

A public health and budget impact analysis (BIA) of vaccinating adults against pneumococcal-diseases in Austria

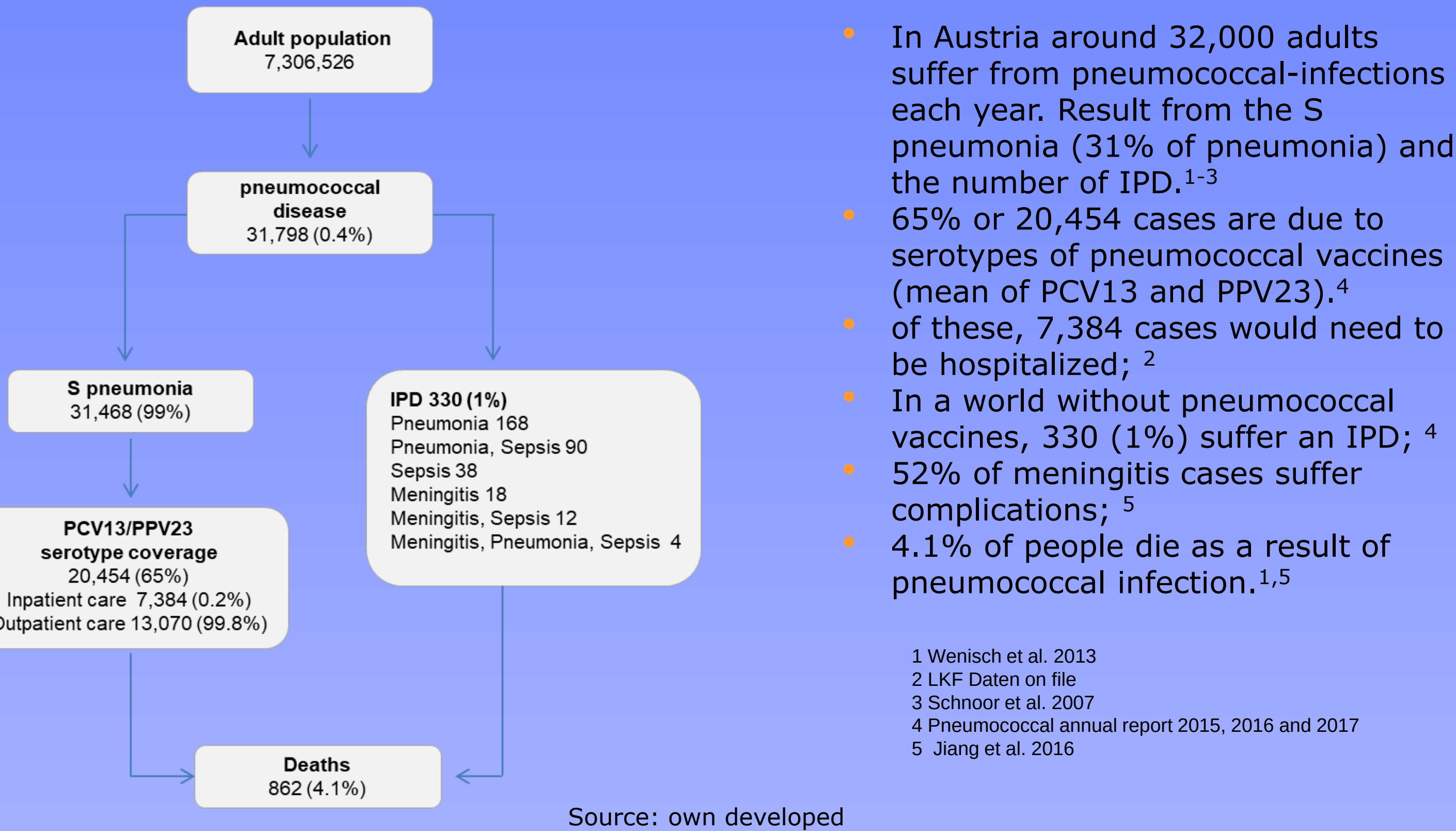
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Objectives

Infection with Streptococcus-pneumoniae may cause noninvasive and invasive pneumococcal-disease (IPD). Globally, pneumococcal-disease is estimated to cause 2 million deaths annually. Vulnerable populations include adults aged ≥50 and at-risk with chronic disease, for whom a vaccination recommendation exists. The aim of the BIA is to compare the current situation of the pneumococcal vaccination-program, where a percentage of older and at-risk adults receive vaccination (PPV23 or PCV13) compared to no vaccination. The budget-impact quantifies the positive effect due to vaccination.

Fig. 1: Patientflow WITHOUT pneumococcal vaccine



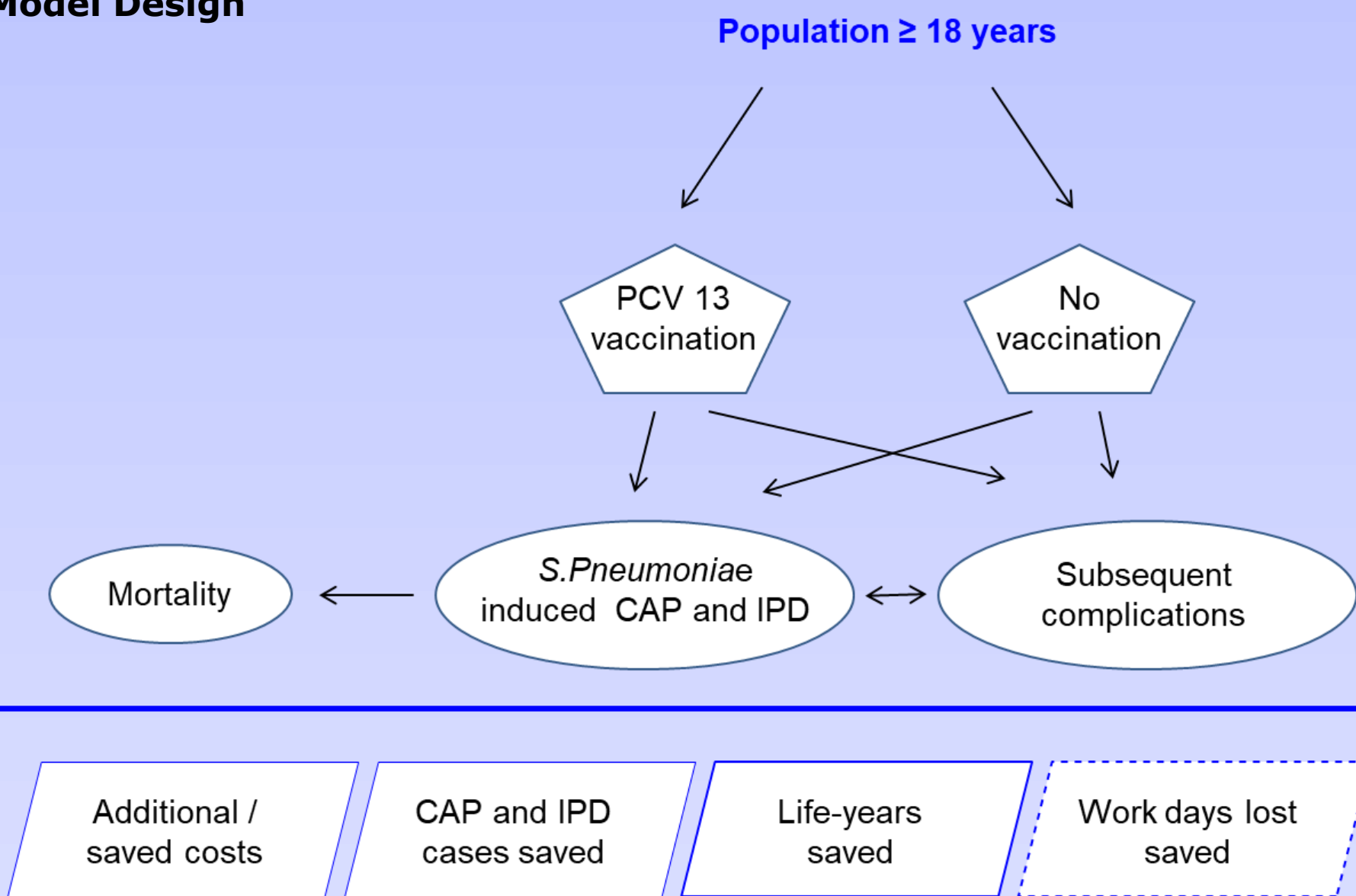
- In Austria around 32,000 adults suffer from pneumococcal-infections each year. Result from the S pneumonia (31% of pneumonia) and the number of IPD.¹⁻³
- 65% or 20,454 cases are due to serotypes of pneumococcal vaccines (mean of PCV13 and PPV23).⁴
- of these, 7,384 cases would need to be hospitalized;²
- In a world without pneumococcal vaccines, 330 (1%) suffer an IPD;⁴
- 52% of meningitis cases suffer complications;⁵
- 4.1% of people die as a result of pneumococcal infection.^{1,5}

1 Wenisch et al. 2013
2 LKF Daten on file
3 Schnoor et al. 2007
4 Pneumococcal annual report 2015, 2016 and 2017
5 Jiang et al. 2016

Methods

A multi-cohort, population-based model was developed over a 5-year time-horizon, which included the following states: hospitalized and outpatient pneumococcal-diseases, IPD, associated complications and mortality. In the vaccination-arm a percentage of adults, corresponding to the market-share, (15% 1st year to 20% 5th year) are vaccinated. The model includes a serotype shift over time. Results showed the amount of savings form the health-care-systems and societal perspective. Vaccination costs are based on the pharmacy-selling-price, which is paid out-of-pocket.

Fig. 2: Model Design



- Cohorts were split among age and risk groups:
- Different transition probabilities were used for the following age groups: 18-34, 35-49, 50-64 and ≥ 65.
 - The following transition probabilities were included:
 - Pneumonia hospitalized
 - Pneumonia outpatient treated
 - IPD Pneumonia
 - IPD Pneumonia and Sepsis
 - IPD Sepsis
 - IPD Meningitis
 - IPD Meningitis and Sepsis
 - IPD Meningitis, Pneumonia and Sepsis
 - IPD Meningitis and Pneumonia
 - Subsequent complications after IPD (neurological problems and deafness)
 - Mortality rate

CAP = Community acquired pneumonia; IPD = Invasive pneumococcal disease

Source: own developed

Epidemiological und clinical Data

After the primary immunization in infancy, vaccination in adults is recommended from the age of 50, as the risk of severe pneumococcal disease increases again significantly from this age. For persons of all age groups with increased risk (22.5%), vaccination is highly recommended. In persons without previous pneumococcal vaccination first the 13-valent conjugated vaccine in recommended and after one year the 23-valent polysaccharide vaccine. With the present vaccination rate (15% see table 1) 19,819 pneumococcal diseases (CAP and IPD) were calculated.

Table 1: No. of IPD cases per age group, 1st year

IPD cases	18-34	35-49	50-64	≥ 65
Pneumonia	7	19	41	95
Pneumonia and Sepsis	4	9	20	54
Sepsis	2	7	9	20
Meningitis	2	3	7	6
Meningitis and Sepsis	0	1	4	6
Meningitis, Pneumonia and Sepsis	0	1	2	1

Source: Pneumococcal annual report 2016 and 2017, Wenisch et al 2013, Austrian DRG data on file

Figure 3: No. of pneumococcal diseases

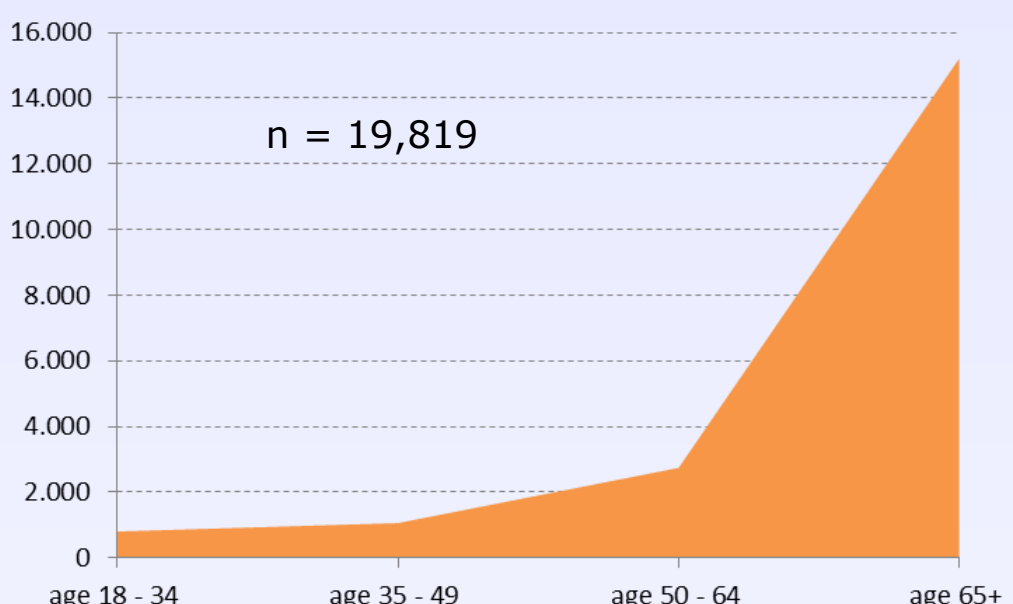
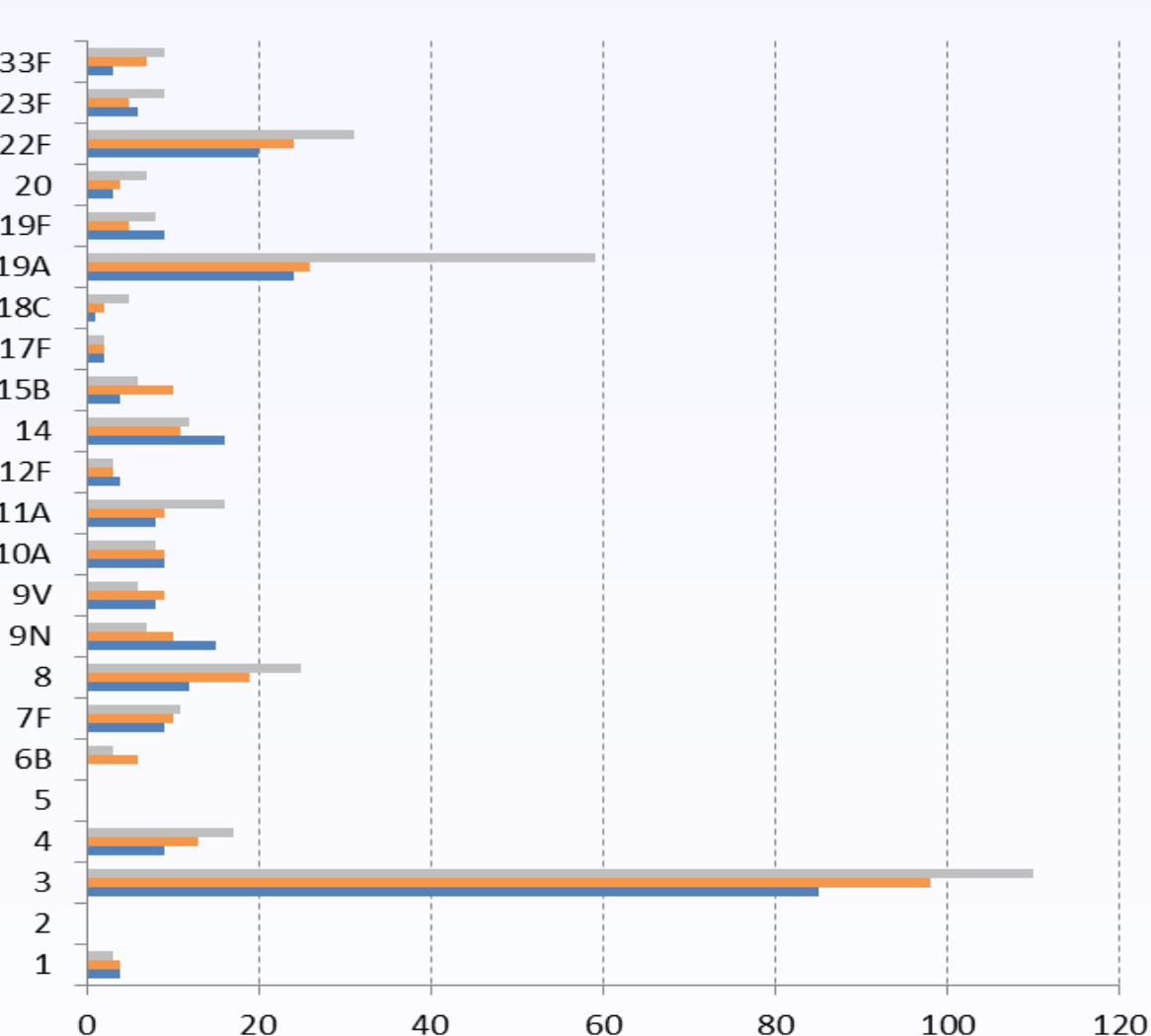
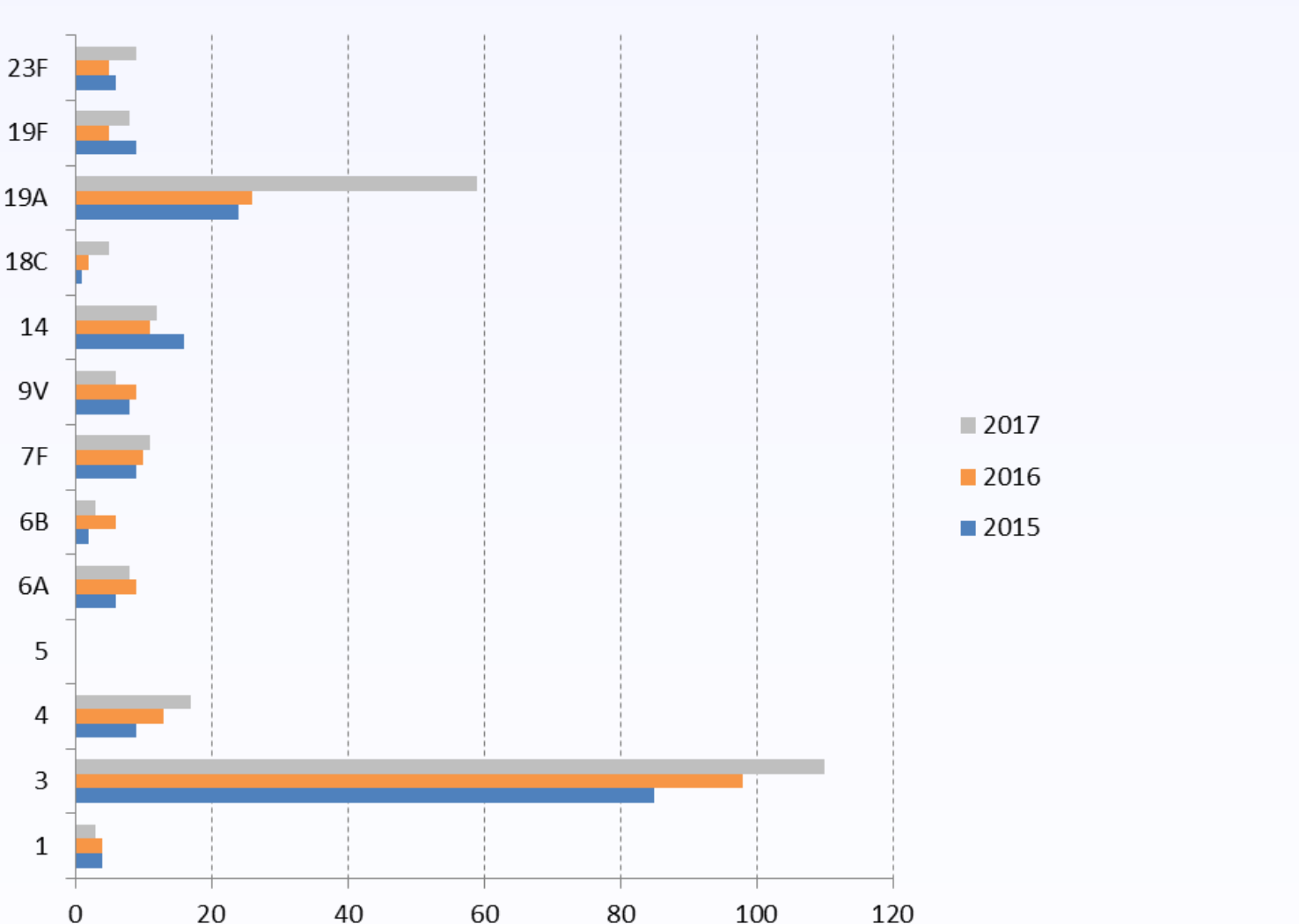


Figure 4: Overview of serotypes covered in PPV23



Source: Pneumococcal annual report 2016 and 2017

Figure 5: Overview of serotypes covered in PPV23



Immunization rate

The vaccination rate was estimated on the basis of an Austrian market research. The target population includes the population over 50 years plus the proportion "at risk" (22.5%). "At risk" includes respiratory and CV diseases, diabetes, HIV and immunocompromised patients.

Table 2: Vaccination rate over 5 years

Age groups	Year 0 (2018)	Year 1 (2019)	Year 2 (2020)	Year 3 (2021)	Year 4 (2022)	Year 5 (2023)
PCV13/PPV23	15%	16%	17%	18%	19%	20%
Target Population*		4,480,517	4,524,549	4,565,199	4,602,619	4,634,577
Covered		716,883	769,173	821,736	874,498	926,915

* ≥ 50 and „at risk“)

Source: own calculations based on Meier et al. 2000

Direct costs

The BIA includes costs of inpatient and outpatient pneumonia treatment, IPD treatment (Pneumonia, Meningitis and Sepsis) including treatment of subsequent complications (neurological problems and deafness). Costs were presented from the payers perspective. The costs of pneumococcal vaccination are borne by vaccinated people (33.20 € for PPV23 and 76 € for PCV13; pharmacy selling price).

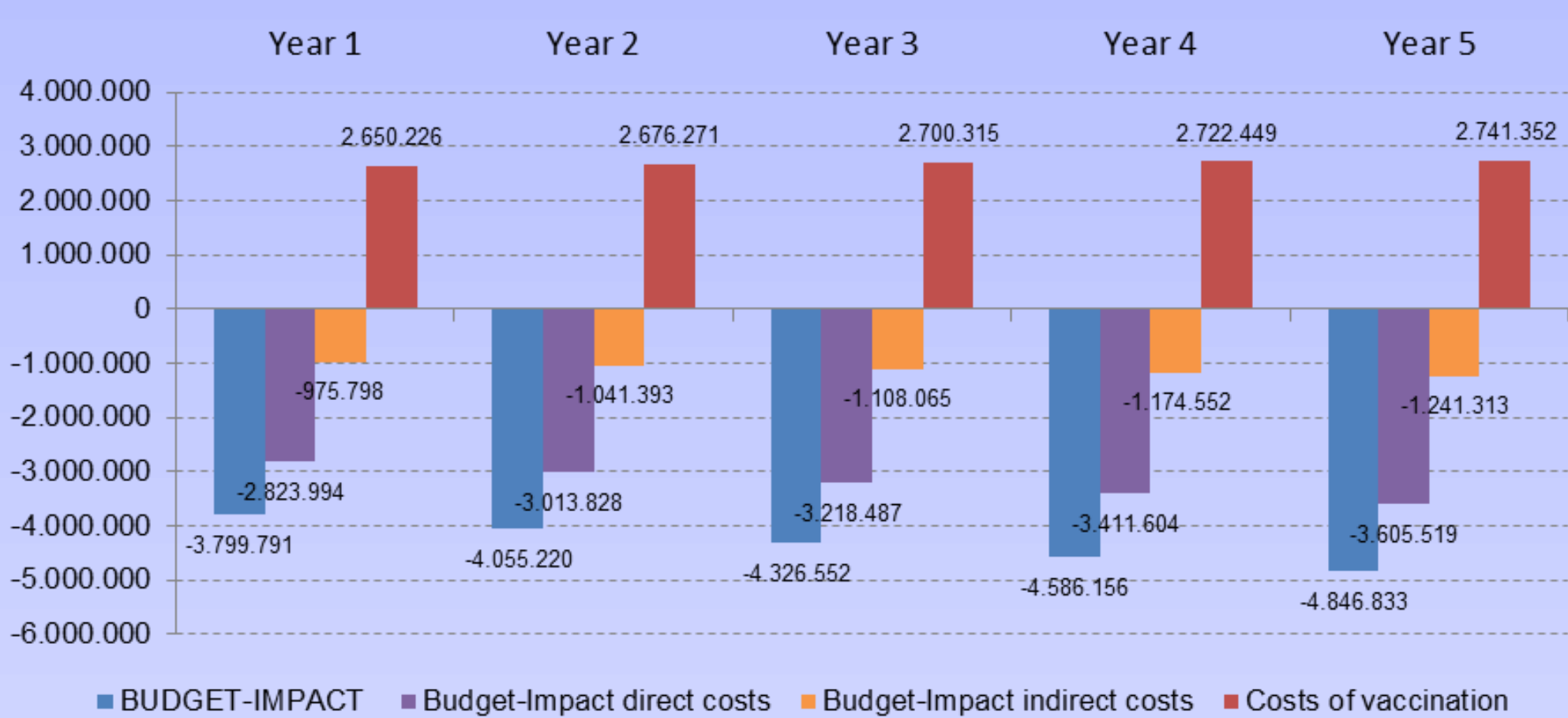
Indirect costs

Indirect costs include sick leave. Indirect costs are calculated on the basis of the employment rate by age group (share of the working-age population). The duration of work loss is calculated based on ICD-10 for the pneumococcal diseases and for the subsequent complications.

Results

Based on the current vaccination coverage annual savings between 3.7 million € (1st year) and 4.8 million € (5th year) [total: 21.6 million € over 5 years] could be achieved. Direct costs contributed between 2.8 million € (1st year) and 3.6 million € (5th year) [total: 16.0 million €] to total annual savings. Financial benefits to society can be achieved by a responsible vaccination strategy. The savings in indirect costs range from 1.0 million € (1st year) to 1.2 million € (5th year) [total: 5.5 million €]. The costs of the vaccination are borne by the patients, who make private payments between 2.6 million € (1st year) and 2.7 million € (5th year) per year [total: 13.5 million €].

Figure 6: Total budget-impact



Multiplier effects:

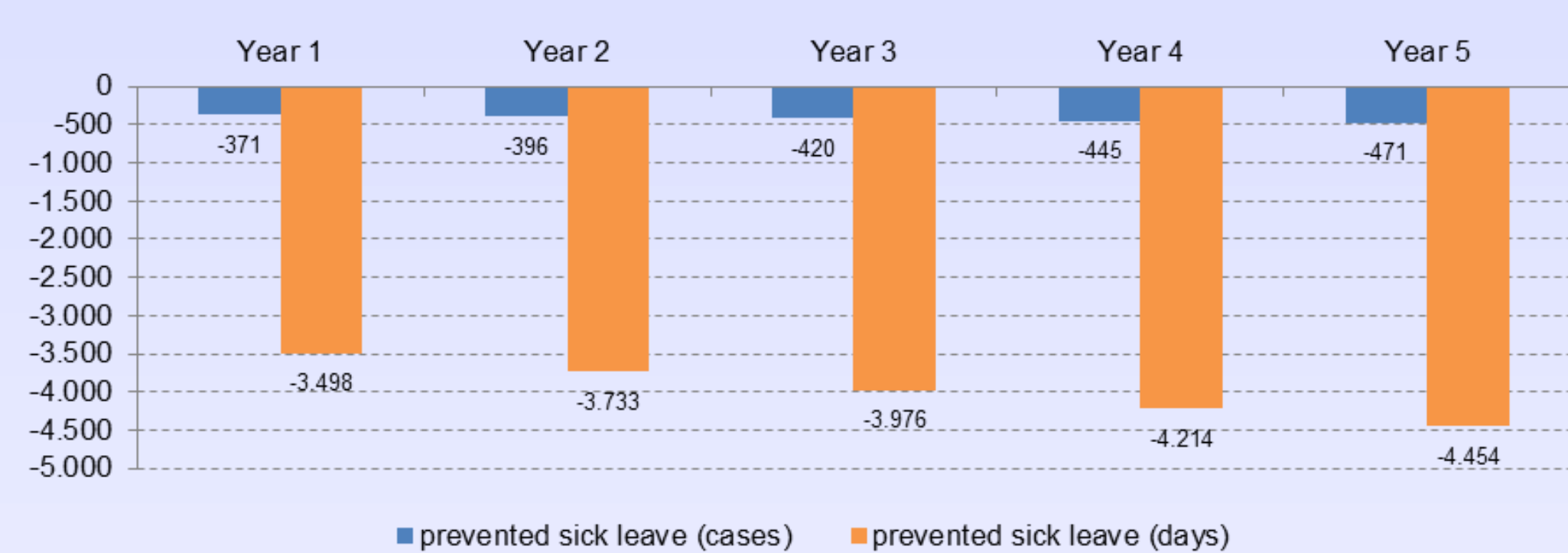
- 1 € invested in the pneumococcal vaccine relieves the society by 1.60 €
- 1 € invested in the pneumococcal vaccine saves 1.19 € within the health care system

Table 4: Prevented cases due to Pneumococcal vaccination

Prevented cases	Year 1	Year 2	Year 3	Year 4	Year 5
S Pneumonia	-1,880	-2,006	-2,125	-2,252	-2,380
IPD cases	-14	-15	-17	-18	-19
Deaths	-77	-82	-87	-92	-97

With the predicted vaccination rate, 10,642 prevented S pneumonia cases, 83 IPD cases and 434 deaths over 5 years result from the vaccination.

Figure 7: Prevented work absenteeism



With the forecasted vaccination coverage, the vaccination will result in reduced work absenteeism of -2,103 cases and -19,875 days over 5 years.

Source: own calculations

Sensitivity Analysis

Table 5: Sensitivity analysis

Vaccination coverage in %	Budget-Impact (in 1,000 €)	pneumococcal disease cases	Sick leave (cases)
20%	-22,949	-11,408	-2,237
30%	-34,424	-17,111	-3,355
40%	-45,898	-22,815	-4,473
50%	-57,373	-28,519	-5,592
60%	-68,847	-34,223	-6,710
70%	-80,322	-39,926	-7,828
80%	-91,796	-45,630	-8,947

Source: own calculations

The sensitivity analysis shows the results as a consequence of a varied vaccination coverage.

With a vaccination coverage of 20%, the total budget impact or social savings increases from 21.6 million € over five years to 22.9 million €; a vaccination coverage of 50% results in a further increase to 57.4 million €. Pneumococcal disease cases (S pneumonia and IPD) are reduced compared to the current situation (10,643 prevented cases over 5 years) to 11.408 prevented cases (20%) or 28.519 prevented cases (50%).

Conclusion

In Austria, 1€ privately invested in pneumococcal vaccination has a 1.60€ return to society and saves the health-care-system 1.19€.

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Additional literature with the author