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Budget impact analysis (BIA) of increased COVID-19 booster vaccinations in Austria

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Objectives

The Austrian population has achieved high immunity to Omicron through vaccination and natural infection. However, individuals aged ≥60 years and with pre-existing conditions are at increased risk for severe disease or COVID-19-related death. Additionally, long-term sequelae may occur in all infected individuals. Booster vaccinations (≥4th dose) provide protection against infection and long-term sequelae. The objective of this BIA is to determine the monetary and public health impacts of a hypothetical increase in booster vaccinations, expressed as a "world with INCREASED rates of booster vaccination" compared to a "world with STABLE rates of booster vaccination".

Methods

A population-based evaluation of Austrian COVID-19 cases, hospitalizations, post-COVID-19 cases, deaths, and vaccinations by age group (5-17 years, 18-59 years, ≥60 years) was performed for the year 2022. Age-specific infection (IFR) and hospitalization rates (HR) were stratified by vaccination status using publicly available data. The BIA captures the benefit of 2.6 million additional booster doses over a three-year period (2022-2024), resulting in a larger at-risk population with booster exposure and correspondingly lower IFR and HR in a "world with INCREASED rates of booster vaccination". The BIA captures the differences in the number and cost of hospitalizations, rehabilitations, post-COVD-19-related hospitalizations, work absences and loss of human capital of the two scenarios.

- First, the mean IFR and HR of the age cohorts considered per month of the index year 2022 were determined.
- Second, for each month, mid-term populations were identified for different age cohorts without vaccine-induced immunity (0/1st dose), with vaccine-induced immunity after the first vaccination series (2nd dose ≤120d), with expired vaccine-induced immunity (2nd/3rd dose >120d, ≥4th dose >180d), and with vaccine-induced immunity after complete basic vaccination or booster (3rd dose ≤120d, ≥4th dose ≤180d).
- Third, by applying reported real-world efficacies against COVID-19 infections and against COVID-19-related hospitalizations, stratified IFR and HR can be determined according to age and status of vaccine-induced immunity:

$$IFR_{age\ total} = \left((IFR_{0/1D} \times n_{0/1D}) + (IFR_{0/1D} \times n_{2Dnv} \times VE_{2Dnv}) + (IFR_{0/1D} \times n_{2Dv} \times VE_{2Dv}) + (IFR_{0/1D} \times n_{3D+v} \times VE_{3D+v})\right) / IFN_{age\ total}$$

$$HR_{age\ total} = \left((HR_{0/1D} \times n_{0/1D}) + (HR_{0/1D} \times n_{2Dnv} \times VE_{2Dnv}) + (HR_{0/1D} \times n_{2Dv} \times VE_{2Dv}) + (HR_{0/1D} \times n_{3D+v} \times VE_{3D+v})\right) / Hosp_{age\ total}$$

0D/1D - No vaccine-induced immunity
*2Dnv - Expired vaccination-induced immunity after first vaccination series equivalent to expired vaccination-induced immunity after complete basic vaccination or booster vaccination**
2Dv - Fully effective vaccination-induced immunity after first vaccination series
*3Dv+ - Fully effective vaccination-induced immunity after complete basic vaccination or booster vaccination**
Age total – Total infections or hospitalizations of the respective age group
Hosp/HR – Hospitalizations / hospitalization rate
IFN/IFR – Infections / infection rate
n – Number of individuals in the age group with the respective vaccine-induced immunity
VE – Effectiveness of vaccine-induced immunity
**IPF own assumption*

- Increasing the number of people with fully effective vaccination-induced immunity after booster leads to a reduction in total infections, hospitalizations and deaths.

Source: IPF own development

Epidemiological und clinical data

The age distribution of all confirmed COVID-19 cases, COVID-related hospitalizations and deaths was obtained from publicly available sources (Austrian COVID-19 Open Data Information Portal, Austrian COVID-19 registry, "Factsheet COVID-19 hospitalizations. Date: 5th September 2022"). The size of the age-stratified mid-term populations was calculated using data from Statistics Austria and the Austrian COVID-19 Open Data Information Portal.

Table 1: Age distribution of total registered COVID-19 cases

Age group	Share of cases
5 - 17y	12%
18 - 59y	73%
≥ 60y	15%

Table 2: Age distribution of total COVID-19-related deaths

Age group	Share of cases
5 - 17y	0%
18 - 59y	17%
≥ 60y	83%

Table 3: Age distribution of hospitalized COVID-19 cases (normal ward)

Age group	Share of cases
5 - 17y	11%
18 - 59y	53%
≥ 60y	36%

Table 4: Age distribution of hospitalized COVID-19 cases (ICU)

Age group	Share of cases
5 - 17y	7%
18 - 59y	50%
≥ 60y	43%

Source: Austrian COVID-19 Open Data Information Portal, Austrian COVID-19 registry (Gesundheit Österreich GmbH)

- The real-world effectiveness of the vaccine-induced immunity against COVID-19 infections and against COVID-19-related hospitalizations was determined from data from the Austrian Agency for Health and Food Safety (AGES) and the Robert Koch Institute (RKI).

Table 5: Vaccine effectiveness against infection and hospitalization

Vaccine	Effectiveness against infection 2D		Effectiveness against infection 3D+		Effectiveness against hospitalization	
	≤120d	>120-180d	≤120d	>120d/180d*	2D	3D+
5 - 11y	19,37%	0,00%*	57,00%	0,00%*	84,4%	84,4%*
12 - 17y	37,84%	29,40%	63,20%	29,40%	75,6%	83,5%
18 - 59y	47,77%	33,41%	54,90%	33,41%	57,9%	71,3%
60 - 74y	72,52%	63,50%	74,68%	63,50%	45,4%	81,6%

Source: Austrian Agency for Health and Food Safety (AGES), Robert Koch Institute (RKI), *IPF own assumptions

Prognoses of vaccination rates

Prognosis for "world with STABLE rates of booster vaccination":
- Continuous monthly % increases in 2D and 3D vaccinations as observed in Jan-Apr 2023
- Increase in booster vaccinations (4D+) until 90% of the population ≥60y with complete basic vaccination (3D) and 90% of all immunosuppressed and active cancer patients aged 12-59y have received booster vaccination (19% of total population in 2023).
- ~5% of people with booster vaccinations (4D+) receive boosters regularly (≤180 days)

Prognosis for "world with INCREASED rates of booster vaccination":
- Continuous monthly % increases in 2D and 3D vaccinations as observed in Jan-Apr 2023
- 2.6 million additional booster doses are administered over a three-year period (2022-2024)
- ~45% of people with booster vaccinations (4D+) receive boosters regularly (≤180 days)

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Table 6: Vaccination rates in 3 years

	STABLE rates of booster vaccination				INCREASED rates of booster vaccination			
	1st quater	2nd quater	3rd quater	4th quater	1st quater	2nd quater	3rd quater	4th quater
2022	1,483,598	315,417	736,217	968,605	1,483,598	315,417	736,217	968,605
2023	102,211	41,471	52,091	52,091	369,899	392,048	393,816	393,816
2024	52,091	52,091	52,091	52,091	393,816	393,816	393,816	393,816

Source: IPF own assumptions

Direct costs

The BIA considers the costs of hospitalizations in the normal and intensive care units, rehabilitations, post-COVID-19-related hospitalizations, and COVID-19-related deaths. Costs were presented from a payer perspective and are stratified by age group (5-17 years, 18-59 years, ≥60 years). The durations of hospitalization in the normal ward and intensive care unit, are based on informations from Gesundheit Österreich GmbH (GÖG). The proportion of patients with rehabilitations and post-COVID-19 disease after inpatient treatment is derived from data from the Austrian Ministry of Health and the Austrian COVID Crisis Coordination Center (GECKO).

Indirect costs

The BIA captures indirect costs of sick leaves due to hospitalizations in the normal or intensive care units and the loss of human capital due to deaths. Indirect costs are calculated based on the employment rate by age group (share of the working-age population). Indirect costs for children and adolescents (5-17 years) are not included.

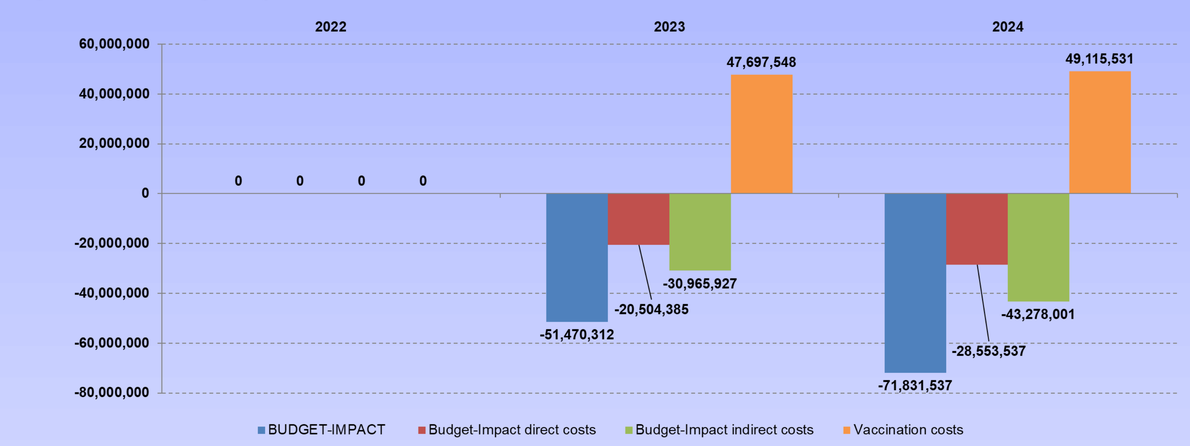
Vaccination costs

Vaccination costs include the cost of the vaccine, weighted by the patient's share for booster doses, and physician fees for the second and subsequent doses.

Results

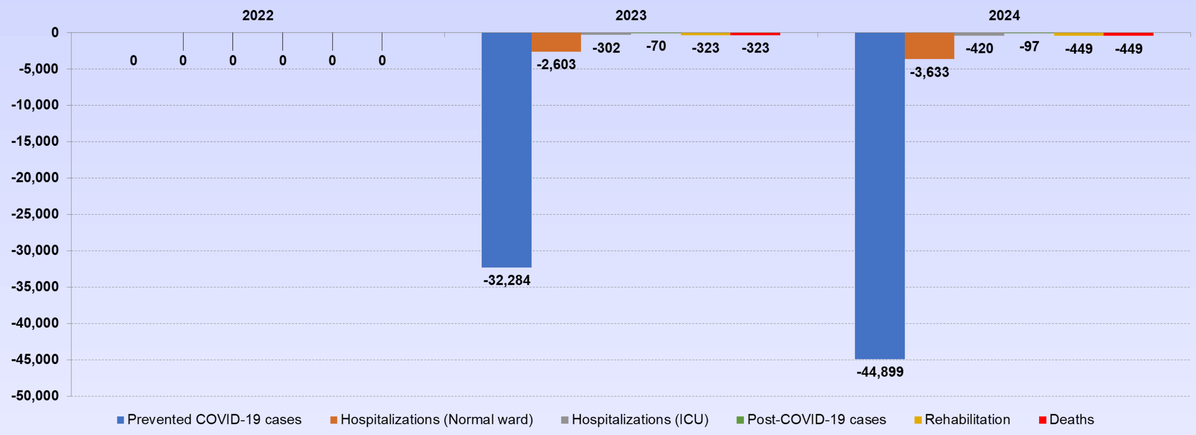
In a "world with INCREASED rates of booster vaccination" annual savings of € 0 (1st year) to € 71.8 million (3rd year) [total: €123.3 million over 3 years] could be achieved. For direct costs, savings range from € 0 (1st year) to € 28.6 million (3rd year) [total: € 49.1 million]. The burden on society is reduced by increased booster vaccinations. Indirect cost savings range from € 0 (1st year) to € 43.3 million (3rd year) [total: € 74.2 million]. Vaccination costs paid by the national health system range from € 0 (1st year) to € 49.1 million (3rd year) [total: € 96.8 million].

Figure 1: Total budget-impact



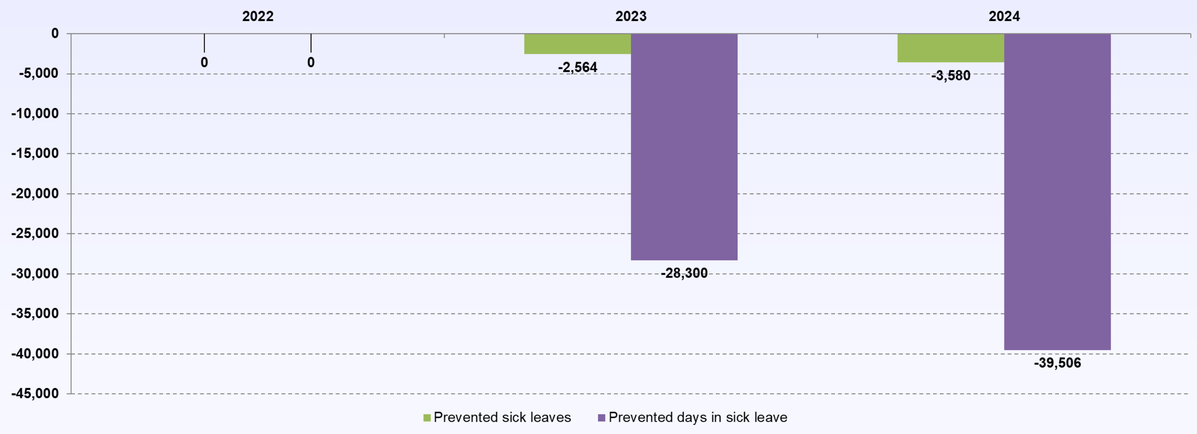
- Multiplicator: 1 € invested in COVID-19 vaccines saves 1.27 € within society.

Figure 2: Prevented infections, hospitalizations, rehabilitations, post-COVID-19 cases and deaths



- With an increased rate of regular booster vaccinations, 77,184 COVID-19 infections, 6,235 normal ward hospitalizations, 722 ICU hospitalizations, 773 rehabilitations, 167 post-COVID-19 cases and 773 deaths can be avoided in three years.

Figure 3: Prevented sick leaves



- In a "world with INCREASED rates of booster vaccination", 6,144 sick leaves corresponding to 67,807 sick leave days can be prevented in 3 years.

Source: IPF own calculations

Conclusion

1 € invested in COVID-19 vaccines saves 1.27 € within society and prevents 77,184 COVID-19 cases and 773 deaths in 3 years.

References

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Additional literature with the author

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