Lessons from Rotavirus Vaccine Implementation in the U.S.

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Public Health - Seattle & King County
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Overview

• General experience of introducing the vaccine in the US
• Impact of the vaccine on the epidemiology of rotavirus in the US
• Monitoring rotavirus vaccine safety
• Lessons learned from the implementation of a live attenuated oral vaccine
Rotavirus

- First identified as cause of diarrhea in 1973
- Most common cause of severe diarrhea in infants and children
- Nearly universal infection by 5 years of age
- Responsible for up to 500,000 diarrheal deaths each year worldwide
Rotavirus

- Reovirus (RNA)
- VP7 and VP4 antigens define virus serotype and induce neutralizing antibody
- 5 predominant strains in US (G1-G4, G9) account for 90% of isolates; G1 strain accounts for 75% of infections
- Very stable, may remain viable for weeks or months if not disinfected
Rotavirus Immunity

- Antibody against VP7 and VP4 probably important for protection
- First infection usually does not lead to permanent immunity
- Reinfection can occur at any age
- Subsequent infections generally less severe
Rotavirus Clinical Features

• Short incubation period (usually <48 hours)
• First infection after age 3 months generally most severe
• May be asymptomatic or result in severe dehydrating diarrhea with fever and vomiting
• Gastrointestinal symptoms generally resolve in 3 to 7 days
Rotavirus Complications

• Severe diarrhea
• Dehydration
• Electrolyte imbalance
• Metabolic acidosis
• Immunodeficient children may have more severe or persistent disease
Rotavirus Epidemiology

- Reservoir: Human-GI tract
- Transmission: Fecal-oral, fomites
- Temporal pattern: Fall and winter (temperate areas)
- Communicability: 2 days before to 10 days after onset
Rotavirus Disease Burden in the US (Pre-Vaccine)

• Etiology of 5%-10% of all gastroenteritis episodes among children <5 years of age
• 95% of children infected by 5 years of age
• Highest incidence among children 3 to 35 months of age
• The most severe disease among children 3-24 months of age
Rotavirus Disease Burden in the US (Pre-Vaccine)

• Each year rotavirus caused:
  – about 3 million cases of gastroenteritis
  – Over 400,000 physician visits
  – Over 200,000 emergency department visits
  – 55,000-70,000 hospitalizations
  – 20-60 deaths among children <5 years of age

• Annual direct and indirect costs estimated at approximately $1,000,000,000
Rotavirus Disease Burden in the US (Pre-Vaccine)

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  - Over 400,000 physician visits
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  - 55,000-70,000 hospitalizations
  - 20-60 deaths among children <5 years of age
- Annual direct and indirect costs estimated at approximately $1,000,000,000
- Lesson: Impact of rotavirus infection underappreciated
Rotavirus Vaccines

• RV5 (RotaTeq®)
  – Contains five reassortant rotaviruses developed from human and bovine parent rotavirus strains
  – Vaccine viruses suspended in buffer solution
  – Contains no preservatives or thimerosal
Rotavirus Vaccines

• RV1 (Rotarix®)
  – Contains one strain of live attenuated human rotavirus (type G1P[8])
  – Provided as a lyophilized powder that is reconstituted before administration
  – Contains no preservatives or thimerosal
Rotavirus Vaccines in the US

- Feb. 2006 – RotaTeq® recommended
- June 2008 – Rotarix® recommended
- Both vaccines significantly reduced both physician visits for diarrhea & rotavirus-related hospitalization
### Rotavirus Vaccine Efficacy

**Clinical Trials RV5**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalizations</td>
<td>96% (91-98%)</td>
</tr>
<tr>
<td>Reduced ED visits</td>
<td>94% (89-97%)</td>
</tr>
<tr>
<td>Reduced office visits</td>
<td>86% (74-93%)</td>
</tr>
<tr>
<td>Condition</td>
<td>Efficacy</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Severe rotavirus</td>
<td>96% (90-99%)</td>
</tr>
<tr>
<td>Rota AGE</td>
<td>87% (80-82%)</td>
</tr>
</tbody>
</table>
Rotavirus Vaccine

Recommendations

• For both rotavirus vaccines
  – maximum age for first dose: 14 weeks 6 days
  – minimum interval between doses: 4 weeks
  – maximum age for any dose: 8 months 0 days
    (no catch-up)

*MMWR 2009;58:(RR-2)*
TABLE 6. Percentage of infants with solicited adverse events (any intensity and Grade 3*) within 8 days following any dose of Rotarix® (RV1) or placebo†

<table>
<thead>
<tr>
<th>Event</th>
<th>RV1 (n = 3,286)</th>
<th>Placebo (n = 2,015)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Any intensity</td>
<td>% Grade 3</td>
</tr>
<tr>
<td>Fever§</td>
<td>39.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Fussiness/irritability</td>
<td>62.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>34.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Vomiting</td>
<td>17.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>6.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Cough/runny nose¶</td>
<td>44.2</td>
<td>3.6**</td>
</tr>
</tbody>
</table>

No serious events

Vaccine for Infant Diarrhea Is Withdrawn as Health Risk

By LAWRENCE K. ALTMAN
Published: October 16, 1999

American Home Products, the manufacturer of the only licensed vaccine to prevent the most common cause of severe diarrhea among infants and children, announced today that it was withdrawing the vaccine from the market because of concerns that it could cause a painful and potentially fatal bowel obstruction.

The diarrhea is caused by the rotavirus, and last year the Government recommended that every infant in the United States get the protective vaccine. One million children swallowed three doses of the vaccine, RotaShield, at 2, 4 and 6 months of age, the company said.

But in July the Centers for Disease Control and Prevention, a Federal agency based here, said no one should get the vaccine because a program that monitors side effects suggested a link between the vaccine and the bowel condition, called intussusception.
Observed age-specific incidence of intussusception associated with use of RotaShield and annual background incidence of intussusception in the U.S. estimated from Healthcare Cost & Utilization Project data.

Background = dotted line
RotaShield = solid line

Simonsen. JID 2005
Age at receipt of 1\textsuperscript{st}, 2\textsuperscript{nd} & 3\textsuperscript{rd} doses of RotaShield among US infants, OCT 1998-July 1999

Simonsen. JID 2005
Current Rotavirus Vaccines and Intussusception – Clinical Trials

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>No. of Infants</th>
<th>Vaccine Recipients</th>
<th>Placebo Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV1*</td>
<td>63,225</td>
<td>7 cases</td>
<td>7 cases</td>
</tr>
<tr>
<td>RV5*</td>
<td>69,625</td>
<td>6 cases</td>
<td>5 cases</td>
</tr>
</tbody>
</table>

*RV1: 0-30 days after either dose; RV5: 0-42 days after any dose. Small increased risk for intussusception not detectable.
U.S. Physicians’ Attitudes Regarding Rotavirus Vaccine

- 2007 survey using network recruited from random sample of AAP and AAFP members
- Designed to be representative of AAP & AAFP membership:
  - Region of country (NE, S, MW, W)
  - Location (urban, suburban, rural)
Adoption of Rotavirus Vaccination by Pediatricians and Family Medicine Physicians in the United States (2007)

Kempe Pediatrics 2009;124;e809
Early Practices Regarding Rotavirus Vaccine Administration by Pediatricians and Family Medicine Physicians in the United States (2007)

Kempe *Pediatrics* 2009;124;e809
## Barriers to Giving Rotavirus Vaccine

<table>
<thead>
<tr>
<th>Definitely a Barrier</th>
<th>PEDS (n=359)</th>
<th>FM (n=264)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent’s concern about the safety of rotavirus vaccine</td>
<td>9%</td>
<td>25%</td>
</tr>
<tr>
<td>Addition of another vaccine to the schedule</td>
<td>5%</td>
<td>22%</td>
</tr>
<tr>
<td>Failure of some insurance companies to cover vaccination</td>
<td>19%</td>
<td>22%</td>
</tr>
<tr>
<td>The “up-front” costs to purchase the vaccine</td>
<td>17%</td>
<td>22%</td>
</tr>
<tr>
<td>Lack of adequate reimbursement</td>
<td>15%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Kempe _Pediatrics_ 2009;124;e809
Complex age of administration guidelines

Survey of pediatricians & family medicine physicians

• 31% of pediatricians (PED) and 70% of family practice providers (FP) did NOT know the age by which the first dose of RV5 should be administered

Kempe Pediatrics 2009;124;e809
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- 31% of pediatricians (PED) and 70% of family practice providers (FP) did NOT know the age by which the first dose of RV5 should be administered

- 38% PED and 68% FP did NOT know the age by which all 3 doses should be administered
Complex age of administration guidelines
Survey of pediatricians & family medicine physicians

• 31% of pediatricians (PED) and 70% of family practice providers (FP) did NOT know the age by which the first dose of RV5 should be administered
• 38% PED and 68% FP did NOT know the age by which all 3 doses should be administered
• 12% of PED and 20% of FP reported that they frequently or sometimes gave the *first dose* of RV5 to infants 12 months of age

Kempe *Pediatrics* 2009;124;e809
Complex age of administration guidelines

Survey of pediatricians & family medicine physicians

- 31% of pediatricians (PED) and 70% of family practice providers (FP) did NOT know the age by which the first dose of RV5 should be administered
- 38% PED and 68% FP did NOT know the age by which all 3 doses should be administered
- 12% of PED and 20% of FP reported that they frequently or sometimes gave the first dose of RV5 to infants 12 months of age
- 7% of PED and 10% FP reported frequently or sometimes administering the third dose to infants >32 weeks of age

Kempe Pediatrics 2009;124;e809
Clinical Issues
Administration of oral vaccines

• April, 2007: Washington State began ordering and distributing Rotavirus vaccine.
  – Licensed Health Care Assistants (HCA) NOT authorized to administer oral vaccines
  – New legislation (2008) required to expand scope of practice for HCAs to allow administration of all FDA approved vaccines given by "injection, orally, or topically, including nasal administration".
A Few Clinical Issues

What if baby spits out or regurgitates the dose?
A Few Clinical Issues

What if baby spits out or regurgitates the dose?

- **RotaTeq**: Replacement dose is not recommended, not studied in the clinical trials.
- **RotaRix**: If the infant spits out or regurgitates *most of* the vaccine dose, a single replacement dose may be considered at the same vaccination visit.
- **ACIP**: Do not re-administer a dose of rotavirus vaccine to an infant who regurgitates, spits out, or vomits during or after administration of vaccine.
  - No data exist on the benefits or risks associated with re-administering a dose.
  - The infant should receive the remaining recommended doses of rotavirus vaccine following the routine schedule (with a 4-week minimum interval between doses).
Clinical Issues
*Dosing/Administration Schedule*

- **RotaTeq**: Administer starting at 6 to 12 weeks of age, with the subsequent doses at 4- to 10-week intervals. The third dose should not be given after 32 weeks of age.
- **ROTARIX** (diluent): Administer first dose beginning at 6 weeks of age. Administer second dose after an interval of at least 4 weeks and prior to 24 weeks of age.
  - Inadvertent IM injection
- **ACIP**:
  - The *maximum age for dose 1* of rotavirus vaccine is 14 weeks and 6 days.
  - The *maximum age for the last dose* of rotavirus vaccine is 8 months and 0 days.
  - The minimum interval between doses of rotavirus vaccine is 4 weeks; no maximum interval is set.
Monitoring Rotavirus Vaccine Safety

- VAERS (As of AUG 2010, 32 million doses of RotaTeq and 2.8 million doses of Rotarix distributed in US)
- Vaccine Safety Datalink (VSD): primary system used for post marketing safety surveillance
  - Data from 10 managed care organizations: No safety signals
  - Excludes risk greater than 1 case per 25,000 infants vaccinated
- Post-marketing surveillance by manufacturer
  - Small increase in intussusception risk in Mexico & Brazil (1 per 51,000 & 68,000 infants vaccinated, respectively) with 96 cases and 5 deaths
  - Vaccination prevents 80,000 hospitalizations and 1300 deaths in these countries each year; Benefit>>>Risk
  - Compensatory decrease in later intussusception in vaccinees by preventing wild-type infection?
Monitoring Rotavirus Vaccine Safety

• *If* risk observed in Mexico present in US, would result in approximately:
  – Risk: 0-4 excess cases per 100,000 infants vaccinated (50-60 cases of intussusception)
  – Benefit: Over 50,000 hospitalizations prevented
Rotavirus Vaccine Safety

• 2010: Porcine Circovirus (PCV) DNA found in Rotarix and RotaTeq using metagenomic and panmicrobial microarray techniques (Delwart, BSRI, San Francisco)
• Common swine virus
• Human exposures likely common, PCV found in human stool, no antibody response
• Not associated with illness in pigs or humans
• FDA: Hypothetical risks do not outweigh benefits
• Advised companies to produce PCV-free vaccines
Coverage With ≥1 dose of Rotavirus Vaccine Among Infants Aged 5 Months, June 2006 - June, 2009

ACIP recommendation

72% coverage
Vaccine-Specific Coverage Rates Among Preschool-Aged U.S. Children: 1967 - 2010

DTP / DTaP(3+)†

MMR(1+)

Polio (3+)

Hib (3+)

Hep B (3+)

Varicella (1+)

PCV 7 (4+)

Rotavirus (3+)

2020 Targets*

† DTP(3+) is not a Healthy People 2010 objective. DTaP(4) is used to assess Healthy People 2010 objectives.

Note: Children in the USIS and NHIS were 24-35 months of age. Children in the NIS were 19-35 months of age.


* Healthy People 2020 targets are 90% except for rotavirus vaccine, which is 80%
Comparison Between 2009 and 2010 NIS 19-35 Month Old Coverage Levels

Source: NIS at www.cdc.gov/vaccines
Rotavirus Series; 19-35 Months of Age; 2010 National Immunization Survey

Source: www.cdc.gov/vaccines
So, How’s It Working?

*Real World Effectiveness Studies*
Effectiveness of Pentavalent Rotavirus Vaccine in a Large Urban Population in the U.S. 

- Case-Control study Texas Children’s Hospital, February-June 2008
- Cases: Children 15 days - 23 months with lab-confirmed rotavirus AGE
- Controls:
  - children with rotavirus-negative AGE
  - children with acute respiratory infection (ARI)

Boom et al. Pediatrics 2010
**Effectiveness of Pentavalent Rotavirus Vaccine in a Large Urban Population in the U.S.**

<table>
<thead>
<tr>
<th></th>
<th>RV-negative AGE</th>
<th>ARI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 dose</td>
<td>65%</td>
<td>65%</td>
</tr>
<tr>
<td>2 doses</td>
<td>82%</td>
<td>72%</td>
</tr>
<tr>
<td>3 doses</td>
<td>89%</td>
<td>85%</td>
</tr>
</tbody>
</table>

Boom et al. Pediatrics 2010
Effectiveness of Pentavalent Rotavirus Vaccine in a Large Urban Population in the U.S.

• Complete series:
  - 100% protection (95% CI: 71–100%) against severe rotavirus disease requiring hospitalization
  - 96% protection (95% CI: 72%–99%) against disease requiring intravenous hydration

• Vaccine effectiveness of partial series against severe disease (hospitalization or ED visits):
  - 1 dose 69% (95% CI: 13%–89%)
  - 2 doses 81% (95% CI: 13%–96%)
U.S. National Respiratory and Enteric Virus Surveillance System (NREVSS)

- Network of 67 laboratories reporting since 2000
- Weekly reporting: # stool specimens tested for rotavirus (EIA) and # positive tests
NREVSS Total & Positive Rotavirus Tests 2000-2010

Vaccine

Tate et al. Pediatrics 2009 and unpublished CDC data
NREVSS Total & Positive Rotavirus Tests 2000-2010

(Vaccine)

60-70% reduction in RV+ tests

(Delayed peak)

Tate et al. Pediatrics 2009 and unpublished CDC data
Active Rotavirus Surveillance - NVSN

- Capture >95% of all pediatric infectious hospital admissions in 3 US counties
- Enrollment of inpatients, emergency room patients, and outpatients with AGE
- Fecal specimens obtained and tested for rotavirus
Total Acute Gastroenteritis and Rotavirus Hospitalizations, NVSN 2006-2009

Payne D et al CID, 2011 and unpublished data
Total Acute Gastroenteritis and Rotavirus Hospitalizations, NVSN 2006-2009

Payne D et al CID, 2011 and unpublished data
### Age-Specific Rotavirus Hospitalization Rate Reduction and Vaccine Coverage, NVSN

<table>
<thead>
<tr>
<th>Age</th>
<th>Rotavirus vaccine coverage in 2008 (≥1 dose)</th>
<th>Decline in rotavirus hospitalization rate (2008 vs. 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 year</td>
<td>56%</td>
<td>66%</td>
</tr>
<tr>
<td>1 to &lt; 2 years</td>
<td>44%</td>
<td>95%</td>
</tr>
<tr>
<td>2 to &lt; 3 years</td>
<td><strong>&lt;1%</strong></td>
<td>85%</td>
</tr>
</tbody>
</table>

_Herd immunity?_

Payne D et al CID, 2011 and unpublished data
Reduction in Acute Gastroenteritis Hospitalizations among US Children After Introduction of Rotavirus Vaccine: Analysis of Hospital Discharge Data from 18 US States

Aaron T. Curns, Claudia A. Steiner, Marquette Barrett, Katherine Hunter, Emily Wilson, and Unesh D. Parashar

1National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia; 2Healthcare Cost and Utilization Project, Center for Delivery, Organization and Markets, Agency for Healthcare Research and Quality, Rockville, Maryland; 3M.L. Barrett, Del Mar, and 4Thomson Reuters, Santa Barbara, California
Rates of AGE hospitalization by year and rotavirus season among children 5 years of age, 18 states, January 2000 - June 2008

Curns. J Infect Dis. 2010
Monthly AGI and rotavirus *ICD-9*–coded hospitalization rates among children aged <5 years from January 2000 through June 2008, in 18 states

Curns. *J Infect Dis.* 2010
Reduction in Acute Gastroenteritis Hospitalizations among US Children After Introduction of Rotavirus Vaccine: Analysis of Hospital Discharge Data from 18 US States: National Estimate of Reduction

• Approximately 55,000 acute gastroenteritis hospitalizations prevented during the 2008 rotavirus season
• Elimination of 1 in 20 hospitalizations among US children aged <5 years
• Substantial decreases among those too young or old to be vaccinated

Curns. *J Infect Dis.* 2010
Impact of Rotavirus Vaccination on Hospital-Acquired Rotavirus Gastroenteritis in Children

WHAT'S KNOWN ON THIS SUBJECT: Approximately 27% of children with rotavirus in the hospital acquire it while hospitalized for another condition. Pediatric rotavirus vaccination greatly decreased the number of children hospitalized with rotavirus from 2007 to 2008.

WHAT THIS STUDY ADDS: Routine community-based rotavirus infant vaccination protects hospitalized children from acquiring rotavirus. Thus, community-based vaccination efforts should be encouraged as a strategy to decrease hospital-acquired rotavirus.

abstract

OBJECTIVE: Data show that after the implementation of routine rotavirus vaccination for infants in the United States, community-acquired (CA) rotavirus cases declined substantially in the 2007–2008 season. The impact of community-based rotavirus vaccination on the substantial burden of hospital-acquired (HA) rotavirus has not been documented.

PATIENTS AND METHODS: We assessed CA and HA rotavirus, respiratory syncytial virus, and influenza infections at Children’s Memorial Hospital for 5 winter seasons (defined as occurring from September through May) from 2003 to 2008. We also report rotavirus data from the 2008–2009 season.

RESULTS: A similar dramatic decline (>80% compared with the median of previous seasons) occurred in the rates of cases of both CA (P < .0001) rotavirus hospitalizations and HA (P < .01) rotavirus infec-
Community-Acquired Infections per 100,000 Admissions

FIGURE 1
CA viral infection admissions per 100 admissions. a $P \leq .003$ versus the 2003–2004 season; b $P < .04$ versus the 2003–2004 season; c $P \leq .007$ versus the 2004–2005 season; d $P \leq .0001$ versus previous seasons. For exact $P$ values, see the text.

Anderson. Pediatrics, 2011
Hospital-Acquired Infections per 100,000 Patient-Days

**FIGURE 2**
HA viral infections per 1000 patient-days. \(^a\) \(P < .05\) versus the 2003–2004 season; \(^b\) \(P < .04\) versus the 2004–2005, 2005–2006, and 2007–2008 seasons; 
\(^c\) \(P < .01\) versus all previous years. For exact \(P\) values, see the text.
Effectiveness of Pentavalent Rotavirus Vaccine Against Severe Disease

**Authors:** Mary Allen Staat, MD, MPH, Daniel C. Payne, PhD, MSPH, Stephanie Donauer, MS, Geoffrey A. Weinberg, MD, Kathryn M. Edwards, MD, Peter G. Szilagyi, MD, MPH, Marie R. Griffin, MD, MPH, Caroline H. Hall, MD, Aaron T. Curns, MPH, Jon R. Gentach, PhD, Sheila Salisbury, PhD, Gerry Fairbrother, PhD, and Umesh D. Parashar, MBBS, MPH, the New Vaccine Surveillance Network (NVSN)

**What's Known on this Subject:** The pentavalent rotavirus vaccine RV5 was licensed and recommended for routine immunization in US infants in 2006. Results of studies performed before licensure demonstrated this vaccine to be highly efficacious against rotavirus-associated hospitalizations and emergency department visits.

**What This Study Adds:** In this case-control study the effectiveness of RV5 under field conditions was examined. Both full and partial immunization with RV5 were found to be highly effective against rotavirus-associated hospitalizations and emergency department visits, and effectiveness in children persisted during the second year of life.

NVSN population-based study, 2006-2009
Effectiveness against hospitalization or ED visits
- 1 dose = 74% (37-90%)
- 2 doses = 88% (66-96%)
- 3 doses = 87% (71-94%)

Staat. Pediatrics 2011
Brief Report

Infant Rotavirus Vaccination May Provide Indirect Protection to Older Children and Adults in the United States

Ben A. Lopman, Aaron T. Curns, Catherine Yen, and Umesh D. Parashar
Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia

(See the editorial commentary by Glass, on pages 975–7.)

Following the introduction of rotavirus vaccination in the United States, rotavirus and cause-unspecified gastroenteritis discharges significantly decreased in 2008 in the 0–4, 5–14, and 15–24-year age groups, with significant reductions observed in March, the historic peak rotavirus month, in all
Infant Rotavirus Vaccination May Provide Indirect Protection to Older Children and Adults in the United States

• Database covering 20% of all US hospital admissions (Nationwide Inpatient Sample)
• Over 1000 hospitals in 42 states
• ICD-9CM codes for rotavirus and cause – unspecified gastroenteritis-associated hospital discharges 2000-2008
• Regression model to control for seasonal effects and secular trends

Lopman. JID 2011;204:980–6
Observed and Model-Predicted Monthly Rotavirus and Cause-Unspecified Gastroenteritis Discharges
Observed and Model-Predicted Monthly Rotavirus and Cause-Unspecified Gastroenteritis Discharges

(F) Cause-unspecified discharges; 0 to 4 years

(G) Cause-unspecified discharges; 5 to 14 years

(H) Cause-unspecified discharges; 15 to 24 years

Lopman. JID 2011;204:980–6
Infant Rotavirus Vaccination May Provide Indirect Protection to Older Children and Adults in the United States - Results

- Significant reductions in rotavirus and cause-unspecified gastroenteritis hospital discharges in the 0-4, 5-14, & 15-24 year age groups in 2008
- Estimated 66,030 hospitalizations prevented; 15% in the 5-24 year age group
- Approx. $204 million in averted hospitalization costs with 21% in the 5-24 year age group
  - Studies supporting introduction of rotavirus vaccine in US estimated potential cost savings from averted hospitalizations at $130 million
Conclusions

• Introduction of rotavirus vaccine has had an immediate and dramatic impact on the epidemiology and burden of rotavirus disease in the U.S.

• Marked indirect benefits among unvaccinated not anticipated and greatly enhanced impact of vaccination in initial assessment of vaccination program
Summary

• Uptake of new rotavirus vaccines improving steadily but lags behind other vaccines

• Value of monitoring the public health impact and safety of new vaccination programs using surveillance systems and epidemiological studies
  – Ongoing monitoring needed to determine if early effects will be sustained
  – Awaiting more data on duration of protection
Acknowledgements

Thank you to the following individuals who contributed information to this presentation:

• Umesh Parashar (CDC)
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• Janna Bardi (Washington State DOH)
Questions?