COVID-19 Webinar:
Fiscal, monetary and health policy responses and implications for the economic outlook

Thursday, April 2, 2020   11 a.m. ET
A discussion with
Alan Blinder, Bill Dudley, Jessica Metcalf
Moderated by Senator Bill Frist, M.D.

Webinar recording will be available
at https://gceps.princeton.edu/events/

Sponsored by:
COVID-19: Current health trajectory, policy implications

C. Jessica Metcalf & Bryan T. Grenfell
Early outbreak

Two key quantities:
$R_0$, here $= 2$
Serial interval:
Early outbreak

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Serial interval: 

Exponential growth

Early outbreak

Two key quantities:
$R_0$, here = 2
Serial interval:

Exponential growth

Intervention impacts appear 2-3 weeks in the future.

Early outbreak

A major public health issue:
- **asymptomatic** transmission (?30-80%), impedes containment
- **severe outcomes** for many, overwhelming health systems
Early outbreak

A major public health issue:
-asymptomatic transmission (?20-80%), impedes containment
-severe outcomes for many, overwhelming health systems

Cases are not infections
IFR << CFR

https://www.cdc.gov/mmwr/volumes/69/wr/mm6912e2.htm?s_cid=mm6912e2_w#T1_down
http://weekly.chinacdc.cn/en/article/id/e53946e2-c6c4-41e9-9a9b-fea8db1a8f51
Early outbreak

A major public health issue:
- **asymptomatic** transmission (20-80%), impedes containment
- **severe outcomes** for many, overwhelming health systems

Cases are not infections

IFR << CFR
Over time

Combine county level **demography** (Census data) and # of **hospital beds** (American Hospital Association), assume **40%** of the pop. is infected; **80%** show symptoms:

- **no beds; cases allocated to neighbouring counties.**

https://github.com/ianfmiller/covid19-burden-mapping

Ian Miller, Alex Becker
Over time

\[ R_0 = 3 \]

Metcalf et al. 2015 Trends in Immunology
Over time

\[ R_0 = 3 \]

Metcalf et al. 2015 Trends in Immunology
Over time

\[ R_0 = 3 \]

Metcalf et al. 2015 Trends in Immunology
Over time

![Diagram showing the susceptible (black), infected (red), and recovered (green) populations over time. The graph illustrates the concept of herd immunity, where as more individuals become immune, the spread of the infection decreases. The parameter $R_0 = 3$ is shown, indicating the basic reproduction number.](image-url)

- Susceptible
- Infected
- Recovered

R_0 = 3

Metcalf et al. 2015 Trends in Immunology
Over time

Policies implemented:
• Case based self-isolation mandated
• Social distancing encouraged
• Public events banned
• School closure ordered
• Lockdown ordered
Coronaviruses are ‘winter’ pathogens: reduced humidity / lower temperatures may increase transmission
Seasonality

Coronaviruses are ‘winter’ pathogens: reduced humidity / lower temperatures may increase transmission

But magnitudes unlikely to overwhelm the effects of the large pool of susceptible individuals.
Seasonality

1918–1919, Copenhagen

60%

35%

5%

typical flu season

Miller et al. 2009 NEJM
Serology: a Global Immunological Observatory

Cases and deaths:

- Susceptible
- Infected
- Recovered
Serology: a Global Immunological Observatory

Susceptible

Infected

Recovered

Cases and deaths:
Provide an incomplete window onto the epidemic

Use of serological surveys to generate key insights into the changing global landscape of infectious disease

C Jessica E Metcalf, Jeremy Farrar, Felicity T Cutts, Nicole E Basta, Andrea L Graham, Justin Lessler, Neil M Ferguson, Donald S Burke, Bryan T Grenfell
Serology: a Global Immunological Observatory

Cases and deaths:
Provide an incomplete window onto the epidemic

Serology:
Measurement of antibodies can complete the picture

Use of serological surveys to generate key insights into the changing global landscape of infectious disease

C Jessica E Metcalf, Jeremy Farrar, Felicity T Cutts, Nicole E Basta, Andrea L Graham, Justin Lessler, Neil M Ferguson, Donald S Burke, Bryan T Grenfell
Serology: understanding the early phase

![Graph showing serology understanding the early phase. The graph plots cases (under-reported) against weeks, with a peak around week 5. The line represents true x under-reporting, and the dots represent observed values.](image-url)
Serology: understanding the early phase

![Graph showing cases over weeks with different lines representing fitted, true x under-reporting, and observed data.]
Serology: understanding the early phase

Cases (under-reported)

Weeks

Proportion susceptible

Weeks
Serology: the step-down

What will 'seropositive' mean?

‘Recovereds’ may be recalcitrant to re-infection for at least a season, based on:
- Experimental evidence from beta-coronaviruses
- Indirect math models for alpha-coronaviruses
- Profile of immunity following COVID-19 infection

Testing health care workers, other essential professions could be part of movement to moving back to normality.
Low and Middle Income Countries

Social distancing may be impossible.

Engineering efficient spread of trusted information is essential.

Economic safety nets are urgent.

The backdrop of infection that the pandemic is spreading across is poorly understood.
Open questions

What will be **social and economic impact vs. epidemiological advantages** of different shut down strategies be?

Will **combinations of testing, registration and tracking** open the way to advancing the Pandemic Recovery Trajectory?

What can we **learn for next time?**
EXTRA SLIDES
Over-dispersion

Estimates from Hubei:
$R_0$ between 2 and 3
Serial interval $\sim 1$ week

Note! this assumes that new infections per infected individuals are $\sim$ consistent.
Over-dispersion

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<thead>
<tr>
<th>Not over-dispersed</th>
<th>Over-dispersed</th>
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<tbody>
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<td><img src="https://twitter.com/JustinLessler/status/1227375168130928641?s=20" alt="Diagram" /></td>
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<td>20% causes 80%</td>
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Estimates from Hubei:
- $R_0$ between 2 and 3
- Serial interval ~ 1 week

Over-dispersion = rarer onward transmission but potentially more explosive outbreaks.
## Over-dispersion

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- **Estimates from Hubei:**
  - $R_0$ between 2 and 3
  - Serial interval $\sim 1$ week

  - 60% causes 80%
  - 20% causes 80%

- 100% of introductions cause onward transmission

https://twitter.com/JustinLessler/status/1227375168130928641?s=20