

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

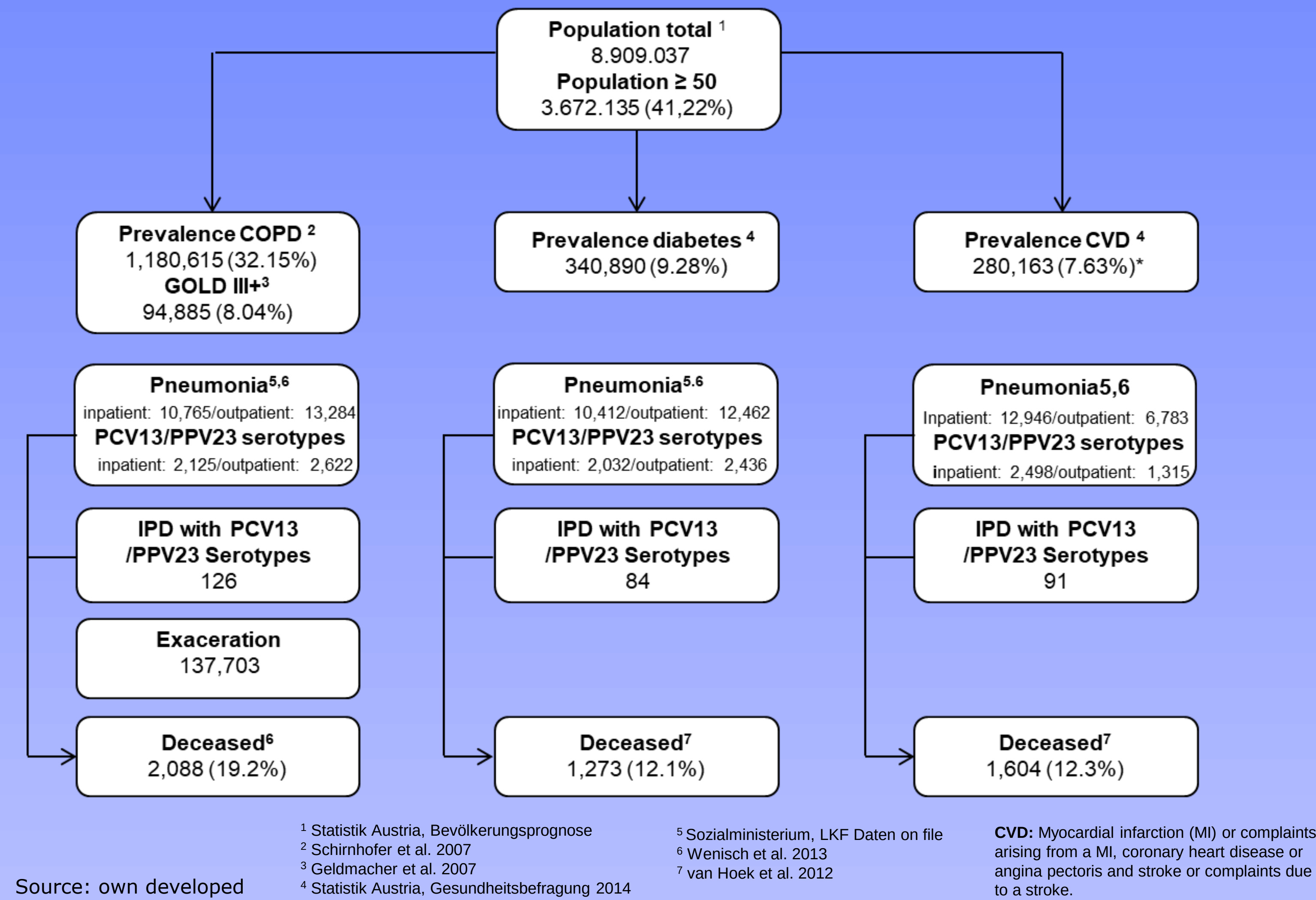
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Objectives

Pneumococcal-disease in adults, including community-acquired-pneumonia (CAP) and invasive-pneumococcal-disease (IPD), is a global problem, especially in individuals with chronic-diseases such as COPD, diabetes-mellitus (DM) and cardiovascular disease (CVD). A vaccination recommendation for these populations exists (aged ≥50) in Austria. A sequential vaccination, PNC13 and after ≥8 weeks PPV23, is strongly recommended. This sequential vaccination should be repeated every 6 years. The aim of the BIA is to compare the current situation with a higher vaccination-coverage scenario, in risk groups (COPD, DM, CVD) ≥50 years. The budget-impact quantifies the effect due to vaccination regarding health-care budget and events avoided.

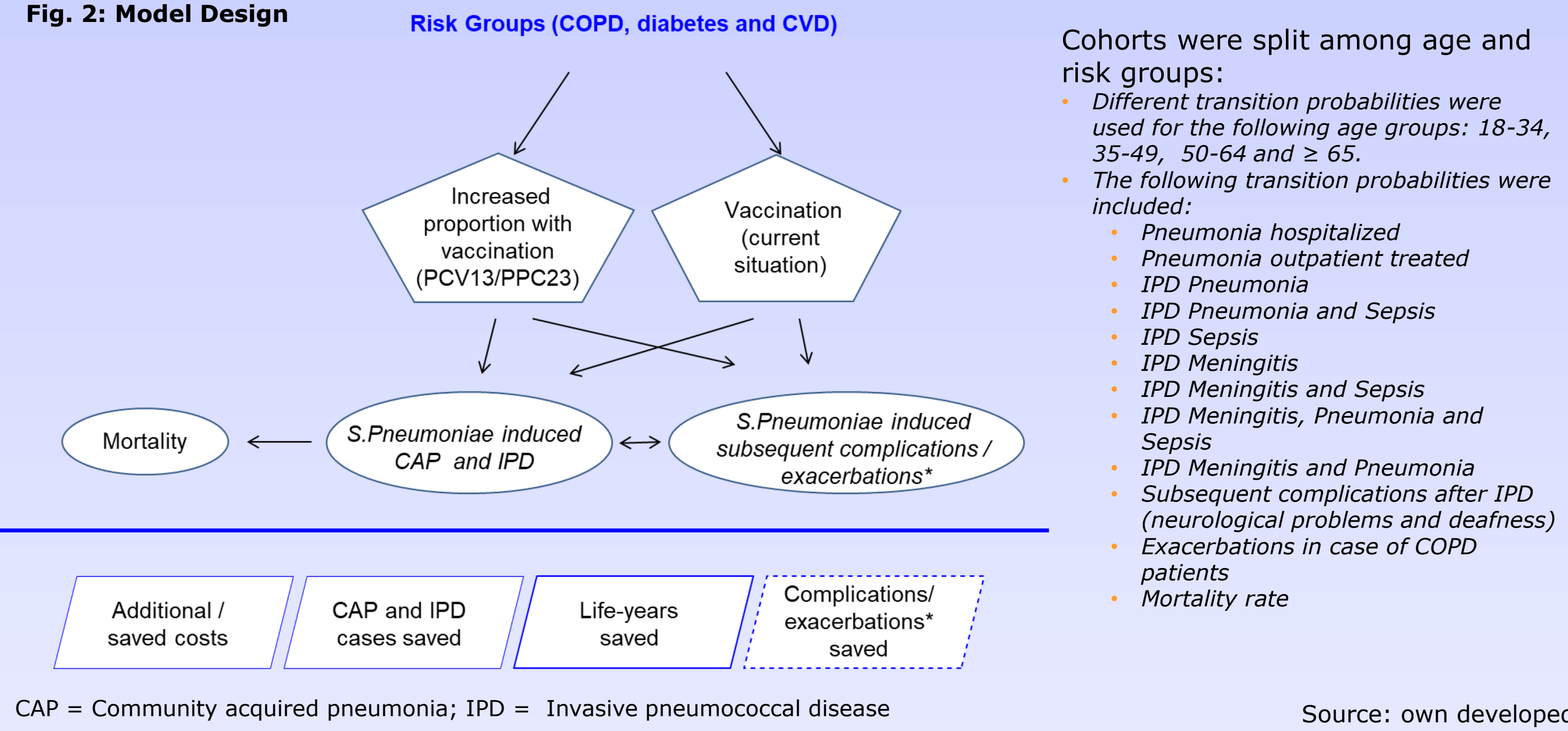
Fig. 1: Patientflow; current situation



Methods

A multi-cohort, population-based model was developed over a 5-year time-horizon for each risk-group (COPD, DM, CVD; ≥50 years). The following states were included: hospitalized/outpatient CAPs, IPDs, associated complications and mortality. The current vaccination-rate is 14% (1st year) to 22% (5th year). After the market shift, a vaccination-rate of 60% is assumed. The model includes a serotype shift over time. Results showed savings form the health-care-systems perspective and prevented events (CAPs, IPDs and deaths).

Fig. 2: Model Design



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. The current vaccination recommendation includes persons at high risk (all age groups) and appropriate indications (including the risk groups considered: cardiovascular diseases (except hypertension), respiratory diseases, diabetes mellitus, etc.) are strongly recommended for sequential vaccination, PNC13 and after 8 weeks PPV23. This sequential vaccination should be repeated every 6 years.

PCV13 and PPV23 serotype shift was analyzed in adult population over the period from 2020 to 2024. The forecast estimation is based on the mean of the observations from the past using a simulation.

Table 1: PCV13 and PPC23 serotypes over time in % of pneumococcal isolates of IPD cases

Age groups	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)
PCV13	53.3%	52.3%	51.4%	50.4%	49.5%
PPV23	76.7%	76.6%	76.6%	76.5%	76.4%

Source: Pneumococcal annual report 2015 and 2018

Data from the CAPTA study and from the publication of Gessner et al. (2018) are used for vaccination efficacy.

Table 2: Vaccination efficacy

Age groups	Year 1 (2020)
VT-IPD	75,8%
VT-PP	37,5%
Sp-CAP	22,2%
Clinical CAP	8,1%%

Source: CAPITA, Gessner et al. 2018

Thus, a distinction is made in the BIM between VT pneumococcal pneumonia (PP), PP without serotype coverage and other clinical pneumonia in terms of efficacy.

VT = serotypes included in PCV13
Sp-CAP = pneumococcal CAP

Immunization rate

The vaccination rate was estimated based on 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 3: Vaccination rate over 5 years based on the current situation

Population	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)
Vaccinated	14%	16%	18%	20%	22%
% with PCV13	8.5%	9.8%	11.0%	12.2%	13.4%
Population ≥ 50 with COPD and GOLD III +	13,284	15,366	17,477	19,602	21,542
Population with DM	47,725	55,451	63,411	71,579	79,949
Population with CVD	39,223	45,649	52,310	59,191	66,283

Table 4: Vaccination rate over 5 years after market shift

Population	Year 1 (2020)	Year 2 (2021)	Year 3 (2022)	Year 4 (2023)	Year 5 (2024)
Vaccinated	60%	62%	65%	69%	74%
% with PCV13	36.6%	37.8%	39.7%	42.1%	45.1%
Population ≥ 50 with COPD and GOLD III +	56,931	59,545	63,112	67,626	73,136
Population with DM	204,534	214,871	228,985	246,947	268,920
Population with CVD	168,098	176,890	188,898	204,209	222,951

Source: market research

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) and exacerbations in case of the COPD risk group. Costs were presented from the payer's perspective. The cost of vaccination corresponds to the reimbursement price (30 € for PPV23 and 45 € for PCV13).

Results

In COPD patients (N=94,885; GOLD III) an increased vaccination-rate results in total savings of 41.6 million € (m €) over 5 years; between 5.8 m € (1st year) to 11.2 m € (5th year). In total 8,967 CAPs, 343 IPDs and 753 deaths could be avoided (see Fig. 3 and Fig. 4).

A higher vaccination-rate in the DM population (N=340,890) lead in total savings of 21.3 m € over 5 years; 4.0 m € (1st year) to 4.6 m € (5th year). Savings are associated with 8,852 prevented CAPs, 174 IPDs and 531 deaths in a 5-year time horizon (see Fig. 5 and Fig. 6).

In the CVD risk-group (N= 280,163) saving of 27.2 m € could be achieved in total; 5.5 m € (1st year) to 5.9 m € (5th year). 7,974 CAPs, 189 IPDs and 704 deaths could be avoided (see Fig. 7 and Fig. 8).

Figure 3: Total budget-impact (€) COPD

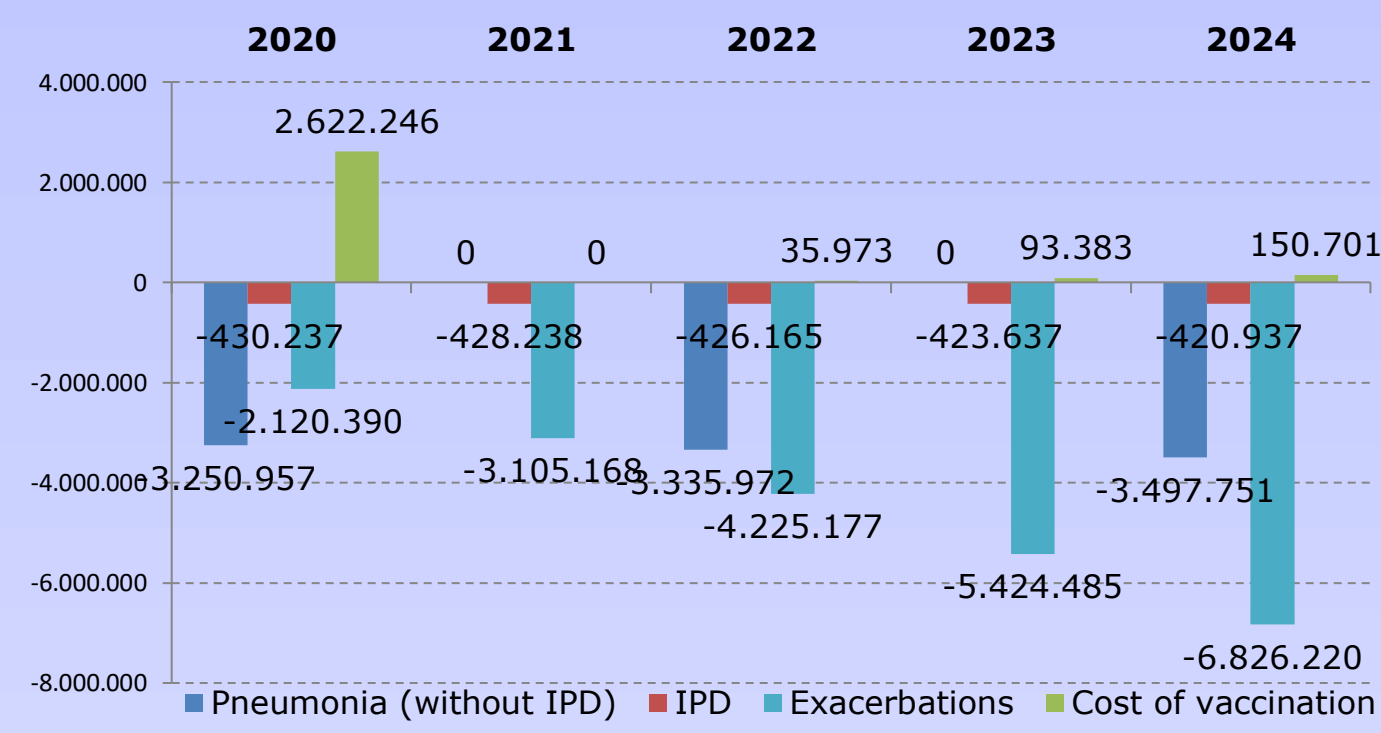


Table 4: Prevented cases due to Pneumococcal vaccination; COPD

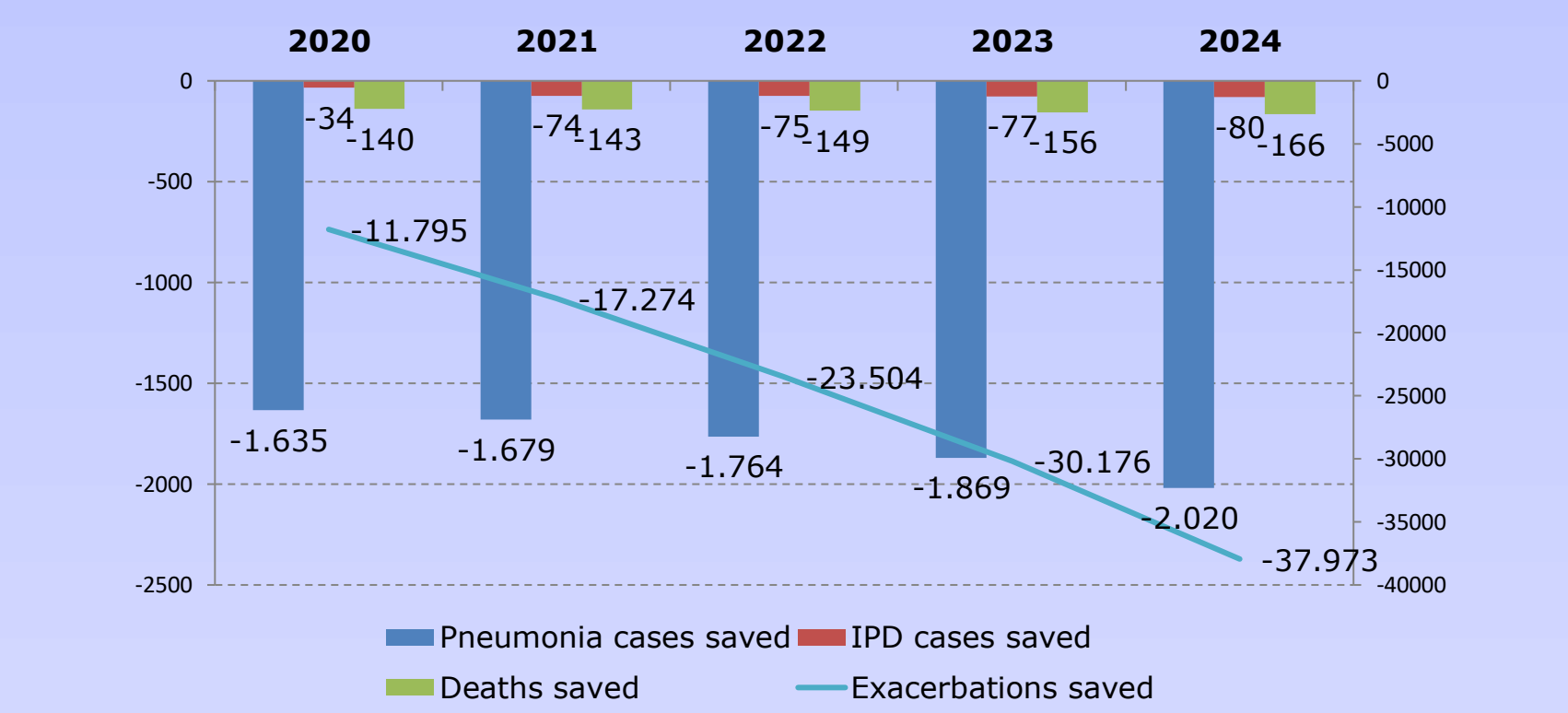


Figure 5: Total budget-impact (€) DM

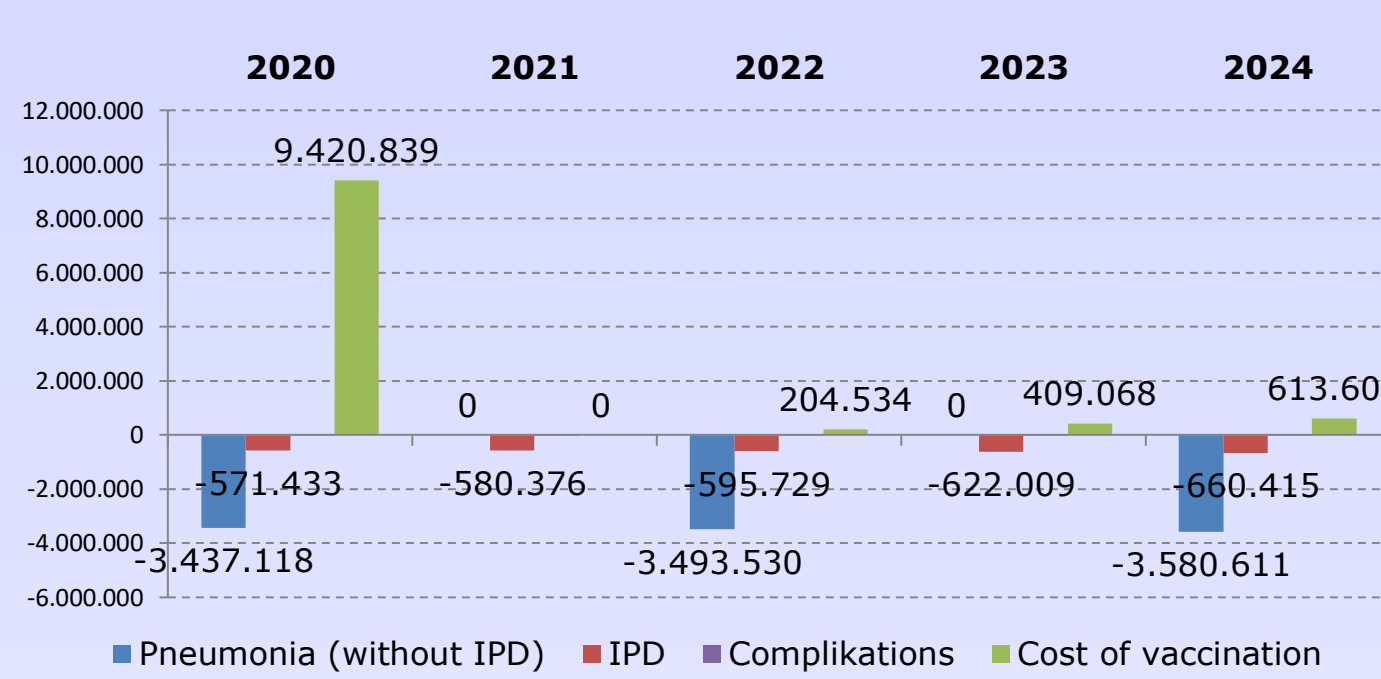


Table 6: Prevented cases due to Pneumococcal vaccination; DM

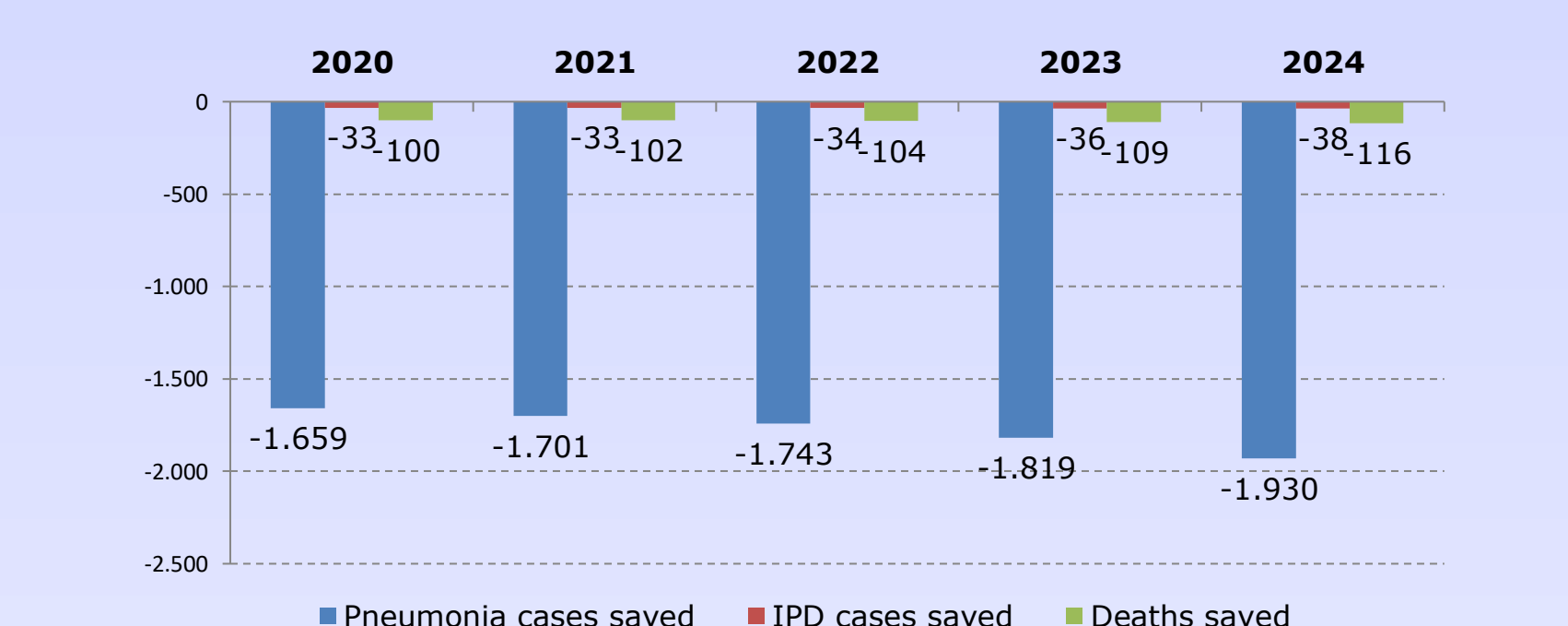


Figure 7: Total budget-impact (€) CVD

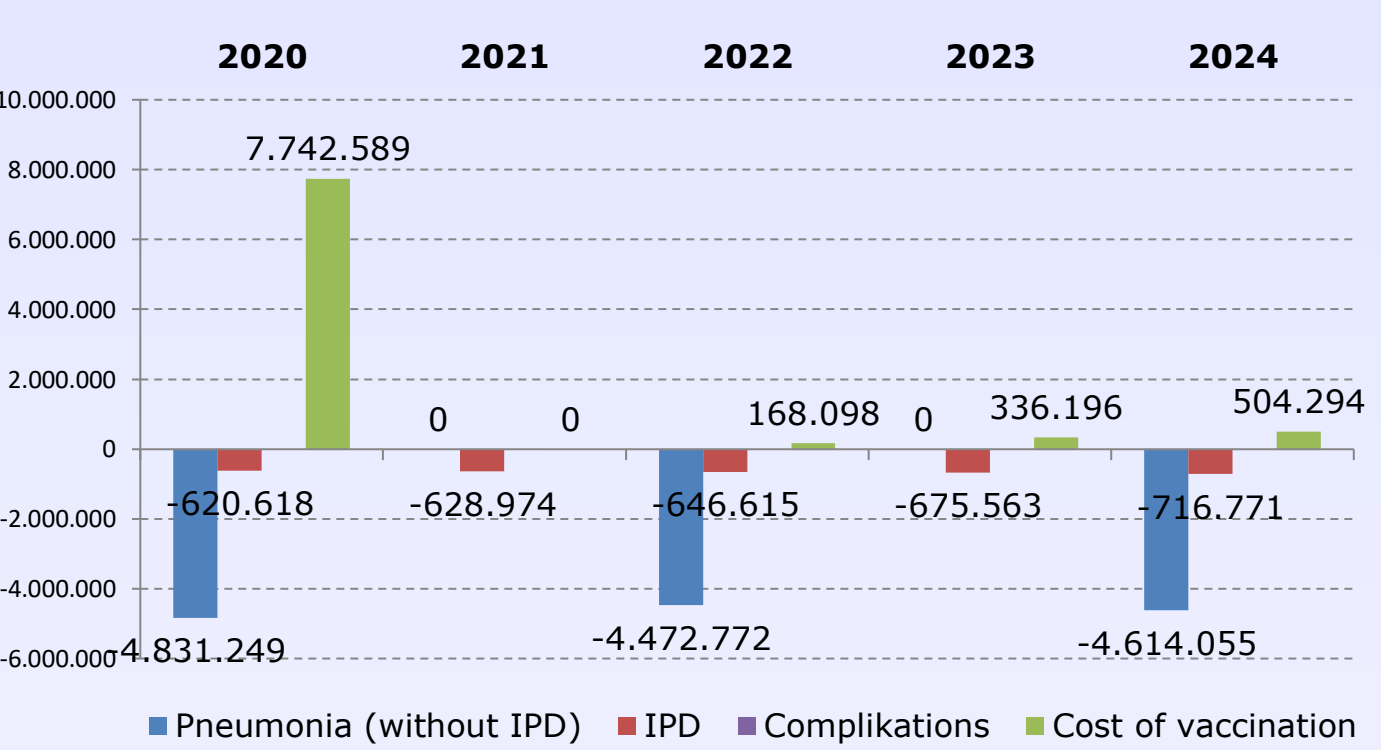
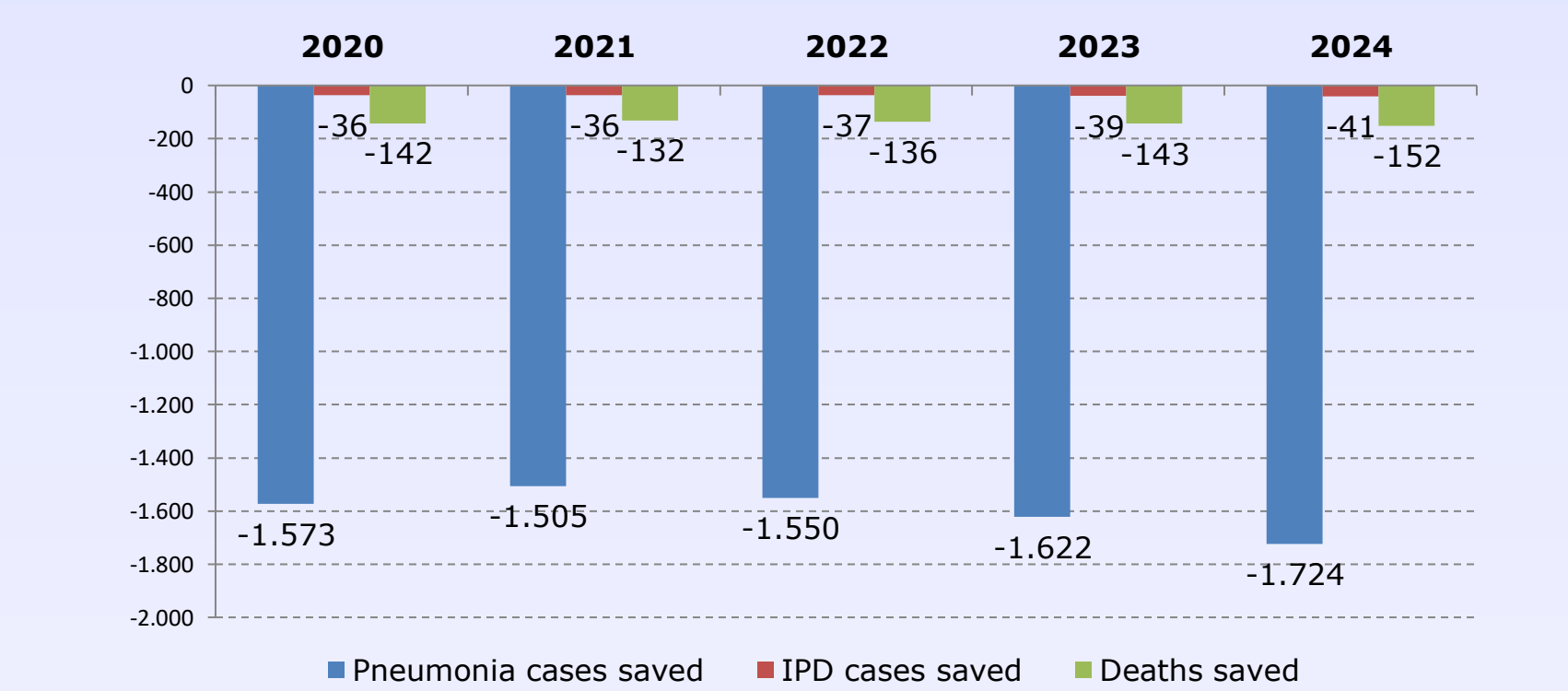


Table 8: Prevented cases due to Pneumococcal vaccination; CVD

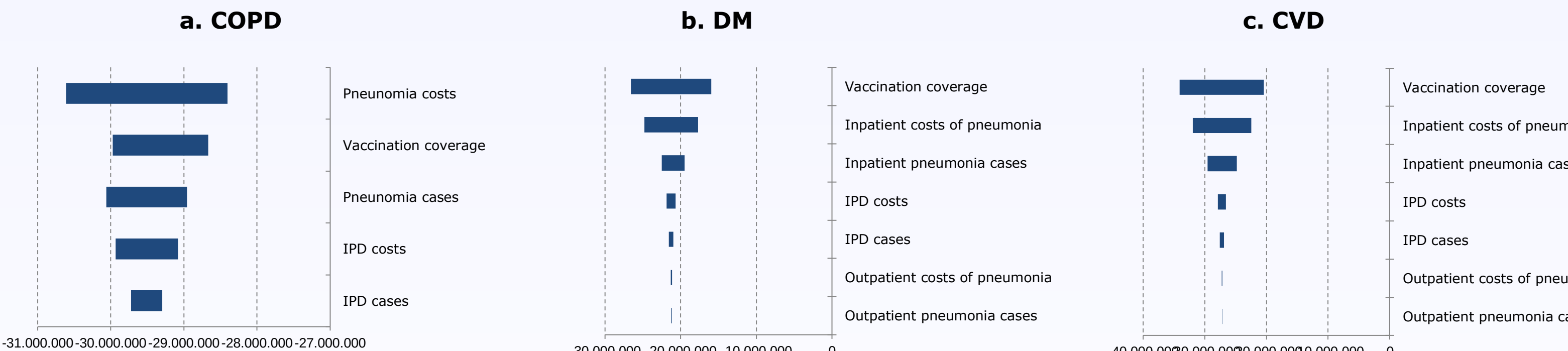


Source: own calculations

Sensitivity Analysis

Sensitivity analysis was carried out in order to assess the impact of variation in the respective variable on final results. The vaccination rate, the cost of inpatient pneumonia and the number of pneumonia cases have the greatest impact.

Table 9: Sensitivity analysis



Source: own calculations

Conclusion

In Austria, 1 € invested in pneumococcal vaccination obtained a return-on-investment between 2 and 13.3 € according to risks groups for the health-care-system.

References

Gessner BD, Jiang Q, Van Werkhoven CH, Sings HL, Webber C, Scott D, Neuzil KM, O'Brien KL, Wunderink RG, Grobbee DE, Bonten MJM, Jodar L. A public health evaluation of 13-valent pneumococcal conjugate vaccine impact on adult disease outcomes from a randomized clinical trial in the Netherlands. Vaccine. 2019 Sep 10;37(38):5777-5787. doi: 10.1016/j.vaccine.2018.05.097. Epub 2018 May 31.
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Additional literature with the author

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