Early Impact of PCV10/PCV13 Vaccine Program on Invasive Pneumococcal Disease (IPD) in Toronto, Canada

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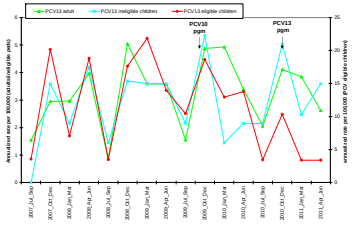
Abstract

Objective:
To assess the Ontario PCV10/PCV13 immunization program.

Methods:
TIBDN has performed population-based surveillance for IPD in Toronto/Peel (4M) since 1995. Publicly funded PCV programs started as follows: PCV7: 1/2005 (2,4,6,15m), PCV10: 10/2009 (2,4,6,15m), PCV13: 11/2010 (2,4,12m + catch-up 12-36m). We compare post-PCV10/13 IPD in vaccine eligible (VEC) & ineligible children (VIC).

Results:
For 2005-10, adult IPD incidence was stable: 8/100,000/y. The percent of IPD due to PCV7 serotypes (STs) declined: 51% pre-PCV7 - 7% in 2011; that of PCV13/not7 increased (18-45%). 19A comprised 25% of PCV13/not7 STs in 2007 and 39% in 2010, 7F 16% (2007) and 33% (2010). In children <5y, IPD decreased: 37.3 pre-PCV7 - 13.5/100,000/y in 2010. The percent of PCV7 STs decreased (79-10%); PCV13/not7 STs increased (8-65%). Among PCV13/not7 STs, 19A was stable (65%); 7F increased (0-19%). By Jan 2011, children 6-35m should have received adequate PCV13 (=VEC). Compared to Jan-Jun 2008-10, PCV13/not7 incidence in Jan-Jun 2011 did not change for adults or VIC; that in VEC decreased (14 - 3.4/100,000/y, P=.06) (Figure).



All cases of PCV13/not7 ST IPD in VEC in 2011 were in children >12m with PCV7/10 at 2, 4, 6m, but no PCV at >12m or PCV13.

Conclusion: PCV13 & PCV10 appear to prevent IPD due to additional STs. Catch-up dose uptake and conversion to PCV at 12m vs. 15m was incomplete in the program's first 2m.

Methods

From 1995 to 2011, all sterile site isolates of pneumococci identified through population-based surveillance for invasive pneumococcal disease (defined as illness associated with a sterile site isolate of *S. pneumoniae)* were collected in metropolitan Toronto and Peel region.

Serotype is determined using latex pneumococcal antisera (Statens Serum Institute, DK) and the Quellung reaction. Population data are obtained from Statistics Canada. Demographic and clinical data are collected from review of health records and interviews with patients and attending physicians.

PCV programs in Ontario

In Ontario, PCV7 was licensed in June 2001 and, in January 2002, the Canadian National Advisory Committee on Immunization (NACI) recommended routine vaccination of all children aged <24 months. By late 2002, uptake in the private market resulted in usage of approximately 1 dose per child in the birth cohort in Ontario; data on the distribution of these doses are not available. In January 2005, PCV7 became publicly funded for healthy children. PCV10 was introduced in October 2009 and PCV13 in late November 2010 (Table 1).

Table 1: Licensing and public funding of pneumococcal conjugate vaccines for healthy children, Ontario.

Date	Vaccine	Availability/program change
Jun 2001	PCV7	Licensed (available private market)
Jan 2005	PCV7	Public funding for routine immunization (2,4,6, 15 months)
Dec 2008	PCV10	Licensed
Oct 2009	PCV10	Replaces PCV7 in publicly funded program Children who have had ≥1 dose of PCV7 to complete course with PCV7
Dec 2009	PCV13	Licensed
Nov 2010	PCV13	Replaces PCV10 in publicly funded program Change to 3 dose (2,4,12 months) Catch-up PCV13 dose for children 12-36 months who have completed PCV7 schedule

As shown in Figure 1, the introduction of PCV7 and the routine infant PCV7 vaccination program were associated with a prompt reduction in disease (overall and due to PCV7 serotypes in children under 5 years, and a more delayed reduction in disease due to PCV7 serotypes in older children and adults). In older children and adults, overall rates of disease have not changed due to an increase in disease caused by non-PCV7 serotypes.

Figure 1a: Rate of IPD by serotype category in children aged <5 years.

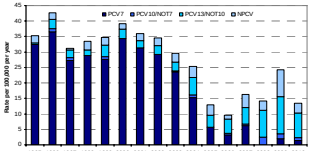


Figure 1b: Rate of IPD by serotype category in children aged 5-14 years.

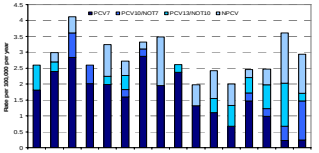
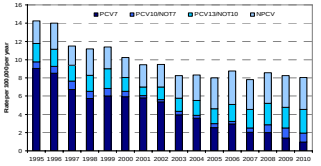


Figure 1c: Rate of IPD by serotype category in adults.

(Publicly funded PPV23 was introduced for at risk adults in November, 1996.)



Results (cont'd)

During 2010, 51 cases of IPD due to serotypes included in PCV13 were identified in children in our surveillance area. The serotype distribution of the 39 isolates in children under 5 years was: 19A (26), 7F (7), 3 (2), 19F (2), 23F (1), 6A (1). In children 5-15 years old, the serotype distribution was: 7F (9), 19A (1), 6A (1), 6B (1).

Because PCV10 was introduced into the birth cohort in November 2009 (Table 1), only children 2 months of age or less as of November 2009 would have had any protection against PCV10/not7 STs in 2010 and protection would be incomplete (<3 doses) until October 2010 at the earliest.

If the subsequent November 2010 PCV13 program uptake was complete by January 2011, most children aged 6-35 months during 2011 should have been protected from PCV13 serotype IPD. The exception would be children aged >4 months to <10 months in November 2010, who should not have received a dose of PCV13 until they were 12 months old (between January and June 2011). However, concern about the efficacy of the three dose program might have led pediatricians to give an additional dose of PCV13 to some members of this group.

We therefore anticipated that, if extended spectrum conjugate vaccines were effective against IPD, rates of disease due to PCV13/not7 serotype pneumococci should decrease in 2011 compared to 2008-2010 in children aged 6-35 months, but not change in other children and adults.

The six-month rate (Jan-June) of IPD due to PCV13/not7 serotypes in children aged 6-35 months decreased from a mean of 7.4 per 100,000 in years 2008-10 combined to 2.6 per 100,000 in 2011. Rates of PCV13/not7 in other children and adults did not change. (Figure 2)

Figure 2a: Rate of IPD due to PCV13 not PCV7 serotypes in children aged 6-35 months, by 6 month period Jan 2008 to July 2011.

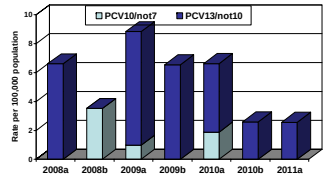


Figure 2b: Rate of IPD due to PCV13 not PCV7 serotypes in children 0-6months and 3-14 years of age, by 6 month period, Jan 2008 to July 2011.

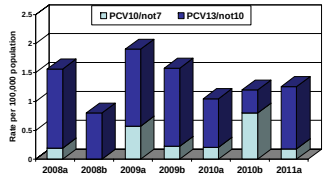
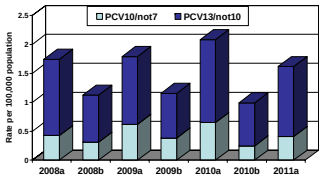


Figure 2c: Rate of IPD due to PCV13 not PCV7 serotypes in adults (15+ years), by 6 month period Jan 2008 to July 2011.



Results (cont'd)

To date in 2011, no cases of IPD due to PCV7 serotypes have been identified in children <5 years of age. Characteristics of cases of IPD due to serotypes included in PCV13 but not PCV7 are shown in Table 2. All but two cases occurred in children who were either ineligible for vaccination or missed the catch-up PCV13 dose.

Table 2: Characteristics of 2011 cases of IPD (to September 7, 2011) caused by serotypes included in PCV13 in children <5 years of age.

Date of infection	Serotype	Age (months)	Chronic illness	Vaccination history	Classification
2011/01/15	3	0	None	N/A	Too young for vaccination
2011/01/30	19A	16	None	PCV7 at 2, 4, and 6 mos; missed 12 mo PCV7 and catch-up PCV13	Missed catch-up PCV13
2011/02/08	3	51	None	Single dose PCV7 at 41 mo	Program ineligible
2011/02/28	19A	14	None	PCV7 at 2, 4, and 6 mos; missed 12 mo PCV13	Missed catch-up PCV13
2011/03/12	19A	58	None	PCV7 at 2, 4, 6, and 13 mos	Program ineligible
2011/03/19	19A	53	None	PCV7 at 2, 4, 7, and 18 mos	Program ineligible
2011/04/17	19A	18	None	PCV7 at 2, 4, and 6 mos; missed 12 mo PCV7 and catch-up PCV13	Missed catch-up PCV13
2011/05/02	3	2	Pierre Robin syndrome	N/A	Too young for vaccination
2011/05/11	7F*	41	None	PCV7 at 2, 5, 7, and 17 mos	Program ineligible
2011/05/23	3	59	Tetralogy of Fallot	PCV7 at 2, 4, 6 and 42 mos	Program ineligible
2011/06/13	19A	16	Down syndrome, ASD	PCV13 at 14.5 mos	Post single dose PCV13
2011/07/12	19A	33	None	PCV7 at 2, 4, 10, and 15 mos	Missed catch-up PCV13
2011/08/20	19A	10	None	PCV10 at 2 mo; PCV13 at 4 and 6 mos	Post 2 doses PCV13 (4,6 mos)
2011/08/26	3	35	None	PCV7 at 2, 4, 6, and 15 mos	Missed catch-up PCV13

*Serotype included in both PCV10 and PCV13. All other cases due to PCV13/not10 strains.

Conclusions

These early data suggest that PCV13 is effective in preventing IPD due to serotype 19A strains and either/both PCV10 and PCV13 are effective in preventing IPD due to serotype 7F strains.

About half of cases of IPD in our surveillance area in 2011 occurred in children who were either too young to be vaccinated or too old to be eligible for vaccination in our program. Most of the remainder occurred in children who were eligible for a "catch-up" dose of vaccine but did not receive it.

Two cases of IPD, both due to serotype 19A, were identified in children who had received PCV13. One case aged 16 months had received 1 dose of PCV13 at 14 months; another aged 10 months had received 2 doses of PCV13 at 4 and 6 months of age.

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