Vaccine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Review

Indirect (herd) protection, following pneumococcal conjugated vaccines introduction: A systematic review of the literature

Gal Tsaban, Shalom Ben-Shimol *

Pediatric Infectious Disease Unit, Soroka University Medical Center, Beer Sheva, Israel
Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer Sheva, Israel

ARTICLE INFO

Article history:
Received 20 December 2016
Received in revised form 5 April 2017
Accepted 12 April 2017
Available online xxxx

Keywords:
Pneumococcal conjugated vaccine (PCV)
Herd protection
Indirect immunity
Pneumonia
Invasive pneumococcal disease (IPD)

ABSTRACT

Background: Pneumococcal diseases are major causes of morbidity among adults, especially those over 50 years of age. While pneumococcal conjugated vaccines (PCV's) impact on pneumococcal disease rates among children is well established, the extent of its impact on adult pneumococcal related illness remains unclear. The aim of this systematic literature review was to describe the impact of PCV introduction to childhood national immunization programs worldwide on PCV-naive adult population.
Methods: A systematic literature search was performed using the PubMed database. The search was limited to articles written in English and published between January 2000 and February 2016. Studies evaluating pneumococcal disease rates in individuals over 5 years of age were included. Independent extraction of articles was performed by the two authors. Search terms included: Pneumococcal conjugated vaccine, herd, indirect, adults, and pneumonia.
Results: Forty-nine articles meeting the selection criteria were identified, 39 regarding invasive pneumococcal disease (IPD, one on meningitis only), 8 regarding pneumonia, and 2 on both IPD and pneumonia. The majority of reports were from the US, UK and Canada. Considerable variability in the data sources, quality and completeness was observed. While most studies reported either statistically significant reduction or insignificant changes in IPD and pneumonia disease rates in adults following PCV nationwide implementation, few studies reported statistically significant increase in pneumococcal disease rates, these were mainly from countries with low PCV coverage rates and/or inadequate surveillance.
Conclusion: Invasive pneumococcal diseases and pneumonia rates among the adult population decreased in most countries following PCV introduction into the NIP. This indirect effect on older population seems to be dependent on PCV coverage rates and time from PCV nationwide implementation. Adults >65 years old seem to benefit the most from PCV introduction.

Contents

Abbreviations: IPD, invasive pneumococcal disease; CAP, community-acquired pneumonia; PCV, pneumococcal conjugate vaccine; VT, vaccine type; PPV23, 23-valent polysaccharide vaccine.

* Corresponding author at: Pediatric Infectious Disease Unit, Soroka University Medical Center, Beer Sheva, Israel.
E-mail address: shalomb2@clalit.org.il (S. Ben-Shimol).

http://dx.doi.org/10.1016/j.vaccine.2017.04.032
0264-410X/

1. Introduction

Pneumococcal diseases are major causes of morbidity in both children and adults [1,2]. The age-specific incidence of invasive pneumococcal disease (IPD) and community-acquired pneumonia (CAP) are highest in the younger and older populations, with a rise in adults starting from approximately 50 years of age [3].

Following the introduction of pneumococcal conjugate vaccine (PCV) to national immunization programs (NIPs) worldwide, substantial decrease in IPD and CAP rates in children was observed, with a parallel reduction in vaccine-type (VT) IPD rates in adults [4]. However, similar indirect effect on non-invasive disease in adults has not been conclusively demonstrated [3].

The reduction observed in pneumococcal disease rates in unvaccinated children and susceptible adults was mainly attributed to the reduction in nasopharyngeal carriage of *Streptococcus pneumoniae* VT-serotypes in vaccinated children [5,6]. This indirect, or herd, protection increases PCV impact, both in terms of public health gain and economic value [3,4].

Profound indirect protection can only be achieved in populations with high (>70–80%) vaccine coverage [7]. Therefore, vaccine uptake in children has a major impact on the magnitude of herd protection. Additionally, the 23-valent polysaccharide vaccine (PPV23) is effective in preventing IPD in younger adults. Thus, routine usage of PPV23 may also contribute to a reduction in pneumococcal disease rates in adults, regardless of PCVs impact. However, in elderly subjects or in those with underlying co-morbidities, the duration of protection, guidelines for revaccination, and the impact on all-cause pneumonia have not been clearly established [8,9].

The aim of this systematic literature review was to assess the impact of PCVs introduction to childhood NIP worldwide on PCV-naive adult population.

2. Methods

2.1. Data sources and searches

Literature search was performed using the PubMed database. The PRISMA reporting guidelines were followed to conduct this systematic review. Only articles written in English were reviewed.

Five different searches were conducted, limiting searches to articles published between January 1st 2000 and February 29th 2016, using a combination of selected words.

2.2. PubMed search strategy

The following key words were used in five literature searches:

"Pneumococcal Conjugated Vaccine (PCV)", "herd protection", "indirect immunity", "pneumonia", "invasive pneumococcal disease (IPD)", and "adults".

Search no. 1 – 'Pneumococcal Conjugated Vaccine', 'herd'. (187 results)

Search no. 2 - 'Pneumococcal Conjugated Vaccine', 'indirect'. (154 results)

Search no. 3 – 'Pneumococcal Conjugated Vaccine', 'adults', 'indirect'. (85 results)

Search no. 4 – 'Pneumococcal Conjugated Vaccine', 'adults', 'herd'. (106 results)

Search no. 5 - 'Pneumococcal Conjugated Vaccine', 'adults', 'pneumonia'. (250 results)

Search no. 6 – 'Pneumococcal Conjugated Vaccine', 'adults', 'indirect', 'invasive pneumococcal disease'. (68 results)

2.3. Selection criteria

The following predetermined inclusion criteria were used: (1) study population of children >5 years and/or adults with CAP and/or IPD; (2) studies comparing disease rates before and after different PCVs (7, 10, 13-valent); (3) studies published in English.

Outcome measures included CAP and IPD rates before and after PCVs introduction.

All meta-analyses and reviews, cost-effectiveness models, as well as studies reporting PCVs impact on children <5 years of age, were excluded.

2.4. Study selection and data extraction

All articles identified in the primary search were screened independently for relevancy by the 2 authors who read all article titles and abstracts in a standardized manner. Disagreements between the authors were resolved by discussion and consensus reached.

A preformed questionnaire form was used by both authors to extract the data evaluating study type (cohort studies, randomized controlled trials) population (age, size, ambulatory or hospital setting), geographic location, case definition of CAP and IPD, diseases rates in the pre and post-PCVs period, vaccine type (PCV type −7, 10 or 13-valent), date of PCVs implementation and date of impact measured, PPV23 in the population and outcome.

Outcome measures recorded were: (1) Rates (incidence) dynamics of IPD (including different case definitions) in populations >5 years; (2) Rates (incidence) dynamics of pneumonia in populations >5 years.

Calculations of change in IPD and pneumonia rates were based on those reported in each manuscript. In manuscripts not reporting change specifically, the last year/period reported rate was compared with the pre-PCV rates. If several age groups were reported, we only detailed the age group with the most prominent rate changes.

2.5. Data items

Identified relevant articles were further evaluated for inconsistencies, by both authors (SB, GT), as was the case with articles without available abstracts. Disagreements were resolved by discussion between the 2 authors.

Please cite this article in press as: Tsaban G, Ben-Shimol S. Indirect (herd) protection, following pneumococcal conjugated vaccines introduction: A systematic review of the literature. Vaccine (2017), http://dx.doi.org/10.1016/j.vaccine.2017.04.032