Empowering the crowd: Feasible strategies to minimize the spread of COVID-19 in IDP camps in NW Syria

Dr. Alberto Pascual-García, PhD, ETH-Zürich (Switzerland)
Dr. Eduard Campillo-Funollet, PhD, Univ. of Sussex (UK)
Jordan Klein, Mph, Princeton Univ. (USA)
Dr. Jennifer Villers, PhD, Princeton Univ. (USA)
Chamsy Sarkis, Pax Syriana Foundation

August 21th, 2020

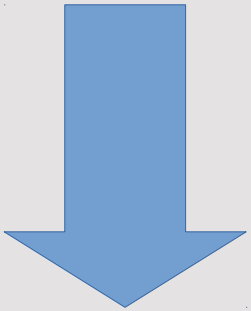
PaxSyriana Foundation

crowdfight COVID-19

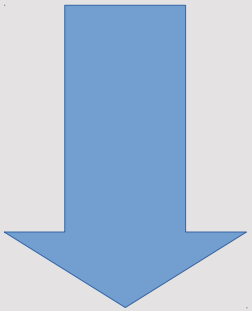
PaxSyriana Foundation

crowdfight COVID-19

PaxSyriana Foundation



crowdfight COVID-19



SCIENTISTS

AIM

Identify feasible interventions:

– Immediate applicability

– No need of complex technical infrastructure (e.g. testing, protection)

– Cost: as low as possible

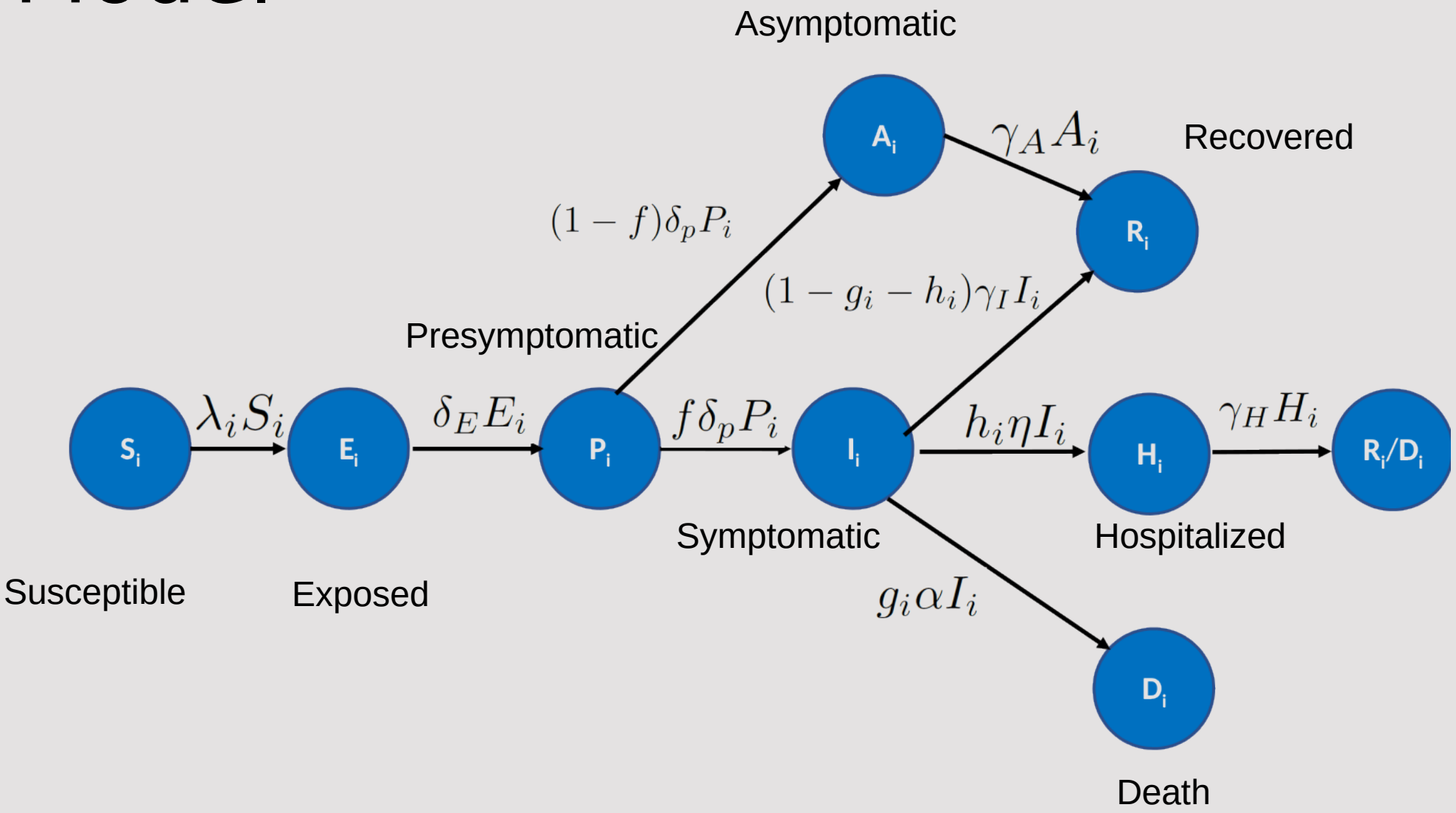
The model

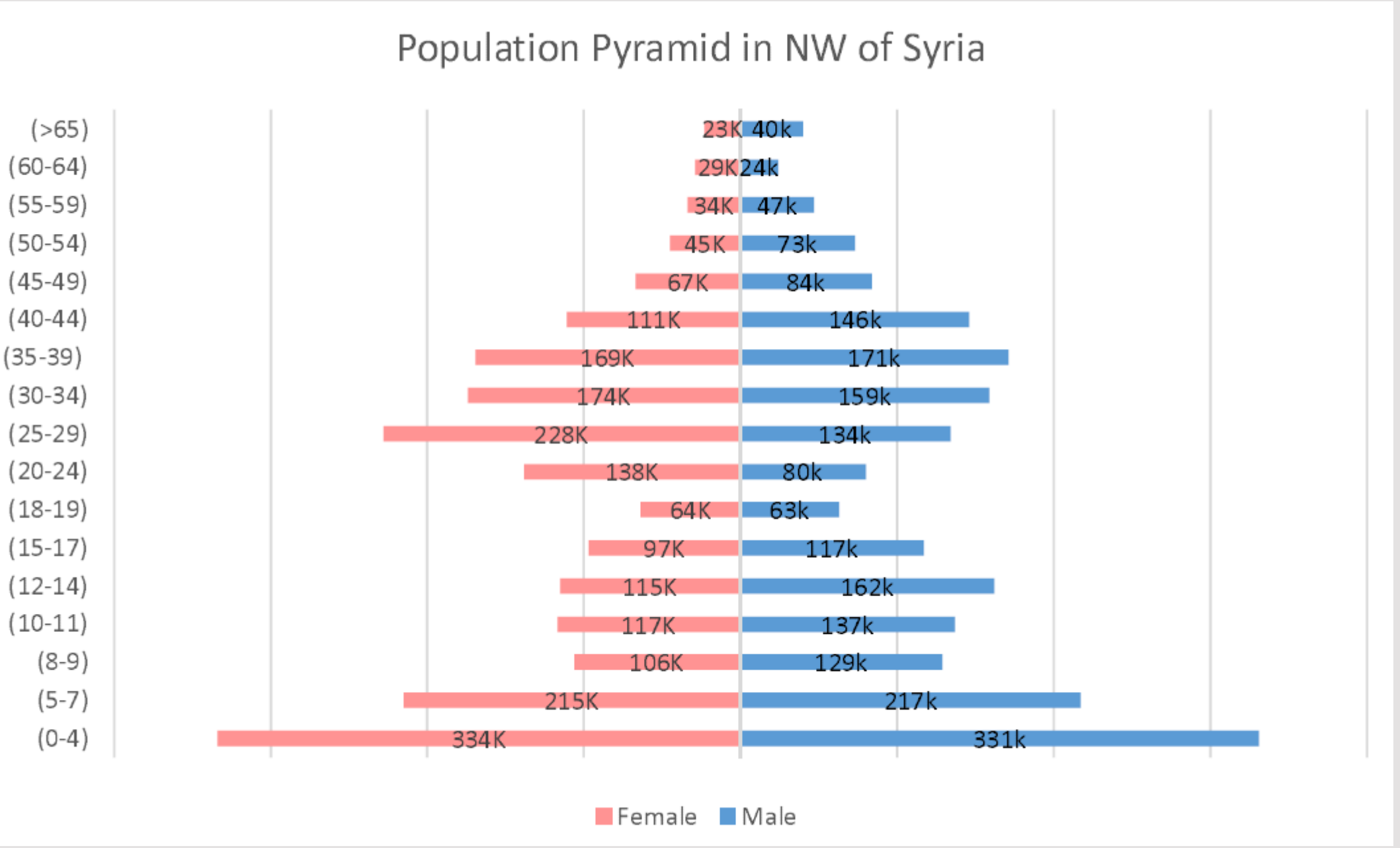
Outlook

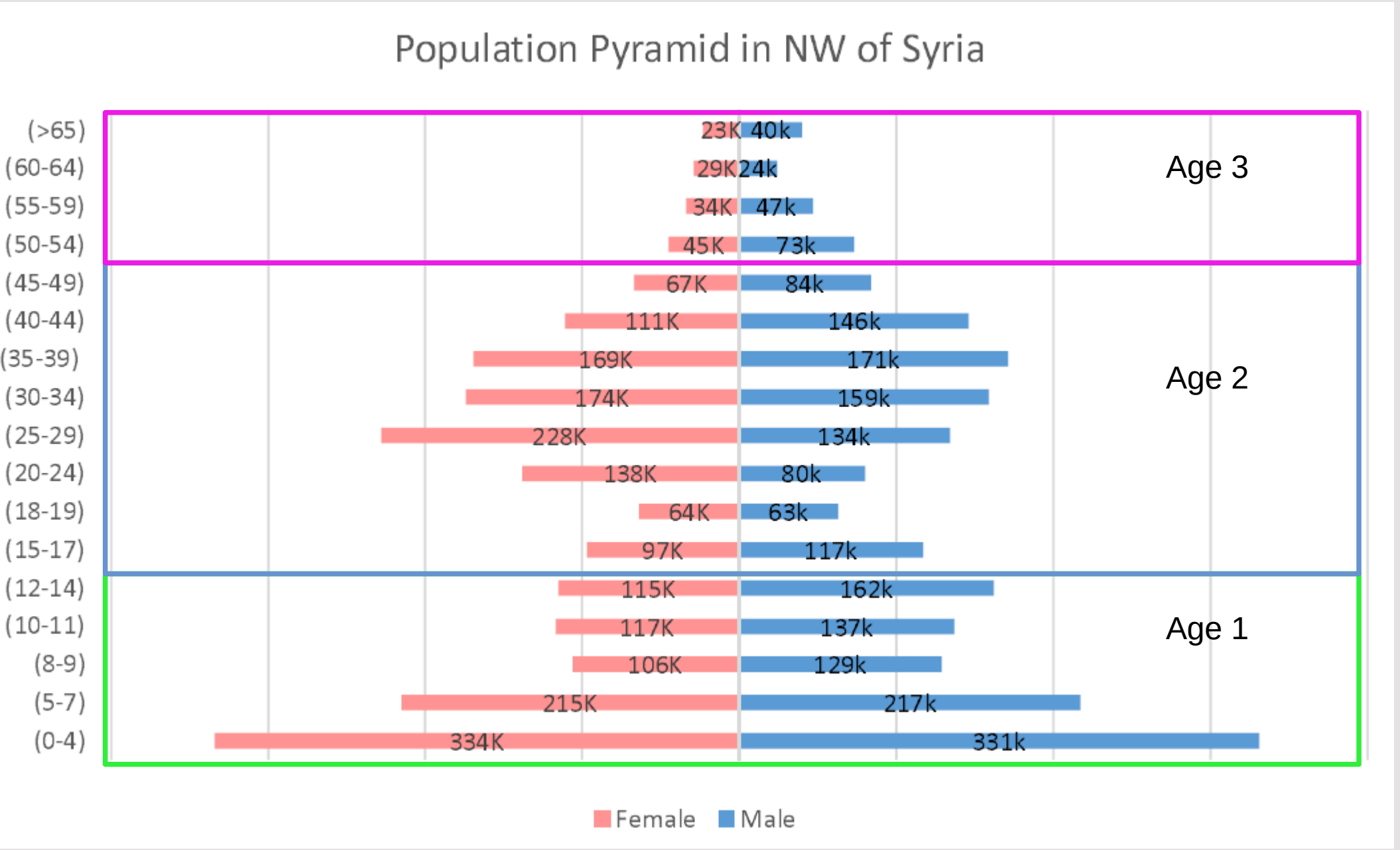
Modelling

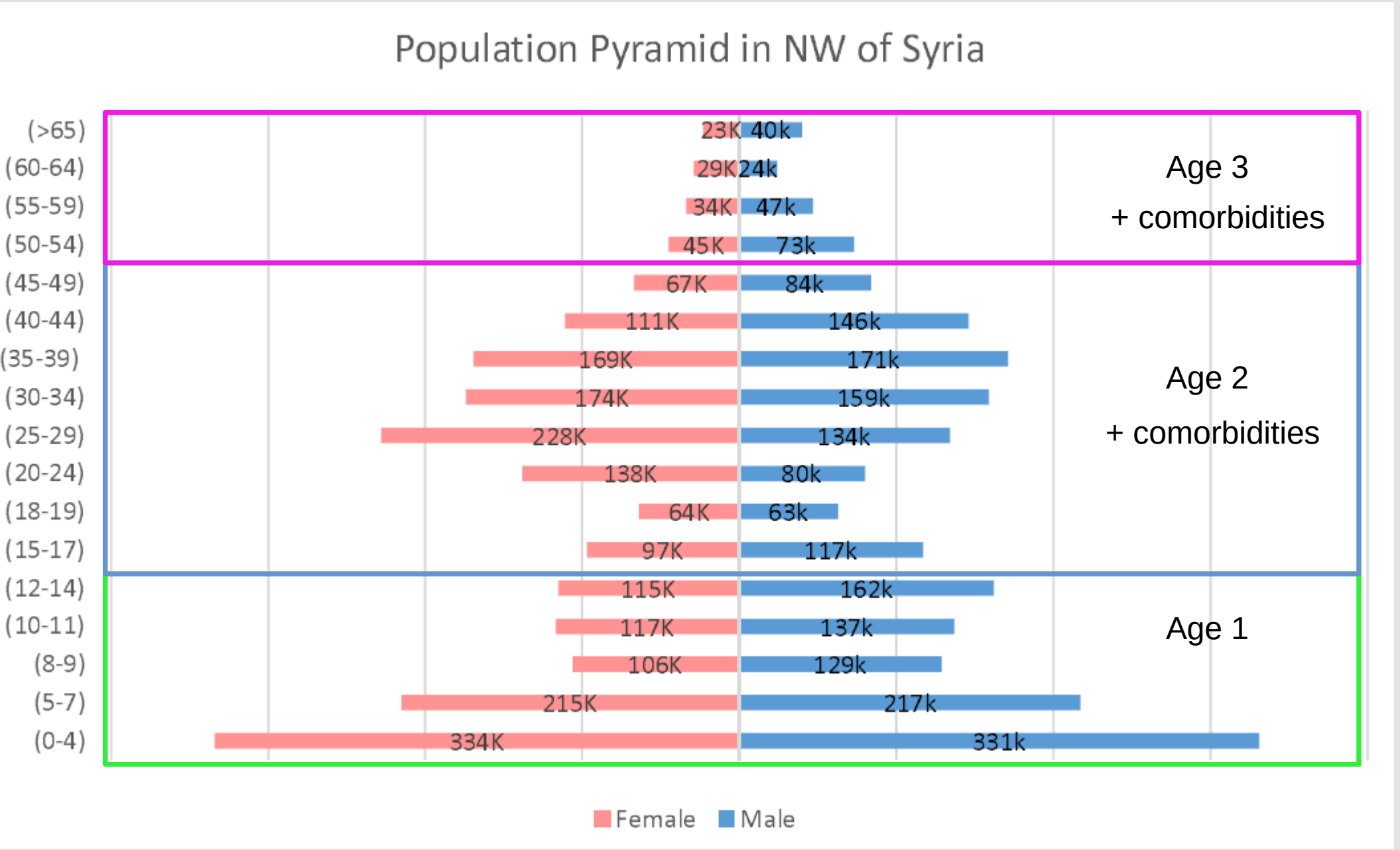
- Compartment models.
- Age-structured.
- Deterministic and stochastic simulations.
- Parameters estimated for IDPCs.

Model


Asymptomatic
A_i
$\gamma_A A_i$
Recovered
R_i
$(1-f)\delta_p P_i$
$(1-g_i-h_i)\gamma_I I_i$
Presymptomatic
S_i
$\lambda_i S_i$
E_i
$\delta_E E_i$
P_i
$f\delta_p P_i$
I_i
$h_i \eta I_i$
H_i
$\gamma_H H_i$
R_i/D_i
Symptomatic
Hospitalized
Susceptible
Exposed
$g_i \alpha I_i$
D_i
Death


Population Pyramid in NW of Syria
(>65)
(60-64)
(55-59)
(50-54)
(45-49)
(40-44)
(35-39)
(30-34)
(25-29)
(20-24)
(18-19)
(15-17)
(12-14)
(10-11)
(8-9)
(5-7)
(0-4)
23K
40k
29K
24k
34K
47k
45K
73k
67K
84k
111K
146k
169K
171k
174K
159k
228K
134k
138K
80k
64K
63k
97K
117k
115K
162k
117K
137k
106K
129k
215K
217k
334K
331k
Female
Male


Population Pyramid in NW of Syria
(>65)
(60-64)
(55-59)
(50-54)
(45-49)
(40-44)
(35-39)
(30-34)
(25-29)
(20-24)
(18-19)
(15-17)
(12-14)
(10-11)
(8-9)
(5-7)
(0-4)
23K
40k
29K
24k
34K
47k
45K
73k
67K
84k
111K
146k
169K
171k
174K
159k
228K
134k
138K
80k
64K
63k
97K
117k
115K
162k
117K
137k
106K
129k
215K
217k
334K
331k
Age 3
Age 2
Age 1
Female
Male


Population Pyramid in NW of Syria
(>65)
(60-64)
(55-59)
(50-54)
(45-49)
(40-44)
(35-39)
(30-34)
(25-29)
(20-24)
(18-19)
(15-17)
(12-14)
(10-11)
(8-9)
(5-7)
(0-4)
23K
40k
29K
24k
34K
47k
45K
73k
67K
84k
111K
146k
169K
171k
174K
159k
228K
134k
138K
80k
64K
63k
97K
117k
115K
162k
117K
137k
106K
129k
215K
217k
334K
331k
Age 3
+ comorbidities
Age 2
+ comorbidities
Age 1
Female
Male

The results

Outlook

Modelling

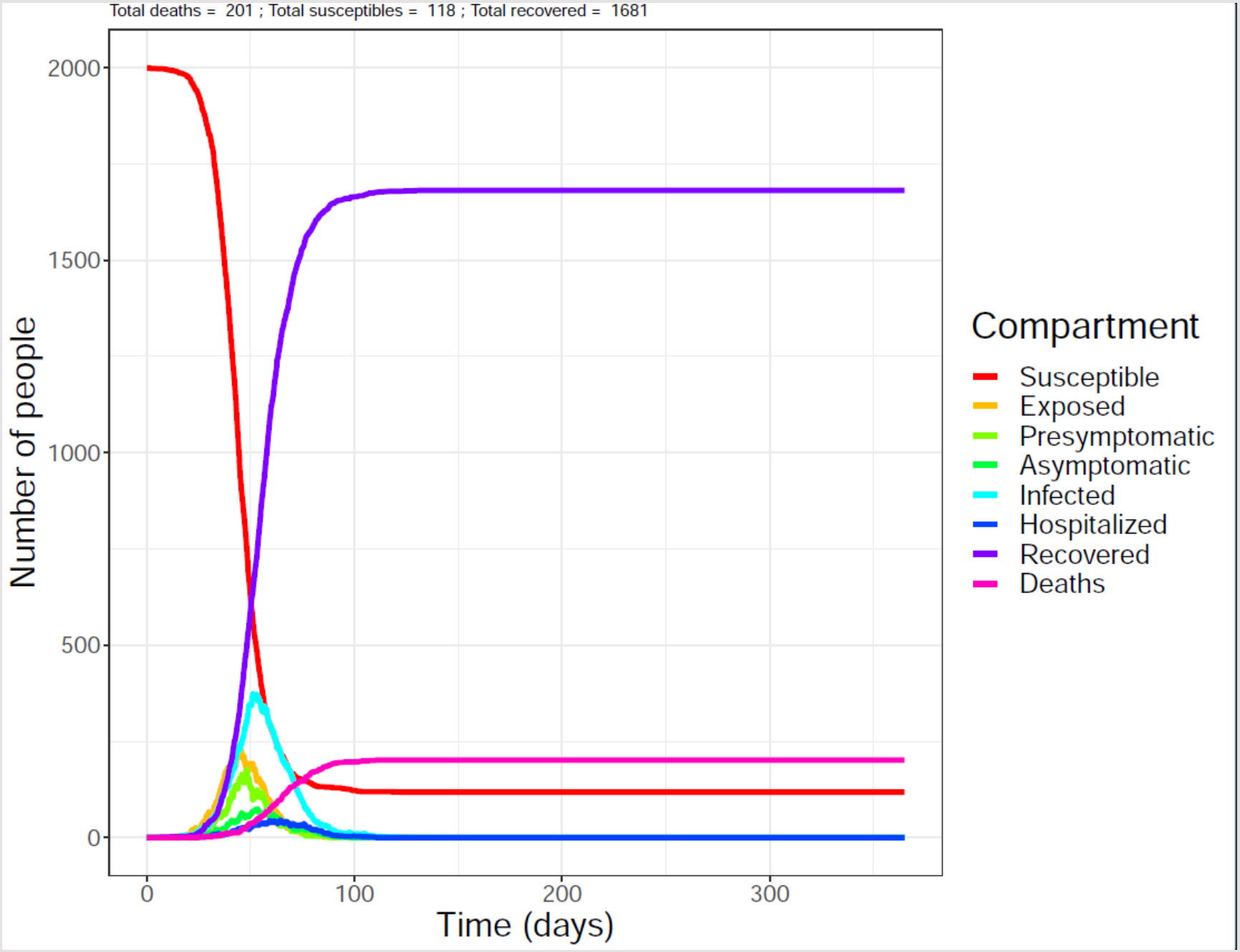
~70 different interventions modelled

~100K different simulations.

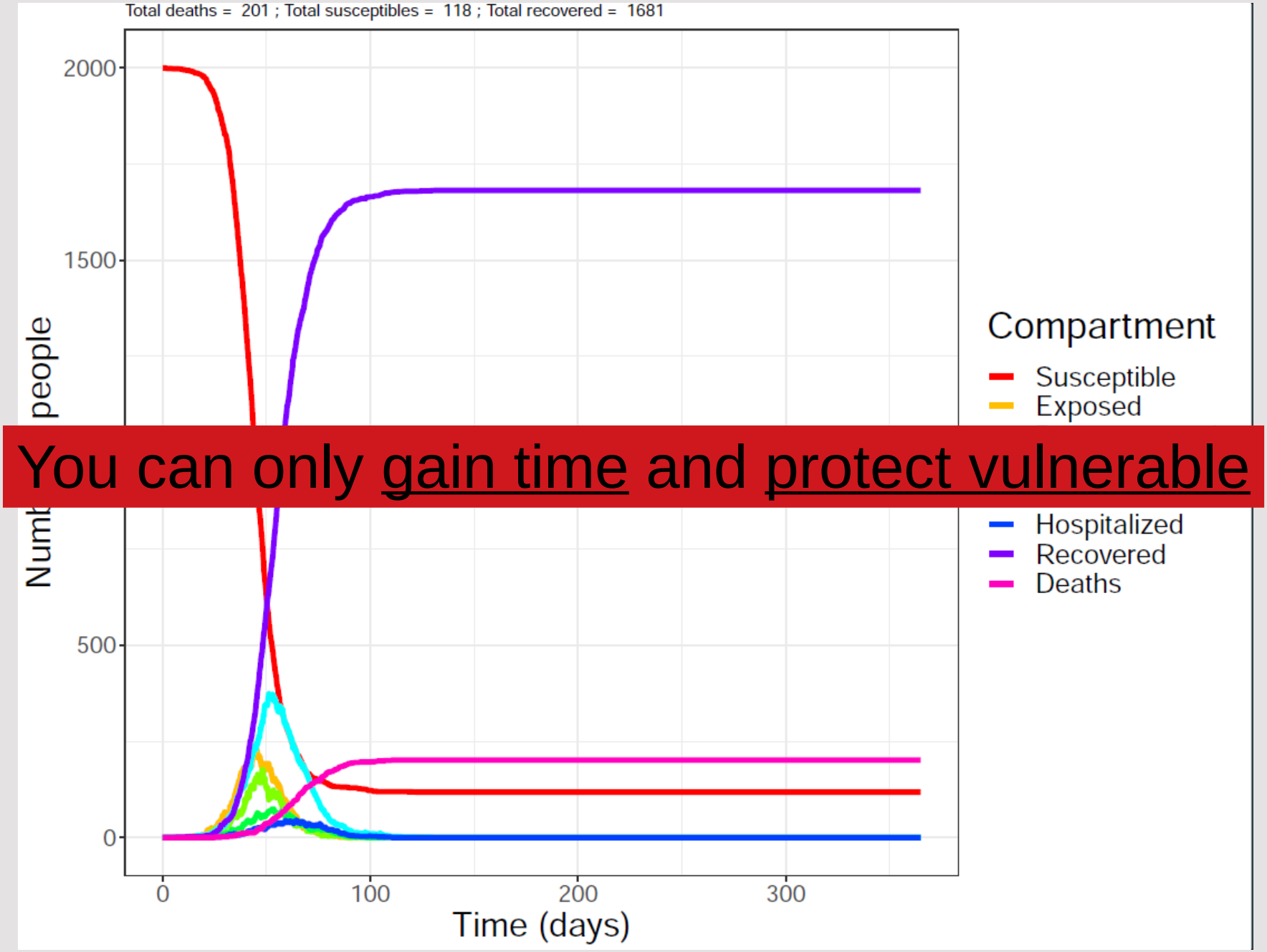
Strategies

- Self-distancing
- Shielding, lockdown
- Self-isolation
- Evacuation
- Combined strategies

Model


Total deaths = 201 ; Total susceptibles = 118 ; Total recovered = 1681
Number of people
2000
1500
1000
500
0
0
100
200
300
Time (days)
Compartment
Susceptible
Exposed
Presymptomatic
Asymptomatic
Infected
Hospitalized
Recovered
Deaths

Model



You can only gain time and protect vulnerable

No intervention: spread like wildfire

- Probability of general outbreak in the camp 80%

No intervention: spread like wildfire

- Probability of general outbreak in the camp 80%
- 10% of the population in the camp will die

No intervention: spread like wildfire

- Probability of general outbreak in the camp 80%
- 10% of the population in the camp will die
- For 1000 camps means 100K individuals dying

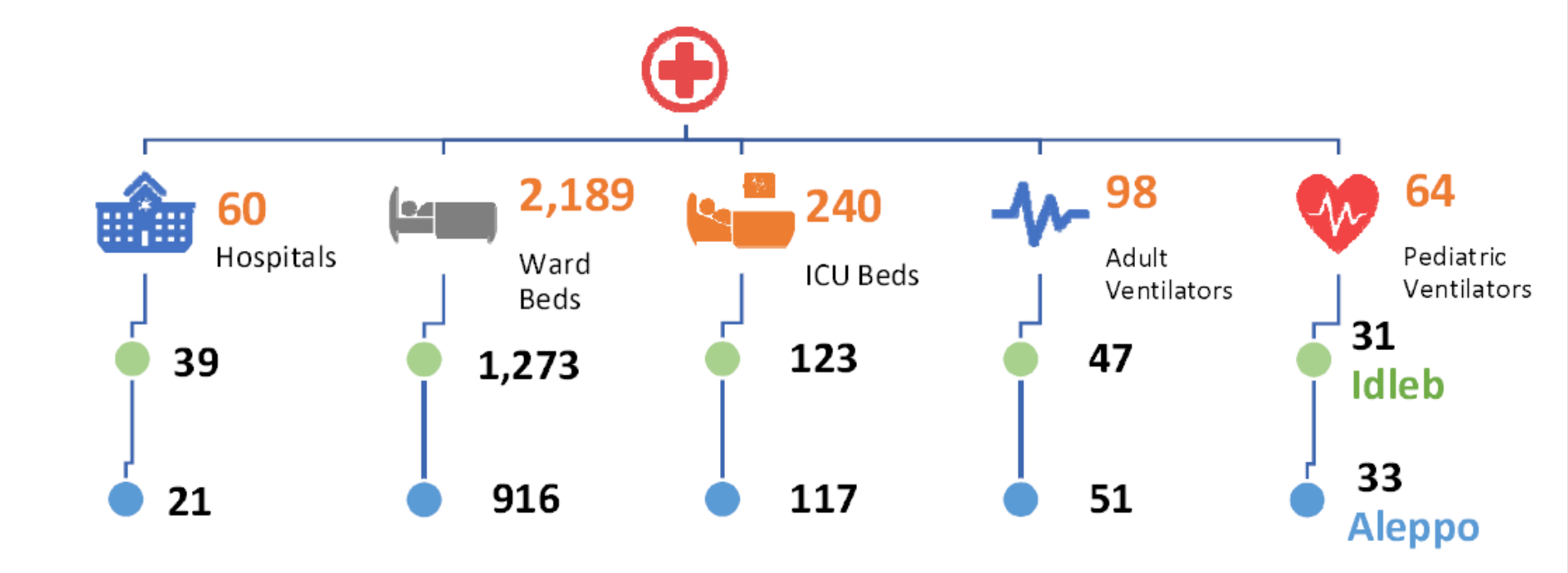
No intervention: spread like wildfire

- Probability of general outbreak in the camp 80%
- 10% of the population in the camp will die
- For 1000 camps means 100K individuals dying
- Maximum of infections in 60 days

No intervention: spread like wildfire

- Probability of general outbreak in the camp 80%
- 10% of the population in the camp will die
- For 1000 camps means 100K individuals dying
- Maximum of infections in 60 days
- At that time, 60K people may have required healthcare.

Hospitalization capacity



Hariri et al. The COVID-19 forecast in NW Syria. *MedRxiv* (2020)

Hospitalization capacity

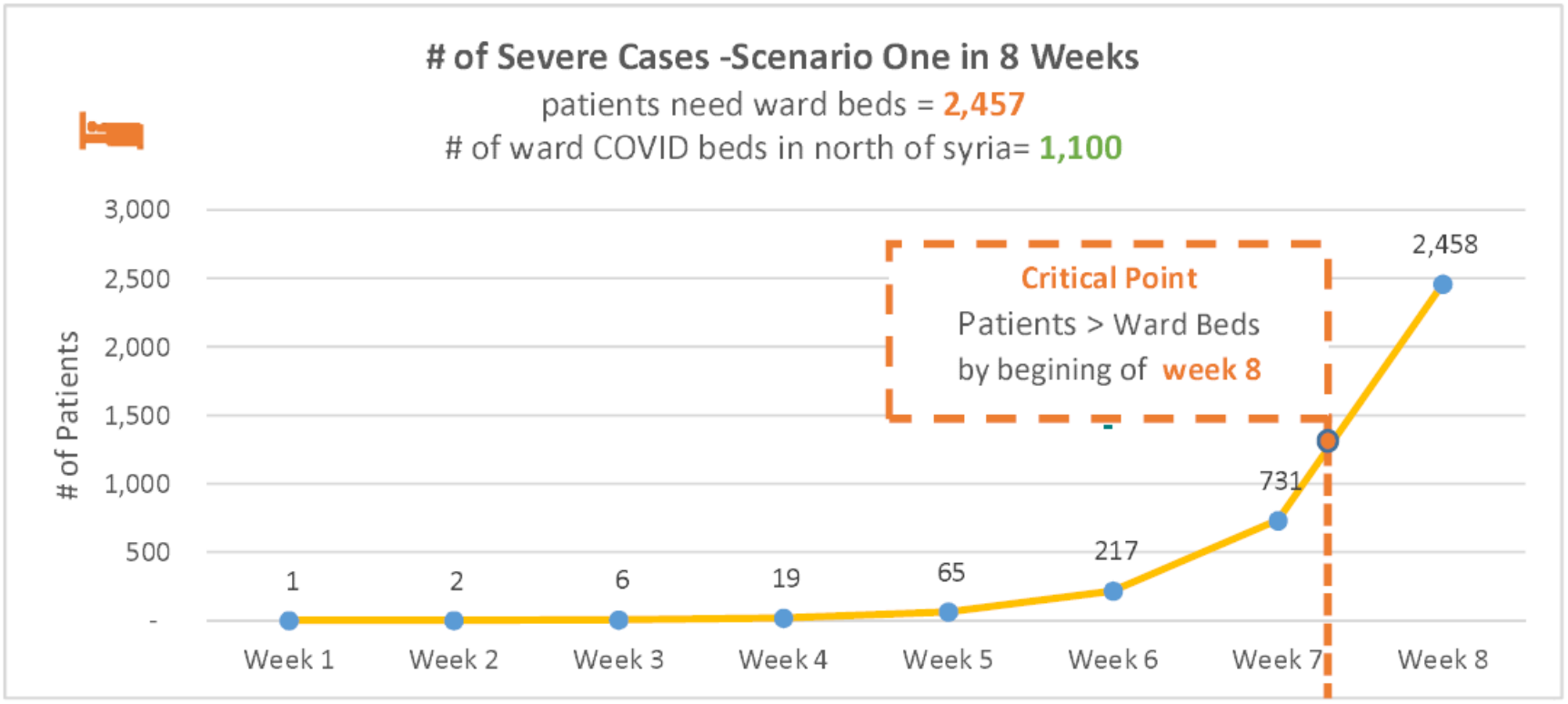
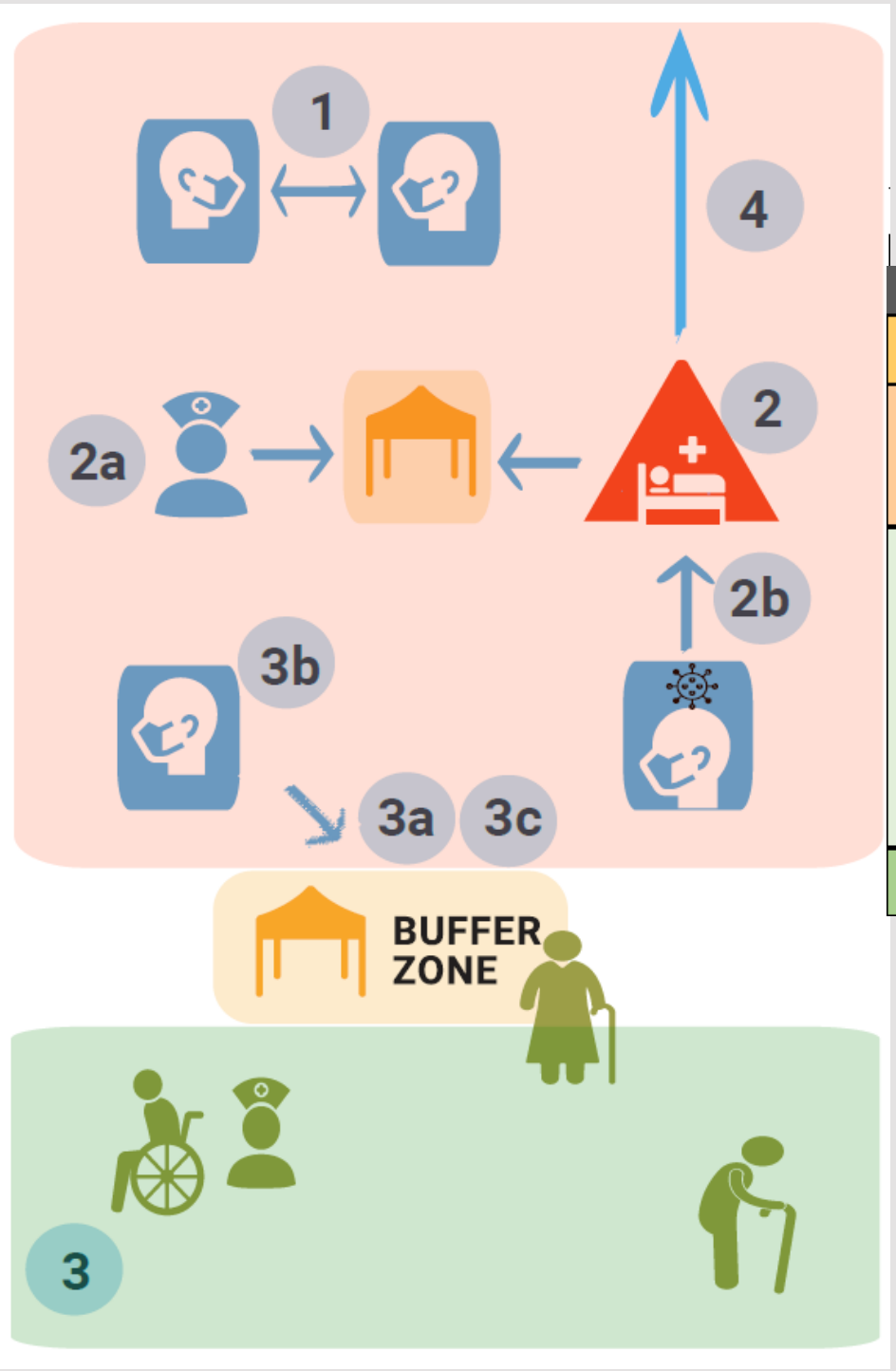


Figure 6 Scenario One predicted severe cases

The health system in NW Syria would be unable to cope by the beginning of week 8; as such, severe cases could become critical and mortality could increase

Hariri et al. The COVID-19 forecast in NW Syria. *MedRxiv* (2020)



Interventions

	Description	Values/Effect
1	**Seld-Distancing:** reduction mean number of contacts per day and per individual	20% , 50%
2	**Self-Isolation** of symptomatic in individual tent	Available tents: 10, 20, 50, 100, 250, 500, 1000, 2000
2a	Number of carers	1 per tent
2b	Self-Isolation delay	12h, 24h, 48h
3	**Safety zone** for vulnerable population	Elderly only Elderly + Comorbid Adults Elderly + Comorbid Adults + Children (up to 20%, 25%, 30% population)
3a	Number of contacts	2, 10 (per week and individual in safety zone)
3b	Health checks	Exclude symptomatic from buffering zone if in place
3c	Lockdown of buffering zone if one case is detected	Reduce values of 3a at 50% or 90%
4	**Evacuation** of severely symptomatic	Evacuated individuals are no longer infectious, don't receive health care

Strategy 1: Self-distancing

Description

- Reduction of contacts between individuals.

Key-points

- Simple and rapid implementation.
- Educational-based, long-term benefit
- Starting investment

  then mouth-to-word

Strategy 1: Self-distancing

Description

- Reduction of contacts between individuals.

Population class	Null model	Reduction 20%	Reduction 50%
Kids	25	20	12.5
Adults	15	11	7.5
Elderly	10	8	5

Key-points

- Simple and rapid implementation.
- Educational-based, long-term benefit
- Starting investment then mouth-to-word

Strategy 1: Self-distancing

Description

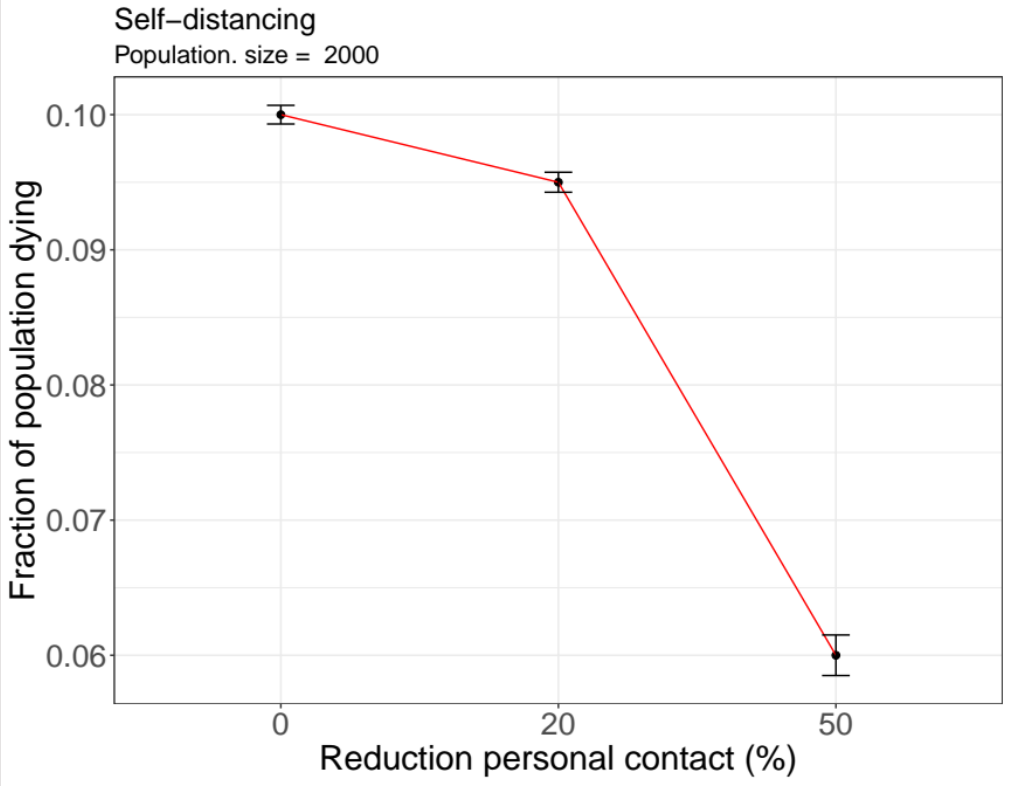
- Reduction of contacts between individuals.

Population class	Null model	Reduction 20%	Reduction 50%
Kids	25	20	12.5
Adults	15	11	**7.5**
Elderly	10	8	5

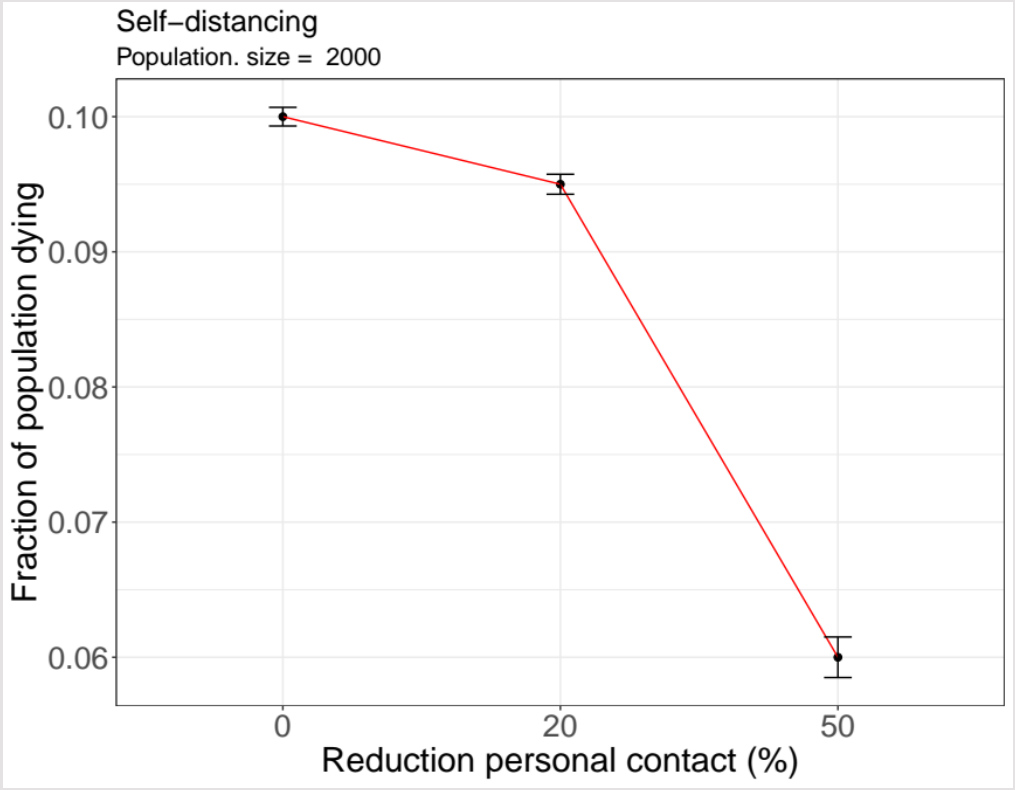
Key-points

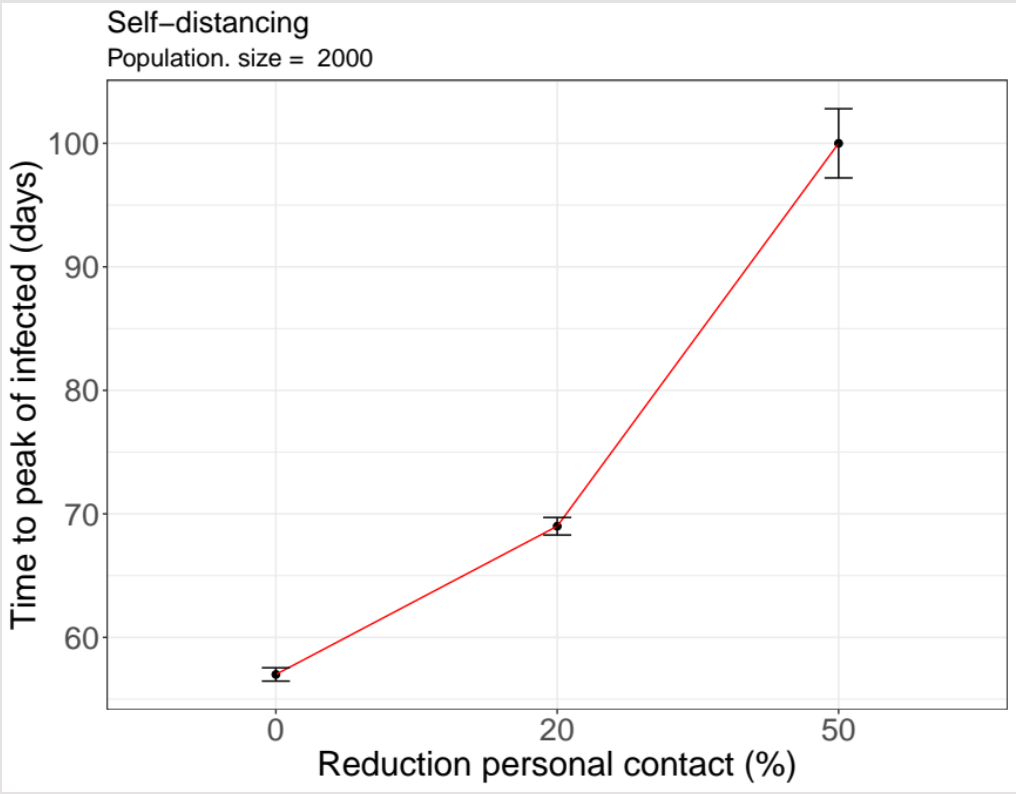
- Simple and rapid implementation.
- Educational-based, long-term benefit
- Starting investment then mouth-to-word

Strategy 1: Self-distancing

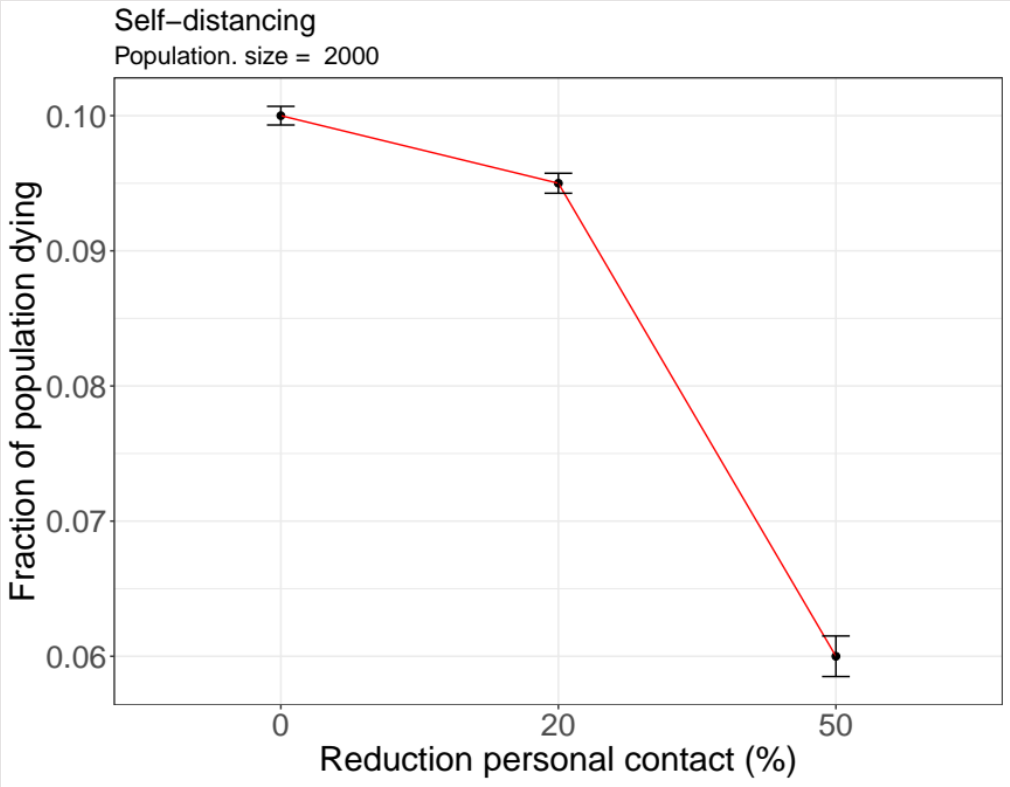


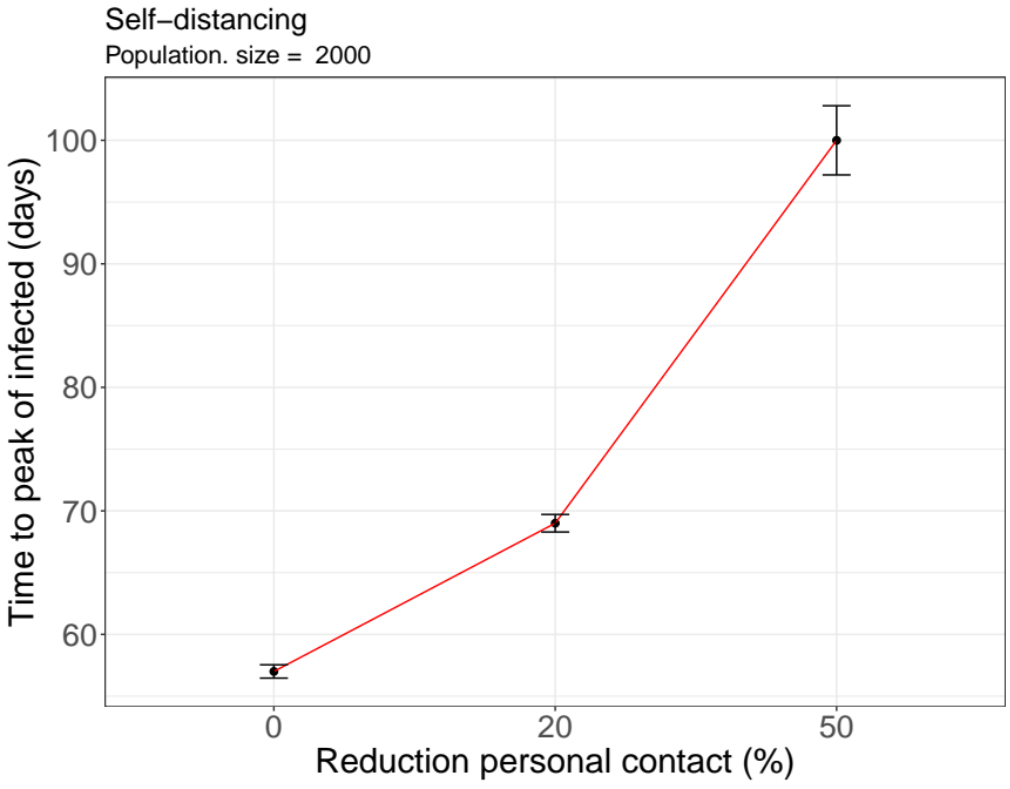
Strategy 1: Self-distancing





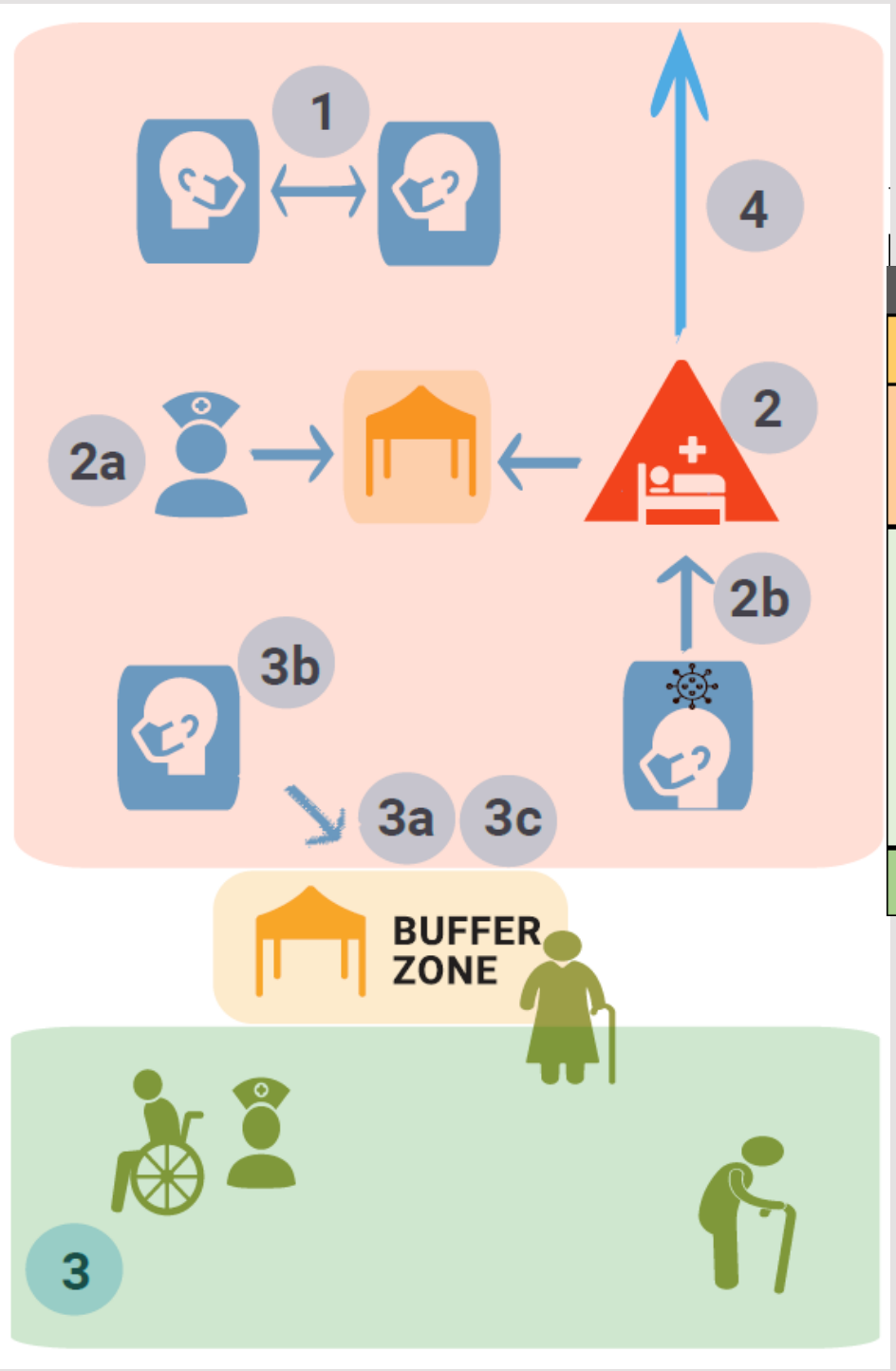
Strategy 1: Self-distancing





Up to 40% reduction in the the death tolls

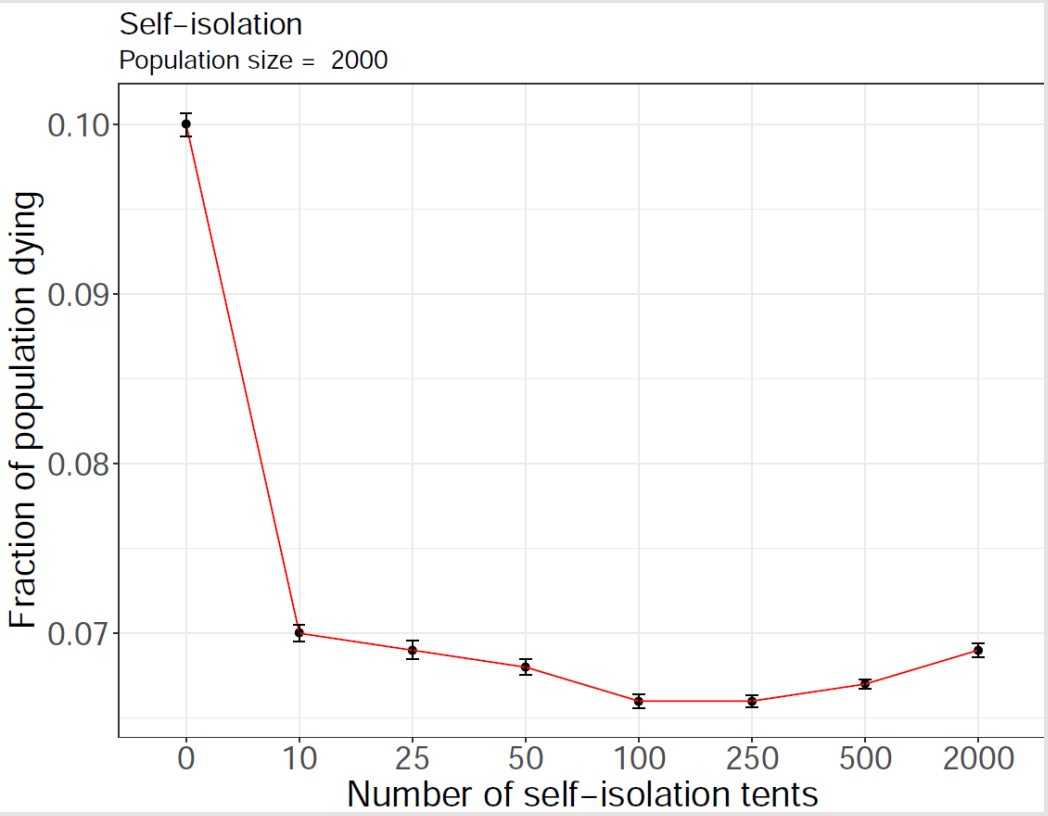
Up to 40% delay in the peak of infected population



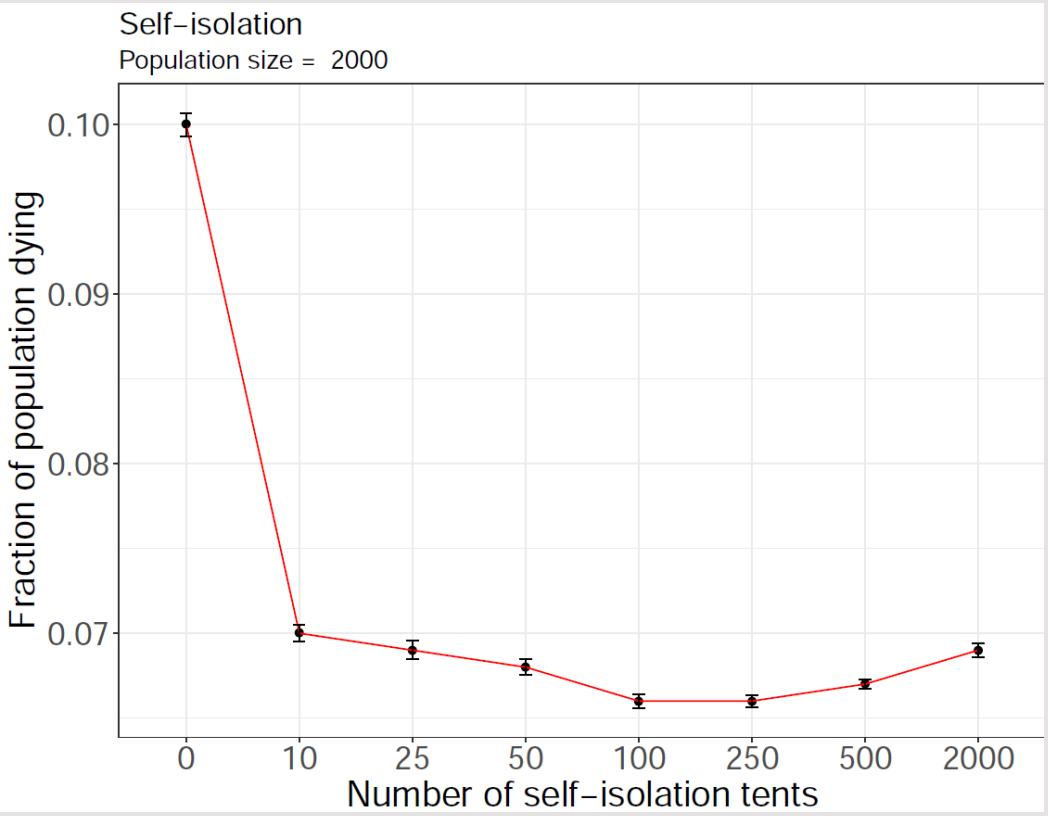
Interventions

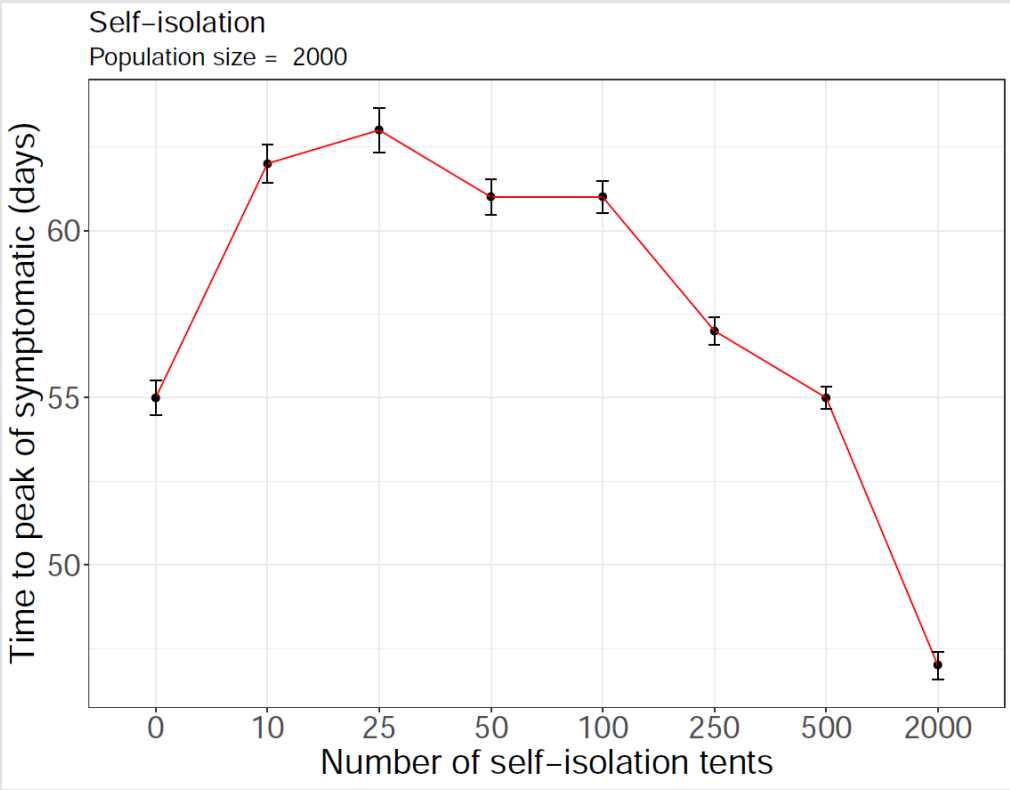
	Description	Values/Effect
1	**Seld-Distancing:** reduction mean number of contacts per day and per individual	20% , 50%
2	**Self-Isolation** of symptomatic in individual tent	Available tents: 10, 20, 50, 100, 250, 500, 1000, 2000
2a	Number of carers	1 per tent
2b	Self-Isolation delay	12h, 24h, 48h
3	**Safety zone** for vulnerable population	Elderly only Elderly + Comorbid Adults Elderly + Comorbid Adults + Children (up to 20%, 25%, 30% population)
3a	Number of contacts	2, 10 (per week and individual in safety zone)
3b	Health checks	Exclude symptomatic from buffering zone if in place
3c	Lockdown of buffering zone if one case is detected	Reduce values of 3a at 50% or 90%
4	**Evacuation** of severely symptomatic	Evacuated individuals are no longer infectious, don't receive health care

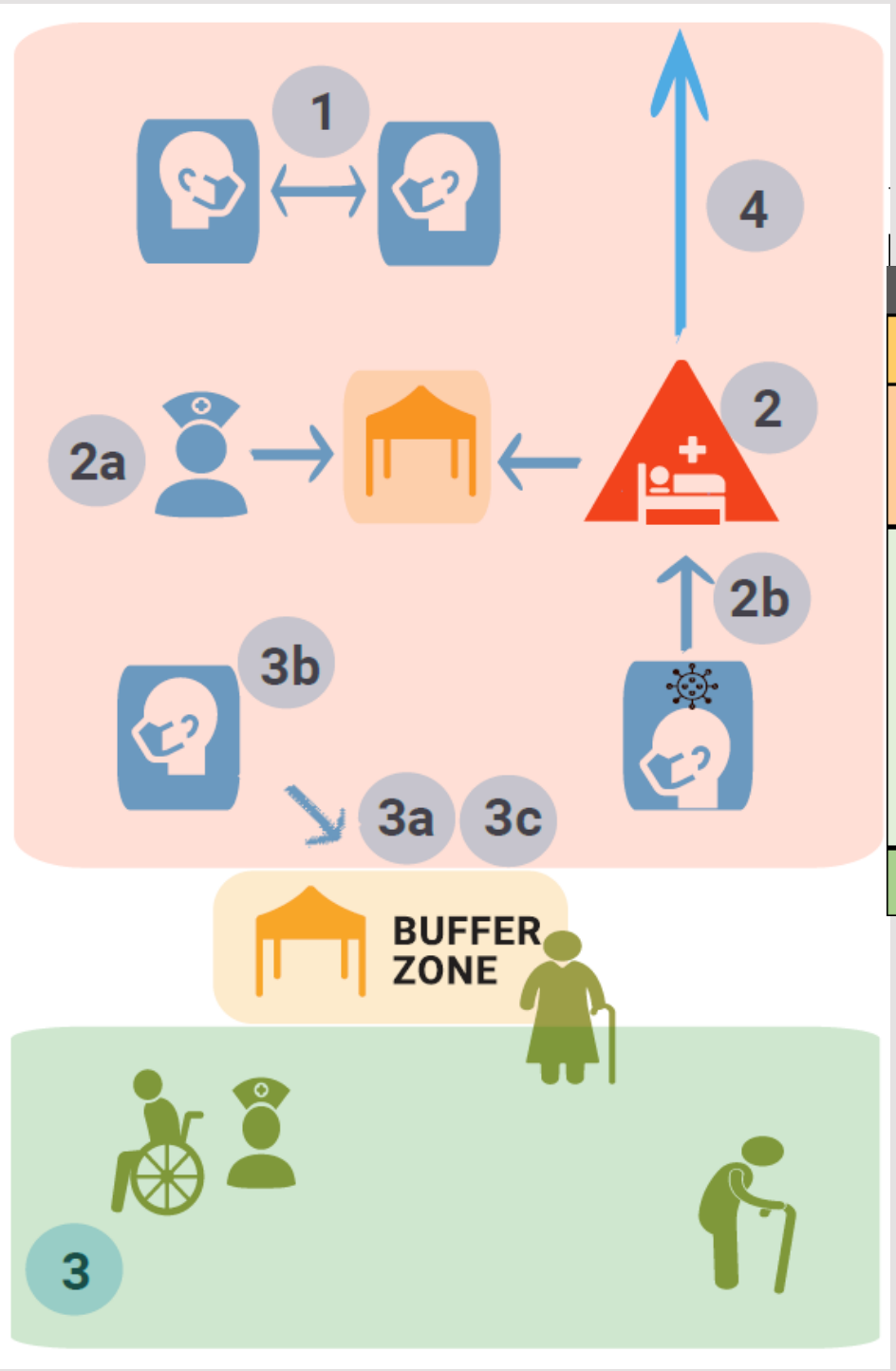
Strategy 3: Isolation



Strategy 3: Isolation



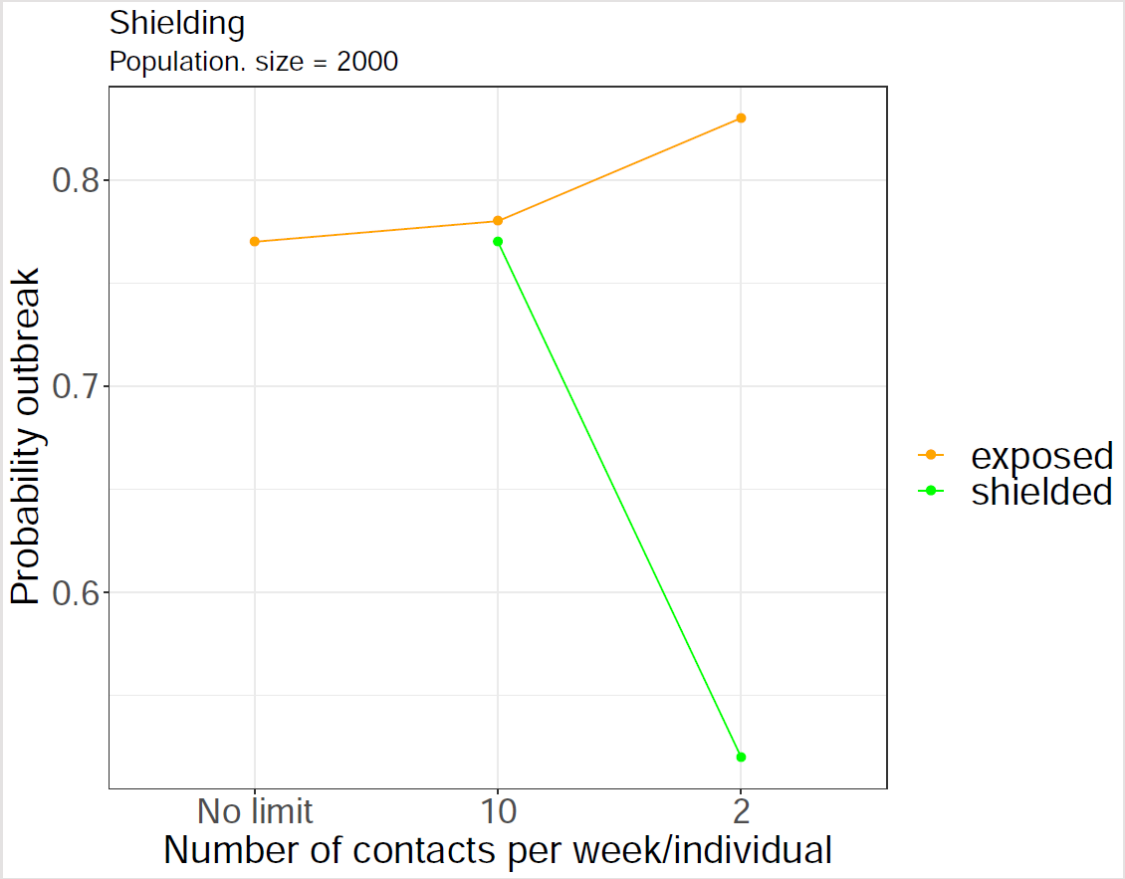




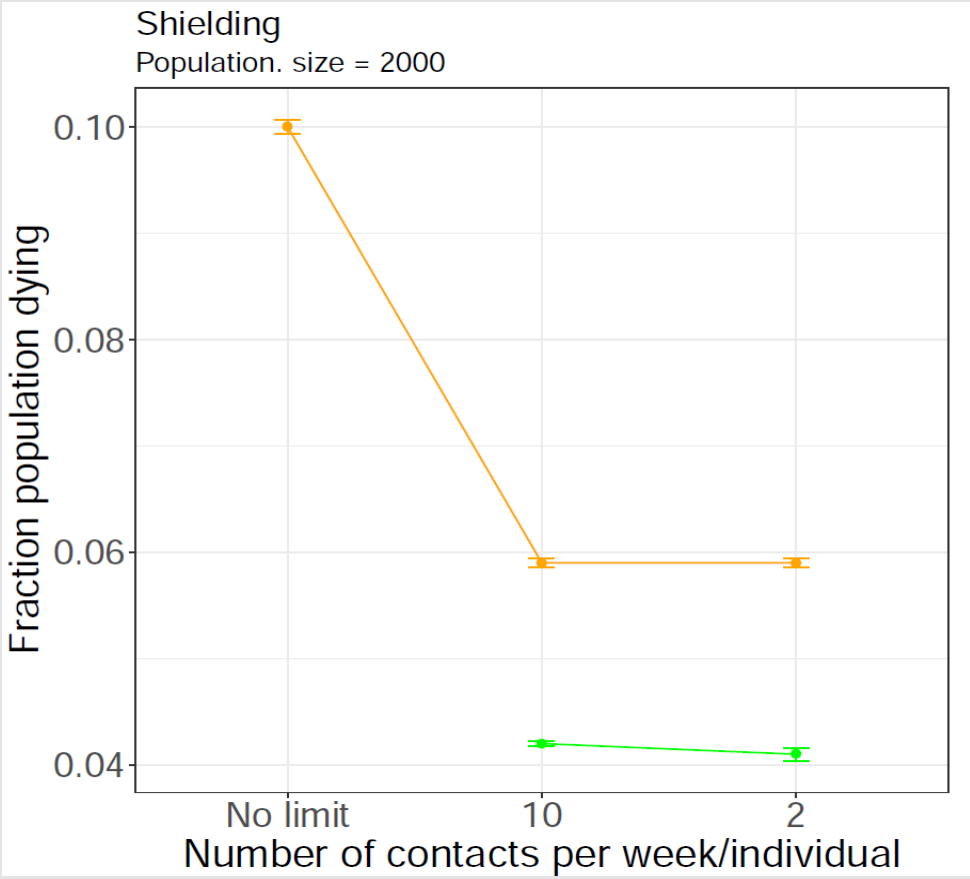
Interventions

	Description	Values/Effect
1	**Seld-Distancing:** reduction mean number of contacts per day and per individual	20% , 50%
2	**Self-Isolation** of symptomatic in individual tent	Available tents: 10, 20, 50, 100, 250, 500, 1000, 2000
2a	Number of carers	1 per tent
2b	Self-Isolation delay	12h, 24h, 48h
3	**Safety zone** for vulnerable population	Elderly only Elderly + Comorbid Adults Elderly + Comorbid Adults + Children (up to 20%, 25%, 30% population)
3a	Number of contacts	2, 10 (per week and individual in safety zone)
3b	Health checks	Exclude symptomatic from buffering zone if in place
3c	Lockdown of buffering zone if one case is detected	Reduce values of 3a at 50% or 90%
4	**Evacuation** of severely symptomatic	Evacuated individuals are no longer infectious, don't receive health care

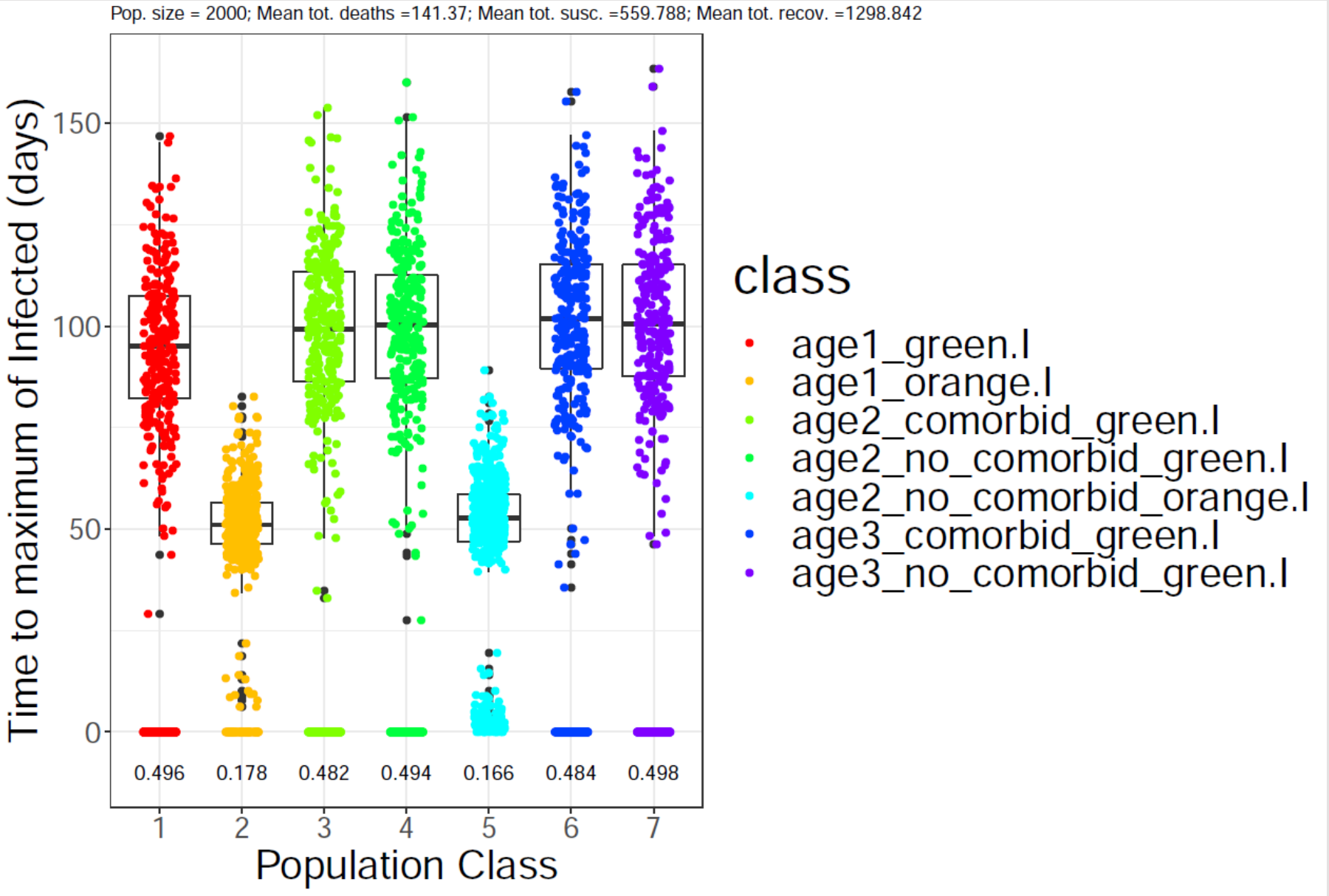
Strategy 2: Shielding only

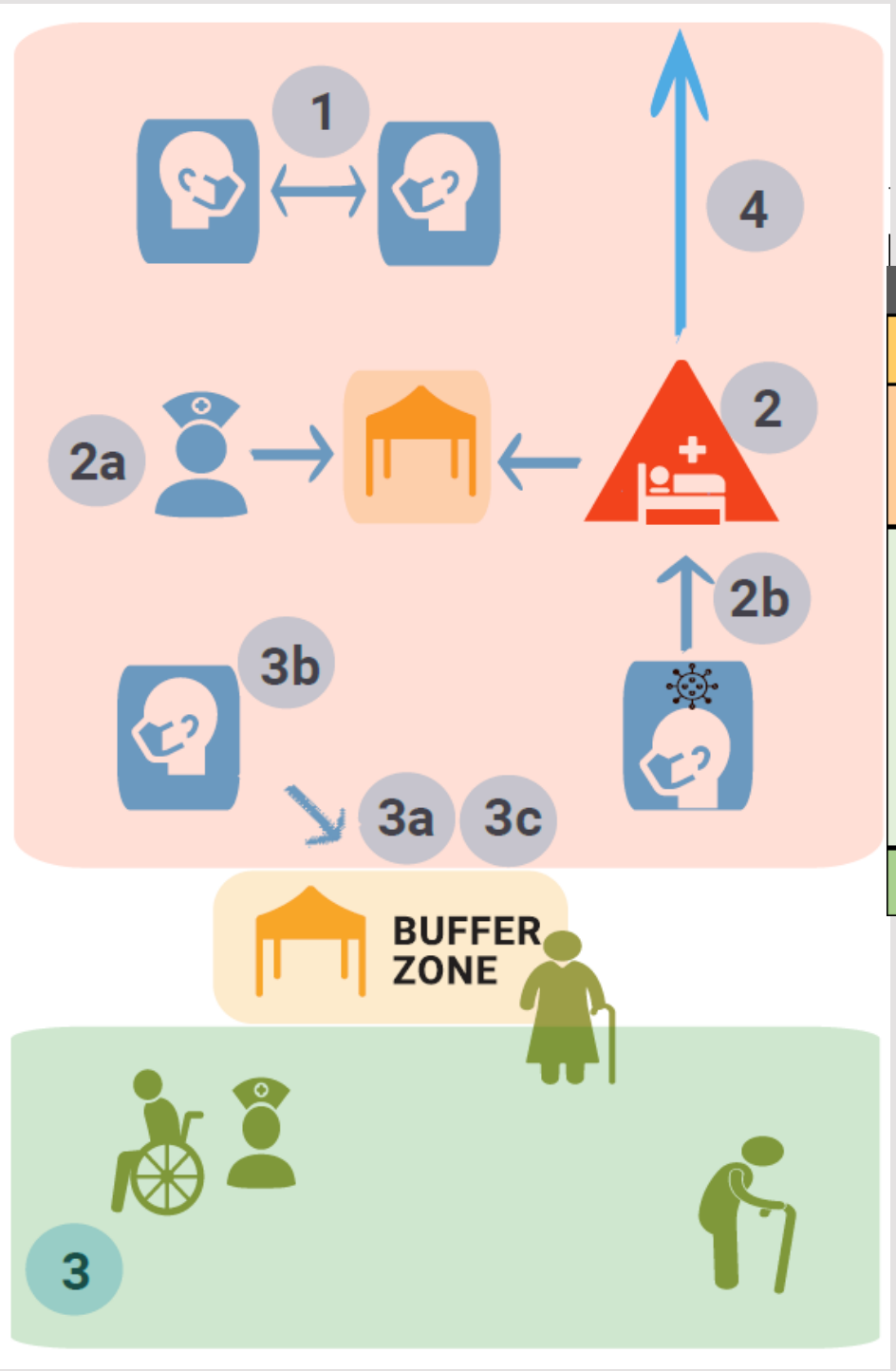


Strategy 2: Shielding only



Strategy 2: Shielding only

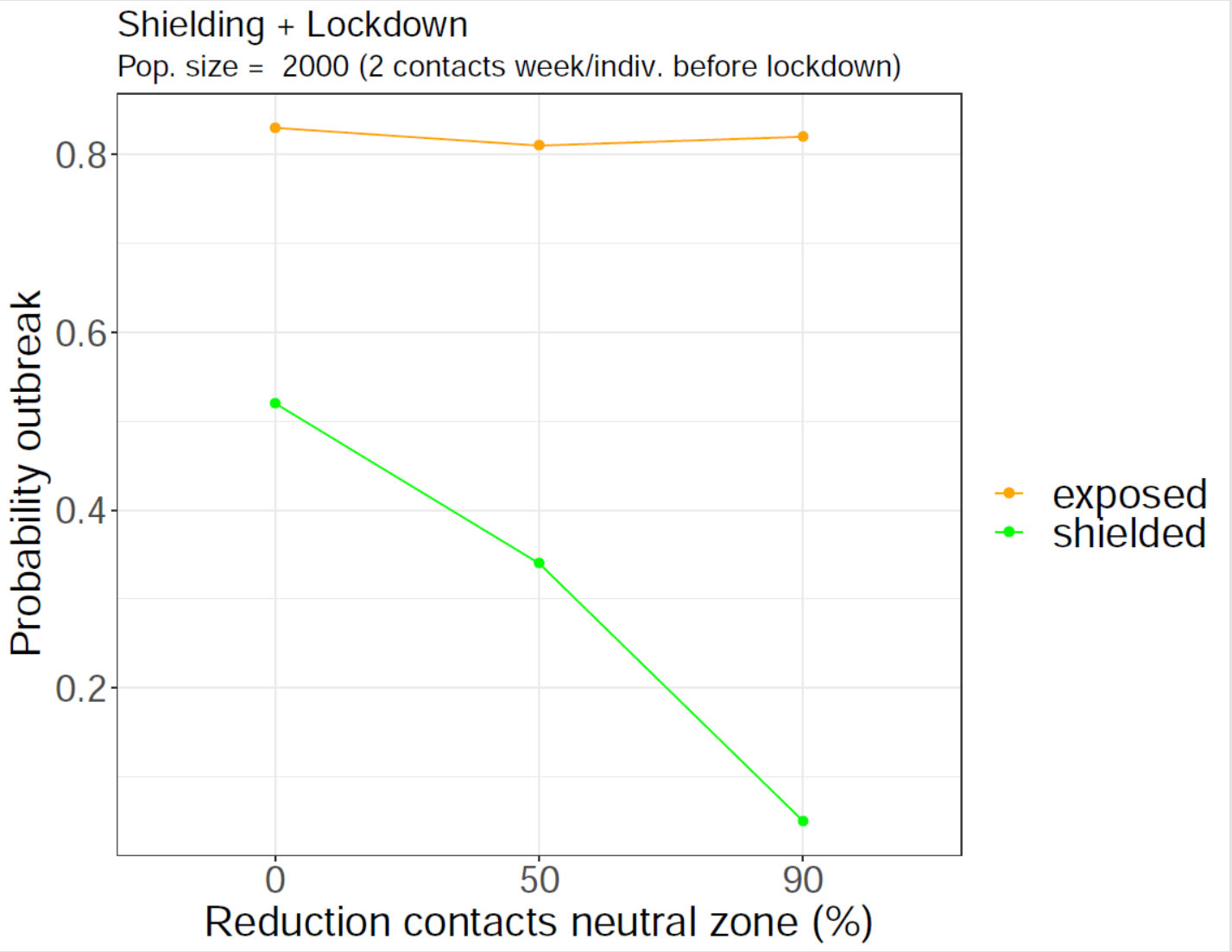




Interventions

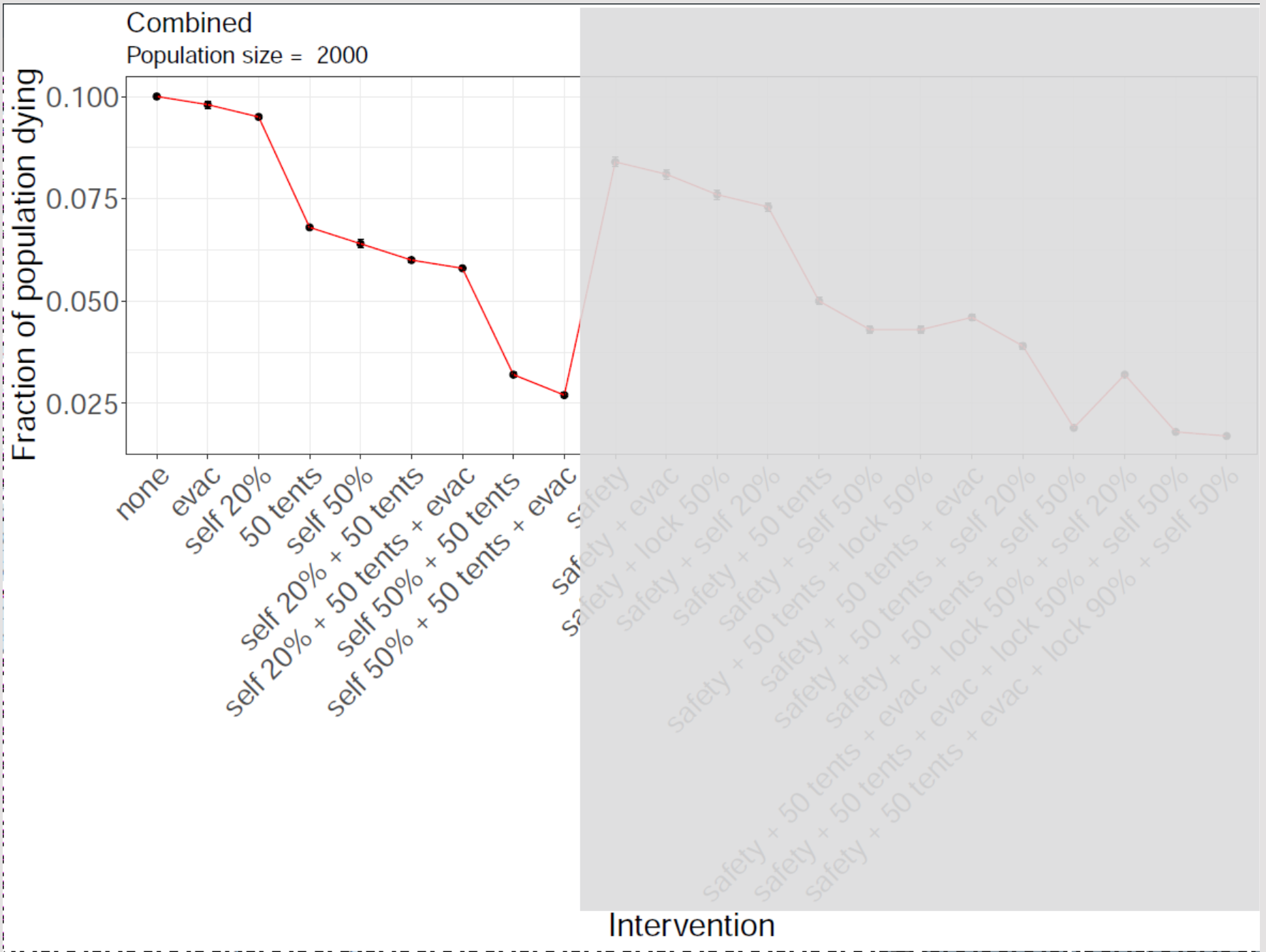
	Description	Values/Effect
1	**Seld-Distancing:** reduction mean number of contacts per day and per individual	20% , 50%
2	**Self-Isolation** of symptomatic in individual tent	Available tents: 10, 20, 50, 100, 250, 500, 1000, 2000
2a	Number of carers	1 per tent
2b	Self-Isolation delay	12h, 24h, 48h
3	**Safety zone** for vulnerable population	Elderly only Elderly + Comorbid Adults Elderly + Comorbid Adults + Children (up to 20%, 25%, 30% population)
3a	Number of contacts	2, 10 (per week and individual in safety zone)
3b	Health checks	Exclude symptomatic from buffering zone if in place
3c	Lockdown of buffering zone if one case is detected	Reduce values of 3a at 50% or 90%
4	**Evacuation** of severely symptomatic	Evacuated individuals are no longer infectious, don't receive health care

Strategy 2: Shielding and Lockdown

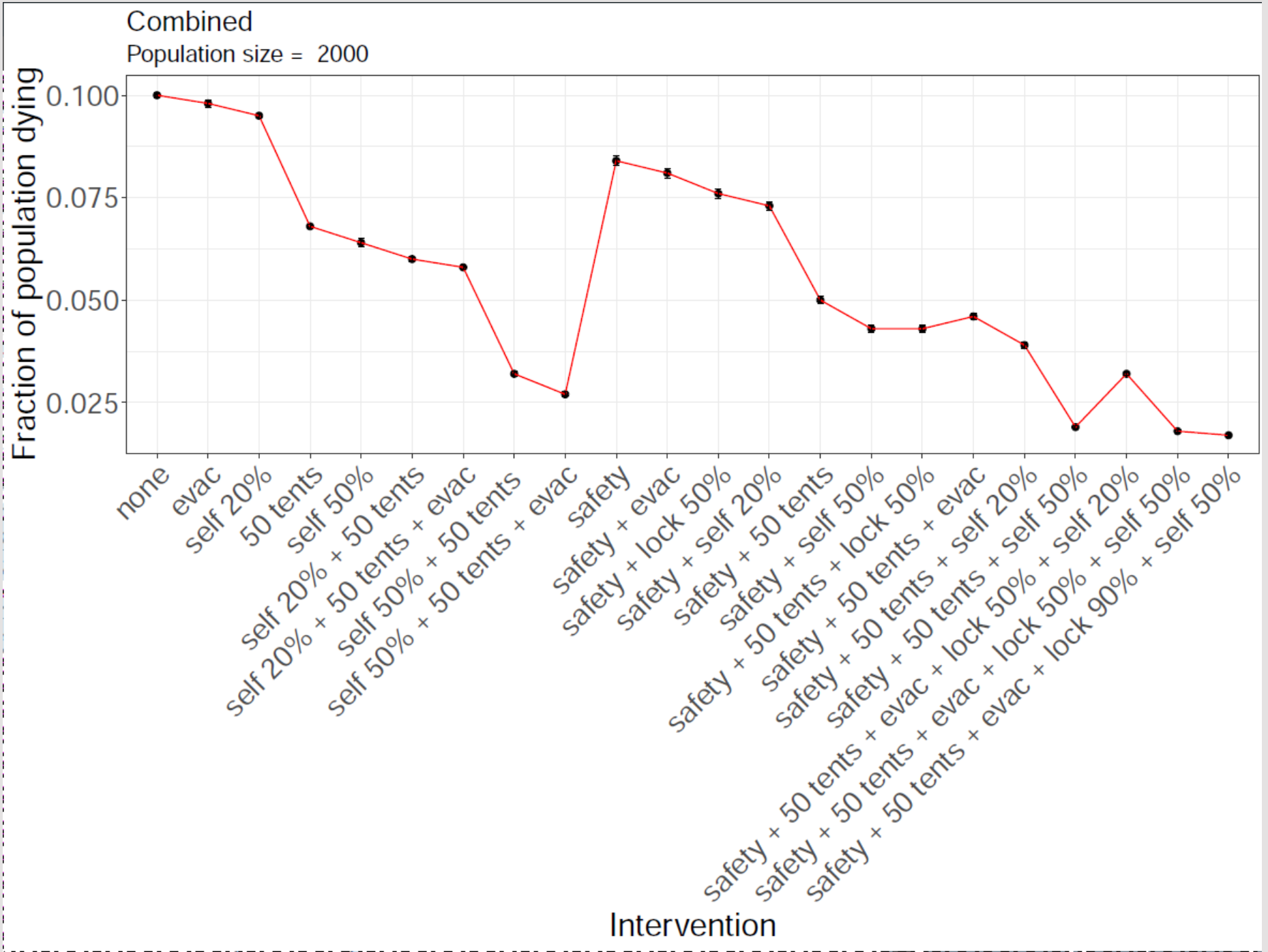


Combined strategies

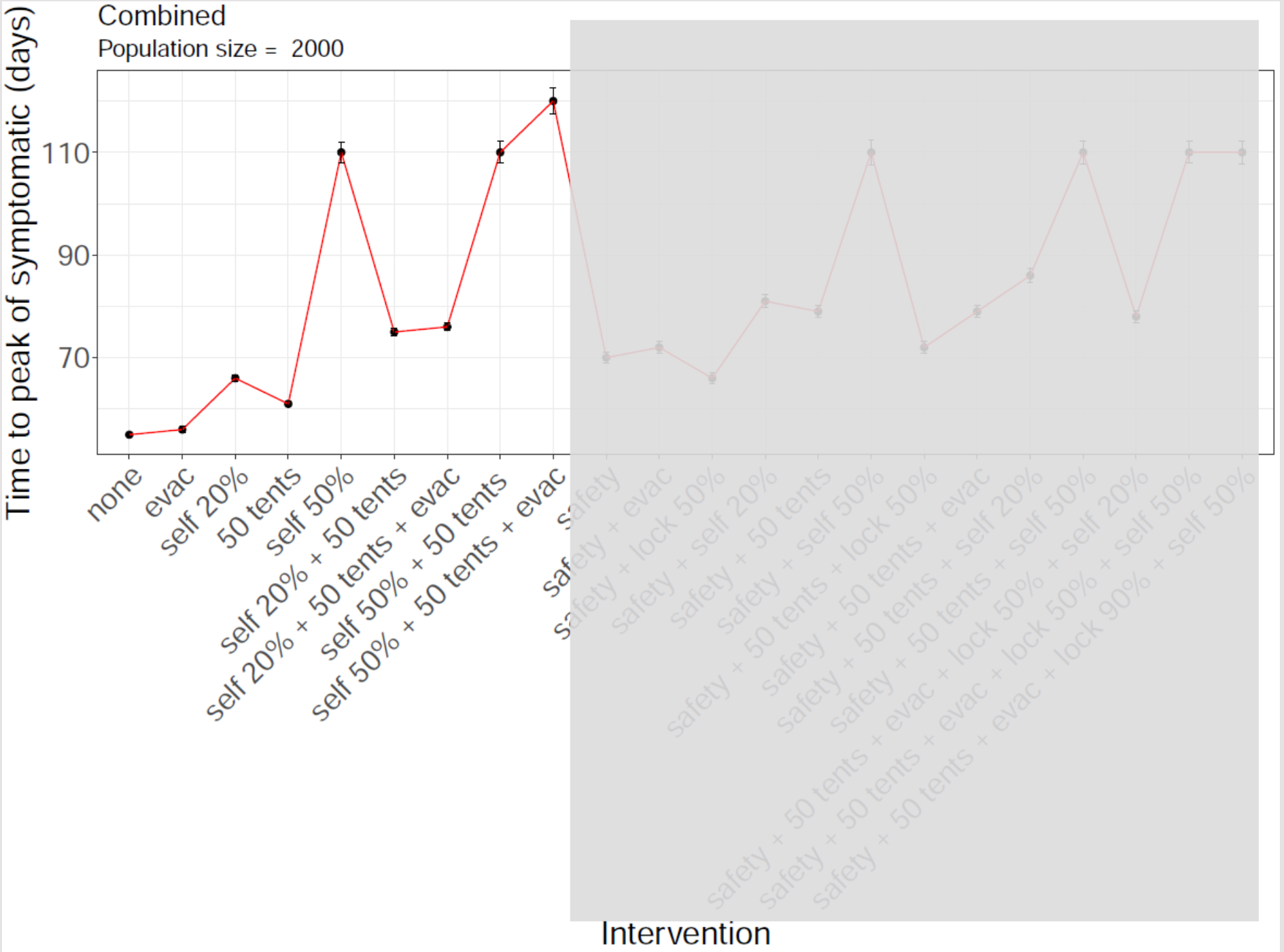
Combined strategies



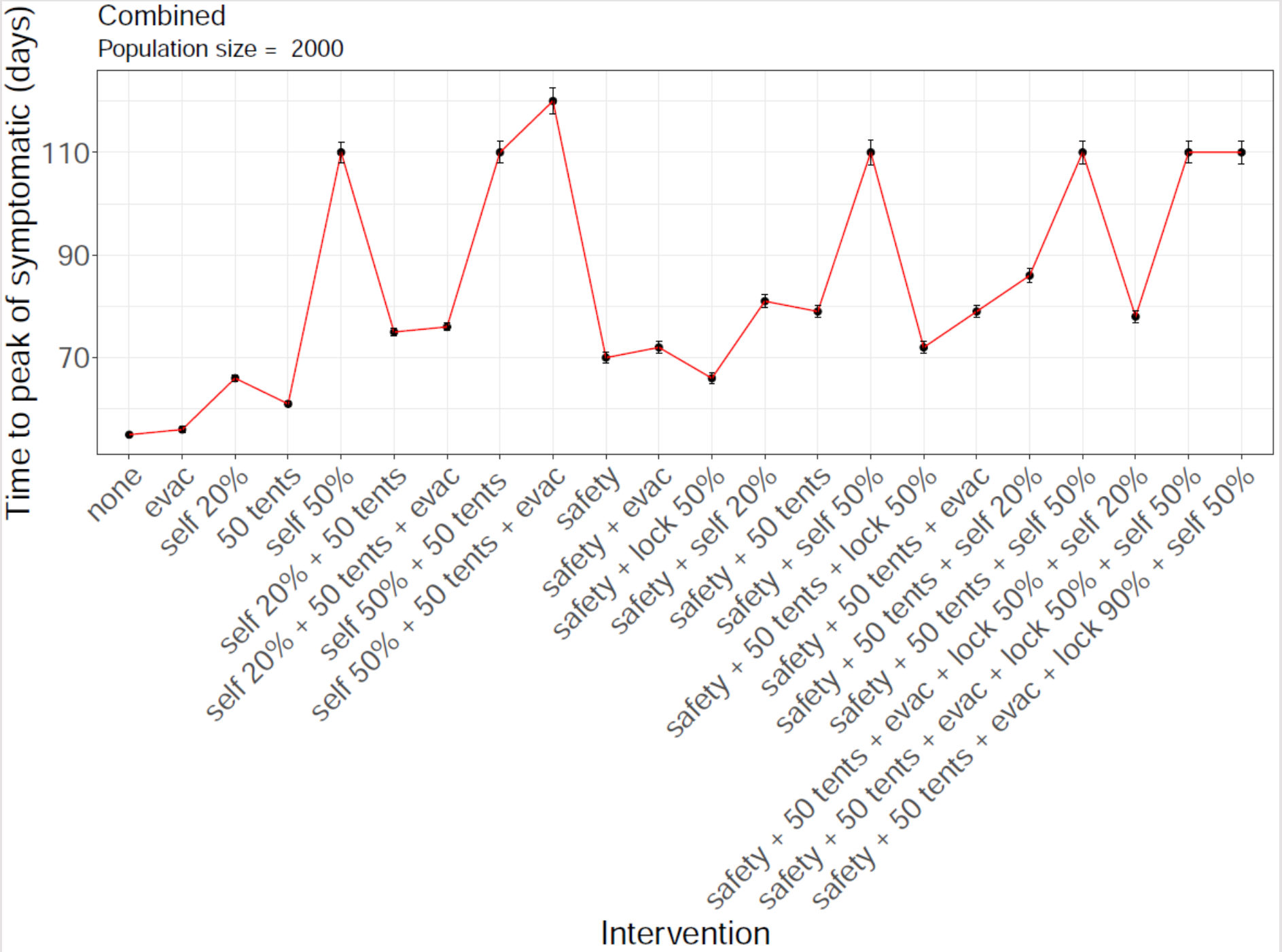
Combined strategies



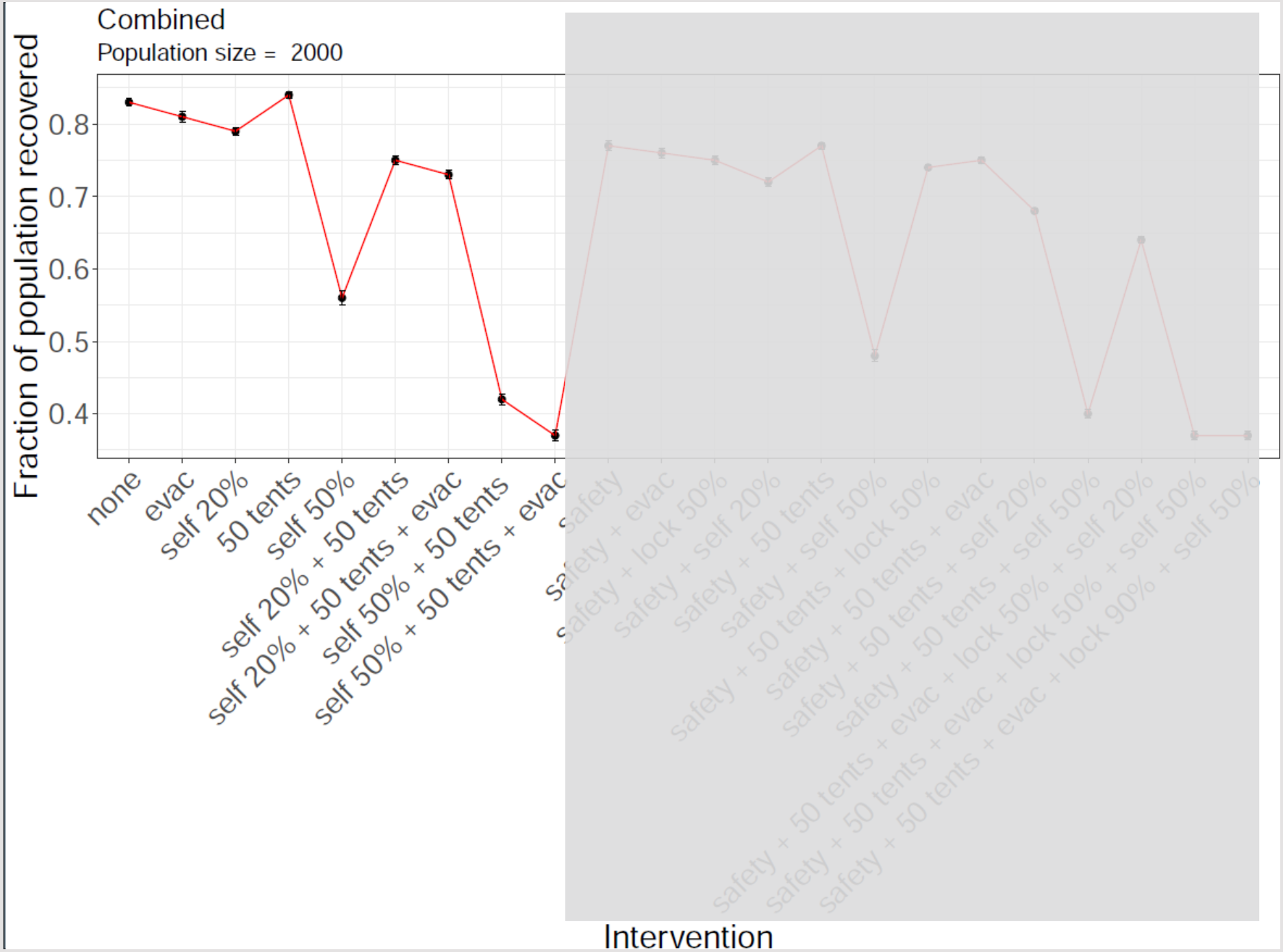
Combined strategies



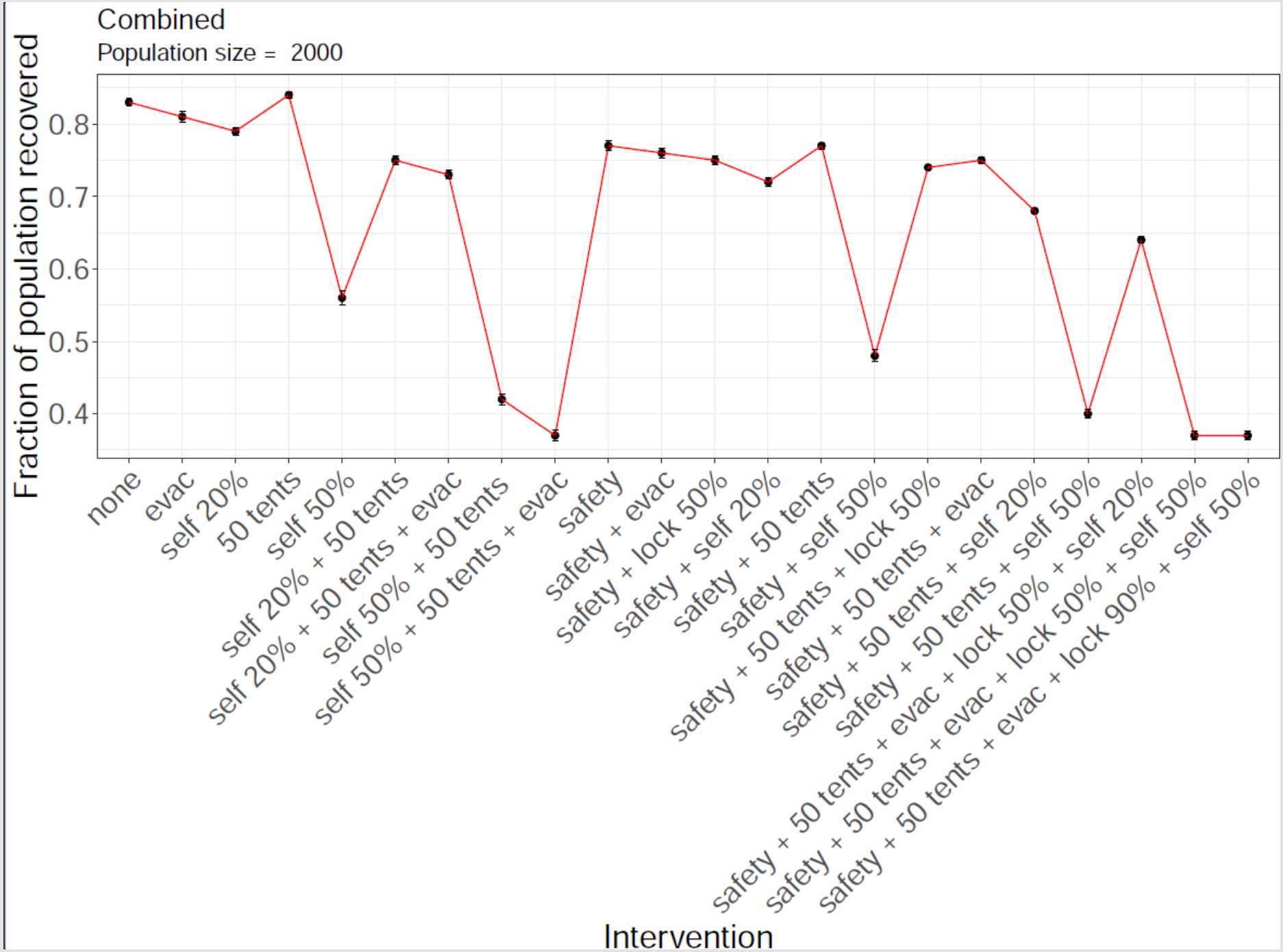
Combined strategies



Combined strategies



Combined strategies



Conclusions

- Empower communities to manage the spread of the virus or the consequences will be dramatic.

Conclusions

- Empower communities to manage the spread of the virus or the consequences will be dramatic.

- It is feasible and can be done immediately

Acknowledgements

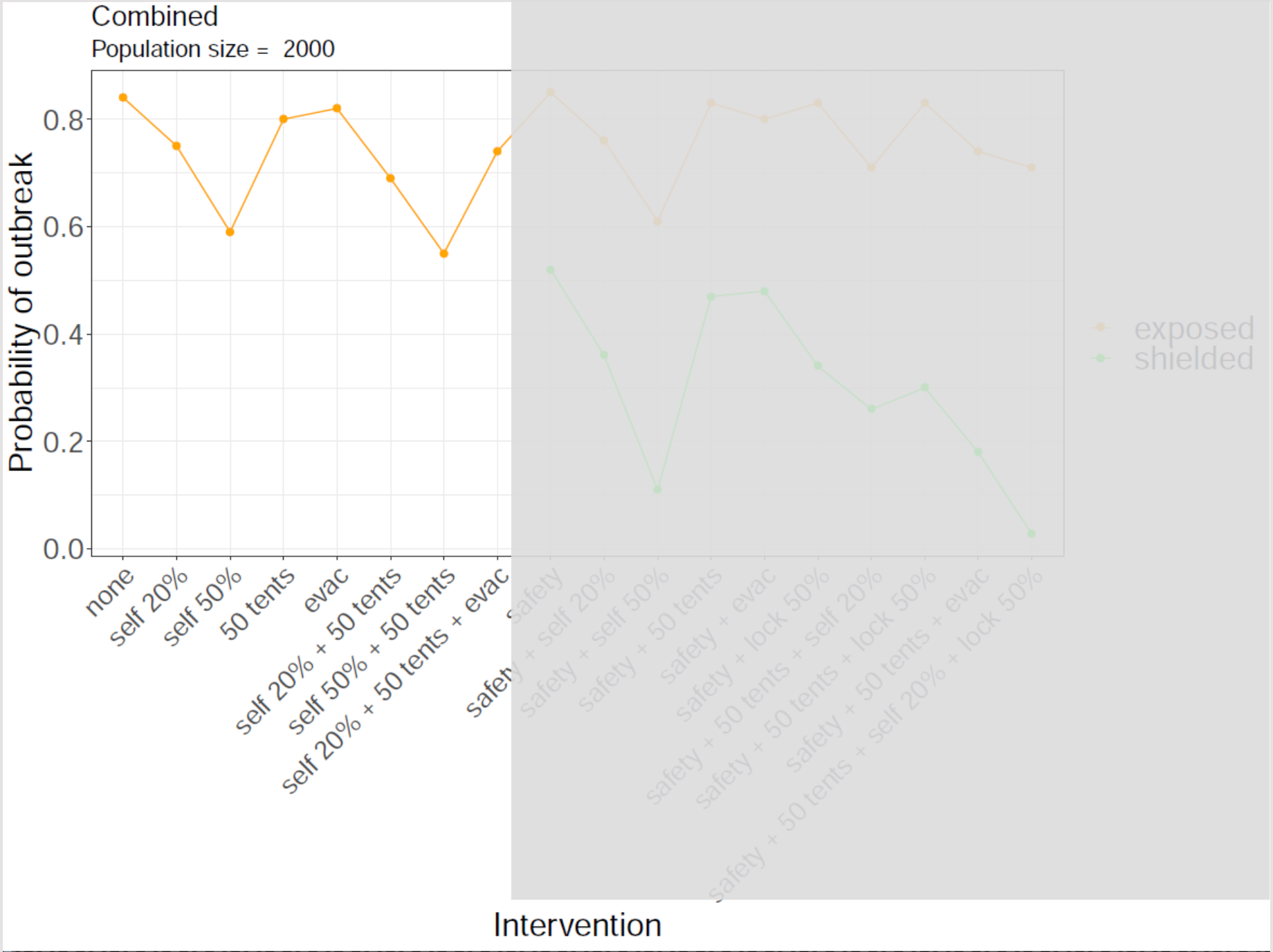
Contributors:

- Jordan Klein (Princeton University)
- Jennifer Villers (Princeton University)
- Eduard Campillo-Funollet, University of Sussex
- Judith Bouman (ETH-Zürich)
- Chamsy Sarkis (Pax Syriana Foundation)

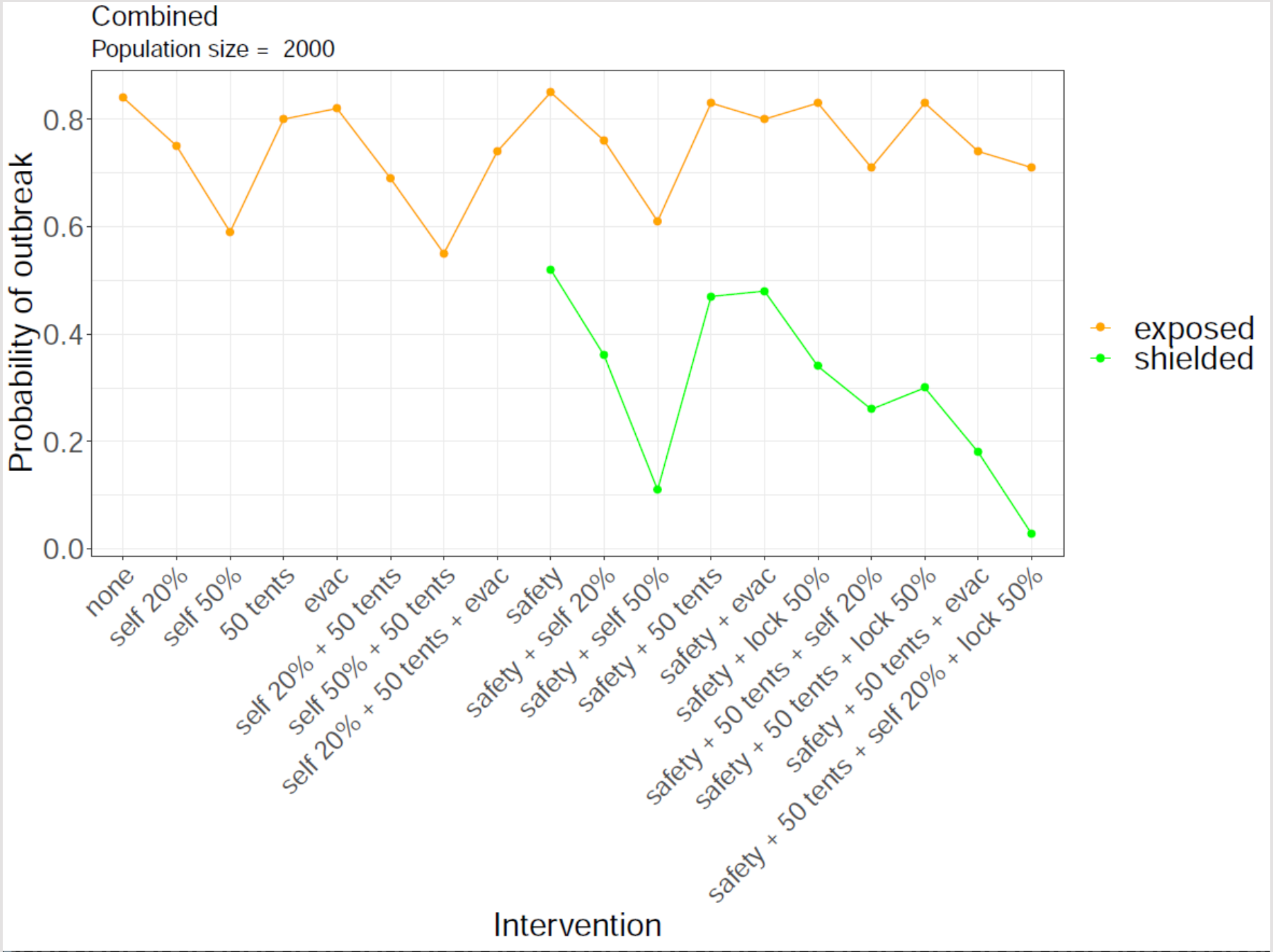
Thanks for useful discussions:

- Burcu Tepekule (ETH-Zürich)
- Juan Poyatos (Spanish Research Council)

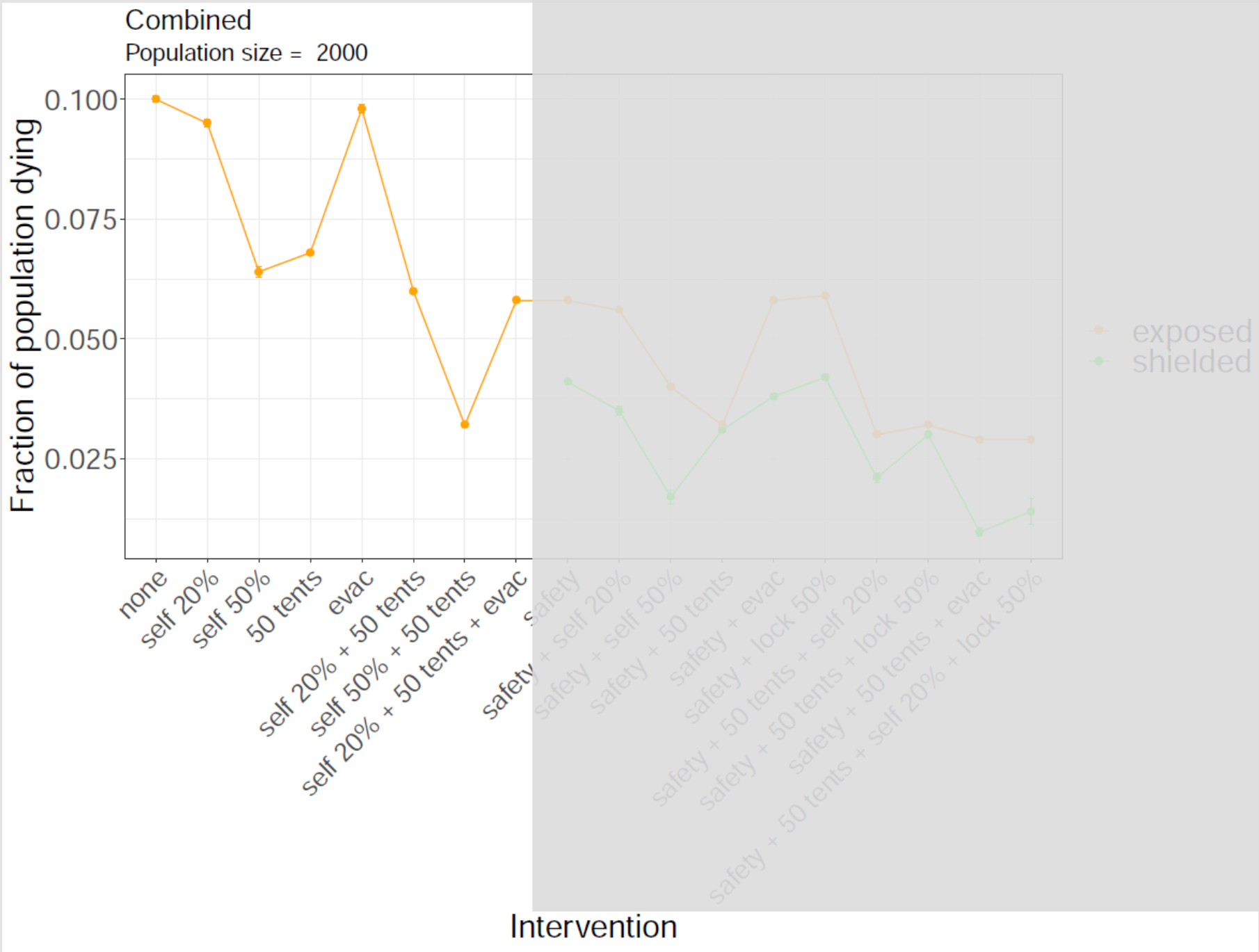
Combined strategies



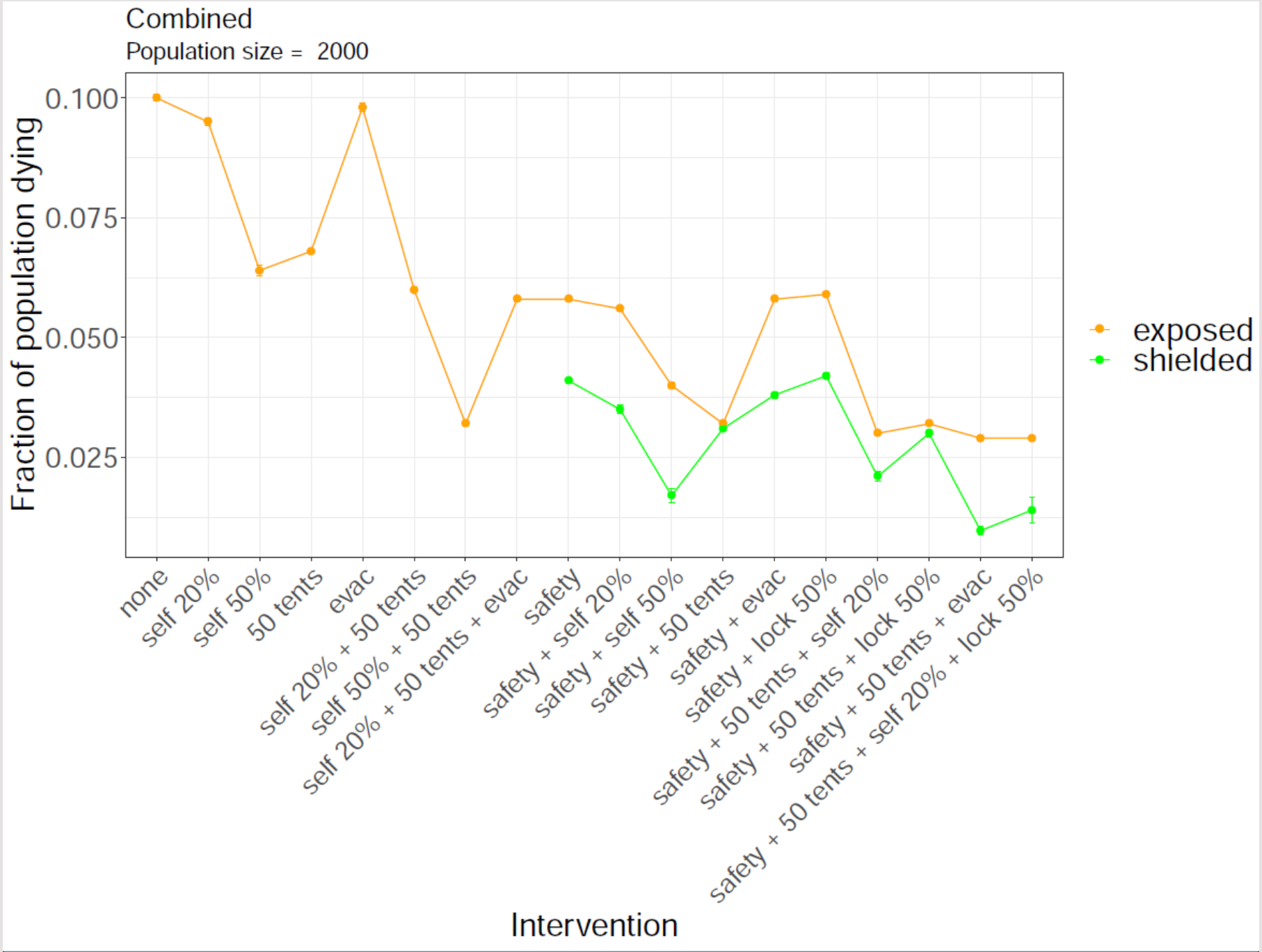
Combined strategies



Combined strategies



Combined strategies



Combined strategies