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The Epidemiology of Rotavirus in Connecticut, 2011–2016

Rotavirus is an infection that causes gastroenteritis primarily in infants and young children. Illness ranges from limited watery diarrhea to severe diarrhea with vomiting and fever. Mild illness can resolve with additional fluid intake, whereas severe illness can require hospitalization or may cause death (*1*). In 1998, RotaShield®, a tetravalent oral vaccine marketed as a 3-dose series, was the first rotavirus vaccine approved for use in the United States by the Food and Drug Administration (FDA). The following year, it was withdrawn from the market due to association with an increased risk of intussusception (*2*). In 2006, the FDA approved the use of RotaTeq®, a pentavalent oral vaccine administered as a 3-dose series to infants between ages 6–24 weeks. The Advisory Committee on Immunization Practices (ACIP) recommended routine infant immunization at ages 2, 4, and 6 months. In 2008, Rotarix®, a monovalent oral vaccine, was approved as a 2-dose series administered at 2 and 4 months.

In the United States, before the introduction of rotavirus vaccines, the disease caused an estimated 60,000 hospitalizations and 37 deaths annually in children under the age of 5 years (*3*). Among children who received three doses of RotaTeq® or two doses of Rotarix® in accordance with the ACIP schedule, 70% were protected from any rotavirus illness and 90% were protected from severe rotavirus illness (*4*). Between 2011–2015, CDC's National Immunization Survey (NIS) reported rotavirus vaccination (≥2 doses for Rotarix® [RV1] and ≥3 doses for RotaTeq® [RV5]) rates for Connecticut children ages 19–35 months that ranged from 69.6–81.1% (*5, 6, 7, 8, 9*). This analysis describes the epidemiology of rotavirus cases reported to the Connecticut Department of Public Health (DPH) during 2011–2016, and assesses vaccination status among rotavirus cases through data reported to the Connecticut Immunization Registry and Tracking System (CIRTS).

In 2011, rotavirus was added to the list of Reportable Diseases, Emergency Illnesses and Health Conditions and the list of Reportable Laboratory Findings. Laboratory information provided for each rotavirus report was entered into the Connecticut Electronic Disease Surveillance System; clinical information and rotavirus type were not reported. Because rotavirus is not nationally notifiable, there is no national surveillance case definition. A Connecticut case was considered confirmed if reported by a physician or identified by a positive laboratory report received by DPH. During 2011–2015, rotavirus rates by age group and county were calculated using census estimates for the corresponding year; 2016 rotavirus rates were calculated using provisional 2016 Connecticut population estimates.

CIRTS is a statewide database that records immunization doses administered to children in Connecticut. Since January 1, 1998, all children born in Connecticut have been enrolled in CIRTS at the time of birth; parents can opt their children out of the system. CIRTS was searched to determine if cases born during 1997-1999 or 2005-2016, who would have been eligible to receive one of three licensed rotavirus vaccines, were in the registry. For cases born 2005–2016, the number of doses of rotavirus vaccine received, age at time of receipt of each dose, and intervals (days) between doses were calculated to determine if rotavirus vaccination was administered in accordance with ACIP guidelines, and thus considered valid. Being fully vaccinated

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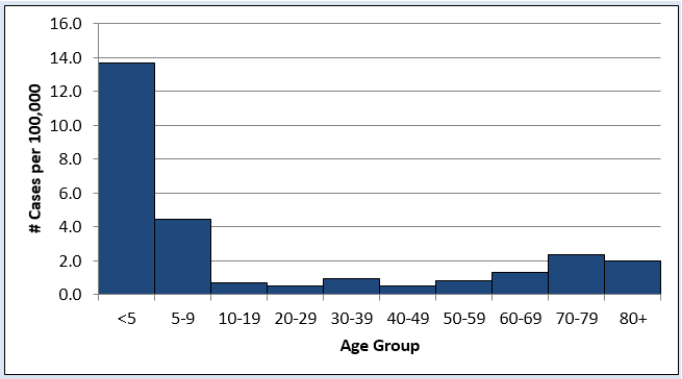
was defined as receiving three valid doses of RotaTeq® or two valid doses of Rotarix®. Among fully vaccinated cases, days between the final vaccine dose date and specimen collection date were calculated to determine if a case was fully vaccinated at the time of rotavirus detection. Children enrolled in CIRTS who were not classified as "opt-outs", and had no documentation of rotavirus vaccination, were classified as not receiving any rotavirus vaccine before becoming infected.

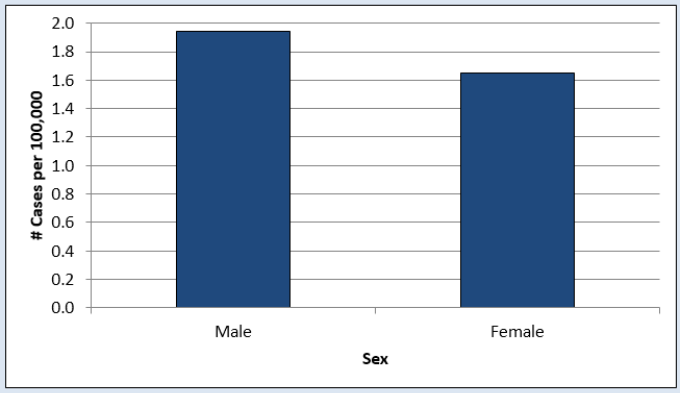
During 2011–2016, 398 rotavirus cases were reported to DPH; the median age was 7 years (range 0–101 years). Of the total, 182 (46%) were ≤5 years, and of those, 40 (22%) were aged <1 year. For cases where gender was known, 204 (53%) were male (Figure 1). Cases were reported from all counties. For cases where county was known, two counties with the highest 6-year average incidence rates accounted for 73% of all cases: Fairfield (3.3/100,000) and New Haven (1.7/100,000). During 2011–2016, rotavirus incidence in Connecticut declined overall from 3.4/100,000 population to 1.0/100,000 population ($p < 0.01$) (See Figure 3). During this period, a decreasing incidence rate was observed among the 0–4 year age group ($p<0.01$) and 5–9 year age group ($p<0.01$). An increasing incidence rate was observed among the 50–59 year age group ($p<0.05$). There was no statistically significant change in rotavirus incidence among other age groups during this period.

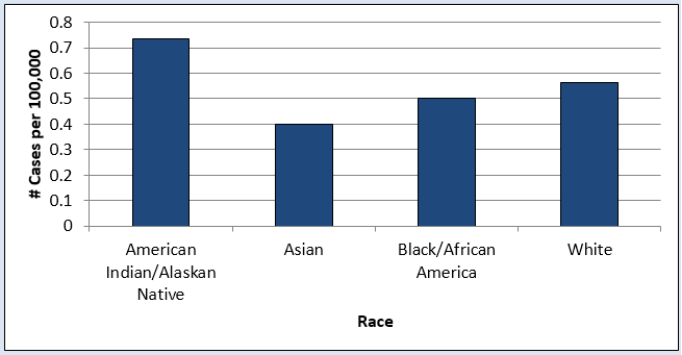
During 2011–2016, 206 cases (51%) occurred during April and March (Figure 3). Performing laboratory was available for 316 (79%) cases. Twenty-two laboratories reported cases during 2011–2016; of these, four laboratories located in Fairfield and New Haven counties accounted for 224 (71%) cases. Laboratory testing method was available for 308 (77%) cases; 287 (93%) were diagnosed using enzyme immunoassay (EIA) and 21 (7%) by multiplex polymerase chain reaction (PCR) panels. No rotavirus cases were diagnosed by PCR before 2015 (Figure 4).

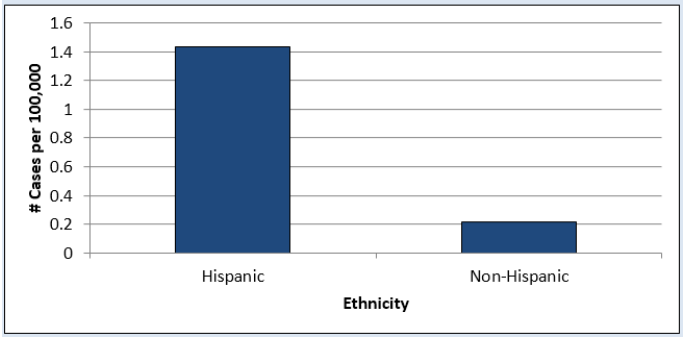
Among the confirmed rotavirus cases reported during 2011–2016, 4 (1.0%) were born during 1997–1999 and 202 (50.8%) during 2005–2016, and were eligible to receive one of the three licensed rotavirus vaccines. None of the cases born during 1997–1999 received documented rotavirus vaccine, and were thus excluded from analysis of vaccination status.

Figure 1. Six year average incidence* of rotavirus infections by age, sex, race and ethnicity— Connecticut, 2011-2016









*per 100,000 people

Among the 202 confirmed rotavirus cases born 2005–2016 and reported during 2011–2016, linked records could not be found in CIRTS for 68 (34%) cases and 18 (9%) cases were found to be opted out of CIRTS; these cases were excluded from analysis of vaccine status at time of infection. Linked records in CIRTS were identified for 116 (57%) cases. Thirty-one (27%) cases born during 2005–2016 with matching CIRTS records received a full series of vaccine by the date of specimen collection.

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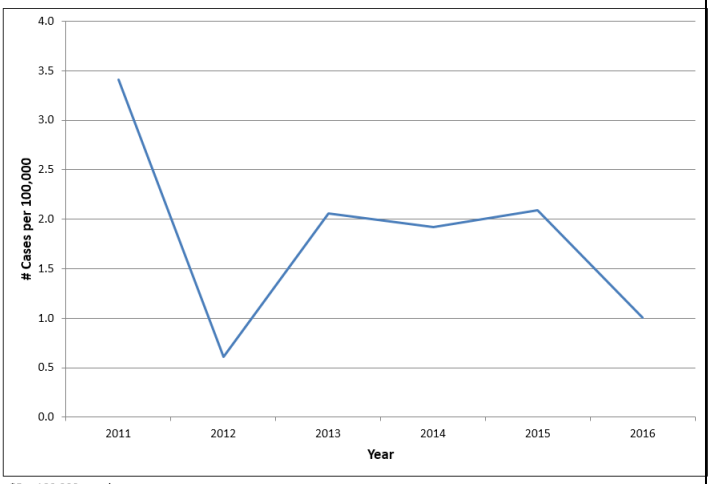
Editorial

Overall, a 70% decrease in rotavirus incidence was observed in Connecticut during 2011–2016. Age specific incidence declined among children <10 years of age. Given that rotavirus has been a vaccine preventable disease since 2006, the decrease in rotavirus incidence in Connecticut during 2011–2016 was expected and consistent with findings from studies conducted immediately post-licensure. A study of hospital discharge data found that hospitalization rates for acute gastroenteritis in children <5 years decreased by 16% in 2007 and 45% in 2008 compared to 2000–2006 rotavirus seasons (*10*); a CDC analysis of laboratory data found a 78% reduction in positive rotavirus tests in 2008 compared to the previous 7 seasons (*11*). Despite these decreases, the majority of Connecticut rotavirus cases had no evidence of being vaccinated against rotavirus; among the cases born 2005–2016 with vaccination history documented in CIRTS, only 27% were fully vaccinated.

Differing test methods used by labs in Connecticut likely influence incidence rates in the counties they service. Because multiplex PCR assays screen for 8-22 enteric pathogens, they may detect rotavirus in patients for whom the diagnosis was not suspected and who would not have been tested using EIA. A study comparing rotavirus detection rates using EIA and PCR found that PCR was more sensitive and was able to detect low-level viral shedding in individuals, but had lower specificity,

Figure 2. Incidence* of rotavirus infections - Connecticut, 2011-2016.



*Per 100,000 people

Figure 3. Percentage of rotavirus infections by month - Connecticut, 2011-2016

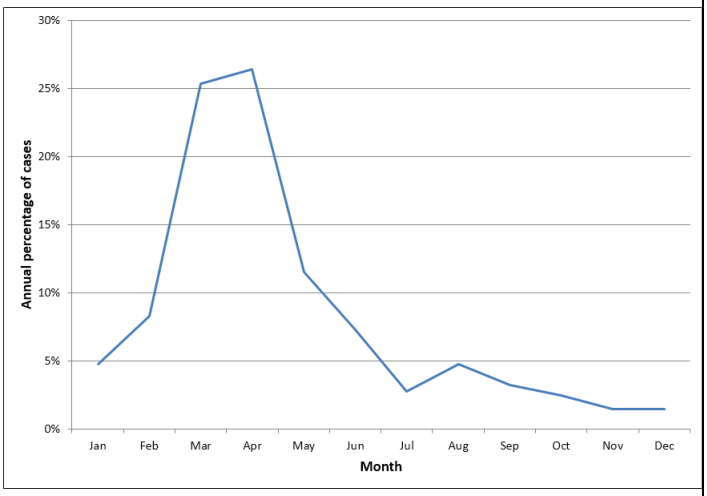
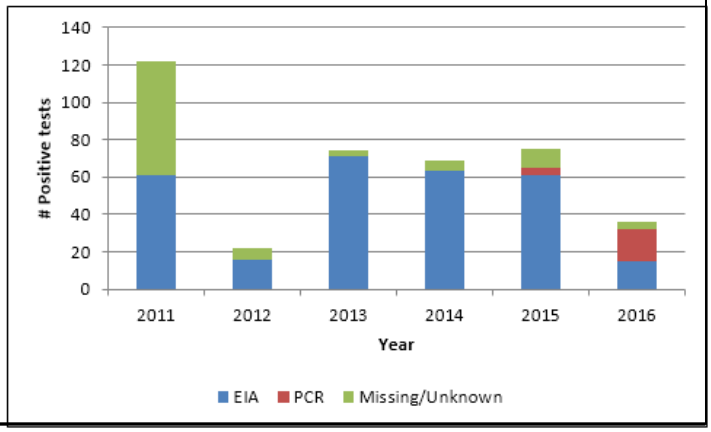


Figure 4. Laboratory testing method used to diagnose rotavirus (n=398) -Connecticut, 2011-2016.



and detected rotavirus in asymptomatic individuals (*12*). The true disease burden of rotavirus may be underestimated in counties with laboratories that do not use PCR testing.

While this information has been useful in understanding the epidemiology of rotavirus in Connecticut, there are limitations to this passive surveillance system. Since severity of symptoms was unknown, it cannot be determined whether vaccinated rotavirus cases had less severe illness. There were additional limitations in determining vaccination status at the time of rotavirus infection. Analysis was limited to 116 cases with vaccine histories that could be found in CIRTS. Methods used to determine vaccination status were biased towards classifying cases as not vaccinated. Because type of vaccine administered (monovalent or pentavalent) was not specified for all cases, the number of children who completed a series of monovalent vaccine is likely underestimated in this analysis.

Rotavirus surveillance data have demonstrated a decreasing incidence in Connecticut, both overall and especially in children ages <10 years. This finding is consistent with expectations based on the introduction of rotavirus vaccine in 2006. Given the high number of cases that did not have any evidence of rotavirus vaccination, increased education of healthcare providers about the importance of rotavirus vaccine could be considered. Significant challenges exist in further describing rotavirus epidemiology due to the limited amount of information collected and differences in test methods used throughout the state. The utility of continueing rotavirus surveillance in Connecticut is being assessed for 2018.

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