**Introduction**

Parainfluenza viruses (PIV) are a known cause of respiratory illness in children and contribute substantially to ambulatory care visits and hospitalizations in the United States, with rates of hospitalization estimated at 1.02 per 1000 among children aged <5 years [[1](#_ENREF_1)]. The four distinct types of PIV are associated with specific clinical presentations, causing a spectrum of respiratory illness. Parainfluenza viruses 1 and 2 are the leading cause of croup in young children, and PIV1 is isolated in most cases of croup. Infection with PIV3, often considered the most clinically severe of the PIVs, can lead to lower respiratory tract disease, bronchiolitis and pneumonia [[2-5](#_ENREF_2)]. Together, PIVs are second only to respiratory syncytial virus (RSV) as a cause of hospitalization for respiratory tract illness (RTI) in young children [[6](#_ENREF_6)].

Outpatient and community studies have demonstrated the considerable impact of PIVs on pediatric respiratory disease outside the hospital setting; however little has been published since the widespread use of more sensitive molecular laboratory methods. Studies published in the 1990’s demonstrated that PIVs were responsible for 64-65% of croup, 18-45% of viral upper RTI, and 22-38% of viral lower RTI in children [[2](#_ENREF_2), [7](#_ENREF_7)], and most children will experience infection with each PIV type by the time they reach 5 years of age [[8](#_ENREF_8)]. Despite the substantial contribution of PIVs to respiratory illness, to date there has been no systematic domestic surveillance to ascertain the population-based burden among pediatric outpatients.

The Influenza Incidence Surveillance Project (IISP) provides a unique opportunity to assess the age-specific burden of PIVs in outpatient practice across multiple years and a broad geographic range in the United States. Since 2010, the IISP has monitored the year-round incidence of influenza-like illness (ILI) and associated incidence of respiratory viruses, including PIVs 1-4, in a network of outpatient clinics across 13 US states and jurisdictions. Using IISP data from 2010 through 2014, we describe the seasonality and age-specific burden of PIVs in the IISP, which will help to improve understanding of these viruses in the outpatient setting and support efforts for the prevention and treatment of PIV-associated illness.

**Materials and Methods**

*The Influenza Incidence Surveillance Project and parainfluenza virus surveillance*

Detailed methodology for the IISP has been published previously [[9](#_ENREF_9), [10](#_ENREF_10)](Fowlkes 2015). Briefly, surveillance was conducted year-round, with surveillance years defined from August through July. We included data from 12 state and local health departments (sites) from August 2010 to July 2013, and from 5 sites from August 2013 to July 2014 as follows: Florida (FL), Los Angeles County (LAC), Minnesota (MN) and Wisconsin (WI) from 2010 to 2014; Iowa (IA), New Jersey (NJ), New York City (NYC), North Dakota (ND), Oregon (OR), Philadelphia (PHIL) and Virginia (VA) from 2010 to 2013; Utah (UT) from 2010 through 2011; and Texas (TX) from 2011 to 2014. The IISP conducted non-research, public health surveillance.

Participating public health departments, or sites, recruited approximately five small to moderate sized outpatient healthcare providers (HCPs) with enumerated patient populations to report weekly age-specific counts of influenza-like illness (ILI) and all-cause patient visits. Among patients aged ≥2 years, ILI was defined as fever with cough or sore throat; among patients aged <2 years, fever with ≥ 1 of the following respiratory symptoms: cough, sore throat, nasal congestion or rhinorrhea. Respiratory specimens (nasal, nasopharyngeal or oropharyngeal) were collected from the first 10 ILI patients each week along with demographic and clinical data; the sampling of up to 10 ILI patients each week ensured a that a large proportion of all ILI patients would be sampled, given the small clinic size of HCPs.

Specimens were tested using molecular-based respiratory virus panels (RVP) chosen by the participating laboratories: LAC, NJ, NYC, ND, TX and VA used Luminex xTAG® RVP (Luminex Diagnostics, Toronto, Canada); FL, IA, MN, OR and PHIL used the virus-specific RT-PCR assay developed by CDC [[11](#_ENREF_11)]; UT and WI used ResPlex II v2.0 (Qiagen, Venlo, The Netherlands). Parainfluenza viruses 1-3 were included in the RVPs at all health departments; PIV4 was included in the testing panel in MN, UT and WI. Information regarding proficiency testing was published previously [[10](#_ENREF_10)].

*Data analysis*

Analysis was limited to children aged <18 years who met the ILI case definition, presented for care within seven days of illness onset, and were tested for PIV. Parainfluenza virus 4 detections were insufficient for analyses beyond overall proportions.

To identify PIV seasons, we calculated the weekly percent contribution, or the percent of the entire surveillance year’s PIV positives that were detected each week. Onset of a season was defined as the first of three consecutive weeks with ≥2% of the specimens contributing to the total yearly detections; the conclusion of a season was defined as the last of three consecutive weeks with ≥2% contribution. At least four consecutive weeks of ≥2% contribution were required to be determined as a season.

The proportion of ILI patients who tested positive for each PIV type each week, or the weekly percent positive, was multiplied by the weekly count of ILI patients to extrapolate the number of PIV-associated ILI visits. Incidence estimates were then calculated per 100,000 children, using the weekly patient population size as the denominator. Incidence estimates for individual weeks were summed by surveillance year to generate the cumulative incidence for each year and age group. Bootstrapping methods were used to calculate 95% CIs of PIV rates [[9](#_ENREF_9), [10](#_ENREF_10)] (Fowlkes 2015).

Differences in seasonality between PIV types were demonstrated by plotting the three-week moving average of the extrapolated detections totals for each week for the four surveillance years; the three-week moving average was centered on the week reported and was used to better visualize the seasonal trends of each PIV.

To evaluate the frequency of symptoms included in the ILI case definition (fever, cough and sore throat) across the parainfluenza virus types, we used a subset of IISP data collected among sites that systematically conducted surveillance for more broadly defined acute respiratory illness (ARI). Patients with ARI were defined as having at least two respiratory symptoms, including fever, cough, sore throat, nasal congestion and rhinorrhea. These patients were inclusive of ILI, and sites followed the same methodology as previously described for ILI surveillance. Data from the following sites participating in ARI surveillance was included: MN and WI from 2010 to 2014; IA from 2010 to 2013; NJ and NYC from 2010 to 2012; and FL, LAC, ND, UT and VA from 2010 to 2011. All other symptoms were evaluated using data from ILI surveillance conducted by all sites in all years.

Demographic characteristics and symptoms were compared between PIV-positive and PIV-negative cases and across PIV types using the χ2 test for association. A p-value of <0.05 was considered statistically significant. Relative risk (RR) and 95% confidence intervals (CIs) for PIV detections by age group were calculated using the 5-17 year age group as the reference. Analyses were conducted using SAS Version 9.3 (SAS Institute Inc., Cary, NC, USA).

**Results**

From August 2010 to July 2014, a total of 114 HCPs participated in IISP, ranging from 30-74 per year. Participating HCPs were primary care clinics (90%), urgent care (9%), and student health (1%) facilities. The clinics were split between rural (27%), suburban (32%), and urban (41%) locations, and 57% of the HCPs were identified as private organizations. The distribution of ages in the surveillance population was similar to the US population; 25% of the population was pediatric compared with 24% in the US, with the following age distribution: 2% <12 months (US 1%), 2% 12-24 months (US 1%), 4% 2-4 years (US 4%) and 16% 5-17 years (US 17%).

*Parainfluenza viruses within the IISP population*

Among 560,941 pediatric outpatient visits, 19,277 (3.4%) were reported as ILI. Specimens were collected from 7,716 (40%) children and tested for PIV 1-3; the distribution of PIV 1-3 detections by type are shown in **Table 1**. Among 2552 (33%) children tested for all four PIV types, 229 (9.0%) tested positive for at least one PIV, including 62 (2.4%) PIV1, 57 (2.2%) PIV2, 98 (3.8%) PIV3 and 12 (0.5%) PIV4. The distribution of virus types among all detections was: 27% PIV1, 25% PIV2, 43% PIV3, and 5% PIV4. At least one additional respiratory virus was detected in 19% of 619 children positive for PIV 1-3; most commonly rhinovirus/enterovirus (49%), adenovirus (23%), coronavirus (18%) and influenza (11%). Parainfluenza virus co-detections were identified in 5 children (0.8%), including 1 PIV1/PIV2, 1 PIV3/PIV4, 1 PIV2/PIV3, and 2 PIV1/PIV3. Across all years, 63% of ILI patients negative for PIV 1-3 tested positive for at least one respiratory virus (data not shown).

*Parainfluenza Virus Seasonality*

During the four surveillance years, PIV1 and PIV2 were most frequently detected in the fall and winter (**Figure 1**). The PIV1 season generally lasted from October through January, with onset occurring between 28 August and 29 October and offset between 1 January and 17 March; the PIV2 season began between 16 September and 23 October, but demonstrated a wide offset range between 27 November and 13 March (**Figure 2**). Detection of PIV1 was significantly increased in odd-numbered years compared to even-numbered years (RR 6.1, CI 4.4-8.6), with a peak percent positive of 29% in elevated seasons. Conversely, PIV2 detections were significantly higher in even-numbered years as compared to odd years (OR 2.4, CI 1.6-3.6) with a peak between 14% and 22% positive. PIV3 demonstrated an annual spring with an onset between 3 February and 13 April and offset between 21 April and 22 July (**Figure 1**), and peak percent positive between 17% and 33%. The percent of ILI patients with PIV3 detected was significantly lower in odd-numbered years compared with even-numbered years, when circulation of PIV1 was elevated (p<0.05). During the 2012-13 surveillance year, two time periods met PIV3 season criteria including 14 weeks from September to December 2012 and 12 weeks from February to April 2013; detections occurring during January and February did not meet season criteria (**Figure 2**). Circulation patterns of PIV1, 2 and 3 were evaluated by geographic region and found to be consistent across the United States.

*Burden of parainfluenza viruses by surveillance year*

The incidence of parainfluenza virus-associated ILI visits varied significantly by surveillance year and virus type (**see Table, Supplemental Digital Content 2,** [**http://links.lww.com/INF/C420**](http://links.lww.com/INF/C420)**, which provides incidence of parainfluenza virus-associated ILI by surveillance year and age group**). In 2010-11, PIV3 predominated (110 per 100,000 children), while PIV1 predominated in 2011-12 (89 per 100,000 children). The 2012-13 surveillance year was characterized by dual-predominance of PIV2 and PIV3 (88 and 131 per 100,000 children, respectively), and in 2013-14, PIV3 predominated (100 per 100,000 children). A particularly high burden of PIV was observed in 2012-13, indicated by an incidence of PIV-associated visits of 251 per 100,000 children and age-specific incidence ranging from 367 to 1307 per 100,000 children.

*Burden of parainfluenza viruses by age*

Children with any PIV detection were significantly younger than PIV-negative children (median age 4.7 vs 6.3 years respectively, p<0.05). Sixty-three percent of PIV 1-3 detections were in children aged <5 years, and age varied significantly between each of the PIV types. Parainfluenza virus 3 affected significantly younger children than PIV1 or PIV2 (median age = 3.3 years, p<0.05) while PIV2 affected older children than the other PIV types (median age = 7.1 years, p<0.05) **(Table 1**).

**Figure 3** demonstrates the variation in cumulative incidence of PIV types by age group and surveillance year. The burden of PIV3 tended to be highest among children aged 1 to <2 years in all years (range by season 222 to 868 per 100,000 children). During biennial years of elevated circulation, the incidence of PIV1- and PIV2-associated visits was greatest in children aged 2 to 4 years (388 and 273 per 100,000 children for PIV1 in 2011-12 and 2013-14; 193 and 412 per 100,000 children for PIV2 in 2010-11 and 2012-13). In general, PIV3 affected children aged <2 years more frequently than PIV1 or PIV2 with the exception of 2011-12 when PIV1 overwhelmingly predominated (**Figure 3, Supplemental Digital Content 2, http://links.lww.com/INF/C420**)**.**

*Comparative symptomatology of PIVs*

Among children presenting with more broadly-defined ARI, 79% (282/355) of PIV-positive children met ILI case criteria, which did not vary significantly by PIV type or age group (**see Table, Supplemental Digital Content 1,** [**http://links.lww.com/INF/C419**](http://links.lww.com/INF/C419)**, which provides symptomatology of PIV-associated ILI and ARI**). Children with ARI and any PIV detection were more likely to have cough (91%) and fever (80%) compared with PIV-negative ARI children (p<0.05). PIV2 was detected more frequently among children with sore throat (71%) than were PIV1 (55%) or PIV3 (35%) (p<0.05). Among children presenting with ILI, myalgia and chills were reported significantly more frequently among PIV-negative ILI patients as compared to PIV-positive ILI patients (p<0.05). Children with ILI and PIV3 were 1.7 times as likely to report rhinorrhea compared to those with PIV1 or PIV2 (CI 1.4-2.0).

**Discussion**

Parainfluenza viruses represented a substantial burden of respiratory illnesses among children in IISP, accounting for 9% of all ILI-related pediatric outpatient visits overall and up to 33% of visits at season peak. Consistent annual spring PIV3 and biennial fall PIV1 and PIV2 epidemics were observed across four years, yielding an ILI visit incidence range by season of 130 to 251 visits per 100,000 children. The incidence of PIV-associated visits was highest among children aged <5 years, and we also observed substantial variation by age for PIV types.

Each parainfluenza virus type demonstrated unique and distinct seasonal circulation patterns, consistent with previous studies [[6](#_ENREF_6), [7](#_ENREF_7), [12](#_ENREF_12)]. Parainfluenza viruses 1 and 2 in the IISP circulated annually in the fall but caused alternating biennial epidemics, with substantial seasons of PIV1 in odd years and PIV2 in even years. Annual spring epidemics of PIV3 were observed, but PIV3 circulation was significantly reduced during odd years of elevated PIV1 circulation. Prior studies have attributed this inverse pattern of activity to viral interference and cross-protection of PIV1 and PIV3 antibodies, producing consistent PIV seasonality [[3](#_ENREF_3), [5](#_ENREF_5), [7](#_ENREF_7), [12](#_ENREF_12), [13](#_ENREF_13)]. Patterns of PIV2 circulation were varied, and we were unable to identify any season onset during 2013-14. Seasonality findings for PIV2 have varied over the last half century and include reports of annual, biannual or biennial seasonality in either even or odd years, or irregular activity [[1](#_ENREF_1), [3](#_ENREF_3), [6](#_ENREF_6), [14-17](#_ENREF_14)], and may be explained by evolving seasonality, regional variability, difficulties in virus isolation or sample size limitations [[2](#_ENREF_2), [7](#_ENREF_7), [12](#_ENREF_12), [18](#_ENREF_18), [19](#_ENREF_19)]. Consistent with previous studies, PIV4 was too infrequently detected to identify any circulation patterns or associated epidemiologic trends, but comprised 5% of all PIV detections [[12](#_ENREF_12), [14](#_ENREF_14)].

Parainfluenza viruses contribute substantially to the burden of medically-attended ILI in children, accounting for 9% of ILI-related pediatric outpatient visits and 12% among children aged <5 years. Comparable estimates from two recent studies were found [[20](#_ENREF_20), [21](#_ENREF_21)], though our estimates were higher than many other estimates of non-hospitalized PIV which used more broadly-defined case definitions, less sensitive testing methods, or included adults [[2](#_ENREF_2), [8](#_ENREF_8), [13](#_ENREF_13)]. Corresponding cumulative incidence estimates from IISP suggest that PIVs are detected among pediatric outpatients aged <5 years at a rate of 259 to 1307 visits per 100,000 children, compared with estimates of 180 to 2740 per 100,000 children for influenza virus (Fowlkes 2015). Trends in the detection of PIV among pediatric outpatients are consistent with previous estimates among children with acute respiratory and/or febrile illnesses [[7](#_ENREF_7)]; however, population-based rates of parainfluenza virus outpatient visits among children are unique to IISP.

Parainfluenza viruses were shown to have a substantial burden among children aged <5 years, and variation in detection by age was observed between PIV types. In particular, PIV3 affected younger children than either PIV1 or PIV2 and was significantly more likely to be detected in children aged <2 years than those aged >2 years. These observed age patterns have been well-established [[2](#_ENREF_2), [4](#_ENREF_4), [7](#_ENREF_7), [22](#_ENREF_22)]. PIV3 has been shown to have the lowest median age among respiratory viruses [[14](#_ENREF_14)] and infects most children by age 2, with high rates of reinfection among the very young, while PIV1 and PIV2 each infect most children by age five [[2](#_ENREF_2), [4](#_ENREF_4), [6](#_ENREF_6), [8](#_ENREF_8), [13](#_ENREF_13)]. Detections of PIV in very young children may be attributable to less mixing among pre-school aged children, which may lead to a build-up of immunologically susceptible children and seasonal epidemics among the very young [[13](#_ENREF_13)]. This analysis supports previous findings that viral co-detections are frequent among young PIV-positive children, with estimates around 20% [[22](#_ENREF_22), [23](#_ENREF_23)]. High rates of co-detection may be attributable to immature immune systems and prolonged viral shedding in the very young; however, whether co-detections lead to increased severity among outpatients is unclear [[23](#_ENREF_23)].

Analysis of symptom data demonstrated that fever and cough were associated with PIV positivity among patients presenting with ARI. While cough is reported consistently in PIV cases [[24](#_ENREF_24)], the presence of fever among PIV-positive patients presenting with symptoms of respiratory tract illness varies widely in the literature, with estimates between 33% and 80% [[2](#_ENREF_2), [5](#_ENREF_5), [22](#_ENREF_22)]. The difference in fever presentation across PIV studies may be attributable to differences in study populations, but most analyses assess clinical diagnoses rather than symptomatology.

The IISP is a well-established respiratory virus surveillance network; however this analysis was nevertheless subject to limitations. The IISP reflects ILI in the outpatient setting, thus our analysis does not capture PIV patients with non-ILI presentation. However, we found that among a limited number of sites conducting surveillance including all ARI patients, 79% of the PIV-positive patients reported ILI symptoms within the seven days prior to the clinical visit. As a more sensitive case definition, we expect that surveillance of ARI patients would have produced greater numbers of PIV cases than ILI surveillance; however due to decreased specificity the percent positivity of PIV among ARI patients would be lower than among ILI patients. Surveillance for PIVs was reduced in the 2013-14 surveillance year from 12 to 5 participating health departments, leading to decreased PIV detections for that year; while PIV data from 2013-14 was consistent with previous surveillance years, the analysis may have been subject to bias related to decreased specimen collection and testing. Finally, while all sites used sensitive and specific RT-PCR assays for PIV detection, small differences between the assays may have resulted in minor differences in PIV detection.

It is well-established that PIVs contribute substantially to ILI morbidity and hospitalization among children, being second only to RSV in hospitalizations due to respiratory tract infections among children ages <5 years [[2](#_ENREF_2), [3](#_ENREF_3), [6](#_ENREF_6), [16](#_ENREF_16), [25](#_ENREF_25)]. Here we use population-based surveillance data to calculate the incidence of ILI visits and demonstrate the appreciable contribution of parainfluenza viruses to respiratory illness among children in the outpatient setting. Although PIVs are the leading cause of croup and contribute substantially to rates of upper and lower respiratory tract disease among children, there are currently no available antivirals or vaccines to treat PIV infection. Since PIV infections may be clinically indistinguishable from other ILI etiologies, it is important that surveillance be conducted to provide a resource to inform clinicians of viral circulation. We demonstrated the consistent seasonality and high-risk age groups which may help outpatient providers to better identify the etiology of PIV-related illness. Furthermore, population-based estimates of the incidence of PIV-associated outpatient ILI visits improve our understanding of the circulation and burden of PIV and support efforts for the prevention and treatment of infections, including the development of a PIV vaccine for very young children.

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**References**

1. Weinberg, G.A., et al., *Parainfluenza Virus Infection of Young Children: Estimates of the Population-Based Burden of Hospitalization.* The Journal of Pediatrics. **154**(5): p. 694-699.e1.

2. Reed, G., et al., *Epidemiology and clinical impact of parainfluenza virus infections in otherwise healthy infants and young children < 5 years old.* J Infect Dis, 1997. **175**(4): p. 807-13.

3. Glezen, W.P. and F.W. Denny, *Epidemiology of Acute Lower Respiratory Disease in Children.* New England Journal of Medicine, 1973. **288**(10): p. 498-505.

4. Fox, T.G. and J.C. Christenson, *Influenza and Parainfluenza Viral Infections in Children.* Pediatrics in Review, 2014. **35**(6): p. 217-228.

5. Frost, H.M., C.C. Robinson, and S.R. Dominguez, *Epidemiology and Clinical Presentation of Parainfluenza Type 4 in Children: A 3-Year Comparative Study to Parainfluenza Types 1–3.* The Journal of Infectious Diseases, 2014. **209**(5): p. 695-702.

6. Hall, C.B., *Respiratory Syncytial Virus and Parainfluenza Virus.* New England Journal of Medicine, 2001. **344**(25): p. 1917-1928.

7. Knott, A.M., C.E. Long, and C.B. Hall, *Parainfluenza viral infections in pediatric outpatients: seasonal patterns and clinical characteristics.* Pediatr Infect Dis J, 1994. **13**(4): p. 269-73.

8. Monto, A.S. and K.M. Sullivan, *Acute respiratory illness in the community. Frequency of illness and the agents involved.* Epidemiol Infect, 1993. **110**(1): p. 145-60.

9. Fowlkes, A., et al., *Estimating influenza incidence and rates of influenza-like illness in the outpatient setting.* Influenza Other Respi Viruses, 2012.

10. Fowlkes, A., et al., *Viruses associated with acute respiratory infections and influenza-like illness among outpatients from the Influenza Incidence Surveillance Project, 2010-2011.* J Infect Dis, 2014. **209**(11): p. 1715-25.

11. Sakthivel, S.K., et al., *Comparison of fast-track diagnostics respiratory pathogens multiplex real-time RT-PCR assay with in-house singleplex assays for comprehensive detection of human respiratory viruses.* J Virol Methods, 2012. **185**(2): p. 259-66.

12. Fry, A.M., et al., *Seasonal trends of human parainfluenza viral infections: United States, 1990-2004.* Clin Infect Dis, 2006. **43**(8): p. 1016-22.

13. Glezen, W.P., et al., *Parainfluenza Virus Type 3: Seasonality and Risk of Infection and Reinfection in Young Children.* Journal of Infectious Diseases, 1984. **150**(6): p. 851-857.

14. Weigl, J.A., et al., *Ten years' experience with year-round active surveillance of up to 19 respiratory pathogens in children.* Eur J Pediatr, 2007. **166**(9): p. 957-66.

15. Glezen, W.P., et al., *Epidemiologic patterns of acute lower respiratory disease of children in a pediatric group practice.* The Journal of Pediatrics, 1971. **78**(3): p. 397-406.

16. Counihan, M.E., et al., *Human parainfluenza virus-associated hospitalizations among children less than five years of age in the United States.* Pediatric Infectious Disease Journal, 2001. **20**(7): p. 8.

17. Downham, M.A.P.S., J. McQuillin, and P.S. Gardner, *Diagnosis and clinical significance of parainfluenza virus infections in children.* Archives of Disease in Childhood, 1974. **49**(1): p. 8-15.

18. Weinberg, G.A., *Parainfluenza Viruses: An Underappreciated Cause of Pediatric Respiratory Morbidity.* The Pediatric Infectious Disease Journal, 2006. **25**(5): p. 447-448.

19. Henrickson, K.J., *Parainfluenza Viruses.* Clinical Microbiology Reviews, 2003. **16**(2): p. 242-264.

20. Ahmed, J.A., et al., *Epidemiology of respiratory viral infections in two long-term refugee camps in Kenya, 2007-2010.* BMC Infectious Diseases, 2012. **12**: p. 7-7.

21. Kocik, J., et al., *Diversity of influenza-like illness etiology in Polish Armed Forces in influenza epidemic season.* Acta Biochim Pol, 2014. **61**(3): p. 489-94.

22. Liu, W., et al., *Epidemiology and clinical presentation of the four human parainfluenza virus types.* BMC Infectious Disease, 2013. **13**(28).

23. Drews, A.L., et al., *Dual Respiratory Virus Infections.* Clinical Infectious Diseases, 1997. **25**(6): p. 1421-1429.

24. Monto, A., *The Tecumseh study of respiratory illness: V. Patterns of infection with the parainfluenza viruses.* American Journal of Epidemiology, 1973. **97**(5): p. 338-348.

25. Iwane, M.K., et al., *Population-based surveillance for hospitalizations associated with respiratory syncytial virus, influenza virus, and parainfluenza viruses among young children.* Pediatrics, 2004. **113**(6): p. 1758-64.

**Figure Legend**

**Figure 1.** The extrapolated\* weekly number (three-week average) of parainfluenza virus (PIV)-associated ILI visits among pediatric outpatients, August 2010 through July 2014.

**Figure 1 Footnotes:** \* Extrapolated counts of PIV-associated ILI visits were calculated as the weekly proportion of PIV-positive ILI visits multiplied by the weekly count of ILI visits.

**Figure 2.** Seasonal circulation of parainfluenza virus (PIV) 1-3 detections across 12 months, by surveillance year, August 2010 through July 2014.

**Figure 2 Footnotes:** \* A PIV2 season was not detected during the 2013-14 surveillance year.

**Figure 3.** Comparison by surveillance year of age-specific cumulative incidence estimates of parainfluenza virus (PIV) 1-3 associated outpatient visits per 100,000 children, August 2010 through July 2014.

**Supplemental Digital Content Legend**

**Table, Supplemental Digital Content 1 (docx)**. Demographic characteristics and symptomatology of pediatric outpatients with influenza-like illness (ILI) tested for parainfluenza viruses (PIV) 1-3, August 2010 through July 2014.

**Table, Supplemental Digital Content 2 (docx)**. Age-specific cumulative incidence\* estimates by surveillance year of influenza-like illness (ILI) and parainfluenza virus (PIV) 1-3 associated outpatient visits per 100,000 children, August 2010 through July 2014.