Sustained Decline in Acute Gastroenteritis-Associated Hospitalizations and Outpatient Visits Among American Indian/Alaska Native Children After Rotavirus Vaccine Introduction, 2001–2014

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We examined the uptake of rotavirus vaccine and compared trends in acute gastroenteritis (AGE)-associated hospitalizations and outpatient visits among American Indian and Alaska Native (AI/AN) children aged <5 years before and after introduction of the rotavirus vaccine. The rates of AGE-associated hospitalization and outpatient visits among AI/AN children remained below prevaccine levels.

Keywords. Alaska Native; American Indian; children; infants; rotavirus.

Before introduction of the pentavalent and monovalent rotavirus vaccines (RotaTeq [Merck and Co., New York] and Rotarix [GSK Biologicals, Brentford, United Kingdom], respectively) in the United States in 2006 and 2008, respectively, rotavirus was a leading cause of acute gastroenteritis (AGE)-associated hospitalizations and outpatient visits among children <5 years of age [1, 2]. The introduction of these vaccines into the routine childhood immunization schedule has resulted in declines in healthcare utilization for rotavirus-associated AGE among US children [3–5].

Infectious AGE, including AGE caused by rotavirus, has been a particular public health problem among American Indian/Alaska Native (AI/AN) populations [6, 7]. AGE-associated hospitalization rates among AI/AN children were almost twice the rate among children in the general US population in the early 1980s [6], but by the mid-1990s, AGE-associated hospitalization rates were similar among AI/AN and US children <5 years of age. However, AGE-associated hospitalization rates among AI/AN children <1 year of age remained high compared with those of US infants through the mid-2000s [8]. In addition, AGE-associated outpatient visit rates among AI/AN children <5 years of age were greater than those among US children [8].

The Indian Health Service (IHS), the federal agency responsible for providing health services to AI/AN people, began administering rotavirus vaccine in all IHS areas in 2006. In 1 study, AGE-associated hospitalization and outpatient visit rates among AI/AN children declined after the implementation of rotavirus vaccines [9], but that early examination of the vaccine’s effects on AGE-associated hospitalization and outpatient visit rates was limited to the first 3 years after vaccine implementation. To examine further the impact of the vaccine, we compared AGE-associated hospitalization and outpatient visit rates in the prevaccine era with those in the first 6 years after rotavirus vaccine implementation among AI/AN children <5 years of age.

MATERIALS AND METHODS

The IHS provides healthcare to the AI/AN population through a network of IHS, tribal, and urban Indian healthcare facilities. Rotavirus vaccination coverage estimates were obtained from the IHS Division of Epidemiology and Disease Prevention, which reports vaccination information from its electronic health records on a quarterly basis [10]. Average rotavirus vaccination coverage for the first and second doses of vaccine among infants aged 3 to 4 months (dose 1) and 5 to 6 months (dose 2) were calculated from calendar years 2008 to 2014. Third-dose coverage was not assessed because of site-to-site differences in the use of RotaTeq and Rotarix.

AGE-associated hospitalization and outpatient visit data for AI/AN children <5 years of age from calendar years 2001 to 2014 were obtained from the IHS National Patient Information Reporting System. These data consist of records of hospital discharges and outpatient visits to IHS-operated, tribally operated, and community hospitals and clinics and health services that were contracted with the IHS or specific tribes. As in the previous examination of these data, the west region was excluded from the hospitalization analysis because of its lack of tribally or IHS-funded hospitals and limitations in contract health service.
data [9]. Data were categorized according to age group (<1 and 1–4 years) and time period with respect to rotavirus vaccine availability (prevaccine period, 2001–2006; transitional year, 2007 [3, 4, 9]; postvaccine period, 2008–2014). AGE-associated outpatient visit data for calendar years 2001 through 2014 for AI/AN children <5 years of age were obtained from all regions (including the west region). Hospital discharge and outpatient visit records were classified as AGE-associated when 1 of up to 15 discharge diagnosis codes matched an International Classification of Diseases, Ninth Revision, Clinical Modification code list for AGE [9]. Newborn birth hospitalizations were excluded from this study.

Annual and average annual hospitalization and outpatient AGE-associated visit rates were documented as the number of hospitalizations or visits per 10 000 AI/AN children <5 years of age in the corresponding population. Population denominators for rate-calculation estimates were identified by using the IHS/tribal user population counts for each age category for calendar years 2001 through 2014; the IHS user population includes all registered AI/AN people who had received IHS-funded healthcare services at least once in the preceding 3 years. Poisson regression was used to compare rates and test for trends. Statistical significance was determined at a P value of <.05. All analyses were completed using SAS/STAT software.

RESULTS

Average annual rotavirus vaccine coverage for dose 1 among AI/AN infants aged 3 to 4 months and for dose 2 among infants aged 5 to 6 months increased significantly (P < .05) over the study period (Figure 1).

In the 2001 to 2014 period, 7257 AGE-associated hospitalizations among AI/AN children <5 years of age were reported to the IHS. The prevaccine (2001–2006) average annual AGE-associated hospitalization rate among AI/AN children <5 years of age was 61 per 10 000 (annual range, 52–78 per 10 000). The rate declined progressively to reach a low of 24 per 10 000 in 2014, which is a decrease of 61% (P < .0001) (Figure 1A). The prevaccine average annual AGE-associated hospitalization rate among AI/AN children <1 year of age was 232 per 10 000, and this rate declined to 80 per 10 000 in 2014, which is a 66% decrease (P < .0001).

During the 2001 to 2014 period, 342 188 AGE-associated outpatient visits among AI/AN children aged <5 years were reported to the IHS. The prevaccine average annual AGE-associated outpatient visit rate among AI/AN children aged <5 years was 2188 per 10 000 (annual range, 2095–2401 per 10 000) and declined to 1438 per 10 000 in 2014, which is a decrease of 34% (P < .0001) (Figure 1B). The prevaccine average annual AGE-associated outpatient visit rate among AI/AN children aged <1 year was 5865 per 10 000 and declined to 2982 per 10 000 in 2014, which is a 49% decrease (P < .0001).

DISCUSSION

We previously highlighted the decrease in AGE-associated hospitalization and outpatient visit rates among AI/AN children for the first 3 years after introduction of the rotavirus vaccine [9], and we show here that these decreases have been sustained from 2010 to 2014.

The sustained declines in AGE-associated hospitalization and outpatient visit rates are likely attributable to rotavirus vaccination. The declines in the AGE-associated hospitalization rate were found to be more pronounced almost every subsequent year after vaccine introduction as increasing numbers of children were being vaccinated. In addition, although we have seen dramatic reductions in AGE-associated hospitalization rates since the introduction of rotavirus vaccine, the reduction in AGE-associated outpatient visit rates were more modest. This observation provides additional evidence that the introduction of rotavirus vaccine has contributed to the substantial decrease in more-severe AGE-associated illness. Rotavirus-related gastroenteritis among children is commonly more severe than that attributable to other causes [1]; therefore, a greater proportion of AGE-associated hospitalizations would be prevented through vaccination than the proportion of less-severe episodes of gastroenteritis that lead to outpatient visits.

We estimated that annual AGE-associated hospitalization rates among AI/AN children <5 years of age declined up to 64% annually compared with those in the 2001 to 2006 period. Our estimated hospitalization rates are consistent with those found in another study from which AGE hospitalization rates among US children aged <5 years were reported to range between 39 per 10 000 in 2008 and 27 per 10 000 in 2010 [5] but were somewhat lower than those reported from another study in which hospitalization rates among US children aged <5 years in 24 states were examined [4]. In addition, our estimated hospitalization rate reductions are similar to or greater than the rate reductions (ranging from 25% to 55% annually) reported by these studies.

We estimated that annual AGE-associated outpatient visit rates among AI/AN children aged <5 years declined up to 39% annually compared with those in the 2001 to 2006 period. Our estimated AI/AN outpatient visit rates are notably higher than those reported among US children aged <5 years between 2008 and 2010; in 2014, the estimated AGE-associated outpatient visit rate among AI/AN children was 1438 per 10 000, whereas in 2008, the outpatient visit rate among US children aged <5 years was 1360 per 10 000 [5]. However, AGE-associated outpatient visit rates decreased more dramatically among AI/AN children than among US children from 2008 to 2010.

Our study had some limitations. First, International Classification of Diseases, Ninth Revision, Clinical Modification–coded AGE-associated diagnoses might be
incomplete or inaccurate. Although our results strongly suggest that the use of rotavirus vaccine led to decreases in AGE-associated hospitalization and outpatient visit rates, we could not directly detect any decreases in rotavirus-coded AGE because of the small number of rotavirus-coded outpatient visits and hospitalizations, and we did not directly analyze laboratory-confirmed rotavirus infections. In addition, annual trends in other pathogens associated with less-severe gastroenteritis (eg, norovirus) would likely affect our findings, particularly AGE-associated outpatient visit rates. Furthermore, our ecological analysis of hospitalization and outpatient visit rates is susceptible to variability across IHS regions, including variations in host factors such as comorbidities and disease factors such as rotavirus strain differences and AGE outbreaks, variations in the use of vaccines that require 2 doses and those that require 3 doses, and variations in social factors such as access to healthcare and variability in physician treatment practices. Last, AI/AN patients within the IHS healthcare system can receive care outside the IHS system, and such care episodes were not included in this study.

CONCLUSIONS

Sustained decreases in AGE-associated hospitalization and outpatient visit rates in the years after introduction of the rotavirus vaccine among AI/AN children in the IHS underscore the health benefits of vaccination. Continued efforts to increase rotavirus vaccination coverage among AI/AN children are expected to further reduce AGE-associated hospitalization and outpatient visit rates.

Notes

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Disclaimer. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the IHS.

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