

Pertussis Outbreak Investigation Report

Office of the Chief Medical Officer of Health

Department of Health
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Summary

In January 2012, The Office of the Chief Medical Officer of Health (OCMOH) was notified of an increase in pertussis activity in Health Regions 1 (Moncton and surrounding areas) and 2 (Saint John and surrounding areas) in New Brunswick. At that time, available data was analyzed and compared with historical values to describe the epidemiology and determine if there was an aberration or outbreak. Over the next weeks, OCMOH monitored the provincial situation and more specifically these two Health Regions.

On February 27 2012, a provincial outbreak was declared based on comparisons with historical values, age specific rates and regional data. During this outbreak, 1421 confirmed cases were reported to Public Health. The outbreak was declared over at the end of January 2013 based on epidemiological data, including the return to 5 year rolling averages (baseline) rates. This outbreak has been the largest pertussis outbreak recorded to date in New Brunswick.

An outbreak control team (OCT) was established with members from the OCMOH and the Regional Health Authorities communicable disease coordinators. Many meetings and teleconferences were held from March 5th 2012 to February 7 2013.

The public health response to this outbreak involved many aspects including developing guidelines on testing, treatment and contact tracing; communications with community clinicians, government sectors, and the public.

Acronyms

CD	Communicable Diseases
CDC	Communicable Disease Control
OCMOH	Office of the Chief Medical Officer of Health
OCT	Outbreak Control Team
RDSS	Reportable Disease Surveillance System
PCR	Polymerase Chain Reaction
CNPHI	Canadian Network of Public Health Intelligence
FPT	Federal/Provincial/Territorial
Tdap	Tetanus, diphtheria, acellular pertussis

Introduction

This report contains a brief description of the pertussis outbreak epidemiology, public health measures that were implemented, the communication strategy, the coordination efforts and the lessons learned.

1. Outbreak epidemiology

1.1 Surveillance

1.1.1 Case finding enhanced surveillance

An enhanced surveillance system was developed and implemented to ensure timely surveillance and to capture additional data on pertussis cases that would be important to formulate hypotheses, monitor/describe the outbreak, identify risk groups, and inform targeted interventions. While the enhanced surveillance form and system were in the process of approval, the Regions were required to increase timeliness of data entry of pertussis cases in RDSS, and CDC Epi staff reviewed log-sheets from Region 1 to obtain up-to-date information. The enhanced surveillance system was approved internally and then implemented on March 9th 2012.

The enhanced surveillance form captured data on:

Demographics

Symptoms

Clinical outcomes

Details on linkages with other cases

Immunization status

Laboratory results

Please see Appendix 2 New Brunswick Enhanced Pertussis Surveillance Form.

1.1.2 Case definitions

The following national case definitions for pertussis were used during this outbreak.

Confirmed Case definition:

Laboratory confirmation of infection:

Isolation of *B. pertussis* from an appropriate clinical specimen

OR

Detection of *B. pertussis* DNA from an appropriate clinical specimen **AND** one or more of the following:

cough lasting 2 weeks or longer

paroxysmal cough of any duration

cough with inspiration "whoop"

cough ending in vomiting or gagging, or associated with apnea

OR

Epidemiologic link to a laboratory-confirmed case **AND** one or more of the following for which there is no other known cause:

paroxysmal cough of any duration
cough with inspiratory “whoop”
cough ending in vomiting or gagging, or associated with apnea

Probable Case Definition:

Cough lasting 2 weeks or longer in the absence of appropriate laboratory tests and not epidemiologically linked to a laboratory-confirmed case **AND** one or more of the following, with no other known cause:

paroxysmal cough of any duration
cough with inspiration “whoop”
cough ending in vomiting or gagging, or associated with apnea

Suspect Case Definition:

One or more of the following, with no other known cause:

paroxysmal cough of any duration
cough with inspiration “whoop”
cough ending in vomiting or gagging, or associated with apnea

Hypotheses

Several hypotheses were considered. However, the observation that most cases were seen in the 10-14 year old age group with a large percentage of them immunized with 5 doses of pertussis containing vaccine, lead to the main hypothesis of waning immunity of pertussis containing vaccine.

1.2 Epidemiological Summary ¹

Variation across Region

Of the 1421 confirmed cases, 1186 were laboratory confirmed and 235 were epi-linked confirmed cases.

The most affected Health Regions (based on rate) varied across the outbreak period. From January to June, the highest Region specific rates were seen in Regions 1 and 2. In mid-June, activity started to decrease for these Regions and increase in Regions 4 and 6 such that the latter Regions had the highest Region specific rates from that point until the fall. Over the entire outbreak period, the highest Region-specific rates varied over time. Overall Health Region 6 had the highest region-specific rate (407 per 100,000), followed by Health Region 4 (391 per 100,000).

¹ Please see Appendix 3 for latest Epidemiological Report.

Graph 1. Region Specific Incidence Rate (per 100,000) by Month (up to February 4 2013)

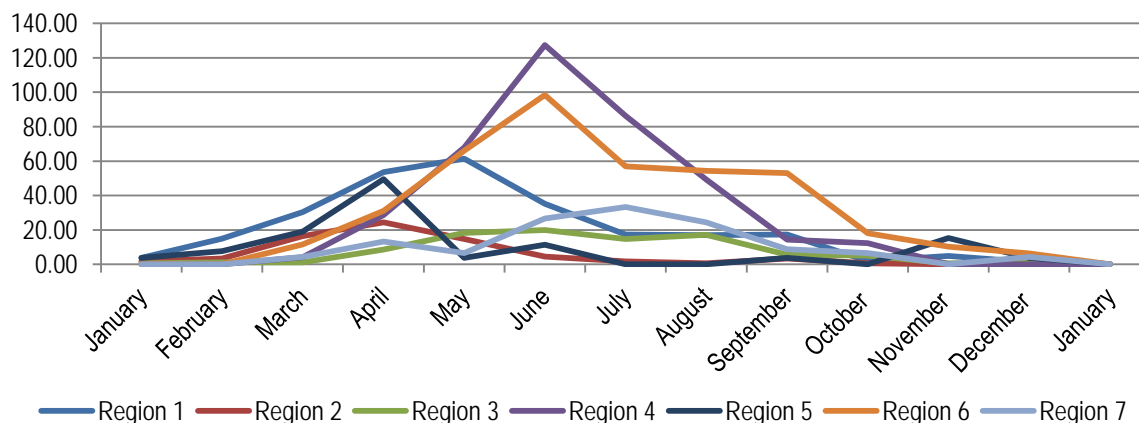


Table 1. Health Region-specific rate per 100,000 population.

	R1	R2	R3	R4	R5	R6	R7
Region-specific rate	263	71	95	391	118	407	129

Over the entire outbreak period, most of the cases were concentrated in Regions 1 and 6. The highest proportion (60%) of cases was seen in **R1 & R6**. Table 2 gives an overview of the average annual pertussis cases by Health Region from 2006-2011 and in 2012-2013.

Table 2. Case Counts and Percentages per Health Region, 2006-2013 (up to February 4 2013)

	R1		R2		R3		R4		R5		R6		R7		Total #
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Avg 2006-11	18.3	79%	2	9%	0.3	1%	1	4%	0.3	1%	0	0%	1.2	5%	23.2
2012-2013	537	38%	126	9%	165	12%	190	13%	31	2%	314	22%	58	4%	1421

Clinical characteristics and outcomes

The majority of cases reported having paroxysmal cough (88%), while 21% reported a whoop. Table 3 gives an overview of the symptoms reported.

Table 3. Count and Percent of Individual Symptoms Reported* (as of February 4 2013)

	Confirmed	
	Count	%
Non-paroxysmal cough	1088	77%
Paroxysmal cough	1251	88%
Whoop	293	21%
Apnea	163	11%
Gagging	584	41%
Pneumonia	11	1%
Seizures	0	0%
Other	328	23%
Coryza	92	6%
Fever	59	4%
Sore throat	49	3%
Difficulty breathing	31	2%
Cyanosis	8	1%
Wheezing	4	0%
Chronic bronchitis	6	0%
other	79	6%

*Multiple responses were possible for this question

Overall, 2% of the cases were hospitalized (3 in ICU, 19 non-ICU hospitalizations) and 0 deaths were reported. The hospitalization duration was 1 to 13 days with a median of 3 days. Table 4 provides an overview of the outcome and level of care for pertussis cases.

Table 4. Outcome and level of care at time of report to Public Health, by age group (as of February 4 2013)

		<1		01-04		05-09		10-14		15-19		20+		NB	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%
Level of Care*	Physician	9	21%	45	40%	83	38%	222	41%	50	43%	153	39%	562	40%
	ER	20	47%	64	57%	126	57%	294	55%	58	50%	218	55%	780	55%
	Hospitalization (non-ICU)	11	26%	1	0%	2	1%	0	0%	1	1%	4	0%	19	1%
	ICU	3	7%	0	0%	0	0%	0	0%	0	0%	0	0%	3	0%
Outcome	Recovered	6	14%	9	8%	13	6%	55	10%	7	6%	40	10%	130	9%
	Not recovered	32	74%	96	86%	191	87%	446	83%	102	87%	342	87%	1209	85%
	Deaths	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
	Unknown	5	12%	7	6%	15	7%	35	7%	8	7%	12	3%	82	6%

*Totals don't add up to 100% due to missing data

Age groups

The highest proportion of cases was seen in the 10-14 year old age group (38% of the cases), followed by persons 20 years of age and over (28%), children aged 5-9 yrs (15%); adolescents aged 15-19 yrs (8%); children aged 1-4 yrs (8%) and infants under 1 (3%). The highest age-specific rates were seen in the 10-14 year old age group (1337 per 100,000), followed by the 5-9 year old age group (604 per 100,000), and infants under 1 (583 per 100,000). The median age was 12, the mean was 19.2, and the age range was 0 to 91 years.

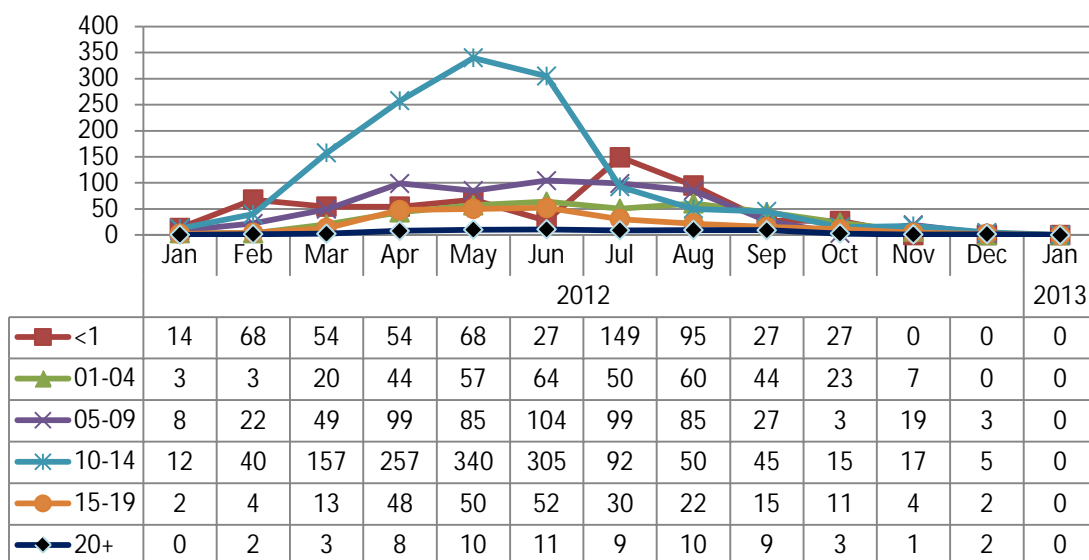
Table 5. Case Count and Percent by Age and Health Region for 2012 (up to February 4 2013)

	R1 (N=537)		R2 (N=126)		R3 (N=165)		R4 (N=190)		R5 (N=31)		R6 (N=314)		R7 (N=58)		NB (N=1421)	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
<1	14	3%	9	7%	10	6%	5	3%	1	3%	4	1%	0	0%	43	3%
01-04	35	7%	16	13%	20	12%	20	11%	2	6%	17	5%	2	3%	112	8%
05-09	86	16%	18	14%	19	12%	46	24%	12	39%	35	11%	4	7%	220	15%
10-14	210	39%	50	40%	53	32%	73	38%	10	32%	120	38%	19	33%	535	38%
15-19	49	9%	5	4%	19	12%	9	5%	3	10%	29	9%	3	5%	117	8%
20+	143	27%	28	22%	44	27%	37	19%	3	10%	109	35%	30	52%	394	28%

Table 6. Case Count and Age-Specific Rate (per 100,000 population) by Health Region for 2012 (up to February 4 2013)

	R1		R2		R3		R4		R5		R6		R7		NB	
	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate	#	Rate
<1	14	702	9	489	10	535	5	1042	1	483	4	710	0	0	43	583
01-04	35	436	16	213	20	269	20	1120	2	234	17	746	2	111	112	376
05-09	86	880	18	198	19	206	46	2220	12	1159	35	1148	4	184	220	604
10-14	210	2085	50	498	53	531	73	3034	10	788	120	3190	19	718	535	1337
15-19	49	420	5	42	19	173	9	299	3	190	29	674	3	114	117	255
20+	143	86	28	21	44	33	37	95	3	14	109	172	30	85	394	66
Total	537	263	126	71	165	95	190	391	31	118	314	407	58	129	1421	189

Graph 2. NB Age-Specific Incidence Rate (per 100,000), per month in 2012 (up to February 4 2013)



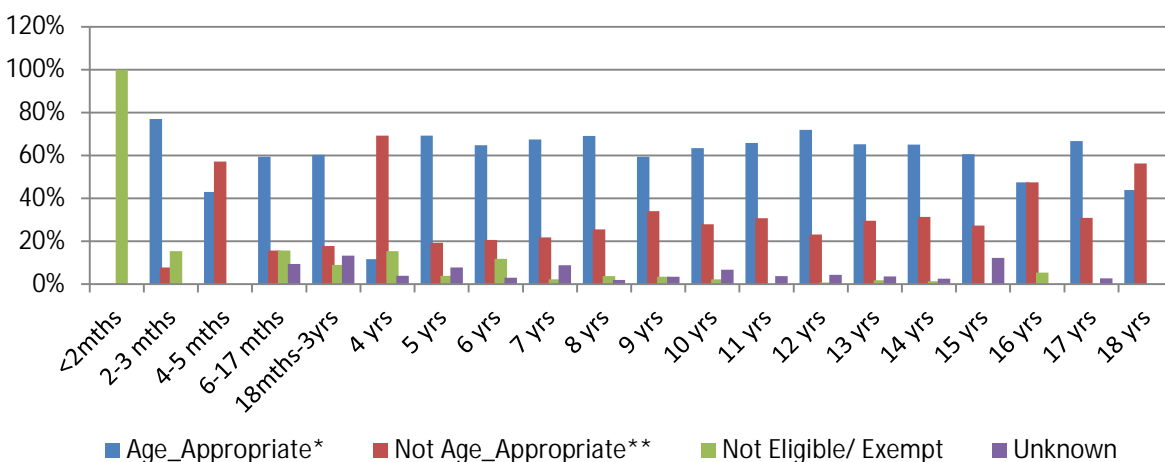
Immunization status

Less than half (43%) of the pertussis cases that were over 4 years old had proof of being immunized with 5 or more doses of pertussis containing vaccine. This varied by age group and by Region. Table 7 and Graph 5 give an overview of the percentage of cases immunized with 5 or more doses of pertussis containing vaccine by region and age group.

Table 7. Percentage immunized with at least 5 doses of pertussis containing vaccine for cases aged 4 years to 20 years or more in NB and by Region (as of February 4, 2013)

Age Group	R1	R2	R3	R4	R5	R6	R7	NB
4-9 yrs	59%	35%	18%	60%	100%	89%	75%	60%
10-14 yrs	67%	51%	38%	66%	60%	84%	79%	67%
15-19 yrs	61%	50%	32%	89%	0%	73%	67%	59%
>20 yrs	11%	0%	5%	26%	0%	6%	17%	10%
Total	46%	29%	19%	50%	58%	52%	43%	43%

Graph 3: NB percentage of age-appropriate vaccination in pertussis cases up to 18 years old (up to February 4 2013)



1.2.1 Epidemiological reports

Internal Epidemiological Reports were produced regularly during the course of the outbreak and distributed to the target audience of Regional staff (Medical Officers of Health, Communicable Disease Coordinators, Managers, Directors, Immunization Coordinators), OCMOH CDC Team and Dept of Health Communications. The latest report can be found in Appendix 3.

Declaring the outbreak over

In the fall, there were CDC disease team discussions on criteria used to support determination of the outbreak as over and for official ‘declaration’ internally and externally. Determination of the outbreak as over was based on each Region’s activity returning within 2 standard deviations of the 5 year smoothed rolling average (5YSA)² for at least 2 weeks. However, other considerations included continuation of closely monitoring the period in which increases in pertussis activity would normally occur (January) and continuation of data collection for a complete month of surveillance data.

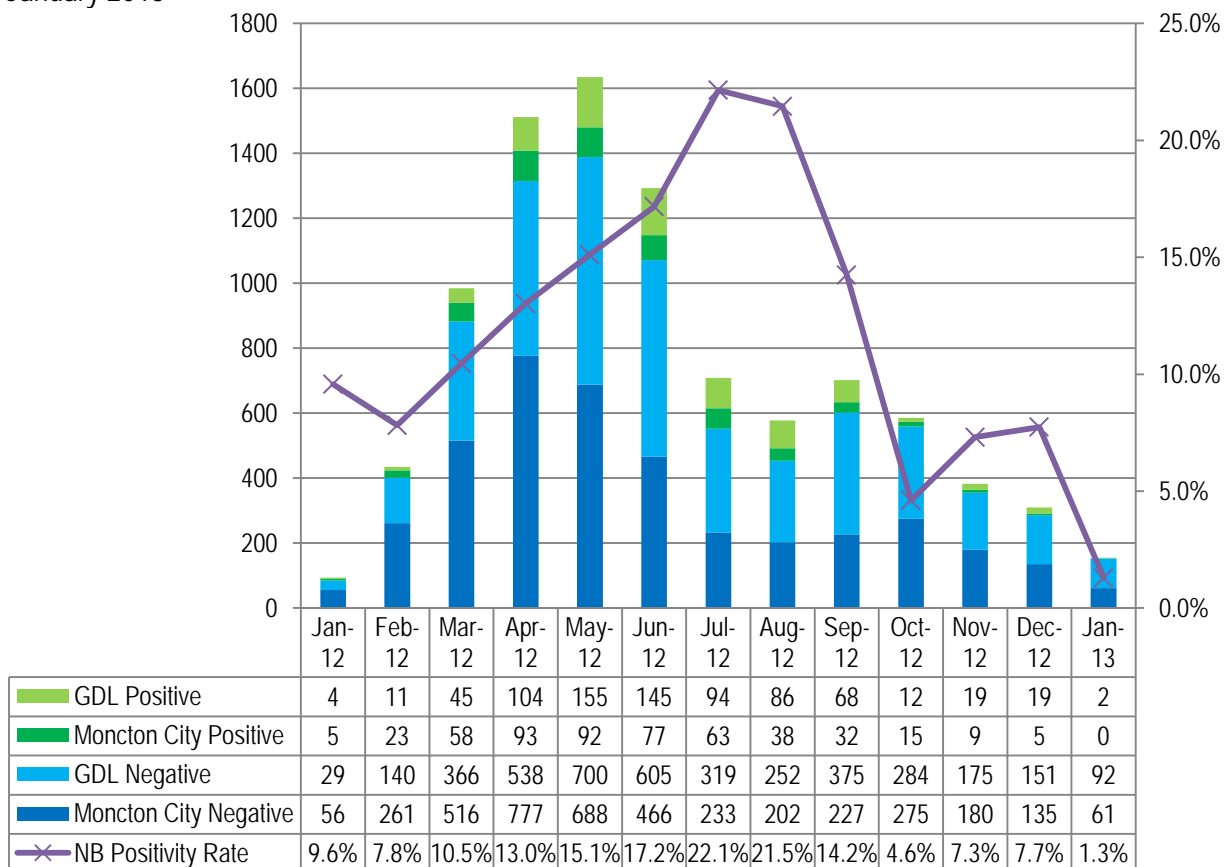
2. Laboratory

Lab Testing

Pertussis detection testing was done by PCR at the Moncton Hospital and at the Dr. Georges-L.-Dumont laboratories. Data from the Moncton Hospital laboratory was available weekly during the outbreak. Graph 4 depicts the trends in positivity rates for all samples processed in New Brunswick which was done by Moncton City Laboratory and Georges L. Dumont.

² Each 5YSA includes 15 months of data and is calculated as follows: average # cases over 3 months (includes the months before and after) for each year is summed then averaged across 5 years. For example 5YSA calculation for Dec 2011: 3 month averages- Nov,Dec,Jan- for each year starting from 2006 to 2010 are calculated then averaged across 5 years.

Graph 4. NB Positive and Negative pertussis lab result counts and positivity rates by month, January 2012 to January 2013



Issues: Supply and Testing Delays

Due to the high level of activity and increased physician awareness, there was a high demand for testing supplies. In the early stages of the outbreak, there were some issues with having enough supplies that were resolved within a few weeks.

In the early stages there were some delays in sending specimens from local laboratories to Dr. Georges-L.-Dumont or Moncton Hospital, this led to delays in case finding and case management. Some of those delays were attributed to the practice of sending multiple specimens two times per week instead of sending specimens the same day they were collected.

3. Public Health Measures

Outbreak guidelines

Outbreak guidelines were developed early in the outbreak with information on clinical presentations of the illness, case definitions, diagnosis, surveillance and notification and public health measures (prophylaxis,

immunization and isolation). The purpose of these outbreak guidelines was to ensure a similar approach to Public Health Outbreak Measures across the regions. The outbreak guidelines can be found in Appendix 4.

Immunization campaigns and recommendations

As pertussis is a vaccine preventable disease, immunization of the population in general and more specifically contacts of cases and contacts of vulnerable persons was the priority during this outbreak. The goals of the immunization campaign were:

1. To improve immunity against pertussis in general population (adhering to New Brunswick schedule);
2. To improve immunity against pertussis in the most affected cohort (immunization campaign);
3. To provide indirect protection to vulnerable individuals (immunization campaign and targeted immunization).

Recommendations on immunization in the outbreak situation:

General population:

Ensure that the Routine Immunization Schedule is adhered to and immunization was offered to those who had missed a dose. Special attention was given to the 4 year old booster immunization.

Immunize school age children and adolescents (less than 18 year of age) in close contact with infants less than 1 year of age if they had not received a pertussis containing vaccine in the last 5 years.

Immunize adults, who had not received a pertussis containing vaccine in adulthood (after 18 years of age) and were in close contact with infants less than 1 year of age.

For adults who had already received a pertussis containing vaccine in adulthood (after 18 years of age), there are no national recommendations for more booster doses as the duration of protection induced by acellular pertussis vaccine is unknown³. Vaccine for these individuals was not be provided by Public Health.

To protect newborn infants (0-2 months), immunization for pregnant women in the third trimester of their pregnancy in affected areas could be offered. This was optional and left to the discretion of the attending physicians. Mothers who were not immunized during pregnancy were to be offered immunization postpartum.

Cases and contacts:

Pertussis cases were to be immunized after recovery and according to the Routine Immunization Schedule if the case was not up-to-date.

Unimmunized/ partially immunized close contacts of a case were to be offered immunization according to the Routine Immunization Schedule. However in an outbreak situation the Medical Officer of Health had the flexibility to use the minimal intervals for administration of a pertussis containing vaccine.

Outbreak Immunization Campaign Targeted to Grades 6, 7, 8 in Region 1 and 2:

The decision to launch a school-based immunization campaign in Health Regions 1 and 2 took several factors into consideration. The most affected age group was children 10-14 years of age. In the early stages, the outbreak was concentrated in Health Regions 1 (Moncton area) and 2 (Saint John area)

³ Canadian Immunization Guide, Public Health Agency of Canada, 7th edition, 2006.

and sporadic cases were seen in the rest of the province. Lastly, school-based immunization programs are effective in obtaining higher coverage rates and deemed the best approach.

Budgetary considerations, time restrictions and vaccine supply concerns were taken into account in the decision not to implement a province-wide immunization campaign at that time. It was anticipated that immunization of school aged children in the spring might prevent the continued rise of pertussis during the summer months.

The immunization campaign was launched before the end of the school year (April and May 2012) for students in grades 6, 7 and 8 in the most affected Health Regions. Approximately, 74% of the students enrolled in grades 6, 7 and 8 in Regions 1 and 2 were immunized. Of the 26% not immunized, 73% had not returned their consent forms. Other regions would be offered Tdap immunization in early fall. The full report can be found in Appendix 2.

Fall Immunization Campaign:

A school-based immunization campaign for all the other Regions was implemented in the fall of 2012. Tdap was offered to students in grades 7, 8 and 9 (these students are in the same age group as the students targeted in the spring of 2012 in Health Regions 1 and 2).

The uptake for the fall campaign ranged from 75% in Health Region 3 to 96% in Health Region 6.

Plans were formulated to re-start routine Tdap adolescent school-based campaign 2012/13 school year for students in grade 7, but with a catch-up for grades 8 and 9.

4. Communications

Media

Several media releases were issued to inform the public of the pertussis outbreak and to emphasize the importance of and promotion of immunization. A total of 3 media releases were issued in February, March and September.

In addition to media releases, there were several media requests (TV, radio, newspapers) to speak about the situation in New Brunswick. The requests for information lead to the posting of outbreak information on the OCMOH website.

A technical briefing to declare the pertussis outbreak over was held May 2013.

Clinicians

Clinicians were informed of the outbreak by OCMOH via letters, Disease Watch Articles and presentations by the MOH's in the regions (to health care providers in acute care and hospital settings). The letters were sent in March, May and September. The letters were also included on the health professionals' page of the OCMOH website.

Department of Education and Early Childhood Development

The Department of Education and Early Childhood Development was informed about the pertussis outbreak and upcoming school-based campaign by letter and phone.

Tele-Care

Tele-Care was informed on a regular basis regarding the status of the outbreak and advice for the public.

Website

The pertussis webpage contained disease and vaccine factsheets and information on the immunization campaigns.

Due to the frequent media requests, weekly status reports on the outbreak with basic distribution of cases by week and region were posted on the website from June onwards. The website was well visited in 2012, with peaks around the times when media releases were issued or when there was media attention. A total of 7,000 visits were made to the pertussis webpage. Users stayed on the webpage an average of 2 minutes.

PHAC/ Other jurisdictions

PHAC and other jurisdictions were updated on current epidemiology via CNPHI alert, presentations made through various Public Health Network FPTs, Eastern Border Health Initiative, ProMed, distribution of NB internal report, personal communication with inter jurisdictional Public Health colleagues etc.

Facebook campaign

To increase Tdap immunization uptake in the fall campaign, a Facebook campaign was launched for students in grades 7, 8 and 9 and their potential parents or caregivers as the target audience. An ad was developed for Facebook and by clicking on it; users were directed to the pertussis webpage for information on the immunization campaign, the disease and the number of cases.

5. Coordination

5.1 Internal OCMOH

The Internal OCMOH Outbreak Team Meetings took place at regular intervals. In the early stages and at the peak of the outbreak the team met weekly. The internal outbreak team consisted of the Provincial Medical Officer of Health for Communicable Disease Control, Communicable Disease Control Branch Director, Epidemiologist, Surveillance Officer, Laboratory Liaison and Senior Program Advisors for the disease area and immunization.

5.2 Regional meetings

The Regional Outbreak Control Meetings were established in March 2012. The provincial outbreak team consisted of the internal OCMOH outbreak team, the Medical Officers of Health, CD coordinators and Public Health nurses from each health area. In the early stages and at the peak of the outbreak weekly meetings were held. The frequency was later adjusted according to need, with meetings being held bi-weekly or monthly.

6. Key Learnings

An internal OCMOH debrief session took place on February 11, 2013. The debrief session with regions took place on February 14, 2013. The following is a list of areas for improvement based on the team's feedback.

OCT operations

For long outbreaks it is recommended to incorporate regular reviews throughout the outbreak period which could allow for identification of any challenges and finding optimal solutions during the response.

Key process steps such as determination of the agenda, length of time and frequency required for meetings, required participants, roles and responsibilities and a communication plan that specifies the audience, frequency of reporting etc. should be decided at the beginning of the outbreak and to be re-evaluated as needed. This could be incorporated into a standardized template for the outbreak-response teams' terms of reference that is adapted to each situation upon convening the team.

Surveillance and disease reporting

In the absence of real time surveillance, timely reporting of CD's in RDSS or heads up via weekly calls with regions would help identify aberrations or outbreaks sooner than the current process and would be beneficial for regions for public health follow-up and guidance.

Clarification on case definitions used for surveillance purposes versus triggers for public health actions in the early stages of an outbreak is needed to avoid delay in decision-making processes.

Guidelines for declaring an outbreak in school settings should be developed.

Discussion and agreement on enhanced disease surveillance timelines and processes should occur at the outset. This should attempt to balance the reporting requirements of OCMOH with regional needs while meeting the requirements as per *the Public Health Act and Regulations*.

OCMOH provision of regular situational and epidemiological report updates to the team is a recommended strategy for all outbreaks and response situations.

Quality management processes

It is recommended that quality control measures be implemented both regionally and provincially to ensure quality of deliverables (e.g. consistency / completeness of data on enhanced surveillance forms; availability / accuracy of immunization data in RDSS etc.)

Communications

A communication risk based plan with timeframes, targeted audiences and pro and reactive media lines should be developed early in the outbreak and updated as needed. The use of social network analysis for similar outbreaks is recommended however clarifying and agreeing upfront on the required information would provide consistency in data collection. Regions need access to social media tools.

It is important to communicate with clinicians early in the response for the purposes of notifying them of the outbreak and requesting their help in identifying cases.

It is recommended that communication materials for clinicians be brief and infrequent and that using other modalities such as Grand Rounds and Disease Watch Bulletin may be more engaging than print material and available more readily and efficiently.

Research

Timely processes for applied public health research including expedited ethics approval are recommended. In the context of an outbreak, research would help to more accurately describe epidemiology, determine source, assess VE or waning of immunity etc.

Gaps

A centralized provincial immunization registry is highly recommended to more effectively assess immunization rates and coverage, and to plan and evaluate targeted interventions.