Handout:

UKHSA Directorate of Analysis and Intelligence Assessment Away-day: Pandemic Response Simulation Exercise

17th June 2025

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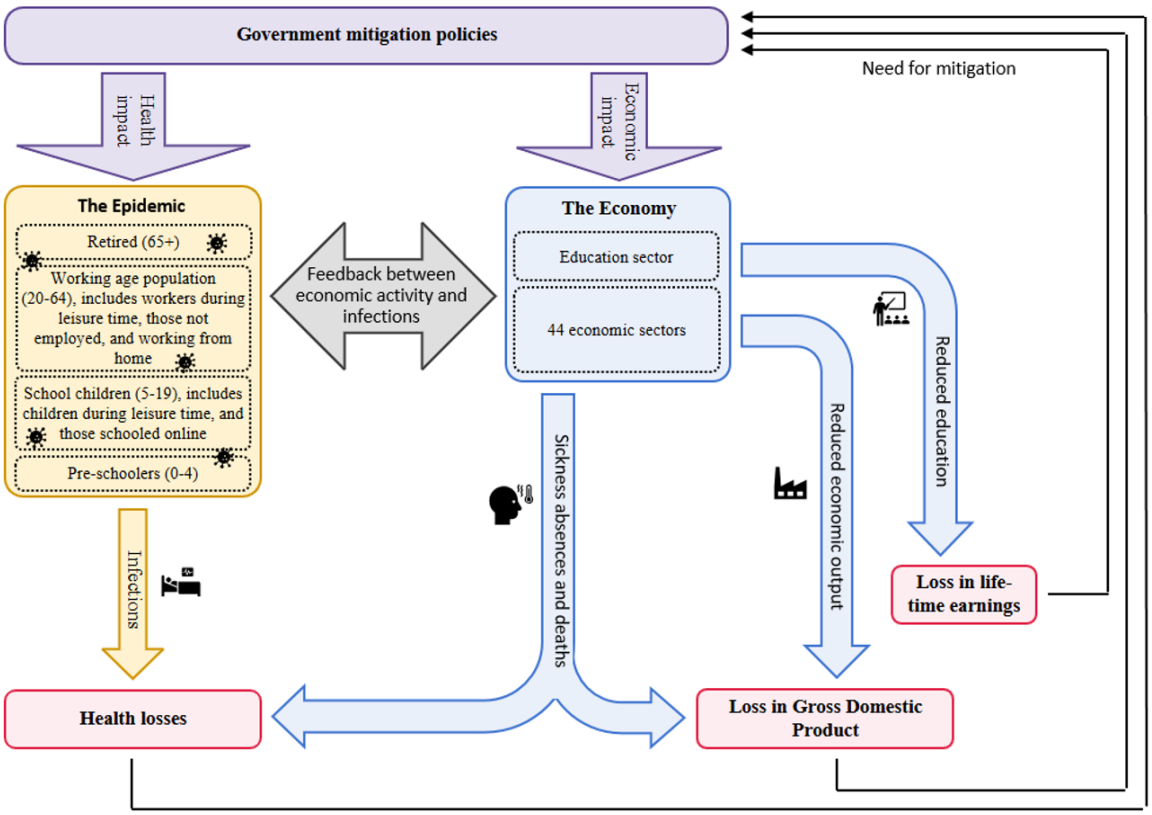
Section I Explainers

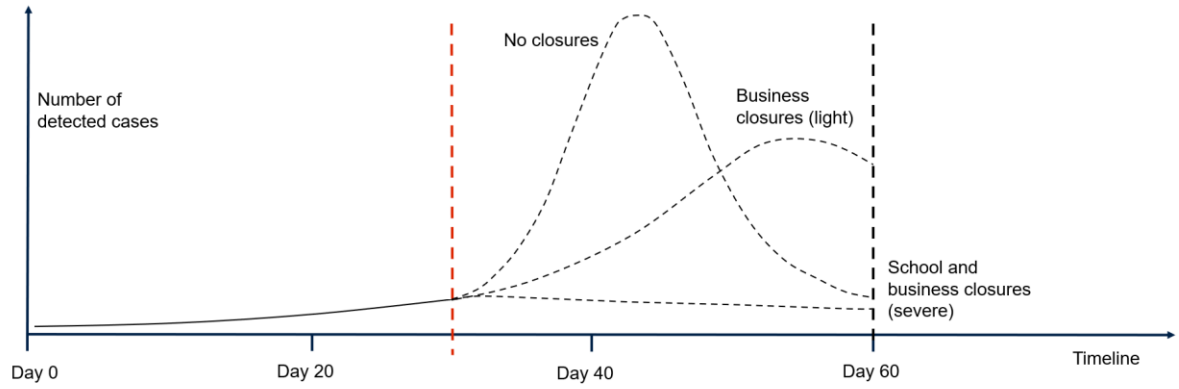


The DAEDALUS Model

DAEDALUS models infection transmissions within the community, the economy, and during travel between these places. The community consists of individuals who are not employed, workers during their leisure time and when working from home, school children and students during their leisure time and when attending school online. The economy consists of workers in 45 economic sectors, including the education sector. There is an exchange between the community and the economy, via workers travelling between home and workplaces, students and teachers traveling to educational institutions, and individuals consuming goods and services. Transmission of infections in the community, at workplaces, in educational institutions, while consuming goods and services and travelling is modelled via a deterministic compartmental SEIR model. This determines the number of infected individuals seeking hospital treatment. Contact rates vary by age group and by economic sectors. The government can implement partial closures of schools and/or of economic activity not essential to day-to-day life. This reduces workplace infections because workers and/or students stay in the community and do not travel and spend time at workplaces, which has a dampening effect on infections. However, closures reduce sectors' economic production to the percentage they are closed; this results in a loss of economic output (measured by sectoral Gross Value Added, or GVA) and a reduction in short-term GDP in the aggregate, compared to pre-pandemic production. Sickness absences and deaths of workers, teachers and students reduces economic output, proxied by the GVA of the sector per worker and days of sickness, and for deaths until the end of the projection (adjustments are made for sectors that are partially closed by government mitigation). There is a circular loop, in that health, economic and education losses may instigate governments to implement or lift mitigation policies. See the online dashboard: https://daedalus.jameel-institute.org/scenarios/new.

Figures 1: Timeline of the exercise

Figure 1A: Day 30 after the first case



First detected case in the UK

Day 30: start of exercise

You need to decide:

1. Implement closures or not?
2. What closure strategy?
3. Implement on what day, over the next 30 days?

You will get projections for alternative closure strategies until day 60 (for the next 30 days)
Choice of one strategy is made

End of projection horizon

Figure 1B: Uncertainty at day 30

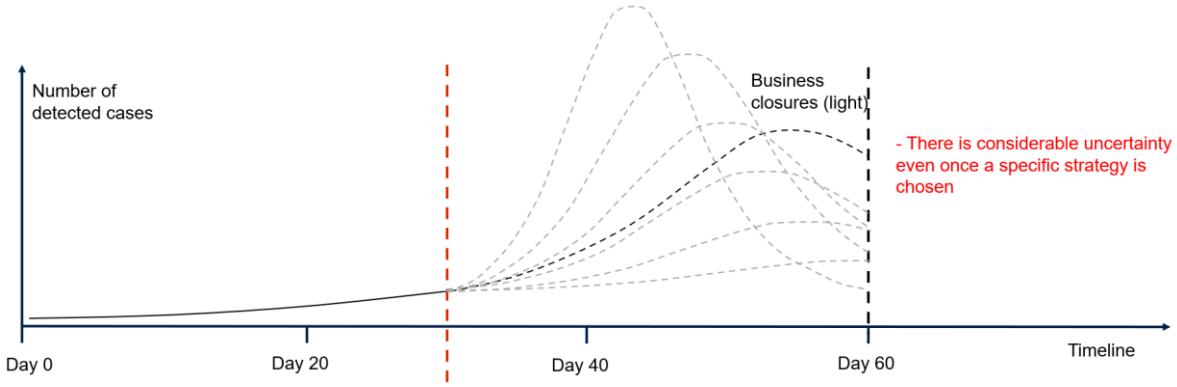
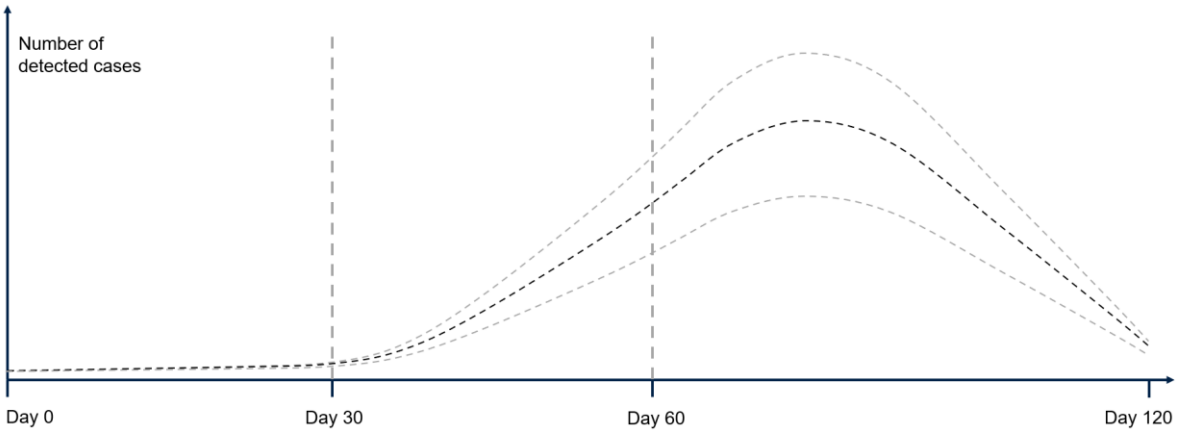


Figure 1C: Day 60 after the first case



After coffee

- Projections of the next 60 days (to day 120)
- Considering the chosen strategy
- There is less uncertainty

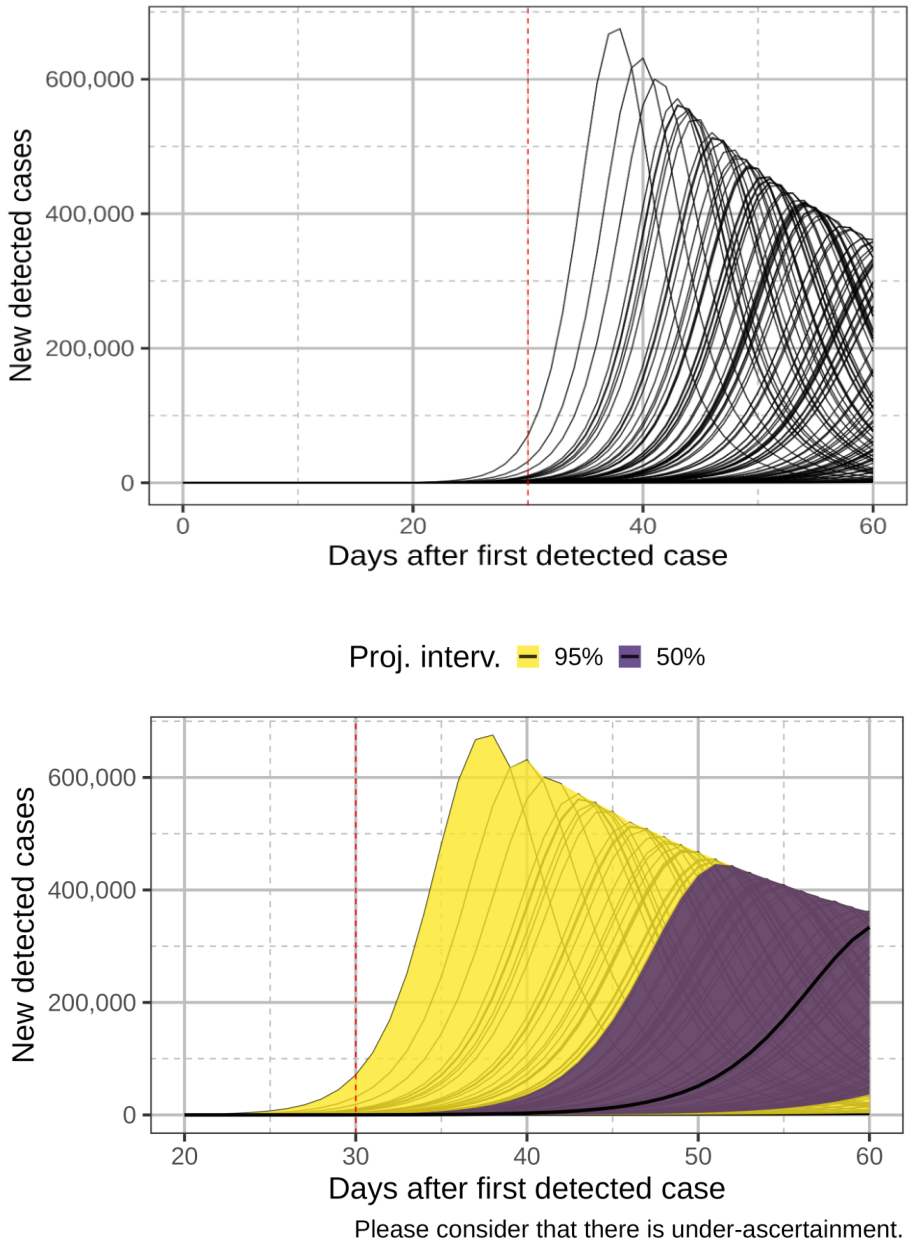
Table 1: Government mitigation strategies (choose one)

See Table 2 in this handout for more information on economic productivity and workplace contacts.

Strategy	Explanation	Health losses	Economic losses	Educational losses
No Closures	There are no closures of businesses or schools	Years of lives lost	-Sickness absences and deaths	-Sickness absences and deaths of teachers[1]
Business closures (light)	Economic sectors are closed to varying but pre-set percentages[2]	Years of lives lost	-% GVA reductions compared to pre-pandemic GVA of 45 economic sectors -Sickness absences and deaths	-Sickness absences and deaths of teachers[1]
School closures (severe) + business closures (light)	Educational institutions are closed for in-person schooling; there is online schooling of lower efficacy, reflecting data on digital access for the UK; there are some business closures, to varying but pre-set percentages[2]	Years of lives lost	-% GVA reductions compared to pre-pandemic GVA of 45 economic sectors - Sickness absences and deaths	-Future earning losses of students due to interrupted schooling -Sickness absences and deaths of teachers[1]
School and business closures (severe)	Economic sectors are closed to varying but pre-set percentages; sector closures more stringent than under business closures[2]	Years of lives lost	-% GVA reductions compared to pre-pandemic GVA of 45 economic sectors -Sickness absences and deaths	-Future earning losses of students due to interrupted schooling -Sickness absences and deaths of teachers[1]
Bespoke closure strategy	Participants can choose whether and by how much education and economic sectors are closed; there is an essential level of production below which sectors cannot be closed	Years of lives lost	-% GVA reductions compared to pre-pandemic GVA of 45 economic sectors -Sickness absences and deaths	Losses as above; depend on whether and how much education sector is closed

[1]Educational loss due to sickness and death of teachers is based on education sector GVA; [2]Sector closures are informed by data from various countries observed during 2020; GVA = Gross value added; the contribution of an economic sector to economic output

Figure 2: Uncertainty in epidemic projections



We summarise newly detected cases by highlighting the median curve and shading the areas covering 50% and 95% of curves closest to the median. These are the 50% and 95% projection intervals.

Section II: Epidemic projections under alternative mitigation

Projected epidemic outcomes without closures (figures 3 to 9)

Figure 3: Daily new detected cases

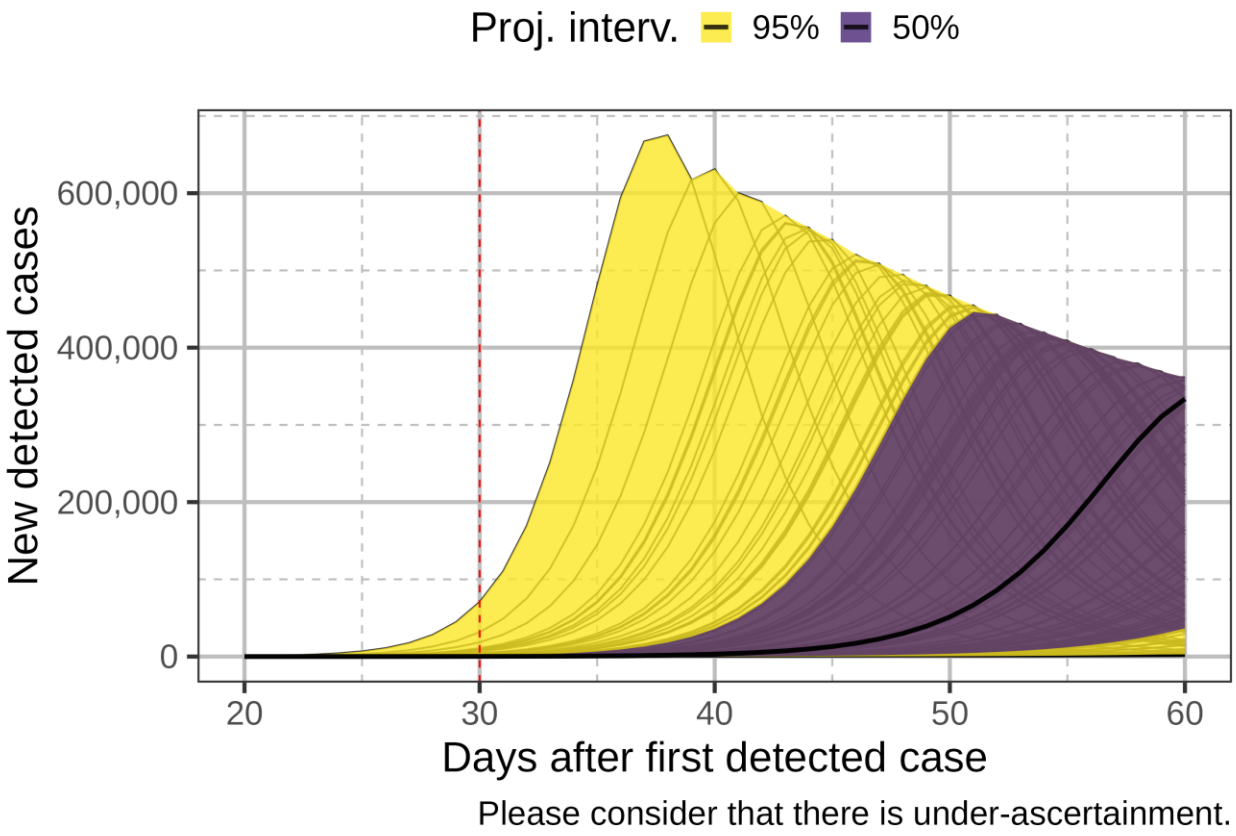


Figure 4: Daily new hospital demand (admissions)

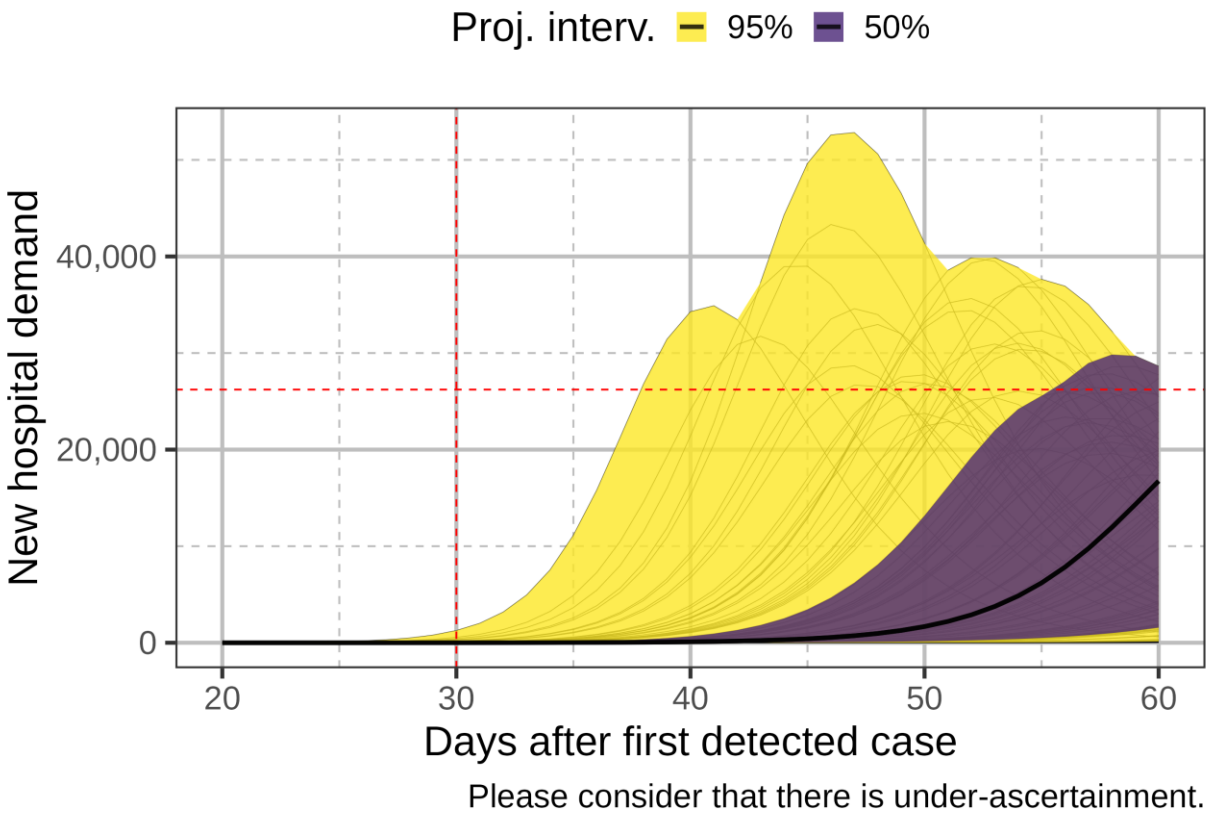
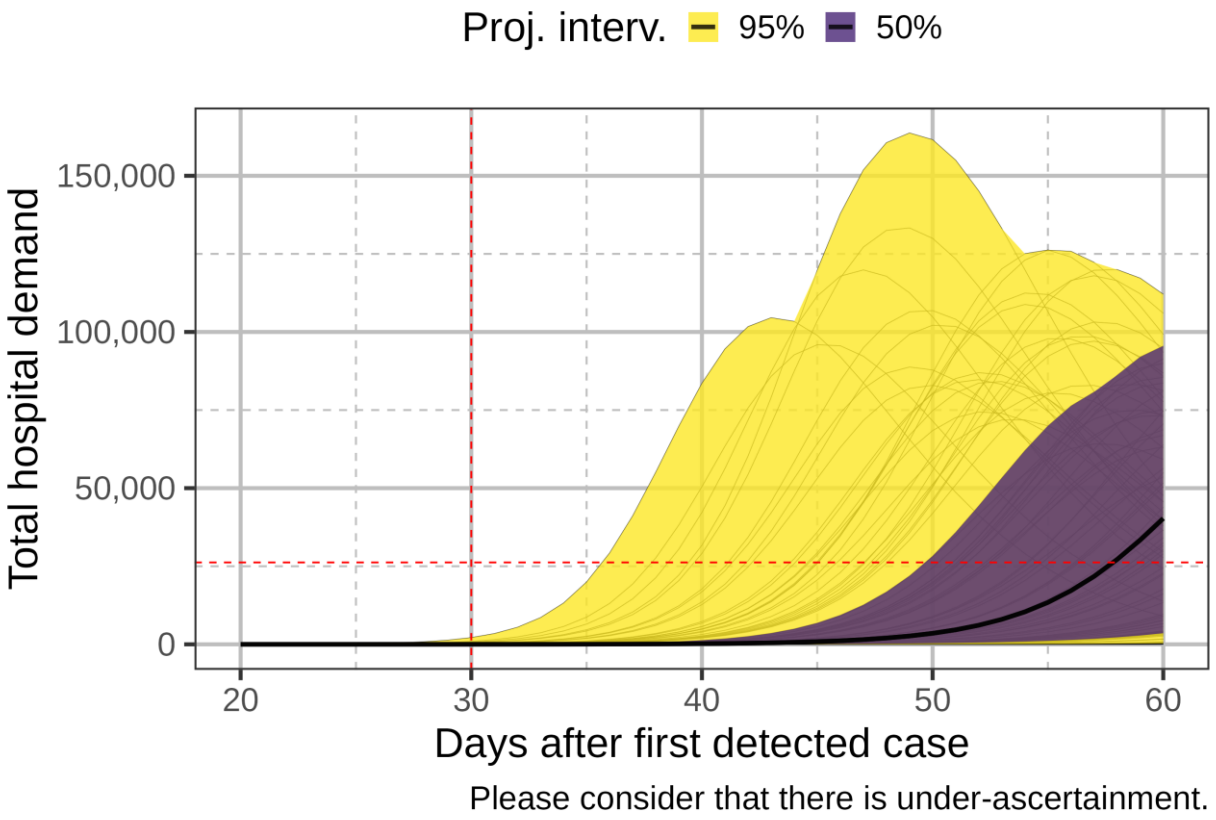


Figure 5: Total hospital demand (occupancy)



Note: The red line indicates surge hospital capacity assuming all elective surgeries are cancelled.

Figure 6: Daily deaths

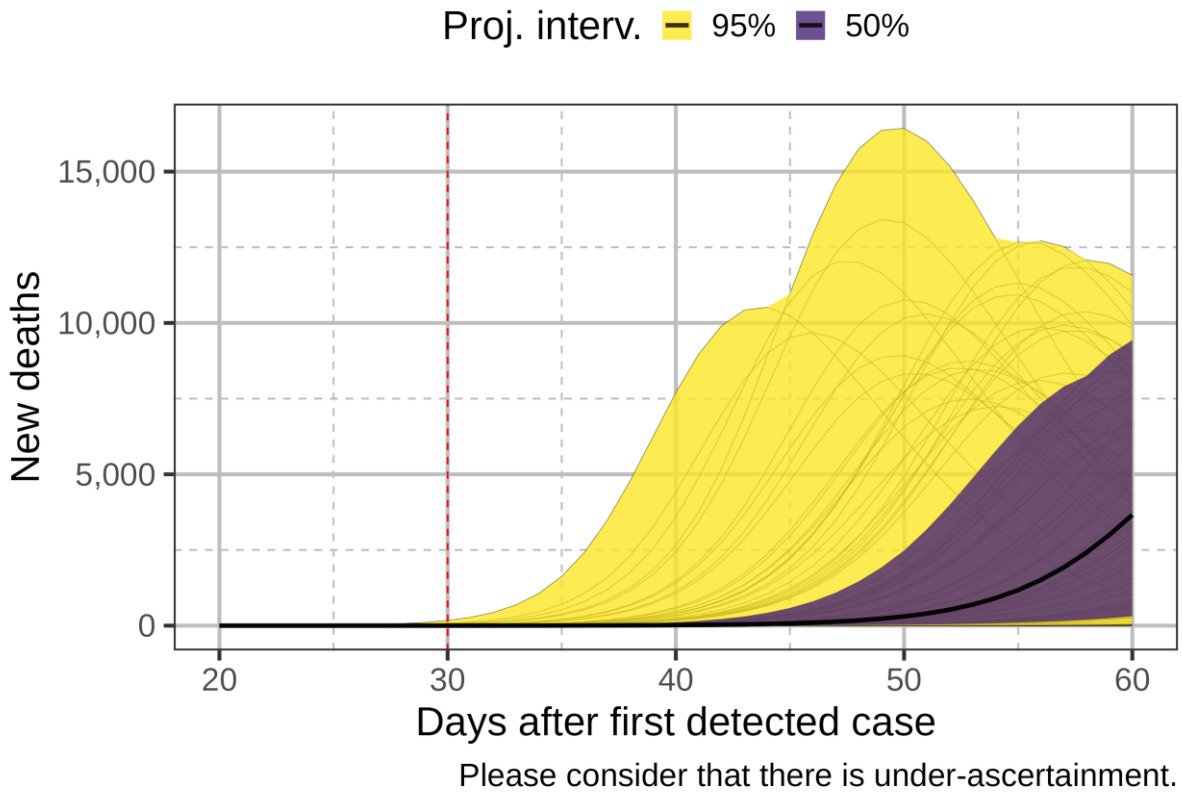


Figure 7: Cumulative detected cases and deaths (by day 60)

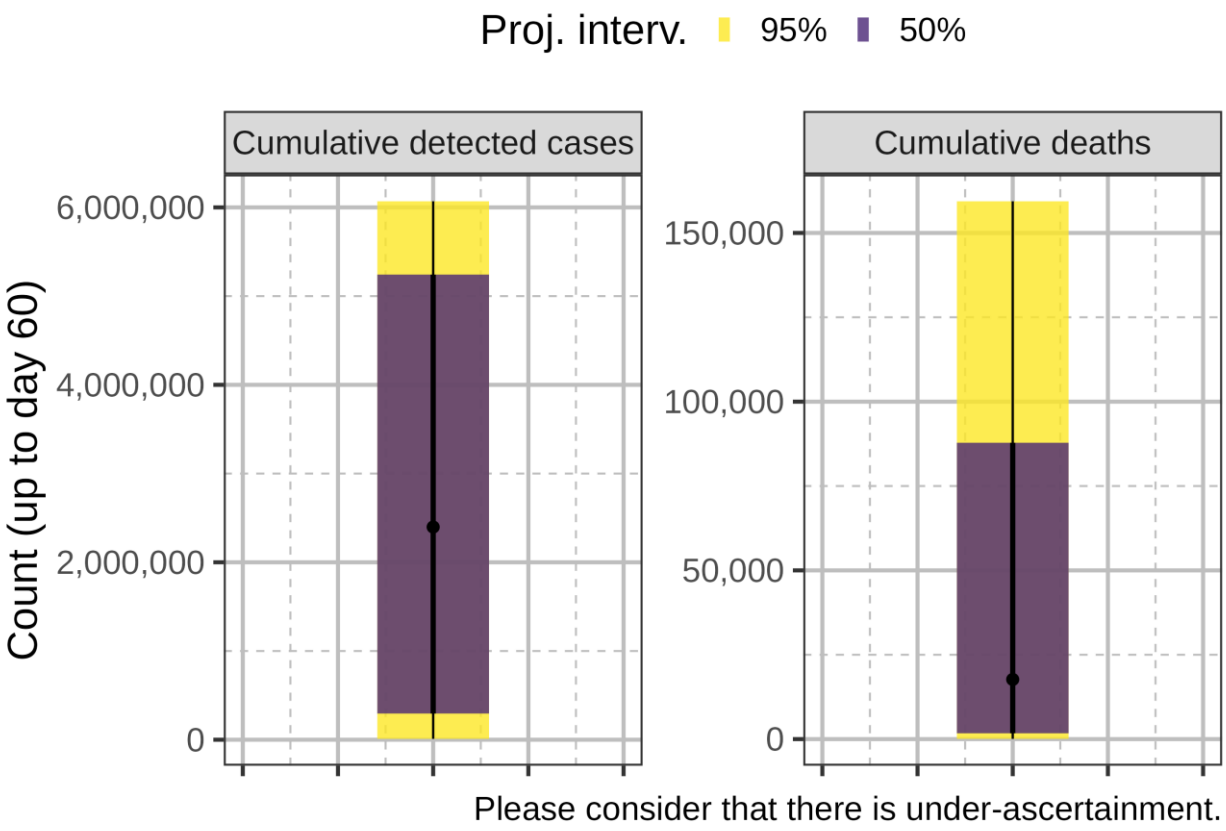


Figure 8: Cumulative deaths by age group (by day 60)

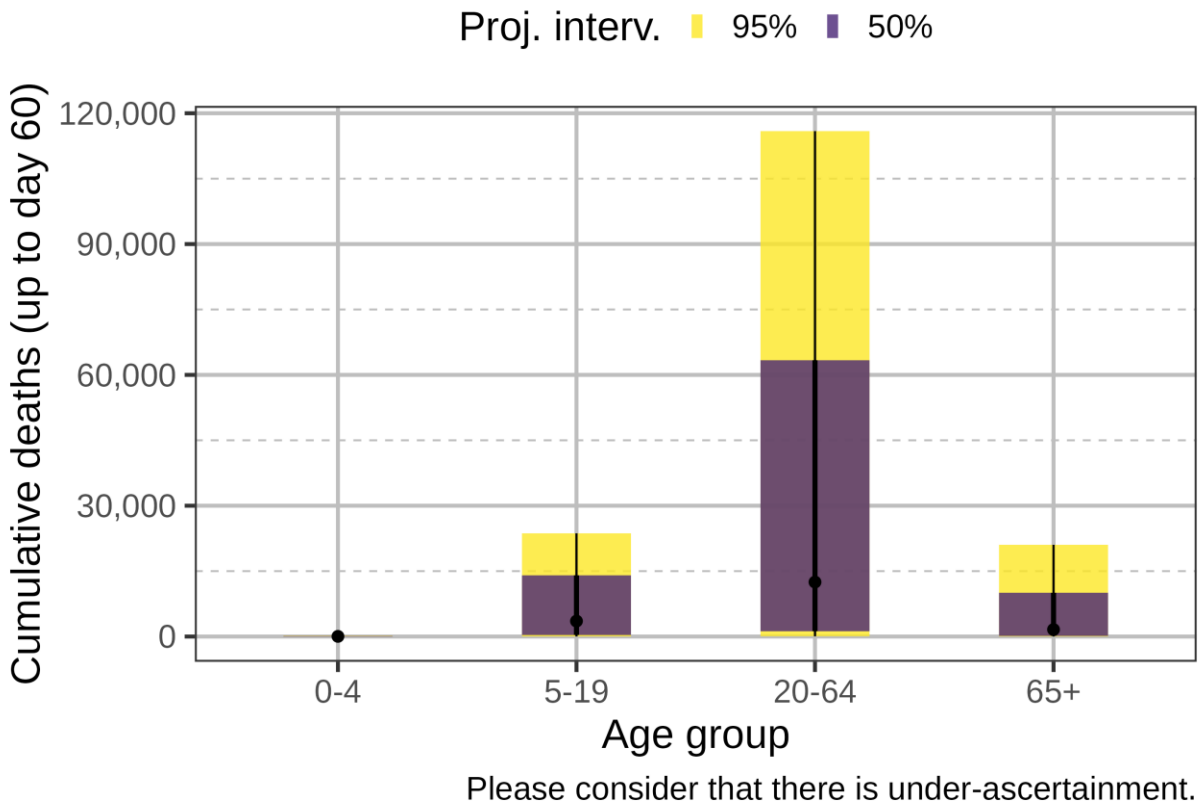
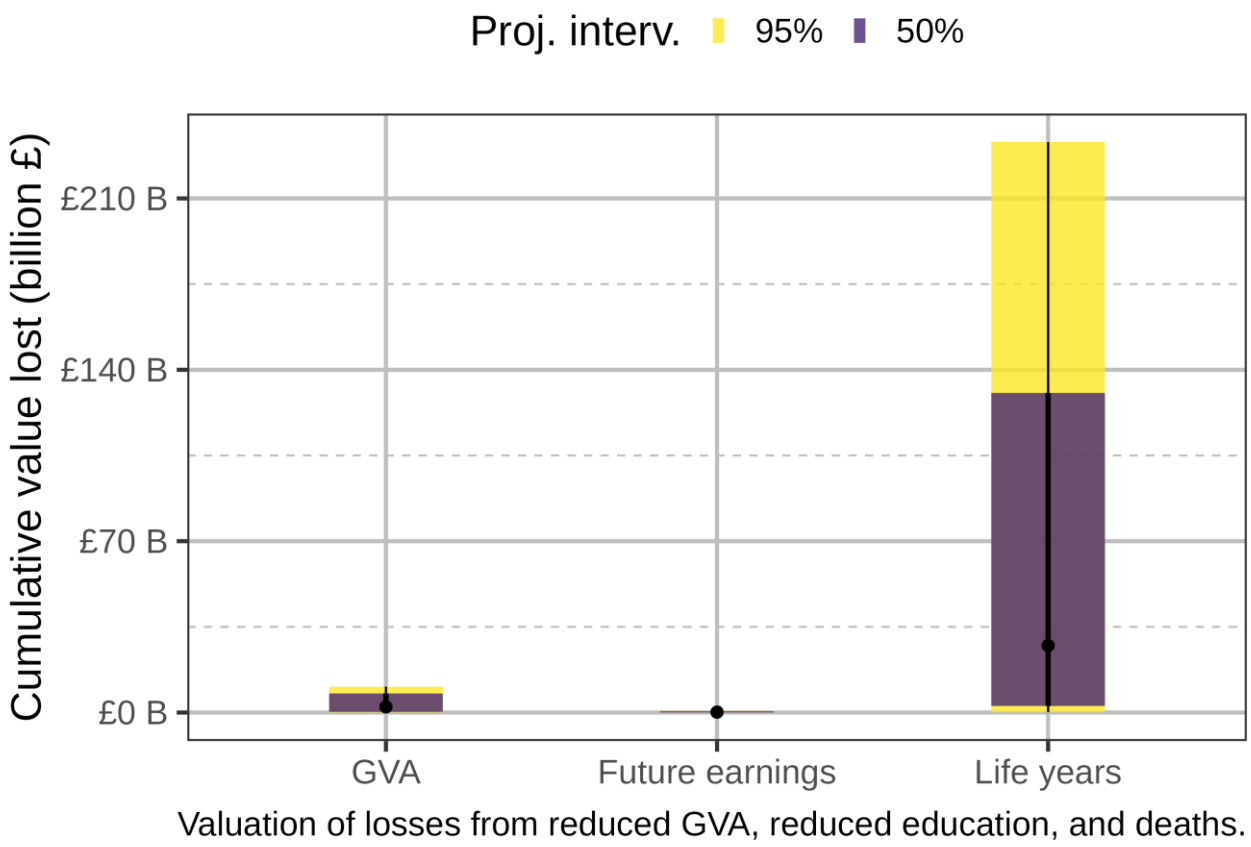


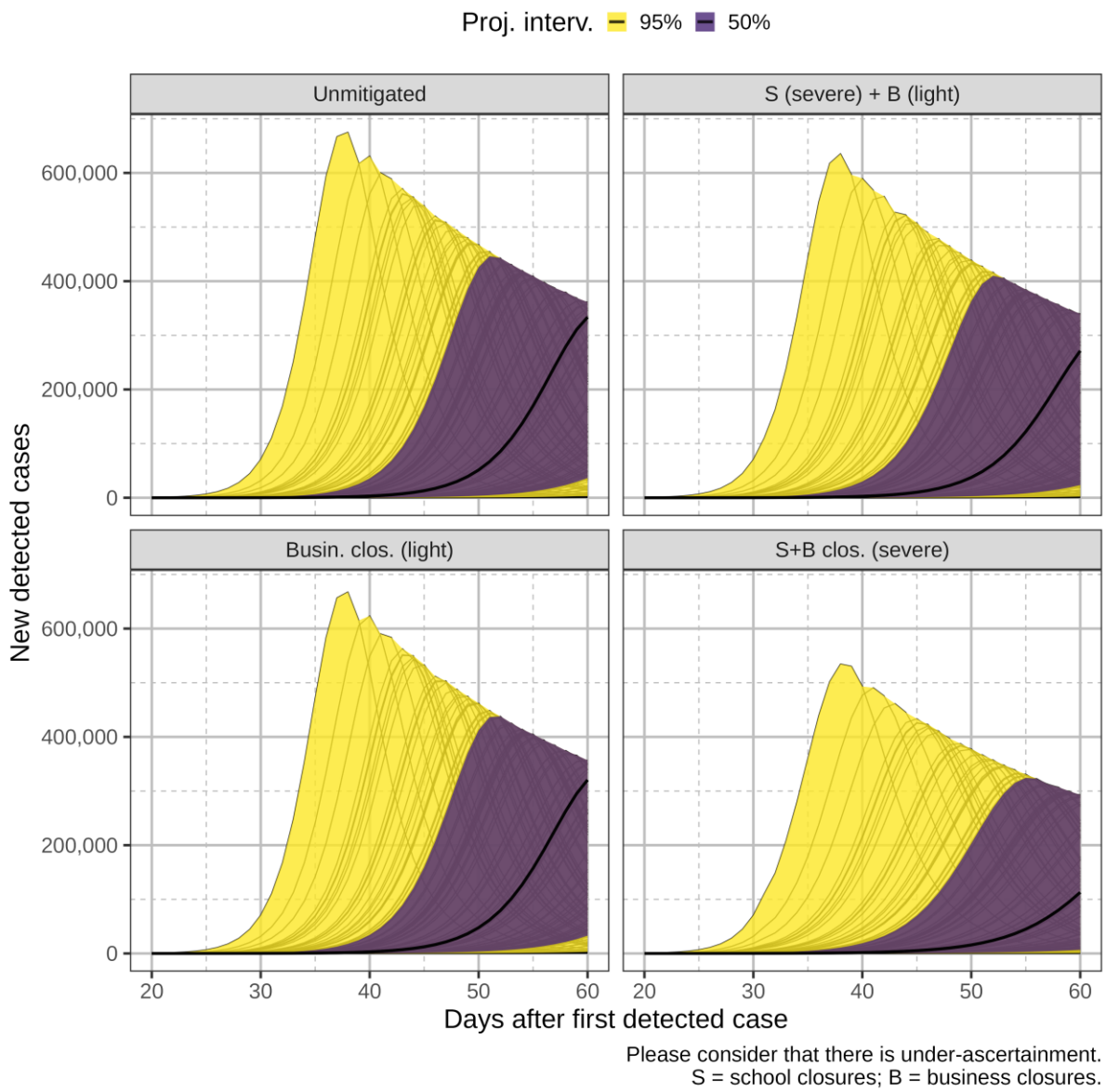
Figure 9: Cumulative economic losses (by day 60)



Note: Lost life years are valued in monetary terms with a value-of-a-statistical life approach (mean VSL = 1.68 million GBP)

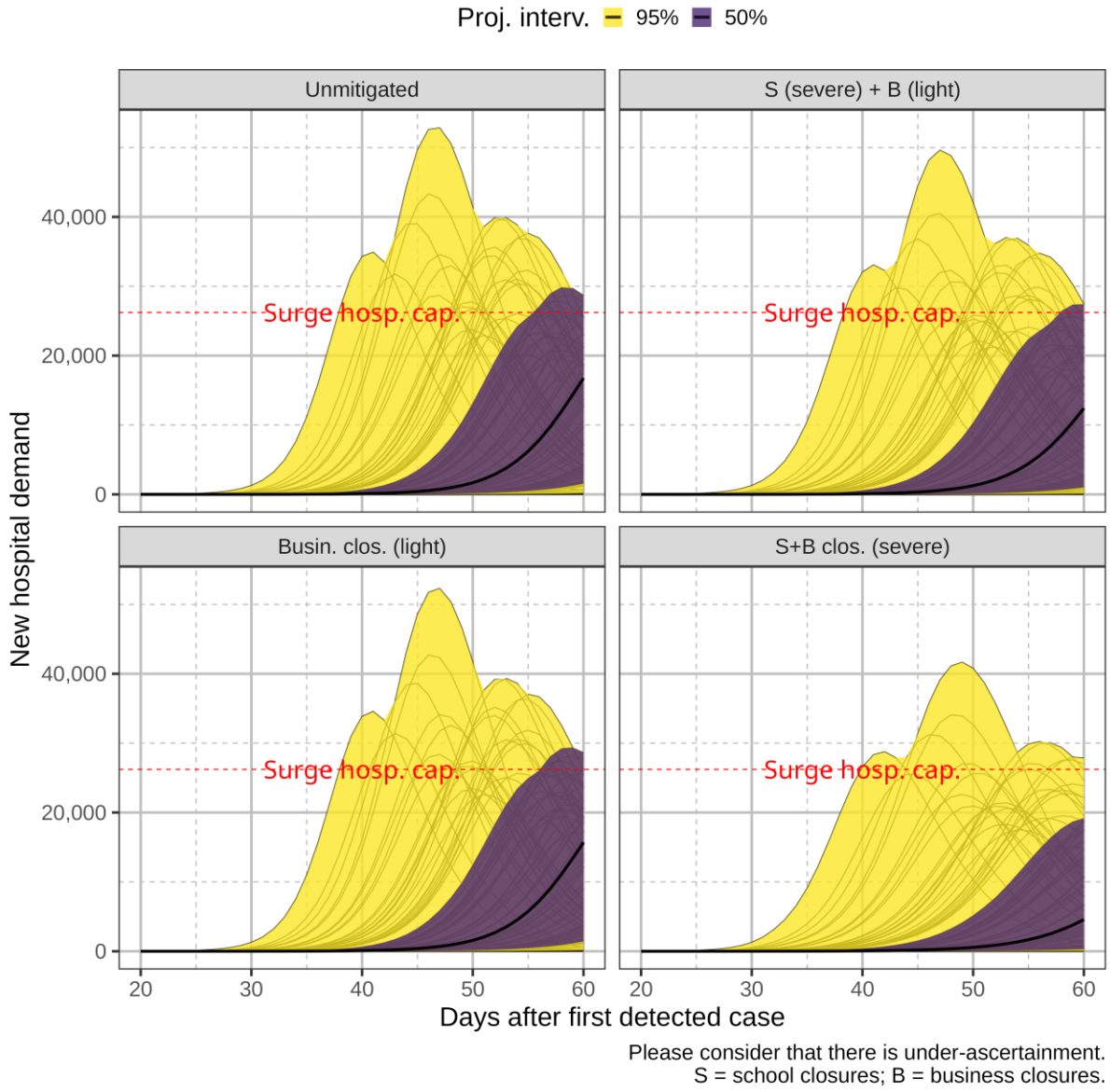
Projected epidemic outcomes under mitigation (Figures 10-18)

Figure 10: Daily new detected cases



Unmitigated = No closures
S (severe) + B (light) = School closures (severe) + business closures (light)
Busin. clos. (light) = Business closures (light)
S + B (severe) = School and business closures (severe)

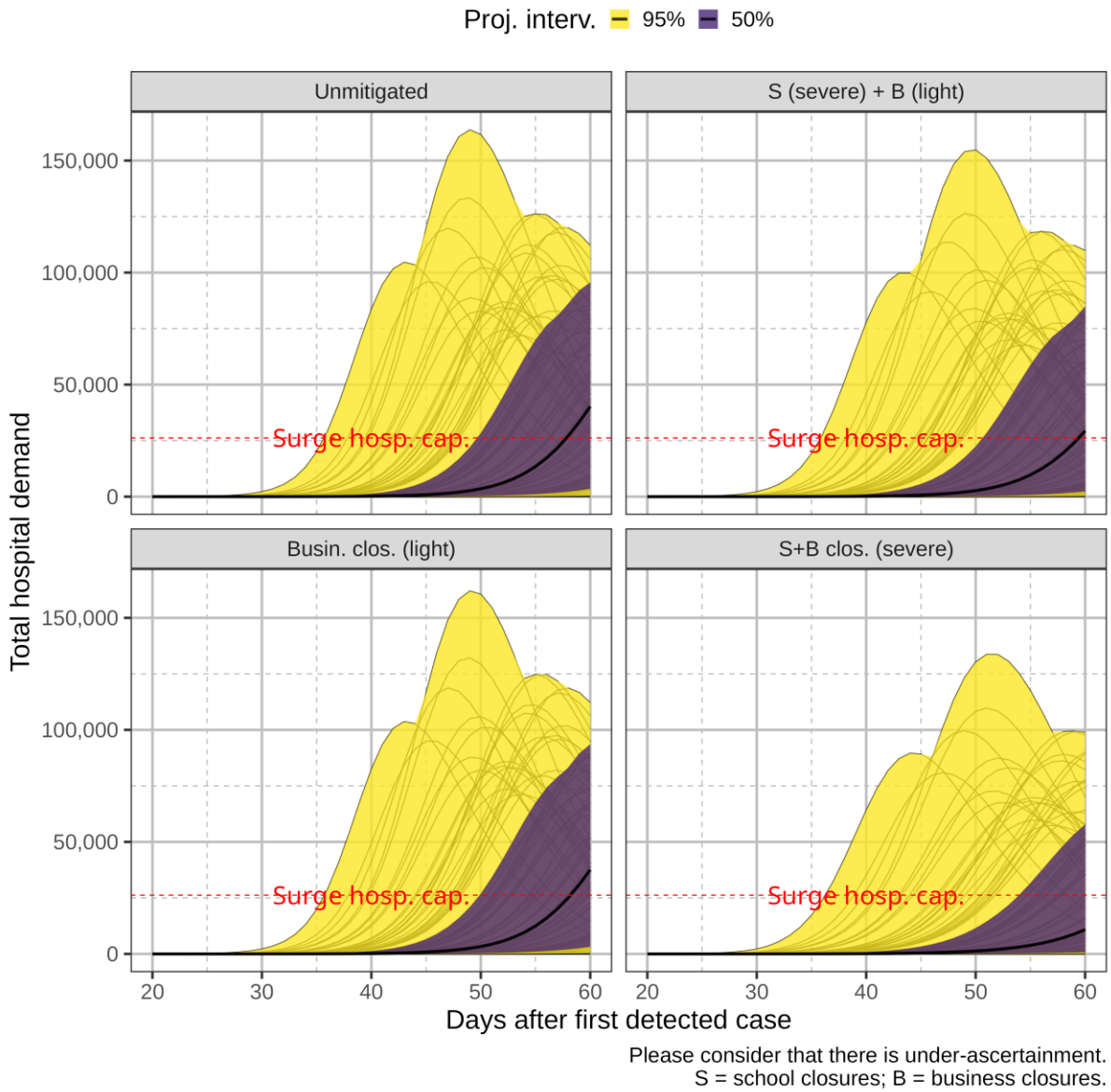
Figure 11: Daily new hospital demand (admissions)



Note: red line indicates surge hospital capacity when cancelling all elective surgeries

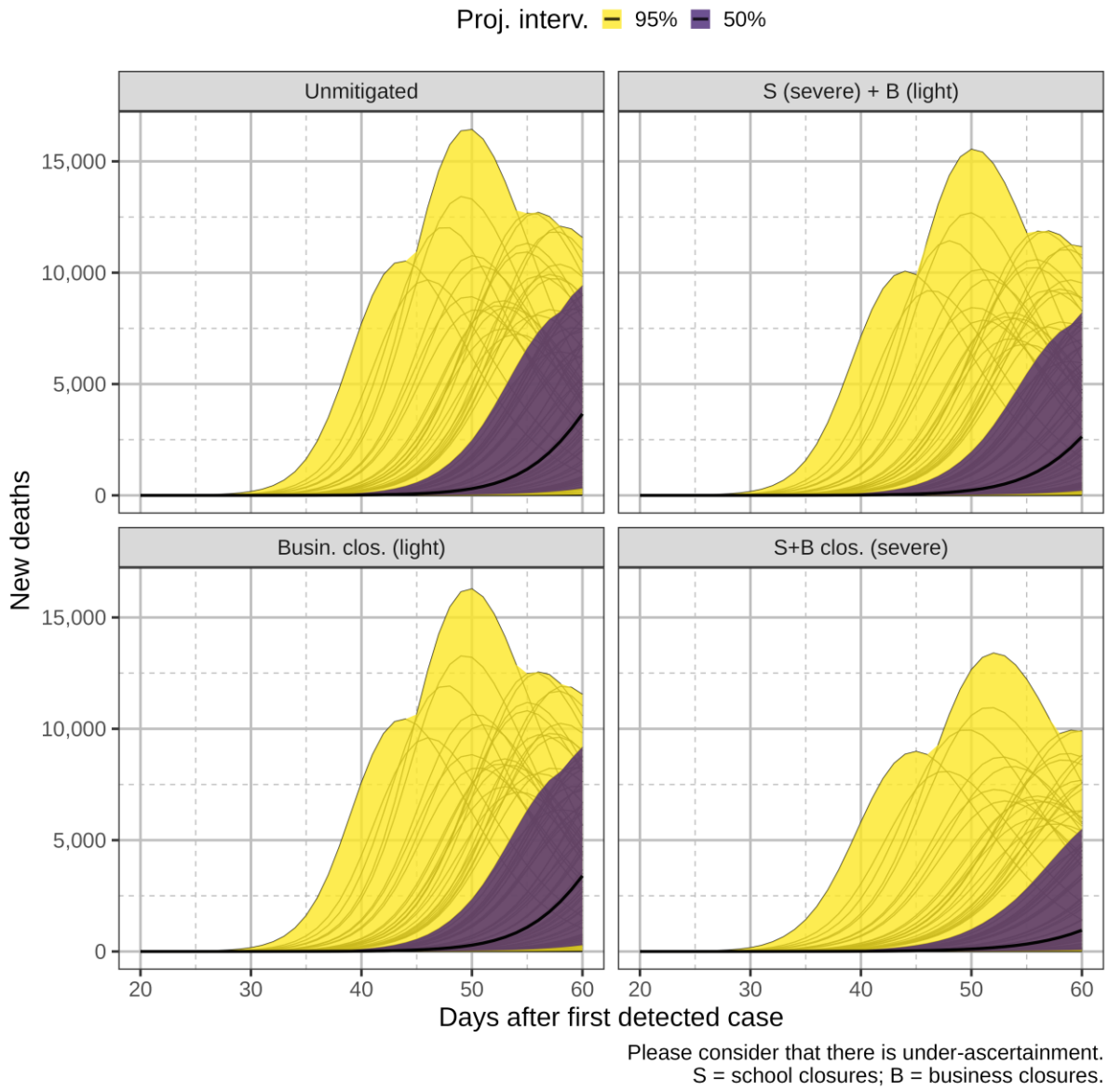
Unmitigated = No closures
S (severe) + B (light) = School closures (severe) + business closures (light)
Busin. clos. (light) = Business closures (light)
S + B (severe) = School and business closures (severe)

Figure 12: Total hospital demand (occupancy)



Unmitigated = No closures
S (severe) + B (light) = School closures (severe) + business closures (light)
Busin. clos. (light) = Business closures (light)
S + B (severe) = School and business closures (severe)

Figure 13: Daily deaths



Unmitigated = No closures
S (severe) + B (light) = School closures (severe) + business closures (light)
Busin. clos. (light) = Business closures (light)
S + B (severe) = School and business closures (severe)

Figure 14: Cumulative detected cases and deaths (by day 60)

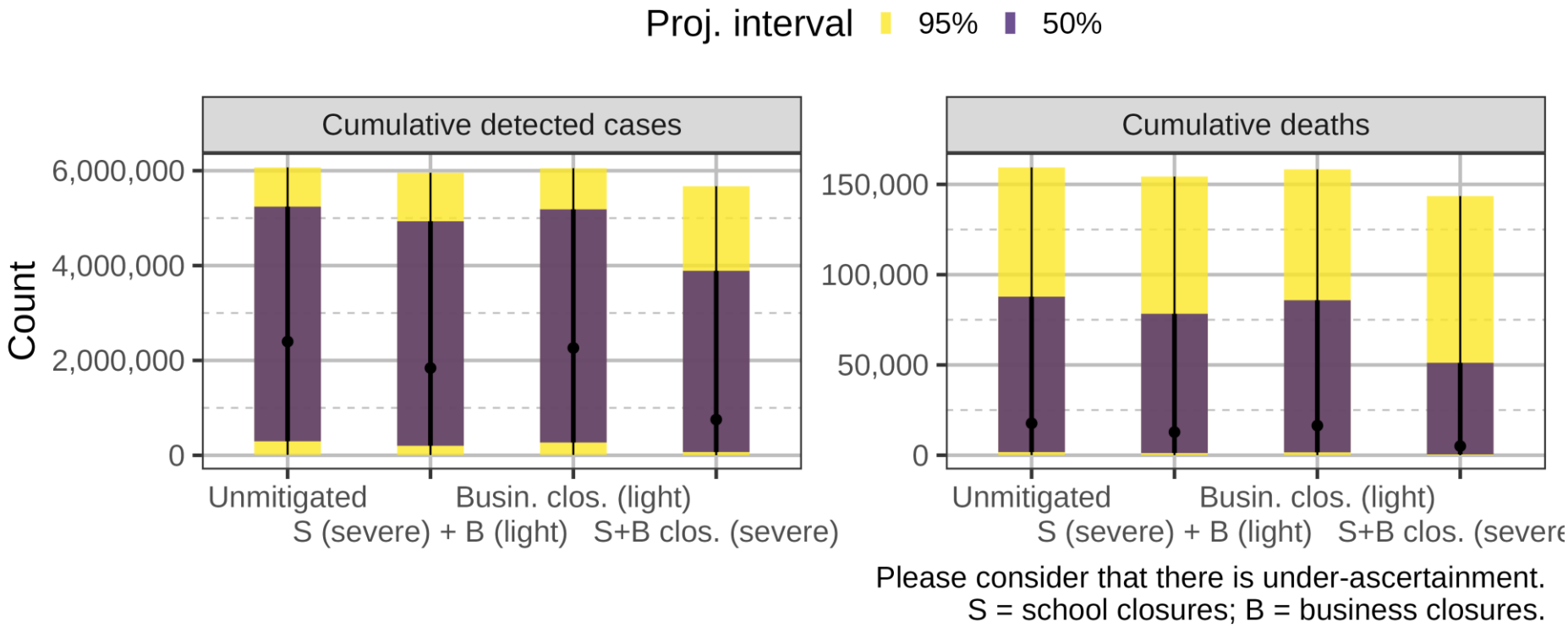


Figure 15: Cumulative deaths by age group (by day 60)

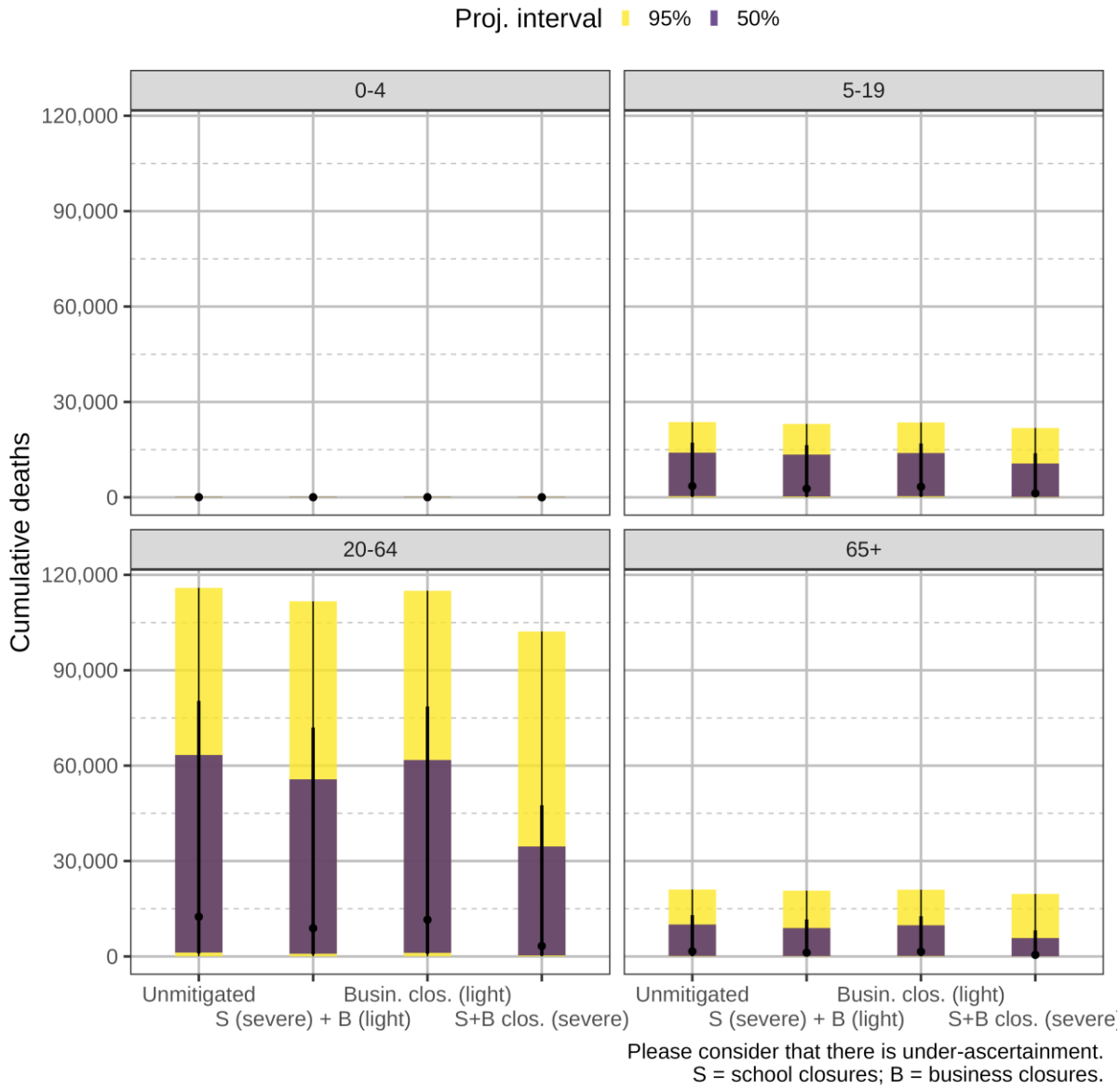
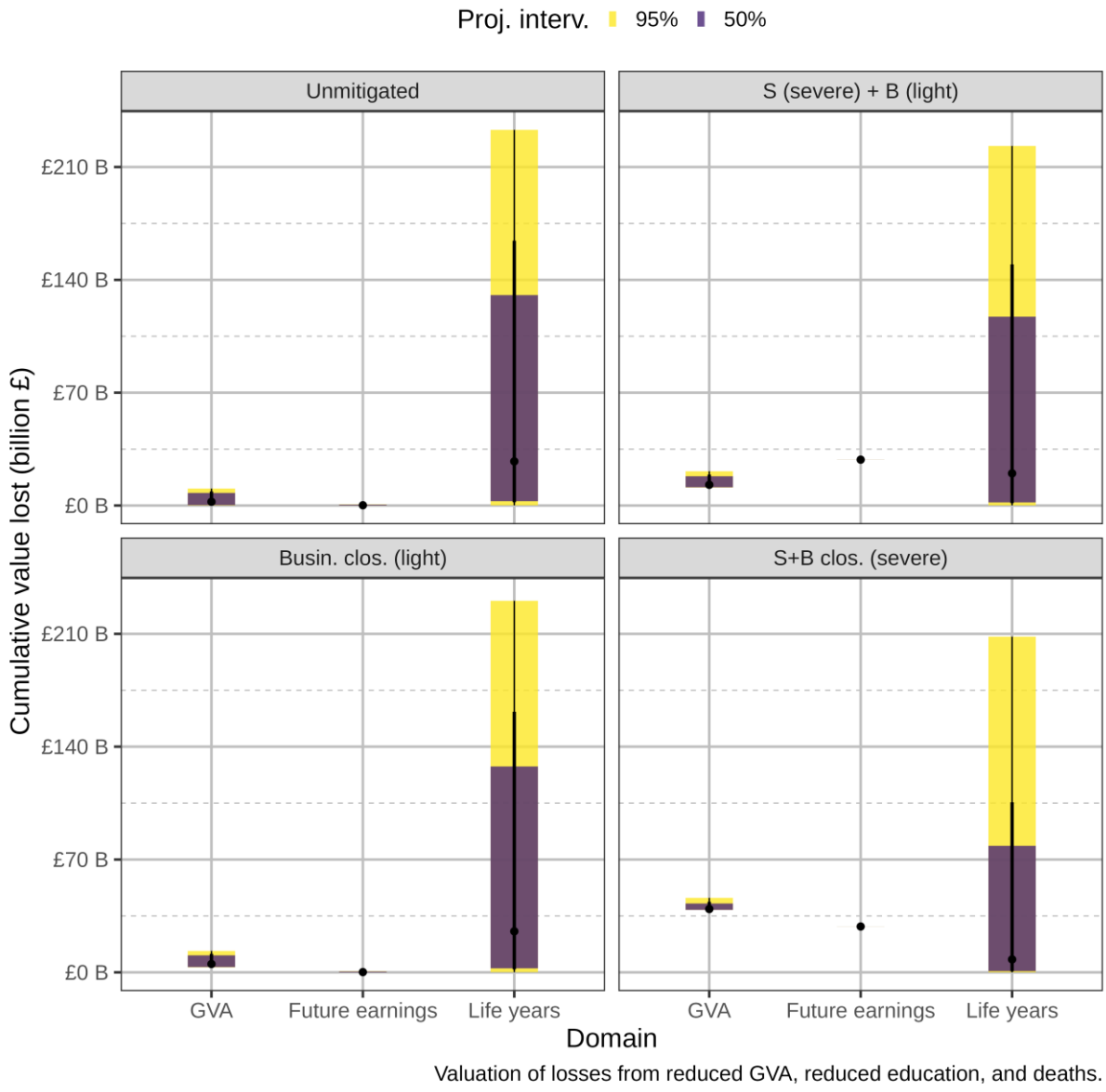
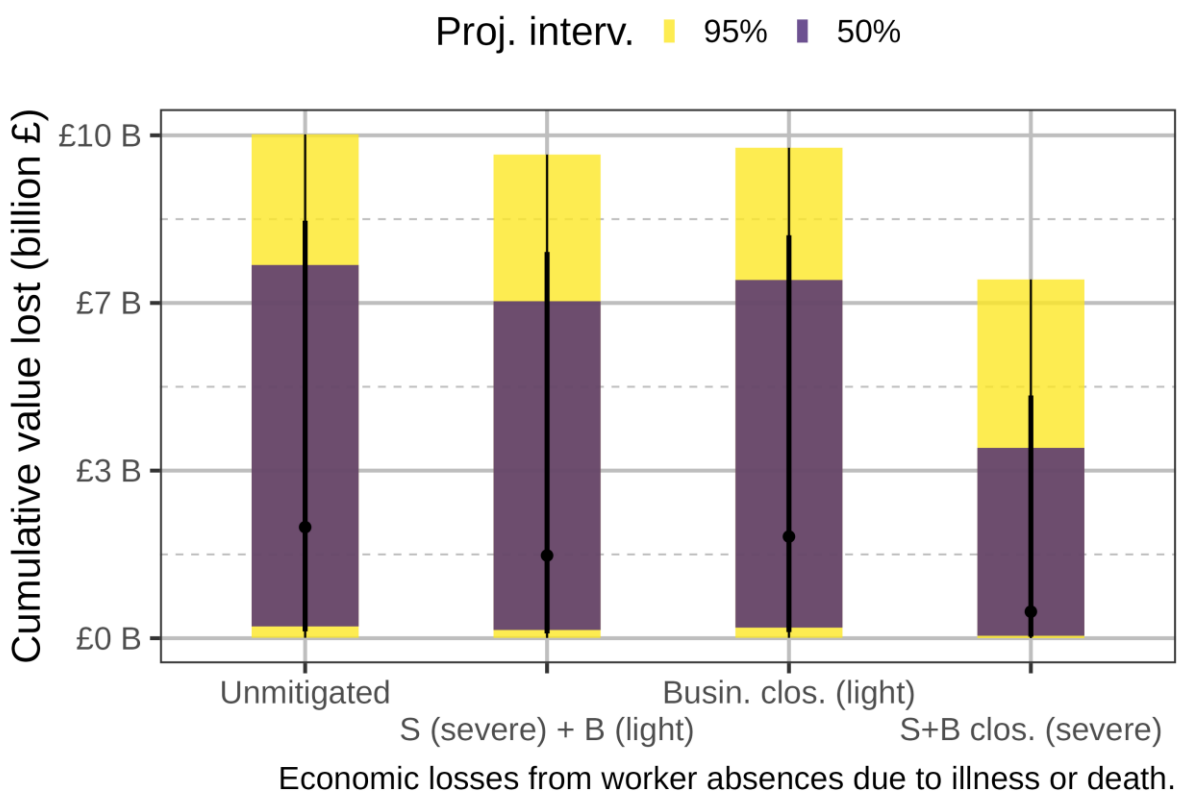


Figure 16: Cumulative economic losses (by day 60)



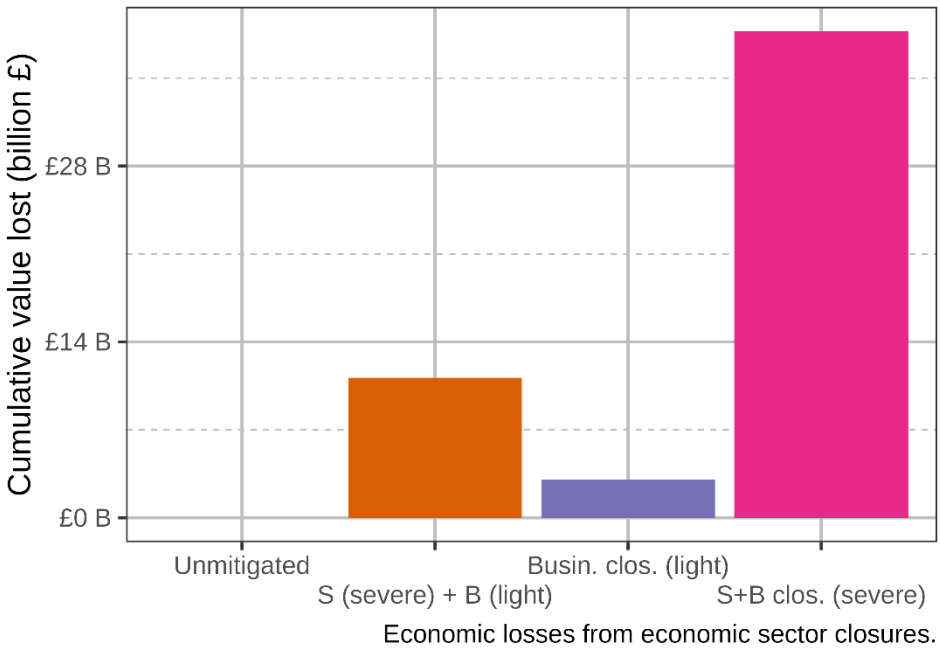
Note: Lost life-years are valued in monetary terms with a Value-of-a-statistical life approach (mean VSL = 1.68 million GBP).

Figure 17: Cumulative economic losses due to absences (by day 60)



Note: Aggregate over three types of economic losses

Figure 18: Cumulative economic losses due to closures (by day 60)



Section III: Additional decision-making aids:

Table 2: Gross Value Added (GVA) and workplace contacts for each economic sector*

Industry/Sector	Daily GVA (GBP million)	Workplace
D68: Real estate activities	659.9	6.2
D45T47: Wholesale and retail trade; repair of motor vehicles	510.5	6.2
D69T75: Professional, scientific and technical activities	375.6	4.6
D86T88: Human health and social work activities	367.9	5.9
D64T66: Financial and insurance activities	330.8	4.8
D41T43: Construction	315.2	2.8
D85: Education	277.6	8.8
D77T82: Administrative and support services	257.7	4.9
D84: Public administration and defence; compulsory social security	240.1	5.0
D62T63: IT and other information services	150.7	3.4
D55T56: Accommodation and food service activities	143.9	6.8
D61: Telecommunications	87.7	4.0
D94T96: Other service activities	87	3.4
D58T60: Publishing, audiovisual and broadcasting activities	82.7	5.1
D90T93: Arts, entertainment and recreation	78.6	6.0
D10T12: Food products, beverages and tobacco	76.9	3.9
D49: Land transport and transport via pipelines	74.3	4.4
D35: Electricity, gas, steam and air conditioning supply	69.3	3.8
D36T39: Water supply; sewerage, waste management and remediation activities	62.2	4.2
D52: Warehousing and support activities for transportation	60.4	5.1
D05T06: Mining and quarrying, energy producing products	46.8	1.6
D31T33: Manufacturing nec; repair and installation of machinery and equipment	46.6	4.0
D29: Motor vehicles, trailers and semi-trailers	43.6	4.3
D28: Machinery and equipment, nec	41.2	3.8
D25: Fabricated metal products	40.8	3.6
D26: Computer, electronic and optical equipment	34.7	4.6
D21: Pharmaceuticals, medicinal chemical and botanical products	32.9	4.3
D30: Other transport equipment	31.3	3.7
D53: Postal and courier activities	30.9	5.5
D01T02: Agriculture, hunting, forestry	29.8	2.6

D20: Chemical and chemical products	29.1	3.4
D17T18: Paper products and printing	24.5	4.2
D22: Rubber and plastics products	20.3	4.1
D50: Water transport	17.8	3.1
D13T15: Textiles, textile products, leather and footwear	17.7	3.7
D97T98: Activities of households as employers; undifferentiated goods- and services-producing activities of households for own	14.8	3.3
D23: Other non-metallic mineral products	14.6	3.5
D51: Air transport	14.3	4.9
D27: Electrical equipment	12.3	4.2
D24: Basic metals	10.3	3.4
D16: Wood and products of wood and cork	7.5	2.9
D19: Coke and refined petroleum products	7.4	3.4
D07T08: Mining and quarrying, non-energy producing products	4.9	4.1
D09: Mining support service activities	3.2	3.4
D03: Fishing and aquaculture	1.3	3.0

* Restrictions on education are assumed to be equivalent to school closures.

Table 3: Percentage of runs for each response strategy in which hospital capacity is exceeded (by day 60)

Mitigation response strategy	Hospital capacity exceeded (percentile)
No closures (unmitigated)	59
School closures	54
Business closures	59
School and business closures	42

Tables 4-6: Median, 25th & 75th percentile of additional outcomes, by strategy

Table 4: Deaths by age group:

Mitigation response strategy	Age group	Median (50th percentile)	25th percentile	75th percentile
No closures (unmitigated)	0-4	39	4	119
No closures (unmitigated)	20-65	12489	1213	63358
No closures (unmitigated)	5-19	3543	357	14039
No closures (unmitigated)	65+	1607	150	10038
School closures (severe) + business closures (light)	0-4	30	3	116
School closures (severe) + business closures (light)	20-65	8869	843	55699
School closures (severe) + business closures (light)	5-19	2716	266	13436
School closures (severe) + business closures (light)	65+	1187	110	8931
Business closures (light)	0-4	37	4	119
Business closures (light)	20-65	11539	1113	61778
Business closures (light)	5-19	3331	332	13916

Business closures (light)	65+	1497	140	9797
School and business closures (severe)	0-4	14	1	99
School and business closures (severe)	20-65	3282	312	34584
School and business closures (severe)	5-19	1258	122	10635
School and business closures (severe)	65+	498	47	5781

Table 5: Domain-specific costs (in millions GBP):

Mitigation response strategy	**Cost domain**	**Median (50th percentile)**	**25th percentile**	**75th percentile**
No closures (unmitigated)	Economic	2319	247	7792
No closures (unmitigated)	Education	171	18	532
No closures (unmitigated)	Life years	27384	2690	130541
School closures	Economic	12861	11306	18170
School closures	Education	28449	28436	28485
School closures	Life years	19955	1914	117176
Business closures	Economic	5178	3276	10535
Business closures	Education	162	17	527
Business closures	Life years	25450	2480	127736
School and business closures	Economic	39282	38778	42701
School and business closures	Education	28440	28435	28474
School and business closures	Life years	8032	768	78516

Table 6: Breakdown of economic costs due to closures and absences (in millions GBP):

Mitigation response strategy	Cost type	Median (50th percentile)	25th percentile	75th percentile
No closures (unmitigated)	Closures	0	0	0
No closures (unmitigated)	Absences	2319	247	7792
School closures	Closures	11134	11134	11134
School closures	Absences	1728	172	7036
Business closures	Closures	3055	3055	3055
Business closures	Absences	2123	221	7480
School and business closures	Closures	38727	38727	38727
School and business closures	Absences	555	51	3974

Section IV: Slido access

There will be a few opportunities during the simulation exercise to ask clarification questions via Slido – an online Q&A platform.

To access slido, you can scan the QR code or use the link below.

QR code:

Link:
https://app.sli.do/event/dJ3gx92wT3onmW5xXSx8of