Potential Public Health Impact Model Assessing the Switch Back to Use of the 13-valent Infant Pneumococcal Conjugate Vaccine in Belgium on Children Under 18 Years

Wilson M,[1] Moffatt M,[2] Mignon A,[3] McDade C,[1] Wasserman M[2]

[1]RTI Health Solutions, Research Triangle Park, NC, United States; [2]Pfizer Inc, New York, NY, United States; [3]Pfizer N.V-S.A, Brussels, Belgium

INTRODUCTION

- Pneumococcal disease, which is caused by *Streptococcus pneumoniae*, represents a significant healthcare burden which has been significantly reduced since the introduction of pneumococcal conjugate vaccines (PCVs).[1-3]
- A 10-valent (PCV10) and 13-valent (PCV13) vaccine are currently licensed globally. Belgium introduced PCV13 into routine immunization in 2011.
- After 4 years of use of PCV13 in regional infant immunization programs, the Flanders and Wallonia/Brussels regions switched to PCV10 in 2015/2016 due to a substantial reduction in vaccine serotypes.
- Since PCV10 introduction in Belgium, a continual increase in invasive pneumococcal disease (IPD) has been seen in children 0–2 years old, from 121 cases in 2015 to 154 in 2017, primarily due to serotypes 3 and 19A, contained only in PCV13.[4,5]

OBJECTIVES

- The objective of this study was two-fold:
  - Estimate the public health impact of a change to PCV13
  - Retrospectively assess the accuracy of applying vaccine impact trends from a country with PCV10 experience to predict observed changes in disease in Belgium since 2015

METHODS

- A decision-analytic model was adapted to predict future serotype behavior under PCV13 or PCV10 use in Belgium.
- The model estimates future serotype dynamics based on observed surveillance of vaccine impact on serotype behavior.
- Serotype specific incidence rates were derived from published evidence in countries with robust surveillance systems to test variability in future trends with PCV13 or PCV10 in two analyses.

Analyses

- *Analysis 1*: Estimate the public health impact of the change from PCV10 to PCV13 in 2018
- *Analysis 2*: Retrospectively assess the robustness of using real-world evidence of serotype behavior from countries with PCV13 (Belgium) or PCV10 (Finland) experience to predict the observed impact of change in vaccine from PCV13 to PCV10 in 2015
- Results were estimated over a 5-year time horizon.

Epidemiological Inputs

- Outcome estimates for IPD, hospitalized pneumonia and hospital-treated otitis media (HTOM) were included.
- Historical IPD cases were obtained for children under 18 years old from the National Reference Laboratory for Pneumococci Surveillance.[4]
- Hospitalized pneumonia and HTOM rates were derived using differentials to IPD incidence from observed data in Finland.[6] Future rates were then assumed to be proportional to predicted IPD changes in Belgium.
- IPD incidence from Finland was derived from the Finnish National Institute for Health and Welfare pneumococcal surveillance dataset.[7]

RESULTS

Analysis 1

- Using historic surveillance data from Belgium under use of each of the vaccines, the model predicts lower incidence of disease under PCV13 versus PCV10 use **(Table 1)**.
- The majority of the difference in disease incidence is driven by 0–2 year olds **(Table 2, Figure 1)**, including increases in serotype 19A under PCV10 use, and a decrease to pre-2016 19A levels under PCV13 use **(Figure 2)**. The overall difference in disease being driven by 0–2 year olds could be due to the short time period from the switch to PCV10 and 19A increases, therefore not yet being seen in other age groups.
- By switching back to PCV13 use in the regional immunization programs in Belgium, 7,200 cases of pneumococcal disease and 9 deaths can be avoided in children <18 years over the next 5 years **(Table 1)**.

Table 1: Clinical Outcomes With PCV13 or PCV10 Over a 5-year Period, in Under 18 Year Olds

Parameter	Under PCV13 use	Under PCV10 use	Avoided with PCV13
Cases, pneumococcal disease			
IPD	3,912	4,211	299
Hospitalized pneumonia	16,450	17,496	1,046
HTOM	92,196	98,059	5,863
Deaths	72	81	9

Table 2: Clinical Outcomes With PCV13 or PCV10 Over a 5-year Period, in 0–2 Year Olds

Parameter	Under PCV13 use	Under PCV10 use	Avoided with PCV13
Cases, pneumococcal disease			
IPD	690	984	294
Hospitalized pneumonia	3,193	4,221	1,028
HTOM	17,895	23,655	5,760
Deaths	20	28	8

RESULTS (CONTINUED)

Figure 1. Estimated Impact of Switching From PCV10 to PCV13 in 2017, IPD Incidence in 0–2 Year Olds

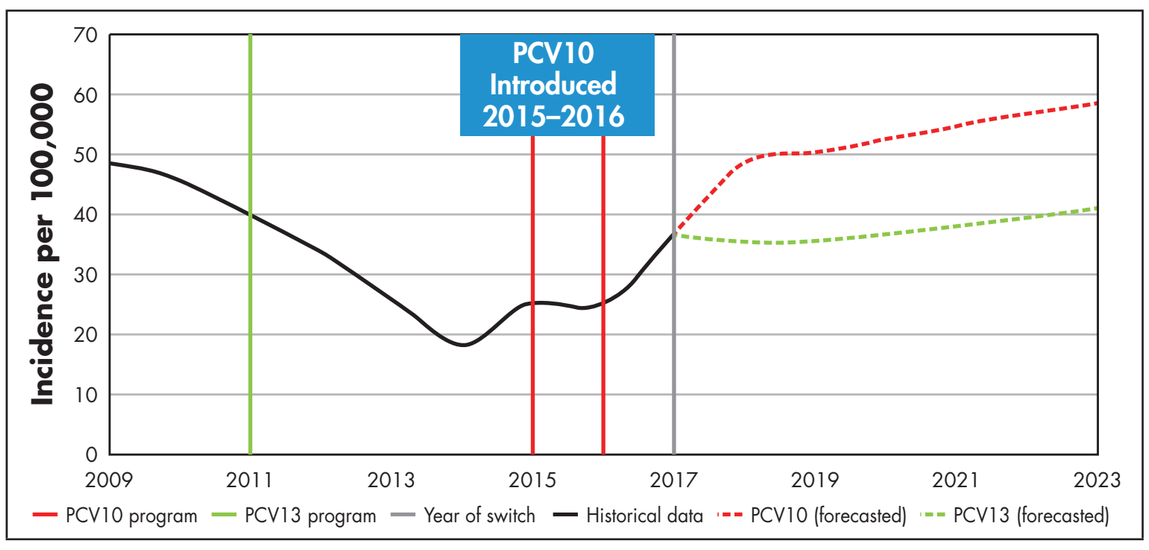
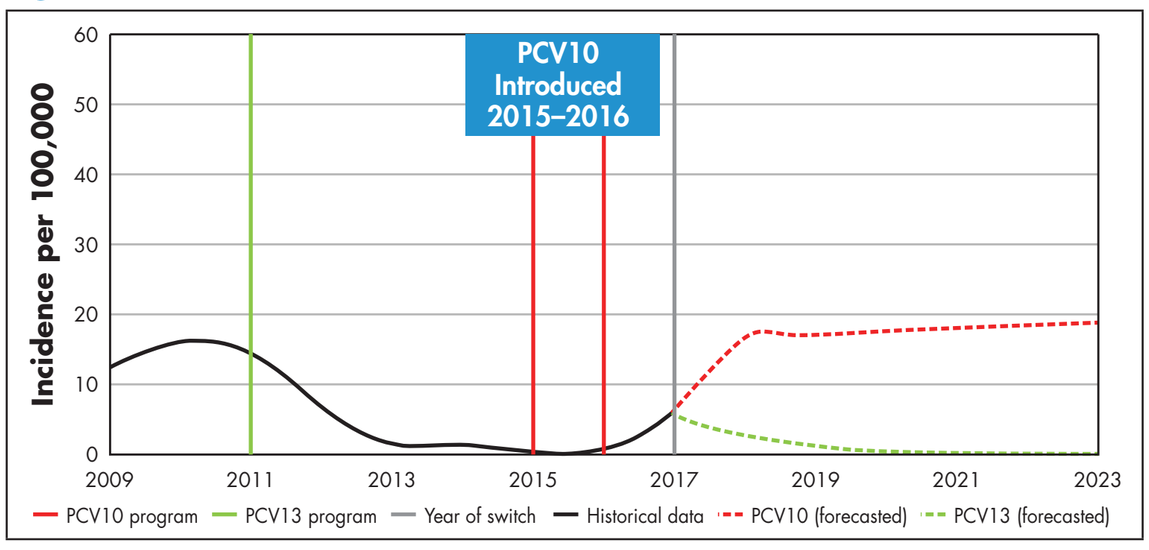


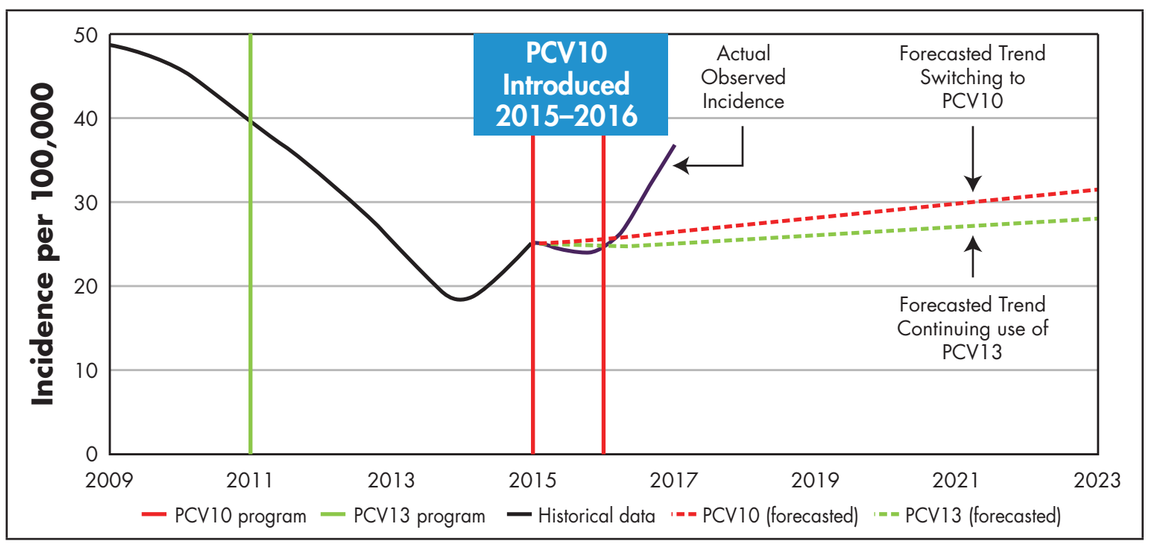
Figure 2. Predicted 19A Incidence in 0–2 Year Olds



Analysis 2

- Using historic real world data from Finland for PCV10 use, consistent with prior publications using this model,[8,9] the predicted incidence from 2015 to 2017 would have underestimated the actual increases observed in Belgium by ~30% **(Figure 3)**, suggesting the model estimated a conservative change in disease.

Figure 3. Estimated Versus Observed Impact of Switching from PCV13 to PCV10 in 2015, IPD Incidence in 0–2 Year Olds



CONCLUSIONS

- **Based on observed serotype behavior in Belgium, a switch back to PCV13 in regional pneumococcal vaccination programs is predicted to have substantial public health impact through reduced disease and mortality compared to continued use of PCV10.**
- **Existing analyses using this model would have underestimated the impact of changing from a higher to lower valent vaccine, and therefore prior analyses may underestimate the impact of changing to a lower valent vaccine.**
- **Our findings are reinforced by recent recommendations by the Belgian Superior Health Council, who have recommended switching back to PCV13 use due to the higher level of protection against disease.[10]**

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Margaret Moffatt
Pfizer Inc
235 East 42nd St.
New York, NY 10017
Margaret.Moffatt@pfizer.com

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