Infectious disease prevention in children: how far have we come in 10 years?

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10 years on - how has the world changed for our kids?
How far have we come?

• **Successes**
  – Reduction in serious life-threatening conditions in children
    • Meningitis caused by *Haemophilus influenzae*, meningococcus, pneumococcus
    • Varicella (Chicken pox) and Herpes zoster (shingles)
    • Rotavirus and all-cause Gastroenteritis

• **Future challenges**
  – Current serious infectious diseases causing death and disability in children
    • Meningococcal B meningitis and septicaemia
    • Pertussis (whooping cough)

• Optimising the dual benefit of immunisation programs (direct and indirect protection) over the next 10 years
How far have we come?

1940 – Donald Hamilton (Sydney paediatrician)

In the previous 50 years pertussis had killed more children under 5 than diphtheria. That year it destroyed 85 infants in our hospital out of 293 admitted. Very many of the infants stopped breathing in their spasms and their colour blackened till a nurse rushed to revive them with oxygen....pneumonia often developed and they lay there in their little cots, emaciated and weak, wracked by their coughing spasms, losing their nutrition by the vomiting or the very breath of life by the respiratory spasms that their cough brought on.

When Director of Health was approached about campaigning for pertussis immunisation his response was “a hospital was to treat illness not prevent it”
Haemophilus influenzae (Hib)

Haemophilus influenzae (Hib)

- A common cause of meningitis, epiglottitis and pneumonia prior to introduction of Hib vaccine
- Meningitis and epiglottitis are almost invariably fatal without treatment
- Most commonly affects children < 5 years, children < 2 years at highest risk of infection
- 3% of children die from Hib meningitis and up to 30% have sequelae including deafness and brain injury
- 3-5% of healthy school-aged children carry Hib bacteria in their naso-pharynx

Impact of Hib vaccine on Hib disease

- Introduced into the Australian Immunisation Program in July 1993
- Schedule 2,4,6 months with a booster vaccination at 12 months
- 549 cases in 1992 – 11 cases in 2013 (<5 year olds)

95% reduction in notifications of Hib disease in the past decade

10-15 deaths per year prior to introduction of Hib
Reduction in Hib disease in both developed and developing countries
Indirect (herd immunity) effects of Hib vaccination

- proportion of children immunised
- carriage of Hib
- transmission of Hib
- Hib disease in unimmunised individuals

Hib notifications in the UK

Meningococcal disease

Meningitis and septicaemia
- Caused by serogroups A,B,C,W,X,Y
- Approx. 240 cases per year in Australia
- Case fatality rate of 5-10%
- Bimodal pattern of disease
  - Children < 5 years of age, particularly infants < 6 months of age
  - Adolescents, 15-24 years of age
- Complications (sequelae)
  - Limb amputation due to limb ischaemia/gangrene, deafness, skin scarring

Carriage
- 5 -11% of adults (up to 25% in teenagers)
- invasive strains generally <1 - 2%

Approximately 1/3 of cases of meningococcal disease were due to serogroup C prior to introduction of the Men C vaccine

Meningococcal vaccination

- Meningococcal C immunisation introduced in 2003
- One dose of Men C vaccine is provided to children at 1 year of age
- Vaccines against Meningococcal A, C, W and Y strains are also available for private purchase but not part of a funded program
Impact of Men C vaccine on Meningococcal C disease

Meningococcal serogroup C disease notification rates, Australia, 1999 to 2007, by age group and year of diagnosis in age groups offered vaccination

Direct protection

Impact of Men C vaccine on all age groups (vaccinated and unvaccinated)

- Meningococcal serogroup C disease notification rates, Australia, 1999 to 2007, by age group and year of diagnosis, in all age groups

Reduction in varicella (chicken pox) and Herpes zoster (shingles) since varicella vaccine introduction

- Since introduction of varicella vaccine in a funded immunisation program, there has been a 68% reduction in varicella related hospitalizations
- 80% of the children who were hospitalized were not immunized, including three previously healthy children who needed intensive care

Direct and indirect benefits of rotavirus vaccine introduction

Age-specific RVGE and ACGE hospitalisation rates per 100,000 children; pre and post rotavirus vaccine introduction

Future challenges

Meningococcal B disease
Pertussis (whooping cough)
Meningococcal B Disease

- Serogroup B is now the cause of 85% of cases of meningococcal disease in Australia
- Incidence 1:100,000, but up to 12/100,000 in infants < 12 months
- Case fatality rate is high despite antibiotic treatment (5-10%)
  - Sequelae in up to 57% of survivors
    (major sequelae include amputations, hearing loss, skin scarring)
- Bimodal pattern of disease
  - Peak incidence in infants < 6 months of age; CFR 8%
  - 2nd peak incidence in adolescents; CFR~10%

CDI 2007;31(1):63
Men B vaccine

- Recently licensed in Australia, Canada and the EU
- Currently available in Australia for private purchase
- UK Joint Committee on Vaccines and Immunisation, UK has recommended the Men B vaccine be included in the national immunisation program
- Inclusion of the Men B vaccine in the funded Australian immunisation program is currently under review by the PBAC
Challenge: Pertussis (whooping cough) still causes deaths in babies < 6 months of age

• Pertussis
  – bacterial respiratory infection (Bordetella pertussis)
  – highly infectious (spreads to 90% susceptible household contacts)
  – affects all ages, strictly human

• Complications
  – pneumonia
  – seizures
  – hypoxic encephalopathy
  – cardiomyopathy

• Case fatality 0.03%
  (< 6 months 0.8%)
Epidemics in Australia

Notification of pertussis in South Australia, by age-groups (years):
2001 to 2014 YTD

- Removal 18 mth DTPa Sept 2003
- Yr 9 DTPa Jan 2004

Disease Surveillance & Investigation Section, Communicable Disease Control Branch, South Australia Health.
Challenge: pertussis epidemics still occur

Vaccine efficacy in children following primary vaccination
- wP: variable efficacy (64–96%)\(^1\) good wP vaccines up to 96%
- aP: 84–85%\(^2\)

Challenge: Preventing pertussis in newborn infants who are at highest risk of dying

Infant pertussis immunisation schedule

- 2, 4, 6 months, boosters at 4 years and 13 years of age

Strategies to protect the most vulnerable infants

- Cocooning
- Neonatal vaccination
- Maternal vaccination

Antibody responses to pertussis toxin (anti-PT) when pertussis vaccine is administered at birth

In conclusion

• Immunisation has contributed significantly to preventing death and disability from serious infections in children over the past decade

• We need to improve uptake of vaccines in the community to optimise the dual benefit of direct and indirect protection

• There is the potential to improve reduction in disease even further over the next decade with new vaccines becoming available against life-threatening infections

• We need to continue to provide evidence on the significant benefits vaccines have delivered and ensure parents continue to feel confident in their decision to have their children immunised