What’s Hot in Pediatric Infectious Diseases?

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Disclosures

• No Honoraria

• Not a Consultant

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  – CIHR; NIH; Burroughs Wellcome Fund; Allergen NCE
  – Advaxis; Merck; GSK
Objectives

• To highlight a selection of the most important and interesting literature in pediatric infectious diseases and vaccination from the last year

• To provide a global perspective on recent developments
Objectives

• To highlight a selection of the most important and interesting literature in pediatric infectious diseases and vaccination from the last year
• To provide a global perspective on recent developments
• (To provide a Canadian perspective on recent developments)
What We Don’t See

Margaret Kendrick Hostetter, M.D.

Broad SOCIAL Intervention (e.g. Sanitation)

KNOWLEDGE leads to Prophylaxis (e.g. Smallpox Eradication)

Global APPLICATION (e.g. HIV-ART in MTCT)

Lancet 2007; 370: 1040–54
Child Death
< 5 yo

- Neonatal Deaths, 41%
- Other noncommunicable diseases, 4%
- Pneumonia, 14%
- Preterm birth complications, 12%
- Birth asphyxia, 9%
- Sepsis, 6%
- Congenital abnormalities, 5%
- Tetanus, 3%
- Other, 2%
- Pertussis, 2%
- AIDS, 2%
- Malaria, 8%
- Injury, 3%
- Measles, 1%
- Diarrhea, 14%

61% of <5 y.o. deaths due to infections (globally)

Land
Population
Death < 5 yo due to infection
Early-onset neonatal sepsis: It is not only group B streptococcus anymore

Michael Sgro MD FRCPC¹, Mark H Yudin MD MSc FRCSC², Shoo Lee MD FRCPC PhD³, Koravangattu Sankaran MD FRCPC⁴, Dat Tran MD FRCPC MSc⁵, Douglas Campbell MSc MD FRCPC⁶

Paediatr Child Health Vol 16 No 5 May 2011
Changing Face of Neonatal Sepsis

• Predominant pathogen was GAS in 1930-1940 (pre-antibiotic era)
• The “Coliforms” emerged 1940-1960 (E. coli; P. aeruginosa in up to 20%)
• GBS starts rising in 1960s

Resurgence of (now Amp\textsuperscript{R}) E. coli: 1990 onward

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Gram-positive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBS</td>
<td>56</td>
<td>39</td>
<td>44</td>
<td>139</td>
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<tr>
<td>Enterococci</td>
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<td>4</td>
<td>6</td>
<td>13</td>
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<td>Other streptococci</td>
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<td>3</td>
<td>23</td>
<td>39</td>
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<td>2</td>
<td>5</td>
<td>6</td>
<td>13</td>
<td>3.8</td>
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<tr>
<td>Coagulase-negative staphylococci</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>14</td>
<td>4.2</td>
</tr>
<tr>
<td><em>Listeria</em></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Other Gram-positive species</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>8</td>
<td>2.4</td>
</tr>
<tr>
<td>Ampicillin-resistant, Gram-positive species</td>
<td>5</td>
<td>7</td>
<td>26</td>
<td>38</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>Gram-negative</strong></td>
<td>15</td>
<td>16</td>
<td>40</td>
<td>71</td>
<td>31.0</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Bacteroides</em> spp</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td>4.5</td>
</tr>
<tr>
<td><em>Klebsiella</em> spp</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td><em>Haemophilus influenza</em></td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>1.9</td>
</tr>
<tr>
<td>Other Gram-negative species</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>2.6</td>
</tr>
<tr>
<td>Ampicillin-resistant, Gram-negative species</td>
<td>12</td>
<td>12</td>
<td>38</td>
<td>62</td>
<td>18.5</td>
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<tr>
<td><em>Euplotes</em></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>Total ampicillin-resistant species</strong></td>
<td>17</td>
<td>20</td>
<td>66</td>
<td>103</td>
<td>30.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>96</td>
<td>78</td>
<td>161</td>
<td>355</td>
<td>100</td>
</tr>
</tbody>
</table>

Neonatal Sepsis in Canada

Early-onset neonatal sepsis: rate and organism pattern between 2003 and 2008

M Sgro1,2,5, PS Shah3,4,5, D Campbell1,2, A Tenuta4, S Shivananda6 and SK Lee3,4,5,
The Canadian Neonatal Network

What is *not* clear in 2012

• Whether the increase in Amp-resistance is due to:
  A. Antepartum or intrapartum antibiotic prophylaxis?
  B. Community changes in resistance?
• Global Strategy to combat neonatal sepsis

Pathogens in neonatal sepsis in the developing world:

- Not GBS!
- Gram-negatives predominate

Summary

1. Microbes causing neonatal sepsis are changing. Consider adapting empiric therapy.
Child Death < 5 yo

- Pneumonia: 14%
- Preterm birth complications: 12%
- Birth asphyxia: 9%
- Sepsis: 6%
- Other: 5%
- Congenital abnormalities: 3%
- Tetanus: 1%
- Measles: 1%
- Injuries: 3%
- Malaria: 8%
- Pertussis: 2%
- AIDS: 2%
- Other noncommunicable diseases: 4% (marked with an asterisk)

Diarrhea is highlighted.
Diarrhea: Rotavirus rules!

Globally, rotaviruses (RVs)
- cause of ~40% of all childhood gastroenteritis
- 125 million cases of acute gastroenteritis/yr
- ~ half a million deaths each year

The incidence of RV gastroenteritis is similar both in industrialized and in developing countries.

The outcome is not!

The Journal of Maternal-Fetal and Neonatal Medicine, 2011; 24(S(2)): 48-51
Nearly all children will be infected by RVs before the age of 3-5 years:
- highest incidence rate between 6-24 months of age
- greatest risk for developing severe disease by RV occurs under 12 months of age.

The Journal of Maternal-Fetal and Neonatal Medicine, 2011; 24(S(2)): 48-51
Diarrhea: Rotavirus rules!

In Canada:
- 36% of children with rotavirus will see a physician
- 15% will be assessed in an emergency room
- 7% will be hospitalized
- societal cost ranges from $8.9 to $18.4 million

- Journal of Infection Prevention 2011;
Diarrhea: Rotavirus vaccine rules!

Vaccine efficacy against severe rotavirus gastroenteritis ranges from 85% to 96% during the first rotavirus season and 79% to 86% during the second season.
Diarrhea: Rotavirus vaccine rules!

Efficacy of pentavalent rotavirus vaccine against severe rotavirus gastroenteritis in infants in developing countries in Asia: a randomised, double-blind, placebo-controlled trial


Lancet 2010; 376: 615–23
Diarrhea: Rotavirus vaccine rules?

In 1999 the rhesus tetravalent rotavirus vaccine (RRV, Rotashield, Wyeth) was withdrawn from the market due to a significantly increased risk of intussusception following vaccination.

The largest increased risk (30-fold) of intussusception was observed during the 3 to 7 days following the first dose of the vaccine.

Since then, 2 vaccines to prevent rotavirus infection have been licensed for use in the United States:
- a pentavalent rotavirus vaccine (RV5, RotaTeq, Merck) in 2006
- a monovalent rotavirus vaccine (RV1, Rotarix, GlaxoSmithKline Biologicals) in 2008.
Diarrhea: Rotavirus **vaccine** rules?

A post-licensure safety study in the United States after 2 years of surveillance (~ 200,000 doses) did **not** find evidence for an increased risk of intussusception.

Diarrhea: Rotavirus vaccine rules?

However, 2 international post-licensure evaluations have observed an increased risk of intussusception in the first week after administration of the first dose of rotavirus vaccines:

- An Australian study, found a statistically significant increased risk of nearly 5-fold for intussusception in the week following the first dose of RV5.
  
  Vaccine. 2011;29(16):3061-3066.

- A study in Mexico and Brazil, found an approximate 5-fold increased risk of intussusception in the first week following the first dose of RV1 in Mexico but not in Brazil.

Diarrhea: Rotavirus vaccine rules?

Risk of Intussusception Following Administration of a Pentavalent Rotavirus Vaccine in US Infants

- 786 725 total RV5 doses, which included 309 844 first doses
- No statistically significant increased risk of intussusception with in either the 1- to 7-day or 1- to 30-day risk window.
Diarrhea: Rotavirus vaccine rules?

Risk of Intussusception Following Administration of a Pentavalent Rotavirus Vaccine in US Infants

“The benefits of rotavirus vaccination in US infants outweighs the potential risks, even if a risk similar to that seen in Mexico or Australia would exist in the United States.”
Diarrhea: Rotavirus **vaccine** rules!!

“Rotavirus vaccines are now recommended, and provided free (as of January 1st, 2012), to infants at the routine 2 month and 4 month immunization appointments”.

- Ontario implemented RV1 in August 2011
- QC in November 2011
Global Rotavirus Deaths vs. Vaccination Coverage
Summary

1. Microbes causing neonatal sepsis are changing. Consider adapting empiric therapy.

2. Rotavirus infant vaccination is safe and effective. Give 2 doses before 8 months of age.
Child Death < 5 yo

- Pneumonia: 41%
- Other noncommunicable diseases: 4%
- Other infections: 9%
- Meningitis: 2%
- Pertussis: 2%
- AIDS: 2%
- Malaria: 8%
- Injury: 3%
- Measles: 1%
- Diarrhea: 14%
- Preterm birth complications: 12%
- Neonatal Deaths: 41%
- Birth asphyxia: 9%
- Sepsis: 6%
- Other: 5%
- Congenital abnormalities: 3%
- Tetanus: 1%

PNEUMONIA
THE FORGOTTEN KILLER OF CHILDREN
## Pathogen-Specific Causes of Severe Pneumonia Cases

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Distribution of severe pneumonia cases by cause</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em> (bacterium)</td>
<td>Leading cause</td>
<td><em>S. pneumoniae</em> is the leading pathogen in almost all studies from around the world. Recent vaccine trial data indicate that in Africa it may be responsible for over 50% of severe pneumonia cases, and probably a higher proportion of fatal cases. This proportion may vary in different parts of the world.</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em> (bacterium)</td>
<td>Major cause</td>
<td>Most disease is caused by type b (Hb). Vaccine studies from Bangladesh, Chile and the Gambia suggest that Hb causes around 20% of severe pneumonia cases, although the proportion may vary in different parts of the world.</td>
</tr>
<tr>
<td>Other important pathogens</td>
<td>Less common</td>
<td>These pathogens include important viruses such as respiratory syncytial virus (RSV) and influenza; other bacteria, such as <em>Staphylococcus aureus</em> and <em>Klebsiella pneumoniae</em>; and the fungus <em>Pneumocystis jiroveci</em> (PCP), which is particularly important in young children with AIDS (see Box 3, page 8).</td>
</tr>
</tbody>
</table>
Figure 11. Rates of Invasive Pneumococcal Infection per 100,000 among Children ≤ 23 Months of Age According to Year and Serotype*

PCV7
(4, 6B, 9V, 14, 18C, 19F and 23F)

• PCV7 infant immunization has led to near eradication of vaccine-serotype invasive pneumococcal disease (IPD) in vaccinated Canadian children as well as in older children and adults, through herd effect.
Strain Replacement?

Proportion responsible for PID (%)

<table>
<thead>
<tr>
<th>Time period</th>
<th>7vPCV serotypes</th>
<th>Non 7vPCV serotypes</th>
<th>19A serotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-2001 (n=278)</td>
<td>80</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>2002-2004 (n=145)</td>
<td>80</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>2005-2007 (n=59)</td>
<td>50</td>
<td>70</td>
<td>30</td>
</tr>
</tbody>
</table>

Paediatric Respiratory Reviews; in press 2012
Strain Replacement?

Serotype replacement in disease after pneumococcal vaccination

Daniel M Weinberger, Richard Malley, Marc Lipsitch

- Among asymptomatic carriers, the prevalence of non-vaccine types (NVTs) has increased substantially post PCV7
- In many populations, pneumococcal disease caused by NVT has increased
- In most cases this increase has been less than the increase in NVT carriage (except in Alaska)
Strain Replacement?

complex interactions of host and pathogen lead to changes in patterns of colonization

• diversity of a pathogen (*i.e.* strain replacement) can be explained by the interaction of acquired (capsular) specific and nonspecific immunity to pneumococcus

= attention to the details of immune responses needs to be paid to gauge the impact of vaccines
Strain Diversity

North America

European

Middle East

Asia Pacific

Latin America

Africa

Paediatric Respiratory Reviews; in press 2012
PCV13
(PCV7 & 1, 3, 5, 6A, 7F and 19A)

• The serotypes in PCV13 are the most common serotypes causing IPD globally, accounting for 75% of IPD in children <5 years of age worldwide.
• PCV13 would prevent 64% of the remaining cases of invasive pneumococcal disease (IPD) in children in, mostly attributed to serotype 19A (42%), including serotype 5, which has recently emerged in Western Canada.
• Pneumococcal empyema would also be better covered, given that only 48% of isolates in Canada were PCV7 serotypes, whereas the remainder were contained with PCV13.
Safety and Immunogenicity of a 13-valent Pneumococcal Conjugate Vaccine in Healthy Infants and Toddlers Given With Routine Pediatric Vaccinations in Canada
• Double-blind RCT
• Children at 2, 4, 6, and 12 months received PCV13 (n= 300) or PCV7 (n= 303) with routine immunizations
• 1 month later responses to Hib, pertussis, menC, and specific pneumococcal serotypes were measured
• Safety and tolerability were assessed daily for 4 days by parents
• No statistically significant differences between the groups in responses to Hib, pertussis, or menC after primary or booster vaccinations.
• >95% of subjects in the PCV13 group had antibody titers correlating with protection (>0.35 mcg/mL) to each pneumococcal serotype 1 month after the third dose, except with serotypes 23F (90%), 3 (80%), and 5 (87%).
• After the fourth dose, 98% to 100% of subjects achieved protective serotype-specific antibody concentrations except for serotype 3 (85%).
• Safety and tolerability did not differ between groups.
The Pneumococcal Conjugate vaccine (PCV 13) protects against infection from 13 types of pneumococcal bacteria and is free for children as part of their routine immunizations.

Similar program for PCV13 in all provinces.
Pneumonia (all causes)
In 2011,
- Kenya introduced the PCV10
- Sierra Leone introduced PCV13
Summary

1. Microbes causing neonatal sepsis are changing. Consider adapting empiric therapy.

2. Rotavirus infant vaccination is safe and effective. Give 2 doses before 8 months of age.

3. PCV7 is effective. PCV13 is safe & immunogenic.
Child Death
< 5 yo

- Pneumonia: 14%
- Preterm birth complications: 12%
- Neonatal deaths: 41%
- Birth asphyxia: 9%
- Sepsis: 6%
- Other: 5%
- Congenital abnormalities: 3%
- Tetanus: 1%
- Malaria: 8%
- Injury: 3%
- Measles: 1%
- Other noninfectious diseases: 4%
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- Pertussis: 2%
- Meningitis: 2%
- AIDS: 2%
- Diarrhea: 14%

61% of deaths < 5 yo due to infection
Global APPLICATION

Broad SOCIAL Intervention

KNOWLEDGE leads to Prophylaxis
Objectives
Child Death < 5 yo

- Pneumonia: 41%
- Neonatal deaths:
  - Preterm birth complications: 12%
  - Birth asphyxia: 9%
  - Sepsis: 6%
  - Other: 5%
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- AIDS: 2%
- Malaria: 8%
- Injury: 3%
- Measles: 1%
- Diarrhea: 14%

Pneumonia (all causes)
2007-2009 Mean Invasive Pneumococcal Rates by Age, Gender and Status

(FN = First Nations)

Marcus Lem, MD, MHSc, FRCPC
Health Protection Directorate, First Nations and Inuit Health, Health Canada - BC Region
• Disproportionate burden of respiratory tract infection among First Nations living on-reserve and Inuit children.

(No data for First Nations without status, Métis and urban Aboriginal children.)
Child Death < 5 yo

Neonatal Deaths, 41%

Diarrhea

Pneumonia

Other noncommunicable diseases, 4%*

Other infections, 9%

Meningitis, 2%

Pertussis, 2%

AIDS, 2%

Malaria, 8%

Injury, 3%

Measles, 1%

Preterm birth complications, 12%

Birth asphyxia, 9%

Sepsis, 6%

Other, 5%

Congenital abnormalities, 1%

Tetanus, 1%

14%

14%
Diarrhea (all causes)
“Prolonged diarrhea and malnutrition are primary causes of morbidity and mortality in Canadian native populations.”
(no reference)

- No data on gastroenteritis in the report.
Child Death < 5 yo

- Neonatal Deaths, 41%
- Sepsis, 6%
- Pneumonia, 14%
- Other noncommunicable diseases, 4%
- Other infections, 9%
- Meningitis, 2%
- Pertussis, 2%
- AIDS, 2%
- Malaria, 8%
- Injury, 3%
- Measles, 1%
- Diarrhea, 14%
- Preterm birth complications, 12%
- Birth asphyxia, 9%
- Other, 5%
- Congenital abnormalities, 3%
- Tetanus, 1%
Newborn death < 1 week of age (all causes)
• Neonatal mortality among First Nations is nearly twice the rate in the general Canadian population
• Neonatal mortality among Inuit is four times higher than the general Canadian population
• No data (yet) on specific causes of neonatal sepsis in First Nations or Inuit newborns.
“But gradually, the attitude of helplessness changed, first to inquiry and then to responsibility.”
Thank You!

Questions?

tkollm@mac.com
Child Death

< 5 yo

~1870

Infant mortality and related statistics, Canada, 1921-1990 (STC 82-549)
“With the exception of Japan, Canada has had the most dramatic decline in infant mortality rates in the past 35 years.”
“With the exception of Japan, Canada has had the most dramatic decline in infant mortality rates in the past 35 years.”

http://www.phac-aspc.gc.ca/publicat/meas-haut/mu_c-eng.php#fig1
Pneumonia is a major cause of child deaths in every region

% under-five deaths due to pneumonia, by UNICEF region:

<table>
<thead>
<tr>
<th>Region</th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
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</thead>
<tbody>
<tr>
<td>South Asia</td>
<td>21%</td>
<td>13%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>21%</td>
<td>7%</td>
<td></td>
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</tr>
<tr>
<td>Middle East and North Africa</td>
<td>15%</td>
<td>11%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>15%</td>
<td>9%</td>
<td></td>
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<tr>
<td>Latin America and Caribbean</td>
<td>14%</td>
<td>8%</td>
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<tr>
<td>CEE/CIS (Central and Eastern Europe and the Commonwealth of Independent States)</td>
<td>13%</td>
<td>8%</td>
<td></td>
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<tr>
<td>Developing countries</td>
<td>20%</td>
<td>9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrialized world</td>
<td>2%</td>
<td>3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>World</td>
<td>19%</td>
<td>10%</td>
<td></td>
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</tbody>
</table>

Pneumonia
Neonatal severe infections (mainly pneumonia/sepsis)
Strain Replacement?

Kim Mulholland, Catherine Satzke  www.thelancet.com  Vol 379 April 14, 2012

• Although many countries have published replacement data, none are from the developing world.


• Increase in 19A (more often antibiotic resistant) occurred already prior to PCV7 in several parts of the world.

What is clear in 2012

- Immunize with **PCV13** at 2, 4 and 12 months of age
- Infants and children at higher risk should get four shots of PCV13 (2, 4, 6 and 12 months)

- Give **Pneumococcal Polysaccharide** vaccine as an additional vaccine at 2 years of age in very high risk children.

- Pneumococcal Polysaccharide vaccine is recommended for **adults** who are at high risk of getting sick from pneumococcal infections (everyone > 65 years of age; earlier if specific medical conditions exist)
Invasive Pneumococcal Rates (2007-2009) due to PCV13 serotypes (excluding PCV7 serotypes)

All Ages

(FN = First Nations)

Marcus Lem, MD, MHSc, FRCPC
Health Protection Directorate, First Nations and Inuit Health, Health Canada - BC Region
Reports of invasive pneumococcal disease among First Nations by dwelling (2007-2009)

- On Reserve: 37%
- Off Reserve: 63%

Marcus Lem, MD, MHSc, FRCPC
Health Protection Directorate, First Nations and Inuit Health, Health Canada - BC Region
October 12, 2011
‘Neglected Infectious Diseases in Aboriginal Communities’
Thunder Bay, ON
Neonatal Sepsis & Premature Birth
# Neonatal Sepsis & Premature Birth

![Image of a baby in an incubator](image)

2 MAY 2012

## Table of Birth Data

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Canada</td>
<td>383,100</td>
<td>7.8</td>
<td>1.0</td>
<td>600</td>
<td>1,400</td>
<td>99</td>
</tr>
</tbody>
</table>

www.who.int/pmnch/media/news/2012/borntoosoon
Diarrhea: Rotavirus vaccine rules?

56 Total cases of intussusception identified (2006-2010)

26 Postcomparison vaccine cases
   17 ED and hospital
   9 Outpatient

30 Post-RV5 Cases
   21 ED and hospital
   9 Outpatient

2 ED Cases excluded (missing hospital or medical records)

9 Outpatient cases excluded

Medical Record Review
   17 Confirmed cases
   15 ED and hospital
   2 Outpatient

Medical Record Review
   14 Confirmed cases
   12 ED and hospital
   2 Outpatient

Historical Rate Comparison Analysis
   21 ED and hospital cases

9 Excluded (received vaccine at ≥34 weeks)

Concurrent Group Analysis
   22 Included
   8 Postcomparison vaccine cases
   14 Post-RV5 cases
Diarrhea: Rotavirus rules!
RV associated morbidity
(Canada)

Not just Vomiting & Diarrhea (and dehydration).

- 19% presented with signs and/or symptoms suggestive of sepsis
- 8% suggestive of other serious manifestations*
- 7% with seizures

And
- 7% of healthy children in our study had concomitant infection
- 13% to 22% of hospitalized patients had underlying conditions.

PIDJ 29:879, 2010
Diarrhea: Rotavirus rules!
Nosocomial RV infection
(Canada and beyond)

- **nosocomial** RV infections represented one quarter of all RV infections
- annual rate of 0.45 per 1000 hospital days
- 60% of cases were less than 1 year of age
- 75% had underlying medical illnesses
- 8% required re-admission after discharge due to nosocomial RV

- Journal of Infection Prevention 2011;
Diarrhea: Rotavirus rules!
Cost of RV infection (Canada)

• In Canada, estimated annual healthcare cost for children requiring a rotavirus ED visit ranges from $4.5 to $9.3 million

• When parental costs are included, the total societal cost ranges from $8.9 to $18.4 million
Child Death < 5 yo

Whooping cough outbreak in Yukon

Whooping cough outbreak confirmed in New Brunswick
Health department confirms 47 cases

B.C. prepares for whooping cough outbreak
Fraser East residents urged to get vaccinated
Pertussis Resurgence in Canada

• Changes in the childhood immunization programs?

• Waning immunity?

• Changes in laboratory methods?
Pertussis Resurgence in Canada

The Journal of Infectious Diseases 2002;185:1448–53
Recent surge in pertussis reflects a true increase in local disease activity

However, the apparent size of the outbreaks has likely been magnified by increasing use of pertussis testing by clinicians, and by improved test sensitivity since 2005.
Non-infant/child Pertussis Vaccination

Tdap is recommended for:

• Adults who have not previously received Tdap and who have or who anticipate having close contact with infants younger than 12 months of age
• Healthcare personnel
• Immediately post-partum for pregnant women who had their last Td vaccine at least 2 years but less than 10 years earlier.
• Grade 9 students can get a single booster
Meningococcal C immunization programs have been launched across provinces in Canada

<table>
<thead>
<tr>
<th>Province</th>
<th>Infants</th>
<th>Children/Adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>2,12 mo</td>
<td>14-16 yrs</td>
</tr>
<tr>
<td>Alberta</td>
<td>2, 4, 12 mo</td>
<td></td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>12 mo</td>
<td>11-12 yrs</td>
</tr>
<tr>
<td>Manitoba</td>
<td>12 mo</td>
<td>10-11 yrs</td>
</tr>
<tr>
<td>Ontario</td>
<td>12 mo</td>
<td>12-14 yrs(ACYW135)</td>
</tr>
<tr>
<td>Quebec</td>
<td>12 mo</td>
<td>2001 only: 2-20 yrs</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>12 mo</td>
<td>14-16 yrs(ACYW135)</td>
</tr>
<tr>
<td>PEI</td>
<td>12 mo</td>
<td>14-16 yrs(ACYW135)</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>12 mo</td>
<td>14-16 yrs</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>12 mo</td>
<td>10-11 yrs, 14-16 yrs</td>
</tr>
<tr>
<td>NWT</td>
<td>2,12 mo</td>
<td></td>
</tr>
<tr>
<td>Nunavut</td>
<td>12 mo</td>
<td>14-16 yrs</td>
</tr>
<tr>
<td>Yukon</td>
<td>2,12 mo</td>
<td>14-16 yrs</td>
</tr>
</tbody>
</table>