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Projecting Societal Costs of Potential Pandemics

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Introduction

- Pandemics result in costs at the societal level:
  - mortality and morbidity (can be valued in monetary terms)
  - business closures (GDP loss)
  - school closures (can be valued in monetary terms)

- Significant uncertainty as to:
  - location and timing of emergence of next potential pandemic
  - transmissibility and severity of disease
  - policy-maker response to the outbreak

Introduction

- Aims:
  - projecting societal costs of potential future pandemics
  - compare mitigation strategies for different disease outbreaks
  - identify cost drivers for different disease-mitigation strategy scenarios

- Pandemic preparedness can help to alleviate these costs:
  - averted mortality, morbidity, business and school closures
  - limited evidence as to impact of specific measures in different scenarios
  - first steps towards assessing value-for-money of pandemic preparedness measures

Methods - Integrated Epidemiological-Economic Modelling

- Integrated models developed during the Covid-19 pandemic to navigate the ‘lives vs. livelihoods’ trade-off can be re-purposed to project the societal cost of potential future pandemics

- Daedalus model (Haw et al., Nature Computational Science, 2022):
  - stratification of country population by age and economic sector
  - age- and sector-specific contact rates (community and workplace transmission)
  - impact of economic closures and worker-health state on labour supply (Input-Ouput model)

- Societal cost of a disease outbreak in terms of (Johnson et al., Vaccine, 2023):
  - valued life-years lost (deaths)
  - short-term GDP loss (business closures and worker illness)
  - valued school-years lost (school closures)

Methods - Integrated Epidemiological-Economic Projections

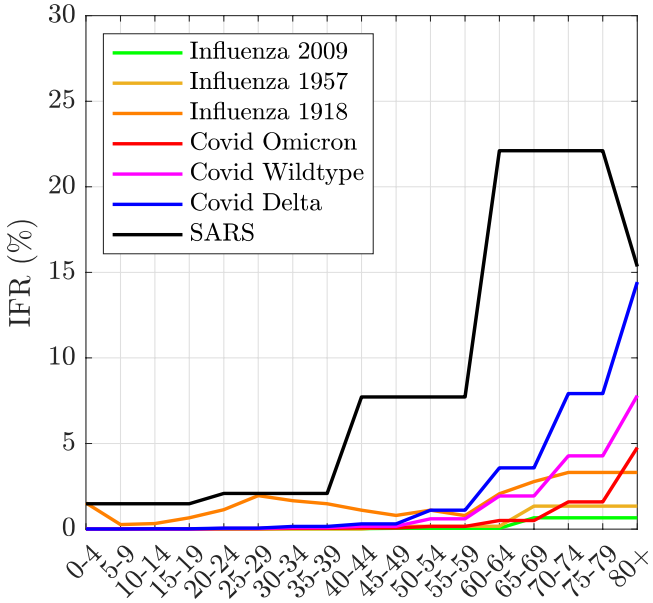
Multi-scenario analysis of societal costs of disease outbreaks over three-year projection horizon:

- different disease profiles based on historic respiratory-disease pandemics with varying transmissibility (R) and severity (IFR)

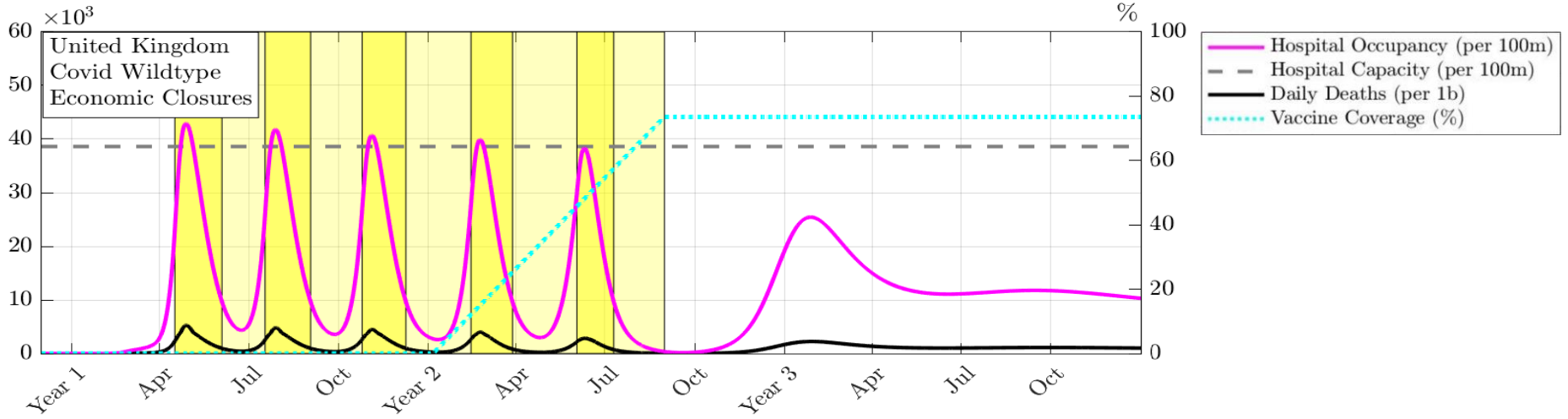
- different mitigation strategies observed during the Covid-19 pandemic (no closures, reactive economic and school closures, elimination)

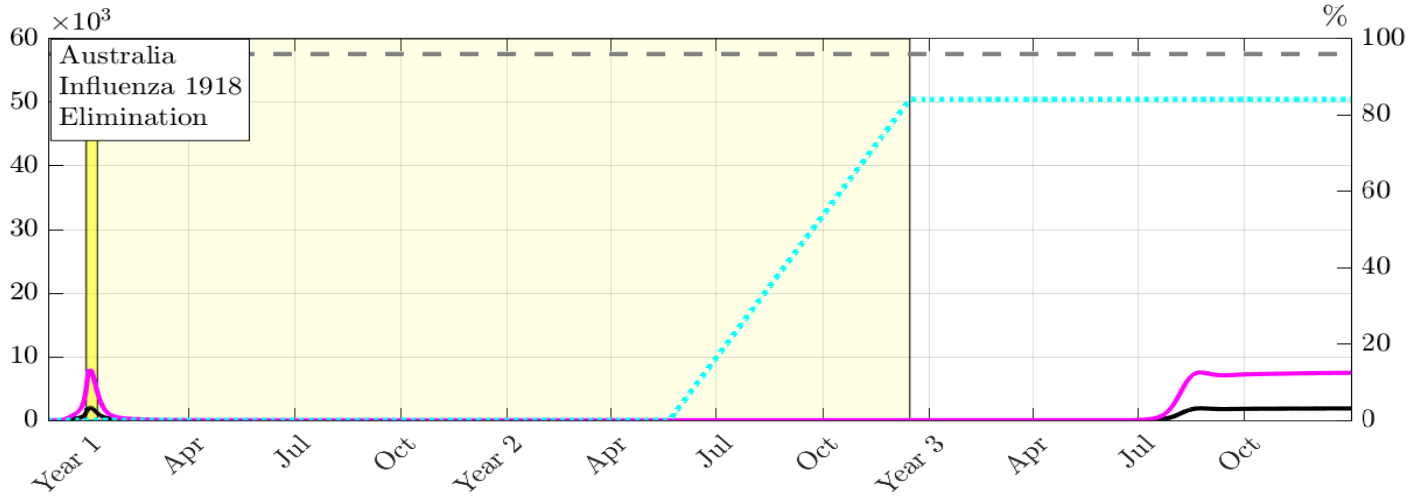
- mitigation measures imposed under each disease-strategy scenario:
  - surveillance: testing and isolation of % of infectious individuals
  - social distancing: reduction in contact rate
  - hospital capacity: beds available for pandemic patients
  - vaccination: administration time, rate and coverage/uptake

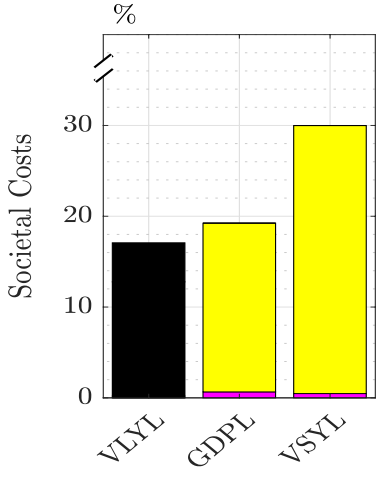
- income-group-specific demography, mixing, economic output and mitigation measures

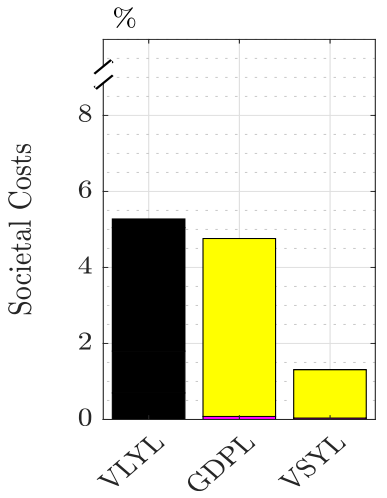


Methods - Integrated Epidemiological-Economic Projections

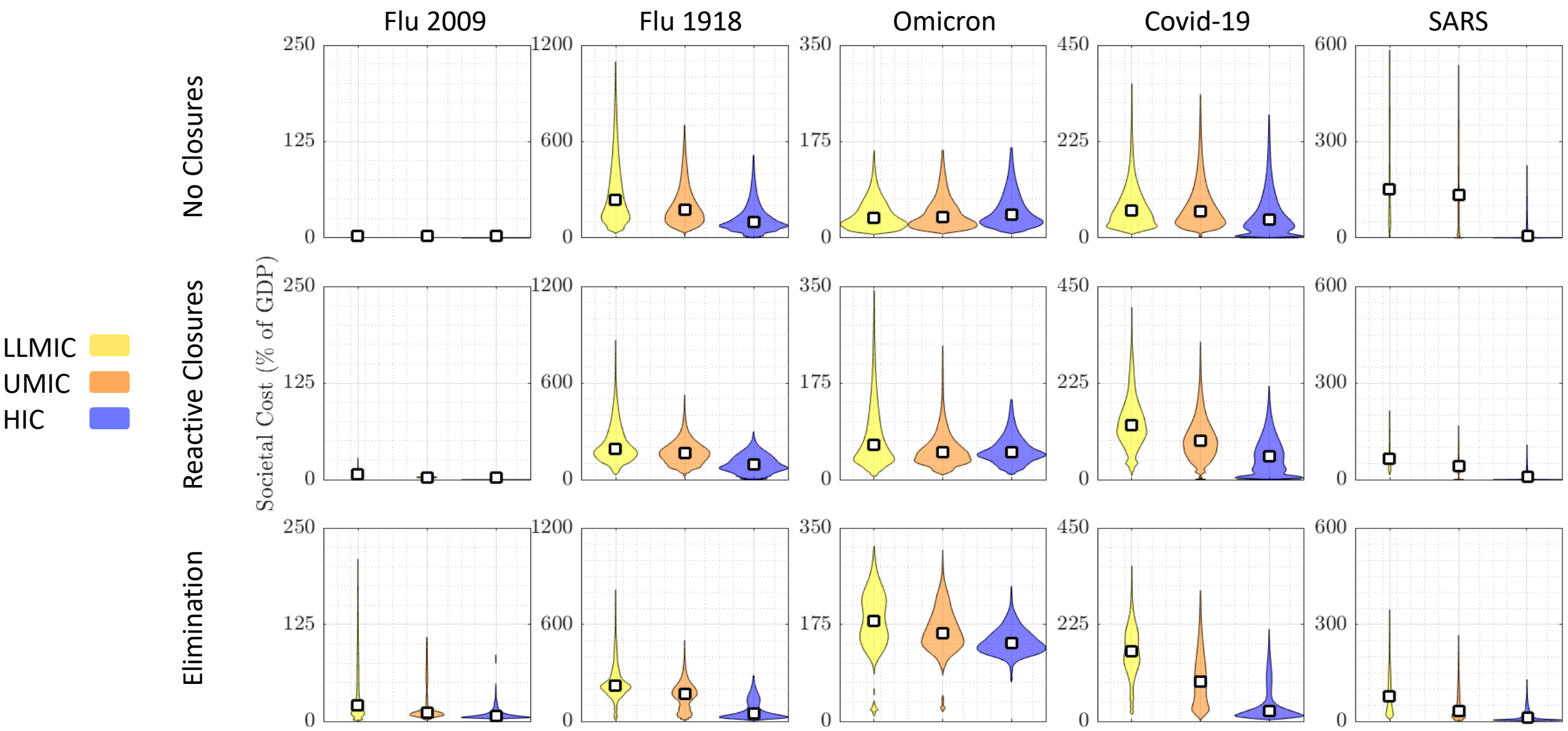








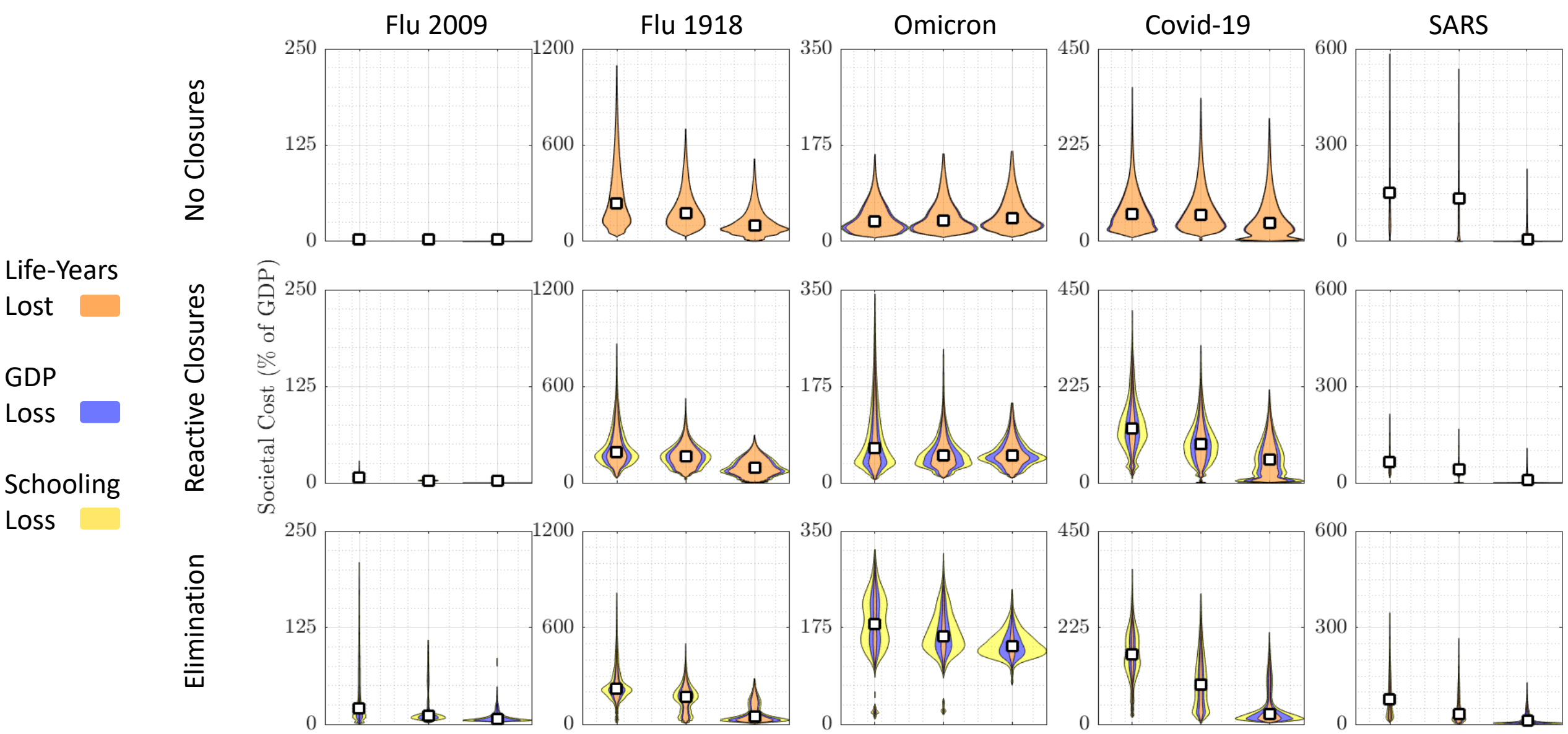
Societal Cost Projections (% of annual pre-pandemic GDP)



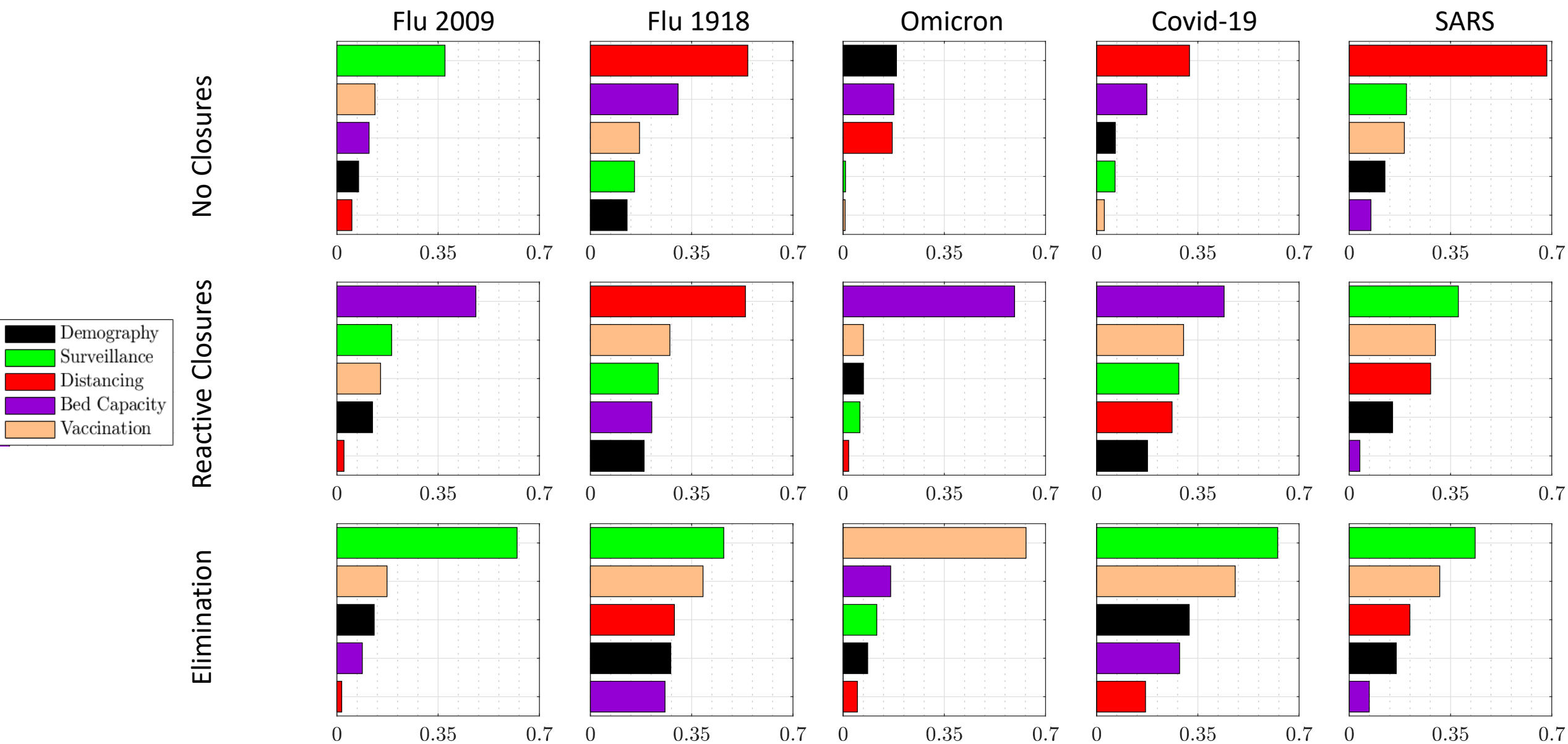
Societal Cost Projections (% of GDP) - Summary

		Flu 2009	Flu 1918	Omicron	Covid-19	SARS
LLMIC	No Closures	3	295	44	75	211
	Reactive Closures	8	228	82	135	90
	Elimination	45	251	184	165	95
UMIC	No Closures	3	206	47	78	182
	Reactive Closures	3	171	56	98	63
	Elimination	22	164	165	99	55
HIC	No Closures	2	126	52	59	48
	Reactive Closures	2	100	54	57	20
	Elimination	10	75	145	42	20

Societal Cost Projections (% of GDP) - Breakdown



Societal Cost Projections (% of GDP) - Cost Drivers



Conclusions

- Even under optimal mitigation strategies, there is great variability in the magnitude of societal costs of pandemics:
  - LLMICS (3-228 % of GDP)
  - UMICS (3-164 % of GDP)
  - HICS (2-75 % of GDP)
  - Flu 2009 (2-3 % of GDP)
  - Flu 1918 (75-228 % of GDP)
  - Omicron (44-52 % of GDP)
  - Covid-19 (42-78 % of GDP)
  - SARS (20-90 % of GDP)

- Cost-drivers depend on the mitigation strategy pursued:
  - Hospital capacity and social distancing most important under No Closures and Reactive Closures strategies
  - Surveillance and vaccination most important under Elimination strategy

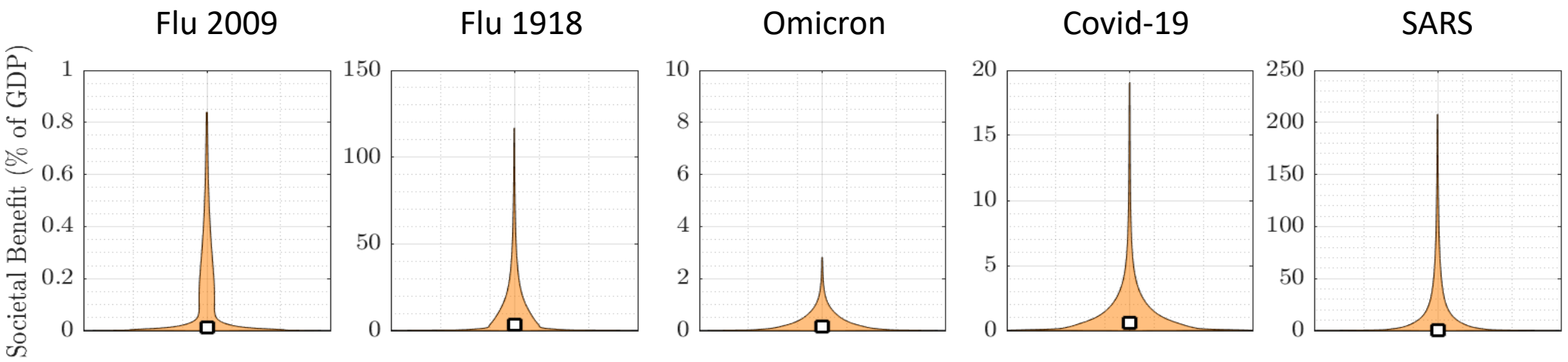
Limitations

- Uncertainty in workplace contact rate estimates
- Impact of migration not included
- Static economic model without international trade
- Extrapolation from Covid-19 data (vaccine rollout, testing, behavioural responses)
- Many cost dimensions not included
- 3-year projection horizon

Societal Benefit Projections (% of GDP) - Preliminary Results

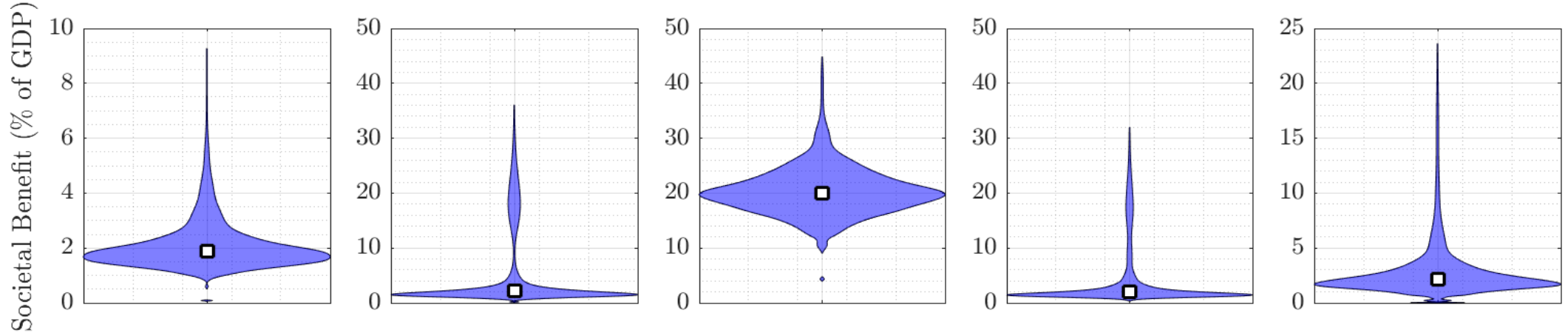
WHO 70% Vaccine Coverage Target:

Reduced VLYL in LLMICs with No Closures



CEPI 100-day Vaccine Rollout:

Reduced GDPL in HICs with Elimination



Questions?