IS COUNTRY *VITALAND* ADEQUATELY PREPARED FOR AN INFLUENZA PANDEMIC?

JASPER ARENDS

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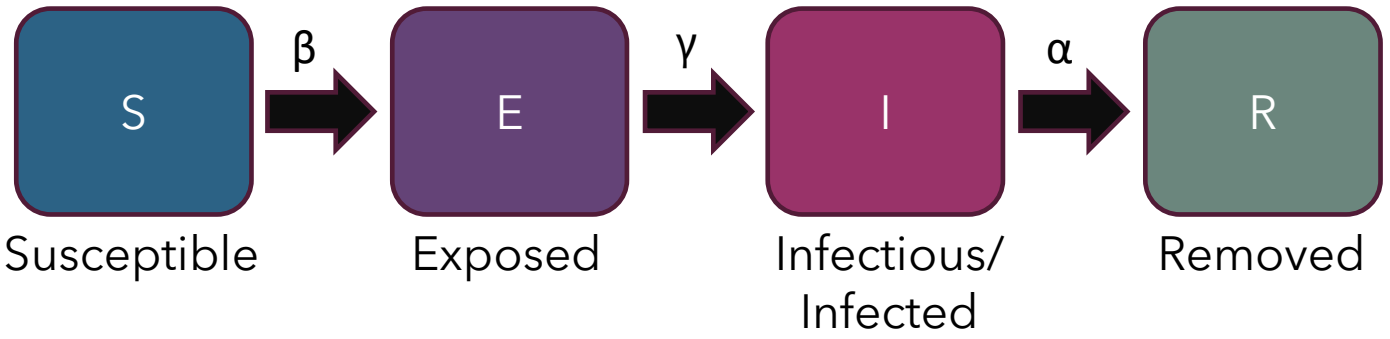
Problem Statement

- Influenza outbreak
- Vaccines for 20% of population
- Model impact of measures
  - Vaccinations
  - Closing of schools
- Based on data from previous pandemic

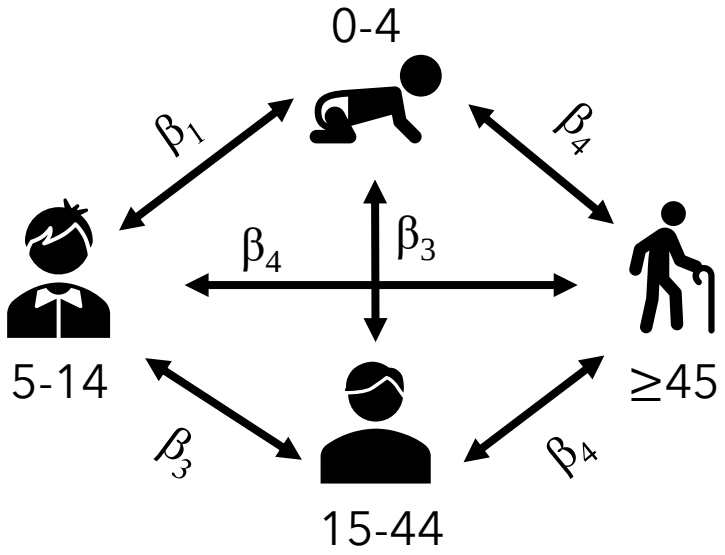
Model

- **β** – contact matrix, describing interactions between and within the age group
- **γ** – parameter connected with latency period length
- **α** – parameter connected with infectious period length



Contact Matrices/Parameters

	Matrix 1	Matrix 2	Matrix 3
β_1	$0.12 \cdot 10^{-4}$	$0.13 \cdot 10^{-4}$	$0.53 \cdot 10^{-4}$
β_2	$0.44 \cdot 10^{-4}$	$0.47 \cdot 10^{-4}$	$0.46 \cdot 10^{-4}$
β_3	$5.68 \cdot 10^{-4}$	$0.08 \cdot 10^{-4}$	$6.68 \cdot 10^{-4}$
β_4	$1.63 \cdot 10^{-4}$	$0.03 \cdot 10^{-4}$	$1.90 \cdot 10^{-4}$

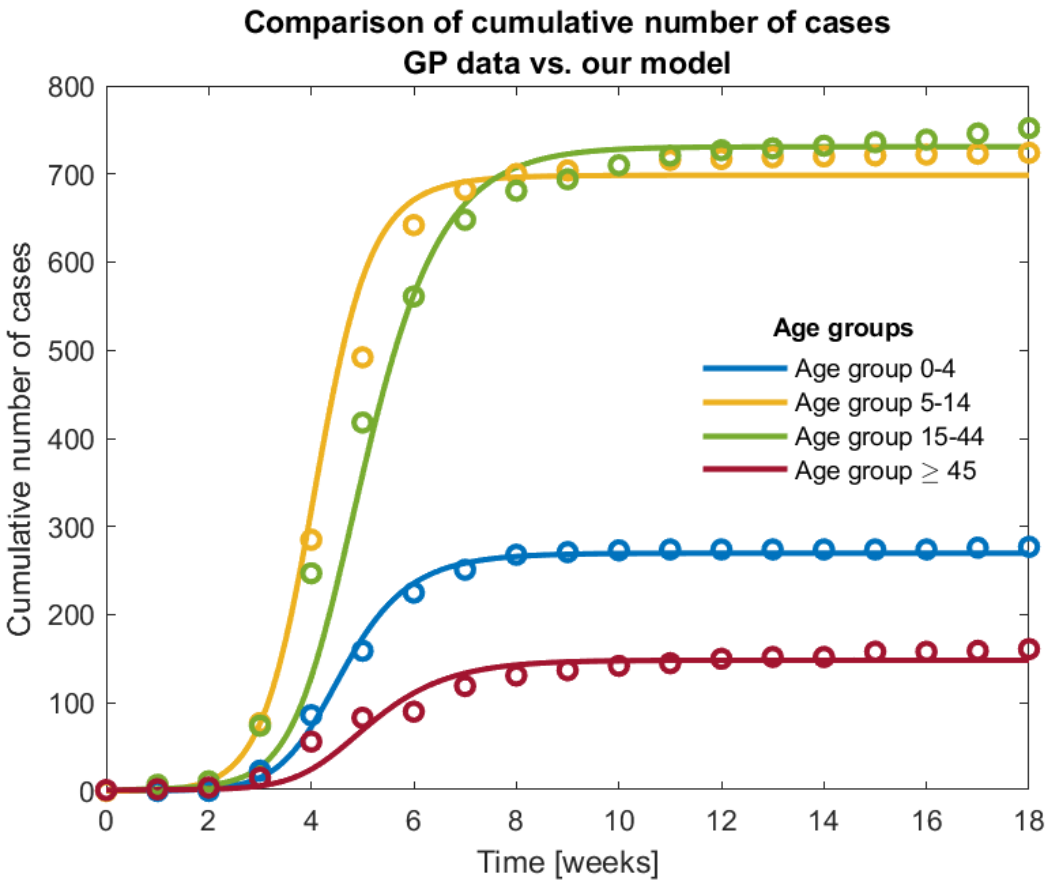


Assumptions

- Based on the **scarcity of data**
  - The GP data reflects well the age distribution and number of infections in each age group
- Based on **expert knowledge**
  - Latent and infectious period length
  - Similarity to other flu outbreaks
- Based on **short period of time considered**
  - Contact matrix does not change in time
  - No immunity loss and reinfections
  - No change in population size and age structure

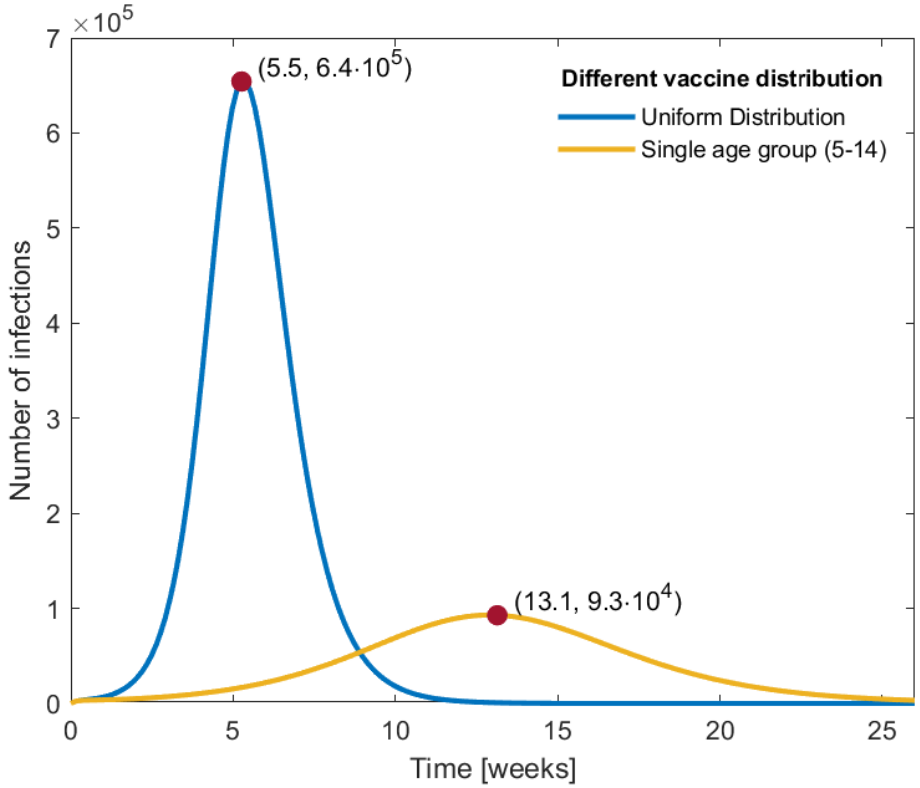
FITTING

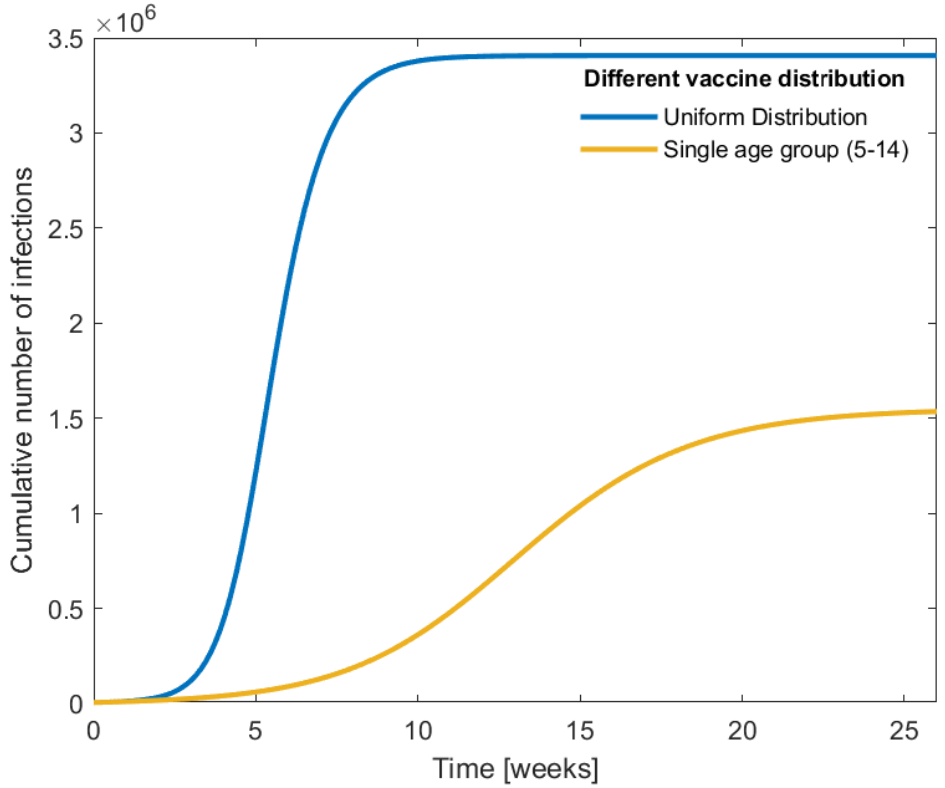
	Matrix 1	Matrix 2	Matrix 3
Fit Error (RMSE)	72.8699	80.3447	85.5511



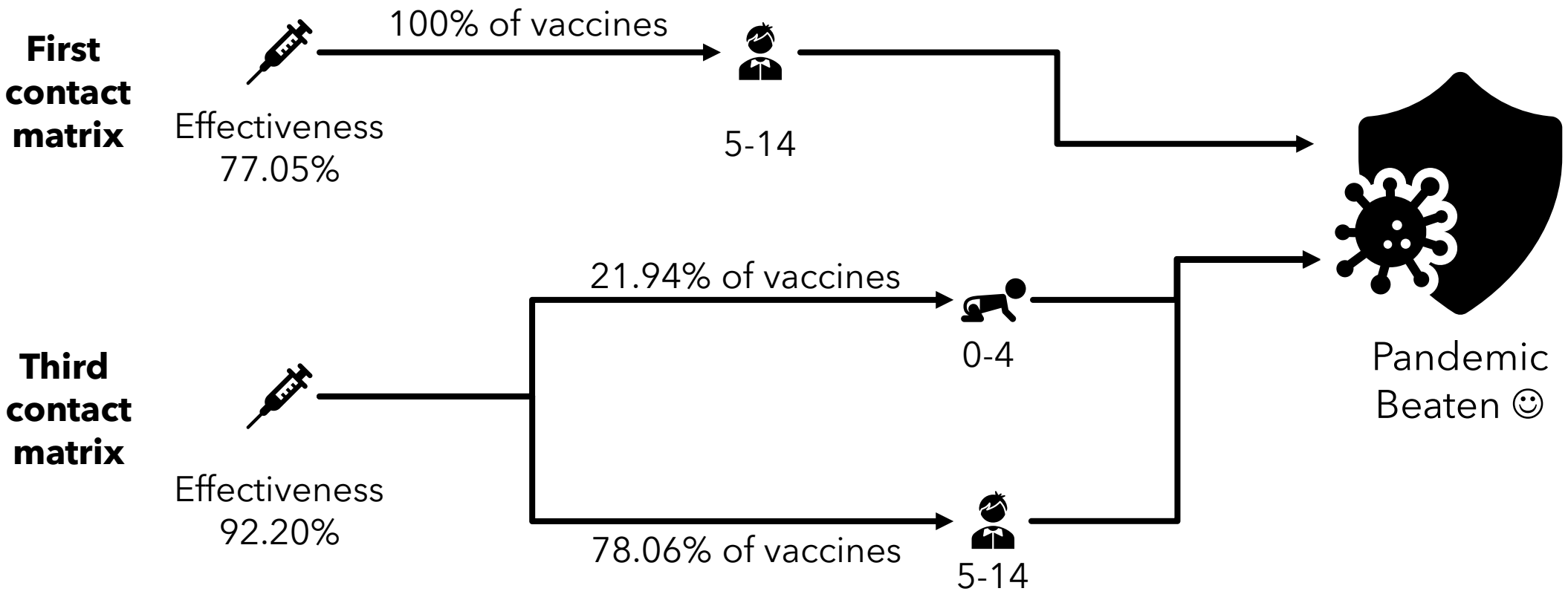
VACCINES DISTRIBUTION

Different vaccine distribution strategies



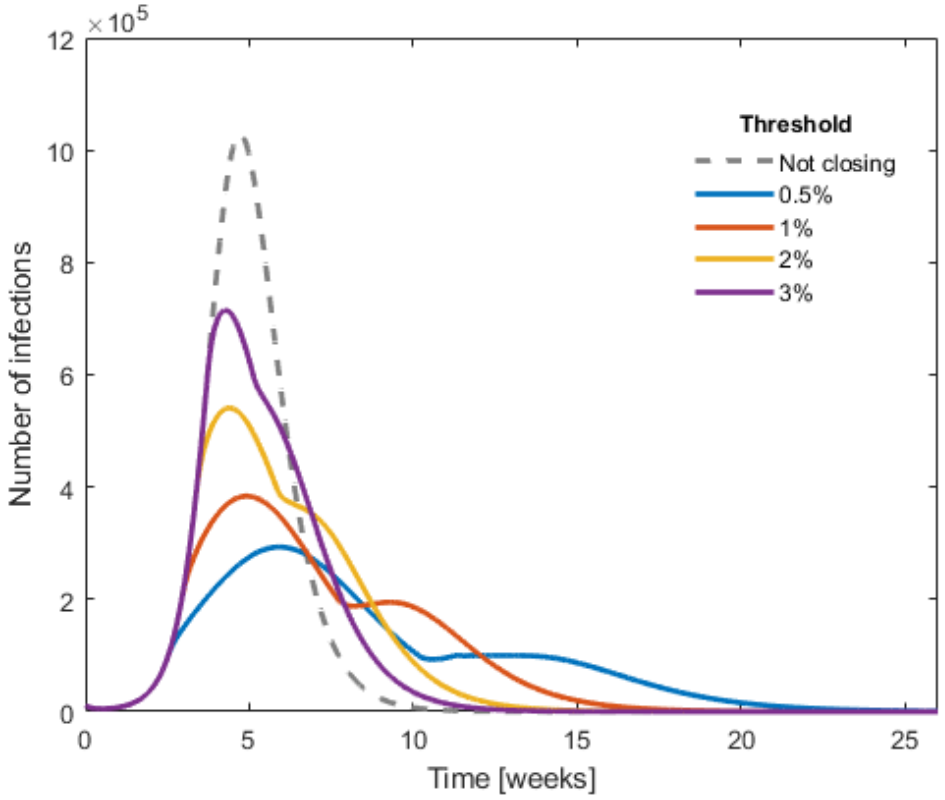


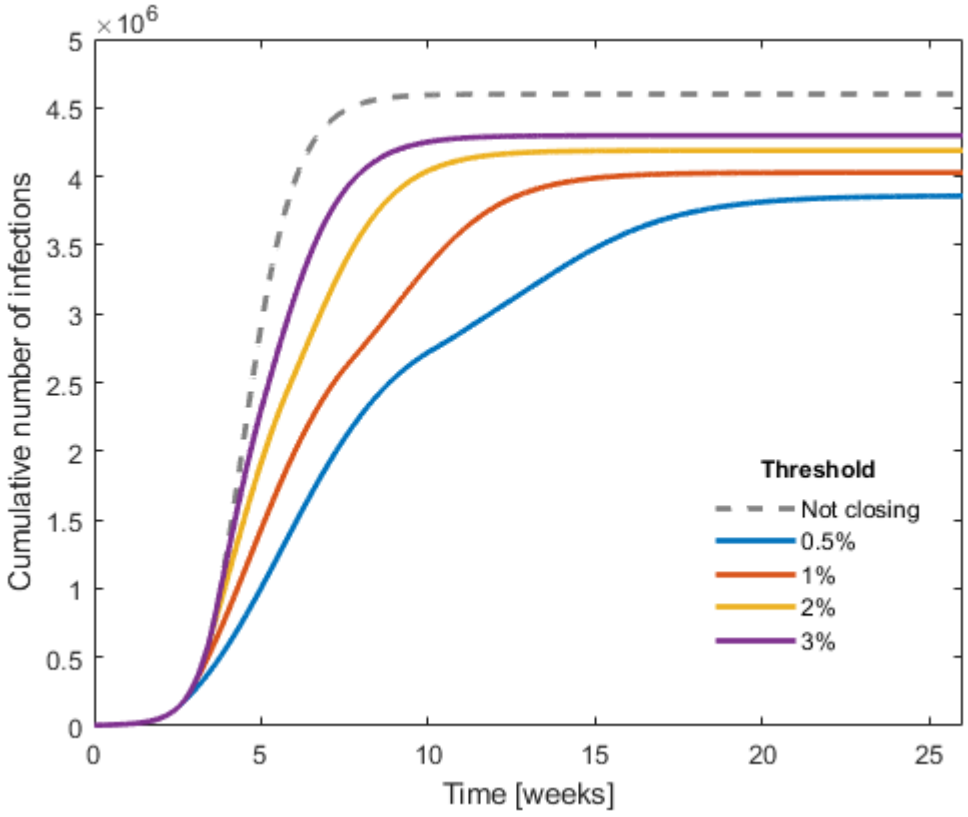
Effectiveness of the Vaccine



Closing Schools

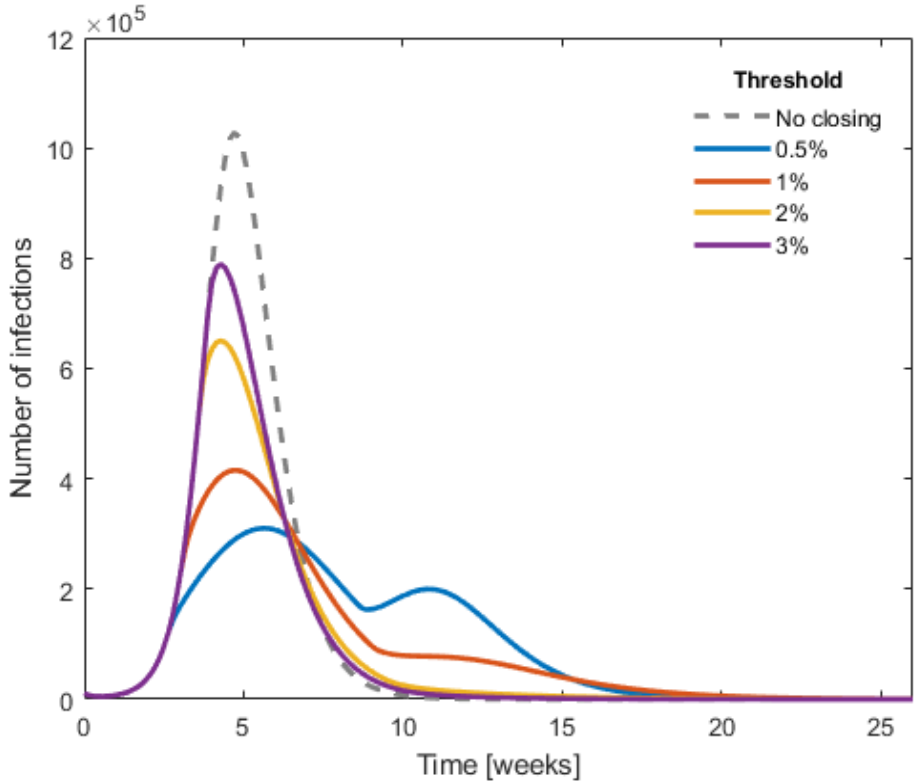
The schools close when the number of infections surpasses a threshold

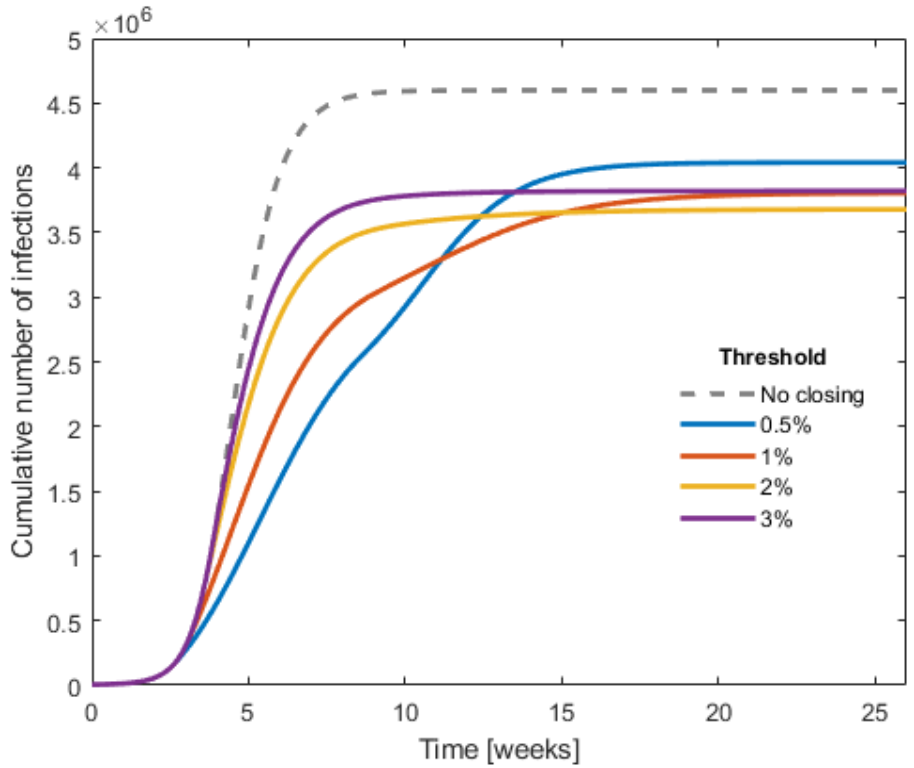




Closing Schools for six weeks

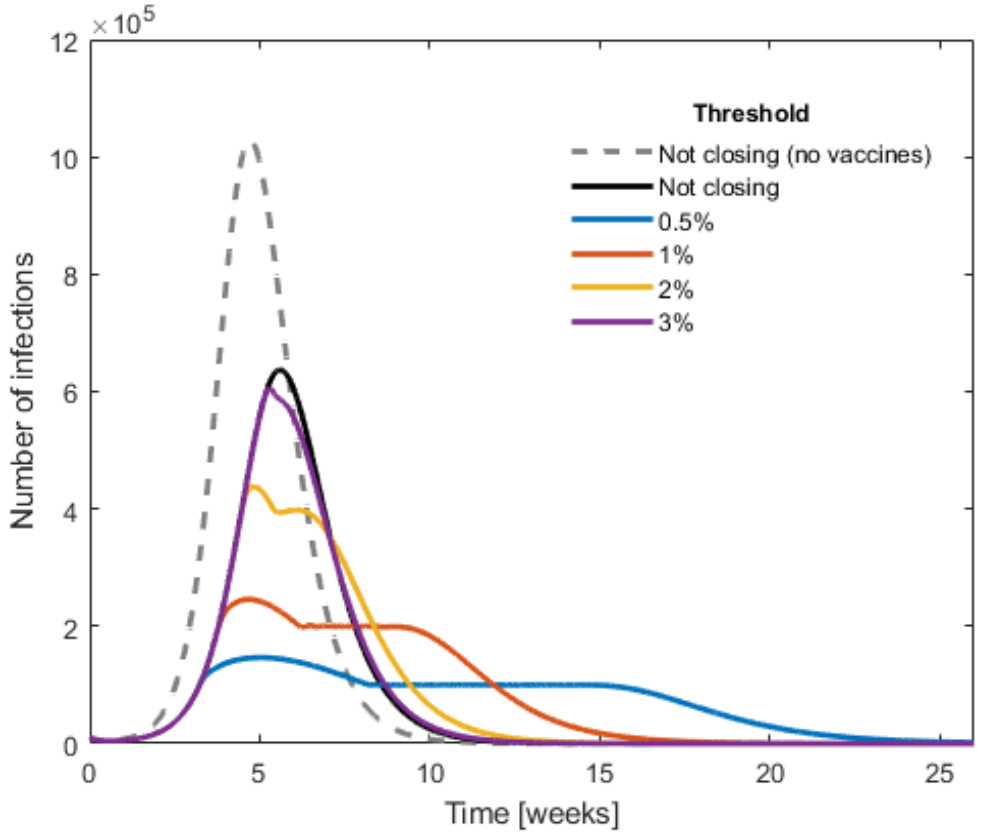
The schools close for six weeks when the number of infections surpasses a threshold

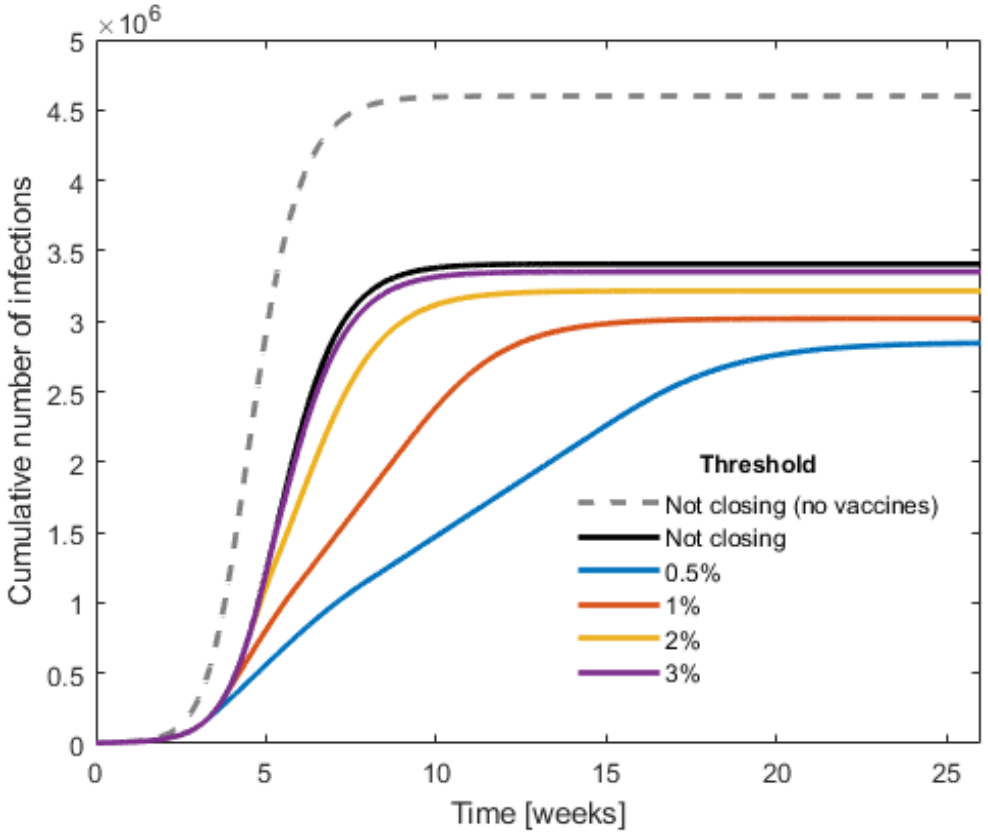




Combining Strategies

Combining vaccinations and closure of schools when the number of infections surpasses a threshold





Key Conclusions

- Uniform distribution of vaccines → not enough vaccines (required **57-59%** coverage)
- Closing nurseries and schools too late → little change
- Optimal distribution of the vaccine **depends** on its effectiveness
- Vaccination of the **5-14 age group** → most effective
- Threshold for school closure → **2%**

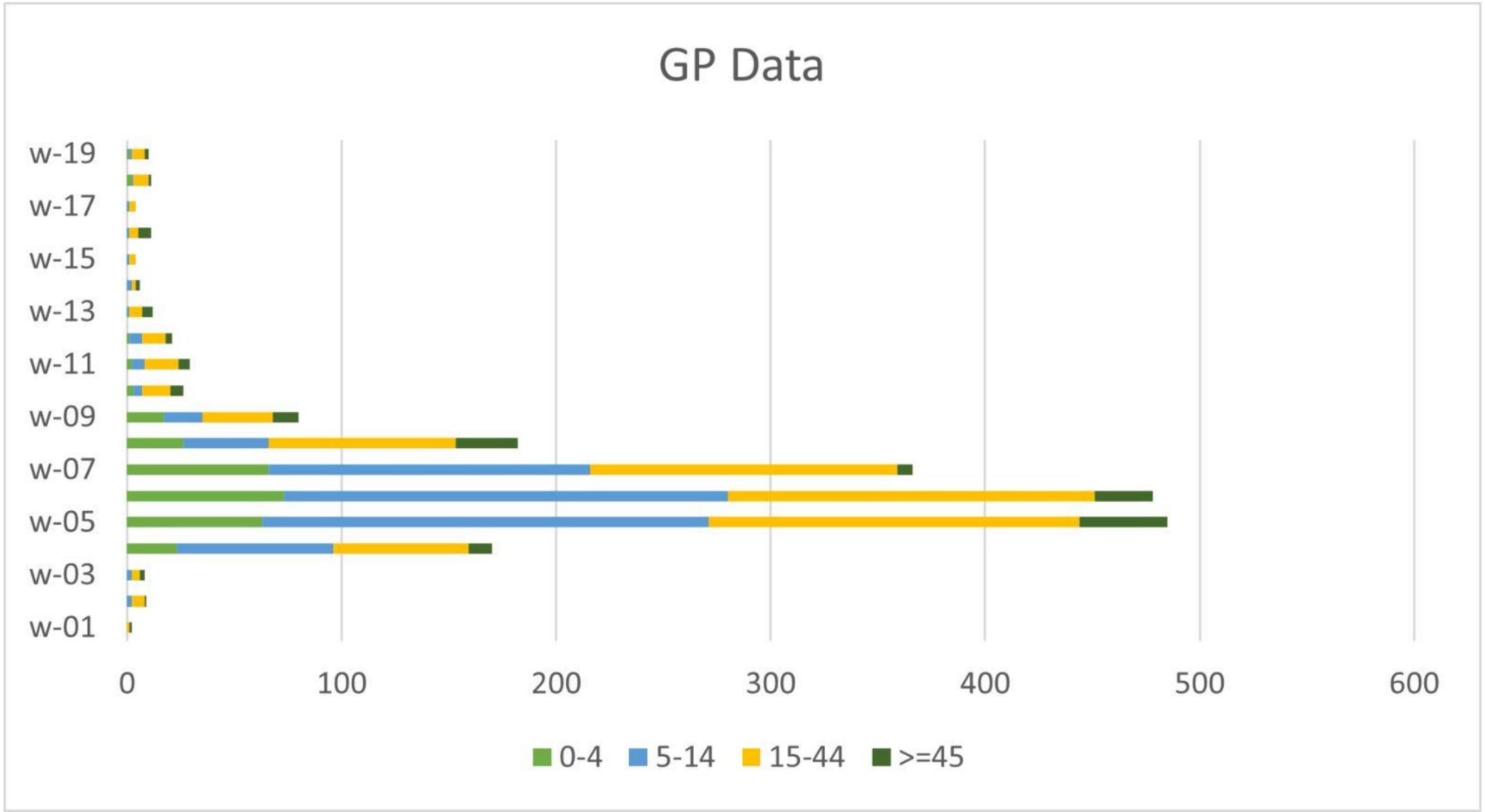
Recommendations

- Continue data collection
  - Contact
  - Recovery and deaths
- Recovered → susceptible
- Moment of vaccination
  - Additional compartment
- Refine age groups

THANK YOU FOR YOUR ATTENTION!

DURATION OF PANDEMIC

Duration [weeks]	**No closing**	**0.5%**	**1%**	**2%**	**3%**
Threshold	9.82	21.0	16.2	13.0	11.5
Threshold + vaccination	10.9	22.5	15.9	12.4	11.2
6 consecutive weeks	9.82	15.1	18.3	11.6	10.1
Peak size [10^5]					
Threshold	10.3	2.93	3.84	5.41	7.15
Threshold + vaccination	6.36	1.47	2.46	4.38	6.06
6 consecutive weeks	3.43	4.12	4.98	7.15	9.60
Total no. of infections [10^6]					
Threshold	4.60	3.86	4.03	4.19	4.30
Threshold + vaccination	3.41	2.84	3.02	3.22	3.35
6 consecutive weeks	3.96	3.81	3.69	3.74	4.08


GP Data
w-19
w-17
w-15
w-13
w-11
w-09
w-07
w-05
w-03
w-01
0
100
200
300
400
500
600
0-4
5-14
15-44
>=45

Model Equations

- $S' = -\beta SI$
- $E' = \beta SI - \gamma E$
- $I' = \gamma E - \alpha I$
- $R' = \alpha I$

Where,
S = Number of Susceptible people
E = Number of Exposed people
I = Number of Infectious people
R = Number of Recovered people
β = Contact matrix, describing interactions between and within the age group
γ = parameter connected with latency period length
α = parameter connected with infectious period length