

## Supplement

# Final Report to Outcomes from the National Consensus Conference for Vaccine-Preventable Diseases in Canada

June 12-14, 2005 — Quebec City, Quebec



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## **Supplement**

# **Final Report of Outcomes from the National Consensus Conference for Vaccine-Preventable Diseases in Canada**

**June 12-14, 2005 — Quebec, Quebec**



## **Acknowledgements**

We would like to thank the national and international experts and program specialists who participated in the consensus conference, the conference co-chairs, the planning committee members, those who donated their time to ensure the evidence presented in the discussion guides was the most current and relevant, and the staff of the Immunization and Respiratory Infections Division of the Public Health Agency of Canada (PHAC) for making the conference a success.

## **Introductory Remarks**

Since its inception in 2003, the National Immunization Strategy (NIS) has facilitated a cohesive approach towards immunization program planning in Canada and has assisted in bringing immunization issues to the forefront of the Canadian public health agenda. The Canadian Immunization Committee (CIC), within the Pan-Canadian Public Health Network, is responsible for overseeing its implementation. The 2003 Federal Budget provided \$45 million over 5 years to assist in the continued pursuit of the National Immunization Strategy.

To further support the implementation of the NIS, the federal government provided \$300 million over 3 years to the provinces and territories to support the introduction of four newly recommended childhood and adolescent vaccines. Following the 2004 funding announcement, a significant number of provinces and territories launched new publicly funded programs for these vaccines which have enabled Canada to move toward harmonization of immunization programs across the country.

A key component of the NIS is the development of national goals for all vaccine-preventable diseases (VPDs) and their recommendation for endorsement by all federal, provincial and territorial (FPT) governments, where appropriate. The purpose of having national goals for immunization programs is to support reductions in all VPDs, improve immunization coverage, measure progress and evaluate programs. Official F/P/T endorsement of national goals for VPDs is a complex process because of differing priorities and funding levels for immunization programs within each jurisdiction. Currently, the goal to eliminate measles by the year 2005 is the only official national goal that has been endorsed by

the FPT Council of Deputy Ministers of Health (1995).

In 2005, a National Consensus Conference for Vaccine-Preventable Diseases (NCC-VPD) was held in Quebec City. The purpose of the conference was to review and assess the current status of the existing disease reduction goals and immunization coverage targets for six selected VPDs, to achieve consensus on the recommendations and to outline the essential requirements to facilitate national adoption and implementation of the recommendations. The 2005 national goals and recommendations were agreed to while acknowledging that provinces and territories would need to develop their own programmatic objectives.

The CIC has reviewed the 2005 national goals and recommendations and has approved their publication and has forwarded the goal to eliminate indigenously transmitted cases of rubella and congenital rubella syndrome (CRS) from Canada by 2010 to the Pan-Canadian Public Health Network for national endorsement. CIC believes that the recommendations from the conference establish a national vision and at the jurisdictional level provide a standard towards which to strive. The World Health Organization (WHO) in collaboration with UNICEF has created similar guidelines for immunization coverage, summarised in the *Global Immunization Vision and Strategy (2006-2015)*<sup>(1)</sup>. This document outlines goals which countries should aim for, but which are not enforceable. National goals and recommendations also serve to create a measurement against which future improvements of immunization programs can be evaluated. The 2005 national goals and recommendations will be re-evaluated in 2010.

The CIC recommended that all jurisdictions assess the relevance of 2005 national goals and recommendations based upon jurisdictional capacity and priorities. Provincial and territorial responses were reviewed to assess the feasibility, measurability and priority of each goal and recommendation in order to gain a jurisdictional perspective of their impact on immunization program delivery. Several limitations were noted, among which were inadequate surveillance data, and the lack of resources available to develop new data collection tools and monitoring systems. Respondents also suggested changes to recommended targets concerning dates and rates, which were thought to be unrealistic within the given time frame. The limitations noted by each province and territory will affect their ability to fully implement the 2005 national goals and recommendations. They can therefore only

act as guidelines for the PTs to use as deemed appropriate.

Despite these current limitations, there are benefits at the jurisdictional level of adopting the 2005 national recommendations. As provinces and territories aspire towards the national vision, their immunizations programs will invariably improve resulting in increased coverage; these improvements can in turn be used to justify additional funding for immunization programs as well. Establishing national goals and recommendations provides a method of accountability at the jurisdictional level.

Based on the process developed for the 2005 consensus conference, future conferences are planned to review, develop and update recommendations for national goals for immunization coverage and disease reduction for all vaccine-preventable diseases.

Drs. T. Tam and G. Hammond  
Co-Chairs of the Canadian Immunization Committee  
April, 2006

## **Table of Contents**

|  |    |
|--|----|
| Executive Summary.....                           | 1  |
| Introduction.....                                | 3  |
| Conference Process.....                          | 5  |
| Disease Summaries.....                           | 7  |
| Rubella.....                                     | 7  |
| Background.....                                  | 7  |
| Discussion.....                                  | 8  |
| Setting goals and recommendations.....           | 8  |
| Vote.....  | 9  |
| Varicella.....                                   | 10 |
| Background.....                                  | 10 |
| Discussion.....                                  | 12 |
| Setting goals and recommendations.....           | 13 |
| Vote.....  | 15 |
| Invasive pneumococcal disease.....               | 16 |
| Background.....                                  | 16 |
| Discussion.....                                  | 18 |
| Setting goals and recommendations.....           | 18 |
| Vote.....  | 20 |
| Invasive meningococcal disease.....              | 21 |
| Background.....                                  | 21 |
| Discussion.....                                  | 23 |
| Setting goals and recommendations.....           | 24 |
| Vote.....  | 26 |
| Influenza.....                                   | 28 |
| Background.....                                  | 28 |
| Setting goals and recommendations.....           | 30 |
| Vote.....  | 32 |
| Pertussis.....                                   | 33 |
| Background.....                                  | 33 |
| Discussion.....                                  | 35 |
| Setting goals and recommendations.....           | 36 |
| Vote.....  | 38 |
| Evaluation summary.....                          | 40 |
| Appendices                                       |    |
| Appendix A: Abbreviations.....                   | 43 |
| Appendix B: Working group discussion guides..... | 45 |

## **Executive Summary**

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The National Consensus Conference for Vaccine-Preventable Diseases in Canada (NCC-VPD), which took place in Quebec City, Quebec, June 12-14, 2005, was the first in a series of consensus conferences that will review disease reduction goals and immunization coverage targets for all VPDs. Establishing national goals and objectives for immunization programs was identified as one of key components of the National Immunization Strategy (NIS). The NIS was endorsed by F/P/T governments in 2003 following a \$45 million dollar (Cdn) funding commitment from the federal government to support a collaborative process to address the challenges facing immunization and to improve the effectiveness and efficiency of immunization programs in Canada. The Canadian Immunization Committee (CIC) was established to coordinate this process and improve program planning in support of the NIS.

The purpose of the 2005 consensus conference was to:

- Review existing goals and targets from previous consensus conferences (post 1990) and where necessary, agree upon new national goals and recommendations for disease reduction and immunization coverage for the following six diseases: meningococcal disease (IMD), pneumococcal disease (IPD), varicella, pertussis, influenza and rubella.
- Achieve consensus on the goals and recommendations; and
- Outline the essential steps to facilitate national adoption and implementation of the goals and recommendations.

The CIC recommended six VPDs for review in this first consensus conference. Four diseases, invasive meningococcal disease (IMD), invasive pneumococcal disease (IPD), pertussis and varicella were selected as public funding, in the amount of \$300 million dollars (Cdn), was given to provinces and territories by the federal government for the purchase of vaccines after the approval of the NIS in 2004. Rubella was included in support of the Pan-American Health Organization (PAHO) regional goal for indigenous rubella and congenital rubella syndrome (CRS) elimination in the Americas<sup>(2)</sup>. Influenza was included as it was thought to be timely.

Conference delegates included representatives from national, international, federal, non-governmental, professional and provincial and territorial agencies and organizations. During the 2-day conference participants were divided into disease specific working groups to review current evidence, identify key issues and develop national goals and recommendations for disease reduction and immunization coverage targets. Recommendations along with rationales were presented in plenary and all conference participants were given the opportunity to vote on each, with the option of “agreeing”, “agreeing with reservation” or “disagreeing” with the proposed statement. To achieve consensus a combined vote of 75% either agreeing or agreeing with reservation was required.

Consensus was reached on three overall goals and 52 recommendations. Goals were either not presented or agreed upon for varicella, IMD and pertussis, however, goals were proposed by CIC following the conference and are included

in this report. For influenza, it was agreed, by consensus, to adopt the 2001 national immunization coverage targets<sup>(3)</sup> and to postpone the development of recommendations for disease reduction for a future conference.

Conference participants stressed the importance of maintaining the momentum gained at the conference, specifically, ensuring that the goals and recommendations proceed expeditiously through the Pan-Canadian Public Health Network. It was further suggested that a review of provincial/territorial infrastructure be undertaken to identify needs and gaps related to the implementation of recommended goals

and recommendations. These were assessed in a post conference survey of the provinces and territories<sup>(3)</sup>.

The CIC will review the recommendations resulting from the 2005 NCC-VPD and work with a task group to consolidate conference proceedings. Recommendations will be forwarded on for endorsement by the Pan-Canadian Public Health Network to the Conference of F/P/T Deputy Ministers of Health.

Future consensus conferences are planned to review, develop and update national goals and recommendations for immunization coverage and disease reduction for all VPDs.

## **Introduction**

From June 12-14, 2005, a cross section of Canada's scientific, public health and medical communities gathered in Quebec City, Quebec for the 2005 National Consensus Conference for Vaccine-Preventable Diseases in Canada (NCC-VPD). The purpose of the conference was to achieve consensus on national immunization coverage and disease reduction goals and targets for six vaccine-preventable diseases (VPDs) (rubella, varicella, invasive pneumococcal disease (IPD), invasive meningococcal disease (IMD), influenza and pertussis) and to identify the process for their adoption and implementation at the national level.

### **Welcome**

(Dr. Ian Gemmill, Chair of the Conference Planning Committee and Dr. Horacio Arruda, Representative of the Ministre de la Santé et des Services sociaux du Québec)

The speakers acknowledged the number of sectors involved and the importance of consensus forums in developing, delivering and evaluating immunization policies and programs; a theme borne out in the introductory presentations highlighted below.

### **Immunization strategy in Canada:**

(Dr. Arlene King, Conference co-chair)

Dr. King presented on 10 years of progress and the status of national recommendations from previous consensus conferences for the six VPDs under review. She also presented the results from a survey to demonstrate jurisdictional uptake of national recommendations into provincial/territorial goals and objectives since 2001. The last time

national goals for VPDs were looked at holistically was in 1993 when influenza, IMD, pertussis and other VPDs were reviewed (pertussis was reviewed again in 2002); disease specific conferences for rubella (1994), IPD (1998), and varicella (1999) took place later. However, to this day the measles elimination goal (1995) is the only fully adopted national goal for vaccine-preventable diseases.

In 2001, and again in 2005 jurisdictions were surveyed to determine the uptake of national consensus recommendations. This information was provided to the expert working groups to review along side existing national goals and recommendations prior to this conference and can be found in the discussion guides for each of the six VPDs in Appendix B.

### **Setting national goals:**

(Dr. Richard Massé, Conference co-chair)

Dr. Massé presented some of the challenges and the role of the Ministry of Health in developing and implementing goals and objectives at the provincial level. Initiatives under Quebec public health program, were presented. His presentation focused on the role of the Quebec Immunization Committee which is responsible for improving the quality of immunization programs and capacity for immunization research and evaluation in Quebec. Quebec has substantial experience in developing and implementing public health goals. Some of the challenges include ensuring public and professional involvement in decision-making and securing the necessary funding to enable successful implementation. These challenges must be overcome to make public health goals a reality.

## **Immunization goals in the United States:**

(Dr. Jane Seward, Centers for Disease Control and Prevention (CDC))

Dr. Seward presented the United States' (US) experience developing and implementing national goals. The Healthy People 2010 Strategy<sup>(4)</sup>, a CDC-led initiative, has set national goals for public health. Immunization and the control

of infectious diseases are among the priorities identified in the strategy. Within these priority areas, specific goals have been established for diseases preventable through universal and targeted immunization programs, infectious diseases and emerging antimicrobial resistance, immunization coverage and strategies, and vaccine safety. Dr. Seward concluded with an update on the tracking and implementation of the goals and objectives in each of these categories.

# Conference Process

(Dr. Ian Gemmill)

The 2005 Consensus Conference is the first in a series of consensus conferences which will develop national goals and recommendations for disease reduction and immunization coverage in Canada for all VPDs. The CIC, which oversees the implementation of the NIS, approved of and determined the focus and parameters of the conference.

## Conference process

The conference took place over 2 days. Following introductory remarks and presentations on the first day, participants remained in plenary session to consider and vote on recommendations for rubella elimination. Participants then spent the rest of day-one in their assigned disease-specific working groups. Presentations on surveillance, epidemiology, laboratory issues and immunization programs and coverage were given in each group. Led by a chairperson and assisted by subject-matter experts, a rapporteur and a note-taker, working group members reviewed disease-specific evidence, identified key issues, and developed and provided rationales for all recommendations.

On the second day, recommendations from the working groups from the five remaining diseases were presented in plenary by panels selected by each disease-specific working group. After presenting the recommendations and rationales, participants asked questions for clarification and then voted using an electronic voting system provided by the National Microbiology Laboratory (NML) in accordance with the rules outlined below. Once the initial level of agreement was determined, the floor was opened for comment

and discussion. If consensus was not achieved in the first vote or achieved through a minority vote, a second vote was held after the comment and discussion period.

For the purpose of conference deliberations, the definition of terms is as follows:

*Goal:* Is defined as a broad statement of a desired achievement over a specific time frame. Goals are not required to be quantitative or measurable.

*Objectives/recommendations:* Are statements of intent that are specific, measurable, achievable, realistic, and timed. An objective may include a target.

At a subsequent meeting of the CIC, it was recommended that the term objective be reserved for use by the jurisdictions to determine individually how best to work towards nationally agreed upon goals, in a feasible timeframe, given their own unique requirements. Therefore throughout these documents the term objective has been replaced with recommendation.

*Targets:* Are measurable: they specify the amount of progress to be made and the time by which it is to be made.

Further, time lines for national goals and recommendations should be reasonable and feasible, with 5 years suggested as an appropriate planning horizon.

*Vaccine eligibility:* For the purpose of developing recommendations for national goals, participants agreed that vaccine eligibility should be based on NACI recommendations rather than jurisdictional public health programs.

## **Adoption and implementation**

(Dr. Greg Hammond)

All consensus goals and recommendations will be moved through the CIC and the new Pan-Canadian Public Health Network. Within this network CIC functions as an “Issue Group” and makes recommendations to the Communicable Disease Control Expert Group (CDCEG), formerly the Communicable Disease Control Network (CDCN), which functions as an “Expert Group”. In turn, the CDCEG makes recommendations to the F/P/T Council, which is accountable to the F/P/T Conference of Deputy Ministers of Health. A governing body with a strategic perspective on health, the Conference of Deputy Ministers of Health determines final outcomes on all matters under its consideration.

## **Consensus development and voting**

(Dr. Richard Massé)

The process for voting on consensus recommendations was supported by the assurance that all participants would have an opportunity to express their views in either plenary or working group sessions.

- Options for voting include “agree”, “agree with reservations” and “disagree”.
- At least 66% of participants eligible to vote must be present to have quorum.

- Consensus was achieved when at least 75% of participants eligible to vote either “agreed” or “agreed with reservations” to a recommendation. The election of a recommendation with 50% to 74% of eligible participants agreeing without reservation constituted a majority vote, while a vote achieving consensus with only 25% to 49% agreeing without reservation represented a minority vote.
- A recommendation was not considered supported if the combined number of participants “agreeing” or “agreeing with reservation” represented < 75% of eligible participants or if > 33% of eligible participants were absent from or declined to take part in a vote.

Participants with voting rights included: provincial/territorial representatives including chief medical officers of health, epidemiologists, and program experts; experts from IRID and the NML; CIC members not functioning in an alternate role; members of the conference planning committee; representatives of non-governmental organizations and health professional associations; and conference co-chairs (in situations where results would be otherwise inconclusive). Voting rights did not extend to international experts, PHAC staff working as rapporteurs and conference support, industry representatives, or participants with a conflict of interest.

## **Disease Summaries**

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This section is a summary of workshop and plenary session outcomes for each of the six diseases, as well as the highlights of participant feedback from the consensus conference.

Discussion guides used to support working group deliberations can be found in Appendix B. Reference articles and conference documents are available on CD-Rom by sending a request to: [programs\\_irid-diir@phac-aspc.gc.ca](mailto:programs_irid-diir@phac-aspc.gc.ca).

### **Rubella**

#### **Background**

The purpose of this session was to review recent evidence and determine the feasibility of adopting the WHO/PAHO (World Health Organization/Pan-American Health Organization) goal of rubella elimination by 2010. To support discussion, presentations were given on rubella incidence and elimination in the US, the Americas and Canada.

#### **United States:**

(Dr. Jane Seward, CDC)

In November 2004, the US announced the achievement of its goal of eliminating rubella and congenital rubella syndrome (CRS), well ahead of 2010. Reported rubella and CRS cases have declined significantly since immunization coverage was extended to adults, including foreign-born adults, people in workplaces and women of child-bearing age. There is extremely high coverage with the recommended one dose of a rubella-containing vaccine and many children receive two MMR (measles, mumps and rubella) doses due to school requirements for measles immuni-

zation. In the US, there are record low levels of reported rubella with < 1 case per million people and only isolated and import-related cases identified. Surveillance has shown population immunity among persons 6 to 49 years of age to be very high, at over 91%. After reviewing these and other data, an expert panel, convened in October 2004, concluded that the US had achieved rubella elimination or absence of endemic rubella transmission.

#### **The Americas:**

(Dr. Carlos Castillo-Solórzano, PAHO)

PAHO is currently pursuing its 2003 goal to interrupt endemic rubella virus transmission in the Americas and eliminate CRS cases associated with endemic transmission by 2010. The PAHO strategy incorporates integrated surveillance systems, rubella virus isolation, routine childhood immunization programs, and follow-up and public awareness campaigns for children and adults using the MMR vaccine. Challenges include strengthening surveillance and reporting, developing a regional database, accelerating implementation of immunization strategies, improving follow-up with female rubella outbreak victims, and collecting specimens.

#### **Canada:**

(Dr. Gaston De Serres)

In 1994, a goal to eliminate rubella and CRS by the year 2000 in Canada was recommended. Immunization targets included one-dose immunization coverage of 97% for children by their second birthday and two-dose coverage at school-entry age, as well as immunization for 14 to 15

year-olds who may have been missed. Targets were also established for pregnant women, with all susceptible women to receive postpartum immunization prior to hospital discharge. Immunization is currently required for all children and recommended for women of childbearing age and people from countries with no rubella immunization program.

The incidence of rubella in Canada has decreased steadily since the implementation in 1996 of a two-dose MMR vaccine for measles, mumps and rubella. Still, as demonstrated by an outbreak in Manitoba in 1997, an outbreak in Ontario in 2005, and a handful of isolated cases, limited rubella virus transmission will continue due to importation, secondary spread, gaps in immunization coverage (e.g., men or populations declining to participate in immunization programs).

**Ontario:**  
(Dr. Barbara Kawa)

A large rubella outbreak (305 cases) occurred in the summer of 2005 in a close-knit religious community in south western Ontario. Ontario legislation requires that school pupils be immunized against rubella (or present a valid medical exemption or exemption due to religious/philosophical belief). While the overall coverage rate in Oxford County is comparable to the provincial rate of 95%, the affected community has a high proportion of unvaccinated persons, due to religious reasons. Despite outbreak control activities, including ongoing monitoring and immunization of susceptible populations, communities with low coverage continue to be a concern.

**Discussion**

The following issues related to the development of national goals for rubella control were identified during the plenary session. The discussion guide used by participants is attached in Appendix B.

*School entry targets:* It was recommended that the age of “school entry” be changed to “by the 7<sup>th</sup> birthday” for coverage measurement purposes. Further, it was suggested that regions with legislated school-entry requirements be identified and studied in comparison with other regions to assess the impact of legislation on immunization coverage.

*Adolescent targets:* The merit in setting a rubella immunization target for children aged 15 to 17 was questioned, given that there is no system in place to monitor coverage of this age group. In response, it was noted that this age group is currently targeted for the Tdap booster; presenting a final opportunity to administer rubella-containing vaccine.

*Unvaccinated populations:* Experiences with rubella outbreaks in unvaccinated populations were shared, including possible response strategies. Acknowledgement was made of the challenge posed by populations refusing immunization and the importance of developing a prevention culture in which immunization is promoted and accepted. Ideally, governments could “decree immunization as a national priority without resorting to legal measures”. However, this may prove difficult; as evidenced in the US, where pressure is growing to disallow religious and philosophical exemptions.

**Setting goals and recommendations**

Taking into account the evidence presented, participants agreed upon the following consensus statements for national goals and recommendations for implementation to eliminate indigenous rubella transmission in Canada.

**Goal**

Adopt the WHO/PAHO regional goal to eliminate indigenously transmitted cases of rubella and CRS from Canada by 2010.

## **Disease incidence**

### **Recommendation 1**

Decrease the rate of rubella-negative primigravida women to < 4% by 2010, by ensuring that all women of childbearing age have a documented history of rubella immunization and, if not, that they are offered a rubella-containing vaccine.

**Rationale:** The target date was changed from 1997 to 2010 to conform with the WHO/PAHO goal.

## **Immunization coverage**

### **Recommendation 2**

Achieve and maintain age-appropriate immunization coverage for rubella-containing vaccine in 97% of children by their 2<sup>nd</sup> birthday (1 dose) by 2010.

**Rationale:** The coverage target was reduced from 99% to 97% in recognition of the continued possibility of imported cases and the challenge of controlling rubella outbreaks in under-immunized pockets of the general population.

### **Recommendation 3**

Achieve and maintain age-appropriate immunization coverage with rubella-containing vaccine in 97% of children by their 7<sup>th</sup> birthday (2 doses) by 2010.

**Rationale:** The age milestone was changed from “school entry” to “by the 7<sup>th</sup> birthday” to conform with current coverage standards for age milestones.

### **Recommendation 4**

Achieve and maintain age-appropriate immunization coverage with rubella-containing vaccine among 97% of adolescents 14 to 16 years of age by 2010.

**Rationale:** The upper boundary of the age range was increased to 16 years to provide increased opportunity to immunize susceptible teens by taking advantage of the health encounter for Adacel® (acellular pertussis [Tdap]) booster.

### **Recommendation 5**

Achieve and maintain rubella postpartum immunization coverage in 99% of susceptible women prior to hospital discharge by 2010.

**Rationale:** The target date was changed from 1997 to 2010 to conform with the WHO/PAHO goal.

## **Other**

### **Recommendation 6**

Screen serology and/or obtain date of immunization of ALL pregnant women seen prenatally for rubella susceptibility by 2010.

**Rationale:** The target date was changed from 1997 to 2010 to conform with the WHO/PAHO goal.

## **Vote**

Participants achieved consensus on all goals and recommendations for rubella elimination. In conclusion, it was also recommended that a national action plan for eliminating rubella should be developed collaboratively and endorsed by all levels of government in the coming year.

**Table 1 – Rubella votes**

| Goals and recommendations   | Agree | Agree with reservations | Disagree |
|---|-------|-------------------------|----------|
| <b>Goal</b>   |       |                         |          |
| Adopt the WHO/PAHO regional goal to eliminate indigenously transmitted cases of rubella and CRS from Canada by 2010.  | 96%   | 4%                      | 0%       |
| <b>Disease incidence</b>  |       |                         |          |
| <b>Recommendation 1</b><br>Decrease the rate of rubella-negative primigravida women to < 4% by 2010 by ensuring that all women of childbearing age have a documented history of rubella immunization and, if not, that they are offered a rubella-containing vaccine. | 59%   | 37%                     | 4%       |
| <b>Immunization coverage</b>  |       |                         |          |
| <b>Recommendation 2</b><br>Achieve and maintain age-appropriate immunization coverage for rubella-containing vaccine in 97% of children by their 2 <sup>nd</sup> birthday by 2010.  | 93%   | 7%                      | 0%       |
| <b>Recommendation 3</b><br>Achieve and maintain age-appropriate immunization coverage with rubella-containing vaccine in 97% of children by their 7 <sup>th</sup> birthday by 2010.   | 88%   | 12%                     | 0%       |
| <b>Recommendation 4</b><br>Achieve and maintain age-appropriate immunization coverage with rubella-containing vaccine among 97% of adolescents 14 to 16 years of age by 2010.   | 66%   | 30%                     | 4%       |
| <b>Recommendation 5</b><br>Achieve and maintain rubella postpartum immunization coverage in 99% of susceptible women prior to hospital discharge by 2010.   | 77%   | 23%                     | 0%       |
| <b>Other</b>  |       |                         |          |
| <b>Recommendation 6</b><br>Screen serology and/or obtain date of immunization of ALL pregnant women seen pre-natally for rubella susceptibility by 2010.  | 80%   | 20%                     | 0%       |

## Varicella

### Background

The purpose of this session was to review outcomes from the 1999 Consensus Conference on Varicella within the context of recent evidence, to identify issues, and to make recommendations on updating the national goals, recommendations and targets for varicella immunization and disease reduction. Below are highlights of presentations on varicella incidence in the US and Canada.

### United States:

(Dr. Jane Seward, CDC)

In the US, following the introduction of the varicella vaccine program in 1995, a decline in 80% to 90% of reported varicella cases was observed. With varicella immunization coverage currently at 85% and climbing for children 19 to 35 months, the US has experienced an 80% reduction in hospitalizations and a significant increase in herd immunity. Rates of varicella as an underlying cause of death have also declined in all ages < 50 years (90% decline in children 1 to 9 years), except among persons > 50 years of age

(the cause of death in this group may be herpes zoster, misclassified as varicella). The vaccine has an excellent safety profile, with only rare reported occurrences of serious adverse effects, and has been shown to be more than 95% effective in preventing severe disease and 80% to 85% effective in preventing all disease.

The US varicella immunization program began with a goal of disease reduction of more than 90% in all age groups by 2010, with targeted immunization rates of 90% among children age 19 to 35 months and adolescents aged 13 to 15 years. Current recommendations for varicella vaccine use include one dose for all healthy children aged 12 months to < 12 years, two doses 3 months apart for immunocompromised children, immunization requirements for daycare and school entry, and post-exposure and outbreak control immunization. Among adults, immunization is recommended for health care workers and family contacts of immunocompromised people, individuals at high risk of exposure and transmission, women of childbearing age, and international travellers.

Evidence in the US suggests that a one-dose vaccine program is cost-beneficial or break-even from a medical perspective and a two-dose program is cost-beneficial from a societal perspective. The US is considering elevating the goal of its varicella vaccine program from reduction to elimination (reduction is defined as the absence of endemic disease transmission). A two-dose vaccine policy for children will be needed for improved disease control and elimination. As of mid-June 2005, the Advisory Committee on Immunization Practices (ACIP) had not yet voted on this proposal.

**Canada:**  
(Jeannette Macey, MSc, MA)

The current recommendation of the National Advisory Committee on Immunization (NACI) is “to reduce the incidence, morbidity, and mortality

related to varicella, through routinely immunizing children between 12 to 18 months of age and immunizing susceptible older children, adolescents and adults who are at high risk for severe varicella and its complications”<sup>(5)</sup>. Catch-up priorities include women of child-bearing age, post-partum women, immunocompromised individuals, health care workers, teachers and daycare workers, and persons from tropical climates who are still susceptible to varicella. While the US is currently pursuing a goal of varicella elimination, this is not yet a goal in Canada.

Since the introduction of the varicella vaccine in Canada in 1998, there has been a trend toward pre-exposure immunization, with post-exposure immunization also found to be effective. Varicella immunization programs have been introduced in 11 of the 13 jurisdictions for children 12 to 18 months of age, with evidence revealing a link between increased immunization coverage and declining varicella-related hospital admissions across all age groups. Nine provinces and territories have varicella catch-up programs in place, although stages of implementation, standards and coverage vary. There are currently no daycare or school-entry requirements for varicella, and outbreaks are not reported or subject to mandatory investigation. Some jurisdictions follow Canadian Paediatric Society (CPS) guidelines for return to daycare or school following illness, but there is no consistency across the country.

Active varicella surveillance is carried out by the CPS Immunization Monitoring Program Active (IMPACT) which consists of 12 paediatric centres and captures 90% of pediatric tertiary beds across Canada. Still, Canada does not have adequate systems in place for national varicella surveillance. Provinces/territories either report inconsistently or incompletely resulting in under-reporting of disease incidence.

## Discussion

Participants agreed that the US experience should serve as the main evidence for decision-making, given the relatively recent introduction of the varicella vaccine in Canada. Discussion ensued on key considerations in the development of updated goals and targets for varicella, with unresolved or “parking lot” issues also flagged. The discussion guide used by participants is attached in Appendix B.

*Surveillance:* Surveillance data do not accurately reflect the disease burden of varicella in Canada due to under-reporting. Data on varicella-related mortality is also lacking. Contributing factors include variations in reporting methods and inadequate laboratory diagnostics; issues aggravated by a national case definition which limits a confirmed case to one in which there is virus isolation or clinical illness and an epidemiological link to a laboratory-confirmed case. As part of a review of the national Notifiable Diseases Reporting System Database (NDRS), case definitions are being updated to reflect actual experience and incorporate epidemiological definitions.

*Epidemiology:* Data suggest parallels between the Canadian and US experience, including varicella epidemiology in the pre-vaccine era as well as linkages between immunization coverage, varicella cases and other disease-related outcomes.

*Breakthrough disease:* While varicella immunization has been shown to be highly effective, practitioners and the general public must be made aware that there are isolated cases of vaccine failure or “breakthrough disease” (i.e. most children experience a sero-response, but may not develop sufficient antibodies to mount an adequate response to be completely protected). Breakthrough disease occurs at a rate of 0.7% to 3.0% per year. Available data indicate that a two-dose immunization regimen could noticeably reduce this rate (i.e. a study of varicella antibodies 10 years post-immunization revealed breakthrough rates of

0.7% per year for single-dose vaccinees and 0.2% for two-dose vaccinees).

Participants noted that the term “breakthrough”, used only for varicella, implies that the virus is breaking through when, in fact, it refers to a vaccine failure. As such, preference was shown for the term “vaccine-modified varicella” also being considered by the CDC.

*Laboratory testing:* Several factors impede laboratory testing for varicella. Laboratory diagnostic recommendations for varicella differ from those for measles and rubella. Further, there are no reliable tests for demonstrating serological immunity after varicella zoster virus (VZV) immunization: gpELISA is not commercially available; VZV glycoprotein antigen is only available in limited supply; Immunoglobulin G (IgG) serology screening, while effective with wild varicella infection, is not sensitive enough to demonstrate vaccine-induced immunity; and, relative to other diseases, the Immunoglobulin M (IgM) kinetics of the varicella immune response is not well known.

*Immunocompromised people:* Immunocompromised persons, who account for 30% to 40% of varicella-related hospital admissions, experience very few complications following Acyclovir treatment; although cases of acyclovir resistance have been reported. The impact of passive prophylaxis with varicella zoster immunoglobulin post-exposure and early implementation of antiviral treatment has significantly reduced morbidity and mortality in immunocompromised populations.

*Parking lot issues:* A number of issues were identified by participants, but not resolved. Key among these were the incidence of herpes zoster in adults, with participants agreeing to postpone making recommendations for disease reduction goals and targets; and the proposed linking of varicella and measles immunization coverage targets by 2010, which was not supported by participants. With regard to the latter, distinctions between the measles and varicella vaccine

programs were noted, in particular the elimination goal and two-dose regimen on which measles coverage targets are based differ significantly from current national recommendations and existing provincial and territorial programs. Participants determined that varicella should be treated as a standalone disease until a measles, mumps, rubella, varicella vaccine (MMRV) is licensed in Canada, at which time linkage of coverage targets could be considered.

### **Setting goals and recommendations**

Participants made the following recommendations for varicella, with the caveat that each be revisited within 5 years to evaluate progress and consider new experience in both the US and Canada.

#### **Goal**

Reduce illness and death due to complications from varicella through immunization

**Rationale:** This goal was proposed following the consensus conference and not voted upon. Development of elimination goal was deemed premature at time of conference.

#### **Disease incidence**

##### **Recommendation 1**

Achieve a sustained reduction of 70% and 90% in the incidence of varicella by 2010 and 2015 respectively.

**Rationale:** While desirable, it is premature to establish a goal of varicella elimination in Canada. The proposed targets allow needed time to implement vaccine programs. A one-dose regimen is assumed, with high coverage and attendant herd immunity.

#### **Immunization coverage**

##### **Recommendation 2**

Achieve and maintain age-appropriate immunization coverage with varicella

vaccine in 85% of children by their 2<sup>nd</sup> birthday by 2010.

##### **Recommendation 3**

Achieve and maintain age-appropriate immunization coverage with varicella vaccine in 85% of susceptible children by their 7<sup>th</sup> birthday by 2010.

##### **Recommendation 4**

Achieve and maintain age-appropriate immunization coverage with varicella vaccine in 85% of susceptible adolescents by their 17<sup>th</sup> birthday by 2010.

**Rationale:** These targets are believed to be achievable based on single-dose MMR coverage. Further, it is expected that MMRV will be available by 2010. Targets are consistent with planned national coverage surveys in the specified age cohorts.

#### **Other**

##### **Recommendation 5**

Decrease varicella-related hospitalization rates by 80% by 2010.

**Rationale:** Children < 10 years of age are the target of immunization programs and the single largest group hospitalized for varicella-related illness; although significant disease reduction is expected. It is also essential to reduce varicella-related hospitalization rates among older cohorts given rising incidence among these groups. For this reason no age groups have been specified. Active surveillance sites in the US have shown that an 80% reduction in varicella-related hospitalization could be achieved in 5 to 6 years. Similar results are expected in Canada.

**Issues:** Surveillance systems will be required to monitor older cohorts and populations. Surveillance systems should differentiate between immunocompromised and previ-

ously healthy persons and between varicella and herpes zoster.

### **Recommendation 6**

Decrease the number of varicella-related deaths by 80% by 2010.

**Rationale:** Reductions in varicella-related deaths are expected to parallel reductions in hospitalizations. An 80% to 90% decrease in mortality over baseline is expected among both immunocompromised and healthy populations.

**Issues:** Small numbers of fatalities may make it difficult to measure target achievement. Further, surveillance should differentiate between immunocompromised and previously healthy persons and between varicella and herpes zoster.

### **Recommendation 7**

Achieve and maintain 100% demonstrated varicella immunity in health care workers, by either history of disease, positive serology or prior immunization; and vaccinate if not immune, unless contraindicated, by 2010.

**Rationale:** Health care workers (HCW) represent a high-risk group for exposure to varicella, given their close contact with immunocompromised persons and the potential for nosocomial transmission. Some jurisdictions provide publicly funded varicella vaccine for HCW; however there is no national system to assess immunization rates of HCW at the facility level and immunization policy is determined by individual hospitals/facilities. Recent data suggest that improving immunization coverage for HCW reduces costs related to nosocomial transmission and outbreaks.

**Issues:** Post-immunization varicella serological testing cannot be relied upon because of low-titre levels associated with post-immuni-

zation seroconversion and the lack of laboratory tests sensitive enough to detect low levels of antibodies. Scores for antibody negativity also vary.

In the US, the stated outcome of two doses of vaccine is 99% immunity; however, evidence suggests one-third of those vaccinated may lose antibodies over time. A study currently underway in the US involves administering a third vaccine dose to health care workers.

Varicella vaccine should ideally be administered to new HCW at the time of employment. ACIP and NACI do not recommend routine testing post-immunization, however it is important to monitor for varicella among HCW. Days of furlough, cases of disease in HCW, and infection control tools can be used for monitoring. Concerns were raised about implementation (e.g., who is responsible for demonstrating immunity and is there sufficient testing capacity). Another concern is the lack of a common definition of “health care worker”.

### **Recommendation 8a**

Screen 100% of pregnant women annually for immunity to varicella, by either history of disease, prior immunization or positive serology, by 2010.

### **Recommendation 8b**

Achieve and maintain immunization coverage with varicella vaccine in 100% of post-partum women without evidence of immunity, unless contraindicated, by 2010.

**Rationale:** Non-immune pregnant women and their newborns represent a high-risk group for congenital varicella syndrome (CVS), neonatal varicella, and complications from adult disease. Participants agreed that immunization should be offered, not required, for post partum women, although concerns were raised about the feasibility of

tracking offers. A note was made that offers of HIV testing are currently tracked.

**Issues:** Improved prenatal screening is needed. A future goal should be to incorporate varicella into routine prenatal screening, alongside HIV, hepatitis C and rubella.

**Vote**

Participants achieved consensus on the following updated recommendations for varicella reduction. An overarching goal was also proposed following the meeting.

**Table 2 – Varicella votes**

| <b>Recommendations</b>  | <b>Agree</b> | <b>Agree with reservations</b> | <b>Disagree</b> |
|---|--------------|--------------------------------|-----------------|
| <b>Goal (proposed)</b>  |              |                                |                 |
| Reduce illness and death due to complications from varicella through immunization. (Proposed by CIC)  | N/A          | N/A                            | N/A             |
| <b>Disease incidence</b>  |              |                                |                 |
| <b>Recommendation 1</b><br>Achieve a sustained reduction of 70% and 90% in the incidence of varicella by 2010 and 2015 respectively.  | 88%          | 12%                            | 0%              |
| <b>Immunization coverage</b>  |              |                                |                 |
| <b>Recommendation 2</b><br>Achieve and maintain age-appropriate immunization coverage with varicella vaccine in 85% of children by their 2 <sup>nd</sup> birthday by 2010.  | 83%          | 12%                            | 5%              |
| <b>Recommendation 3</b><br>Achieve and maintain age-appropriate immunization coverage with varicella vaccine in 85% of susceptible children by their 7 <sup>th</sup> birthday by 2010.  | 79%          | 19%                            | 2%              |
| <b>Recommendation 4</b><br>Achieve and maintain age-appropriate immunization coverage with varicella vaccine in 85% of susceptible adolescents by their 17 <sup>th</sup> birthday by 2010.  | 68%          | 29%                            | 3%              |
| <b>Other</b>  |              |                                |                 |
| <b>Recommendation 5</b><br>Decrease varicella-related hospitalization rates by 80% by 2010.   | 88%          | 12%                            | 0%              |
| <b>Recommendation 6</b><br>Decrease the number of varicella-related deaths by 80% by 2010.  | 90%          | 10%                            | 0%              |
| <b>Recommendation 7</b><br>Achieve and maintain 100% demonstrated varicella immunity in health care workers, by either history of disease, positive serology or prior immunization; and vaccinate if not immune, unless contraindicated, by 2010. | 71%          | 24%                            | 5%              |
| <b>Recommendation 8a</b><br>Screen 100% of pregnant women annually for immunity to varicella, by either history of disease, prior immunization or positive serology, by 2010.   | 81%          | 17%                            | 2%              |
| <b>Recommendation 8b</b><br>Achieve and maintain immunization coverage with varicella vaccine in 100% of post-partum women without evidence of immunity, unless contraindicated, by 2010.   | 46%          | 44%                            | 10%             |

## **Invasive pneumococcal disease**

### **Background**

The purpose of this session was to update goals, recommendations and targets for the reduction of invasive pneumococcal disease (IPD) in Canada, based on a review of current evidence and the goals established at the 1998 Canadian Consensus Conference on Preventing Pneumococcal Disease. Below are highlights of presentations on IPD immunization and surveillance in Canada and the US.

### **Immunization in Alberta:**

(Dr. James Kellner)

Following the product licensure for infants in mid-2001, Pevnar®, or heptavalent pneumococcal conjugate vaccine (Pneu-C-7) was provided to high-risk and Aboriginal children in Alberta. The Pneu-C-7 program joined an enhanced program for polyvalent pneumococcal vaccine or 23-valent vaccine (Pneu-P-23), which was introduced in 1998 for long-term care facility residents, adults > 65 years of age and high-risk persons > 5 years of age.

Uptake of Pneu-C-7, administered in three doses, approached 88% in children 2 years of age in Calgary and 92% in 12 month-olds in Edmonton. Uptake of Pneu-P-23 in adults ≥ 65 years of age, while below target, increased from 41% to 55% between 1999 and 2003. Following Pneu-C-7 licensure in Alberta, a 93% decline in vaccine serotype cases was observed. Incidence of invasive streptococcal pneumococcal (ISP) in 0 to 23 month-olds dropped from the 1998-2001 average of 53.0 cases per 100,000 to 3.9 cases per 100,000 in 2004, with significant declines observed across all serotypes. During the same period, a 67% decrease in Pneu-C-7 serotype cases was also observed in adults ≥ 65 years of age; a decline which began with introduction of Pneu-P-23 programs. This experience shows that

Pneu-C-7 is effective in preventing IPD and suggests evidence of herd immunity in children and adults > 65 years of age.

### **Immunization in Canada:**

(Christine Navarro, MSc)

The following summary of statistics of pneumococcal immunization programs in Canada was provided:

- As of July 2005, 12 of 13 jurisdictions in Canada will have implemented universal infant immunization programs. Still, the National Immunization Coverage Survey (NICS) revealed that, from 2002 to 2004, following the introduction of programs in Alberta, British Columbia and Nunavut, the coverage rate in the 2-year-old cohort had increased only slightly from 11% to 13%. There is speculation that the increase may have been minimized due to errors in reporting by parents, sampling errors, and/or incomplete program rollout at the time of the survey.
- A 1999 cross-sectional survey of provincial long-term care facilities showed an overall immunization rate of 71% among residents. However, immunizations were not routinely offered in 17% of facilities and overall coverage was low relative to influenza.
- The 2001 NICS national telephone survey revealed low coverage in other groups, with immunization administered to 40% of non-institutionalized adults ≥ 65 years of age and 15% of high-risk persons 18 to 64 years of age.
- Immunization coverage in provinces and territories has generally fallen short of targets for all age groups.

### **Immunization in the US:**

(Dr. Pekka Nuorti, CDC)

In the US in 2003, 87% of children had received at least one dose of vaccine by 2 years of age, with about one-third receiving a booster dose by the same age. Immunization programmers were faced with unprecedented rapid uptake of the vaccine which resulted in vaccine shortages. However, post-Pneu-C-7 data show dramatic reductions (48% to 83% depending on age group) in IPD incidence in children < 5 years of age. Indirect effects (herd immunity) in children and infants outside the targeted age groups have also been observed, along with significant declines in IPD incidence in black and Alaskan native children, basically eliminating racial health disparities for IPD. A 63% drop in IPD cases caused by penicillin-resistant strains was observed. A substantial herd protection has been seen in adults, suggesting that an effective IPD prevention approach is to vaccinate children. This effect is unlikely to be due to immunization with Pneu-P-23. Finally, preliminary data from population-based studies point to the effectiveness of Pneu-C-7 in reducing rates of otitis media and all-cause clinical pneumonia in young children, as well as the need for tympanostomy tubes.

Pneumococcal replacement disease has been observed in non-target age groups after the introduction of Pneu-C-7; increases were found in 24 to 59 month-olds compared to baseline data and in the working-age HIV-AIDS population as compared to the non HIV-AIDS population. However, the absolute rates of replacement disease are low. Serotype 19A is emerging as a problem vaccine serotype, and serotypes 15 and 33-F as problematic non-vaccine serotypes, underscoring the importance of serotype analysis for IPD surveillance.

### **Surveillance in Canada:**

(Dr. David Scheifele, BC Children's Hospital)

Serotype data from IMPACT between 1991-1998 showed an 86% correlation between isolates and vaccine serotypes in children 6 months to 5 years of age. Lower match rates were found in older children and Aboriginal children, with higher penicillin non-susceptibility also seen in the latter group. From 1998 to 2003, a modest decrease in serotype matches was seen in main target groups, with serotype matches in the Aboriginal population remaining low and penicillin non-susceptibility high by comparison. In all cases, match rates varied from year to year and between centres, impeding analysis. The possible role of clonal serotypes in match rate variation was acknowledged, as was the need for increased epidemiological study and standardized reporting across provinces and territories.

### **Surveillance in Canada and Alberta:**

(Dr. Greg Tyrrell)

The National Centre for Streptococcus (NCS) has seen 58 different serotypes in Canada between 1998 and 2004, with Pneu-C-7 covering seven of the eight most common serotypes. Blood and cerebral spinal fluid account for 97% of submitted specimens, most of which come from Alberta. Within Alberta, children  $\leq$  2 years of age have shown the most dramatic decline in pneumococcal cases caused by serotypes covered by the Pneu-C-7 vaccine. A similar decline was observed in isolates from the rest of Canada for this age group although it was not as dramatic. In the elderly (> 65 years), both Pneu-C-7 and non-Pneu-C-7 isolates are common, with only a slight drop in the number of Pneu-C-7 isolates submitted over the same time period. The overall penicillin non-susceptible rate for both Pneu-C-7 and non-Pneu-C-7 serotypes submitted for this age

group is about 11%, with a noted decrease in the number of penicillin non-susceptible Pneu-C-7 isolates.

## Discussion

Taking into account the evidence presented, participants identified the following issues related to updating the IPD reduction goals established at the 1998 Consensus Conference. The discussion guide used by participants is attached in Appendix B.

*Immunization coverage:* It was suggested that the original target of 40% for all vaccine-eligible groups should be revised upward, given the post-Pneu-C-7 declines in observed incidence in infants, even though immunization coverage targets for IPD prevention generally have not been met.

*Hospitalization targets:* It was recommended that hospitalization targets should not be set for IPD, given the difficulties in monitoring hospital data and the projected decline in hospitalization rates associated with the attainment of disease reduction targets.

*High-risk groups:* It was recommended that disease reduction targets should follow the attainment of immunization coverage targets, however should not be set for high-risk groups due to a lack of surveillance data.

*Serotyping:* To establish disease reduction targets for IPD, it is important to be able to monitor the serotype of the causative strain to accurately determine the incidence of vaccine-preventable cases of IPD. This is particularly important with regard to replacement disease. Therefore, it was agreed that a recommendation be made to flag the need for serotype surveillance or to set a target for serotyping IPD isolates (e.g., all isolates, a constant percentage of isolates, all isolates from children < 2 years of age).

## Setting goals and recommendations

Participants revisited the disease reduction goals and targets proposed at the 1998 Consensus Conference, and came to the following recommended updates and comments.

### Goal

Reduce illness and death due to pneumococcal disease through immunization.

**Rationale:** The 1998 overarching goal to “reduce the incidence/impact of pneumonia disease by immunization across all ages” should be revised to focus on illness and death.

### Disease incidence

#### Recommendation 1

Achieve a sustained reduction of 80% in the incidence of IPD in children < 2 years of age compared with pre-conjugate vaccine incidence by 2010.

**Rationale:** Given the experience in the US, an 80% reduction in all serotype disease relative to pre-vaccine incidence rates should be attainable in children < 2 years of age. Spin-off benefits in other age groups are also anticipated. A target date of 2010 reflects the current state of surveillance in Canada and allows for the extension of government interest should targets be attained sooner than planned.

#### Recommendation 2

Achieve a sustained reduction of 40% in the incidence of IPD in adults ≥ 65 years of age compared with 1998 incidence by 2010.

**Rationale:** The original disease reduction target of 40% in this age group is realistic based on the evidence that shows a 20% reduction can be achieved with Pneu-C-7 coverage and the balance with existing poly-

saccharide vaccines. Further evidence demonstrated reductions in IPD incidence in this age group of 25% in Calgary between 1998 and 2004 and 31% in the US between 1998 and 2003.

**Issues:** The role of Pneu-P-23 in the attainment of disease reduction targets was debated. It was generally agreed that the impact of the polysaccharide vaccine is likely modest, with uptake and effectiveness cited as issues. Questions regarding the value of continuing with Pneu-P-23 for high-risk groups and the elderly gave rise to the need for program reevaluation.

### **Immunization coverage**

#### **Recommendation 3**

Achieve and maintain age-appropriate immunization coverage with pneumococcal conjugate vaccine in 90% of children by their 2<sup>nd</sup> birthday by 2008.

**Rationale:** The target of 90% coverage by the end of 2008, a reduction of 5% from the previously proposed national target<sup>(6)</sup> reflects the fact that all provinces and territories (exception Northwest Territories) have initiated or are in the process of initiating immunization programs; Ontario and Quebec have established coverage targets of 97% and 90% respectively. With respect to programming issues, Pneu-C-7 is administered with DTaP and should approach the 95% infant coverage target established for pertussis.

**Issues:** The original 95% coverage target was discussed, as this has yet to be achieved with existing infant immunization programs (e.g., in Alberta and US programs, 88% and 67% of children, respectively, received three doses by their 2<sup>nd</sup> birthday). In contrast, it was noted that Pneu-C-7 is administered with DTaP and therefore should approach the 95% infant coverage target established for pertussis. The

ability to achieve national coverage targets is negatively influenced by the varied schedules and delivery programs among provinces and territories.

#### **Recommendation 4**

Achieve and maintain age-appropriate immunization coverage with a single dose of pneumococcal polysaccharide vaccine in 80% of adults  $\geq$  65 years of age by 2010.

**Rationale:** As seen with influenza, rapid increases in coverage can be achieved once a vaccine has gained acceptance. On this basis, a target of 80% is recommended despite the current 40% coverage rate for non-institutionalized adults  $\geq$  65 years of age. The extended timeframe acknowledges the potential for vaccine supply shortages.

#### **Recommendation 5**

Achieve and maintain age-appropriate immunization coverage with pneumococcal polysaccharide vaccine in 95% of residents of long-term care facilities by 2008.

**Rationale:** The recommended target is based on the current 80% coverage rate for residents of long-term care facilities, up from 71% in 1999, and the likelihood of continued incremental increases in coverage is consistent with the influenza example.

### **Other**

#### **Recommendation 6**

Achieve a sustained reduction of 20% in mortality rates due to IPD in adults  $\geq$  65 years of age compared with 1998 baseline rates by 2010.

**Rationale:** Mortality rates are an important indicator, given the potential impact on society, cost to the health care systems and the significance of death as a disease outcome and performance driver in the medical system.

The proposed disease reduction target is achievable considering, a pre-vaccine mortality rate of 4.1 per 100,000 reported for this age group. However, the original recommendation should be revised to read “mortality rates” instead of “deaths”.

#### **Recommendation 7 (Statement)**

All provinces and territories should continue to optimize their pneumococcal immunization programs for individuals at high risk for IPD as defined by NACI guidelines.

**Rationale:** A numeric target is not recommended for high-risk groups, as disease reduction and immunization coverage in these populations will become less of an issue the longer universal immunization programs are in place. However, a statement is appropriate, given the need to generate increased surveillance data and improve coverage across provincial/territorial programs targeting high risk groups. Further, rather than focus on persons with conditions which significantly increase the risk of IPD (e.g., asplenia, asthma), the statement should cover high-risk groups as defined by NACI guidelines.

**Issues:** Questions were raised about the focus on Pneu-C-7 despite the availability of Pneu-P-23. Consideration was given to lowering the age for universal Pneu-P-23 immunization to capture more high-risk persons; however, experience in the US suggests there is little to be gained by this strategy. In addition, issues arise related to re-immunization, duration of the vaccine effect, and shortage of vaccine supply.

#### **Recommendation 8 (Statement)**

Serotype determination should be made on a representative sample of invasive *Streptococcus pneumoniae* isolates starting in 2006.

**Rationale:** Comprehensive population-based surveillance is needed to support accurate rate calculations and to monitor replacement disease. Recommended areas of focus include IPD, which has the greatest impact and can be readily diagnosed; serotyping of isolates; high-incidence and high-risk populations including ethnic groups. The working group also supported the creation of a national network of linked provincial/territorial immunization registries to support comprehensive surveillance.

**Issues:** Consideration was given to limiting representative sample collection to serotypes responsible for severe outcomes; however, the decision was made to promote comprehensive surveillance and confirmation by serotyping all isolates.

#### **Vote**

Participants achieved consensus on the following recommendations for IPD reduction, with statements provided in lieu of targets for high-risk groups and surveillance. For all recommendations, it was agreed that the National Case Definition for IPD should apply. The impact of replacement strains on achieving disease reduction targets was also noted, however no offsetting increases in immunization coverage targets were proposed.

**Table 3 – Invasive pneumococcal disease votes**

| Recommendations  | Agree | Agree with reservations | Disagree |
|--|-------|-------------------------|----------|
| <b>Goal</b>  |       |                         |          |
| Reduce illness and death due to pneumococcal disease through immunization.   | 97%   | 3%                      | 0%       |
| <b>Disease reduction</b>   |       |                         |          |
| <b>Recommendation 1</b><br>Achieve a sustained reduction of 80% in the incidence of IPD in children < 2 years of age compared with pre conjugate vaccine incidence by 2010.                              | 88%   | 10%                     | 2%       |
| <b>Recommendation 2</b><br>Achieve a sustained reduction of 40% in the incidence of IPD in adults ≥ 65 years of age compared with 1998 incidence by 2010.  | 78%   | 22%                     | 0%       |
| <b>Immunization coverage</b>   |       |                         |          |
| <b>Recommendation 3</b><br>Achieve and maintain age-appropriate immunization coverage with pneumococcal conjugate vaccine in 90% of children by their 2 <sup>nd</sup> birthday by 2008.                  | 76%   | 24%                     | 0%       |
| <b>Recommendation 4</b><br>Achieve and maintain age-appropriate immunization coverage with a single dose of pneumococcal polysaccharide vaccine in 80% of adults ≥ 65 years of age by 2010.              | 78%   | 22%                     | 0%       |
| <b>Recommendation 5</b><br>Achieve and maintain age-appropriate immunization coverage with pneumococcal polysaccharide vaccine in 95% of residents of long-term care facilities by 2008.                 | 79%   | 21%                     | 0%       |
| <b>Other</b>   |       |                         |          |
| <b>Recommendation 6</b><br>Achieve a sustained reduction of 20% in mortality rates due to IPD in adults ≥ 65 years of age compared with 1998 baseline rates by 2010.                                     | 69%   | 27%                     | 3%       |
| <b>Recommendation 7 (Statement)</b><br>All province/territories should continue to optimize their pneumococcal immunization programs for individuals at high risk for IPD as defined by NACI guidelines. | 81%   | 12%                     | 7%       |
| <b>Recommendation 8 (Statement)</b><br>Serotype determination should be made on a representative sample of invasive <i>Streptococcus pneumoniae</i> isolates starting in 2006.                           | 84%   | 9%                      | 7%       |

## Invasive meningococcal disease

### Background

The purpose of this session was to review current evidence and recommendations for national goals to control of invasive meningococcal disease

(IMD) in Canada, focusing on *Neisseria meningitidis* (*N. meningitidis*) serogroup C, one of the leading causes of bacterial meningitis in Canada. Below are highlights of presentations on IMD incidence and immunization programs in Canada and other countries.

**Disease incidence in Canada:**  
(Kerri Watkins, MHSc)

The annual incidence of IMD in Canada was approximately 305 cases per year between 1985 and 2003, with outbreaks occurring during the periods from 1989 to 1993 and 1999 to 2001. Preliminary data from 2002 to 2003 show a larger decrease in IMD incidence in the provinces which first implemented meningococcal C conjugate (Men C-C) vaccines immunization programs relative to other jurisdictions in Canada; however, it was noted that the 2002 rates in the early implementer provinces were higher and in 2003 decreased only to levels reported in other provinces. There is an added challenge of identifying disease trends given the unpredictability of IMD epidemiology; adding that the federal government is working with provinces and territories to strengthen IMD surveillance, focusing on under-reporting and data quality.

**National Microbiology Laboratory (NML):**  
(Dr. Raymond Tsang)

Immunization programs may contribute to induce changes in *N. meningitidis* circulating strains. Data collected in Quebec following mass immunization campaigns after a serogroup C IMD outbreak in 2001 showed a decrease in the number of serogroup C cases; however, by 2004, a cluster of serogroup B cases had been identified. Subsequent DNA analysis revealed that a unique clone of serogroup B meningococcus had emerged to cause an outbreak dating back to 2003. Evidence of capsule switching involving C:2a:P1.1,7 meningococci changing to B:2a:P1.1,7 was also found, suggesting that one strain may switch to another naturally or under pressure from increasing immunization rates. Dr. Tsang concluded by asking participants to consider whether reduced circulation of the C strain had created an opportunity for a B clone to proliferate and whether the change in bacterial community structure was

related to the 2001 serogroup C outbreak and the subsequent mass immunization campaign.

**Immunization in Canada:**  
(Dr. Philippe De Wals)

Currently all Canadian provinces administer Men C-C vaccines, with most offering primary programs consisting of one dose at 12 months of age. Current evidence shows that, regardless of a vaccine recipient's age, one dose of vaccine is sufficient to prime immune capacity for at least 5 years. Two to three doses are required for children < 12 months of age, although the benefit of the second and third doses is modest.

NACI recommends routine immunization of infants at 2, 4 and 6 months of age, with infants between 4 to 11 months of age who have not previously received Men C-C vaccine to be immunized with two doses given at least 4 weeks apart. A single dose of the vaccine is recommended for immunization of children 1 to 4 years of age and for adolescents and young adults, given the increased risk of IMD in these age groups.

Seeking the optimal Men C-C immunization schedule, the efficacy of selected provincial programs over an 8-year period was examined. Using a simulation model, assuming 96% coverage in the first year after primary immunization or booster dose, it was shown that staging multiple doses over several years conferred greater benefit than administering all doses during infancy. The most effective schedule was 12 months, 12 years, and 18 years which was found to be only marginally more effective than 12 months and 12 years. From a cost-effectiveness standpoint, a one-dose strategy was preferable to both a three-dose strategy and mass immunization campaigns. Ultimately a two-dose regimen, given at 12 months and 12 years, emerged as the optimal strategy.

Dr. De Wals concluded by challenging participants to consider the optimal age for initiating

primary immunization; the optimal number of doses for primary immunization; and at what age catch-up immunization and/or booster doses should be given. Issues impacting the resolution of these questions included the unpredictable epidemiology of IMD, uncertainty around the long-term effectiveness of conjugate vaccine, and the rate at which immunity wanes suggesting that control strategies must remain flexible to enable responsiveness to new developments.

### **Immunization in other countries:** (Dr. Eric Bertherat, WHO)

The experience of selected countries with Men C-C immunization was reviewed, focusing on the United Kingdom (UK). A marked increase in the incidence of IMD in the UK in the late 1990s led to the initiation of a mass Men C-C immunization campaign in 1999. Other countries followed suit (e.g., Ireland, Spain, Belgium, the Netherlands, Australia and Iceland), adopting a variety of routine and catch-up immunization schedules. Evidence in the UK demonstrated high short-term protection and a reduction in both carriage and incidence of IMD, as well as good herd immunity levels obtained through catch-up. However, in Spain, serogroup switching from serogroup C to B occurred following mass immunization. The duration of immunity, in both the UK and Spain, rapidly fell-off among infants vaccinated at an early age, raising questions about booster timing. Dr. Bertherat noted that, while the effectiveness of the Men C-C vaccine has been demonstrated, its impact is less clear given the natural cycles of IMD. To improve understanding, increased surveillance is required.

### **Discussion**

Participants identified the following issues concerning the development of national goals and recommendations for the control of IMD in Canada, recognizing that no national goals have been established since the implementation of

Men C-C immunization programs. The discussion guide used by participants is attached in Appendix B.

*Strain switching:* The linkage between strain switching and vaccination programs was considered. In some cases, IMD carriers carry both B and C strains, allowing for switching. High mutation rates have also been observed. Referencing the 2001 IMD outbreak in Quebec, Dr. De Wals asserted that mass campaigns do not create the foundation for subsequent epidemics. Dr. Tsang clarified that most of the B strain cases identified following the 2001 Quebec outbreak were in adolescents, suggesting an invasive clone.

*Duration of immunity:* Participants questioned the high rate of post-immunization fall-off in the UK, comparing the infant dosage ages of 2, 3 and 4 months to the Canadian standard of 2, 4 and 6 months. Dr. De Wals noted that, in Quebec, with immunization at  $\geq 12$  months of age, protection decreased following immunization, but to a lesser extent than in the UK.

*Immunization registries:* Participants agreed on the potential role of immunization registries in strengthening IMD epidemiological analysis, acknowledging the need to address issues related to consistency and quality of data with entries being made by hundreds of physician and public health offices. However, registries are of limited use in assessing immunization coverage, due to a lack of denominator information.

*Education campaigns:* It was determined that, given the current public demand for Men C-C vaccines, there is limited need for professional or public education campaigns. However, the importance of alerting decision-makers and funding bodies to disease reduction targets was noted, prompting the suggestion that a “report card” be developed on the establishment and achievement of targets.

*Quadrivalent vaccine:* Participants discussed the pending approval of the quadrivalent conjugate vaccine Menactra™ (serotypes A, C, Y and W-

135) in Canada. Questions were raised about how the vaccine will be used and the age groups for which it will be licensed. Also considered was the prospect of replacing the monovalent vaccine currently used in adolescent programs with the quadrivalent conjugate vaccine, with the cost of the new vaccine cited as a likely issue. The potential need for an incremental cost-benefit analysis was also noted.

**Surveillance:** The next steps of the recommendations will require the standardization of data elements to improve surveillance; due to the cyclical nature of this disease, a baseline using the average incidence for the period from 1995-2001 was recommended. Surveillance will also need to be enhanced to capture IMD cases, including information on age-specific disease incidence, hospitalization and mortality. Priority should be given to developing and implementing standard data elements and data collection methods. Other areas to be addressed include the completeness of provincial/territorial laboratory data on *N. meningitidis* isolates; the collection of serotype data to support target-setting and outcome evaluation; the measurement of long-term disease sequelae; and the inclusion of clinical information with specimens submitted to the national laboratory.

## Setting goals and recommendations

### Goal

Reduce illness and death due to *N. meningitidis* serogroup C through immunization.  
(Proposed by CIC)

### Disease incidence

#### Recommendation 1

Prevent *N. meningitidis* serogroup C outbreaks in those < 25 years by 2012.

**Rationale:** An age-specific target is appropriate; outbreaks tend to occur among adolescents and adults in their early 20's. Targeting

persons up to 25 years of age might prompt provinces/territories to expand the age range of immunization programs, including catch-up programs, beyond the 15 to 19 age group currently targeted by NACI.

The proposed timeline of 2010 was debated in plenary session. Concern was expressed that a significant number of cohorts would have to be immunized to achieve the desired outcome, which could necessitate mass immunization campaigns. Alternate timelines of 2012 and 2015 were suggested, with 2012 ultimately being selected.

Subsequent to proposed age and timing changes, plenary participants considered replacing "prevent" with "eliminate" or "eradicate". The original wording was retained as the group agreed that there will continue to be un-immunized persons and outbreaks.

#### Recommendation 2

Achieve a sustained reduction of 90% in the incidence of *N. meningitidis* serogroup C in children < 5 years of age by 2010.

**Rationale:** The reduction target is attainable, given current immunization programs, and appropriate, given that children < 5 years of age constitute a high-risk group.

**Discussion:** It was suggested that immunization at 2, 4 and 6 months of age may not be necessary to achieve the proposed recommendation; rather, a comprehensive program targeting young children and adolescents should be sufficient when considering the effect of herd immunity.

#### Recommendation 3

Achieve a sustained reduction of 95% in the incidence of *N. meningitidis* serogroup C in adolescents 12 to 19 years of age by 2010.

**Rationale:** Two age groups were considered for targeting adolescents; 12 to 19 versus 15

to 19 years of age. The more comprehensive age group was recommended for the following reasons; the herd immunity impact would be greater, the age at which persons begin engaging in higher risk social activity is closer to 12 years of age than 15; and IMD incidence starts rising at 10 years of age.

#### **Recommendation 4**

Achieve a sustained reduction of 70% in the incidence of *N. meningitidis* serogroup C by 2010.

**Rationale:** The proposed target can be achieved indirectly through implementing recommendations 1, 2, and 3. While there are currently no programs targeting older Canadians, the effect of herd immunity may contribute to this reduction.

### **Immunization coverage**

#### **Recommendation 5**

Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 100% of *N. meningitidis* serogroup C close contacts\* of cases by 2010. (\* as defined by NACI)

**Rationale:** An age generic immunization coverage target was recommended because close contacts of serogroup C IMD cases of all ages, as defined by NACI, constitute a high-risk group.

#### **Recommendation 6**

Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 95% of high-risk groups\* for *N. meningitidis* serogroup C disease. (\*as defined by NACI)

**Rationale:** Building on recommendation 5, it was considered essential to achieve maximum immunization coverage among all high risk groups, as defined by NACI.

#### **Recommendation 7**

Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 97% of children by their 2<sup>nd</sup> birthday by 2010.

**Rationale:** The recommended target is necessary to prevent fatal disease outcomes in children and to achieve established disease reduction targets.

#### **Recommendation 8**

Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 90% of adolescents by their 17<sup>th</sup> birthday by 2012.

**Rationale:** The proposed target is measurable and encourages immunization prior to the end of secondary school. The coverage level is lower than that for children  $\leq 2$  years of age, as older age groups are more difficult to access. Further, there is public demand, by parents, for their children to receive Men C-C vaccine.

**Discussion:** In plenary session, it was proposed to extend the time frame from 2010 to 2012 as the additional time would be needed to accommodate the limitations and variations of current immunization programs.

In jurisdictions where age at the end of secondary school may be  $< 17$  years of age, it was recommended that immunization programs target children  $< 17$  years of age.

An interim target for assessing program implementation progress was recommended to respond to the intense public demand for Men C-C immunization programs for school-age cohorts.

### **Other mortality**

Mortality targets for children < 5 years of age and adolescents 15 to 19 years of age were considered however, due to the variability of programs currently delivered across all the jurisdictions, no mortality reduction targets were set at this time.

#### **Recommendation 9**

Enhance epidemiological\*\*, clinical and laboratory\*\*\* surveillance of invasive meningococcal C disease.

(\*includes immunization status and  
\*\*\*includes access to uniform PCR technology for all jurisdictions in Canada)

**Rationale:** Enhanced surveillance is required to improve data quality and track *N. meningitidis* serogroup trends. Access to immunization histories is also needed to enable provinces and territories to assess immunization rates.

#### **Recommendation 10 (Statement)**

Provinces and territories should evaluate *N. meningitidis* serogroup C immunization programs including, but not limited to, immunization coverage, vaccine effectiveness, vaccine safety and epidemiological changes.

**Rationale:** Evaluation is needed to measure outcomes and determine the need and nature of revisions to existing immunization schedules, programs and targets.

#### **Vote**

Participants achieved consensus on the following recommendations for IMD control, with extensive discussion ensuing and second votes being held (see Votes 1 and 2) on recommendations 1 and 8. No overarching goal was presented for consideration at the conference; however, a goal was proposed later and approved by CIC.

**Table 4 – Invasive meningococcal disease votes**

| Recommendations  | Agree |            | Agree with reservations |            | Disagree |            |
|--|-------|------------|-------------------------|------------|----------|------------|
|  | V1    | V2         | V1                      | V2         | V1       | V2         |
| <b>Goal (proposed)</b>   |       |            |                         |            |          |            |
| Reduce illness and death due to <i>N. meningitidis</i> serogroup C outbreaks through immunization.   | N/A   |            | N/A                     |            | N/A      |            |
| <b>Disease incidence</b>   |       |            |                         |            |          |            |
| <b>Recommendation 1</b>  | V1    | V2         | V1                      | V2         | V1       | V2         |
| Prevent <i>N. meningitidis</i> serogroup C outbreaks in those < 25 years by 2015.  | 50%   | <b>68%</b> | 26%                     | <b>22%</b> | 24%      | <b>10%</b> |
| <b>Recommendation 2</b>  | 82%   |            | 13%                     |            | 5%       |            |
| Achieve a sustained reduction of 90% in the incidence of <i>N. meningitidis</i> serogroup C in children < 5 years of age by 2010.  |       |            |                         |            |          |            |
| <b>Recommendation 3</b>  | 67%   |            | 22%                     |            | 11%      |            |
| Achieve a sustained reduction of 95% in the incidence of <i>N. meningitidis</i> serogroup C in adolescents aged 12 to 19 years by 2010.  |       |            |                         |            |          |            |
| <b>Recommendation 4</b>  | 78%   |            | 20%                     |            | 2%       |            |
| Achieve a sustained reduction of 70% in the incidence of <i>N. meningitidis</i> serogroup C by 2010.   |       |            |                         |            |          |            |
| <b>Immunization coverage</b>   |       |            |                         |            |          |            |
| <b>Recommendation 5</b>  | 91%   |            | 7%                      |            | 2%       |            |
| Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 100% of <i>N. meningitidis</i> serogroup C close contacts* of cases by 2010. (*as defined by NACI)                      |       |            |                         |            |          |            |
| <b>Recommendation 6</b>  | 69%   |            | 28%                     |            | 4%       |            |
| Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 95% of high-risk groups* for <i>N. meningitidis</i> serogroup C disease. (*as defined by NACI)                          |       |            |                         |            |          |            |
| <b>Recommendation 7</b>  | 76%   |            | 16%                     |            | 7%       |            |
| Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 97% of children by their 2 <sup>nd</sup> birthday by 2010.  |       |            |                         |            |          |            |
| <b>Recommendation 8</b>  | V1    | V2         | V1                      | V2         | V1       | V2         |
| Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in 90% of adolescents by their 17 <sup>th</sup> birthday by 2012.  | 45%   | 72%        | 24%                     | 24%        | 31%      | 4%         |
| <b>Other</b>   |       |            |                         |            |          |            |
| <b>Recommendation 9</b>  | 87%   |            | 11%                     |            | 2%       |            |
| Enhance epidemiological*, clinical and laboratory** surveillance of invasive meningococcal C disease. (*includes immunization status and **includes access to uniform PCR technology for all jurisdictions in Canada)        |       |            |                         |            |          |            |
| <b>Recommendation 10 (Statement)</b>   | 94%   |            | 6%                      |            | 0%       |            |
| Provinces and territories should evaluate <i>N. meningitidis</i> serogroup C immunization programs including, but not limited to, immunization coverage, vaccine effectiveness, vaccine safety, and epidemiological changes. |       |            |                         |            |          |            |

## **Influenza**

### **Background**

The purpose of this session was to develop updated goals and recommendations for influenza immunization in Canada, based on a review of current issues and the outcomes from the 1993 National Influenza Consensus Conference and a 2001 meeting on the role of vaccines in influenza control. Below are highlights of presentations on influenza immunization initiatives and challenges in Canada and the US.

### **Immunization in the US:**

(Dr. Nancy Cox, CDC)

Young children have become a new focus of CDC influenza immunization efforts, as they have been determined to have an increased risk for influenza-associated hospitalization. In 2004, annual immunizations were recommended for all children 6 to 23 months, a newly designated high-risk group.

The challenges of vaccine production were subsequently reviewed, beginning with obtaining the most current available virologic and surveillance data on which to base strain recommendations issued by the WHO approximately 6 months prior to flu season. While there has been relatively good vaccine matching with predominant circulating strains, some difficulty has been encountered in determining precise antigenic match. New methods are being developed by the WHO and CDC for antigenic matching between circulating and vaccine strains.

Ultimately, many factors influence influenza vaccine effectiveness: recipient age and immune status; vaccine match with circulating strains, quantification of herd immunity, basis of outcome measurement, all contributing to impede measurement of program impacts.

### **Vaccine recommendations in Canada:**

(Drs. Theresa Tam and Pamela Orr)

NACI recommends that immunization programs focus on those at high risk of influenza-related complications, those capable of transmitting influenza to individuals at high risk of complications, and those who provide essential community services to reduce the morbidity and mortality associated with influenza and the impact of illness in our communities. Also recommended for immunization are people in direct contact with poultry infected with avian influenza during culling operations. Further, healthy persons ages 2 to 64 years are encouraged to receive influenza vaccine<sup>(7)</sup>.

The controversy surrounding the recommendation to immunize healthy pregnant women was discussed. CDC recommends that pregnant women in their 2<sup>nd</sup> or 3<sup>rd</sup> trimester be immunized, due to the high risk of hospitalization, and considers immunization during any trimester safe. However, further Canadian research is proposed on the need for and safety of influenza vaccines during pregnancy.

In addition to the NACI recommendations, at the 1993 National Influenza Consensus Conference it was determined that “the goal of the influenza immunization program should be 100% coverage of vaccine-eligible groups to prevent serious morbidity and mortality due to influenza in both inter-pandemic and pandemic periods”<sup>(8)</sup>. Specific immunization coverage targets were established as follows: 95% of residents of long-term care facilities and staff by the 1995-1996 season; 70% of persons  $\geq$  65 years by 2000-2001; and 70% of persons with high-risk conditions by 2000-2001.

Building on the targets established in 1993, additional coverage recommendations were put forward at a 2001 meeting on the role of vaccines in influenza control. Among these were immu-

nization of 80% of persons  $\geq 65$  years, 80% of health care workers, and 100% of vaccinators by 2003; and 80% of household contacts of high-risk persons by 2005. There were no previous recommendations on national influenza disease reduction targets.

### **Immunization in Canada:** (Dr. Theresa Tam)

The results of a recent PHAC survey of provincial/territorial immunization programs relative to NACI recommendations for influenza were reviewed. Twelve of 13 jurisdictions have publicly funded influenza programs targeting seniors  $\geq 65$  years, long-term care facility residents and high-risk individuals 2 to 64 years of age. Only Ontario has a totally universal program (Yukon has a “universal program” for persons  $\geq 18$  year of age). As of 2004-2005, 12 jurisdictions will have programs for children 6 to 23 months; 10 jurisdictions have programs for health care workers in contact with high-risk people, while seven have programs for household contacts of high-risk people and for essential services. Canada distributes about 10 to 12 million doses of influenza vaccine per year through the public and private sectors.

The most recent national immunization coverage survey (NICS) for selected adult immunizations, conducted in 2001, showed that Canada was close to achieving the identified immunization target for seniors but below the targets for people with chronic medical conditions and those age 18 to 64 years. Coverage was about 68% for persons  $\geq 65$  years of age, 50% for health care workers and 38% for persons 18 to 64 years of age with chronic medical conditions. While rates varied, provincial/territorial data showed higher coverage for staff (65% to 83%) and residents of long-term care facilities (83% to 95%).

### **Research and program evaluation:** (Dr. Danuta Skowronski)

Influenza is an important disease that places a burden on Canadian society. It affects 10% to 20% of the Canadian population each year, with 90% of mortality occurring in the elderly, and comparable rates of hospitalization in infants and the elderly. Social costs range from \$500 million to \$2 billion annually, compared with annual immunization program costs of over \$100 million. A national universal program would cost \$200 to \$500 million per year.

Investment in influenza research and program evaluation is essential to identify current challenges and successful initiatives. Economic analysis is needed to inform changes to publicly funded influenza immunization programs and programs should be evaluated to measure the direct and indirect benefits to society, including the cost effectiveness of vaccinating proposed target groups relative to stated goals. The demand for these studies becomes more urgent as influenza vaccine is recommended to growing segments of the population. Unfortunately, there is currently no routine, annual public spending on program evaluation, a gap the Initiative for Directed Influenza Evaluation and Management (iDIEM) aims to fill. iDIEM is a proposal promoting the strategic design and evaluation of publicly funded influenza prevention and control programs through the ongoing review and effective integration of current evidence covering the spectrum of applied public health research.

The following questions related to setting targets, measuring outcomes and informing program decisions-makers involved with influenza immunization were presented to the audience before moving into working group:

- How much uncertainty about vaccine effectiveness is tolerable when expanding programs beyond persons at high risk of

serious sequelae? Do we need a better sense of the relative benefit from year to year? Can this be assessed efficiently?

- How should cost effectiveness be captured in decision-making involving publicly funded programs, and which perspectives should be considered (e.g., third party payer or societal; individual clinician or population-based)?
- Is it practical to set disease reduction targets for influenza?
- What would be appropriate targets for immunization coverage; for specific groups?
- What is needed to measure the impact of influenza immunization programs?
- What mechanisms or strategies are needed to achieve established goals?

It was concluded that influenza is a vaccine-preventable disease that poses unique challenges. It is a moving target, given year-to-year variation in circulating strains, virulence, disease activity and impact, underscoring the importance of ongoing research and program evaluation. To this end, a centrally coordinated and funded Institute similar to the IDIEM was proposed. Participants were also asked to develop a recommendation on the evaluation of existing and proposed influenza programs.

### Setting goals and recommendations

Participants recommended the following updated goals and recommendations related to influenza immunization. The discussion guide used by participants is attached in Appendix B.

#### Goal

The goal of the annual influenza immunization program is to prevent serious illness caused by influenza and its complications, including death.

**Discussion:** Participants proposed wording changes to the goal set at the 1993 National Influenza Consensus Conference. Rather than “morbidity and mortality” it was agreed the goal should refer to “complications of influenza, including death”. Further, rather than “inter-pandemic and pandemic periods,” reference should be made to the “annual” influenza program. Consideration was given to identifying “high risk groups”, however participants agreed this reference was implicit in the goal and suggested specific populations be addressed as part of a separate recommendation.

#### Disease incidence

##### Recommendation 1

National disease reduction goals should be established for influenza.

**Discussion:** Participants did not recommend disease reduction targets at this time, on the basis that they are difficult to achieve and measure. Specific issues include variability of the influenza virus from year to year, variability in vaccine match to circulating strains, variability in vaccine effectiveness, a lack of disease impact indicators, and limited ongoing research and evaluation.

However, participants did agree that, in conjunction with the establishment of influenza immunization coverage targets and inroads in research and evaluation, disease reduction targets should be established although a timeline was not set for this.

##### Statement

Herd immunity at the community level is not recognized to be a feasible goal at this time.

**Discussion:** Participants prepared a statement suggesting, that outside of confined settings, herd immunity is not attainable in

Canada at this time. Reasons cited included variability in vaccine effectiveness and practical limitations in achieving necessary coverage levels. It was acknowledged that, in lieu of striving for herd immunity, immunization programs must focus on high-risk groups. Concern was expressed that a limiting statement on herd immunity may negatively impact provinces/territories which have already introduced or are planning to introduce a universal influenza immunization program. However, no changes were made to the proposed statement.

### **Immunization coverage**

#### **Recommendation 2**

The following 2001 national immunization coverage targets should be maintained until a task group has been convened and made updated recommendations:

- 95% coverage of residents of long-term care facilities and staff who have extensive contact with residents
- 80% coverage of persons aged  $\geq 65$  years of age
- 80% coverage of persons  $< 65$  years of age with high risk conditions
- 80% coverage of health care workers
- 100% coverage of vaccinators
- 80% coverage of household contacts of people at high risk

**Discussion:** Participants devoted substantial discussion to the establishment of immunization coverage targets, ultimately agreeing to maintain the targets set at the 2001 meeting on the role of vaccines in influenza control. It was further agreed that a task group should be established to address gaps and make

recommendations related to immunization coverage and program implementation.

Factors contributing to participant concerns about target-setting included the current lack of scientific data upon which to base targets, an inability to quantify the changing target's "denominator" (i.e. the number of persons with high-risk conditions), difficulties defining target groups, and measurement challenges. Further, the design and delivery of vaccine programs varies among provinces and territories, prompting some participants to suggest that provincial/territorial targets may be more appropriate than national targets.

In supporting the maintenance and updating of existing coverage targets, participants cited the critical role of targets in enabling program planning, delivery and evaluation. While the year-to-year variation in influenza incidence and outcomes makes target-setting a challenge, participants agreed that dispensing with targets was not an option.

In arriving at the proposed recommendations, participants agreed that immunization coverage should be maximized for high-risk persons, household contacts of high risk persons, and health service providers. Some concern was expressed about the potential size of the household contacts group, as well as the lack of evidence regarding the effectiveness of this prevention strategy. Ultimately, the following coverage options were considered: 100% of vaccinators; 95% of residents and staff of long-term care facilities; and 80% of persons  $\geq 65$  years of age. While a priority, no targets were proposed for children 6 to 23 months of age and persons with respiratory and cardiovascular disease.

## Other

### Recommendation 3

Governments should work collaboratively to ensure that a safe and immunogenic vaccine is available for annual influenza immunization programs.

**Discussion:** A mechanism is needed to ensure the safety of influenza vaccines, given their unique nature (i.e. a new vaccine is produced yearly under tight time frames based on best available evidence). The suggestion was made to evaluate vaccine safety and immunogenicity annually, with safety defined as a lack of serious adverse effects.

### Recommendation 4

Governments should work collaboratively to efficiently deliver influenza immunization to eligible persons each year.

**Discussion:** Participants agreed on the need to minimize the burden on the health care system posed by influenza. Immunogenicity, based on antibody measurement, may not be an accurate reflection of protection as it does not capture the boost to cell-mediated immunity provided by the vaccine. Rather, the establishment of systems for the annual assessment of vaccine efficacy would be preferable. Such systems could also be used during a pandemic.

### Recommendation 5

Governments should work collaboratively to establish a mechanism for strategic design of influenza immunization programs, including applied public health research and program evaluation of:

- basic science
- surveillance
- evaluation of interventions
- knowledge, attitudes and behaviours
- mathematical and economic modeling

**Discussion:** Participants recommended the establishment of a mechanism for ongoing influenza research and program evaluation to optimize program efficiency and impact.

### Vote

Participants agreed to the following goals and recommendations for influenza control, with the lowest level of support given to the recommendation on disease reduction targets. In addition, participants issued a statement indicating that “*herd immunity at the community level is not recognized to be a feasible goal at this time*”.

**Table 5 – Influenza votes**

| Recommendations   | Agree | Agree with reservations | Disagree |
|---|-------|-------------------------|----------|
| <b>Goal</b>   |       |                         |          |
| The goal of the annual influenza immunization program is to prevent serious illness caused by influenza and its complications, including death.   | 82%   | 9%                      | 9%       |
| <b>Disease incidence</b>  |       |                         |          |
| <b>Recommendation 1</b><br>National disease reduction goals should be established for influenza.  | 36%   | 25%                     | 38%      |
| <b>Immunization coverage</b>  |       |                         |          |
| <b>Recommendation 2</b><br>The following 2001 national immunization coverage targets should be maintained until a task group has been convened and made updated recommendations:<br><ul style="list-style-type: none"> <li>■ 95% coverage of residents of long-term care facilities and staff who have extensive contact with residents</li> <li>■ 80% coverage of persons aged ≥ 65 years of age</li> <li>■ 80% of persons &lt; 65 years of age with high risk conditions</li> <li>■ 80% coverage of health care workers</li> <li>■ 100% coverage of vaccinators</li> <li>■ 80% coverage of household contacts of people at high risk</li> </ul> | 89%   | 9%                      | 2%       |
| <b>Other</b>  |       |                         |          |
| <b>Recommendation 3</b><br>Governments should work collaboratively to ensure that a safe and immunogenic vaccine is available for annual influenza immunization programs.   | 85%   | 11%                     | 4%       |
| <b>Recommendation 4</b><br>Governments should work collaboratively to efficiently deliver influenza immunization to eligible persons each year.   | 78%   | 15%                     | 7%       |
| <b>Recommendation 5</b><br>Governments should work collaboratively to establish a mechanism for strategic design of influenza immunization programs, including applied public health research and program evaluation of:<br><ul style="list-style-type: none"> <li>■ basic science</li> <li>■ surveillance</li> <li>■ evaluation of interventions</li> <li>■ knowledge, attitudes, beliefs and behaviours</li> <li>■ mathematical and economic modeling</li> </ul>  | 82%   | 13%                     | 5%       |

## Pertussis

### Background

The purpose of this session was to develop updated recommendations and targets for pertussis immunization in Canada, based on a review

of current evidence and the recommendations and targets set at the 2002 Pertussis Consensus Conference. Below are highlights of presentations on pertussis surveillance, epidemiology and immunization.

## **Epidemiology:**

(Drs. Scott Halperin and Shelley Deeks)

The incidence of pertussis in Canada has risen since the 1990s, with the highest incident rates occurring in infants < 1 year of age. Further, the disease is cyclical (every 4 to 5 years) and has undergone a shift in age distribution since 2000, with pre-adolescents (10 to 14 years) replacing preschool children as the age group with the second highest incidence rate. Increases in incidence may be artifact (e.g., due to increases in reporting, use of newer diagnostic methods such as polymerase chain reaction [PCR], changes in case definition) or real (e.g., due to low efficacy of whole-cell vaccines, decreases in coverage, waning immunity, changes in strains) or a combination of both.

## **Immunization:**

(Dr. Shelley Deeks)

Pertussis vaccine was first introduced in Canada in 1943. From 1958-1996, a series of combined whole-cell pertussis vaccines were licensed and used throughout the country. Pertussis vaccines are most commonly given in combination with other immunizing agents such as in combination with inactivated polio (IPV) as a quadravalent (DTaP-IPV) or pentavalent and *Haemophilus influenzae* Type b (Hib) (DTaP-IPV-Hib) vaccine. Because of the frequency of local and systemic adverse events following immunization with a whole-cell pertussis containing vaccine, acellular pertussis vaccines, previously used in Japan since the early 70's, were licensed for use in the mid 90's. The benefits of acellular vaccine are that it boasts fewer side-effects and higher efficacy than the whole-cell vaccine and is safe to use in adolescents and adults. Currently, NACI recommends that pertussis vaccines be given at 2, 4, 6, and 18 months, followed by a preschool vaccine at 4 to 6 years and a booster for adolescents (14 to 16 years). An adult booster is recommended for adults who have not been previously immunized

with acellular pertussis vaccine. As of September 2004, all provinces/territories had implemented universal adolescent acellular pertussis programs with Tdap.

*Age related controls:* While disease elimination across the age spectrum is desirable, it is not likely achievable at this time given the high prevalence of pertussis in the population and the time-limited immunity afforded by immunization. As an alternative, age-related controls for infants, children, adolescents and adults, focusing on the following prevention gaps were recommended.

- *Infants:* Infants < 1 year of age have the highest morbidity and account for virtually all of the mortality among pertussis cases. Infants < 2 months of age are not being effectively protected (i.e. current immunization programs begin at 2 months of age). Questions for participants to consider include: 1) Would immunizing parents effectively decrease pertussis among infants 2) Would post-partum immunization produce protective levels quickly enough and 3) Would maternal immunization provide passive protection to infants in the first 2 months of life?
- *Adolescents:* Immunization coverage for adolescents will improve over time, given the recent implementation of adolescent immunization programs in all provinces and territories. Questions for participants to consider include: 1) Will adolescents who received all preschool doses with acellular need a Tdap booster 2) What is the duration of protection after the five-dose acellular preschool series 3) What is the duration of protection for the acellular adolescent pertussis vaccine and 4) What is the optimal time for a booster?
- *Adults:* Adult immunization is impeded by a lack of awareness among health care professionals regarding the importance of adult

immunizations and generally held concerns about adult immunization and immunization during pregnancy. Suggested strategies include immunizing the entire adult population. (It was noted that no country has implemented a universal adult immunization program) or targeting adults who are in close contact with children. Questions for participants to consider include: 1) Is there an age-related burden of illness among adults 2) Are there special populations at higher risk of contracting pertussis 3) What is the appropriate interval for adult immunization and 4) What are the costs versus benefits of various strategies for adult immunization?

### **Immunization costs/benefits:**

(Dr. Gaston De Serres)

Economic analyses in Ontario and Quebec suggest a high cost of pertussis immunization per case averted. However, had societal costs been considered in these studies (e.g., homecare costs, lost work days), the pertussis immunization cost-benefit ratio might have been slightly better.

### **Surveillance:**

(Dr. Shelley Deeks)

Pertussis is a nationally notifiable disease and voluntary reporting to the national level occurs however, age-based data analysis is impeded by non standardized reporting practices (i.e. aggregate versus case-based). Surveillance activities are further challenged by problems relating to underdiagnosis of pertussis in adolescents and adults, assessment of immunization coverage in adults, the lack of a national network of immunization registries to collect data on immunization and disease status, and the impact of improvements in diagnostics or diagnosis on reported cases.

### **Laboratory diagnostics:**

(Dr. Mark Pepler)

Goals for laboratory diagnostics put forward at the 2002 Pertussis Consensus Conference were reviewed. This includes: 1) PCR should be established as a gold standard for diagnosis within 3 years; 2) a system should be established for selective performance of culture strain typing and identification of new strains; 3) there should be support for the development of criteria for serologic diagnosis; 4) international reference sera and reference antigens should be available; and 5) an international consensus conference on diagnostic methods should be held.

In the absence of a national framework, initiatives have been undertaken in support of these goals on a random and voluntary basis. It was suggested that the 2002 goals for laboratory diagnostics be incorporated into the updated pertussis reduction goals, with the added recommendation that quality assurance programs be put in place.

### **Discussion**

Taking into account the evidence presented, participants identified the following issues related to the development of updated recommendations and targets for pertussis control. The discussion guide used by participants is attached in Appendix B.

*Laboratory diagnostics:* It was concluded that laboratory issues had not been targeted for discussion and therefore should not be addressed as part of the recommendations arising from the 2005 Consensus Conference. However, given the importance of the issues identified, participants agreed to draft a statement to the CIC and Canadian Public Health Laboratory Network (CPHLN) recommending that laboratory diagnostics for pertussis be examined as soon as possible, and a national strategy developed.

*Equity of coverage:* Questions were raised regarding the relationship between socio-economic status, the incidence of pertussis and access to prevention and vaccine programs in Canada. The prospect of targeting activities to better reach populations with lower than average immunization coverage (e.g., First Nations) was raised. Participants agreed that a goal of all pertussis recommendations should be to provide equitable access across all age and socio-economic groups. Also noted was the importance of collecting more and improved (i.e. case by case versus aggregated) data on pertussis outbreaks, to assist in identifying and reaching high-need populations.

*Hospitalization:* It was agreed that increased immunization coverage should result in decreased hospitalizations, eliminating the need to set hospitalization reduction targets.

*Defining goals:* Participants determined that, while desirable, elimination of pertussis was not a realistic recommendation at this time. Rather, in all age categories, recommendations should focus on disease reduction. It was further agreed that relative targets, as opposed to proportional targets, would be appropriate for all pertussis recommendations, given current issues with diagnosis and surveillance.

## Setting Goals and Recommendations

Based on the recommendations and targets outlined in the pertussis discussion guide (Appendix B), participants recommended the following goal and recommendations for pertussis control in Canada.

### **Goal (proposed):**

Reduction of disease incidence through routine immunization and increased access to immunization in populations with low coverage.

**Rationale:** Disease elimination is not a realistic goal at this time. Awareness of adult immunizations must be increased as protection conferred by pertussis immunization is not life-long. Cost to benefit ratio of immunization remains high.

## **Disease incidence**

### **Recommendation 1**

Achieve a sustained reduction in the reported incidence of pertussis among persons 10 to 19 years of age to at least the levels present in persons 1 to 4 years of age by 2010.

**Rationale:** The 10 to 14 year of age group has the second highest rate of pertussis in Canada and therefore warrants targeting. The recommended goal is achievable given the introduction of universal adolescent immunization programs in all province/territories.

### **Recommendation 2**

Reduce the reported incidence of pertussis in persons 30 to 39 years of age to the same levels as in persons 20 to 29 and 40 to 59 years of age by 2015.

**Rationale:** Elevated incidence rates exist among adults of parenting age (i.e. 30 to 39 years). Targeting this age group is expected to decrease incidence in adults overall, after which other subpopulations of adults can be targeted. Decreased incidence may occur in younger populations (i.e. offspring) as a result; however, adults should be immunized for their own sake. 2015 is a more realistic timeframe for achieving the proposed goal, although considerable reductions are expected by the end of 2010.

**Issues:** Concerns were expressed at the working group and plenary level about the appropriateness and necessity of targeting a

subpopulation of adults, with some participants suggesting that the recommendation should target adults of all ages. Questions were also raised about the existence of a secondary rationale related to the protection of children, an approach which has not been validated as well as the feasibility of implementing the proposed recommendation at the provincial/territorial level.

### **Immunization coverage**

#### **Recommendation 3**

Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of infants by 3 months of age (first dose) by 2010.

**Rationale:** Timely administration of a first dose of acellular pertussis vaccine is critical to reducing illness and death in infants.

**Issues:** It will be difficult to assess immunization status in this age group. Further, 3 months is not a routine age milestone for measuring coverage.

#### **Recommendation 4**

Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of infants by 7 months of age (3 doses) by 2010.

**Rationale:** The first three doses of acellular pertussis vaccine are the most critical in reducing infant mortality and hospitalization rates. Focusing on delivery of the first three doses should produce better results than the typical coverage target of 2 years of age.

**Issues:** Questions were raised about the appropriateness of eliminating the 2-year-old coverage target from the recommendations for pertussis. While coverage is already measured by the second birthday (i.e. the age at which

diphtheria, tetanus and polio coverage are measured) regardless of when immunization occurs, participants agreed to add a recommendation reinforcing the 2-year-old coverage target for pertussis.

#### **Recommendation 5**

Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of children by their 2<sup>nd</sup> birthday (4 doses) by 2010.

**Rationale:** Further to the discussion on recommendation 5, the 2-year-old coverage target is appropriate for pertussis as coverage is routinely measured by the second birthday. However, focus should still be placed on monitoring uptake of the first three doses.

#### **Recommendation 6**

Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of children by their 7<sup>th</sup> birthday (5 doses) by 2010.

**Rationale:** The target builds on the proposal to give the first three doses and fourth dose of acellular pertussis vaccine by the ages of 7 months and 2 years, respectively.

#### **Recommendation 7**

Achieve and maintain age-appropriate immunization coverage with Tdap vaccine in 85% of adolescents by their 18<sup>th</sup> birthday by 2010.

**Rationale:** It is important to capture primary series and boosters. As the age limit of school monitoring programs and the cut-off age between adolescence and adulthood, 18 years is a reasonable age for ensuring immunization in adolescents. The target of 85% recognizes that adolescents are more difficult to monitor than their younger counterparts.

### **Recommendation 8**

Provinces/territories should replace Td with Tdap for the adult population by 2010.

**Rationale:** The absence of provincial/territorial programs for adults renders the establishment of adult coverage targets unrealistic. Switching adult immunization boosters from Td to Tdap is a more feasible way of addressing adult immunization needs.

**Issues:** Concern was expressed that the proposed change may result in adults receiving more antigen than they require; although NACI recommendations allow one dose of Tdap for adults, offering more than one vaccine could cause confusion. The appropriateness and feasibility of targeting adults (versus children and adolescents) was also challenged, notwithstanding the 2002 Consensus Conference conclusion that adults should be immunized for their own sake.

### **Other**

#### **Recommendation 9**

Decrease the number of deaths from pertussis to zero in the target population of  $\leq 3$  months of age by 2010.

**Rationale:** Most deaths currently occur in infants too young to receive immunizations (i.e.  $< 3$  months). A focus on timely first dose,

as well as subsequent doses and boosters in older populations, was seen as essential to achieving the proposed goal.

**Issues:** It will be difficult to assess mortality rates in this age group. Further, 3 months of age is not a routine milestone for measuring immunization coverage.

#### **Recommendation 10**

The Canadian Public Health Laboratory Network should reaffirm the laboratory recommendations from the 2002 Pertussis Consensus Conference.

**Rationale:** Standardization is needed to address differences in provincial/territorial diagnostic tests and enable advances in Canadian diagnostic methods.

### **Vote**

Participants considered a total of 10 recommendations for pertussis control, achieving consensus on eight recommendations including the newly added Recommendation 5. Consensus was not reached on Recommendations 2 and 8, following extensive discussion and second votes (see votes 1 and 2). It was agreed that issues raised in the working group and at the plenary level regarding Recommendations 2 and 8 should be considered by the CIC during its review of the consensus conference recommendations.

**Table 6 – Pertussis votes**

| Recommendations   | Agree |            | Agree with reservations |            | Disagree |            |
|---|-------|------------|-------------------------|------------|----------|------------|
| <b>Goal (proposed)</b>  |       |            |                         |            |          |            |
| Reduction of disease incidence through routine immunization and increased access to immunizations in populations with low coverage. (proposed by CIC)                           |       |            |                         |            |          |            |
| <b>Disease incidence</b>  |       |            |                         |            |          |            |
| <b>Recommendation 1</b>   | 89%   |            | 9%                      |            | 2%       |            |
| Achieve a sustained reduction in the reported incidence of pertussis among persons 10 to 19 years of age to at least the levels present in persons 1 to 4 years of age by 2010. |       |            |                         |            |          |            |
| <b>Recommendation 2</b>   | V1    | V2         | V1                      | V2         | V1       | V2         |
| Reduce the reported incidence of pertussis in persons 30 to 39 years of age to the same levels as in persons 20 to 29 and 40 to 59 years of age by 2015.                        | 56%   | 42%        | 28%                     | 27%        | 16%      | 31%        |
| <b>Immunization coverage</b>  |       |            |                         |            |          |            |
| <b>Recommendation 3</b>   | 82%   |            | 14%                     |            | 4%       |            |
| Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of infants by 3 months of age (first dose) by 2010.                          |       |            |                         |            |          |            |
| <b>Recommendation 4</b>   | 77%   |            | 20%                     |            | 3%       |            |
| Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of infants/children by 7 months of age (three doses) by 2010.                |       |            |                         |            |          |            |
| <b>Recommendation 5</b>   | 88%   |            | 12%                     |            | 0%       |            |
| Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of children by their 2 <sup>nd</sup> birthday (four doses) by 2010.          |       |            |                         |            |          |            |
| <b>Recommendation 6</b>   | 84%   |            | 16%                     |            | 0%       |            |
| Achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in 95% of children by their 7 <sup>th</sup> birthday (five doses) by 2010.          |       |            |                         |            |          |            |
| <b>Recommendation 7</b>   | 95%   |            | 3%                      |            | 2%       |            |
| Achieve and maintain age-appropriate immunization coverage with Tdap vaccine in 85% of adolescents by their 18 <sup>th</sup> birthday by 2010.                                  |       |            |                         |            |          |            |
| <b>Recommendation 8</b>   | V1    | V2         | V1                      | V2         | V1       | V2         |
| Provinces and territories should replace Td with Tdap for the adult population by 2010.   | 46%   | <b>39%</b> | 31%                     | <b>26%</b> | 23%      | <b>35%</b> |
| <b>Other</b>  |       |            |                         |            |          |            |
| <b>Recommendation 9</b>   | 83%   |            | 13%                     |            | 4%       |            |
| Decrease the number of deaths from pertussis to zero in the target population of ≤ 3 months of age by 2010.   |       |            |                         |            |          |            |
| <b>Recommendation 10</b>  | 82%   |            | 11%                     |            | 7%       |            |
| The Canadian Public Health Laboratory Network should reaffirm the laboratory recommendations from the 2002 Pertussis Consensus Conference.                                      |       |            |                         |            |          |            |

**Statement to CIC and CPHLN**

In order to permit accurate monitoring of progress in achieving the national goals for pertussis, there is a need to initiate mechanisms to improve and standardize laboratory methods for the diagnosis of pertussis in Canada. Given the realistic timelines for this to occur and the short (5 year) timeline for the disease reduction goals, consideration should be given to creating a mechanism for immediate collection and storage of specimens (cultures, nasopharyngeal secretions, sera) in order to retrospectively measure progress toward disease reduction goals.

## **Evaluation Summary**

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Feedback on the 2005 Consensus Conference was solicited from participants to assist in the planning of future forums dedicated to the development of national immunization goals and recommendations. Key observations from completed evaluation forms are highlighted below, with ratings on specific conference elements shown in Table 7.

### **Supporting information**

Participants were asked to comment on the adequacy of information materials and presentations intended to support working group and plenary discussion and decision-making (Questions 1 to 3 in Table 7). Respondents remarked that conference binders contained valuable information but should have been distributed farther in advance of the meeting (e.g., at least 1 week before). The discussion guides provided to working groups were also considered useful. The suggestion was made that all participants could have benefited from having information specific to other working groups as well as their own, particularly with regard to the more complex diseases (e.g. influenza).

Both working group and plenary presentations were well received, with several participants proposing that copies of presentations be made available at the conference. Another participant recommended that, in light of time constraints, key issues for each disease be identified in presentation format to facilitate discussion and decision-making. The value of drawing on the experience in the US and other countries was also noted, recognizing that the cost versus benefit of inviting external experts must be considered.

### **Format and scope**

Participants generally felt that more time should have been allotted for discussion and decision-making at the working group level, with only 58% of respondents agreeing or agreeing strongly that sufficient time had been provided for this purpose. The influenza group was particularly challenged to complete the agenda within the available time, prompting more than one participant to suggest that a full day be devoted to working group deliberations in future.

A number of participants commented that future consensus conferences should focus on fewer diseases, to allow sufficient time to consider evidence and make decisions. In some cases, it may be appropriate to devote an entire conference to one disease; with influenza cited as a prime example. In the latter regard, the uniqueness of influenza was highlighted along with the challenges of considering this and other diseases concurrently.

Ultimately it was proposed that the CIC be charged with determining the criteria for selecting which and how many VPDs are included in future consensus conferences, with vaccine programs (e.g. multivalent), population impact and new vaccines identified as possible decision-making considerations.

### **Process**

The process for achieving consensus and voting on proposed goals and recommendations was well received by participants. However, consistent with previous comments, some participants felt that more time should be allotted

for presenting and discussing working group outcomes at the plenary level. A clearly defined process for second votes should be developed.

With regard to the goal setting process, it was suggested that organizers of future consensus conferences determine in advance whether participants are to develop “ideal” or “practicable” goals. In addition, prior to conference agendas being developed, proposed issues and goal-setting priorities should be identified in consultation with NACI and other stakeholders.

Overall, participants responded positively to the 2005 Consensus Conference, with those who completed evaluation forms assigning an average approval rating of over 80%. Support was expressed for future consensus conferences; the inaugural forum being described as very well organized and executed, informative, and an effective medium for discussing and making decisions on goals and recommendations for VPDs. In addition to identifying improvement opportunities in the areas of supporting information, format and scope, and process, participants raised concerns about the quality of the simultaneous translation and the redundancy of having hired note-takers as well as staff rapporteurs.

## **Conclusion**

In conclusion, a number of participants stressed the importance of maintaining the momentum gained at the conference, specifically ensuring that recommendations proceed expeditiously through the national public health framework. It was further suggested that a review of provincial/territorial infrastructure be undertaken to identify needs or gaps related to the implementation of goals and recommendations. To ensure that best practices are implemented, evaluation reports have been summarized and a “Lessons Learned” exercise will be held prior to the planning of subsequent conferences.

Despite current limitations there are clear benefits to developing national goals and recommendations for vaccine-preventable diseases. As provinces and territories aspire towards the national vision, their immunizations programs will invariably improve, resulting in increased coverage. These improvements can in turn be used to justify additional funding for their immunization programs. As well, establishing national goals and recommendations provides a method of accountability at the jurisdictional level. Ultimately, the goals and recommendations from the NCC-VPD 2005 are not binding for provinces and territories. Rather, they provide members of the Pan-Canadian Public Health Network and provincial and territorial partners with a common foundation from which to initiate discussions leading to the adoption and implementation of goals at the jurisdictional level. While provincial/territorial programs and objectives may still vary at the conclusion of this process, they will now be guided by a common vision.

The national goals and recommendations from the 2005 Consensus Conference will be re-evaluated in 2010, and future consensus conferences are planned to review, develop and update national goals and recommendations for immunization coverage and disease reduction for the remaining vaccine-preventable diseases.

## **References**

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5. National Advisory Committee on Immunization. *NACI – update to statement on varicella vaccine.* CCDR 2002;28(ACS-3):1-8.
6. *Preventing pneumococcal disease A canadian consensus conference 16-18 February 1998.* CCDR 1999;25(4):25-35.
7. National Advisory Committee on Immunization. *Statement on influenza vaccination for the 2005-2006 season.* CCDR 2005;31(ACS-6):1-32.
8. *Canadian consensus conference on influenza.* CCDR 1993;19(17):136-46.
9. A complete bibliography of reference articles and conference documents are available on CD-Rom by sending a request to [programs\\_irid-diir@phac-aspc.gc.ca](mailto:programs_irid-diir@phac-aspc.gc.ca).

# **Appendix A**

## **Abbreviations**

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| <b>Acronym</b> | <b>Title</b>   |
|----------------|--|
| ACIP .....     | Advisory Committee on Immunization Programs (US)                             |
| CDC.....       | Centers for Disease Control and Prevention, US                               |
| CDCEG .....    | Communicable Disease Control Expert Group                                    |
| CDCN.....      | Communicable Disease Control Network   |
| CIC.....       | Canadian Immunization Committee  |
| CPS.....       | Canadian Paediatric Society  |
| CRS.....       | Congenital Rubella Syndrome  |
| CVS.....       | Congenital Varicella Syndrome  |
| Tdap.....      | Diphtheria, tetanus, acellular pertussis vaccine adult formulation           |
| Td-IPV .....   | Diphtheria, tetanus, acellular pertussis and inactivated polio virus vaccine |
| F/P/T .....    | Federal/Provincial/Territorial   |
| HC.....        | Health Canada  |
| HIV/AIDS ..... | Human Immunodeficiency Virus / Auto Immune Deficiency Syndrome               |
| iDIEM.....     | Institute for Directed Influenza Evaluation and Management                   |
| IgM.....       | Immunoglobulin M   |
| IMD .....      | Invasive Meningococcal Disease   |
| ImG .....      | Immunoglobulin G   |
| IMPAct.....    | Immunization Monitoring Program Active                                       |
| IPD.....       | Invasive Pneumococcal Disease  |
| IPV .....      | Inactivated Polio Virus vaccine  |
| Men-C-C.....   | Meningococcal C Conjugate Vaccine  |
| MHSc.....      | Master's degree in Health Science  |
| MSc .....      | Master's degree in Science   |
| NACI.....      | National Advisory Committee on Immunization (Canada)                         |
| NCC-VPD .....  | National Consensus Conference for Vaccine-Preventable Diseases               |
| NCS .....      | National Centre for Streptococcus Alberta Canada                             |

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| <b>Acronym</b>               | <b>Title</b>  |
|------------------------------|---|
| NICS.....                    | National Immunization Coverage Survey               |
| NIS.....                     | National Immunization Strategy                      |
| <i>N. meningitidis</i> ..... | <i>Neisseria meningitidis</i>                       |
| NML.....                     | National Microbiology Laboratory                    |
| PAHO.....                    | Pan American Public Health Organization             |
| PCR.....                     | Polymerase Chain Reaction                           |
| PHAC.....                    | Public Health Agency of Canada                      |
| Pneu-C-7.....                | Heptavalent pneumococcal conjugate vaccine          |
| Pneu-P-23.....               | (23) Polyvalent pneumococcal polysaccharide vaccine |
| Td.....                      | Tetanus and diphtheria adult vaccine formulation    |
| US.....                      | United States                                       |
| VZV.....                     | Varicella Zooster Virus                             |
| WHO.....                     | World Health Organization                           |

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# **Appendix B**

## **Discussion Guides**

### **Goals and Objectives for Vaccine-Preventable Diseases in Canada Consensus Conference, 2005 (GOCC-VPD) Rubella Discussion Guide**

#### **Original Objectives and Targets**

##### **Consensus Conference 1994\***

**Goal:** Eliminate indigenous rubella infection during pregnancy and thus prevent fetal damage, congenital rubella syndrome (CRS) and other negative outcomes of infection by the year 2000.

##### **Targets**

##### **Vaccine Coverage:**

- Achieve and maintain 97% vaccine coverage at 2 years of age by the year 1997.
- Achieve and maintain 99% age-appropriate vaccine coverage at school entry by the year 1997.
- Achieve and maintain 99% age-appropriate vaccine coverage of 14 to 15-year-olds by the year 1997.

##### **Immunization of Women:**

- Screen serology and/or obtain date of immunization of ALL pregnant women seen prenatally for rubella susceptibility by 1995.
- Achieve and maintain postpartum immunization for rubella of 99% of all susceptible women prior to hospital discharge by year 1995.
- Ensure that all women of childbearing age have a documented history of rubella immunization and, if not, that they are offered rubella vaccine to decrease the rate of rubella-negative primigravida women to < 4% by the year 1997.
- Ensure that all vaccines administered have been appropriately transported, stored and delivered.
- Review the goal and all targets again in 1997.

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\* Mumps and Rubella Consensus Conference 1994.  
PAHO/WHO: 44<sup>th</sup> Directing Council, 55<sup>th</sup> Session of the Regional Committee September 2003.

## **Revised Objectives and Targets**

**Context:** Adopt WHO/PAHO recommendation to establish the goal of rubella and congenital rubella syndrome elimination from the Americas by the year 2010.

### **Consensus Conference 2005**

**Goal:** To establish the goal of rubella and congenital rubella syndrome elimination in Canada by the year 2010.

### **Targets**

#### **Vaccine coverage:**

- Achieve and maintain 97% one-dose coverage with rubella containing vaccine at 2 years of age by the year 2010.
- Achieve and maintain 97% two-dose coverage with rubella containing vaccine at school entry by the 2010.
- Achieve and maintain 97% age-appropriate vaccine coverage of 8 to 16-year-olds by the year 2010.

#### **Immunization of women:**

- Screen serology and/or obtain date of immunization of ALL pregnant women seen prenatally for rubella susceptibility by 2010.
- Achieve and maintain postpartum immunization for rubella of 99% of all susceptible women prior to hospital discharge by year 2010.
- Ensure that all women of childbearing age have a documented history of rubella immunization and, if not, that they are offered rubella vaccine to decrease the rate of rubella-negative primigravida women to < 4% by the year 2010.
- Ensure that all vaccines administered have been appropriately transported, stored and delivered.
- Review the goal and all targets again in 2010.

## Goals and Objectives for Vaccine-Preventable Diseases in Canada

### Consensus Conference, 2005 (GOCC-VPD)

### Varicella Discussion Guide

#### The 1999 Objectives and Targets\*

VZV = Varicella Zoster Virus

National Varicella Consensus Conference (NVCC)

#### Disease reduction

- **By 2005**, an F/P/T forum should establish reduction goals for VZV-associated morbidity

#### Vaccine coverage

Vaccination should be offered to susceptible persons in the following groups, in descending order of priority: health care workers and other special groups, selected immunocompromised groups, preteens at the time of other vaccination programs, children at 1 year of age, catch-up of children aged 1 year to preteens, and other adults.

- **By 2003**, 100% of health care workers should have known positive varicella serology, or a reliable history of disease, or documentation of varicella vaccination, or an acceptable medical contraindication to varicella vaccination.
- **By 2005**, all provinces/territories should have a routine childhood immunization program for varicella, with initiation and

completion of catch-up programs for susceptible children <13 years of age.

- Primary immunization of children <13 years of age should be done with one dose, pending evidence-based assessment of this policy.
- There should be no booster dose, pending further research to measure the need and appropriate timing for a booster to prevent of varicella and zoster.
- **By 2010**, varicella vaccination coverage targets should be tied to measles vaccination coverage targets\*\* to be achieved by the 2<sup>nd</sup> birthday and by the 7<sup>th</sup> birthday.

#### Issues for Evidence-Based Decision

Summarize NACI recommendations for varicella vaccine.

- Summarize varicella vaccination programs across Canada as well as any international programs in existence.
- How has the disease burden\* of varicella (V) and/or herpes zoster (HZ) changed

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\* **Proceedings of the National Varicella Consensus Conference - Montreal, Quebec, May 5-7, 1999**  
CCDR Supplement Volume 25S5, August 1999

\*\* Note: The coverage targets voted on were 95% and 97% by the 2<sup>nd</sup> and 7<sup>th</sup> birthday, respectively. However, the discussion was to link the varicella coverage targets to those for measles, which are 97% and 99%, respectively. The actual measles targets should be taken into consideration in program implementation and evaluation.

since the introduction of the universal P/T immunization program?

- Does the epidemiological surveillance data accurately reflect the disease burden? Are increases artefact (laboratory testing, increased diagnosis) or real? Is there an age group who is systematically under-diagnosed (i.e., adolescents and adults)?
- Have there been any unexpected adverse events related to varicella vaccination?
- Is there evidence of waning immunity? Consider the need for booster programs.

Re: US Experience and lessons learned

- **Summarize vaccine coverage and V and HZ incidence rates in the US since the introduction of the universal varicella immunization program?**
  - a. National averages
  - b. Regional variation
- Did the US develop national goals and objectives (targets) for varicella vaccine coverage and V and HZ disease reduction when the universal immunization program was initiated?
  - a. If yes, have they been revised recently?
  - b. If no, have any been developed since initiating the program?
- How has the disease burden\*\* of V and HZ changed since the introduction of the universal immunization program in the US?
- How has variation in vaccine coverage impacted on the disease burden\*\* of V and HZ?

- Have there been any changes in disease burden\*\* of V and HZ, specific to the following groups, since the initiation of the universal immunization program?
  - a. Age groups
  - b. At risk groups such as the immunocompromised, women of childbearing years and other at adult at risk groups (southern hemisphere immigrants, healthcare workers)
- What has been the impact (good and bad) of varicella “breakthrough” cases in terms of vaccine coverage rates, disease burden\*\* (severe complications, severity of illness, etc.) and public confidence in the varicella immunization program?
  - a. Is there any evidence to suggest that breakthrough cases boost immunity to V and/or HZ?
- Have observations in the US to date confirmed or refuted mathematical modelling predictions suggesting an association between immunization coverage and V and HZ incidence and disease burden\*\* and/or the impact of waning immunity?
- What lessons can we learn from the US experience with the varicella universal immunization program?

### Cost effectiveness

- What studies have been done on cost effectiveness of varicella vaccination? Summarize the key findings.

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\*\* Disease burden = disease incidence, hospitalizations and mortality

## Revised Goals' Objectives and Targets

### Disease reduction

- 1. Disease incidence targets** (Establishment of disease reduction goals recommended in 1999 NVCC)
  - To achieve a XX% reduction in the incidence of varicella in children aged 12 months to 13 years by the year XXXX.
  - To achieve a XX% reduction in the incidence of zoster in adults by the year XXXX.
  - To (decrease/eliminate – 1 or 2 dose respectively) the number of varicella outbreaks in schools Canada (alternate: give target).
- 2. Hospitalization targets**
  - Decrease rates of hospital and ICU admission among children aged 12 months to 13 years by XX% by the year XXXX.
- 3. Mortality targets**
  - Decrease the number of deaths from varicella to 0 in the target population of children aged 12 months to 13 years by the year XXXX.

### Vaccine coverage

- At least XX% of children should have received age-appropriate immunization with varicella vaccine by 2<sup>(3)</sup> years of age by the year XXXX.

- At least XX% of adolescents should have received immunization with varicella vaccine by 13 years of age by the year XXXX (or by the end of secondary school).
- By 2010, varicella vaccination coverage targets should be tied to measles vaccination coverage targets to be achieved by the second birthday and by the 7th birthday. Actual measles targets should be taken into consideration in program implementation and evaluation.

### Other

- 100% of susceptible health care workers should have received immunization with varicella vaccine by the year XXXX.
- Pre-teens at the time of other vaccination programs (captured above in bullet 2?).
- Catch-up children 12 months to 13 years, susceptible adults?
- Susceptible women considering pregnancy.

### Questions for Next Steps – Implementation

1. Have jurisdictions implemented any of the recommendations from the August 1999 NVCC?
2. How can we identify correlates of immunity with more precision?

3. How can we optimize the use of immunization registries in linking vaccine status to disease?
4. Would we want to consider public awareness campaigns and what would we hope to achieve?
5. **Others**
6. What type of information is needed (surveillance, targeted research) and how do we go about collecting information to inform decision-making regarding?
  - a. Need and timing of booster immunization with varicella vaccine
  - b. Changing epidemiology e.g., age-specific shift or increase in incidence of varicella zoster
  - c. Incidence, impact and any factors related to breakthrough disease
7. Is there a need for further information on cost-benefit, especially with respect to potential future decision-making on two-dose/booster programs.
8. What are the laboratory diagnostic issues, e.g., when/who to test [before/after vaccination/post-rash onset] and testing recommendations for wild type versus vaccine virus strains?

|   |
|---|
| <b>Final Recommendations of<br/>Working Group for National Objectives and Targets</b> |
|   |

## Goals and Objectives for Vaccine-Preventable Diseases in Canada Consensus Conference, 2005 (GOCC-VPD) Invasive Pneumococcal Disease Discussion Guide

### Original Objectives and Targets\*

#### Disease reduction

- To achieve a 40% reduction in the incidence of invasive pneumococcal disease in vaccine-eligible groups by the year 2005.
- To achieve a 40% reduction in the rate of death due to invasive pneumococcal disease in vaccine-eligible groups by the year 2005.

#### Vaccine coverage

- To achieve and maintain 95% vaccine coverage for residents of long-term care facilities by the year 2003.
- To achieve and maintain 80% vaccine coverage in all other groups for whom vaccine is recommended by the year 2003.

### Issues for Evidence-Based Decision

1. Summarize NACI recommendations for pneumococcal immunization programs in Canada.
2. Summarize pneumococcal vaccination programs across Canada and international programs in existence.
3. How has the disease burden (i.e., disease incidence, hospitalizations and mortality) of

IPD changed since the introduction of the universal P/T immunization programs?

- a. Have there been any age-specific changes in disease burden of IPD since the initiation of the P/T immunization programs?
- b. Do 7-valent vaccine programs and 23-valent vaccine programs have an additive impact on IPD in some target populations?

4. What is the impact of the vaccine on herd immunity?
5. Is there evidence of waning immunity?
6. Is there evidence of replacement serotypes causing invasive disease as a result of immunization programs?
7. What is the impact of immunization programs on antibiotic resistance?
8. What lessons can we learn from the US experience with universal pneumococcal immunization programs?
9. Have there been any unexpected adverse events related to pneumococcal conjugate vaccine?
10. Discuss cost effectiveness.

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\* Preventing Pneumococcal Disease: A Canadian Consensus Conference, Feb. 16-18, 1998. *Can J Infect Dis* 1999; 10(Suppl A).

## Revised Objectives and Targets

### Disease reduction

1. Disease incidence targets
  - To achieve a XX% reduction in the incidence of invasive pneumococcal disease in vaccine-eligible serotypes in children < 2 years (alternative: 5 years) of age by the year XXXX.
  - To achieve a XX% reduction in the incidence of invasive pneumococcal disease in vaccine-eligible serotypes in adults  $\geq 65$  years of age by the year XXXX.
  - To achieve a XX% reduction in the incidence of invasive pneumococcal disease in vaccine-eligible serotypes in high-risk groups by the year XXXX.
2. Hospitalization targets
  - To decrease rates of hospital and ICU admission among children < 2 year of age by XX% by the year XXXX.
  - To decrease rates of hospital and ICU admission among high-risk children by XX% by the year XXXX.
  - To decrease rates of hospital and ICU admission among adults  $\geq 65$  years of age by XX% by the year XXXX.
3. Mortality targets
  - Decrease the number of deaths from invasive pneumococcal disease to X in children 2 months to 2 years of age by year XXXX.

- Decrease the number of deaths from invasive pneumococcal disease to X in adults  $\geq 65$  years of age by year XXXX.

### Vaccine Coverage

- At least XX% of children should have received age-appropriate immunization with pneumococcal conjugate vaccine by 2 years of age by the year XXXX.
- At least XX% of adults > 65 years of age should have received a single dose of pneumococcal polysaccharide vaccine by the year XXXX (alternate wording: “by X years of age” for measurement purposes).
- To achieve and maintain XX% vaccine coverage for residents of long-term care facilities by the year XXXX.
- At least XX% of high-risk people should receive age-appropriate immunization with pneumococcal vaccine by the year XXXX (alternate wording: have separate conjugate and polysaccharide coverage targets for high risk).

### Questions for Next Steps

1. Have jurisdictions implemented any of the recommendations from the February 1998 National Consensus Conference on Preventing Pneumococcal Disease?
2. How adequately do we capture age-specific disease incidence, hospitalization and mortality through surveillance, hospital discharge data and Statistics Canada deaths registry?
3. Do any jurisdictions have enhanced surveillance for invasive pneumococcal disease?

4. Which provinces and territories routinely collect serotype data on invasive pneumococcal isolates?
5. Are the serotype data currently collected adequate to determine targets and measure progress towards reducing vaccine-eligible disease outcomes?
6. How can disease outcomes and vaccine coverage be measured for high-risk groups?
7. How can we optimize the use of immunization registries in linking vaccine status to disease?
8. What are the barriers in improving implementation of adult immunization programs and how can we overcome them? How can we address missed opportunities for pneumococcal vaccination among older adults (e.g., during annual influenza vaccinations)?
9. Would we want to consider professional education and public awareness campaigns and what would we hope to achieve?

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| <b>Final Recommendations of<br/>Working Group for National Objectives and Targets</b> |
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## Goals and Objectives for Vaccine-Preventable Diseases in Canada Consensus Conference, 2005 (GOCC-VPD)

### Invasive Meningococcal Disease (IMD) Discussion Guide

#### Original Objectives and Targets\*

There are no original goals and objectives available since the implementation of the serogroup C vaccination programs.

#### Questions/ISSUES for Evidence-Based Decision

1. Summarize NACI recommendations for serogroup C IMD.
2. Summarize IMD serogroup C vaccination programs across Canada. Summarize international programs in existence.
3. How has the disease burden\* of IMD serogroup C changed since the introduction of the universal P/T immunization program?
4. Have there been any age specific changes in disease burden\* of IMD serogroup C since the initiation of the P/T immunization program?
  - a. Has the disease burden changed differentially in P/Ts providing infant immunization versus those providing immunization at 1 year of age.
5. What is the impact of the UK Vaccine effectiveness study and dosage schedules?
6. What is the impact of vaccine on herd immunity?
7. Is there evidence of replacement serogroups occurring as a result of the immunization programs?
8. Is there evidence of waning immunity? Consider the need for re-vaccination programs.
9. Have there been any unexpected adverse events related to meningococcal C conjugate vaccine?
10. Evidence for meningococcal C vaccine in control of outbreaks.
11. Discuss cost effectiveness.

#### Objectives and Targets

##### Disease reduction

1. Disease incidence targets
  - To achieve a XX% reduction in the incidence of *N. meningitidis* serogroup C in children < 5 years of age by the year XXXX.
  - To achieve a XX% reduction in the incidence of *N. meningitidis* serogroup C in adolescents 15 to 19 years of age by the year XXXX.
  - To reduce the reported incidence of *N. meningitidis* serogroup C among adolescents to at least the levels present in pre-school-aged children by the year XXXX.

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\* Disease burden = disease incidence, hospitalizations and mortality

- To achieve a XX% reduction in the incidence of *N. meningitidis* serogroup C in Canada by XXXX.
  - To eliminate meningococcal serogroup C outbreaks in Canada by XXXX.
2. Mortality targets
- Decrease the number of deaths from invasive meningococcal disease to X in children < 5 years of age by year XXXX (or serogroup C specific).
  - Decrease the number of deaths from invasive meningococcal disease to X in adolescents 15 to 19 years of age by year XXXX (or serogroup C specific).
  - Overall target?

### Vaccine coverage

- At least XX% of children should have received age-appropriate immunization with meningococcal conjugate vaccine by 2 years of age by XXXX.
- At least XX% of adolescents should have received age-appropriate immunization with meningococcal conjugate vaccine by 17 years of age by XXXX.

### Questions for Next Steps

1. How adequately do we capture age-specific disease incidence, hospitalization and mortality through surveillance, hospital discharge data and Statistics Canada deaths registry?
2. Which provinces and territories routinely report complete laboratory data on invasive meningococcal isolates?
3. Are the serotype data currently collected adequate to determine targets and measure progress towards reducing vaccine-eligible disease outcomes?
4. Are disease sequelae currently being measured for meningococcal diseases?
5. The need for revaccination/booster dose needs to be assessed by NACI.
6. How can we optimize the use of immunization registries in linking vaccine status to disease?
7. Would we want to consider professional education and public awareness campaigns and what would we hope to achieve?
8. Once approved for use in Canada, what will be the impact of the quadrivalent conjugate vaccine?

