How Much Do Vaccines Cost the Canadian Government?

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Sr. Director, Health Economics, Modeling and Market Access, North America, Sanofi Pasteur
Vaccine procurement processes in Canada rely on tender systems and bulk purchases

- Multiple suppliers of undifferentiated vaccines to one buyer, results in a monopsony
- Frequent tenders by a monopsonistic buyer decreases vaccine prices over time
Impact of Competition on Prices of Pertussis Containing Pediatric Vaccines in Canada

Acellular Vaccine (PENTACEL)

Whole-cell Vaccine (PENTA)

Acellular Vaccine (PEDIACEL)

Inflation-adjusted PENTACEL

Inflation-adjusted PENTA

Tender

Year

Price/Dose

Case Study: Differing Opinions on the Cost-Effectiveness of Quadrivalent Meningococcal Vaccines in Canada
Meningococcal Disease

- *Neisseria meningitidis*
- Thirteen different serogroups, classified by their polysaccharide (sugar) capsule
- Most common A, B, C, Y, W135 and X
- Presents as fever, headache, vomiting, stiff neck, photophobia and petechial rash
- Fatal in approximately 10%
- Long term sequelae 10 - 20% such as hearing loss, amputation or neurologic
Meningococcal by Year and Serogroup

Source: NACI Statement, August 2009
Vaccine Options

- **C vaccines on the market:**
  - Menjugate® (Novartis Vaccines)
  - Meningitec™ (Pfizer)
  - Neisvac-C™ (GlaxoSmithKline)

- **A, C, Y, W135 Vaccines on the market:**
  - Menactra™ (sanofi pasteur) 2006
  - Menveo™ (Novartis) 2008
  - Nimenrix® (GlaxoSmithKline) 2014
## Vaccination Programs in Canada

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MCV-C: meningococcal conjugate vaccine - serogroup C; MCV-4: meningococcal conjugate vaccine - quadrivalent (serogroups A, C, Y, W135)

**Vaccination recommended before age 18 years

*Source: Statistics Canada, Population and Demography
Quebec’s Opinion on Conjugate Meningococcal Vaccines

Quebec Immunization Committee - Comité sur l’immunisation du Québec (CIQ)

- Made up of specialists in public health, pediatrics, and infectious diseases
- Advises the Ministère de la Santé et des Services sociaux du Québec (MSSS) since 1990 on the use of new vaccines

This report outlines CIQ’s recommendation on the choice of conjugate meningococcal vaccine for childhood and adolescent vaccination

This report contained:

- Literature review on meningococcal conjugate vaccines
- Analysis of epidemiological data in Quebec and Canada
- Economic analysis of vaccination scenarios
Economic Analysis of Conjugate Meningococcal Vaccines: Methods and Key Assumptions

Modeled expected cost-effectiveness of quadrivalent meningococcal vaccines using a compartmental static simulation model previously used in [1]

- Cohort of 80,000 children
- MOH and Societal perspectives
- 3% discount rate
- No herd immunity

Interventions

- **Base case:** Men-C at 12 months, Men-C-C booster at 14 years old
- **Alternative scenarios:**
  - Men-C at 12 months, Men-C-ACYW booster at 14 years old
  - Men-C-ACYW at 12 months and for booster at 14 years old
  - Either scenario above, plus herd immunity (50% lower transmission) with Men-C-ACYW booster

Model assumptions:

- Model uses Canadian statistics on quality of life, income, and employment
- Incidence of IMD based on Quebec (LSPQ) and Global (MADO) epidemiological data adjusted for under-reporting and under-diagnosis
- Model uses Canadian death rates and Quebec sequelae rates
- $36 price differential between Men-C-C and Men-C-ACYW

## Results and Conclusions

- Use of quadrivalent vaccine provides additional benefits from short-term protection in childhood and prolonged protection with booster dose (from 10-20 years)
- Herd immunity had only marginal effect on cost-effectiveness
- Cost differential between quadrivalent and monovalent vaccine lead to unfavorable cost-effectiveness ratios

### Conclusions:
- Epidemiological situation of Quebec does not justify use of the more costly quadrivalent vaccine
- Use of quadrivalent vaccine for adolescent booster would be justified if cost was not above $5 than that of monovalent vaccine
- Use of quadrivalent vaccine would also be justified if other serogroups become more prevalent

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Cost-Effectiveness of Quadrivalent vs Monovalent Vaccination against Meningococcal Disease in Canada

Derek Weycker, Ph.D.1 Mark Atwood, M.S.1 Thomas E. Delea, M.S.I.A.1 Anoush Youssoufian, B.A.1 Dion Neame, M.D.2 Vivian Ng, Ph.D.2 Fabian Alvarez, Ph.D.2 Evelyn Forget, Ph.D.3 Ayman Chit, Ph.D.2

1Policy Analysis Inc. (PAI), Brookline, Massachusetts 2Sanofi Pasteur, Toronto ON 3University of Manitoba, Winnipeg, Manitoba
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**Vaccination recommended before age 18 years**

*Source: Statistics Canada, Population and Demography*
# Model Overview

**Approach**
- Probabilistic cohort model

**Population**
- Prevalent cohort of 35 mm Canadians of all ages

**Comparisons**
1. MCV-C/MCV-C: Infant (1y) and adolescent (15 y) MCV-C
2. MCV-C/MCV-4: Infant (1y) MCV-C and adolescent (15 y) MCV-4
3. MCV-4/MCV-4: Infant (1y) and adolescent (15 y) MCV-4

**Perspective**
- Societal

**Time horizon**
- Lifetime (up to 100 y)

**Outcomes**
- Cases of IMD (C, Y, and W135)
- IMD deaths
- LYs and QALYs lost to IMD
- Lifetime costs of IMD (direct and indirect) ($ CAN 2012)
- Cost per QALY gained

**Discounting**
- 5%
Model Schematic

- Incidence rates
- Mortality
- Utilities
- Probability of Sequelae
- Life Expectancy
- QALYs
- Expected Lifetime Costs
- IMD Cases
- Population
- Vaccine Effectiveness
- Vaccine Costs
- IMD Costs
- Indirect Costs
- Input
- Intermediate Outcome
- Final Outcome
- Cost Effectiveness
Annual Incidence of IMD in Canada

IMD Case Fatality in Canada

Vaccine Effectiveness by Age

Herd Effects

- Based on conservative “first order approximation” of herd effects described by Bauch et al. (2009) and further described by Van Vlaenderen et al. (2013)
  - Takes into account only the reduction in the number of susceptible individuals due to vaccination

Vaccine Prices

** Infant MCV-4 assumed to require 2 doses **

SOURCES: MCV-C and MCV-4 Estimated by fitting exponential to unpublished data.
Results – Cost-Effectiveness Plane

- ICER = $CAN 54,100/QALY
- ICER = $CAN 369,300/QALY
- ICER = $CAN 39,700/QALY

Contrast - Quebec Estimate is $523,000/QALY!
Overall Conclusion

- When estimating the cost of vaccines in Canada, researchers are advised to:
  - Review number of interchangeable approved products
  - Review industry pipelines to forecast possible approvals of interchangeable products in the future
  - Review government purchasing mechanism
  - As prices offered to the government are not publicly available, reach out to appropriate procurement agency to estimate vaccine prices over duration of study/analysis