

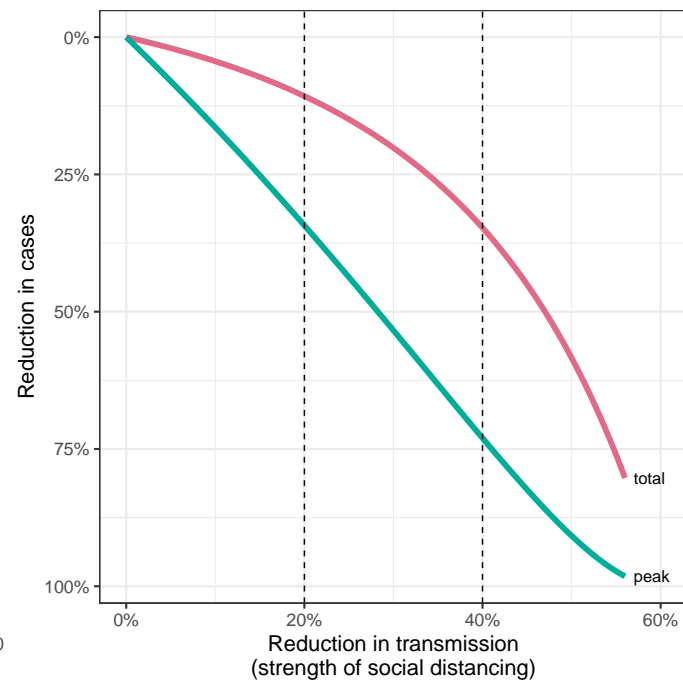
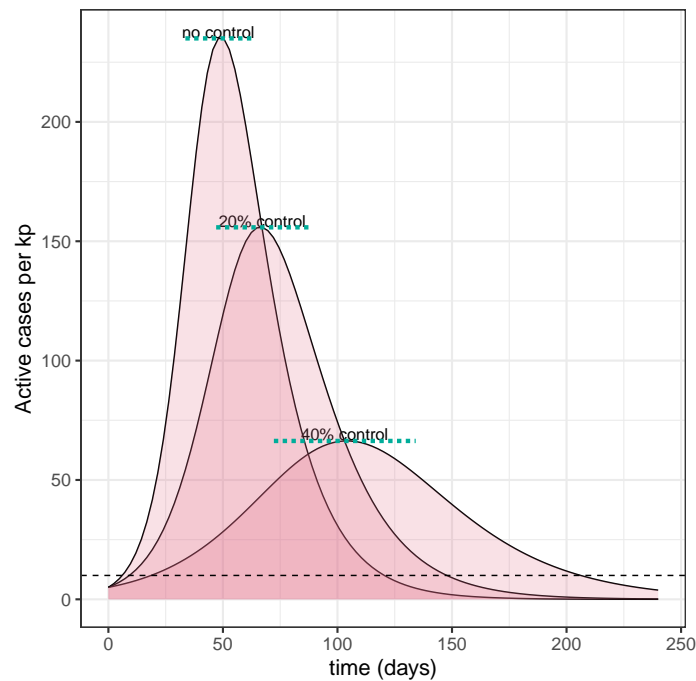
UNIT 8B: Coronavirus

1 Initial projections

What happens when we flatten?

- Poll: Which scenario has the lowest total number of cases shown (area under the curve)?

Flattening the curve



Flattening the curve

- More flattening than reduction in total

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- What are some benefits of just flattening?

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Behaviour and policy change

- Why were our early models so wrong?

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2 Endemic coronavirus

- Poll: What does it mean for SARS-CoV-2 to become “endemic”

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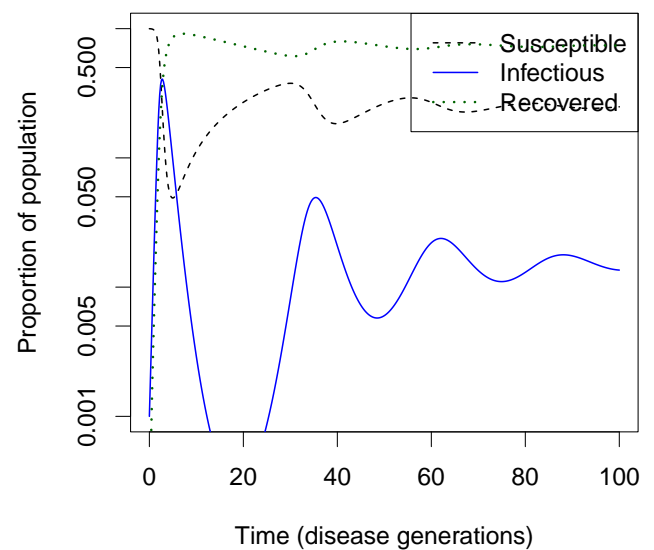
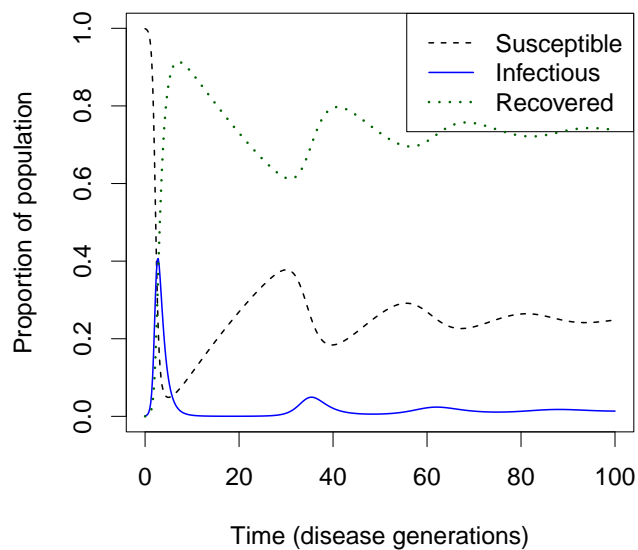
- What it doesn't mean:

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Disease burnout

- A disease that has a big epidemic and leaves very few susceptibles behind can go locally or globally extinct – we call this burnout
- Lots of evidence for influenza or measles burning out in isolated areas during less global times

Disease burnout



Adaptive responses

- How do people respond to fear of COVID-19?
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- What effects do we expect if people's worry levels about SARS-CoV-2 fluctuate with virus levels?
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Burnout and SARS-CoV-2

- Burnout seems very rare in the global era
- Adaptive responses work against burnout
 - When things are bad, people are more careful: less overshoot
 - When things are good, people are less careful: less chance to keep the virus down

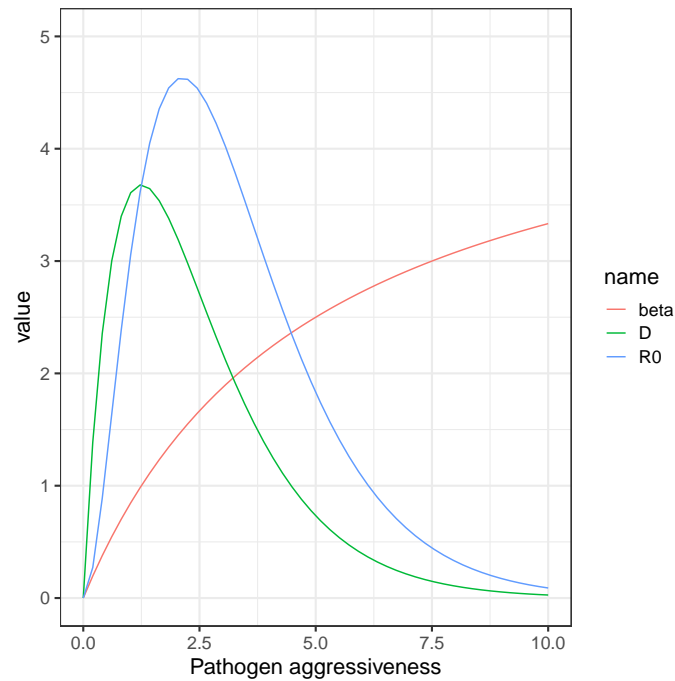
3 Pathogen aggressiveness

- Poll: Should viruses evolve to become more or less dangerous?
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Which strain will win?

- If the competing strains produce similar immune responses, this is exactly like equal competition: infections are competing for a single resource:
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- The winner will be the strain that has the highest “carrying capacity”:
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Pathogen aggressiveness



- Pathogen will evolve to maximize \mathcal{R}_0 .
- Is not affected by whether duration D is ended by host death, or by immune system clearing the pathogen

Human evolution

- We have evolved very good immune systems, but we can't always stay ahead of the viruses
- Should people evolve to favor the spread of more or less dangerous viruses?

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Omicron example

- Omicron spreads *much* better than earlier SARS-CoV-2 viruses
- It does less well in the lungs and better in the upper airways
- SARS-CoV-2 *may* be evolving in a less dangerous direction
 - There is no guarantee
 - Delta spread better and was *more* dangerous than previous

4 The future of SARS-CoV-2

What is different about SARS-CoV-2?

- What is the main difference between SARS-CoV-2 and other colds and flus?
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Human immunity

- The immune system is very complicated and very effective
 - T cells and B cells recognize different parts of the **pathogen**
 - Even partial recognition often protects people against severe outcomes
- Vaccines
 - Also likely to protect against severe outcomes

Immunity and the virus

- Our immune systems may see different variants of the virus differently:
 - Cross-immunity to a different strain might be less effective than direct immunity to the strain I was infected with
- How will this change our picture of competition?
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Herd immunity

- Poll: What is meant by herd immunity?
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- How much herd immunity do we need?
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Can herd immunity drive SARS-CoV-2 extinct?

- What extinct viruses do we know about? How did they get there?

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Levels of disease

- In the long run, how long we go between COVID-19 infections will likely depend mostly on how long our immunity lasts, or else on

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Just another seasonal coronavirus (JASC)

- This is a *theory* that lack of population immunity is the *only* difference between SARS-CoV-2 and other viruses that cause common colds
 - Some versions of the theory account for SARS-CoV-2 continuing to evolve in that direction

- Poll: What do you think of this theory?

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Moving forward

- We need to pay attention and figure out how strongly to prioritize SARS-CoV-2 control
- We also need to be thinking about detecting and responding to the next pandemic!