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

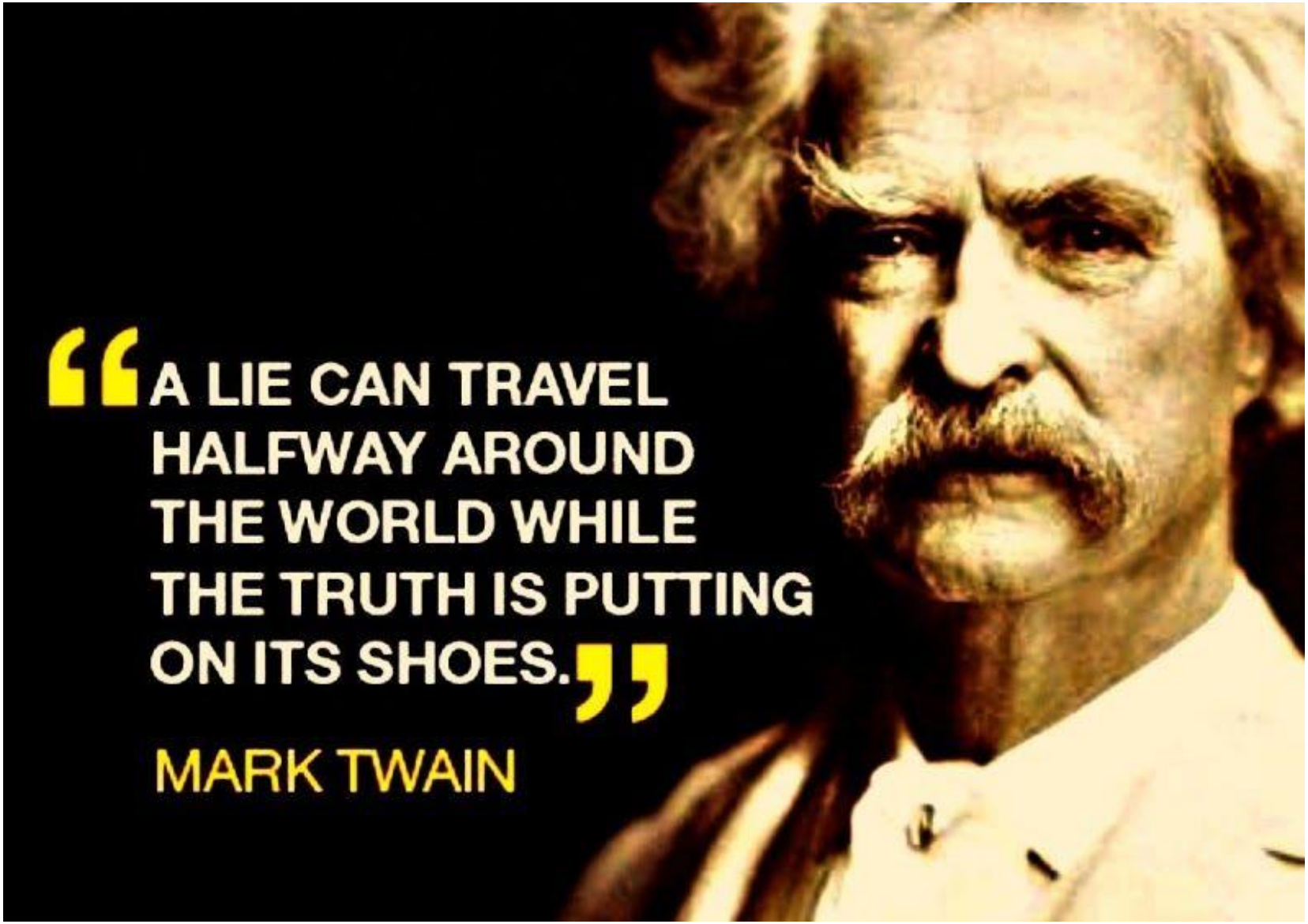
2. Accounting for models' different aims in studies of epidemics

   & how to evaluate them accordingly

3. The basis of expertise

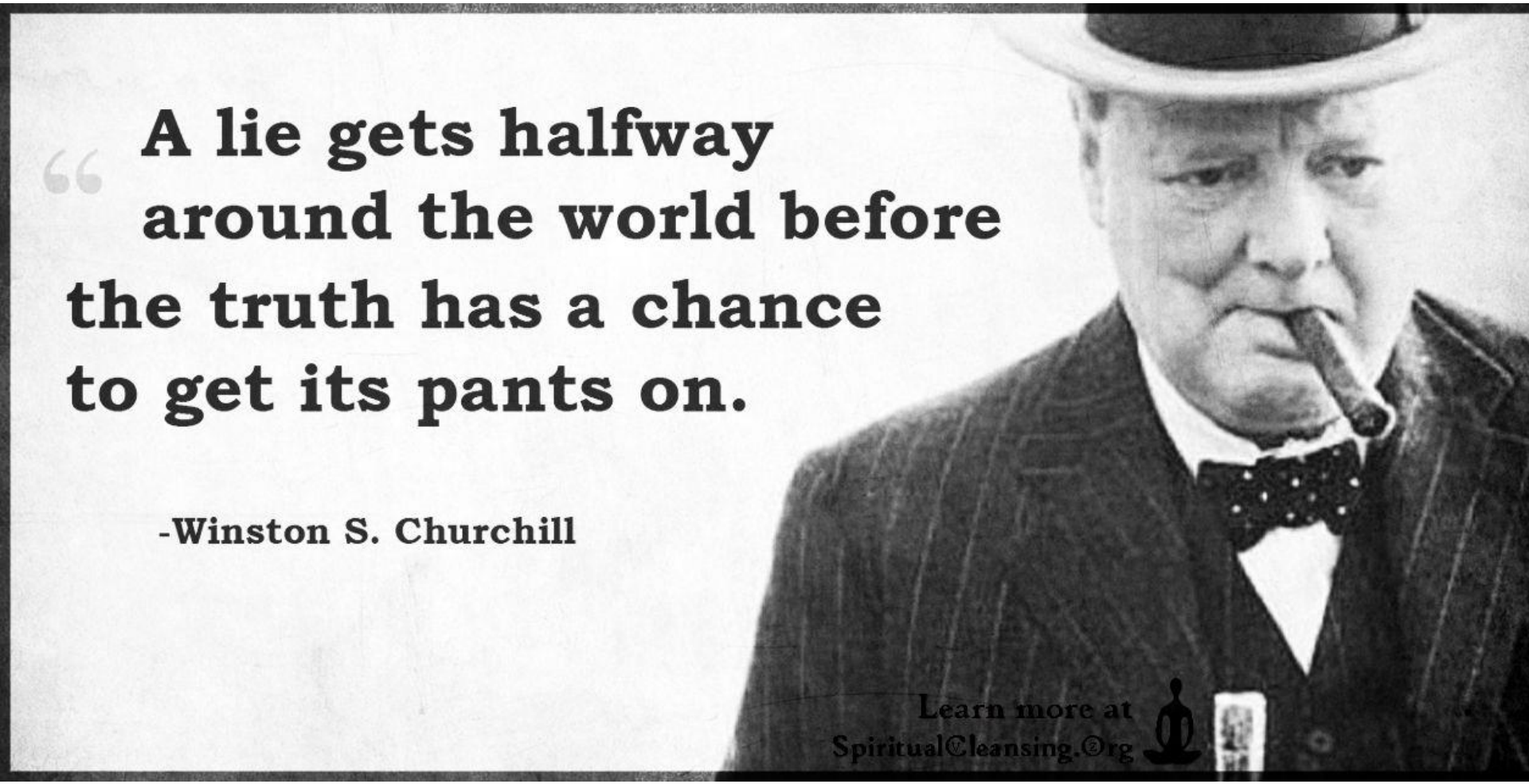
   & why you should trust in it

The ever-quotable Mark Twain:



https://www.pinterest.com/pin/432064157972113715/

… or did he say pants?



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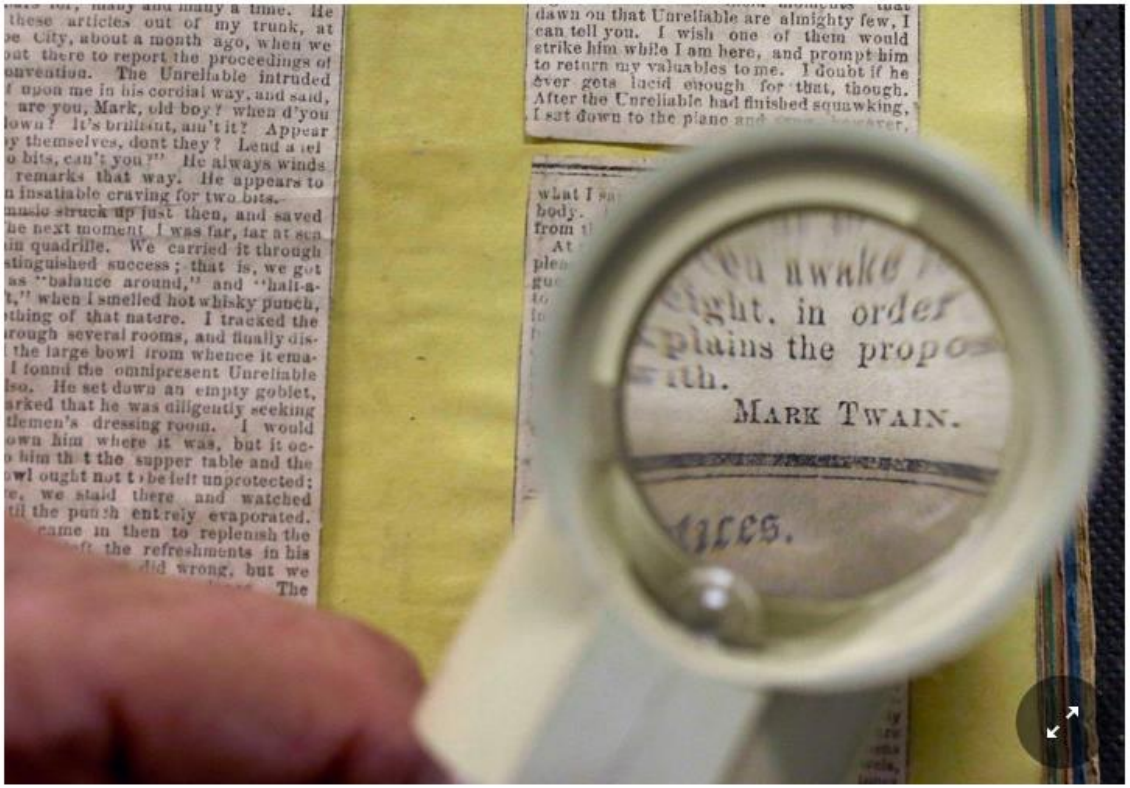
Funny thing is, *neither* of them said it.

The New York Times

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

- 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.)

Q. Jl exp. Psychol. (1970) **22**, 109–114

THE RECALL OF AFFIRMATIVE AND NEGATIVE SENTENCES IN AN INCIDENTAL LEARNING TASK

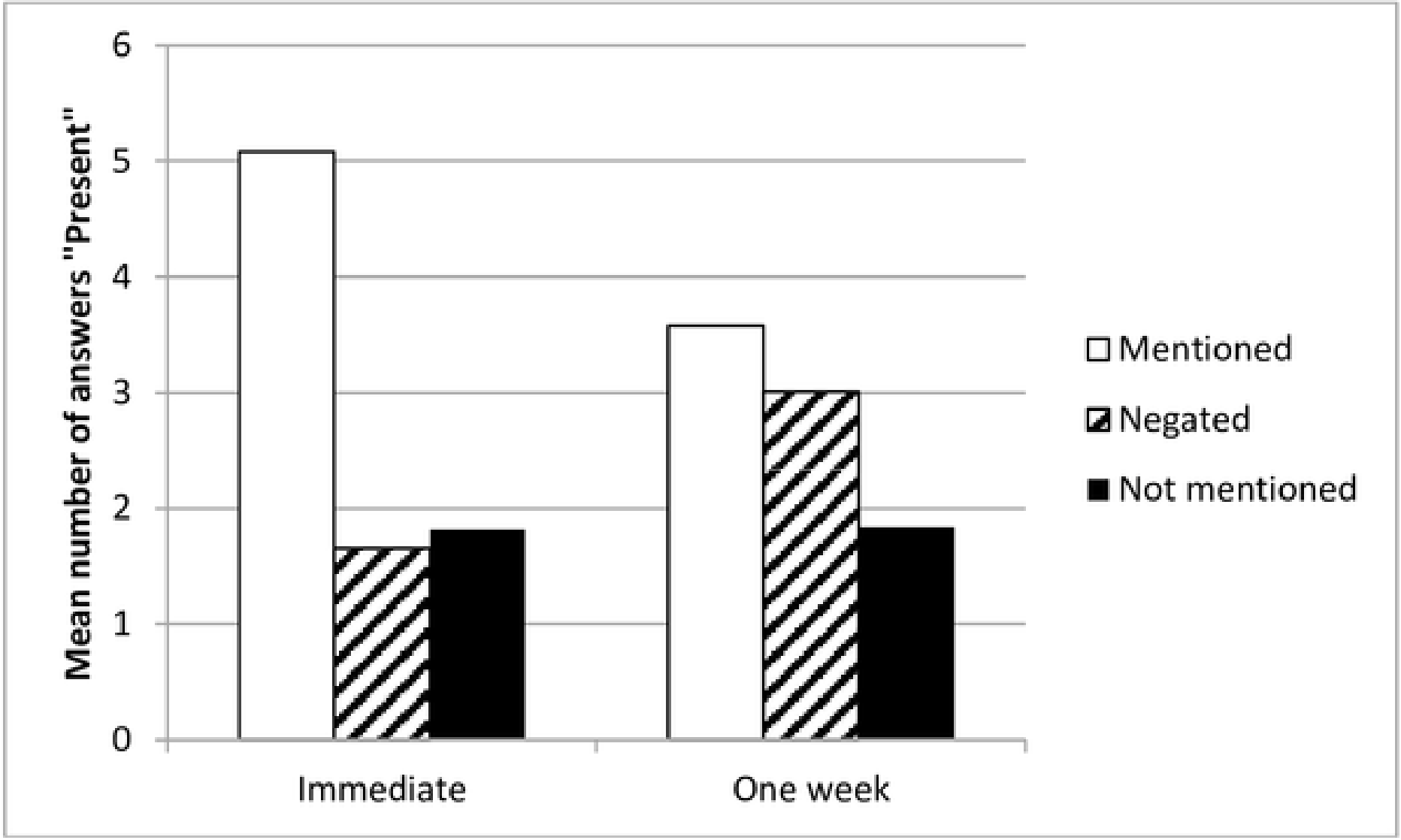
ELIZABETH R. CORNISH AND P. C. WASON

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.

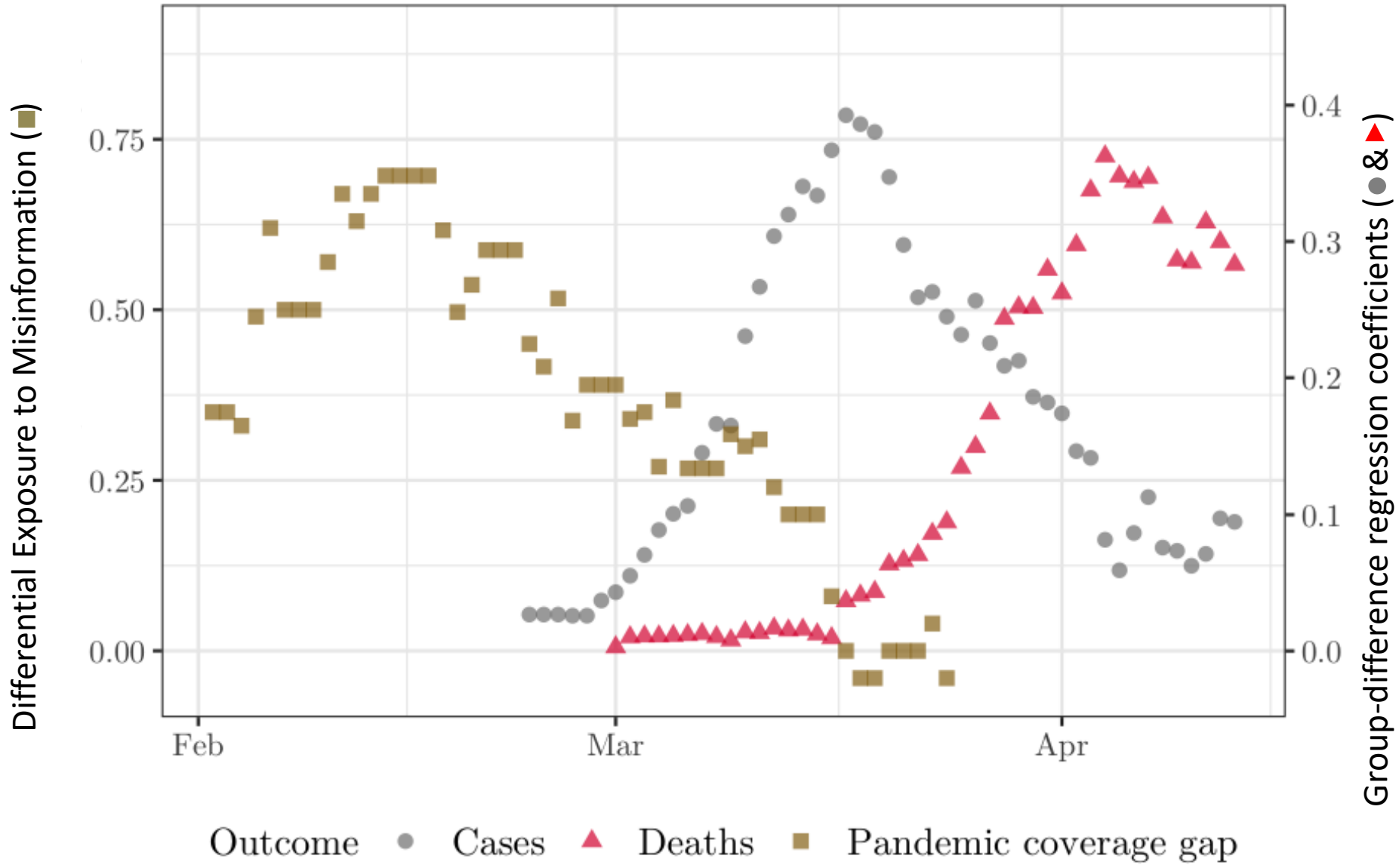
A limitation of memory

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



Source: https://ssrn.com/abstract=3580487

- … 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)

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

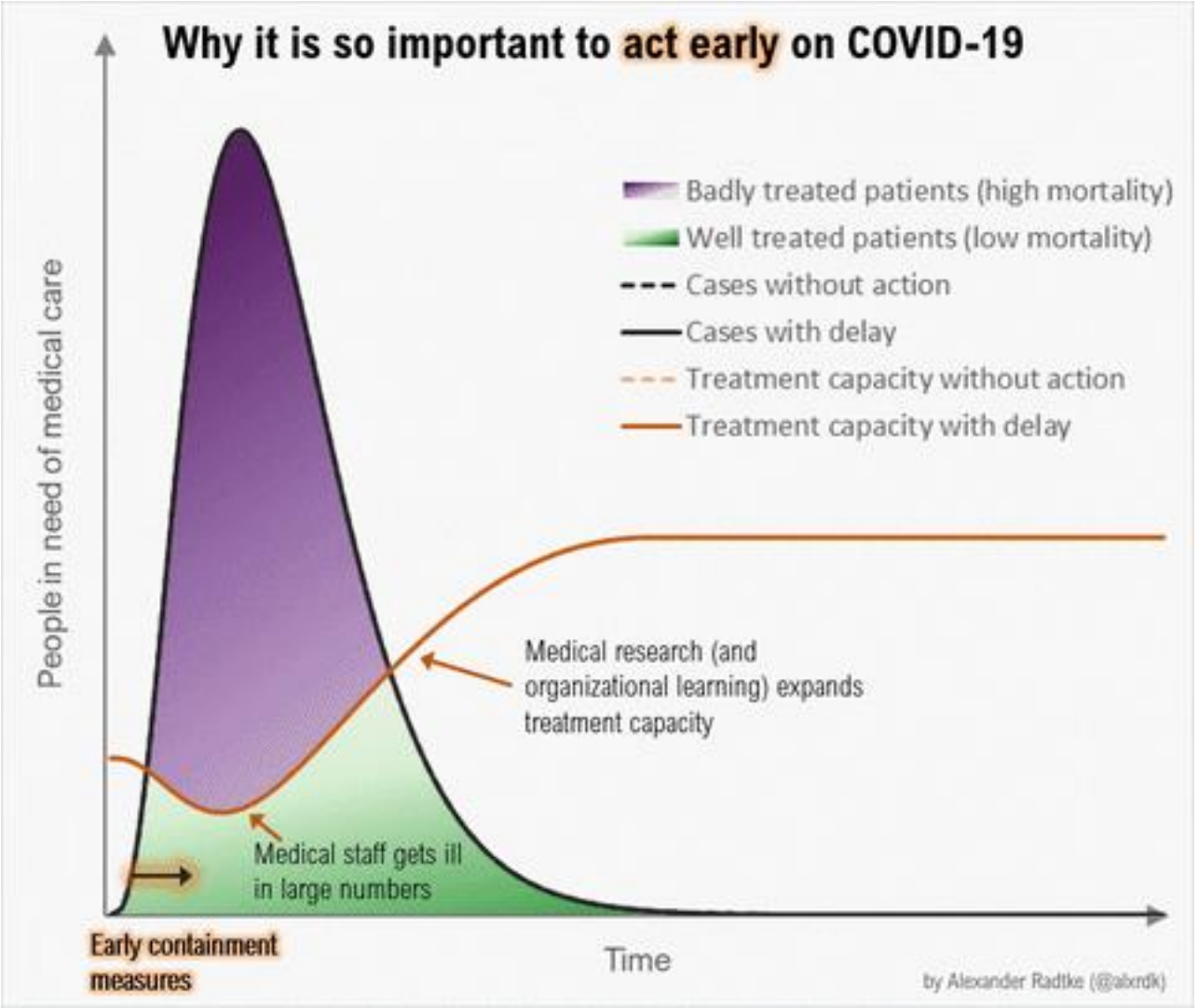
seeks to manage response capacity

- 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.

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

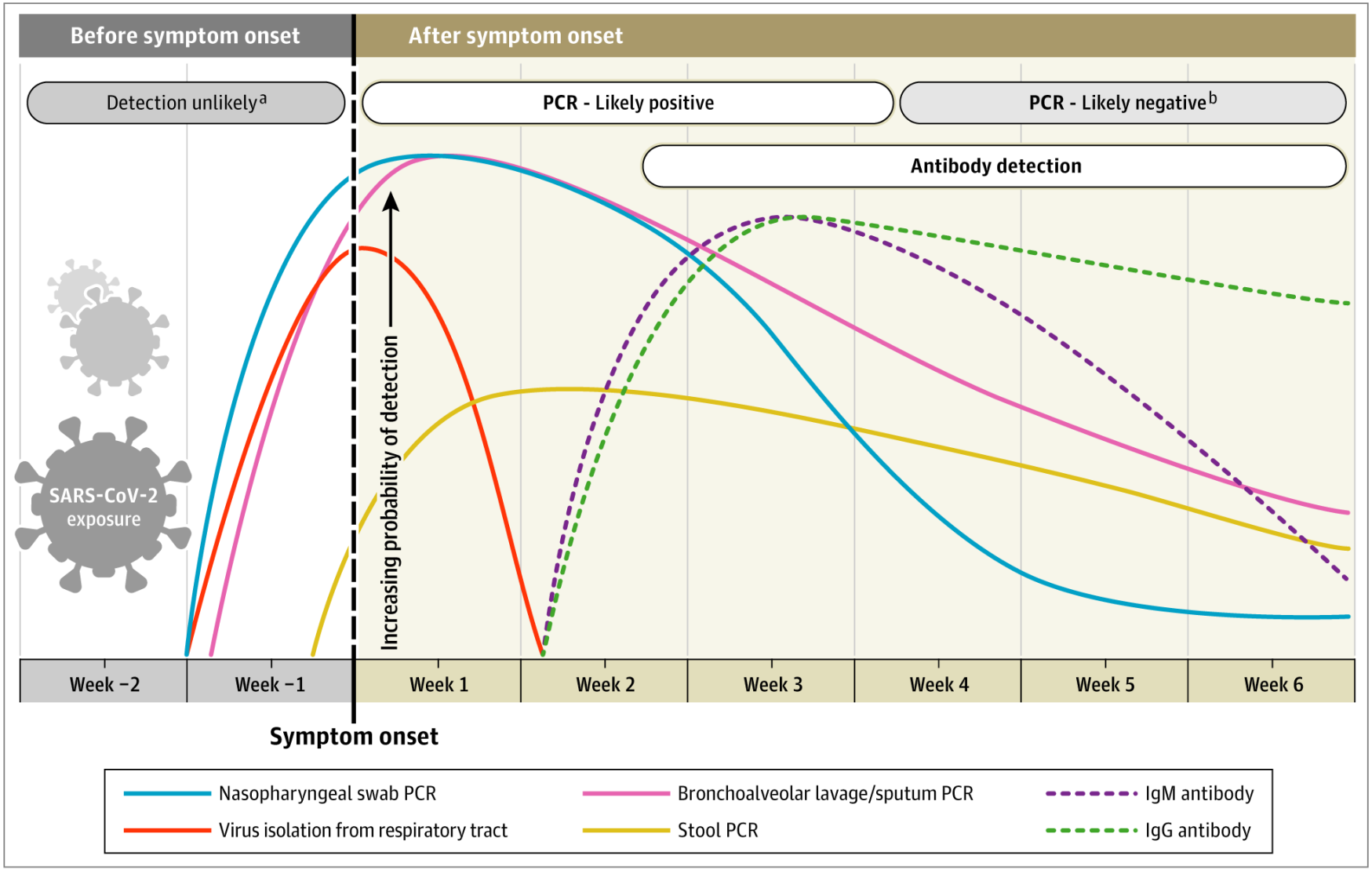
Image source: Reuters

Image source: Omar Marques

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

https://www.fda.gov/emergency-preparedness-and-response/mcm-legal-regulatory-and-policy-framework/emergency-use-authorization

When to Use which Test?



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

JAMA. Published online May 06, 2020. doi:10.1001/jama.2020.8259

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)

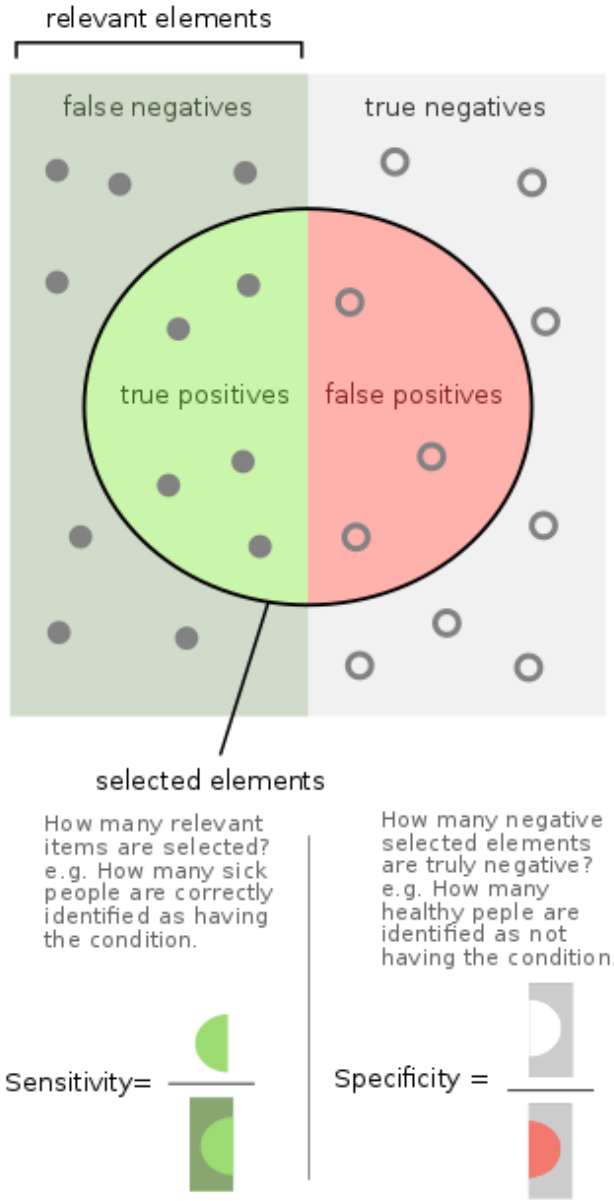


Image source: wikipedia

https://www.centerforhealthsecurity.org/resources/COVID-19/serology/Serology-based-tests-for-COVID-19.html

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)

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

1. What's in the denominator?
2. How do we count the numerator?

Which Fatality Rate?

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

SCCFR	CCFR	CFR	IFR	CAMR
1573 (June 10, CDPHE)				
<CC	28,499	>CC	2-4*CC	5.8m
>CCFR	5.5/100	<CCFR	1.4-2.8%	2.7/10k

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)

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

Is the numerator easier to estimate?

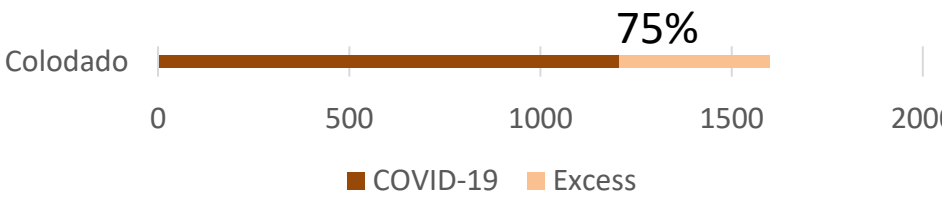
- How do we determine deaths attributable to COVID-19?
  1. Positive test (death w/ SARS-COV-2 infection)
  2. COVID-19 *cause of death* (1,328/1,573)
  3. Presumed status? (cases 2-4 times confirmed cases)
  4. Excess deaths

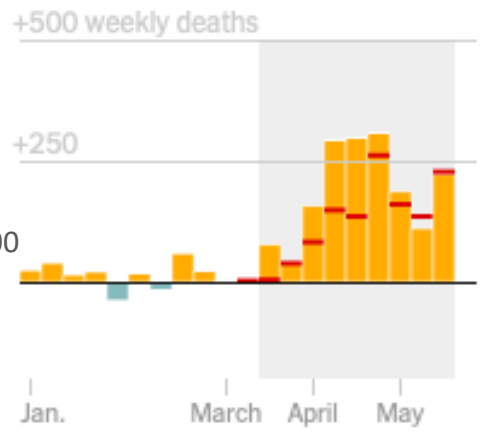
Counting Excess deaths

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

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

https://www.washingtonpost.com/investigations/2020/04/27/covid-19-death-toll-undercounted





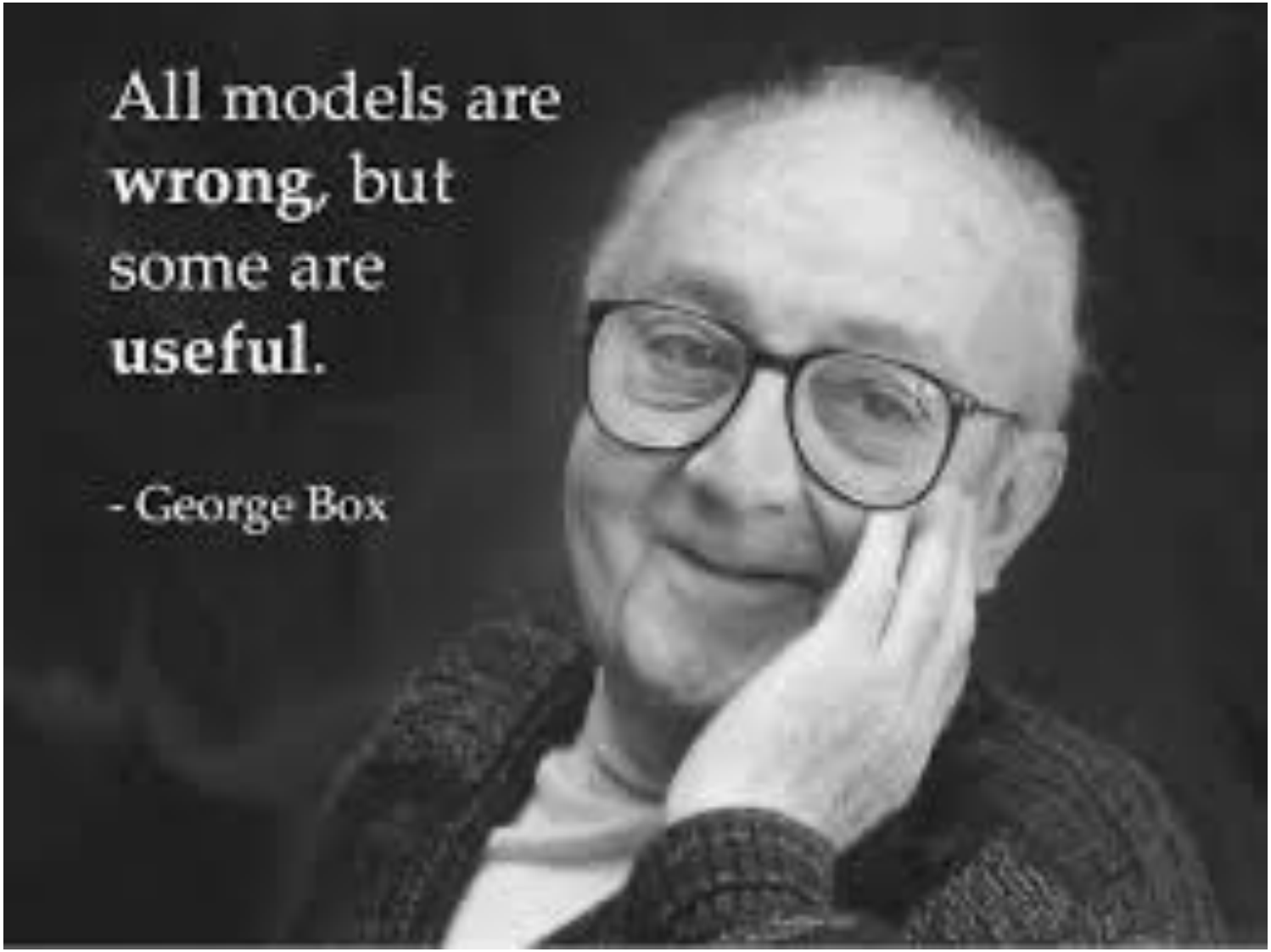
https://nyti.ms/3foi8ja & https://covid19.colorado.gov/cdc-death-counts

- … what measures do & don't meant

1. R0 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

Models – useful *for what*?



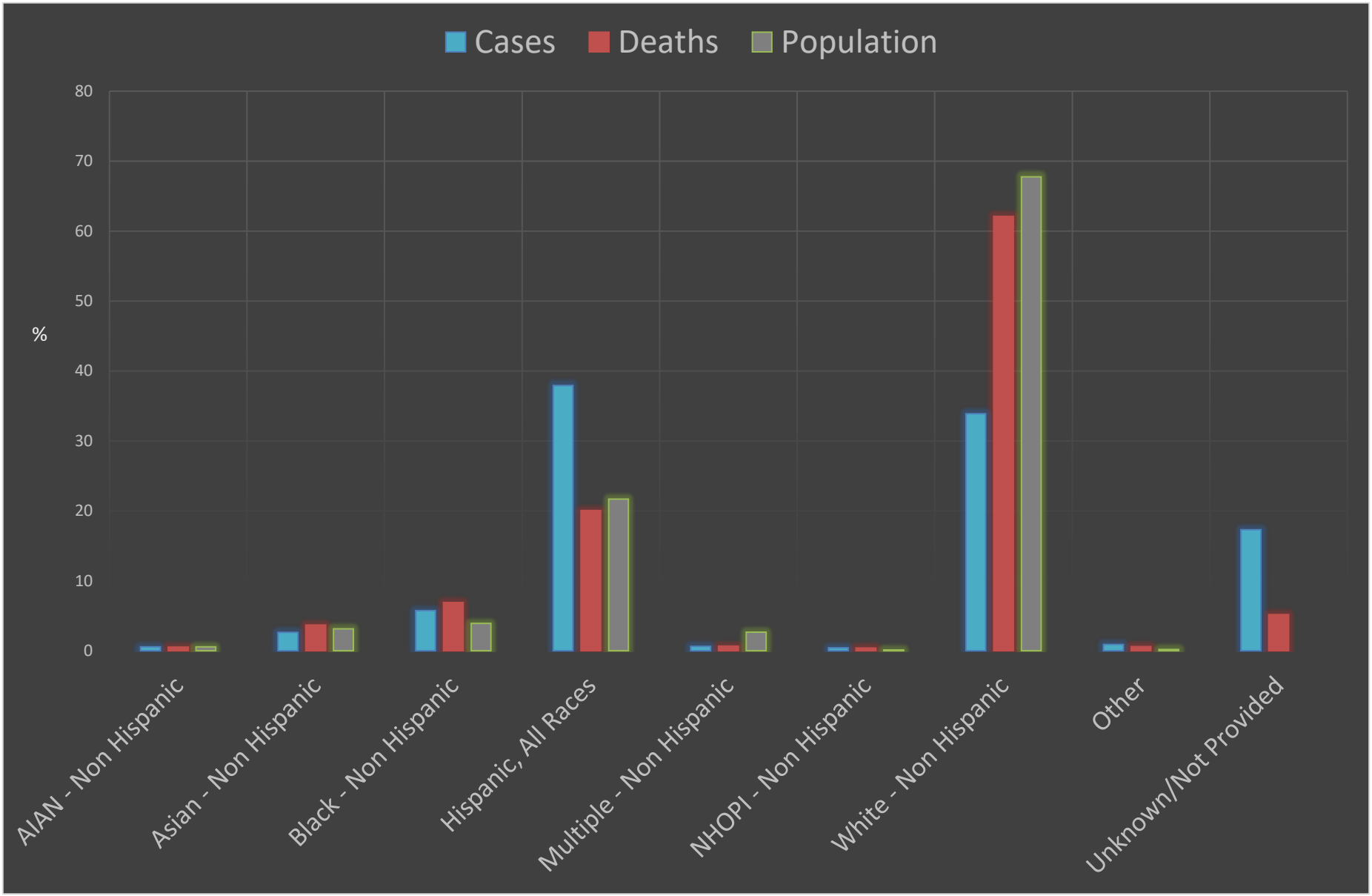
https://thesocietypages.org/specials/what-are-covid-19-models-modeling/

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



Denver

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.

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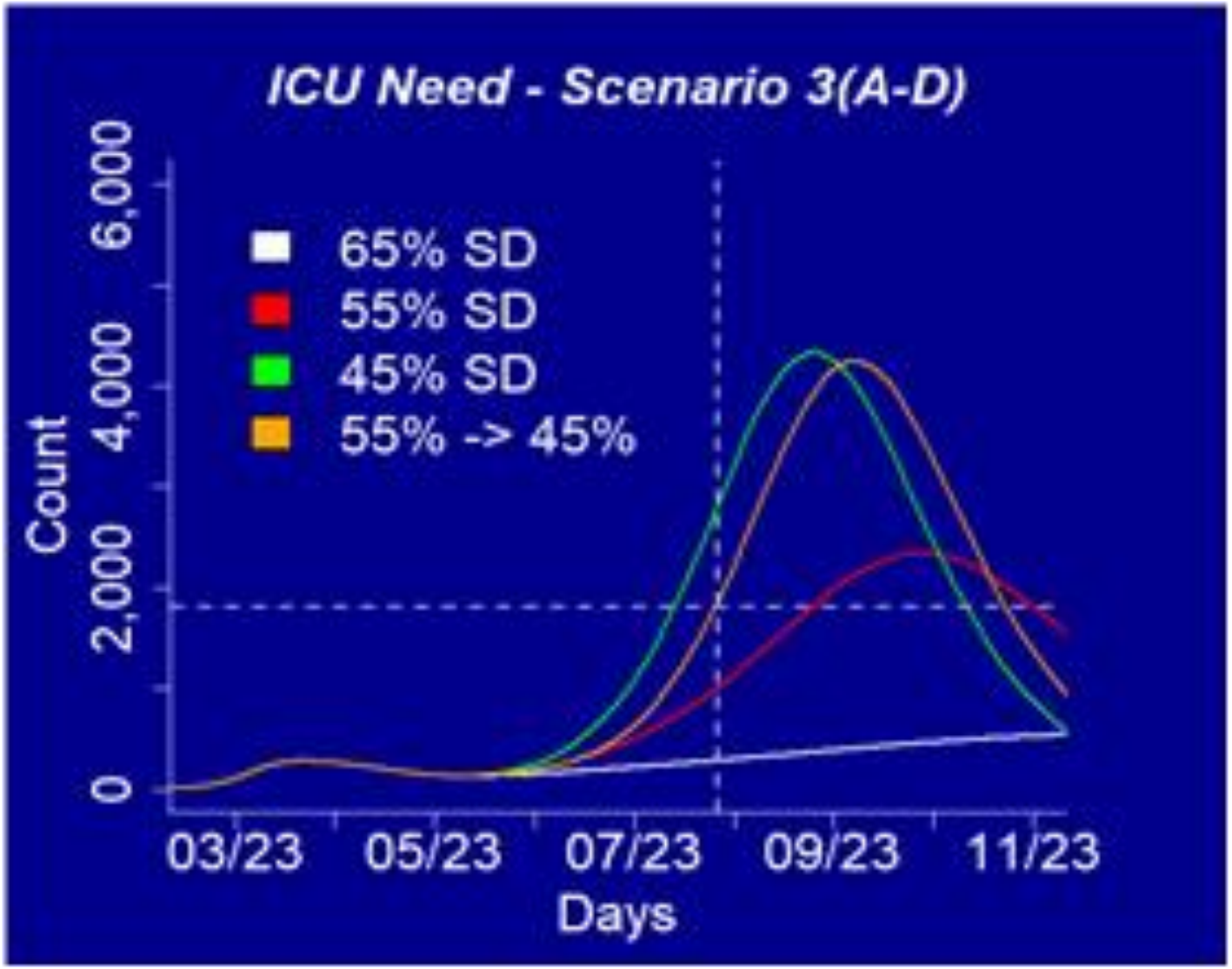
Hospital & ICU Needs based on Social Distancing Scenarios



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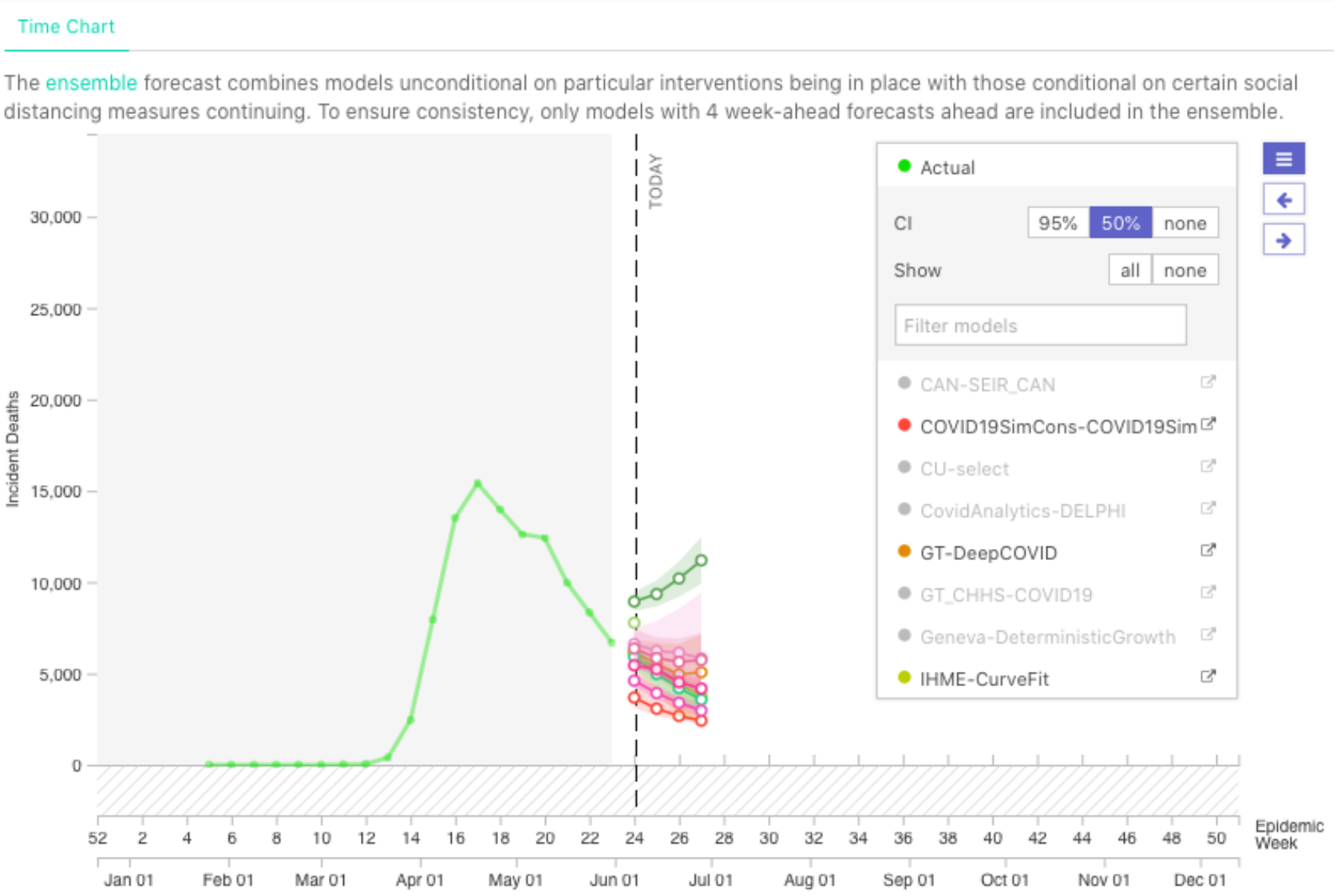
1. Explanatory models – account for details of what has already taken place (focus on exposures or outcomes).
2. Projection scenario models – predictions about what would happen under certain hypothetical conditions.
3. Forecast models – what modelers predict we can expect to happen.

https://thesocietypages.org/specials/what-are-covid-19-models-modeling/

Reich Lab Ensemble Model



Denver

https://reichlab.io/covid19-forecast-hub/

Why do Models Change

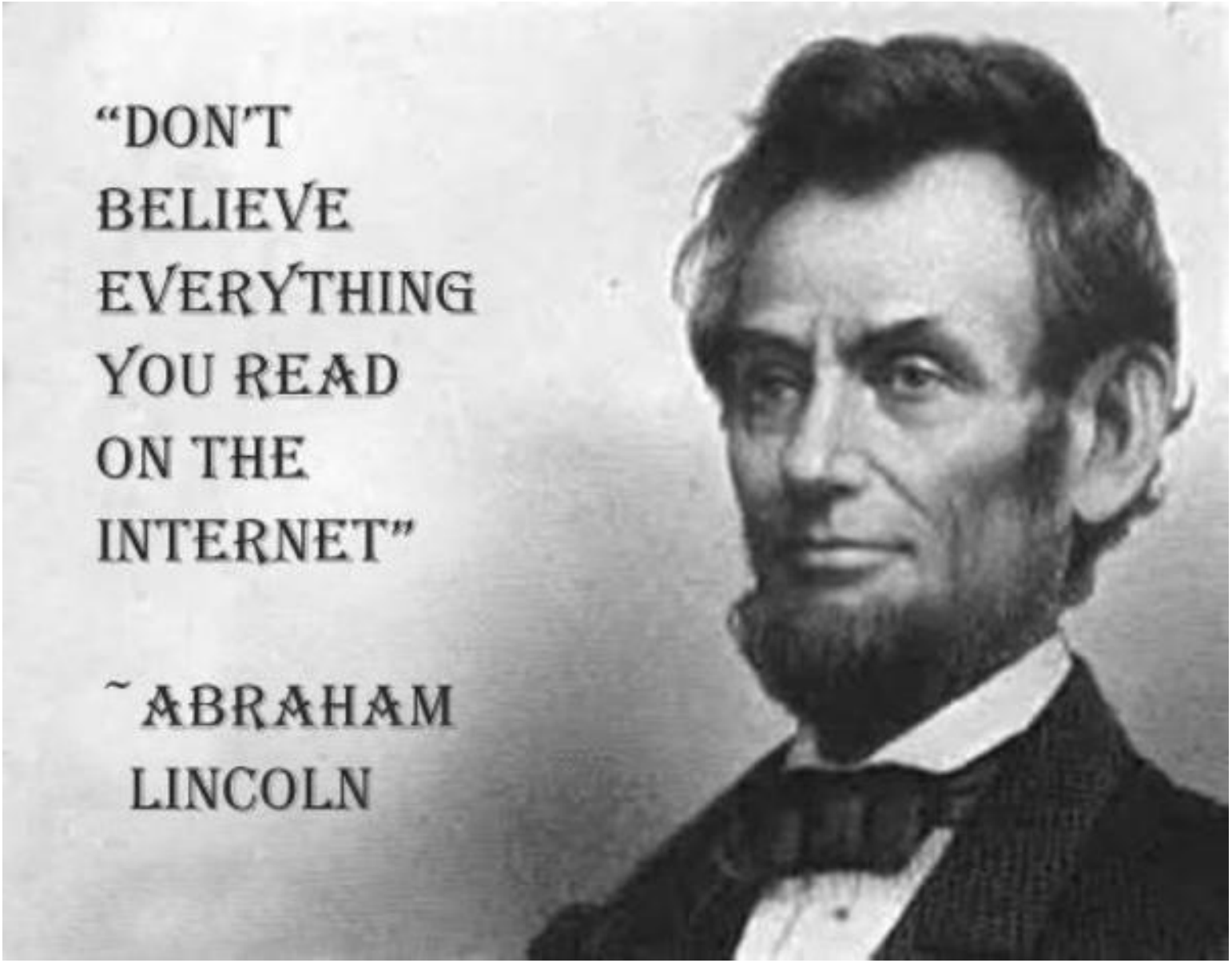
- … how types of models differ in their aims

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

Vet your sources



The New York Times

Opinion

In the Fog of Coronavirus, ~~There Are No Experts~~ Being able to Evaluate Info is Vital

Story by Ed Yong

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

APRIL 29, 2020

- Ask yourself how accurate the information seems

Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention

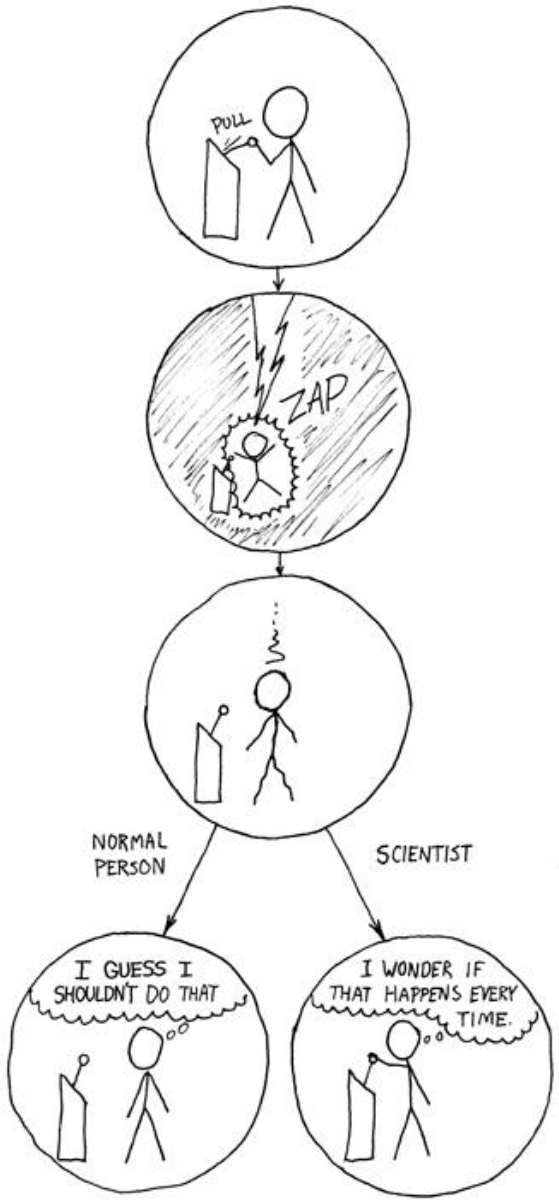
Gordon Pennycook[1,2*], Jonathon McPhetres[1,3], Yunhao Zhang[3], Jackson G. Lu[3], & David G. Rand[3,4,5]

[1]Hill/Levene Schools of Business, University of Regina, [2]Department of Psychology, University of Regina, [3]Sloan School of Management, Massachusetts Institute of Technology, [4]Institute for Data, Systems, and Society, Massachusetts Institute of Technology, [5]Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology

[*]Corresponding author: grpennycook@gmail.com

- encouraging readers to consider truthfulness reduced their likelihood of sharing misinformation

- 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/

https://www.smithsonianmag.com/science-nature/how-avoid-misinformation-about-covid-19-180974615/

- 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

→ some suggested sources - https://bit.ly/ja_CVD19

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.