A Mask is not a Mask: Why Some Facemasks Are Better than Others

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https://tinyurl.com/COVID-Aerosols-Science
https://tinyurl.com/COVID-Aerosols-Protection
Twitter: @jljcolorado
http://tinyurl.com/covid-estimator
http://tinyurl.com/faqs-aerosol
http://tinyurl.com/preguntas-espanol (auto translations)
https://www.youtube.com/c/JoseLuisJimenez

Image from Heikki Kahila and Ville Vuorinen, Aalto University, Finland

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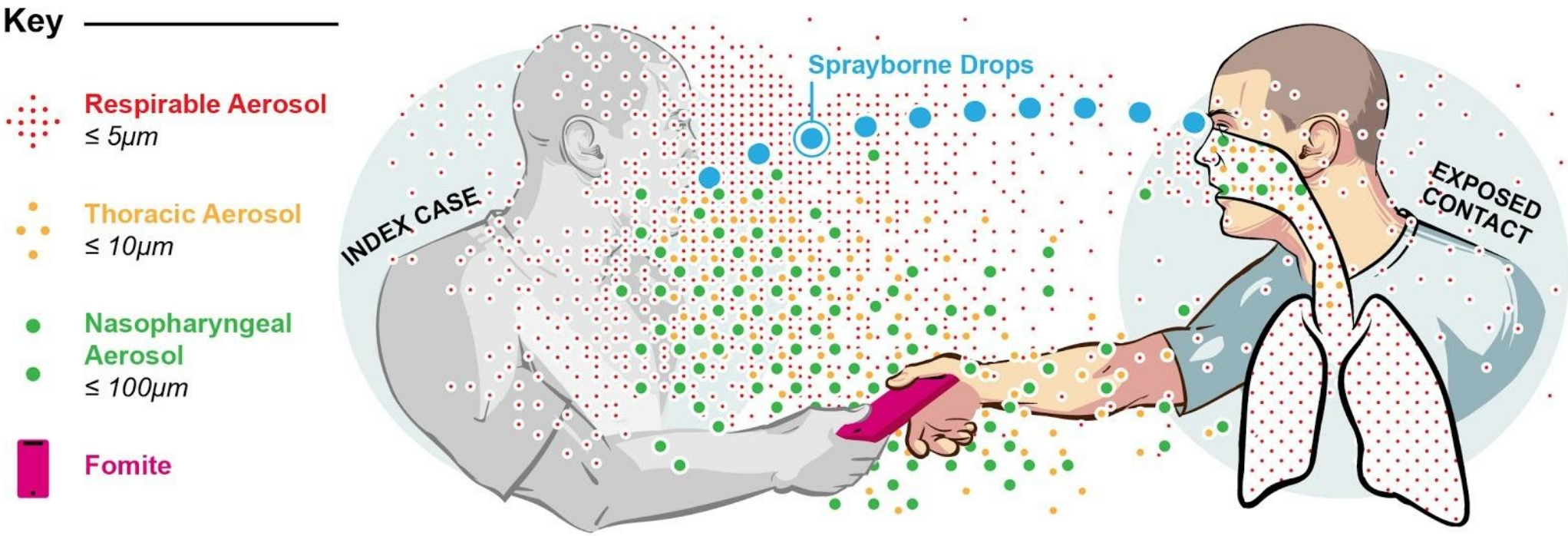
Droplets vs. Aerosols vs. Surfaces



- Droplets:
  - Ballistic projectiles
  - Infect by impact on eyes, nostrils or mouth
- Aerosols
  - Float in the air
  - Infect by inhalation

From Milton, 2020: https://academic.oup.com/jpids/article/doi/10.1093/jpids/piaa079/5875939 (w/ update courtesy of Prof. Milton)

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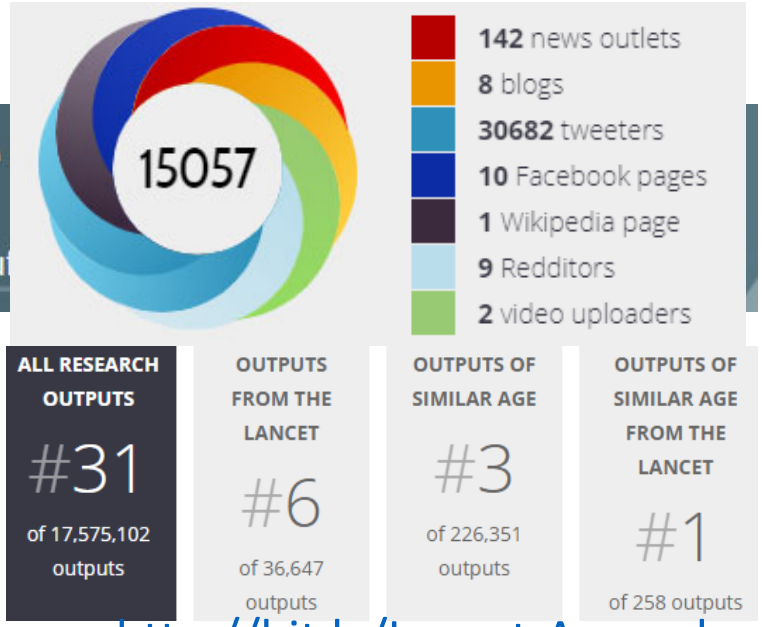
THE LANCET

Ten scientific reasons in support of airborne

Trisha Greenhalgh • Jose L Jimenez • Kimberly A Prather • Zeynep Tu



1. Superspreading events
2. Long-distance transmission
3. Presymptomatic transmission

http://bit.ly/Lancet-Aerosols

4. Outdoors << Indoors; Ventilation works indoors
5. Infections in hospitals w/ surgical masks
6. Viable SARS-CoV-2 captured from the air
7. Virus found in ventilation ducts and filters
8. Demonstrated w/ animals (ferrets + hamsters)
9. No evidence against airborne transmission
10. Limited evidence in favor or of droplets or surfaces

(11. Likely anisotropic infection)

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)00869-2/fulltext

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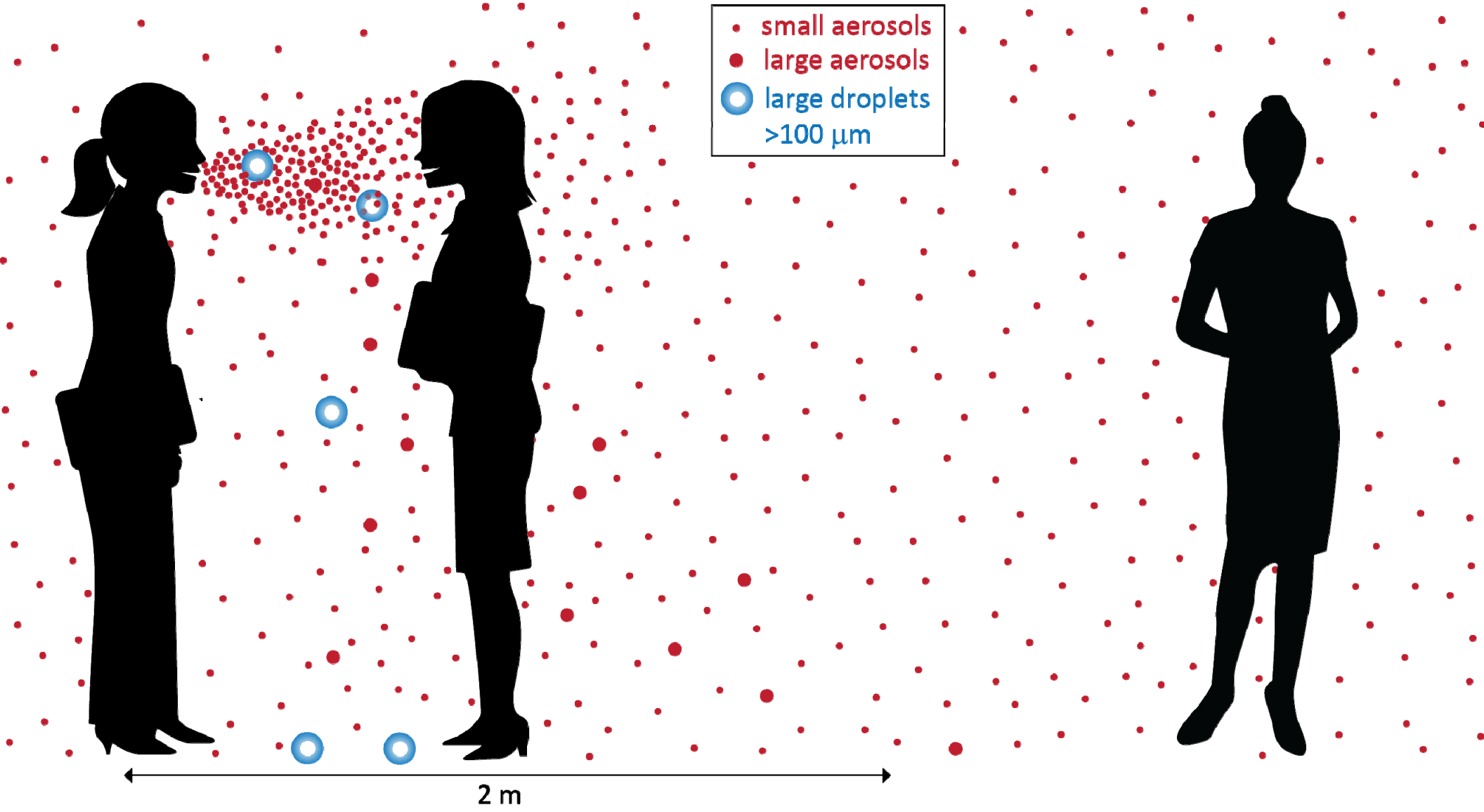
How do we get infected?

Graphic by Prof. Linsey Marr, published in https://www.journalofhospitalinfection.com/article/S0195-6701(21)00007-4/fulltext



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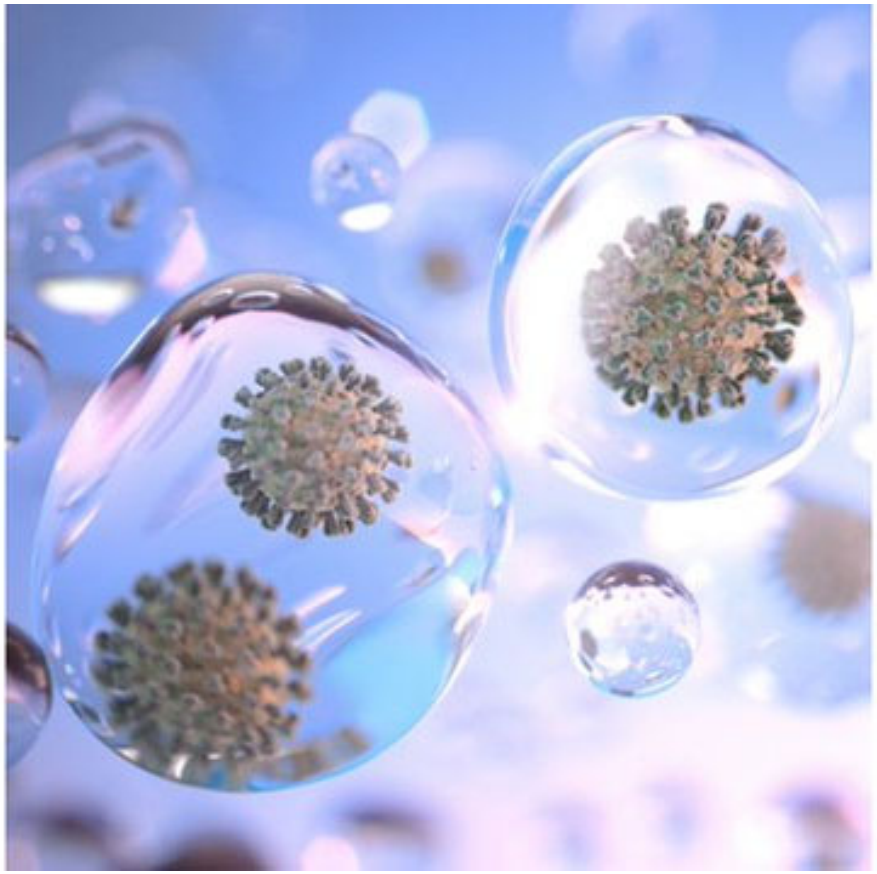
Many visualizations are incorrect

Incorrect

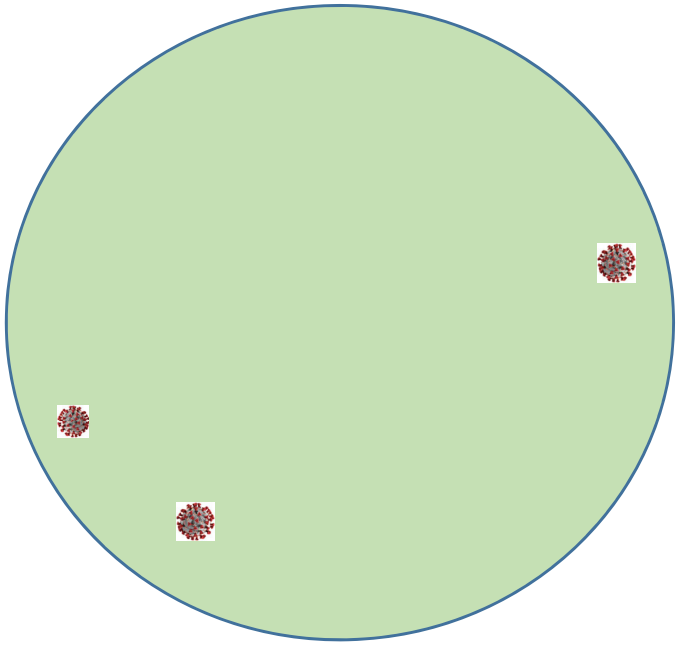
- Aerosols are naked virus (+water) (look like 0.2-0.3 µm)
- Mass fraction of virus very high



From Klompas et al., JAMA (2020)
https://jamanetwork.com/journals/jama/fullarticle/2768396

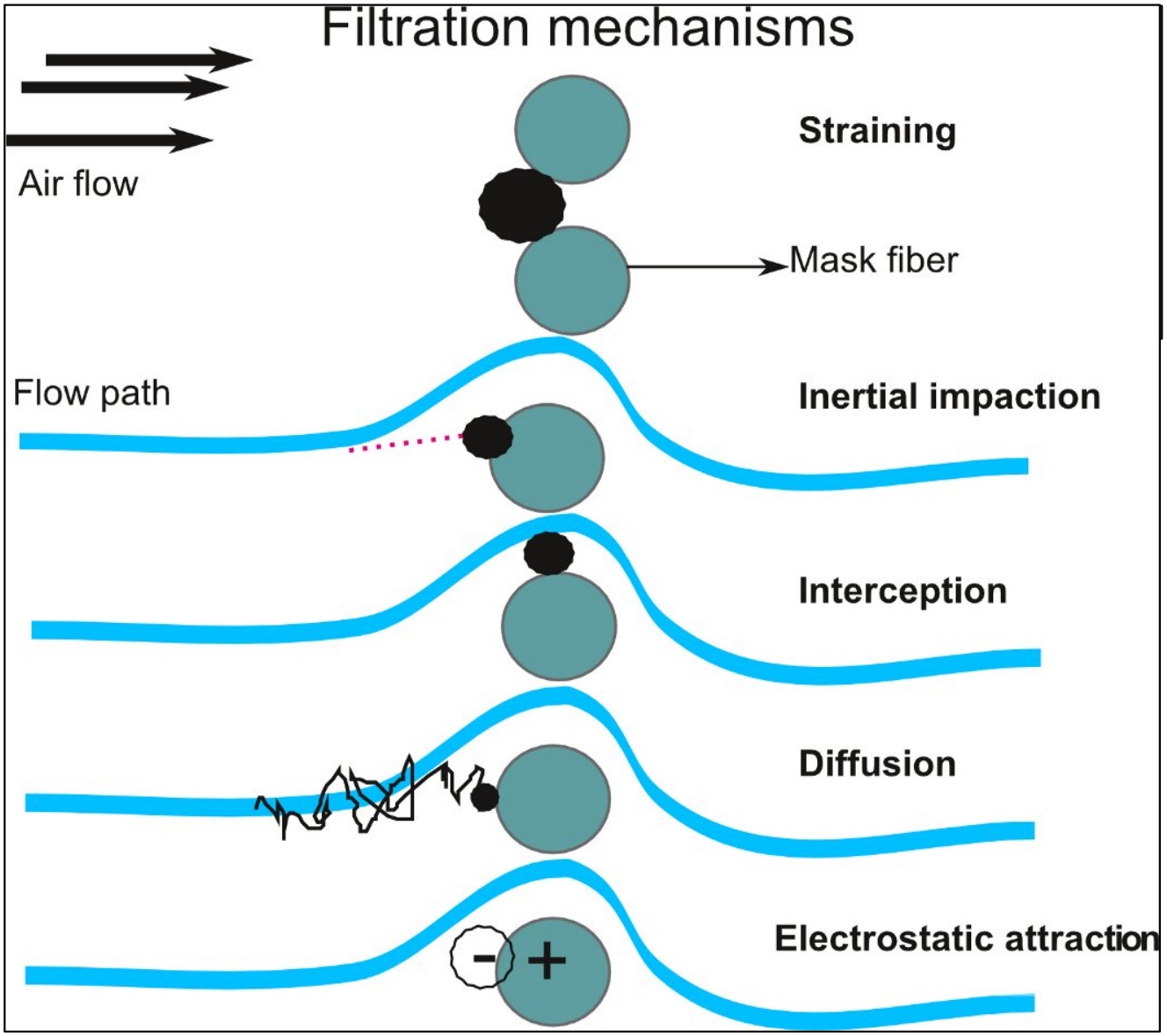
More correct

- Few microns aerosol
- Mostly saliva or respiratory fluid
- Mass fraction of virus low



Johnson et al., J.Aerosol Sci. 2011;
https://www.sciencedirect.com/science/article/pii/S0021850211001200

Masks / filters are not sieves or colanders



- Microscopic physics, not intuitive
- They filter far more than a “colander” would

https://t.co/JPSjST639t?amp=1 https://youtu.be/eAdanPfQdCA

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Different types of masks

A good mask needs:

A. Filtering efficiency
B. Breathability
C. Fit (no gaps)

Mediocre: surgical

Lots of leaks

Some filter better (US),

Not in Europe

Very variable

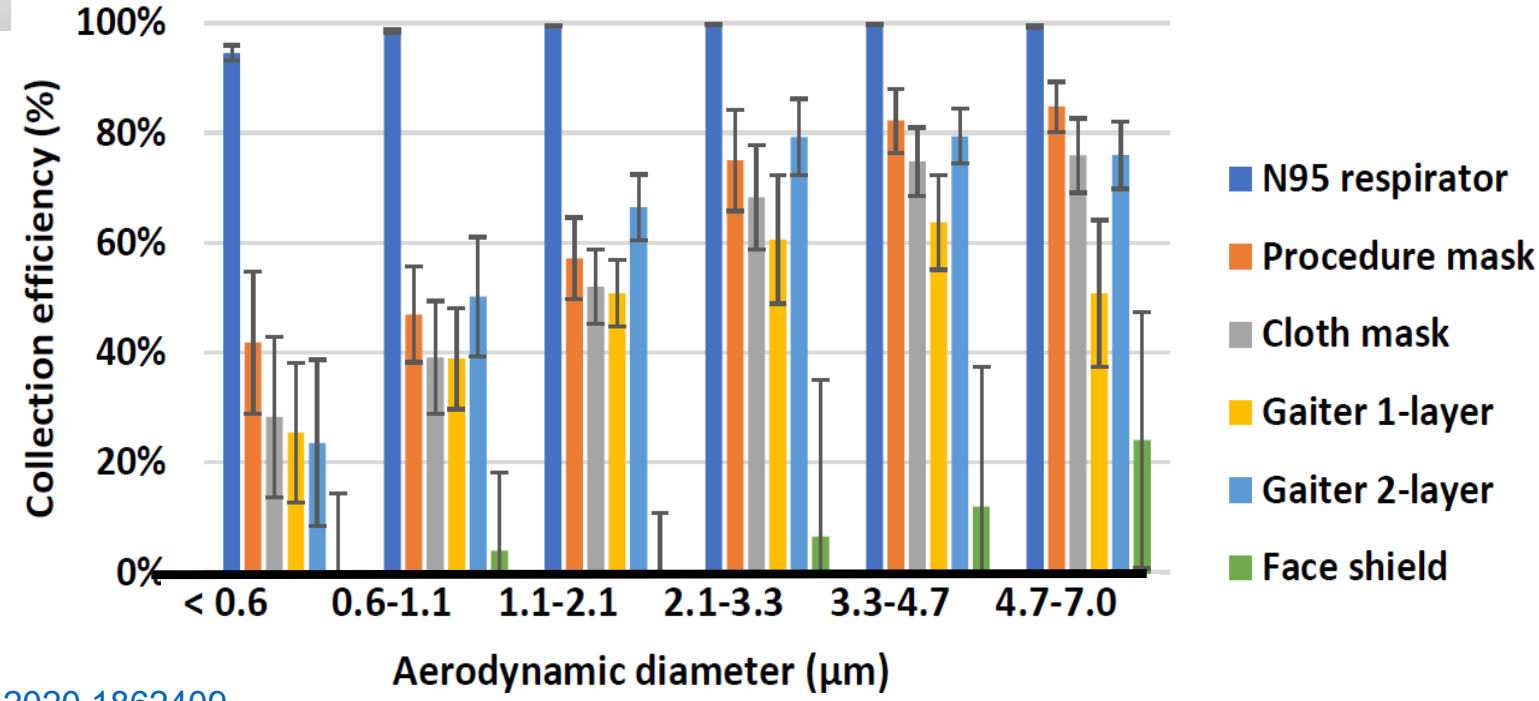
Best: N95 / FFP2/3

Straps behind head

Next: KF94 (Korea) & KN95 (China)

More leaks; many KN95 fakes

CDC Study on Cough Aerosols



https://doi.org/10.1080/02786826.2020.1862409

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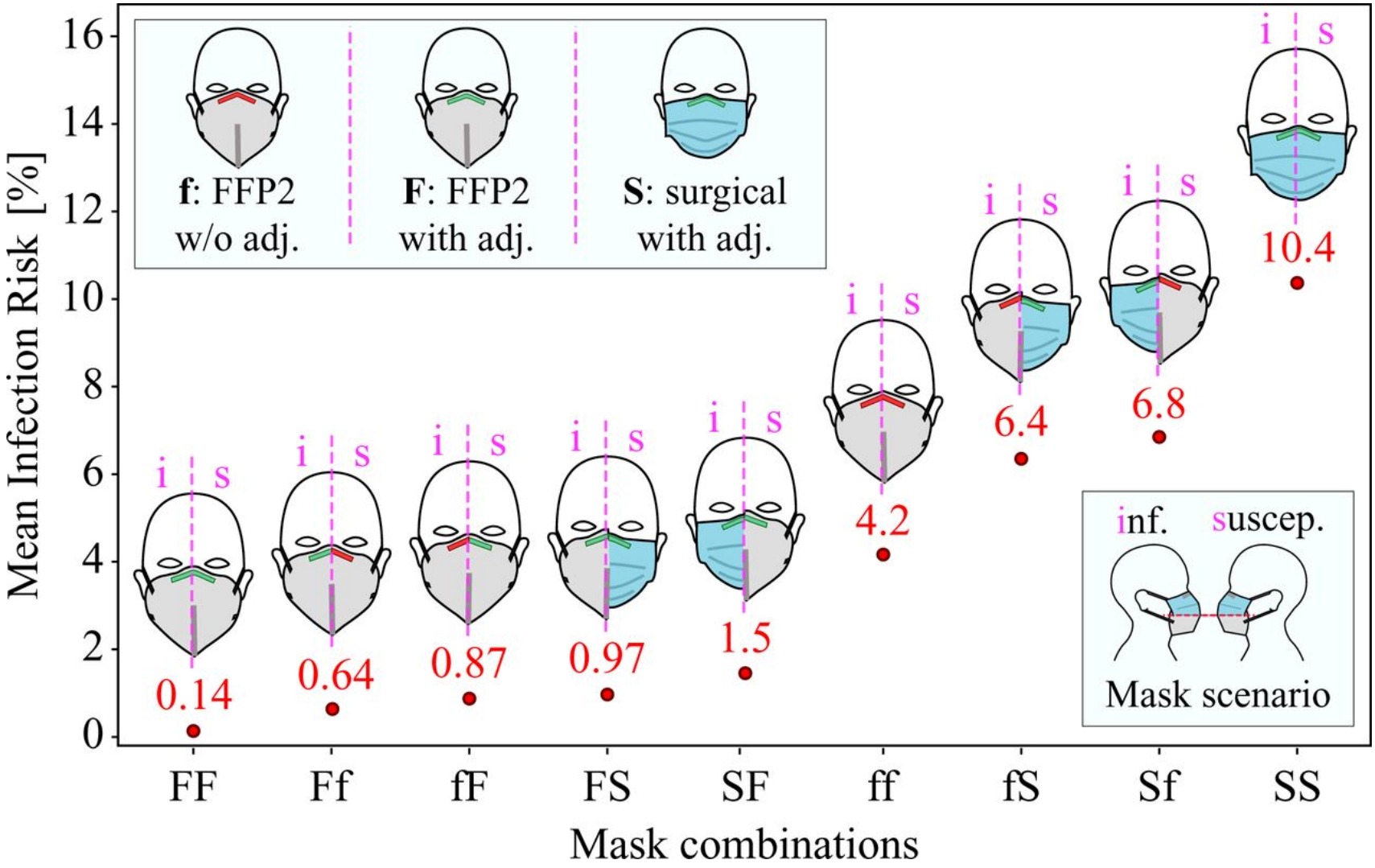
2-Way Masking: Square of Benefit!

PNAS Proceedings of the National Academy of Sciences of the United States of America



https://www.pnas.org/content/118/49/e2110117118

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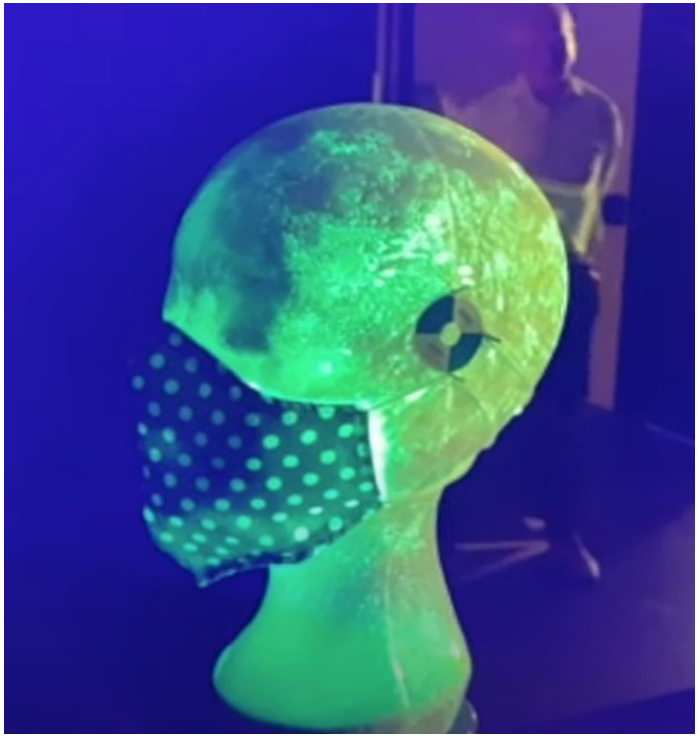
Mask Fit is Critical

A good mask: filtering efficiency, breathability, and fit



- Pay attention to mask fit: avoid gaps, tight around the nose
  - I see lots of people w/ loose masks
  - Don't stand behind someone with a poorly-fitting mask
- Keep mask on when speaking, x10 times more aerosols than just breathing
  - 50 times more when yelling or singing loudly

Visualization by Prof. Philomena Bluyssen, TU Delft, The Netherlands https://youtu.be/mJ81IBTMvcU

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Small Gaps in Mask Kill Efficiency

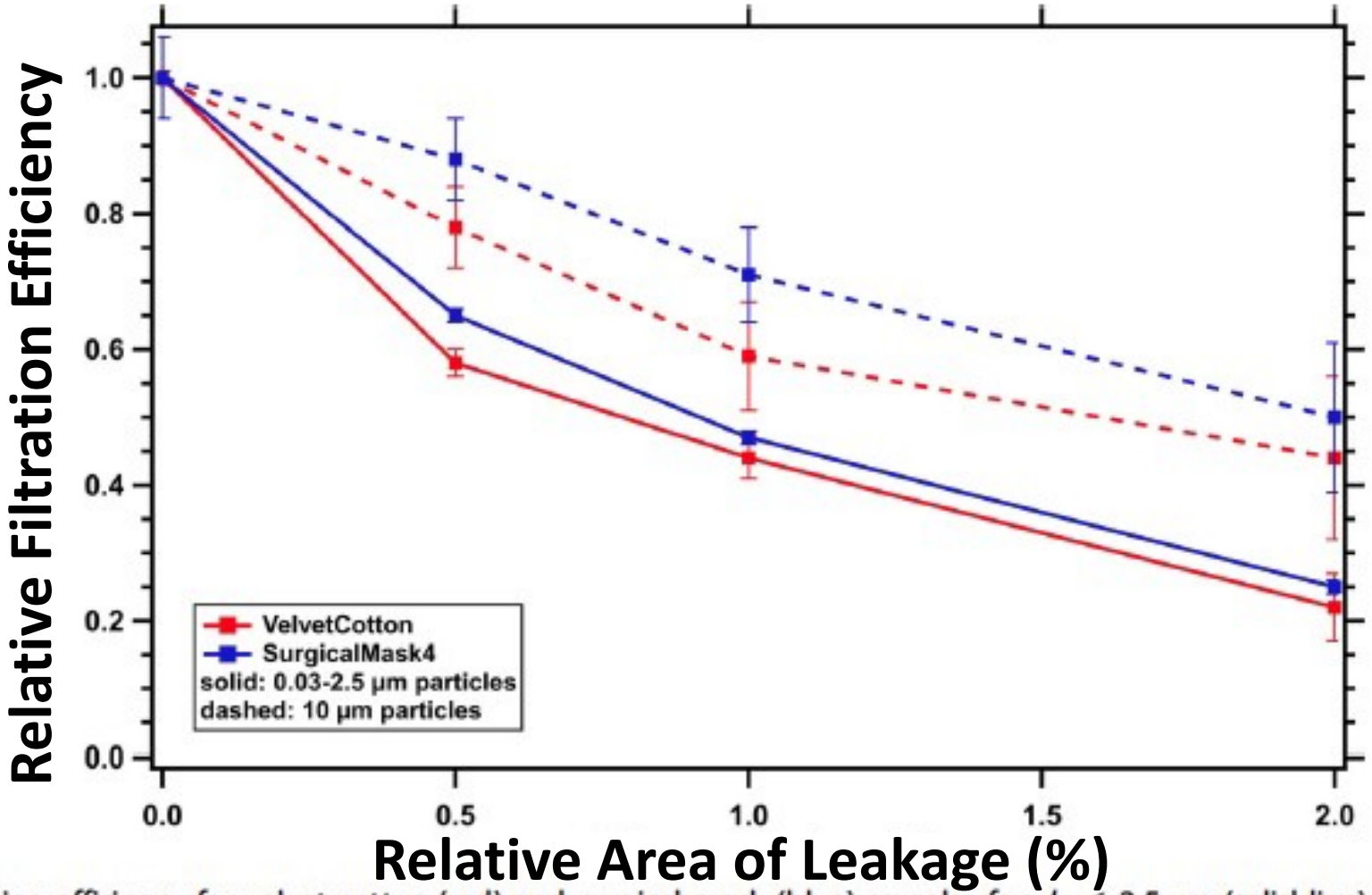

Figure 8. Filtration efficiency for velvet cotton (red) and surgical mask (blue) samples for $d_p \leq 2.5\,\mu m$ (solid line) and $d_p = 10\,\mu m$ (dashed line) versus relative leak area, normalized to the leak-free sample. Here, measurements of neutralized (*CPC setup*) and ambient aerosol (*SMPS/OPC setup*) were averaged, where available.

Figure: Drewnick, F., et al. (2020). *Aerosol Science and Technology*, 1–17. https://www.tandfonline.com/doi/full/10.1080/02786826.2020.1817846

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Some Misleading Mask Tests (e.g. Vaping)

- Some aerosols go through gaps (test is useful)
- Aerosols APPEAR to cross the mask in large amounts
  - "Evaporation-condensation" artifact of Vaping VAPOR
    - Well-known in aerosol sci., less in medicine
  - Molecules cross the mask as gases, just like air
  - Upon mixing with cold air, very quickly condense onto aerosols
  - But most aerosols did NOT cross mask!

https://twitter.com/linseymarr/status/1486834084005531649
https://www.youtube.com/watch?v=CmC0h819OV8

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Mask Braces for Surgical Masks

- E.g. http://fixthemask.com
- Free template, can make yourself
  - https://www.fixthemask.com/products/v2-diy-rubber-sheet-brace
  - No nose pieces though
- Good if combined with surgical mask that DOES filter
  - Many don't, e.g. in Europe (regulations don't include filtering)
  - More common for US masks (regulations include filtering)

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Elastomeric Masks

- A good mask needs:
  A. Filtering efficiency
  B. Breathability
  C. Fit (no gaps)

- FFP2 / N95:
  - Meltblown polypropylene, good A + B
  - Difficulty with fit ("fit testing")
- Best current masks: elastomeric half-masks
  - Filter w/ meltblown PP
  - Seal w/ thick silicone
  - Far superior in tests from my colleagues + my personal experience

US + Canada: https://envomask.com/
Spain: https://kit-survie.org/boutique/es/p/mascarilla-ffp2-reutilizable/

Summary on which Masks

Infectious disease doctor from Harvard

Former head of the CDC

Abraar Karan
@AbraarKaran
Normal 0%

Frankly cloth masks should not be allowed for high risk settings during surges— period. If we are going to wear masks, the obvious public health strategy is to ensure we are using N95 respirators indoors, or surgical masks w/ mask braces for better fit.

Dr. Tom Frieden @DrTomFrieden · Feb 2
Normal 0%
Masks work to stop airborne spread of whatever variant Covid throws at us, and better masks, such as N95s, work better.

11:30 PM · Feb 2, 2022 · Twitter for iPhone

- **Best: Real N95 / FFP2**
- **Next: KN95**
- **Next: surgical mask w/ braces**
- **Everything else is riskier**