), Honduras (n=2), and Haiti (n=2). Countries with one reported Zika case include Trinidad and Tobago, Panama, Nicaragua, Guatemala, El Salvador, Dominican Republic, Columbia, and Bonaire. Women who are pregnant or plan on becoming pregnant should avoid travel to countries with [Zika travel notices](#) as identified by the CDC. Zika can be sexually transmitted. In order to prevent sexual exposure, the CDC currently recommends using barrier methods or refraining from sexual contact. People with concerns about Zika exposure should contact their healthcare provider for evaluation.

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TB (206) 744.4579

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