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Impact of COVID-19 on Healthcare Utilization and Costs: A Detailed Analysis from Inpatient and Outpatient Perspectives

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Background and Objectives

- COVID-19 pandemic burdened healthcare systems and economies, highlighting the need for detailed data on healthcare use and costs [1-3]. Such data support economic evaluations and enhance infectious disease models for public health decisions and resource allocation [3] .
- We assessed outpatient utilization, hospitalization rates, length of stay, costs, and inpatient mortality in German COVID-19 patients using claims data. **Findings are integrated into the German Epidemic Microsimulation System** (GEMS), an **agent-based model** (ABM) that simulates infection dynamics and socio-economic impacts, with a focus on vulnerable groups [4].

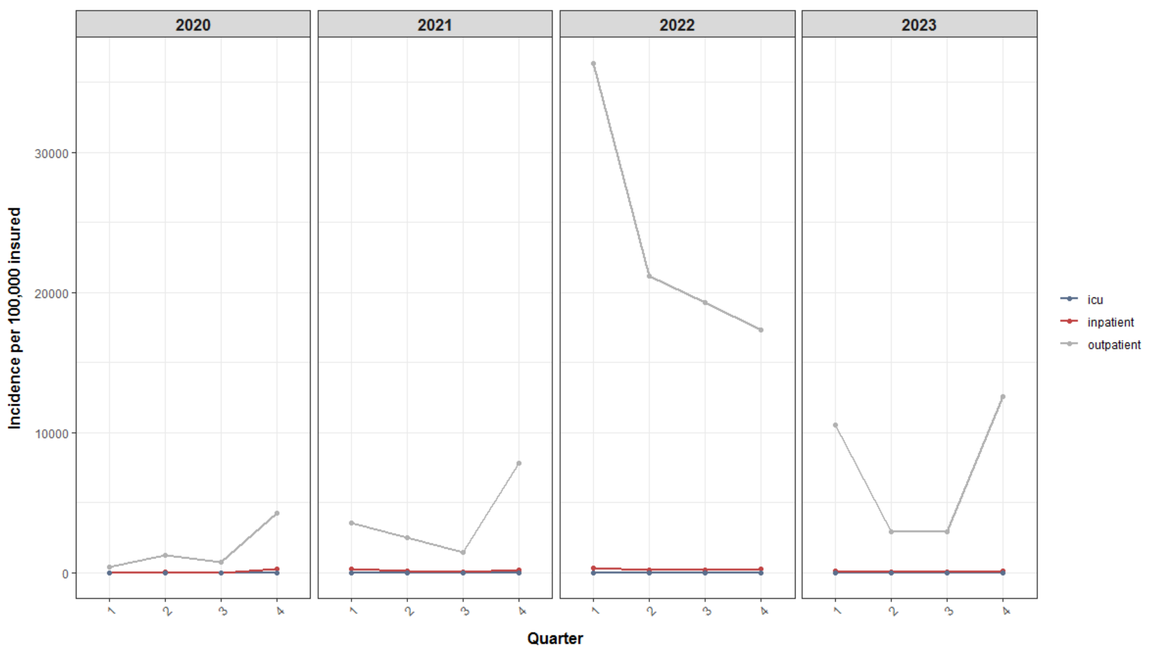
Methods

- **Data**: German statutory health insurance (SHI) claims data, covering ~ 9 million patients (Representative for Germany [5]).
- **Study period**: January 1st, 2020 to December 31st, 2023.
- **COVID-19 patients identification**: ICD code U07.1.
- **Matching:** Coarsened Exact Matching (CEM) [6] to create COVID-19 and non-COVID groups based on Elixhauser Comorbidity Index (ELXH) [7], age, gender, federal state, and diagnosis quarter.
- **Estimation method:** Weighted logistic regression adjusted for ICU, LOS, and hospital mortality to examine the relationship between COVID-19, COVID-19 associated costs, outpatient visits and subsequent hospitalizations.

Results

- High amount of COVID-19 cases during peak infection periods, particularly in early 2022.
- Significantly higher incidence of outpatient cases than for inpatient cases (see Fig. 1).
- Weighted avg. costs increases with higher comorbidity burden.

Figure 1: Incidence for COVID-19 patients per 100,000 insured, stratified for outpatient, inpatient and ICU admission.

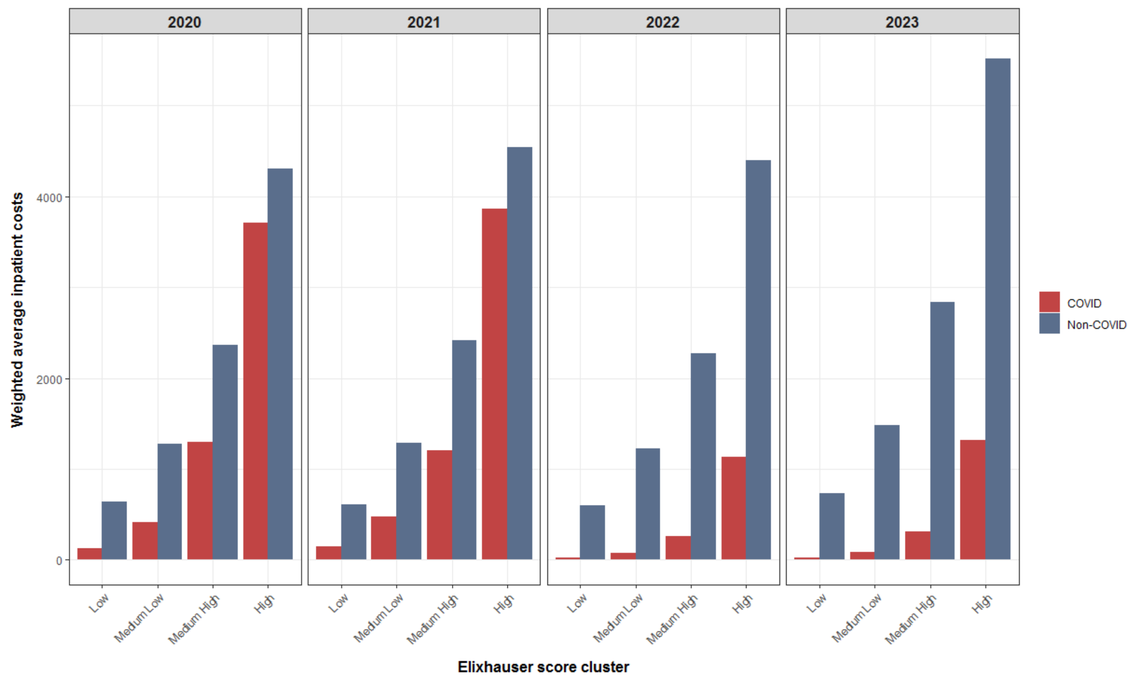


	2020		2021		2022		2023	
	COVID	Non-COVID	COVID	Non-COVID	COVID	Non-COVID	COVID	Non-COVID
Age – Years Mean (SD)	47.3 (21.9)	47.4 (22.5)	43.6 (22.2)	43.7 (22.9)	43.8 (20.1)	44.1 (20.9)	48.1 (18.5)	48.1 (19.5)
Sex –Female (% Female)	61.01	61.01	57.42	57.42	58.22	58.22	61.55	61.55
LOS – days Mean (SD)	9.8 (9.8)	6.6 (10.2)	10.0 (9.6)	6.8 (11.2)	8.7 (10.7)	7.3 (12.8)	8.9 (9.6)	7.1 (11.8)
LOS ICU – days Mean (SD)	9.3 (8.6)	5.0 (6.4)	10.4 (9.8)	5.0 (7.1)	7.1 (8.0)	4.9 (6.9)	5.8 (5.8)	4.6 (7.5)
In-hospital mortality %	0.63	0.09	0.44	0.07	0.05	0.05	0.06	0.06
Elixhauser– Score	1.55	1.51	1.39	1.36	1.22	1.30	1.55	1.46

Table 1: Sample characteristics after CEM shows comparable groups with and without COVID-19.

- Outpatient costs for COVID-19 varied in mean from 173.92 € in 2020 to 118.94 € in 2023.
- Inpatient costs for COVID-19 varied in mean from 1,167.55 € in 2020 to 357.61 € in 2023.
- Inpatient costs of Non-COVID patients remained comparable across all years, however consistently exceed those for COVID-19 patients (see Fig. 2).

Figure 2: Weighted average costs for COVID-19 patients compared to Non-COVID patients stratified by ELXH.



- Weighted regression model shows that COVID-19 patients tend to incur higher inpatient costs.
- Costs increase significantly with ICU admissions, longer hospital stays, higher comorbidity burden and in-hospital mortality.

Conclusion

- COVID-19 pandemic has shown that ABM are invaluable for public health decision-making, as they can simulate complex social interactions and behaviors.
- Accurate healthcare cost data is crucial for assessing the economic impact, guiding resource allocation, and supporting cost-effective intervention strategies to manage current and future health crises sustainably.

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