How to Avoid Misinterpreting Data about a Pandemic

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Today’s Aims:

- Why *misinformation* matters & how to avoid it

1. Understanding some common *measures* for interpreting epidemics & their frequent misinterpretations

2. Accounting for *models’* different aims in studies of epidemics & how to evaluate them accordingly

3. The basis of *expertise* & why you should trust in it
Motivations
Measures
Models
Expertise

The ever-quotable Mark Twain:

“A lie can travel halfway around the world while the truth is putting on its shoes.”

MARK TWAIN

https://www.pinterest.com/pin/432064157972113715/
... or did he say pants?

“A lie gets halfway around the world before the truth has a chance to get its pants on.”

-Winston S. Churchill
That Wasn’t Mark Twain: How a Misquotation Is Born

Mark Twain is one of many who gets credit for famous quotations he never wrote or said. Jeff Chiu/Associated Press
Can’t we just correct misinformation?

- Correcting misinformation is difficult:
  1. Infodemic
     - overwhelming amount of COVID-19 info (WHO)
  2. “Illusory truth effect” –
     - mere exposure to misinformation can increase our belief in its truth (Pennycock et al)
  3. The “back-fire effect”
     - confronting w/ corrections can strengthen prior beliefs (Nyhan & Reifler)
     - but, mixed-evidence (e.g., Wood & Porter)
     - facts more adjustable than attitudes (e.g., Bail et al.)
THE RECALL OF AFFIRMATIVE AND NEGATIVE SENTENCES IN AN INCIDENTAL LEARNING TASK

ELIZABETH R. CORNISH AND P. C. WASON

Department of Psychology, West Ham College of Technology, and the Psycholinguistics Research Unit, University College, London

This experiment examined the recall of positive and negative information in an incidental learning task. The two main findings were that a significantly greater number of affirmative than negative clues were correctly recalled and that the majority of errors took the form of conversions from negative to affirmative, independently of meaning. The difficulty associated with the negative clues was explained in terms of their inappropriateness in the situation, namely in the absence of any prior expectations.
Fig 1. Mean number of ‘Present’ answers as a function of delay and type of information

Maciuszek J, Polczyk R (2017) There was not, they did not: May negation cause the negated ideas to be remembered as existing?. PLOS ONE 12(4): e0176452. https://doi.org/10.1371/journal.pone.0176452
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0176452
COVID-19 Effects of Exposure to Misinformation

Motivations Measures Models Expertise

Figure 12: Carlson-Hannity pandemic coverage gap and effects on cases and deaths

Notes: Figure 12 shows, in brown squares ... income, the unemployment rate, the 2016 Republican votes share, and the total number of votes cast in 2016.

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Source: https://ssrn.com/abstract=3580487
To sum up so far...

- **why** avoiding misinformation is important

1. Can help filter what’s worth paying attention to.
2. MI can be hard to replace.
3. MI can shape behavior & outcomes in detrimental ways.

→ The best way to deal w/misinfo is to **get out ahead of it**.
“In epidemics and pandemics...an **infodemic** [is] an over-abundance of information – some accurate and some not – that makes it hard for people to find trustworthy sources and reliable guidance when they need it.” Including:

- WHO: cause/source, symptoms, transmission, treatment, interventions.

1. R0 (“R-naught”)
2. “Flattening the Curve”
3. Testing
4. Fatality rate(s)

[https://www.who.int/teams/risk-communication/infodemic-management](https://www.who.int/teams/risk-communication/infodemic-management)
- R0 is the “reproductive rate of infection”, or the number of new cases expected to be generated—on average—by each existing case, in a fully susceptible population.
R0 – What does(n’t) it tell us?

- R0 estimates the growth-rate of new infections
- Is the product of three elements ($R_0 = \beta \cdot c \cdot D$):
  1. (D) the duration of infectiousness
  2. (c) rate of contact between susceptibles & infectious
  3. ($\beta$) likelihood of transmission between contacts

- It does not determine final outbreak extent (Watts et al., 2005)
- It is not solely a feature of the virus, but combines with social/biological/cultural differences across societies

→ varies across sub-populations
“Flattening the Curve”

seeks to manage response capacity
- e.g., avoid surpassing hospital beds

w/o other interventions, FtC:
- will not necessarily reduce # of cases,
- will elongate the duration of the outbreak

➔ gives time; is *not* the sole intervention

includes: social distancing, masks, handwashing complements: expanded treatment capacity, developing new treatments/preventatives, etc.
Types of Tests

1. **diagnostic** – detect *current infections* typically w/swab of respiratory tract
   - RT-PCR

2. **serologic** - antibody test tells you if you had a *previous infection*
   - rapid or ELISA
   - IgG, IgM, CMIA


Estimated Variation Over Time in Diagnostic Tests for Detection of SARS-CoV-2 Infection Relative to Symptom Onset

Estimated time intervals and rates of viral detection are based on data from several published reports. Because of variability in values among studies, estimated time intervals should be considered approximations and the probability of detection of SARS-CoV-2 infection is presented qualitatively. SARS-CoV-2 indicates severe acute respiratory syndrome coronavirus 2; PCR, polymerase chain reaction.
Testing accuracy: 2 Questions in 1

- **sensitivity** - probability of a positive result given infection
  - i.e., the test is “sensitive” to the presence of the virus

- **specificity** – probability of a negative result given no infection
  - i.e., the test is “specific” to the particular virus tested for

Generally
- specificity > sensitivity
- antibody > diagnostic
- ELISA > rapid (especially on sensitivity)

Image source: wikipedia

What’s in a Fatality Rate?

Important to know how lethal the COVID-19 is (contributes to what a “proportional response” looks like).

- So we likely want to be able to answer how common are COVID-19 attributable deaths (fatalities)

\[
\text{Fatality Rate} = \frac{N \text{ deaths}}{N \text{ at risk}}
\]

1. What’s in the denominator?
2. How do we count the numerator?
Which Fatality Rate?

Fatality Rate = \( \frac{N \text{ deaths}}{N \text{ at risk}} \)

What’s in the denominator (who’s at risk)?

- SCCFR – confirmed cases among those w/symptoms
- CCFR – confirmed cases
- CFR – presumed cases (confirmed + suspected)
- IFR – among the total number infected
- CAMR – (“cause attributable”) among the entire population (e.g., >1/1,000 in NY-state).

→ Our ability to estimate each of these changes over time (e.g., with testing capacity & standards)

<table>
<thead>
<tr>
<th></th>
<th>SCCFR</th>
<th>CCFR</th>
<th>CFR</th>
<th>IFR</th>
<th>CAMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1573</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(June 10, CDPHE)</td>
</tr>
<tr>
<td>&lt;CC</td>
<td>28,499</td>
<td>&gt;CC</td>
<td>2-4*CC</td>
<td>5.8m</td>
<td></td>
</tr>
<tr>
<td>&gt;CCFR</td>
<td>5.5/100</td>
<td>&lt;CCFR</td>
<td>1.4-2.8%</td>
<td>2.7/10k</td>
<td></td>
</tr>
</tbody>
</table>
Counting Deaths

Fatality Rate = \frac{N \text{ deaths}}{N \text{ at risk}}

Is the numerator easier to estimate?

- How do we determine deaths attributable to COVID-19?
  1. Positive test (death w/ SARS-COV-2 infection)
  2. COVID-19 cause of death (1,328/1,573)
  3. Presumed status? (cases 2-4 times confirmed cases)
  4. Excess deaths
Counting Excess deaths

<table>
<thead>
<tr>
<th>Place</th>
<th>All deaths</th>
<th>Excess deaths</th>
<th>Reported covid-19 deaths</th>
<th>Covid-19 deaths as % of excess deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>280,016</td>
<td>15,400</td>
<td>8,128</td>
<td>53%</td>
</tr>
<tr>
<td>New York City</td>
<td>11,492</td>
<td>6,300</td>
<td>2,543</td>
<td>40%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>9,854</td>
<td>2,200</td>
<td>846</td>
<td>38%</td>
</tr>
<tr>
<td>New York</td>
<td>11,805</td>
<td>1,700</td>
<td>1,022</td>
<td>60%</td>
</tr>
<tr>
<td>Michigan</td>
<td>10,783</td>
<td>700</td>
<td>540</td>
<td>77%</td>
</tr>
<tr>
<td>Maryland</td>
<td>5,312</td>
<td>300</td>
<td>53</td>
<td>18%</td>
</tr>
</tbody>
</table>
| Washington state     | 1,253      | 100           | 310                      | Covid-19-reported deaths exceed excess estimate | 1,600 excess deaths March 15 – May 16

All figures are for March through April 4. New York City and Washington state have since updated the numbers for this period. New York state figures exclude New York City.


To sum up this section

- ... what measures do & don’t meant

1. **$R_0$** varies across outbreaks & doesn’t predict extent
2. **Flattening the curve**
   - aims to not overwhelm medical care capacity
   - can make an outbreak last longer
   - allows time for other interventions
3. Diagnostic & serologic **testing** serve different aims
4. **Fatality rates** are hard to estimate, rely non-comparable information, w/ changing availability/quality

→ hopefully when reading new updates, you now know how to interpret & when (not) to compare common concepts
All models are wrong, but some are useful.

- George Box

https://thesocietypages.org/specials/what-are-covid-19-models-modeling/
What are COVID-19 models modeling? Generally there are 3 different aims that models can have

1. **Explanatory** models – account for details of what has already taken place (focus on exposures or outcomes)

https://thesocietypages.org/specials/what-are-covid-19-models-modeling/
Racial Disparities in COVID-19 in Colorado

https://covid19.colorado.gov/data/case-data
What are COVID-19 models modeling? Generally there are 3 different aims that models can have

1. **Explanatory models** – account for details of what has already taken place (focus on exposures or outcomes).

2. **Projection scenario models** – predictions about what would happen under certain hypothetical conditions.

Hospital & ICU Needs based on Social Distancing Scenarios

**ICU Need - Scenario 3(A-D)**

- 65% SD
- 55% SD
- 45% SD
- 55% -> 45%

Count

0 2,000 4,000 6,000

Days

03/23 05/23 07/23 09/23 11/23

https://drive.google.com/file/d/1ZCX_mloh0kQS-c9-UdPjqlBRVAovQnJl/
What are COVID-19 models modeling? Generally there are 3 different aims that models can have

1. **Explanatory models** – account for details of what has already taken place (focus on exposures or outcomes).
2. **Projection scenario models** – predictions about what would happen under certain hypothetical conditions.
3. **Forecast models** – what modelers predict we can expect to happen.

The **ensemble** forecast combines models unconditional on particular interventions being in place with those conditional on certain social distancing measures continuing. To ensure consistency, only models with 4 week-ahead forecasts ahead are included in the ensemble.

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**Data last updated on Tue, 02 Jun 2020 18:33:47 GMT.**

[https://reichlab.io/covid19-forecast-hub/](https://reichlab.io/covid19-forecast-hub/)
Why do Models Change

"We have said many times before: science is not static.

Science evolves. And as an organization, we evolve with it and make sure the guidance we put out reflects the best evidence out there."

-@WHO epidemiologist @mvankerkhove at a #COVID19 press briefing today. #coronavirus
To sum up this section

- how types of models differ in their aims

1. explanatory, projection, and forecasting models differ in their aims
   → it’s inappropriate to compare across models with different aims, evaluate one based on aims of another

2. science is iterative, not static
   → we should learn from new information
“DON’T BELIEVE EVERYTHING YOU READ ON THE INTERNET”

~ABRAHAM LINCOLN
There are experts

In the Fog of Coronavirus, There Are No Experts

Being able to Evaluate Info is Vital

Why the Coronavirus Is So Confusing

A guide to making sense of a problem that is now too big for any one person to fully comprehend

"The idea that there are no experts is overly glib."

Story by Ed Yong
Finding credible sources

- Ask yourself how accurate the information seems.

  ▪ encouraging readers to consider truthfulness reduced their likelihood of sharing misinformation.
Finding credible sources

- Ask yourself how accurate the information seems
- Seek confirmation
  - multiple, independent, sources can reduce the likelihood of being susceptible to false information
  - science is an ongoing, replicating, iterative, self-correcting process…”

https://xkcd.com/242/
Finding credible sources

- Ask yourself how accurate the information seems
- Seek confirmation
- Rely on experts who:
  - have domain expertise
  - clearly indicate what their work does (& doesn’t) do
  - make their assumptions explicit
  - provide details of data / sources
  - avoid over-confidence / grandiose claims
  - acknowledge limitations / uncertainties

To sum up...

1. Misinformation can lead to negative effects; build strategies to avoid it.
2. Knowing what key concepts mean can help limit susceptibility to misinterpretations of them.
3. Recognize that science is iterative, and has different sets of aims, which indicate bases for its evaluation.
4. Find reliable sources & develop strategies for identifying when sources are (not) accurate.