Invasive pneumococcal disease in birth cohorts receiving PCV7 and PCV10 vaccine regimens in Metropolitan Toronto and Peel Region, 2008-2010

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Presentation/Poster Board # 503

Abstract

Background: There are limited data on how effective PCV10 is at preventing invasive pneumococcal disease (IPD) in children. We performed an epidemiologic analysis to compare IPD in cohorts of children immunized with PCV7 only or with PCV10.

Methods: From 2007 to 2010, all sterile site pneumococcal isolates identified through population-based surveillance for IPD were collected in metropolitan Toronto and Peel region. Serotype was determined using latex pneumococcal antisera (Statens Serum Institute, DK) and the Quellung reaction. PCV7 was introduced in Ontario in January 2005; PCV10 in December 2009 and PCV13 in November 2010. Children born between January 2008 and December 2010 were used to identify birth cohorts in which children had received PCV7 only or PCV10 (2 doses in children aged <5 months or one dose at age >12 months). Observation periods were truncated for age, to determine the effects of post-primary/pre-booster and post-booster to end of follow-up.

Results: The incidence of IPD in children aged 5-11 months who received PCV10 for the primary series was lower compared to those of the same age who received PCV7 (Table 1). Similarly, children who received PCV7 for the primary series and PCV10 as a booster at age 12-15 months had a lower incidence of IPD between ages 16 and 22 months compared to those who received PCV7 for both primary and booster (Table 1).

Table 1. Incidence of IPD in different cohorts exposed to vaccines for primary and/or booster series

Birth Cohort	Observation period	Persons at risk	Person-years at risk	Vaccine for primary and/or booster	IPD cases					IPD rate per 100000 person years
					PCV7 types	Additional PCV10 types	19A	Other types	All types	
Jan 09–Jun 09	5–11 months	27049	10143	PCV7	0	0	1	1	2	19.7
Jan 10–Jun 10	5- 11 months	27237	10214	PCV10	0	0	1	0	1	9.8
Feb 08–Aug 08	16–22 months	27215	9072	PCV7PCV7	1	0	1	1	3	33.1
Feb 09–Aug 09	16-22 months	27288	9096	PCV7PCV10	0	0	1	0	1	11.0

Conclusion: The overall IPD risk was lower in children who were exposed to PCV10 compared to PCV7, supporting similar data from the province of Quebec. Results should be interpreted with care due to small sample size; further collaboration with additional surveillance networks should be explored.

Introduction

Public funding for pneumococcal conjugate vaccines was first implemented in 2005; 3+1 doses for low-risk children (2, 4, 6 and 15 months). PCV7 was first used, replaced by PCV10 in Oct 2009 and then PCV13 in Nov 2012. There is currently limited data on the effectiveness of PCV10 to prevent invasive pneumococcal disease (IPD) in children in Ontario.

The objective of this study is to determine the incidence and serotype distribution of IPD in a cohort of children immunized with PCV7 and/or PCV10 vaccine using population data collected from Toronto Invasive Bacterial Diseases Network (TIBDN).

The Toronto Invasive Bacterial Diseases Network (TIBDN) has performed population-based surveillance for invasive pneumococcal disease in metropolitan Toronto and Peel region (pop 4M) since January 1, 1995.

Methods

From 2008 to 2010, 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 was determined using latex pneumococcal antisera (Statens Serum Institute, DK) and the Quellung reaction.

The eligible population for analysis was all children born between January 2008 and December 2010. Follow up was until December 31, 2010. Population estimates for each month in years 2008 and 2009 were obtained from Statistics Canada; estimates for year 2010 were based on projected estimates.

PCV programs in Ontario

PCV7 was first publicly funded in Ontario in 2005, with four doses scheduled at 2, 4, 6 months (primary series) and 15-18 months (booster); PCV10 replaced PCV7 in 2009, with four doses scheduled at 2, 4, 6 months (primary series) and 15-18 months (booster); PCV13 replaced PCV10 in 2010, with three doses scheduled at 2, 4 months (primary series) and 12 months (booster). Beginning in November 2010, a single catch-up dose of PCV13 was recommended for children aged 13-36 months who had not yet received a dose of this vaccine (Table 1).

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

Date	Vaccine	Availability/program change
Jun 2001	PCV7	Licensed (available private market)
Jan 2005	PCV7	Public funding for routine immunization
Dec 2008	PCV10	Licensed
Oct 2009	PCV10	Replaced PCV7 in publicly funding program Children who have had ≥1 dose of PCV7 to complete course with PCV7
Dec 2009	PCV13	Licensed
Nov 2010	PCV13	Replaced PCV10 in publicly funded program Change to 3 doses Catch-up PCV13 dose for children 12-26 months who have completed PCV7 schedule

Vaccine uptake in Toronto/Peel region

Birth cohorts were determined based on month of birth and the most likely vaccine regimen they would have received based on the Ontario vaccine recommendations at the time of their eligibility for each dose of vaccine. To more accurately identify the time gap between the announcement of a vaccine program and the shipment of vaccine to providers in Toronto and Peel, additional data was obtained from the Ontario Government Pharmaceutical and Medical Supply Services (OGPMSS) and Peel Public Health.

The main type of vaccine used for each month was defined as more than 75% of one particular vaccine distributed (Figure 1).

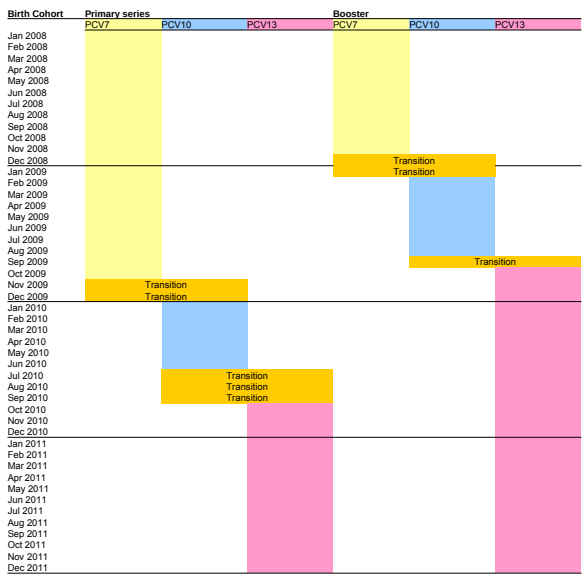

Figure 1. Distribution of pneumococcal vaccine received by month born in Toronto/Peel region

IPD incidence in Toronto/Peel region

As shown in Figure 2, the introduction of the publicly funded PCV7 infant vaccination program was associated with a dramatic reduction in the rate of IDP due to PCV7 serotypes. Disease due to PCV10/not7 serotypes increased in 2008 (the greatest proportion being 7F); then appeared to decrease.

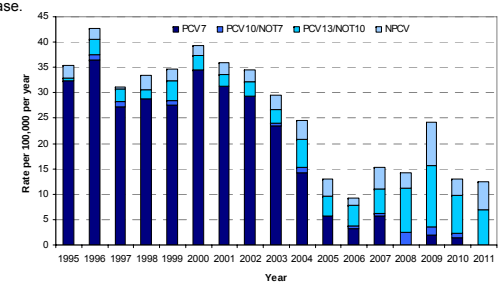

Figure 2. Rate of IPD by serotype category in children aged <5 years old, Toronto/Peel region, 2000 to 2011

A comparison was carried out in children born between Jan 2009 to Jun 2009 who received PCV7 for the primary series and children born between Jan 2010 and Jun 2010 who received PCV10 for the primary series. Follow up period was truncated between 5 to 11 months in the two groups to observe the post-primary/pre-booster effect. The incidence of IPD in children who received PCV10 for the primary series was lower than children who received PCV7 (Table 2).

Table 2. Incidence of IPD in different cohorts exposed to vaccines for the primary series

Birth Cohort	Observation period	Persons at risk	Person-years at risk	Vaccine for primary series	PCV7 types	Additional PCV10 types	19A	Other types	All types	IPD rate per 100,000 person years
Jan 09–Jun 09	5–11 months	27049	10143	PCV7	0	0	1	1	2	19.7
Jan 10–Jun 10	5- 11 months	27237	10214	PCV10	0	0	1	0	1	9.8

A second comparison was performed in children born between Feb 2008 and Aug 2008 who received PCV7 for both the primary series and booster and children born between Feb 2009 and Aug 2009 who received PCV7 for the primary series and PCV10 for the booster. Follow up period was truncated between 16 to 22 months in the two groups to observe the post-booster effect. The incidence of IPD in children who received PCV10 for the booster was lower than children who received PCV7 (Table 3).

Table 3. Incidence of IPD in difference cohorts exposed to vaccines for the primary series and booster

Birth Cohort	Observation period	Persons at risk	Person-years at risk	Vaccine for primary and/or booster	PCV7 types	Additional PCV10 types	19A	Other types	All types	IPD rate per 100,000 person years
Feb 08–Aug 08	16–22 months	27215	9072	PCV7PCV7	1	0	1	1	3	33.1
Feb 09–Aug 09	16-22 months	27288	9096	PCV7PCV10	0	0	1	0	1	11.0

Among children who were exposed to PCV10 for either the primary series and/or booster, the risk for nonPCV10 serotypes appears reduced compared to those who were only exposed to PCV7.

Conclusions

Significant reductions of IPD in children have been observed with the introduction of the pneumococcal conjugate vaccine programs in Ontario. In particular, children exposed to PCV10 appear to have a lower IPD risk compared to children exposed to only PCV7, supporting similar evidence found from the province of Quebec. Results should be interpreted with caution due to the limited number of cases observed; further collaboration with additional surveillance networks should be explored.

Acknowledgements:

We are grateful to the infection control practitioners, microbiology technologists, public health staff and our tireless TIBDN staff for their ongoing contributions to this surveillance. This work has been supported in part by *Glaxo-Smith-Kline*.