Science, pseudoscience and public policy

How did things get this bad, and what can we do about it?

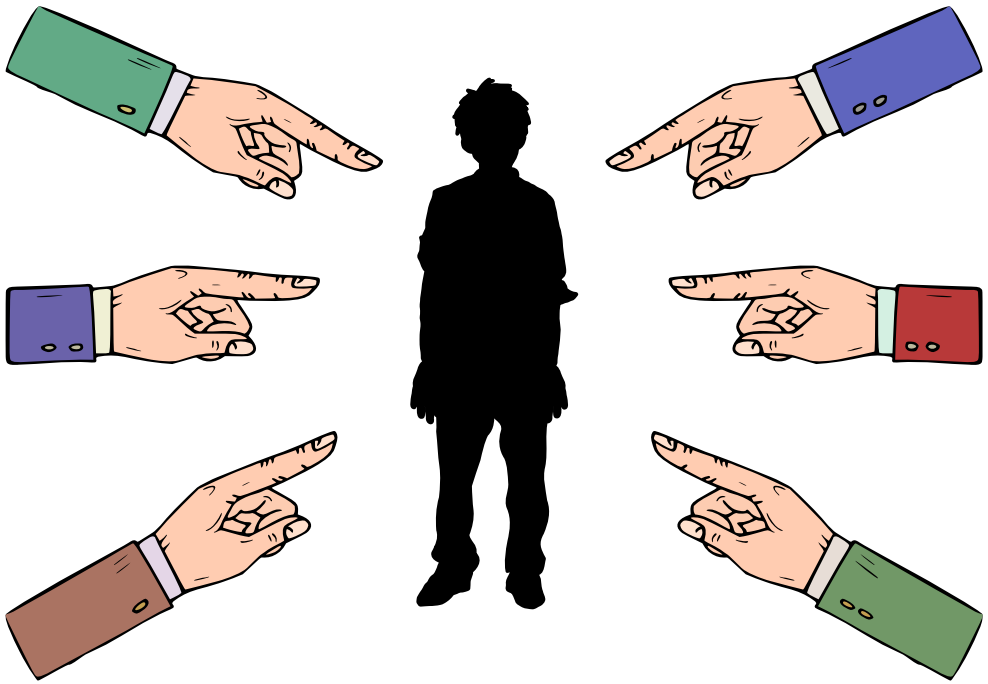
Introduction

- Interdisciplinary researcher focused on efficient translation of biomedical science into positive societal impact
- Married to an MD who had to close her practice due to long COVID
- Advisor to the Canadian COVID Society and co-Chair of the Legal Committee
- Co-author on the most up-to-date interdisciplinary review on masks and respirators for the prevention of respiratory infections currently available
- Vaccinated and boosted (and happy to discuss why that's a good idea)

- **Ask the hard questions!**

Greenhalgh, T. *et al.* Masks and respirators for prevention of respiratory infections: a state of the science review. *Clinical Microbiology Reviews* **0**, e00124-23 (2024).

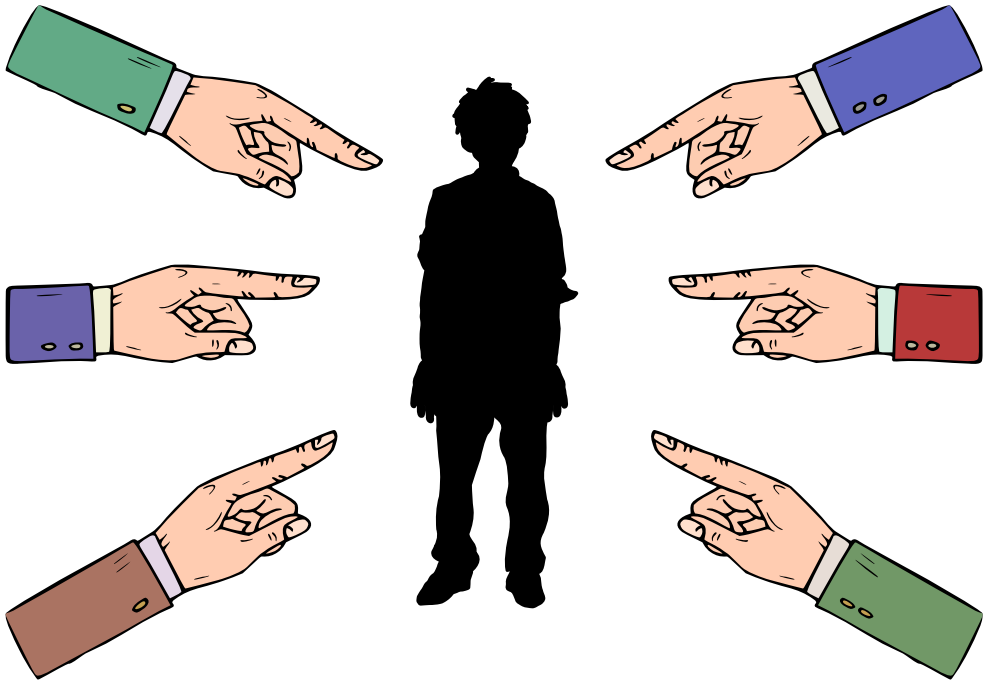
Preamble: “human error” is not a cause



- One of the most common findings of an incident investigation, across fields, is “human error”
- That answers “*Who is to blame?*”
- But humans commit errors – that’s unavoidable!
- Preventing failure is a **systems problem**. We have to ask: “*Why does the system allow a predictable event (human error) to lead to a significant failure?*”

Leveson, N. G. *Engineering a Safer World: Systems Thinking Applied to Safety*. (The MIT Press, 2012). doi:10.7551/mitpress/8179.001.0001.

Preamble: “human error” is not a cause



- This does not mean there is not a place for accountability, but we have an obligation *to learn from failure*
- When the same error is widely repeated, we also have to ask: “*Why is the system creating this error?*”
- “Human error” is at most a component of a bigger systems failure, and often an excuse to stop thinking

Leveson, N. G. *Engineering a Safer World: Systems Thinking Applied to Safety*. (The MIT Press, 2012). doi:10.7551/mitpress/8179.001.0001.

Vigi Mont-Royal

- COVID (SARS-CoV-2) outbreak in May, 2020 – 273 residents, 68 deaths
- Canadian Labour Congress warned public health COVID was airborne on February 7th, 2020
- SARS Commission (SARS-CoV-1) warned everyone it should be treated as airborne in 2006
- "[Isolation zones] *were not put in place by the employer. He had refused, he was not giving protective equipment to staff, no N95 masks for staff, no kit testing for staff*"
- "*After one day of working there, they were coming back with symptoms, testing positive for COVID-19*"
- 'All staff and the dozens of Canadian Forces soldiers on-site started wearing the enhanced protective equipment, including N95s and cowls.'
- 'The Canadian Armed Forces say none of the over 50 soldiers deployed at Vigi Mont Royal have shown COVID-19 symptoms. "*Nobody is sick. None of our military personnel is sick*"'

Nurses brought Vigi-Santé to court in bid to get better protection for staff at Vigi Mont-Royal - Montreal | Globalnews.ca. *Global News* https://globalnews.ca/news/6945991/nurses-vigi-sante-court-staff-protection-coronavirus/.
Access to Information and Privacy (ATIP) Release Package PHAC-A-2020-000210. *Investigative Journalism Foundation* https://theijf.org/open-by-default/25039256.
Campbell, A. *The SARS Commission - Final Report (Recommendations)*. (2006).

“Human error”

(aka “It’s probably the nurses’ fault”)

Quebec’s public health director, **Dr. A**, said the malfunctioning ventilation system could be a possible factor…

“I think there’s probably other factors related to the difficulty to apply infection prevention controls”

“There’s a lot of objects to clean, less people working — they had pressure so they probably did not apply the things correctly”

Nurses brought Vigi-Santé to court in bid to get better protection for staff at Vigi Mont-Royal - Montreal | Globalnews.ca. *Global News* https://globalnews.ca/news/6945991/nurses-vigi-sante-court-staff-protection-coronavirus/.
Access to Information and Privacy (ATIP) Release Package PHAC-A-2020-000210. *Investigative Journalism Foundation* https://theijf.org/open-by-default/25039256.

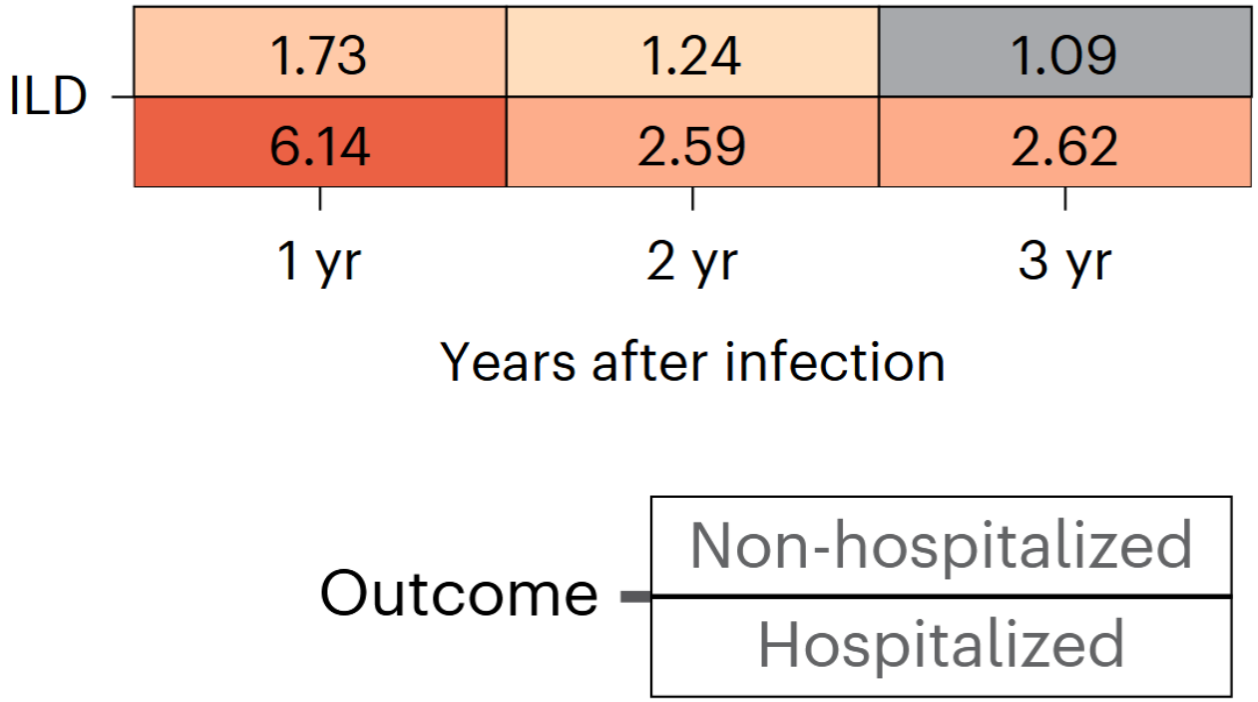
Misinformation: the false dichotomy

- Most discussion of misinformation is overly simplistic: "*With us or against us!*"
- "*Things are OK, back to normal!*" vs "*Things are not OK (because microchips/5G/etc)*"
- Often led by institutional voices
- Frames misinformed beliefs as "human error" (and claims of stupidity, malice, etc)
- Proposed solutions generally involve shouting at (big budgets for PR campaigns) and/or punishing (social media bans) people until they do what they are told
- That's about obedience, not understanding
- It also doesn't work

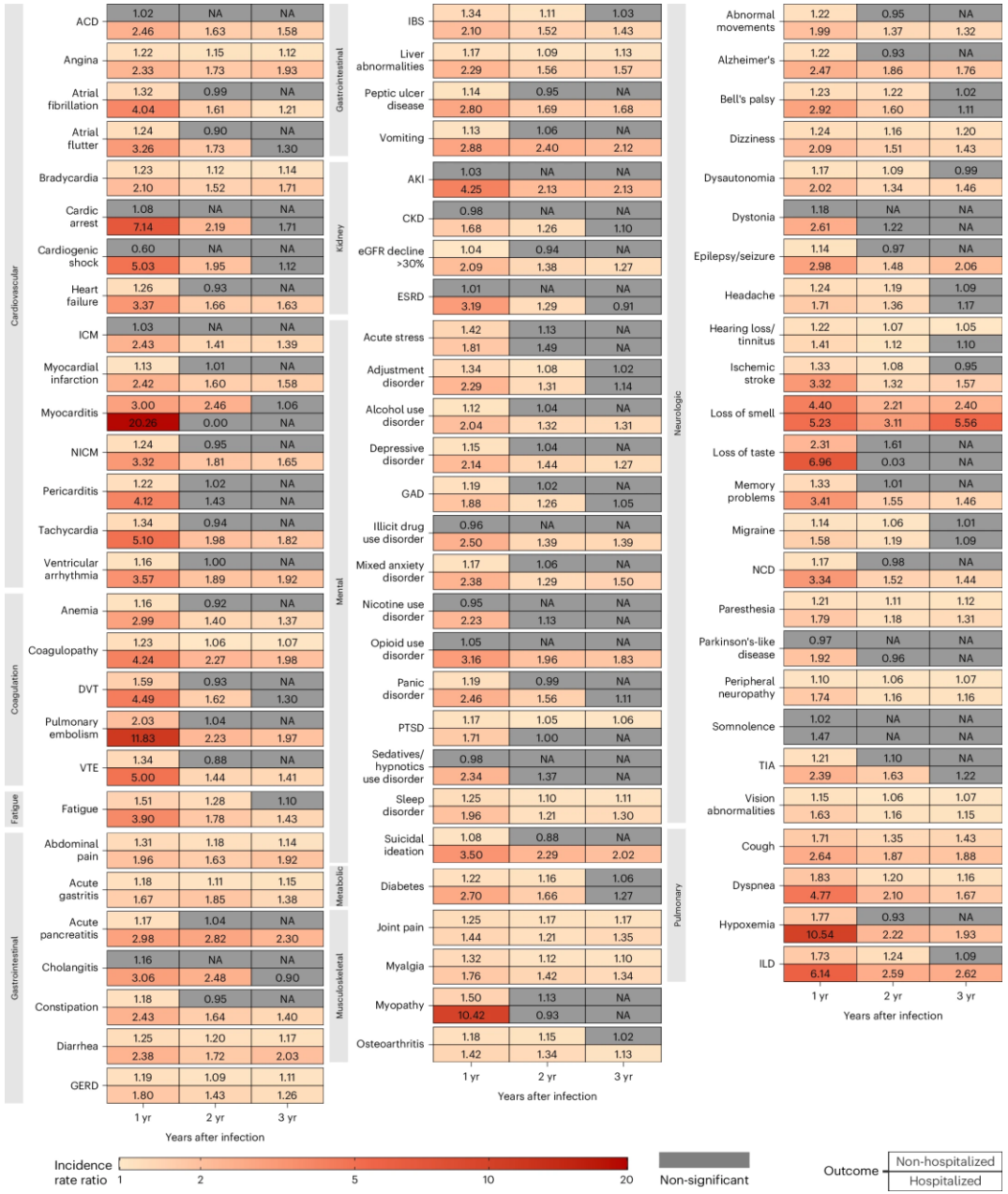
Misinformation doesn't just appear

Things are not OK

Fold increase after a COVID infection

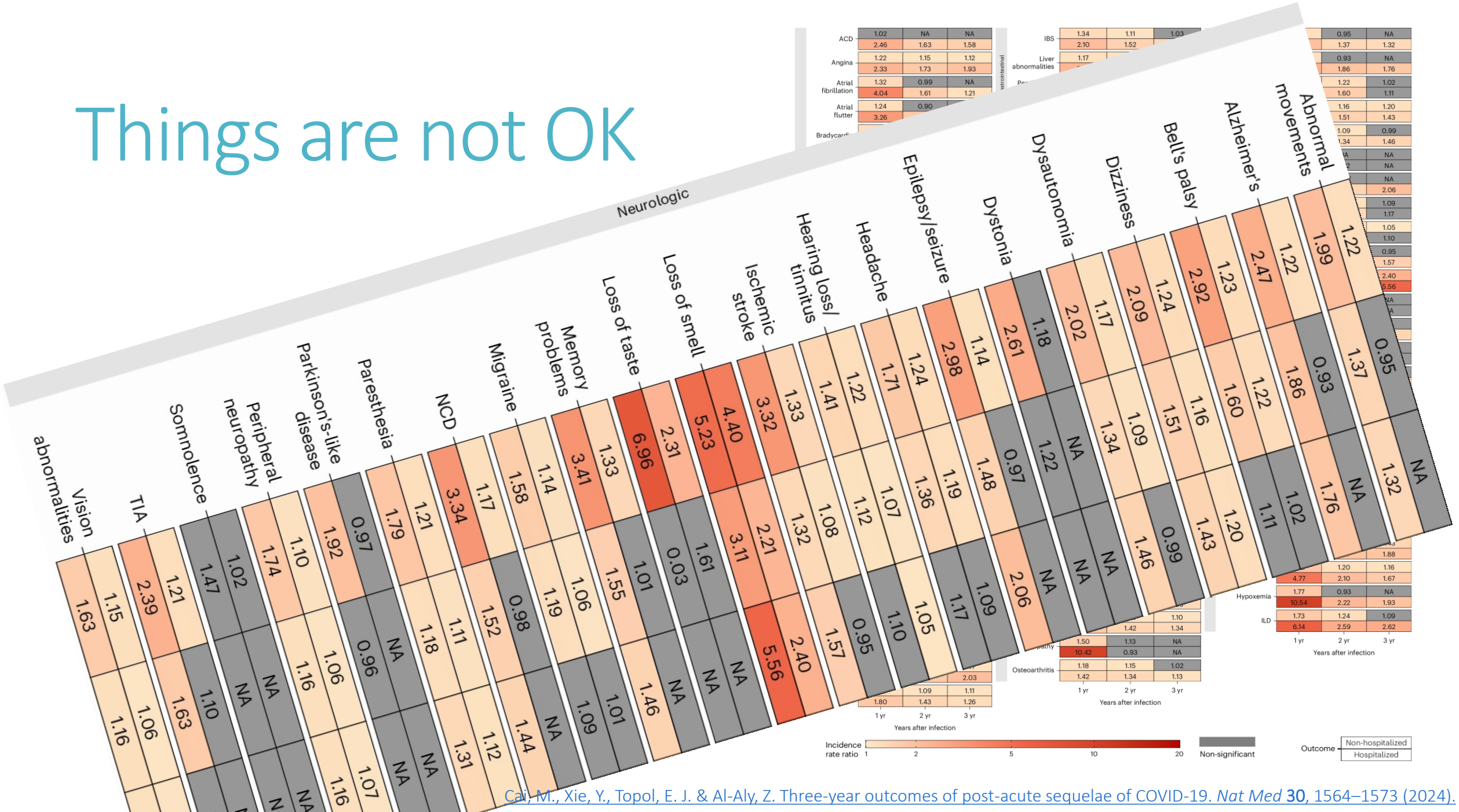


Sample size:
114,864 (non-hospitalized)
20,297 (hospitalized)
5,206,835 (uninfected)



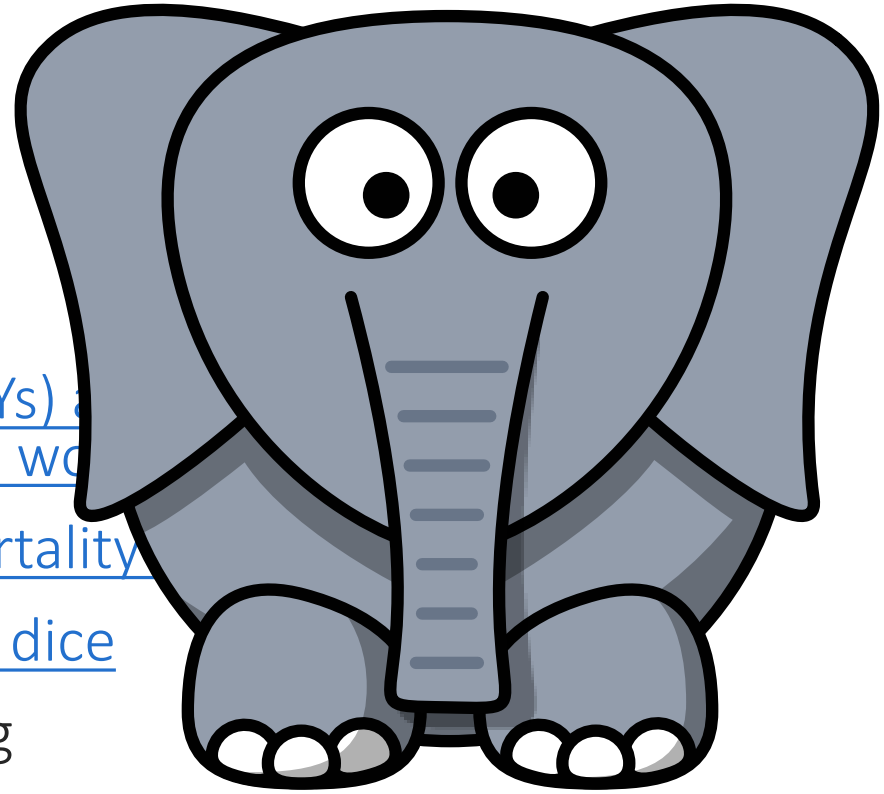
Cai, M., Xie, Y., Topol, E. J. & Al-Aly, Z. Three-year outcomes of post-acute sequelae of COVID-19. *Nat Med* **30**, 1564–1573 (2024).

Things are not OK



Cai, M., Xie, Y., Topol, E. J. & Al-Aly, Z. Three-year outcomes of post-acute sequelae of COVID-19. *Nat Med* **30**, 1564–1573 (2024).

Things are not OK

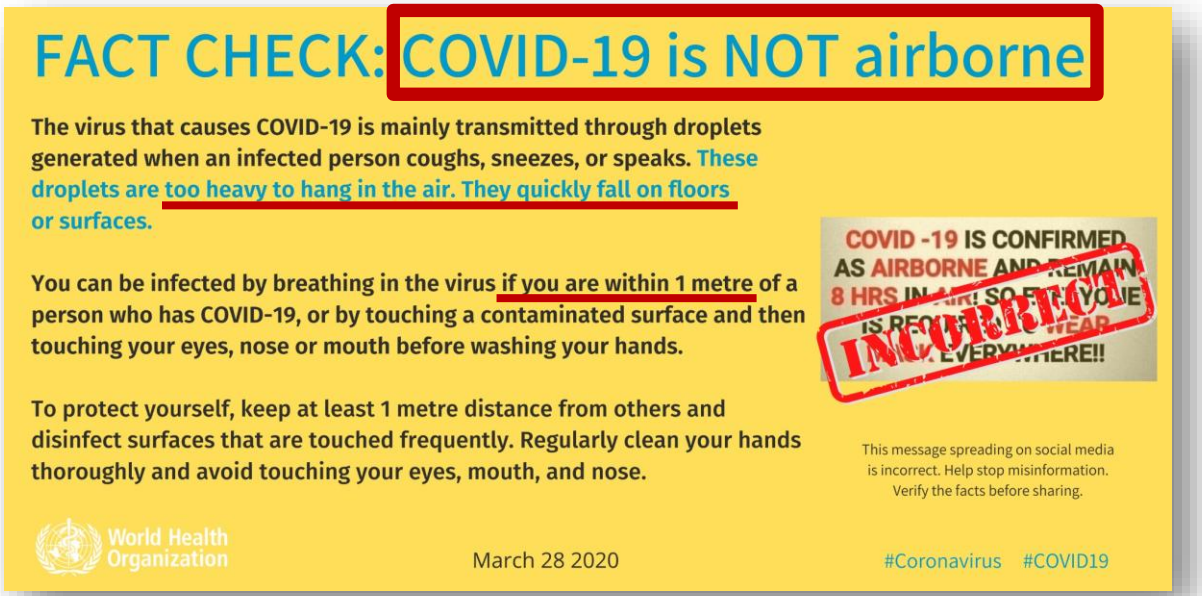


- Annually, long COVID wastes ~7 million life-years (QALYs) a
in the OECD alone, and keeps 3 million people out of the wo
- It's driving the longest period of peacetime excess mortality
- There's no cure, and each infection is a new roll of the dice
- PHAC warned the Provinces in 2020 that it was coming
- Canada's Chief Science Advisor has called out public health agencies for "gaps in public messaging about the importance of PCC prevention"
- It's serious, it's preventable with tools like N95s and better ventilation (**if it can't get inside you, it can't make you sick**), and vaccines improve the odds
- So…why isn't this being shouted from the rooftops?

Gonzalez, A. E. & Elina Suzuki. *The Impacts of Long COVID across OECD Countries*. (2024) doi:10.1787/8bd08383-en.
Daniel Meier, Prachi Patkee, & Adam Strange. The future of excess mortality after COVID-19. *Swiss Re Institute, Zurich, Switzerland* (2024).
Kuang, S. *et al. Experiences of Canadians with Long-Term Symptoms Following COVID-19*. Statistics Canada Report (2023).

Context: the “very big mistake”

HOW IT STARTED (MARCH 2020)



World Health Organization (WHO) [@WHO]. FACT: #COVID19 is NOT airborne. *Twitter* https://x.com/WHO/status/1243972193169616898 (2020).

HOW IT’S GOING (APRIL 2024)

The SARS-CoV-2 virus can spread in several ways: through zoonotic transmission, direct and indirect contact transmission, direct deposition transmission, and inhalation of airborne transmission. An increasing body of evidence [28]–[31] suggests that it is transmitted through infectious fluids released from an infected individual as particles of different sizes and quantities during breathing, speaking, coughing and sneezing [36]. While the largest particles settle quite rapidly, the smaller ones remain suspended in the air for longer periods and can travel longer distances [37], [38]. When people are in close proximity,

World Health Organization. *Indoor Airborne Risk Assessment in the Context of SARS-CoV-2: Description of Airborne Transmission Mechanism and Method to Develop a New Standardized Model for Risk Assessment*. (World Health Organization, Geneva, 2024).

Context: the “very big mistake”

DER SPIEGEL: But even the World Health Organization didn't take the spread via aerosols seriously and didn’t issue a warning about it until the autumn of 2020 …

Farrar: Yes, you are right, that was a very big mistake. We could have prepared better if bigger decisions would have been made around aerosols, around face masks, around the best treatment options, personal protective equipment for nurses, doctors, about the capacity for intensive care units. That would have saved an enormous number of lives.

WHO’s former Chief Scientist and current Associate Director General!

- This is not about “winning”, or taking control of the narrative
- Mistakes that kill an enormous number of people are bad
- We have an obligation to learn from this failure – next time could be even worse
- The foundation of public trust is trustworthiness

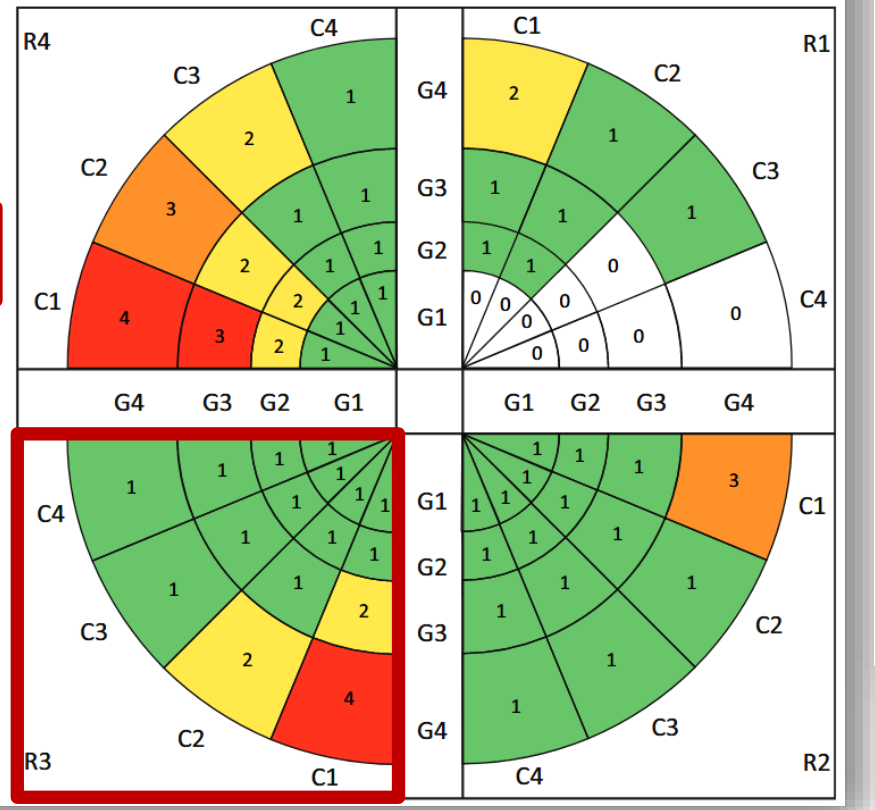
Bredow, R. von & Hackenbroch, V. Epidemiologist Jeremy Farrar on the Next Viral Threat: “I Fear We Are at the Beginning of an Era of Pandemics”. *Der Spiegel* (2022).

What if we had just followed the book?

- SARS Commission
- Medical experts
- Precautionary principle
- Bioaerosol science
- CAN/CSA Z94.4
- Organized labour
- OHS experts
- PPE engineering

Figure 2
Control banding approach for bioaerosols in health care facilities
(See Clauses 7.3.4.2 and 7.3.4.3.4 to 7.3.4.3.6, and 7.3.4.3.8, Figure 1, and Annex K.)

Health care facilities	
Risk group	
Agents not associated with disease or serious adverse health effects in healthy adult humans	R1
Agents associated with human disease or adverse health effects that are rarely serious and for which preventive or therapeutic interventions are usually available	R2
Agents associated with serious or lethal human disease or adverse health effects for which preventive or therapeutic interventions might be available (high individual risk but low community risk)	R3
Agents likely to cause serious or lethal human disease or adverse health effects for which preventive or therapeutic interventions are not usually available (high individual risk and high community risk)	R4
Generation rate	
Patient not coughing or sneezing	G1
Patient coughing or sneezing with mouth covered	G2
Patient coughing or sneezing with mouth uncovered	G3
Aerosol-generating procedures	G4
Control level	
Poorly ventilated, <3 air changes per hour (ACH)	C1
Corridor or patient room, 3–6 ACH	C2
Negative pressure, laboratory, autopsy, 6–12 ACH	C3
Surgery > 12 ACH	C4

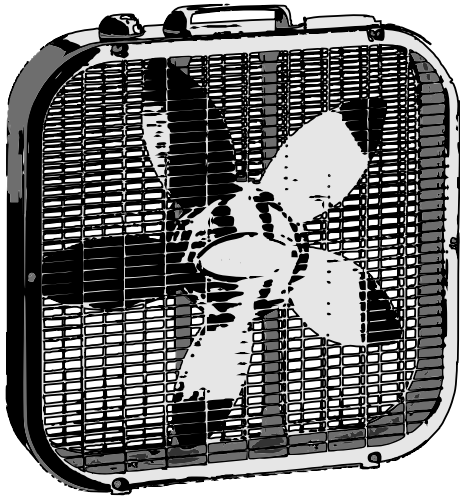


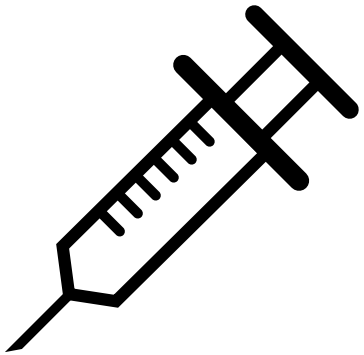
Acceptable level						Air-purifying options	APF
0	1	2	3	4	5		
					5	No air-purifying option available	10000
				4 to 5		Powered air-purifying full-facepiece Powered air-purifying helmet/hood with SWPF study	1000
			3 to 5			Powered air-purifying half-facepiece Air-purifying (negative-pressure) full-facepiece	50
		2 to 5				Powered air-purifying loose-fitting facepiece/visor Powered air-purifying helmet/hood without SWPF study	25
	1 to 5					Air-purifying (negative-pressure) half-facepiece (including filtering facepieces)	10
						No respiratory protection required	<1

Canadian Standards Association. CAN/CSA-Z94.4-18 Selection, use, and care of respirators. (2018).

Prevention is critical, but…

- Vaccines work – much better to trigger your immune system with part of the virus, in a controlled dose, timing etc than the whole thing with no control!
- But: *even if it's 100% safe, an injection is still not a trivial ask*
- Vaccine mandates can be justified – but you *must* try the other options first





Where does misinformation originate?

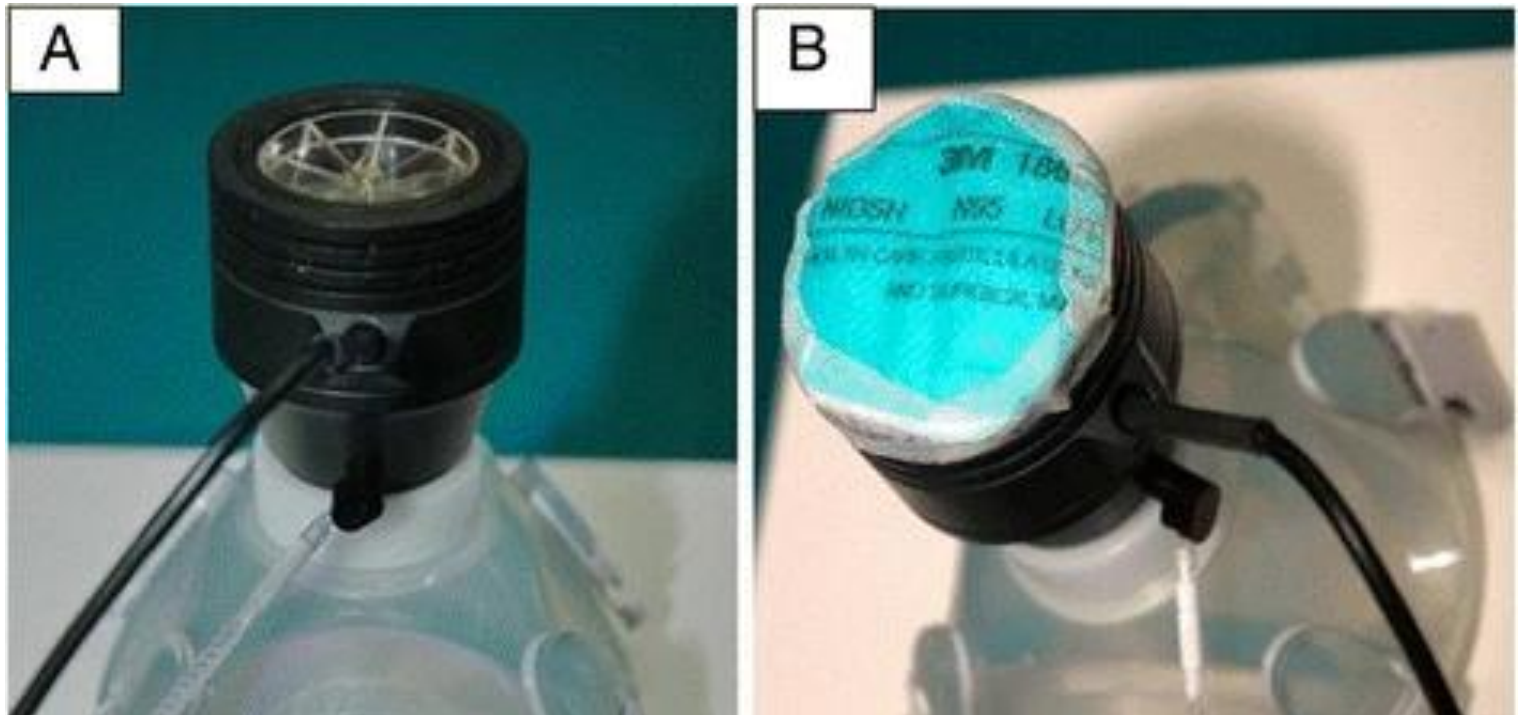
Primary sources

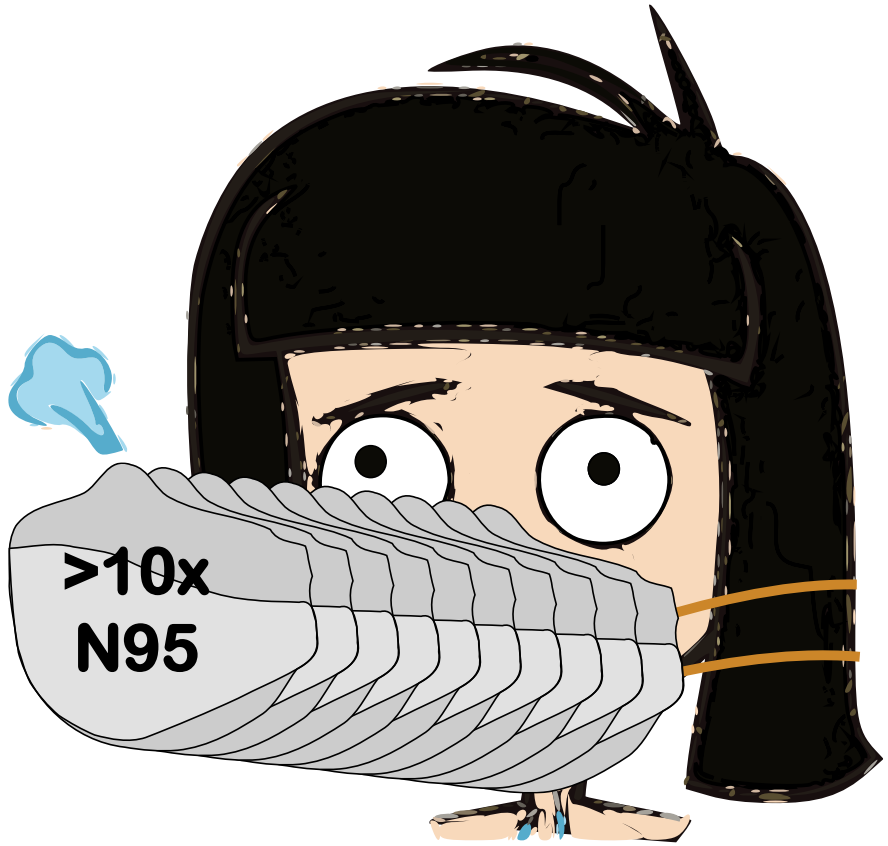
Claim: “Masks (N95s) are harmful”

subjects. Although harm was not demonstrated in the context of this experimental protocol, the significant changes to respiratory physiology caused by breathing through N95 mask materials raise the concern regarding prolonged use of N95-masks by pregnant healthcare workers. Our results suggest that pregnant women may

Tong, P. S. Y. *et al.* Respiratory consequences of N95-type Mask usage in pregnant healthcare workers—a controlled clinical study. *Antimicrobial Resistance & Infection Control* **4**, 48 (2015).

Claim: “Masks (N95s) are harmful”





“N95-mask materials were trimmed to form an airtight seal over the Hans Rudolph mask outlet so that the air flow resistance on inspiration and expiration would come from the mask material, ***simulating the actual wearing of an N95 respirator*** *(Fig. 2)”*

Tong, P. S. Y. *et al.* Respiratory consequences of N95-type Mask usage in pregnant healthcare workers—a controlled clinical study. *Antimicrobial Resistance & Infection Control* **4**, 48 (2015).

Claim: “Masks (N95s) are harmful”

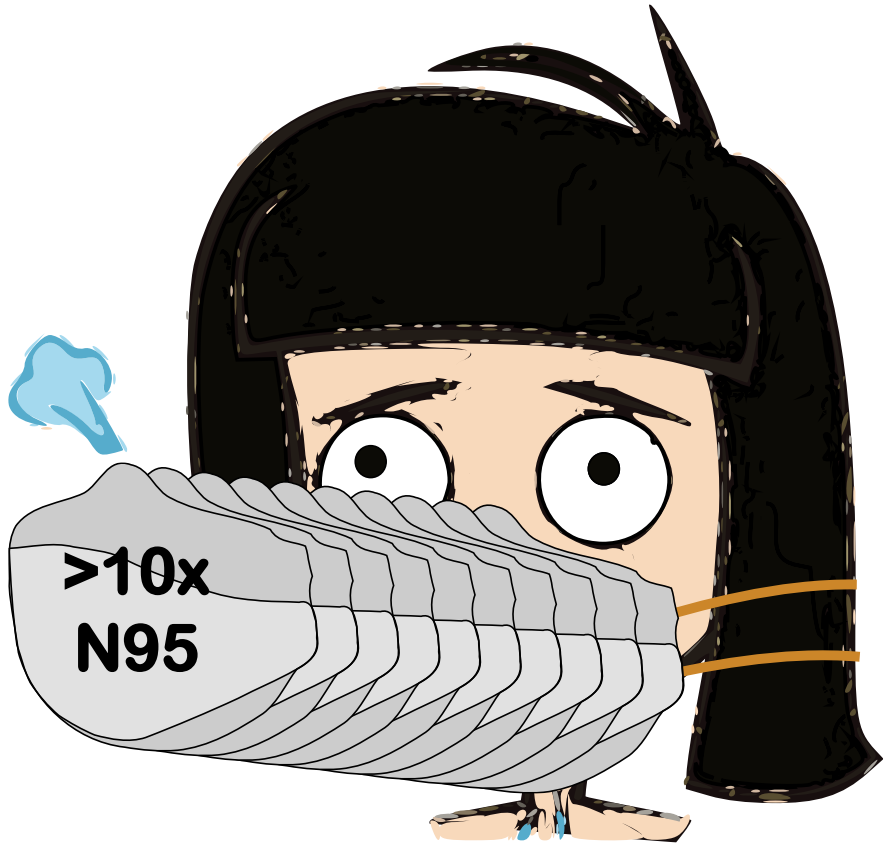
- “Human error”?
- …but Antimicrobial Resistance and Infection Control is a mainstream medical journal
- Why didn’t peer review catch it? Not just at publication, but funding and ethics too?
- The paper had ten authors, including (Dr. B) on WHO IPCRDEG-C19 – why did *no one* catch this?

🔥 lack of expertise

🔥 failure of peer review

🔥 gatekeeping (parochialism)

WHO’s position on COVID prevention was largely based on IPCRDEG-C19 advice through early 2021.

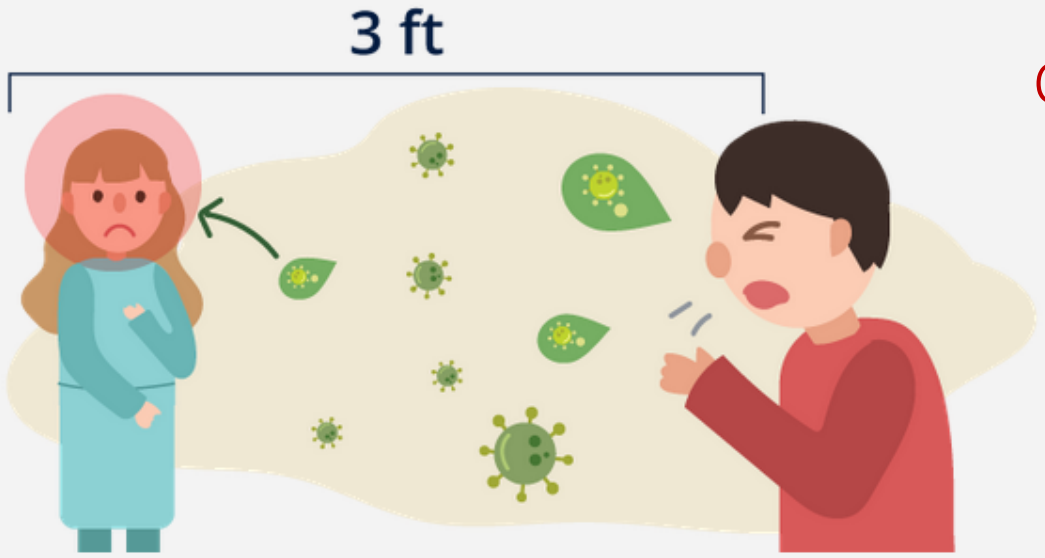


Ruzycki, C. & Ungrin, M. Fatal flaws in a controlled clinical study of respirator usage in pregnant healthcare workers. MetaArxiv preprint at https://osf.io/s4a3b/ (2025).

Claim: “COVID isn’t airborne”

Why aren't N95 respirators recommended for non-AGMPs involving COVID-19-suspected or -confirmed patients?

Respiratory viruses, including COVID-19 viruses, are usually transported in large particle droplets (>5µm), which tend to fall rapidly to the ground, travelling only 1-3ft after being expelled into the air through sneezing, coughing, or exhaling **(droplet transmission)**. These droplets can only infect others if they are loaded with infectious particles and if they contact another individual’s eyes, nose, or mouth.



Taught at a major Canadian medical school until mid 2024 (when I contacted them)

UBC Faculty of Medicine. PPE Online Course (2023).

Claim: “COVID isn’t airborne”

Why aren't N95 respirators recommended for non-AGMP

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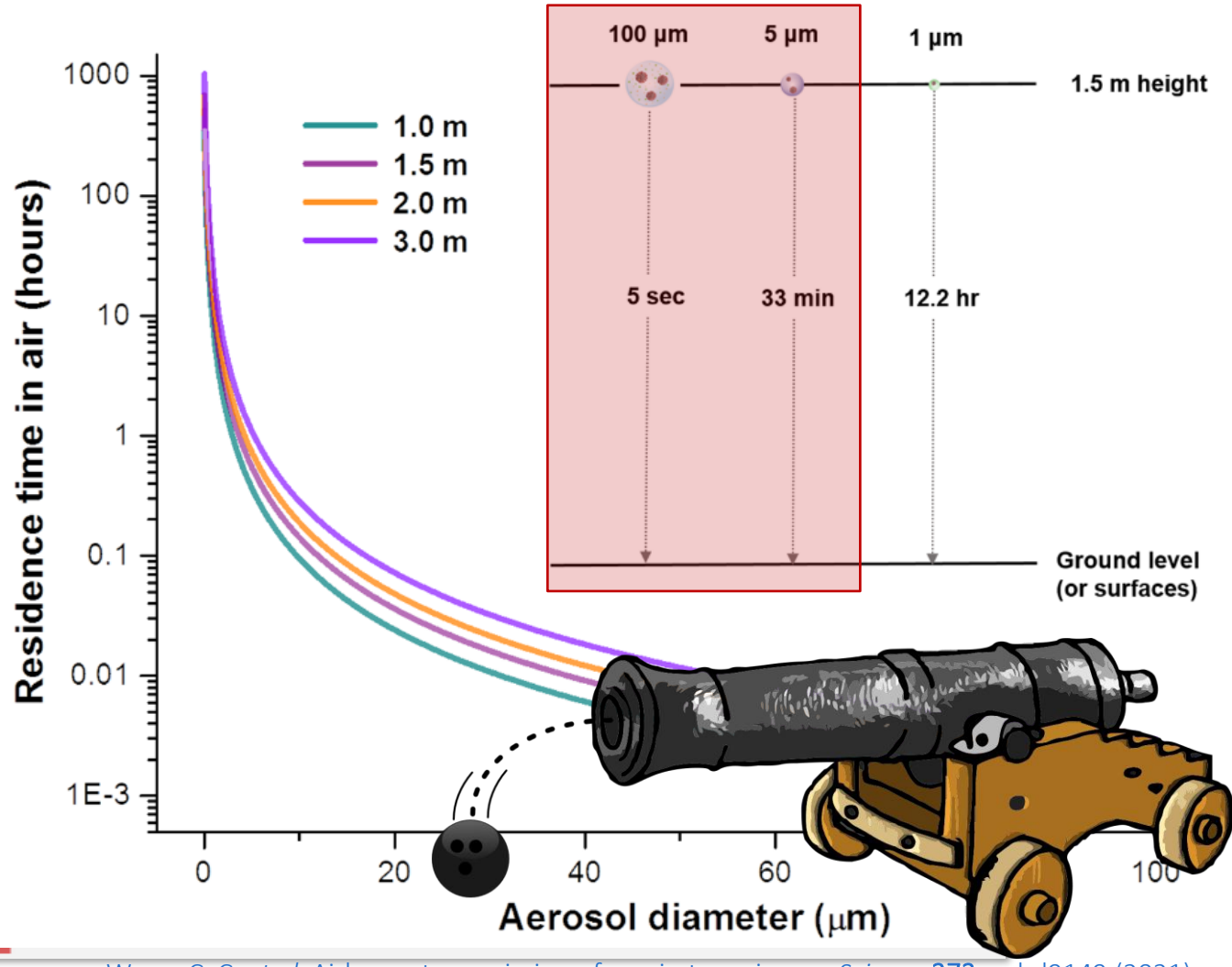


Wang, C. C. *et al.* Airborne transmission of respiratory viruses. *Science* **373**, eabd9149 (2021).

Claim: “COVID isn’t airborne”

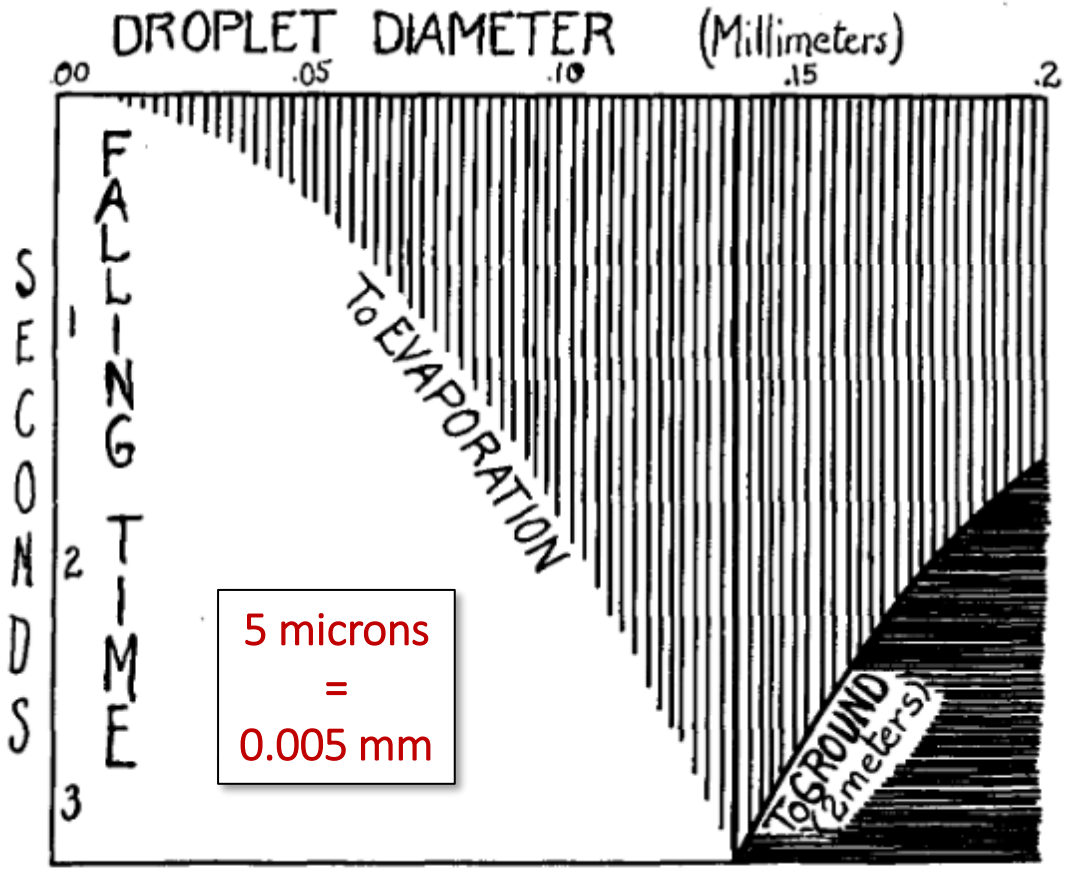


CHART 1. Falling times and evaporation times of droplets of varying diameter.

portant difference since it produces a complete change in state of small droplets in comparison with large drops. On chart 1 the curves of evaporation time and falling time (to fall two meters in saturated air) are seen to be almost similar in shape but opposite in direction. The point of intersection gives the size of droplets which would evaporate and particles which would fall two meters in the same time. Somewhere between .1 and .2 mm. lies the droplet size which identifies droplets of mouth spray that reach the ground within the life of the droplet as against droplets that evaporate and remain in the air as droplet nuclei with attached infection.

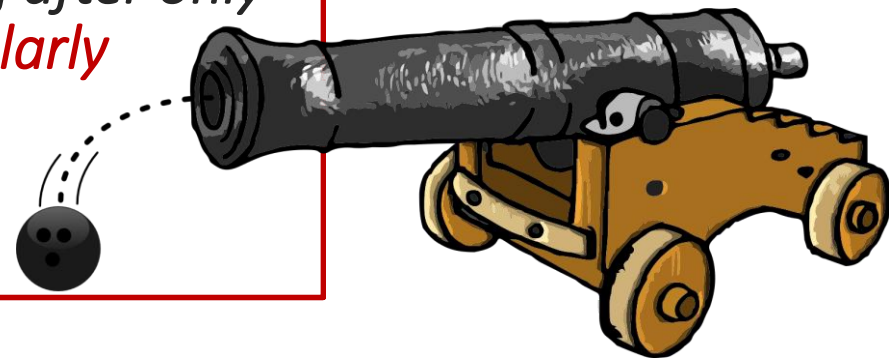
(Received for publication June 14, 1934.)

WELLS, W. F. ON AIR-BORNE INFECTION*: STUDY II. DROPLETS AND DROPLET NUCLEI. *Am J Epidemiol* 20, 611–618 (1934).

Claim: "COVID isn't airborne"

"There is no indication that the 3 foot rule takes into consideration the evaporation factor and the drift factor of airborne droplets, as discussed above. No scientific evidence is offered by WHO, DHHS-CDC, PCAH, or other medical authorities in explaining the rule. If large droplets quickly evaporate to free-floating small droplets, then the 3 foot rule applies only to droplets greater than about 50 – 100 µm in diameter for which there is insufficient time chance for evaporation to take effect before they fall to the ground from a height of 5–6 feet. Free floating small droplets readily go beyond the 3 foot radius. Therefore, if the majority of ejected droplets following a sneeze are evaporated to a size that is free-floating after only seconds in air, the 3 foot rule becomes illogical and not particularly helpful from a disease transmission perspective."

Quoted in the 2006 Report of the SARS Commission



Campbell, A. *The SARS Commission - Final Report: Chapter Eight: It's Not About the Mask.*(2006).

Claim: “COVID isn’t airborne”

- “Human error”?
- …but this is nearly a century out of date – it can’t be an individual human error when *it was known to be wrong before anyone involved was even born*!
- Specifically highlighted by the commission investigating SARS-CoV-1 failures
- Error repeated publicly by many public health leaders

🔥 outdated information

🔥 lack of expertise

🔥 failure of peer review

🔥 gatekeeping (parochialism)

🔥 gatekeeping (authority)

Jimenez, J. L. *et al.* What were the historical reasons for the resistance to recognizing airborne transmission during the COVID-19 pandemic? *Indoor Air* **32**, e13070 (2022).

Claim: “N95 aren’t better”

Surgical masks as good as N95 masks for health-care workers providing routine COVID-19 care

Surgical masks are not inferior to N95 masks for preventing the spread of COVID-19 to health-care workers, says a study led by McMaster University researchers.

“The surgical masks were not statistically less effective than N95s in preventing COVID-19 infections in health-care providers looking after patients with COVID-19,” said lead author (Dr. C) , professor of McMaster’s Department of Pathology and Molecular Medicine and a Hamilton infectious disease physician.

“The major thrust of this study is that there have been no other rigorous comparisons of surgical masks to N95 respirators during the pandemic. As a randomized clinical trial – it offers the highest standards of evidence relating to this question throughout the pandemic, including the Omicron variant.”

🚩 *“If the trial demonstrates that the medical mask is non-inferior to the N95 respirator, it will provide **experimental proof to support a policy of using medical masks**...”* – trial protocol from team responsible for the policy of using medical masks.

Loeb, M. *et al.* Medical Masks Versus N95 Respirators for Preventing COVID-19 Among Health Care Workers. *Ann Intern Med* **175**, 1629–1638 (2022).
McMaster University. Surgical masks as good as N95 masks for health-care workers providing routine COVID-19 care. (2022).

Claim: “N95 aren’t better”

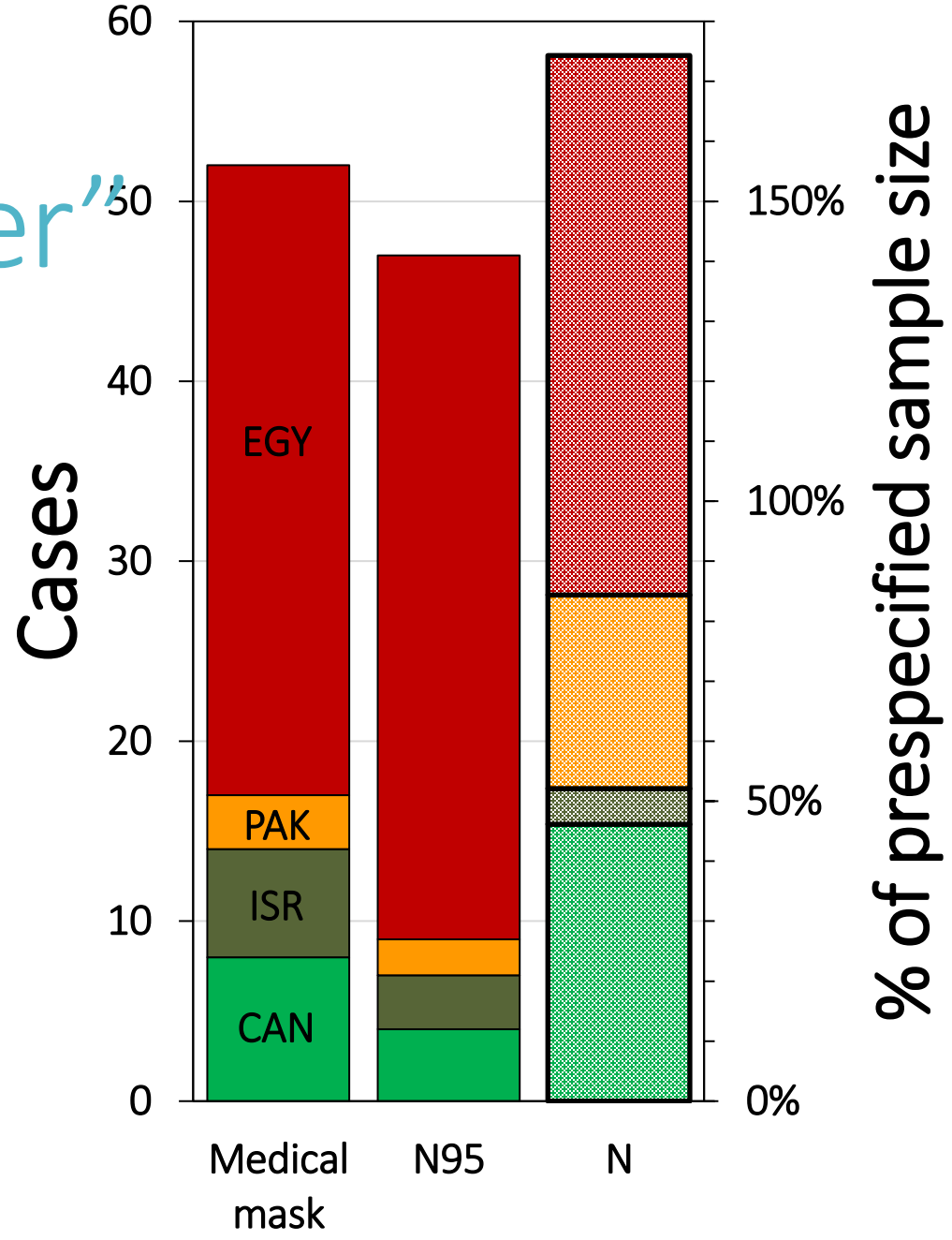
To prevent manipulation, clinical trials must be pre-registered, and the hypotheses, data collection, statistical analyses etc must be specified in advance.

Prespecified sites (Canada + Israel) showed expected benefit of N95s

In the face of major ethical concerns, study shut down and moved to unregistered sites in Pakistan

Similar results, 84% of target N. No plausible data in that last 16% could create “non-inferior” outcome

Moved to unregistered sites in Egypt during Omicron. Target N nearly doubled. Widespread community exposure means the trial there compared “not wearing a medical mask” to “not wearing an N95”



Ungrin, M. *et al.* Medical masks versus N95 respirators for preventing COVID-19 among health care workers: A secondary analysis of findings inconsistent with prior understanding reflects the expected inferiority of medical masks. MetaArxiv preprint at https://doi.org/10.31222/osf.io/ey7bj (2024).

Claim: “N95 aren’t better”

- Did not reference OHS / engineering / PPE literature at all
- Did not reference CAN/CSA-Z94.4 (PPE standard, including infectious aerosols)
- Major, non-pre-registered changes all biasing outcome in the same direction
- Mechanistically problematic: N95s block the aerosols that transmit COVID much more effectively than medical masks
- Designed as intermittent use (“*when providing care to or when within three feet of a patient with any febrile respiratory illness*”)
  - **Ignores asymptomatic transmission**
  - **Ignores real aerosol behaviour**

Loeb, M. *et al.* Medical Masks Versus N95 Respirators for Preventing COVID-19 Among Health Care Workers. *Ann Intern Med* **175**, 1629–1638 (2022).
McMaster University. Surgical masks as good as N95 masks for health-care workers providing routine COVID-19 care. (2022).

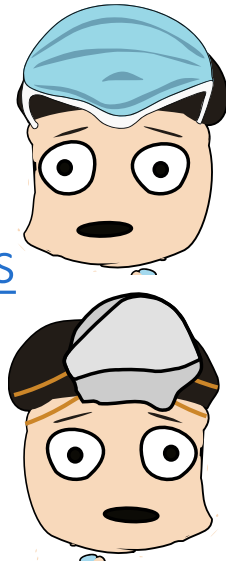
“N95s aren’t better”

🚩 Reported finding of MM noninferiority is entirely a product of the data from unregistered sites and numerous additional alterations to definitions, hypothesis and analyses (each necessary but not sufficient, and added to the registry retroactively)

🚩 Statistically impossible patterns in the data from Egypt ($p<<5.6 \times 10^{-8}$)

🚩 Statistically significant bias towards assigning F participants to the MM arm

🚩 In 2025, authors published a 2022 dataset (obtained prior to publication of N95 study) showing the large majority of COVID transmission in shared hospital rooms is both airborne and prevented by good ventilation



Ungrin, M. *et al.* Medical masks versus N95 respirators for preventing COVID-19 among health care workers: A secondary analysis of findings inconsistent with prior understanding reflects the expected inferiority of medical masks. MetaArxiv preprint at https://doi.org/10.31222/osf.io/ey7bj (2024).

Conly, J. Expression of Concern: Medical Masks Versus N95 Respirators for Preventing COVID-19 Among Health Care Workers. *Annals of Internal Medicine* (2025)

Williams, V. *et al.* Risk mitigation of shared room ventilation and filtration on SARS-CoV-2 transmission: a multicenter test-negative study. *Infection Control & Hospital Epidemiology* 1–7 (2025)

“N95s aren’t better”

NB the fundamental intermittent-use design failure is shared by the widely cited 2009 and 2019 RCTs of N95s vs medical masks for influenza as well

- “Human error”?
- …but Annals of Internal Medicine is a mainstream medical journal, and there are *so many problems*
- Why didn’t peer review catch them? Not just at publication, but funding and ethics too?
- The paper had 31 authors, including (Drs. C & D) on WHO IPCRDEG-C19 – what *happened*?

- lack of expertise
- lack of rigour
- failure to manage COI
- ”gold standard”
- gatekeeping (parochialism)
- failure of peer review
- outdated information

Ungrin, M. *et al.* Medical masks versus N95 respirators for preventing COVID-19 among health care workers: A secondary analysis of findings inconsistent with prior understanding reflects the expected inferiority of medical masks. MetaArxiv preprint at https://doi.org/10.31222/osf.io/ey7bj (2024).

Where does misinformation go next?

Systematic reviews and guidance

“Masks are harmful”

WHO IPCRDEG-C19 (Chair: Dr. D), justifying opposition to N95s (2020):

touches) [61,62,63,64,65,66,67]. These side effects are not encountered with the same frequency with the appropriate use of medical masks. An additional study has suggested pregnant women were not able to maintain their minute ventilation and had decreased oxygen uptake and increased carbon dioxide production even at rest [55]. The effects on the developing fetus are unknown. Studies of the use of particulate respirators in clinical settings for their need. Regardless of whether jurisdictions choose the precautionary principle with consequent use of particulate respirators instead of medical masks as a component of PPE for routine care of COVID-19 patients, this choice must not detract from the critical importance of

- 🔥 lack of expertise
- 🔥 lack of rigour
- 🚩 override precautionary principle = N95s

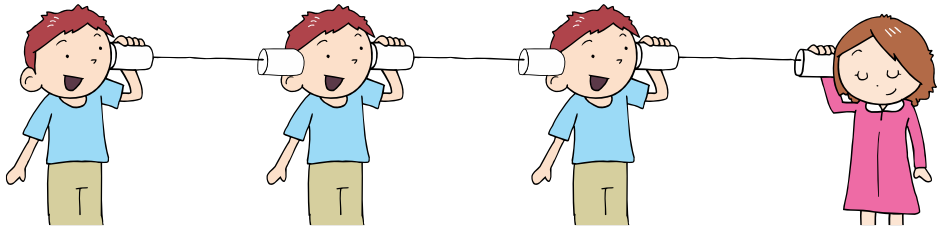
Conly, J. *et al.* Use of medical face masks versus particulate respirators as a component of personal protective equipment for health care workers in the context of the COVID-19 pandemic. *Antimicrobial Resistance & Infection Control* **9**, 126 (2020).

“Masks are harmful”

CAN-PCC (2024): *“According to Padilla-Hernández et al (32), the use of masks, especially N95 face masks, may have adverse effects on the cardiopulmonary function and fetal oxygenation of pregnant women due to increased airflow resistance and dead air static volume during prolonged use.”*

Ref #32 is a 2022 Spanish-language review that relies on the 2015 “ten N95s at once” study plus a 2020 review (that also relies on the same study)

- 🔥 reliance on secondary sources
- 🔥 lack of expertise
- 🔥 lack of rigour



🚩 CAN-PCC is a $9M collaboration between McMaster / GRADE and Cochrane, the two most prominent organizations in the “Evidence Based Medicine” space

CAN-PCC

Cochrane

McMaster GRADE Center

CAN-PCC: *Recommendations: Prevention of Post COVID-19 Condition*. EtD section (2024).

“COVID isn’t airborne”

April 3rd, 2020 – advice provided by the world’s top experts in aerosols, bioaerosols and disease transmission

IPCRDEG-C19 Chair Dr. D (MD/BSc)

WHO

On the video call, tensions rose. At one point, Lidia Morawska, a revered atmospheric physicist who had arranged the meeting, tried to explain how far infectious particles of different sizes could potentially travel. One of the WHO experts abruptly cut her off, telling her she was wrong, Marr recalls. His rudeness shocked her. “You just don’t argue with Lidia about physics,” she says.

Morawska had spent more than two decades advising a different branch of the WHO on the impacts of air pollution. When it came to flecks of soot and ash belched out by smokestacks and tailpipes, the organization readily accepted the physics she was describing—that particles of many sizes can hang aloft, travel far, and be inhaled. Now, though, the WHO’s advisers seemed to be saying those same laws didn’t apply to virus-laced respiratory particles. To them, the word *airborne* only applied to particles smaller than 5 microns. Trapped in their group-specific

Molteni, M. The 60-Year-Old Scientific Screwup That Helped Covid Kill. *Wired* (2021).

“COVID isn’t airborne”

April 3rd, 2020 – response to the world’s top scientific experts

proof of its own. Before long, Jimenez recalled, the temperature hit the boiling point. He watched [Dr. D] scream at Morawska.

“He kept yelling, ‘But, Lidia, where is your evidence? Where is your evidence?’” Jimenez recalled. “I was thinking, ‘Jesus Christ, what is this?’”

April 28th, 2020 – presentation by IPCRDEG-C19 Chair Dr. D

- It is a respiratory virus (contact droplet **not** airborne tran**smission**)
- Airborne may be obligate or preferential or opportunistic and refers to particles that stay aloft for minutes or hours (less than 5-10 µm in diameter) and can be carried by air currents over a measurable distance
- Droplet spread refers to large droplets (>5-10um) that fall within 1 metre

June 14th, 1934 – Wells: “ON AIR-BORNE INFECTION”

Somewhere between .1 and .2 mm. lies the droplet size which identifies droplets of mouth spray that reach the ground within the life of the droplet as against droplets that evaporate and remain in the air as droplet nuclei with attached infection.

WHO

- bullying
- lack of expertise
- outdated information
- gatekeeping (parochialism)
- gatekeeping (authority)
- leadership involvement
- entitlement to control

Carl Zimmer. Air-Borne. ISBN: 9780593473597 | Penguin Random House

WELLS, W. F. ON AIR-BORNE INFECTION*: STUDY II. DROPLETS AND DROPLET NUCLEI. *Am J Epidemiol* 20, 611–618 (1934).

“N95s aren’t better”

Cochrane review (2023)

COVID-19 patients or long-term care residents, laboratory-confirmed SARS-CoV-2 was found in 10.46% (52/497) versus 9.27% (47/507) in the medical/surgical mask group and fit-tested N95 respirator group (hazard ratio 1.14 (95% CI 0.77 to 1.69), respectively. There was a 1.19% absolute increase in risk of COVID-19 with medical masks versus N95 respirato 95% CI (-2.5% to 4.9% . There were 47 (10.8%) adverse events related to the intervention reported in the medical mask group and 59 (13.6%) in the N95 respirator group. The use of medical masks was found to be non-inferior to N95 respirators in the direct care of COVID-19 patients and the study crossed over into the more transmissible Omicron variant period of the COVID-19 pandemic.

- 🔥 lack of expertise
- 🔥 lack of rigour
- 🔥 gatekeeping (parochialism)
- 🔥 gatekeeping (authority)
- 🔥 failure of peer review
- 🔥 failure to manage conflicts of interest
- 🚩 Cochrane is one of the most prominent organizations in the “Evidence Based Medicine” space

First author paid by anti-PPE groups, last author is Dr. D. Various other controversies.

Cochrane

Jefferson, T. *et al.* Physical interventions to interrupt or reduce the spread of respiratory viruses. *Cochrane Database of Systematic Reviews* (2023)

“N95s aren’t better”

WHO COVID IPC Guidelines (2023) (Drs. B, C, D involved, one recusal)

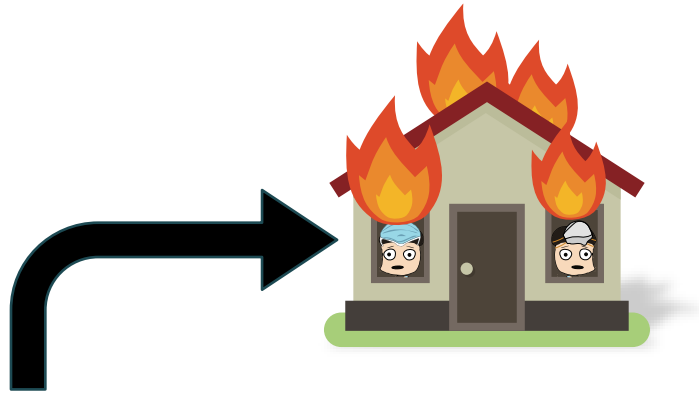
“The GDG considered the evidence for particulate respirators versus medical masks and agreed that the strength of this evidence was insufficient to recommend one type of mask over another, except in some specific conditions (see conditional recommendation).

***The only RCT of medical masks vs respirators** indicated similar effects with regard to the risk of SARS-CoV-2 infection when providing routine care. Therefore, the GDG recommended use of either respirators or medical masks when providing routine care.”*

- 🔥 lack of expertise
- 🔥 lack of rigour
- 🔥 gatekeeping (authority)
- 🔥 lack of contingency planning
- 🔥 gatekeeping (parochialism)
- 🔥 failure of peer review
- 🔥 failure to manage conflicts of interest
- 🔥 ”gold standard”

World Health Organization. *Infection Prevention and Control in the Context of COVID-19: A Guideline*. (2023).

“N95s aren’t better”



CAN-PCC (2024): “*Addressing raised limitations of evidence used (11) by the public…this was identified as **the best available evidence**…**rigorous assessment** of the study by the evidence synthesis team **did not find risk of bias** concerns*”

- 🔥 lack of expertise
- 🔥 lack of rigour
- 🔥 gatekeeping (parochialism)
- 🔥 gatekeeping (authority)
- 🔥 ”gold standard”

🚩 CAN-PCC is a $9M collaboration between McMaster / GRADE and Cochrane, the two most prominent organizations in the “Evidence Based Medicine” space

CAN-PCC

Cochrane

McMaster GRADE Center

CAN-PCC: *Recommendations: Prevention of Post COVID-19 Condition*. EtD section (2024).

What happens when we try to fix it?

Error correction

“Masks are harmful”

Criticisms of the “ten N95s at once” trial were rejected by the journal:

- *“This elaboration of ‘fundamental concepts’ does not render the study or its inferences invalid. Ungrin and Ruzycki **have not demonstrated any methodologic flaws** in the study.”*
- *“**There was no ‘fundamental error’ in this trial.** Tong et al did a well conducted trial with appropriate measurements.”*

- 🔥 failure of peer review
- 🔥 lack of rigour
- 🔥 lack of expertise
- 🔥 gatekeeping (parochialism)
- 🔥 gatekeeping (authority)
- 🔥 ”gold standard”

Ruzycki, C. & Ungrin, M. Fatal flaws in a controlled clinical study of respirator usage in pregnant healthcare workers. MetaArxiv preprint at https://osf.io/s4a3b/ (2025).

“COVID isn’t airborne”

The mechanistic justification for the incorrect medical school guidance was removed, but the actual PPE guidance itself was not corrected: “***We follow the guidelines from the provincial health officer.*** *I am really in no position to be telling her what to do.*”

- lack of rigour
- lack of expertise
- gatekeeping (parochialism)
- gatekeeping (authority)
- outdated information
- lack of contingency planning

Provincial Health Officer’s Annual Report, 2024

The COVID-19 virus spreads by way of respiratory droplets and aerosols (smaller droplets) that enter the air from an infected person’s mouth or nose when they breathe, talk, sing, shout, cough, or sneeze.[27,28] In the

Henry, B. *Examining the Societal Consequences of the COVID-19 Pandemic: Provincial Health Officer’s Annual Report, 2024*.

“N95s aren’t better”

Efforts to correct the MM/N95 RCT have been resisted

- A letter from international experts in 2021 highlighting many of the flaws was ignored, including by the Secretariat for Responsible Conduct of Research
- Criticisms submitted to the journal were dismissed without addressing them, and the editors wrote a letter defending the study
- Expression of Concern added, but the last author (Dr. D) was allowed to write it (saying participants received verbal instructions different from the written ones)

🔥 lack of rigour

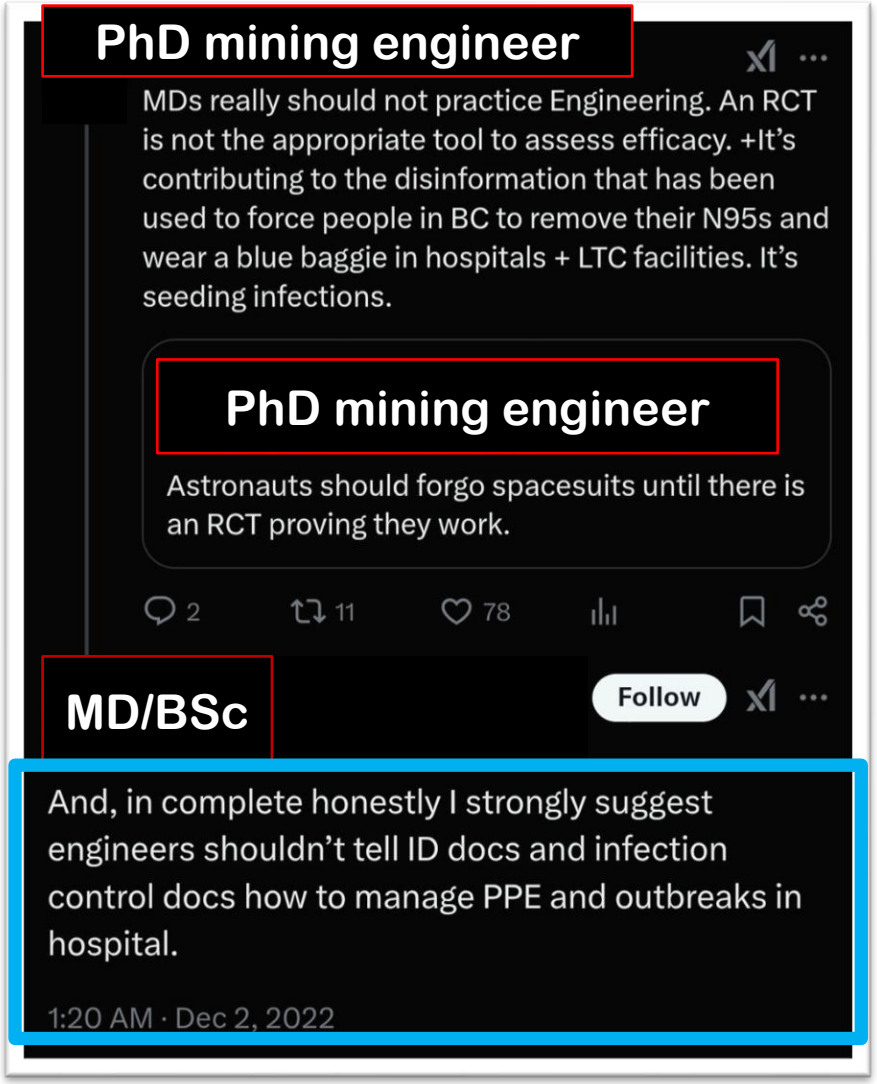
🔥 gatekeeping (parochialism)

🔥 gatekeeping (authority)

🔥 failure of peer review

🔥 failure to manage conflicts of interest

Rejection of outside input



- 🔥 gatekeeping (parochialism)
- 🔥 lack of expertise
- 🔥 gatekeeping (authority)

Social media discussion of shortcomings in the MM/N95 trial shortly after publication

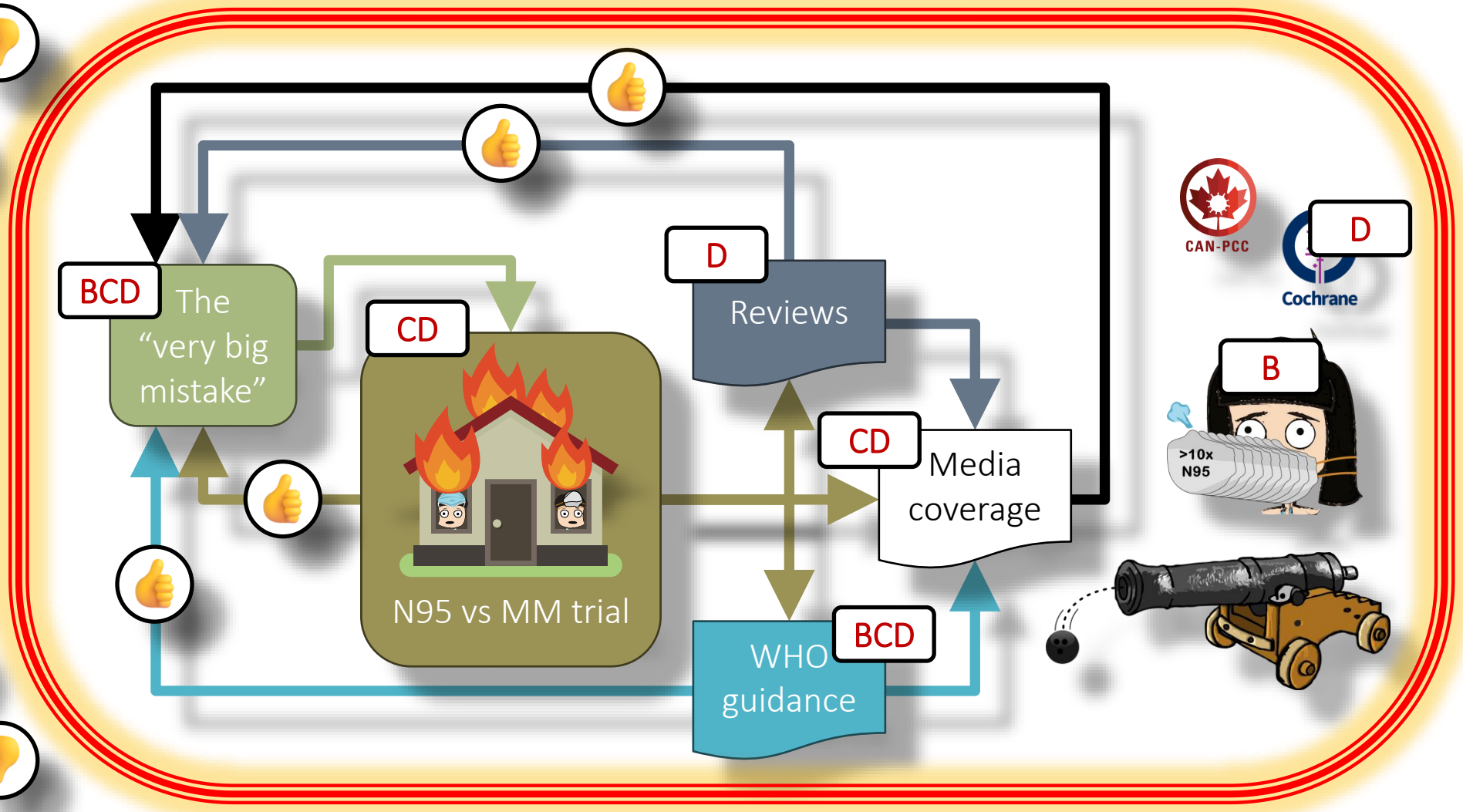
How do the pieces fit together?

The big picture

- lack of contingency planning
- lack of expertise
- lack of rigour
- gatekeeping (parochialism)
- gatekeeping (authority)
- failure to manage COI
- closed-loop self-evaluation
- very few PhDs

Applying PPE science to COVID

- SARS Commission
- Medical experts
- Precautionary principle
- Bioaerosol science
- CAN/CSA Z94.4
- Organized labour
- OHS experts
- PPE engineering



Failure components and red flags

- 🔥 lack of expertise
- 🔥 lack of rigour
- 🔥 failure of peer review
- 🔥 gatekeeping (parochialism)
- 🔥 gatekeeping (authority)
- 🔥 failure to manage COI
- 🔥 reliance on secondary sources
- 🔥 lack of contingency planning
- 🔥 ”gold standard”

- 🚩 bullying
- 🚩 entitlement to control
- 🚩 leadership involvement
- 🚩 closed-loop self-evaluation
- 🚩 outdated information
- 🚩 override precautionary principle = N95s
- 🚩 significant synthesis failures by EBM authorities
- 🚩 very few PhDs*

*Starting with the same undergraduate degree, an MD is exactly as well trained to carry out research in a given area as someone with a PhD in that area is to practice medicine. Neither is “better” but they are *very different* training.

Bennett, S. The 2018 Gosport Independent Panel report into deaths at the National Health Service’s Gosport War Memorial Hospital. Does the culture of the medical profession influence health outcomes? *Journal of Risk Research* **23**, 827–831 (2020).

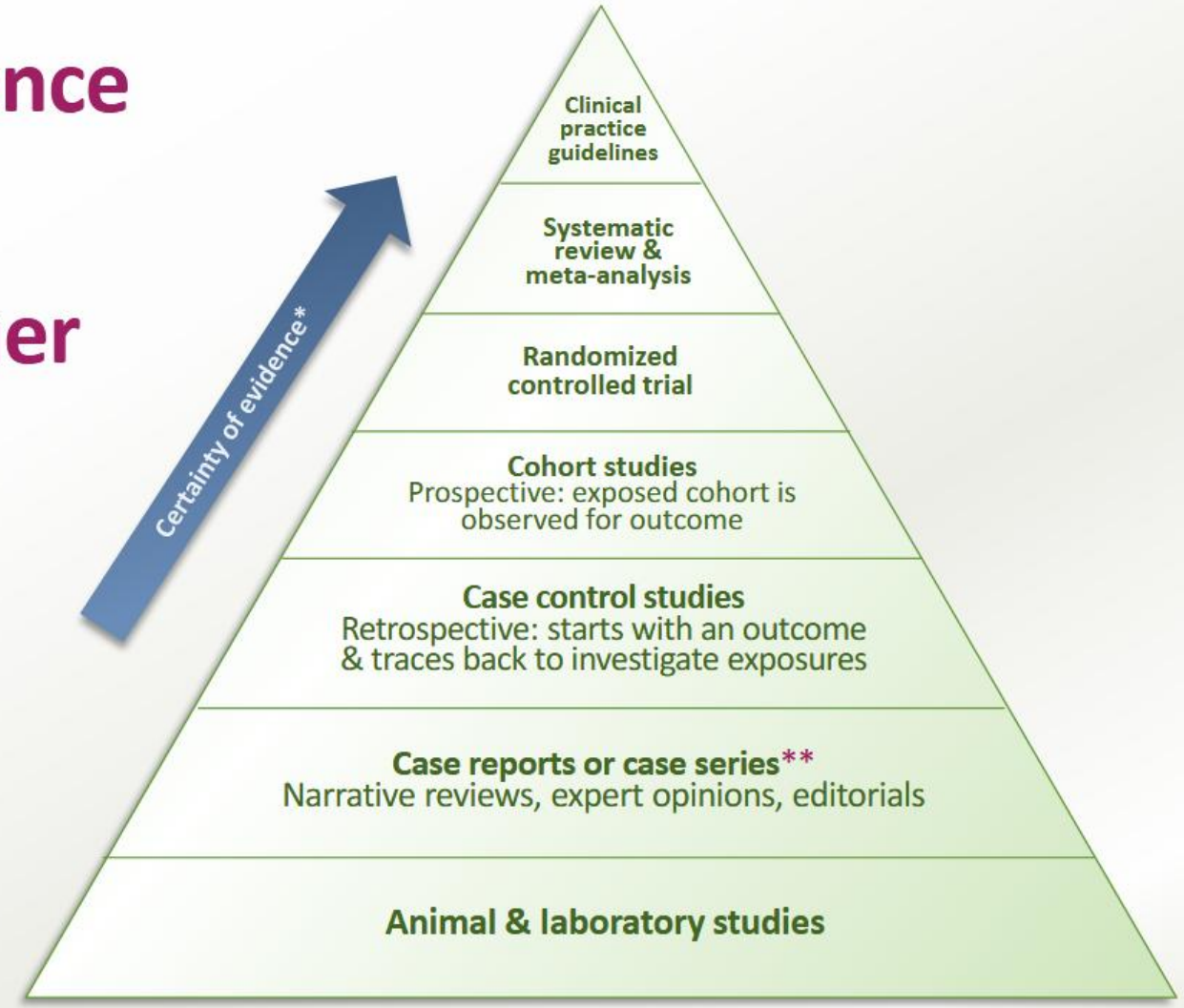
bullying AND ‘medical profession’ - Google Scholar. https://scholar.google.com/scholar?q=bullying+AND+%22medical+profession%22.

Why does this happen?

Mapping the problems onto the system

The "Evidence Based Medicine" paradigm

Certainty of evidence increases when evidence is used from sources higher up the pyramid



* The certainty of evidence is graded as one of 4 categories reflecting the confidence in the findings (high, moderate, low or very low)
** When developing emergency interim guidelines, the evidence to inform recommendations can be based on expert opinion

Epidemic and Pandemic Preparedness and Prevention (EPP). *Update 55 – WHO COVID-19 Guidelines Development Process*. (2021).

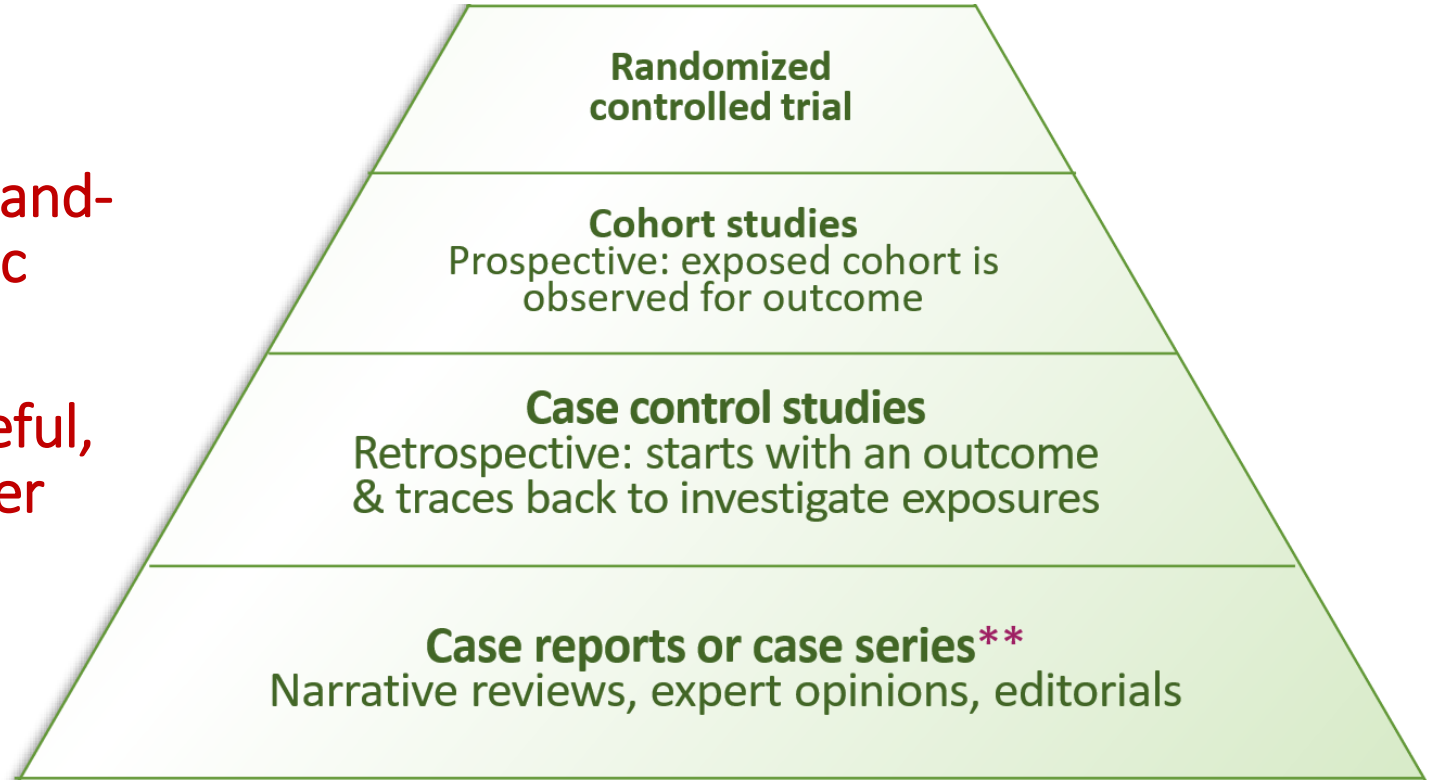
Systems failure

"Around the Godde there forms a Shelle of prayers and Ceremonies and Buildings and Priestes and Authority, until at Last the Godde Dies. Ande this maye notte be noticed."

— Terry Pratchett, Small Gods

Evidence Based Medicine is a *subjective* *heuristic* for quick-and-dirty decisions, not a scientific approach!

That doesn't mean it isn't useful, and "evidence-based" is better than not, but…



Ungrin, M.. Trump's Cronies Aren't What Broke Public Health. *Canada Health Watch* (2025).

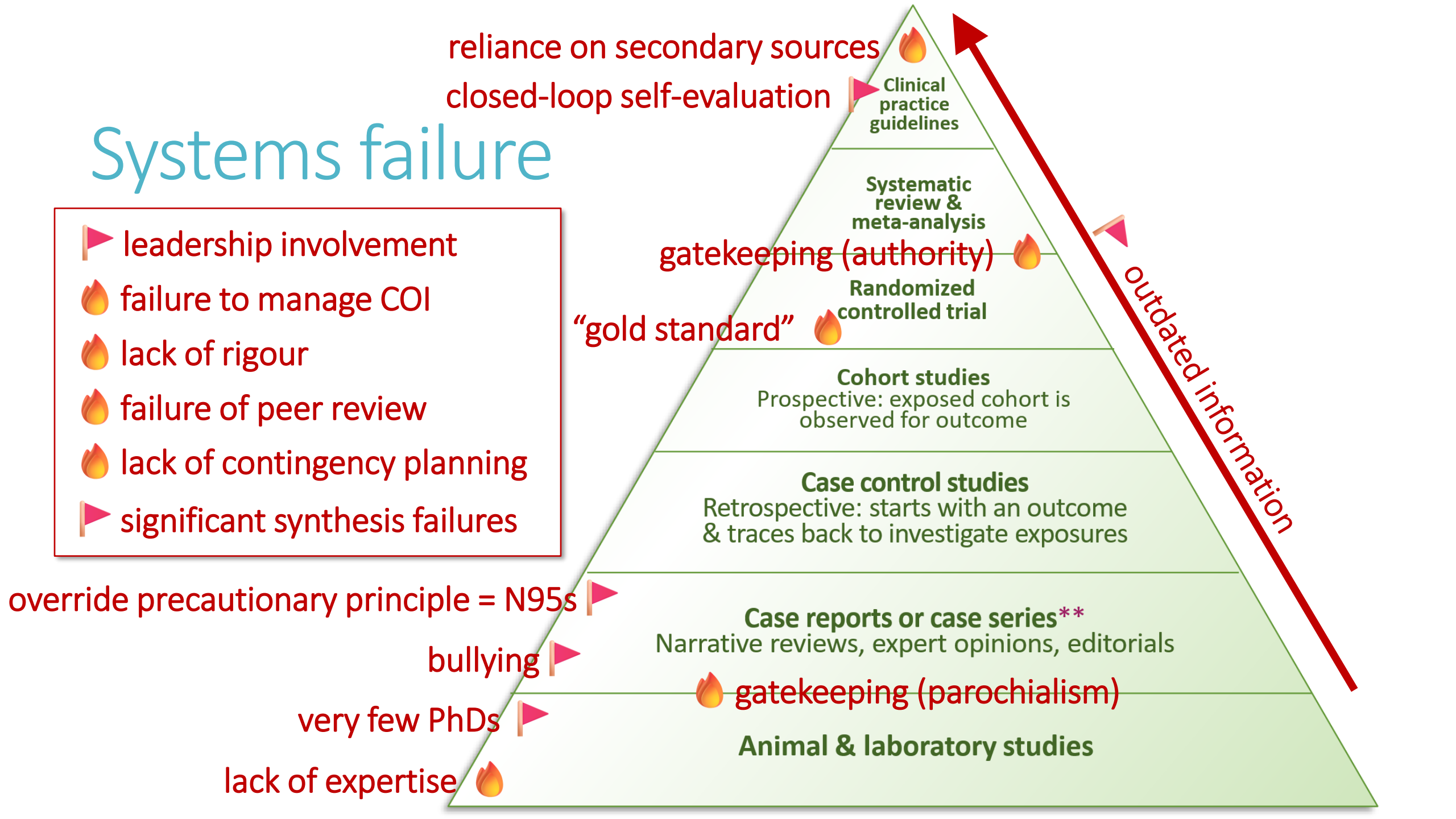
Charlton, B. G. & Miles, A. The rise and fall of EBM. *QJM: monthly journal of the Association of Physicians* **91**, 371–374 (1998).

Rosenfeld, J. A. The view of evidence-based medicine from the trenches: liberating or authoritarian? *Journal of Evaluation in Clinical Practice* **10**, 153–155 (2004).

Greenhalgh, T., Fisman, D., Cane, D. J., Oliver, M. & Macintyre, C. R. Adapt or die: how the pandemic made the shift from EBM to EBM+ more urgent. *BMJ Evidence-Based Medicine* **27**, 253–260 (2022).

Systems failure

- leadership involvement
- failure to manage COI
- lack of rigour
- failure of peer review
- lack of contingency planning
- significant synthesis failures



A lot of things start to make sense now

- Rejection of knowledge from outside the EBM bubble (doesn't count - terra nullius!)
- Studies conducted without essential expertise (randomization is magic!)
- Inability to identify major errors in studies (subject matter expertise is unnecessary!)
- Bad clinical trials treated as "gold standard" (the checklist says so!)
- Out of date information (nothing is real until there are bodies to count!)
- Cognitive lobster traps (secondary sources override primary sources!)
- Refusal to correct / retract (non-clinicians have nothing of value to say!)

And it gets worse…

"We see only one serious limitation in the Core GRADE approach, and that is the subjectivity involved in virtually every important decision in rating certainty of evidence and moving from evidence to recommendations." – the inventor of GRADE

- EBM heuristics are now taught in many medical schools as "how science works"
- Between the subjectivity and the claim to replace science (while discarding the large majority of it), EBM methods like GRADE are an effective vehicle for laundering the opinions of whoever controls a given process into "what science says"

And it gets worse…

"Martin Kulldorff transformed ACIP from a rubber stamp into a committee that delivers ***gold-standard*** *science for the American people,"* Kennedy said in a statement. *"I'm glad to welcome him to my team to help develop bold,* ***evidence-based policies*** *to Make America Healthy Again."*

➢ Ideologues use claims that EBM overrides science to gain control over everything from overriding the CDC and promoting uncontrolled transmission of COVID ("*we want them infected*") in 2020, to vaccine policy and trans health care today.

What can we do about it?

Actionable insights for systemic change

Build bridges

- Look for things everyone agrees on – nobody hates clean air!
- Where people disagree, try to understand why
- “With us or against us” is often an effort to limit your options
- Remember that human error doesn’t really explain anything
- Everyone doesn’t have to agree on everything to make progress on some things
  - Are there shared spaces that could use some help to improve air quality?
  - What about just collecting some data on air quality, and discussing it?

Build better, open scientific processes

- If you have relevant subject matter expertise, don't assume the people who make decisions know more about what they are doing than you do
  - (they might, so don't go too far the other way though either – credentials provide some information but ultimately it comes down to the quality of the science itself)
- Peer-reviewed publication in a prominent medical journal is not proof of rigour
- Discordant evidence must be *reconciled*, not cherry-picked – spread that word
- Don't be afraid to reach out to Ministers, Health Canada, Public Health Agency of Canada, Health Units etc, both for explanations of their policies and to inform them
  - The problems identified here are not the fault of front-line staff! They are doing the best they can with the resources they have available.

Build better, open scientific processes

- Build interdisciplinary networks, and make sure they include subject matter experts
- Learn about mitigations for airborne pathogens
  - COVID, but also seasonal influenza, measles, bird flu, whatever comes next
  - Ventilation, air cleaning, respiratory PPE
  - CO_2 monitors as a proxy measurement of air quality
- Learn about long COVID
- Check the quality of medical research that impacts you, and take a closer look at whether the guidance driving your medical care is scientifically trustworthy
- Be thorough, get (other) experts to check your work
- If you find clear evidence of problems, start writing requests for correction / retraction etc (and treat that process as an experimental probe of a new system too)

Build better, open scientific processes

- Guidance to stop breast cancer screening for women 40-49, produced by the Canadian Task Force on Preventative Health Care (CTF) using EBM approaches, is estimated to contribute to 400 deaths a year in Canada
- Related reductions in screening appear likely to be responsible for a dramatic increase in late-stage (incurable) prostate cancer diagnoses
- A years-long patient-led effort to bring attention to this finally succeeded in triggering a reboot of the CTF this past spring
- EBM/GRADE adherents took control of the process, asserting that having scientific expertise is a conflict of interest incompatible with a voting role in core CTF decision-making, and appear to be structuring the framework for the new CTF to channel both authority and spending to GRADE groups like CAN-PCC / INGUIDE
- You may want to talk to PHAC and/or the Federal Health Minister about this!

A few good, mainstream sources

- Office of the Chief Science Advisor of Canada *"Dealing with the fallout"* report on long COVID
- National Academies report on long-term health effects of COVID infection
- OECD report on workforce and economic impacts of disability due to long COVID
- Statistics Canada *"Experiences of Canadians with long-term symptoms following COVID-19"*
- Clean Air Crew practical tips and resources for air cleaning
- Greenhalgh *et al* review *"Masks and respirators for prevention of respiratory infections"*
- Ontario Society of Professional Engineers Indoor Air Quality Series
- Health Canada Residential IAQ guidelines: CO_2
- Report of the SARS Commission Executive Summary
- Mario Possamai (SARS Commission Sr. advisor): *"Dogma, Hubris, and the Forgotten Lessons of SARS-1"*
- World Health Organization guide to Indoor Airborne Risk Assessment

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Dorothy Wigmore
Cheryl White

Various trainees and members of the public not named due to concerns about retaliation, either professionally or in their medical treatment

Dedication

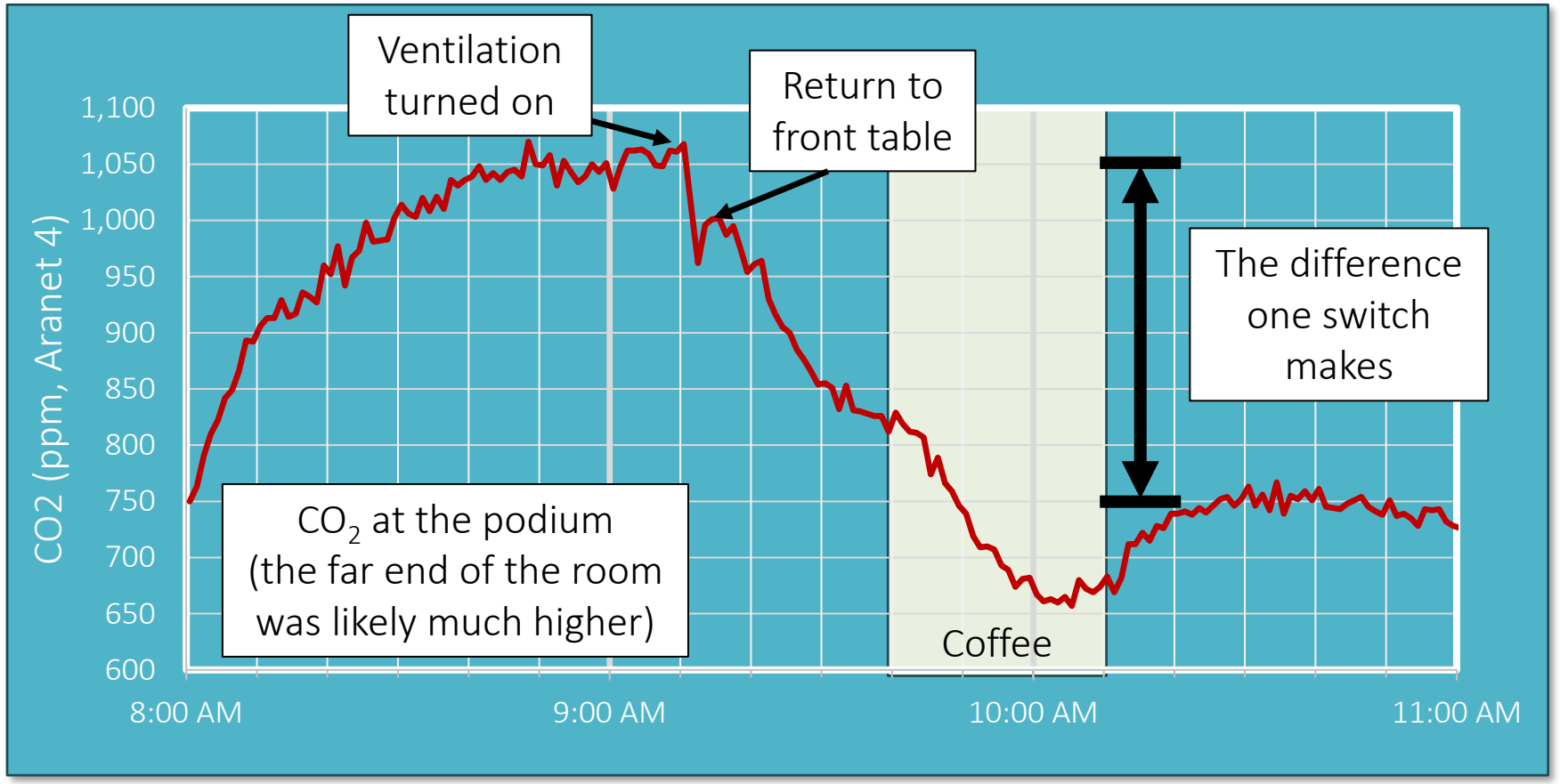
This presentation is dedicated to the enormous – and still growing – number of people killed and disabled by the failure to take reasonable steps to mitigate the airborne transmission of COVID

CO_2 trace during the keynote

These data highlight how monitoring and simple administrative changes can significantly impact transmission risk in multiple-occupant spaces.

In most non-industrial contexts, CO_2 is produced by occupants, so CO_2 is a good proxy for rebreathed air and ventilation rates (and therefore bioaerosols, in the absence of e.g. HEPA units).

CO_2 monitors are available from many libraries via the Community Access to Ventilation Information program.



The Ontario Society of Professional Engineers' Air Quality Calculator can be helpful for interpreting the data. Also…check your elevators!

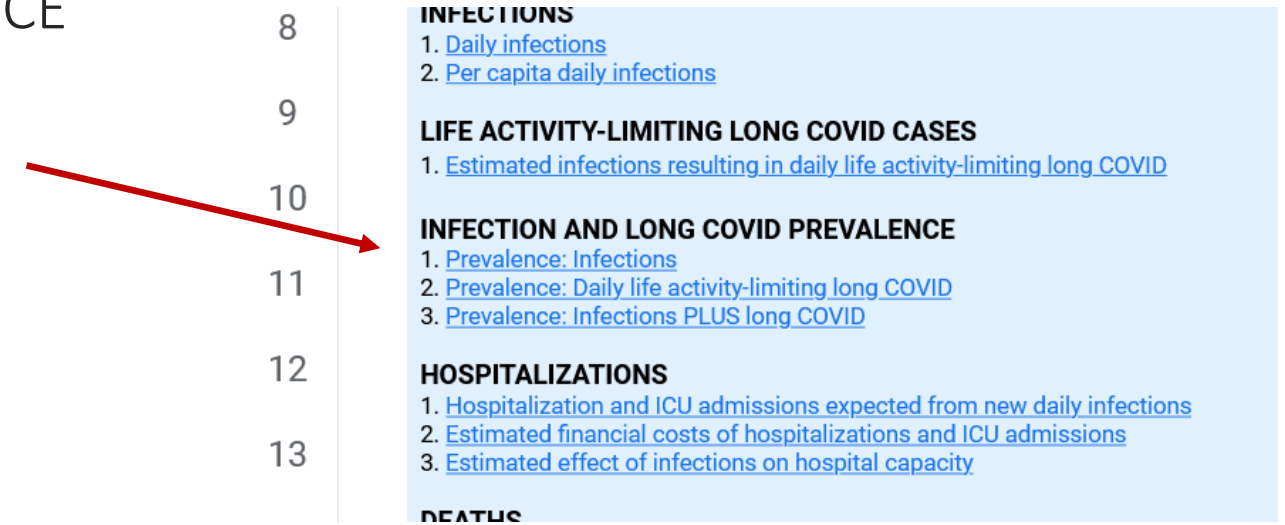
Extra slides

(things that came up in the questions afterwards, plus some terminology at the end)

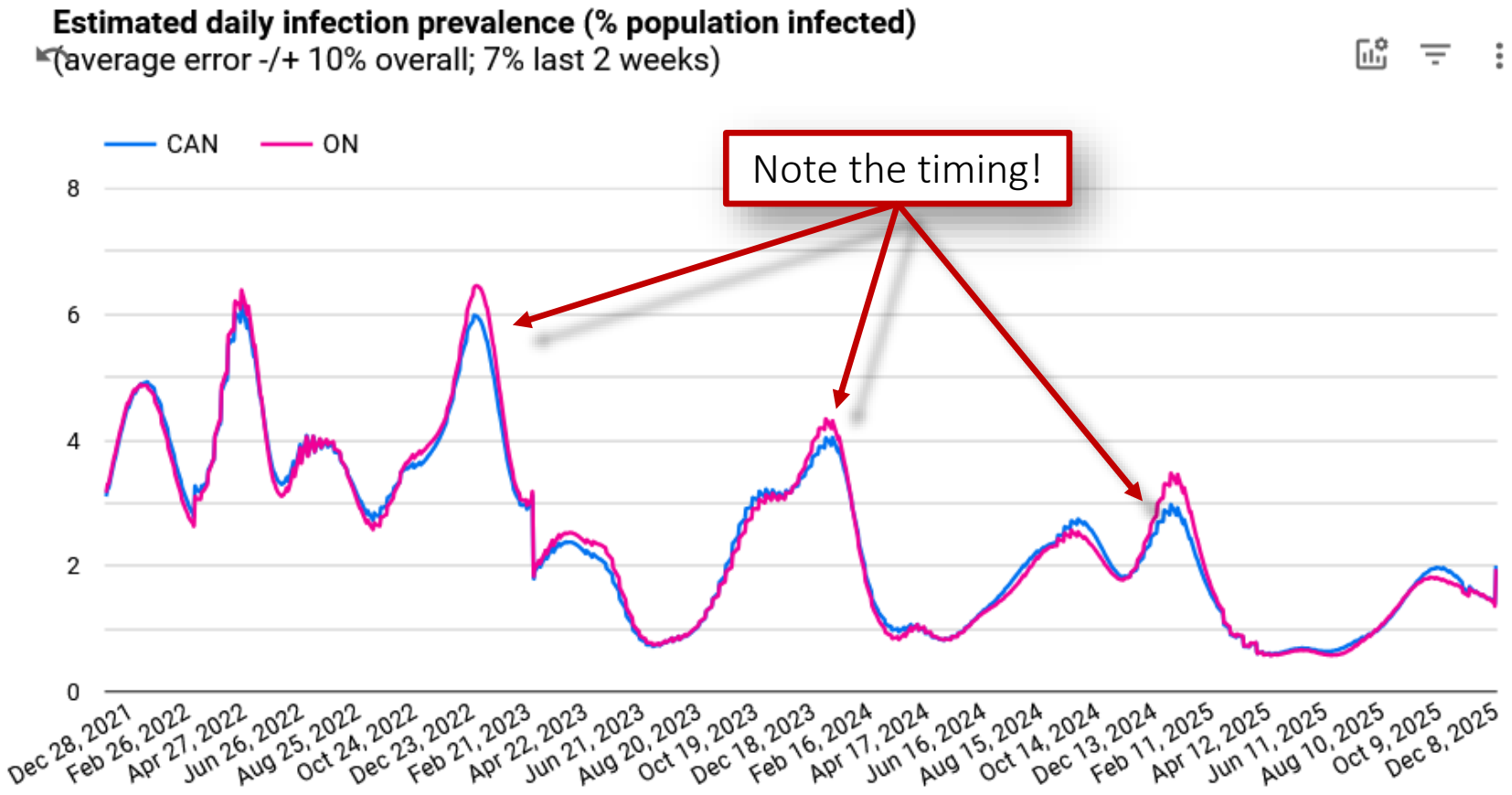
COVID prevalence data

➢ [COVID-19 Resources Canada] has a lot of useful information. My understanding is that there have been active efforts to deny them access to data however this remains one of the most extensive sources currently available to Canadians. Operated by the [Moriarty lab] at the University of Toronto.

➢ For up-to-date versions of the charts on the following slides, [follow this link] and then scroll down and select the options under “INFECTION AND LONG COVID PREVALENCE”



COVID prevalence (acute)

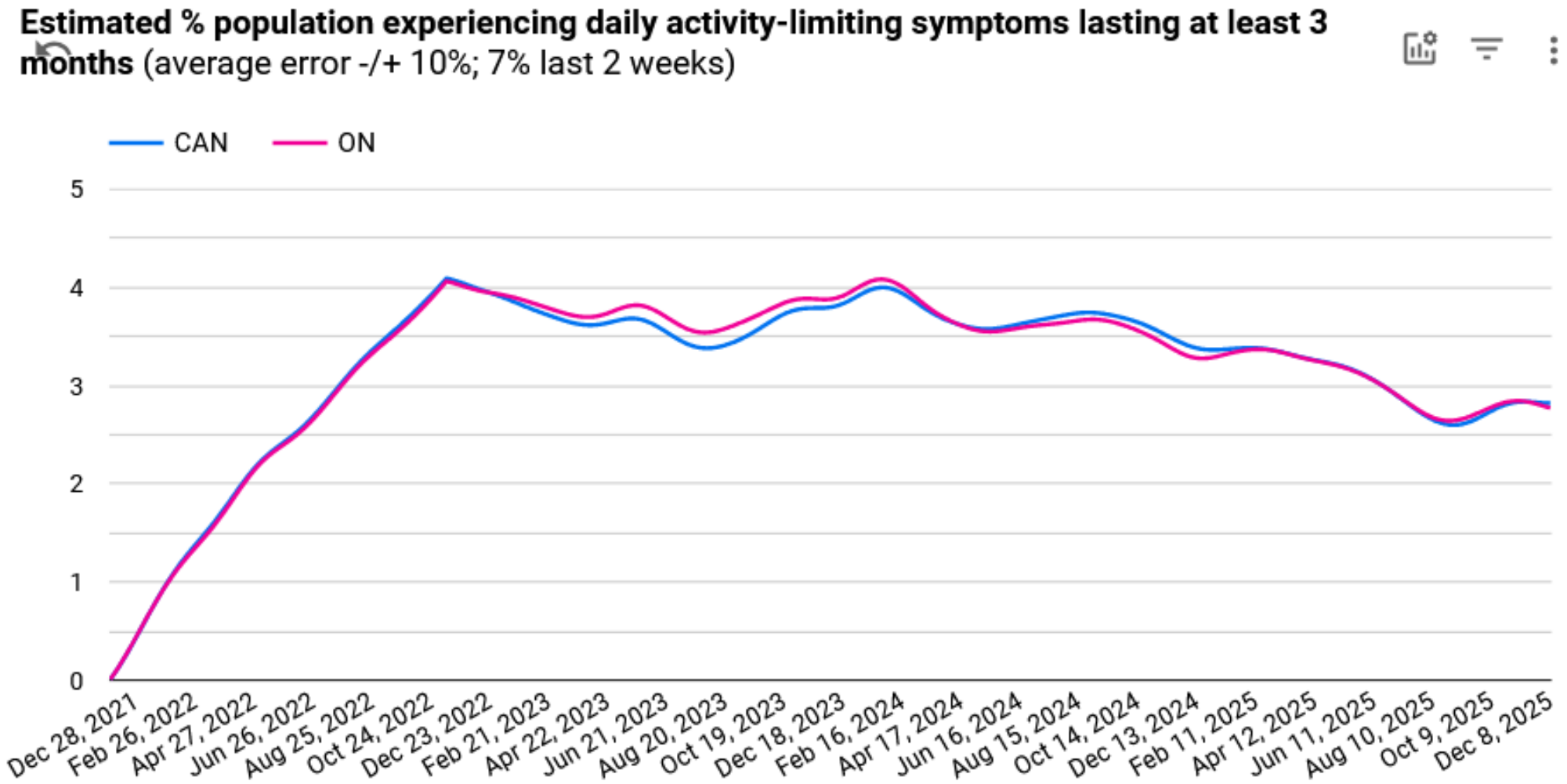


TOP PANEL: Estimated percentage of people in each region infected on any given day, assuming the average infection lasts 7 days. These values are calculated from estimated total daily infections.

BOTTOM PANEL: Estimated prevalence of cases with activity-limiting long COVID lasting at least 3 months. Estimates assume that activity-limiting long COVID symptoms last an average of 6 months. They are calculated from estimated daily long COVID-infections. Assuming an average duration of 6 months, the estimated % of the Canadian population experiencing activity-limiting long COVID symptoms on March 5, 2023 was similar to the % of the UK population reporting activity-limiting long COVID symptoms on that date (after subtracting people with symptoms dating back to the pre-Omicron era).

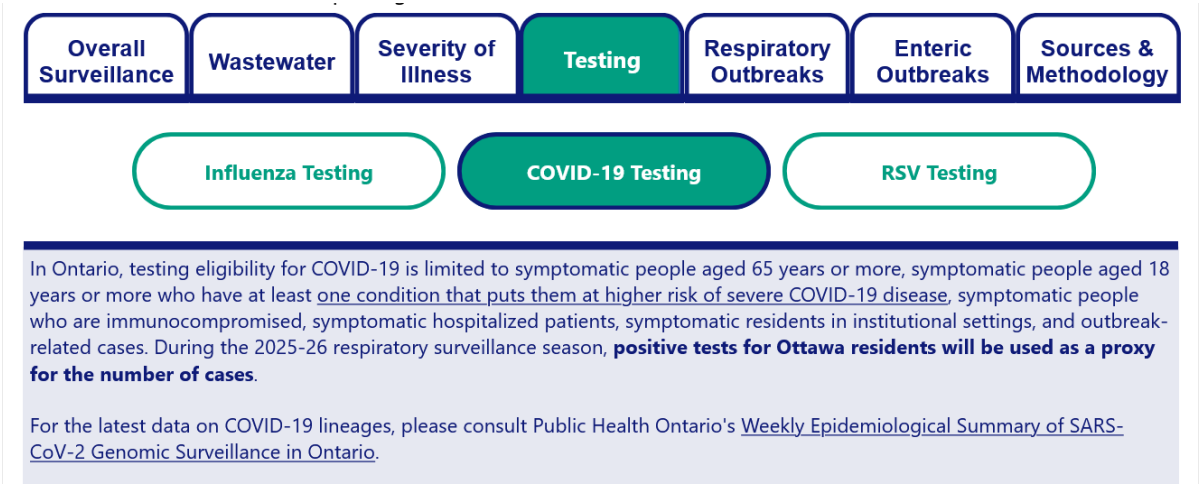
Estimates of the combined prevalence of infections and long COVID are provided on the following page. These estimates are important for understanding the % of the population that may be unable to work, may be experiencing impaired work performance and/or is experiencing limitations in the ability to conduct activities of daily life.

COVID prevalence (long COVID)



Other COVID data sources

- Tracking current COVID numbers is challenging because there is so little testing
- Declaring COVID to be “endemic” is convenient because it asserts nothing can be done, and erases responsibility for monitoring and controlling it
- The Delatolla lab in Ottawa publishes wastewater testing for various pathogens
- Public Health Ottawa has case & testing data, but since testing is so restricted there’s limited information. You have to scroll down a bit to find this:



Long COVID

- As a new illness, there is a significant problem with "medical gaslighting" and dismissal of long COVID, often going unrecognized or mislabelled "burnout"
- This is compounded by bias and differing impacts around gender, race, etc.
- Long COVID affects many healthcare workers (a major contributor to shortages!), often buried by the culture of presenteeism and "toughing it out" in healthcare
- Teachers are also at high risk
- Not everything is long COVID, but anyone who tells you it's rare, not real, doesn't affect kids etc is years out of date

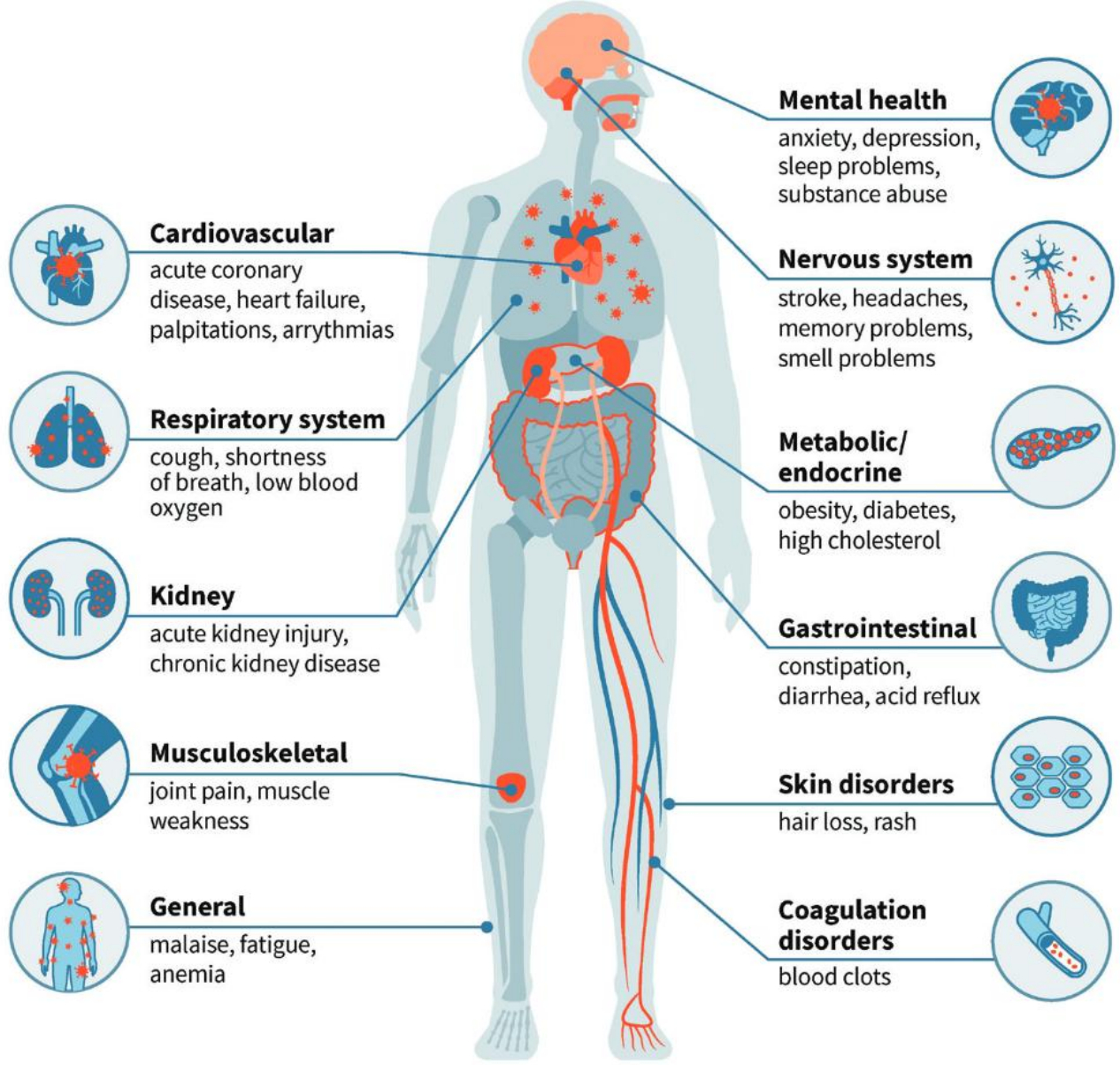
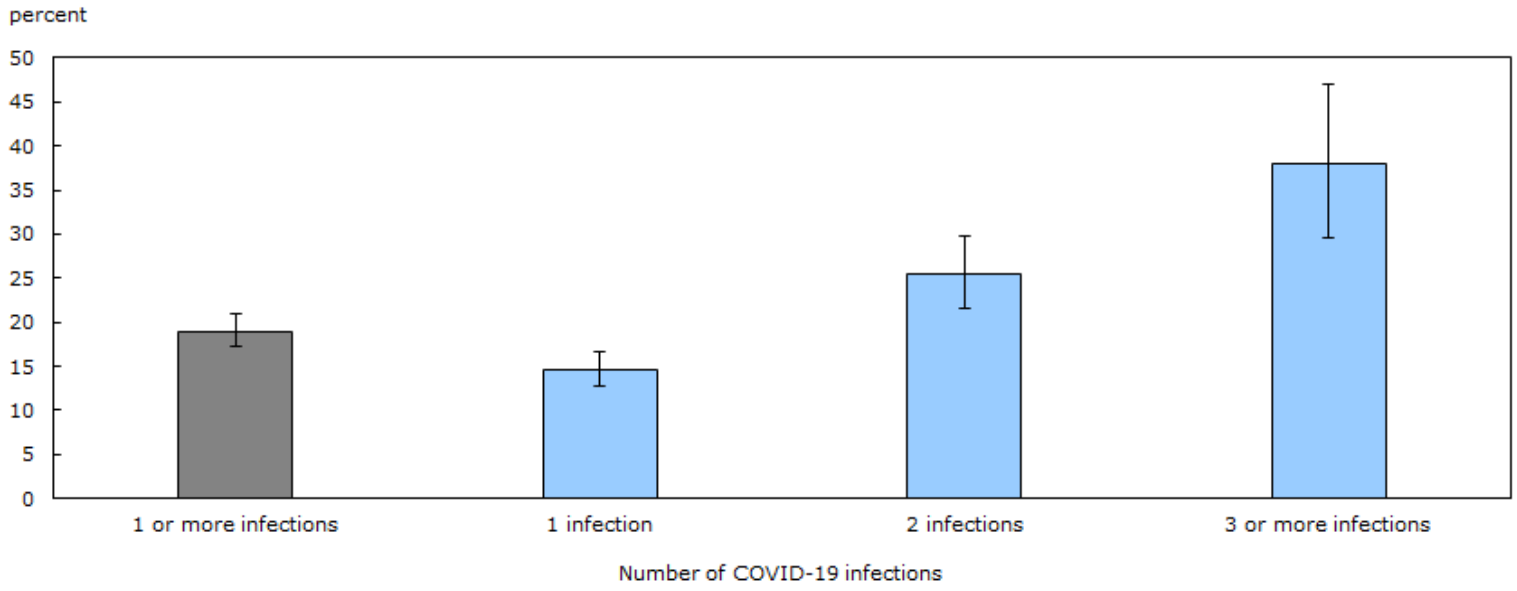


Fig. 3-1, National Academies of Sciences, Engineering, and Medicine. *Long-Term Health Effects of COVID-19: Disability and Function Following SARS-CoV-2 Infection*.

Less COVID means less long COVID

- Ideally, we'd all never get COVID – that's hard without public health support
- But once is better than twice, twice is better than three times, etc

Chart 2
Percentage of Canadian adults with long-term symptoms, by number of self-reported COVID-19 infections, June 2023

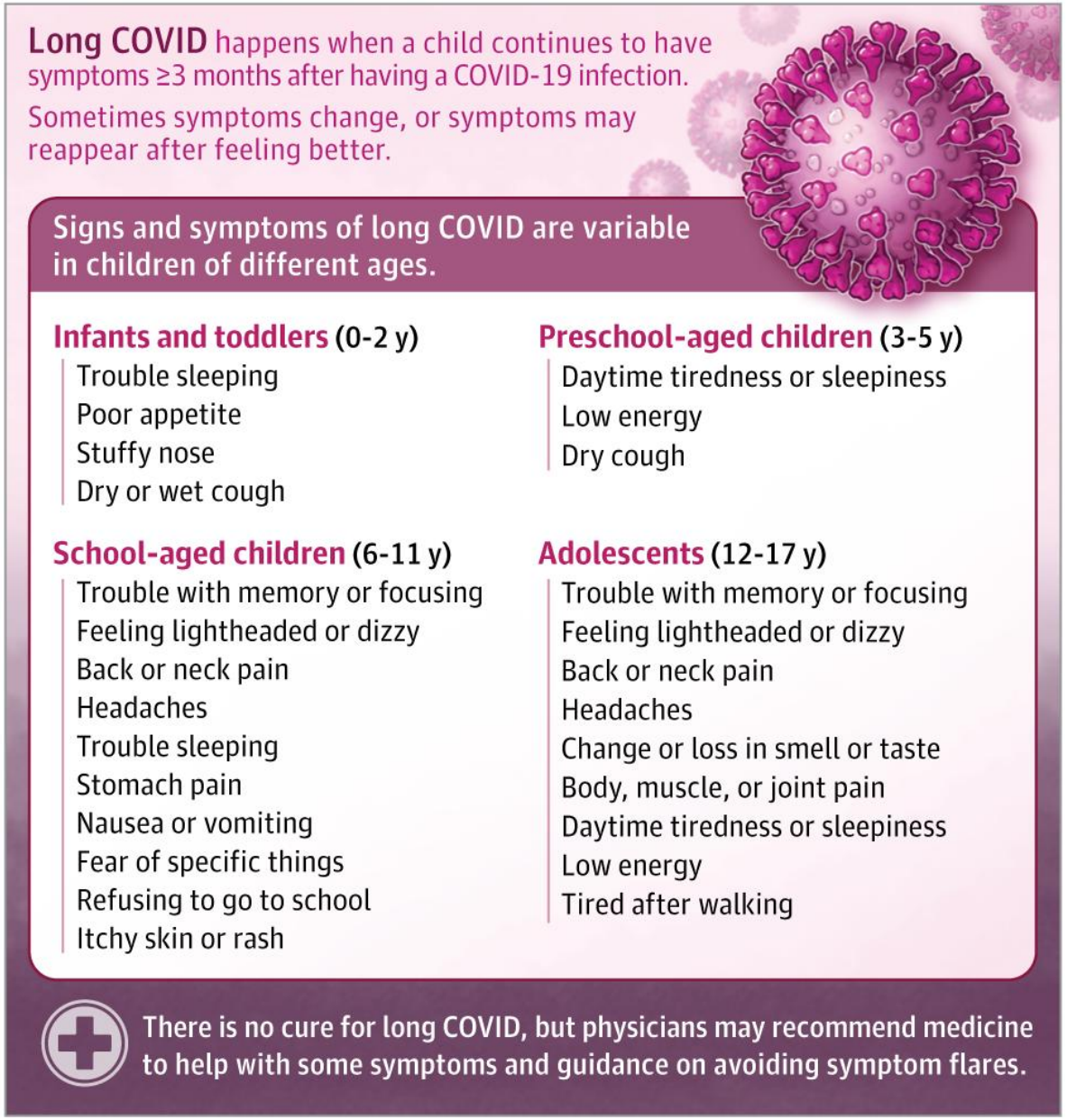


Source: Statistics Canada, Canadian COVID-19 Antibody and Health Survey - Follow-up Questionnaire, 2023.

Kuang, S. *et al. Experiences of Canadians with Long-Term Symptoms Following COVID-19*. Statistics Canada (2023).

Long COVID in youth

- Long COVID in children, teens and young adults often goes unrecognized, or treated as laziness / anxiety / etc, adding an extra layer of harm
- Very important not to just try to "push through it", as that can make it worse
- Children and/or their parents are sometimes accused of making it up



Gross, R. S., Carmilani, M. & Stockwell, M. S. Long COVID in Young Children, School-Aged Children, and Teens. *JAMA Pediatrics* (2025

Long COVID in youth

- Gaslighting is a particular problem in pediatrics (commitment bias likely contributes)
- There is also extensive misinformation due to junk studies like this one
  - We were able to force a retraction in this case, but it took almost a year, and JAMA Pediatrics initially protected the study – even though the authors directly admitted they had not collected the data required to do the analyses they claimed to report
  - The authors misunderstood what long COVID is (treating it as just acute COVID that doesn't go away), but the retraction misrepresented the problem as minor calculation errors – obscuring the (senior, male, MD) senior author's responsibility and throwing the (junior, female, trainee) lead author under the bus
- Media coverage avoided mentioning the major research integrity issues and spun the retraction a minor change and an example of ethical and responsible science!

Clearing the air

- Ventilation is an easy win, as many diseases are airborne (see Terminology pages), and it protects against new diseases that may arise in the future as well
- Commercial HEPA units are available, or for ~$100 you can build a very effective filter unit from a box-fan and some 20” x 20” furnace filters (works great for drywall dust, pollen and other allergens, and wildfire smoke too!)
- For slightly more money you can use computer fans to make something quieter and more energy efficient (Arctic P14 fans come in 5-packs and are good value for money)
- Ventilation and air quality are part of the practice of engineering (as more of public health probably should be), and OSPE has good resources on the topic

Examples

https://www.printables.com/model/519878-air-filtration-lampshade

Box fan + 4x Filtrete MPR 1900 filters + cardboard + duct tape (this design is even UL safety tested!)

Clearing the air you in/exhale

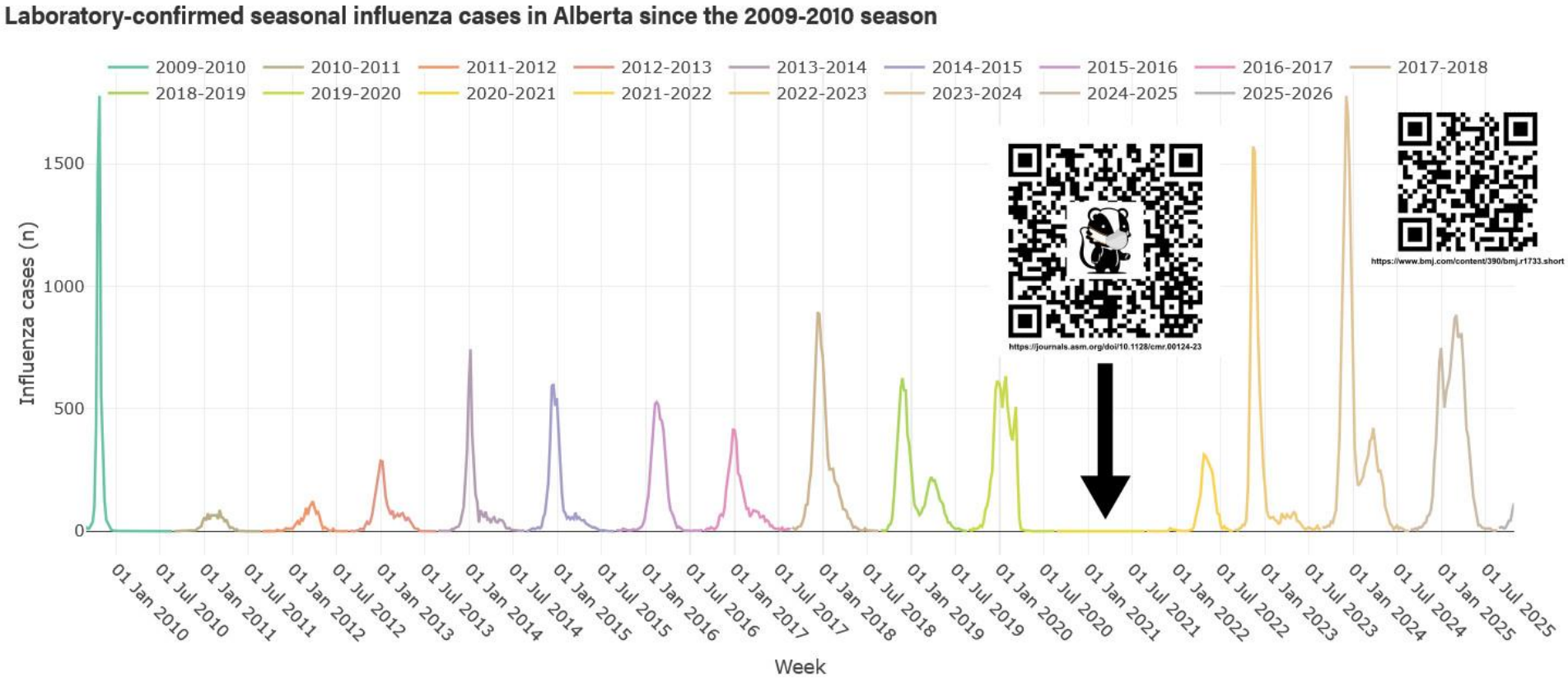
➢ Even if you don't plan on wearing one regularly, it's worth identifying a comfortable style of certified N95 / CA-N95 and keeping a stock accessible for:

- Keeping illness from spreading at home (family members, workers, delivery people)
- If you need to go into the hospital / sit in the ER with a bunch of sick people
- Protecting someone who is (or might be, or might have a family member) dealing with chemo / surgery / heart attack / illness / immune compromise / etc (watch for people wearing one already)
- Travel / high-density gatherings / anything in older buildings with poor ventilation ("meets code" may just refer to the requirements at the time it was built!)
- In case of surges in any airborne disease – COVID, seasonal flu, measles, bird flu, etc

➢ Older N95 models were only designed for Caucasian male face shapes, and may only seal when uncomfortably tight on many people. Modern designs make it much easier to find a comfortable N95. "Sampler packs" are available from Donate A Mask (charity) and Canada Strong, and N95s compliant with the new Q100 standard are particularly easy to breath in.

Major progress is possible

➢ Increased use of PPE and other non-pharmaceutical interventions greatly reduced influenza infections in 2021/2022, and even drove one of the major lineages extinct!



Increased burden now may reflect COVID-induced damage to the immune system. This is sometimes blamed on "immunity debt" from not getting the flu etc, several years ago, but the claim seems to have appeared as an ideological excuse to dismiss the long term impacts of COVID, rather than having a scientific foundation.

Major progress is possible

- As with anything else, the first step towards solving the problem is acknowledging it
- The people responsible for educating the public about the damage from widespread COVID infections are the same people who fought against COVID containment efforts
- Network – a common tactic is to claim anyone who speaks up is alone / irrational / the only one who cares. Support each other, and demand transparency and scientific integrity.
- Check out groups like Ontario School Safety, the Canadian COVID Society, the World Health Network, and CAVI-CO_2 (they provided the library CO_2 monitor – borrow it and try it out!)
- Educate politicians at all levels, school board trustees, senior public servants, etc, and make sure they support those public servants still speaking out, like Canada's Chief Science Advisor
- **Don't take "*it's too complicated for you to understand*" for an answer – it isn't!**

Terminology

Advisory Committee on Immunization Practices (ACIP): A committee within the US CDC that issues national guidance on vaccinations. ACIP members were recently replaced with fringe anti-vaccine figures, and ACIP has started removing vaccine recommendations.

Aerosol: A collection of solid or liquid particles suspended in a gas. Bioaerosols produced from respiratory secretions during breathing, coughing etc contain pathogens present in those secretions, and can transmit them at both short and long ranges. Bioaerosols can remain infectious for minutes, hours, or even longer depending on the pathogen. The outdated belief that particles above 5 microns in diameter fall rapidly to the ground remains widely-held within the clinical infection control field, contributing to the rejection of the standards-compliant PPE required to adequately manage aerosol hazards by many healthcare facilities, and the unnecessary loss of an enormous number of lives.

Airborne transmission: Infection via inhalation of pathogen-containing aerosols at any distance from the source. The term "inhalation transmission" has the same meaning.

Canadian Standards Association (CSA): Generates safety standards based on interdisciplinary expertise. Extended time frames for updating provincial legislation mean they often lag a version or two behind the current CSA standard. In addition to standards themselves, CSA also provides tools for implementation, such as this interactive decision tool for identifying the appropriate respiratory PPE for workplaces where an aerosol hazard such as COVID-19 *may* be present. Specification of N95 respirators as the PPE required for bioaerosol hazards such as COVID in CAN/CSA-Z94.4-18 is relevant to the obligation to take reasonable steps to protect workers and the public under Canada's "Westray law".

Canadian Task Force on Preventative Health Care (CTF-PHC): The body responsible for guidance on e.g. screening for breast cancer, prostate cancer etc. Suspended by former Health Minister Holland in early 2025, after significant concerns were raised by patient groups and clinicians about the quality of guidance across a wide range of topics. The way evidence is evaluated in EBM/GRADE processes means the integration of evidence that previous guidance was in error and causing significant numbers of deaths depends on the subjective opinions of those involved in creating that guidance about the quality of the evidence that contradicts it. The process of modernizing the CTF was placed under the control of groups with significant financial and reputational stakes in the same EBM/GRADE approaches responsible for previous problems.

Centers for Disease Control (CDC): The national public health agency of the United States. Part of the Department of Health and Human Services, which is currently led by anti-vaccine conspiracy theorist Robert F. Kennedy Jr. The CDC's response to COVID-19 was recognized as inadequate by the CDC itself, hampered by both interference from political appointees and rejection of non-clinical expertise.

Canadian Guidelines for Post COVID-19 Condition (CAN –PCC): A collaboration between McMaster-GRADE and Cochrane, two of the highest-profile groups in the EBM field, provided with $9M in Federal support to generate guidelines related to PCC / long COVID. The value of CAN-PCC recommendations is limited by substitution of GRADE approaches for scientific understanding – for example despite warnings of invalidating errors in a deeply flawed clinical trial of N95 respirators vs medical masks, CAN-PCC reported that "*rigorous assessment of the study by the evidence synthesis team did not find risk of bias concerns*" (see "EtD" section).

Droplet transmission: Transmission via large particles (several hundred microns in diameter) that follow ballistic trajectories from the source to cause infections. Physically implausible for many diseases where infection would occur only in the event of direct impact on the eye, or entry into the mouth or nose. Many infection control professionals incorrectly ascribe transmission to such droplets for various diseases including COVID, due to the erroneous belief that all particles above 5 microns in diameter behave in this way (see "Aerosol").

Terminology

EBM: Evidence Based Medicine. Initially a democratizing concept, asserting front-line clinicians can consider scientific evidence in addition to direction from medical authorities. Rapidly re-centralized, returning power to medical authorities to impose their interpretation of the literature. Disseminated in the form of "guidance", often with disclaimers of responsibility for the consequences of following it. In practice, following guidance is widely viewed as mandatory for clinicians to retain medical liability insurance coverage. With the EBM "brand" increasingly required on all medical decision-making, the opportunity for profit and control has given rise to a number of subtypes as well as significant competing interests. Efforts are underway to extend the EBM model beyond medicine, to control the translation of science into policy across fields. Also refers to various systems of heuristics used to guide front-line clinicians in incorporating science into practice, when time / resources / scientific expertise are unavailable. Origins associated with McMaster University and the Cochrane Collaboration.

GRADE: Grading of Recommendations, Assessment, Development and Evaluation. A more granular subtype of EBM developed at McMaster University, and championed by the McMaster-GRADE Centre. Associated with an extensive array of proprietary for-profit software and training programs tied to McMaster. Widely used, including by the WHO in developing its droplet-only COVID policy. Sometimes marketed as "the science of interpreting evidence", as with other EBM variants GRADE does not incorporate fundamental scientific principles such as consilience and is recognized to be subjective throughout, including by its originators.

Infection Prevention and Control Research and Development Expert Group for COVID-19 (IPCRDEG-C19): The WHO committee whose advice largely set WHO COVID policy for the first year of the pandemic. Primarily composed of clinicians, many with limited scientific training, its Chair famously shouted down the world's leading scientific experts on aerosols and disease transmission when they attempted to warn the WHO COVID was airborne in early 2020. While parts of the WHO have since sought to introduce modern scientific understanding of aerosols into guidance, influence by IPCRDEG-C19 members continues to drive commitment to the original "very big mistake".

Long COVID (also known as Post-COVID Condition / PCC and Post-Acute Sequelae of COVID / PASC): a broad range of poorly understood long-term impacts from a COVID infection. Mechanisms are unknown, but may relate to persistent infection. As SARS-CoV-2 can infect many cell types including the endothelial cells lining the blood vessels, infection can occur throughout the body and persist for months or even years after the initial lung infection has resolved. There is presently no cure or effective treatment other than prevention. As long COVID is generally assessed based on chronic symptoms, not all long-term impacts of COVID infection (elevated risk of heart failure, stroke etc) are covered by the term.

Medical / surgical mask: the classic "baggy blue"hospital mask. Provide some benefits in reducing disease transmission, blocking large droplets, redirecting the plume of air from a cough, and preventing a surgeon's nose from dripping into an incision. Unable to seal to the face, they have limited ability to block aerosols as they can bypass the mask material and flow in and out through gaps. Medical masks are not considered to be respiratory PPE.

Personal Protective Equipment (PPE): Includes respirators, protective clothing (including gloves and footwear) and face and eye protection, which can reduce or prevent contact and the absorption of a designated substance.

Public Health Agency of Canada (PHAC): Part of the Federal Public Service, often deferring to Provincial CMOH / PHO

Terminology

Quality Adjusted Life Year (QALY): A widely used metric of health impacts that attempts to take into account disability as well as death. Useful in a general sense but raises complex ethical questions about the value of human life in relation to disability.

Randomized Controlled Trial (RCT): Described as the "gold standard" experimental method in many EBM implementations, which commonly claim an RCT outweighs all other primary evidence as well as mechanistic understanding and knowledge from other fields of science. The use of randomization and controls is often asserted to make mechanistic understanding of the phenomena being studied unnecessary, and many EBM adherents lack awareness of the use of randomization and controls in other fields. RCTs can be a valuable tool if their limitations are understood, but designing a good RCT requires mechanistic understanding to avoid invalidating errors, as discussed in the talk.

Respirator (N95, CAN95, N99, FFP2, FFP3 etc): The specific designation refers to the exact standard under which they are certified. Unlike medical masks, respirators are designed and certified to protect the wearer against aerosols. Their performance is assessed while being worn (rather than just testing the materials from which they are made). Constructed from modern electret materials that filter out large particles but also remove small ones via other mechanisms including static charge, they are rated for performance at the "most penetrating particle size", generally around 0.3 microns in diameter. E.g. for certification an N95 must remove at least 95% of particles at that size, with performance improving for both smaller and larger particles. Effective against COVID and other aerosol hazards both empirically and for obvious mechanistic reasons: If it can't get inside you, it can't make you sick; if less of it gets inside you, you are less likely to get sick.

SARS Commission (Campbell Commission): Investigated failures in the management of outbreaks of Severe Acute Respiratory Syndrome (SARS) in Ontario caused by SARS-CoV-1, a coronavirus closely related to the pathogen that causes COVID, SARS-CoV-2. Its mandate did not permit the finding of fault on the part of individuals. The SARS Commission reported an extensive list of failures in the management of SARS, including limiting decision-making to a narrow group of infection-control and public health clinicians, turf wars, rejection of input from workers and worker safety experts, commitment to outdated assumptions of droplet transmission, and lack of transparency. The Recommendations of the SARS Commission include requirements to apply the precautionary principle; assume future respiratory outbreaks are airborne until proven otherwise; ensure workplace safety decisions are led by the Ministry of Labour rather than medical administrators and integrate worker input; "*ensure that there are clear, specific references to relevant worker safety laws, regulations, guidelines and best practices*". The SARS Commission delivered its final report in 2006, including an annex written while Justice Campbell was dying of cancer, documenting how infection control leaders were already ignoring what had been learned from SARS. A 2020 follow-up report from the SARS Commission's Senior Advisor, documenting the ongoing failure of public health and infection control leaders to follow the Commission's Recommendations was also ignored, as were direct, accurate warnings about airborne transmission of COVID provided by Canadian labour leaders and worker safety experts.

World Health Organization (WHO): Large, multifaceted international public health organization with a budget on the order of ten billion dollars per two-year cycle. WHO guidance heavily influenced the international public health response to COVID-19. Internally, WHO policy largely followed the lead of IPCRDEG-C19. Extensive and valuable direct delivery of public health interventions around the world, but lacks transparency in some areas, particularly administrative functions and budgets - e.g. the WHO partially funded the deeply flawed N95 vs medical mask study conducted by members of the IPCRDEG-C19 (including its Chair) and seeking to provide support for their prior decisions, but no information is available on the amount, timing, or how and by whom that decision was made.