CITIZENSHIELD

Maskit ja ilmanvaihto suojautumisessa

Loppuseminaari 9.10.2023

Aku Karvinen

CITIZENSHIELD

COVID-19 lukuina

771 000 000 tapausta

6 960 000 kuolemaa

13 500 000 000 rokoteannosta

Jopa 16 000 000 000 000 €

Jopa 16 000 000 000 000 €

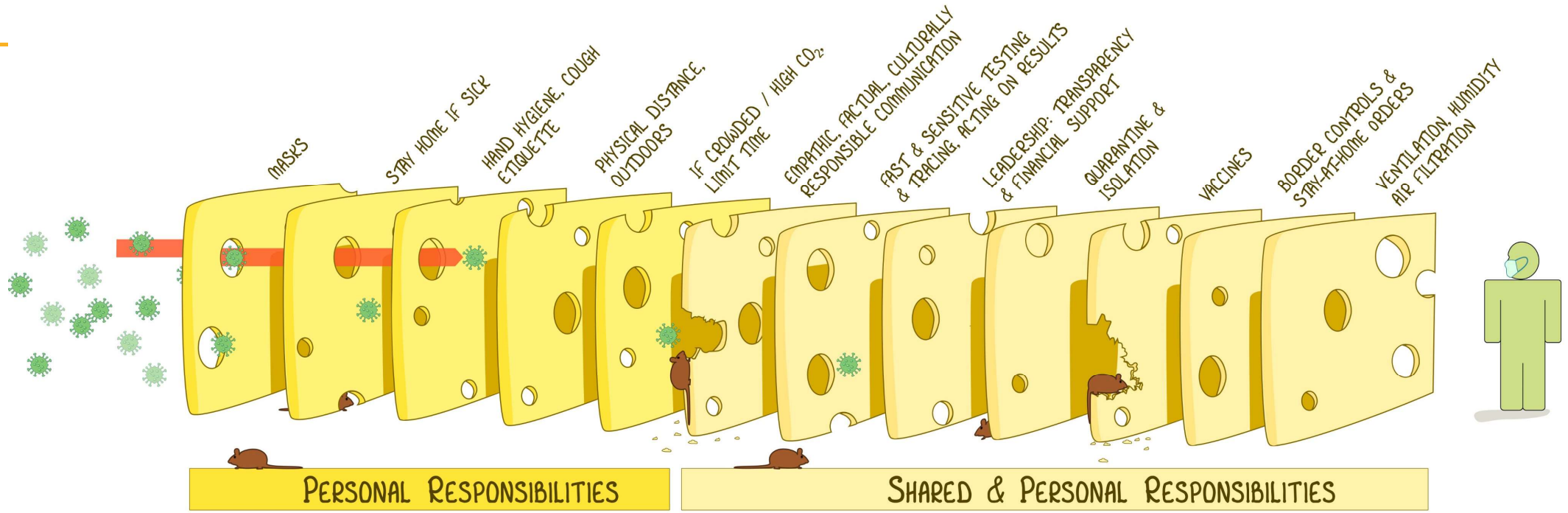
2 000 € jokaista maapallon asukasta kohti

CITIZENSHIELD

Mitä voisimme tehdä?

The Swiss Cheese Respiratory Virus Pandemic Defence

Recognising that no single intervention is perfect at preventing spread



Each intervention (slice) has imperfections (holes) which change in size, number and position depending on how the intervention is rolled out.
Multiple layers improve success.

Misinformation mouse

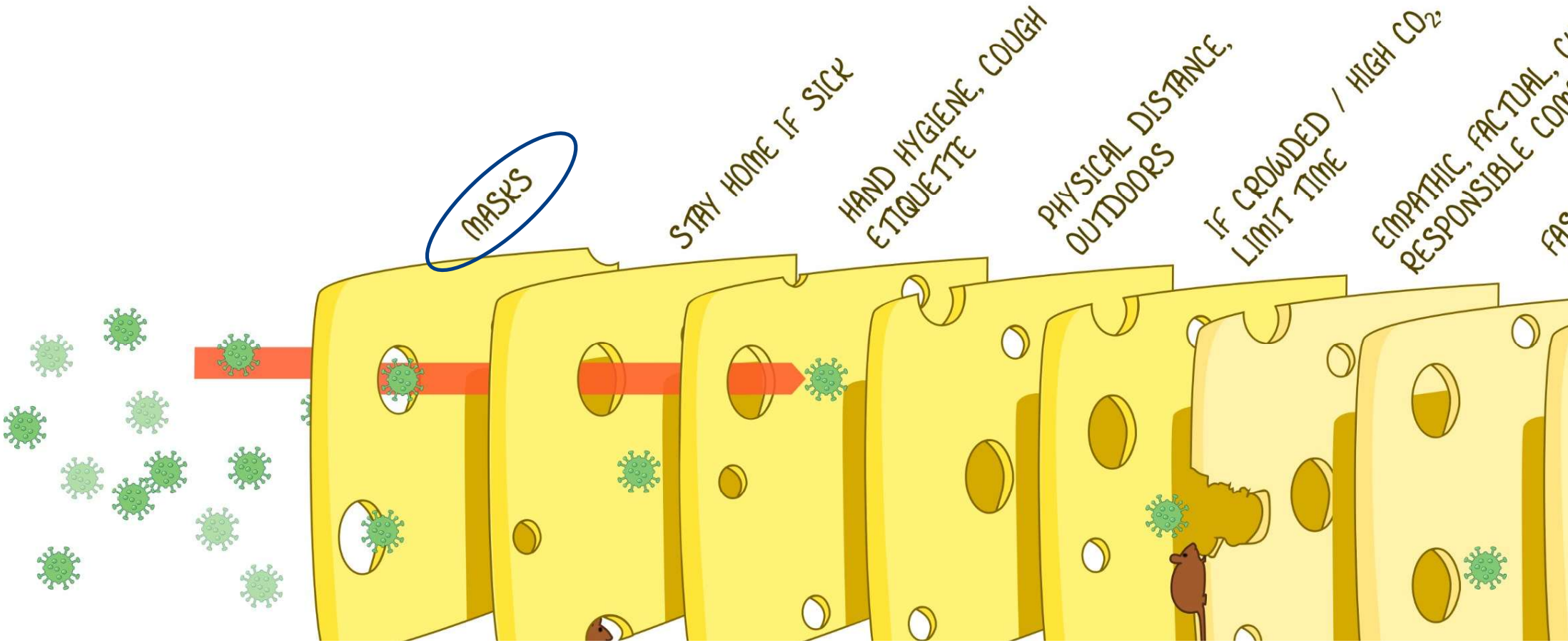
Ian M Mackay
virologydownunder.com

With thanks to Jody Lanard, Katherine Arden & the Uni of Qld
Based on the Swiss cheese model of accident causation, by James T Reason, 1990
version 4.3
Update: 04SEP2021

Twitter: @MackayIM

THE SWISS CHEESE RESPIRATORY VIR

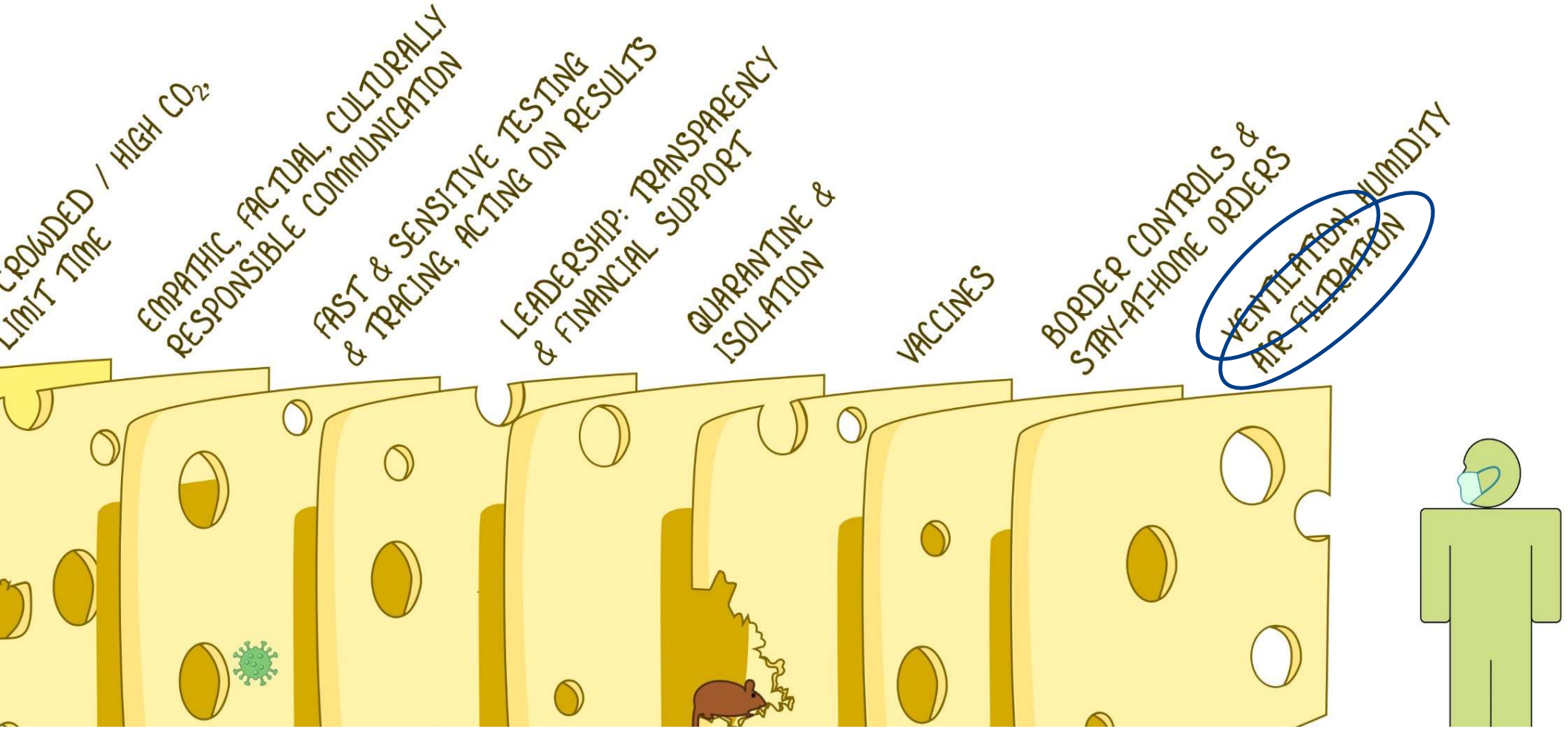
RECOGNISING THAT NO SINGLE INTERVENTION IS PE

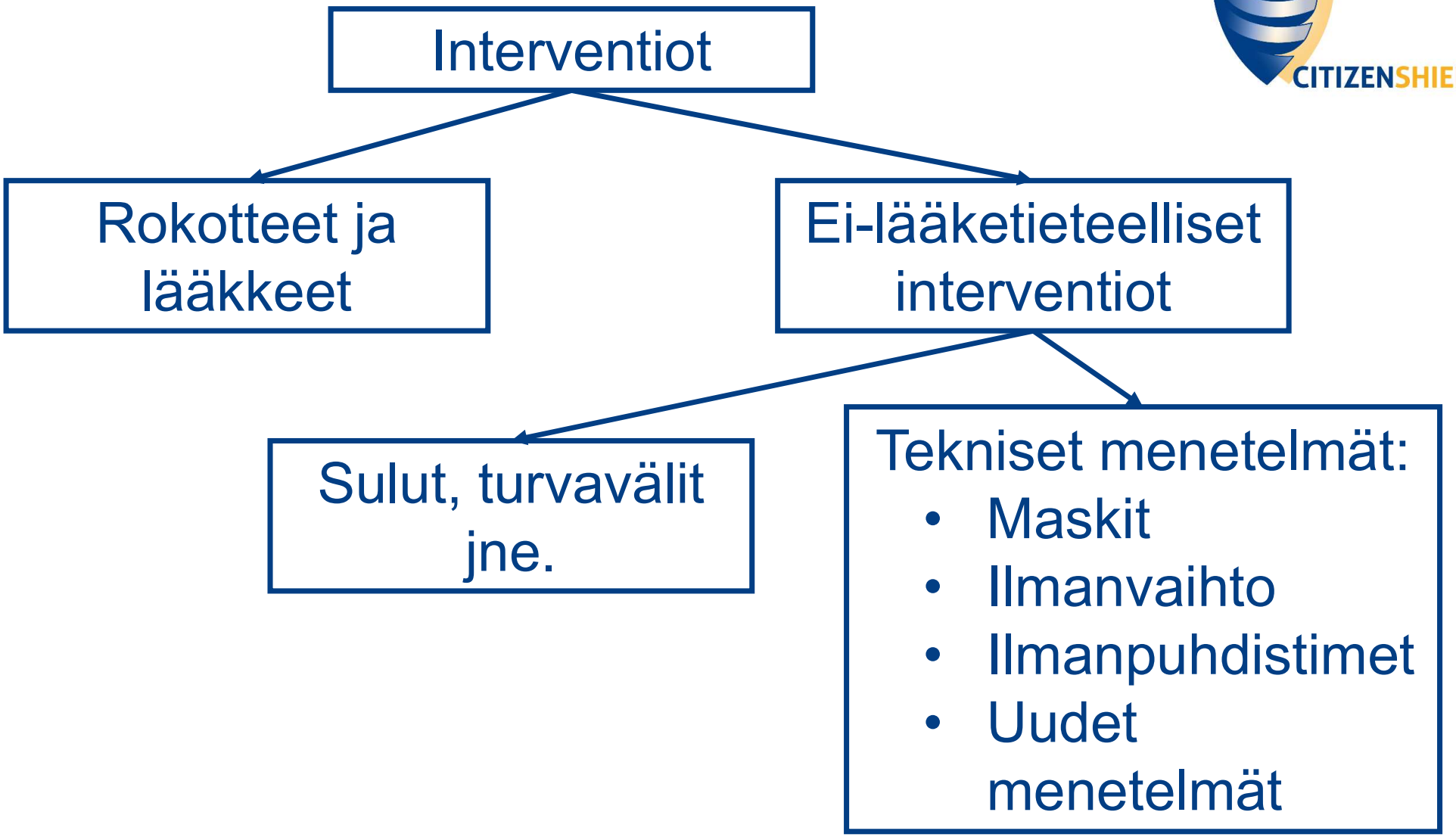


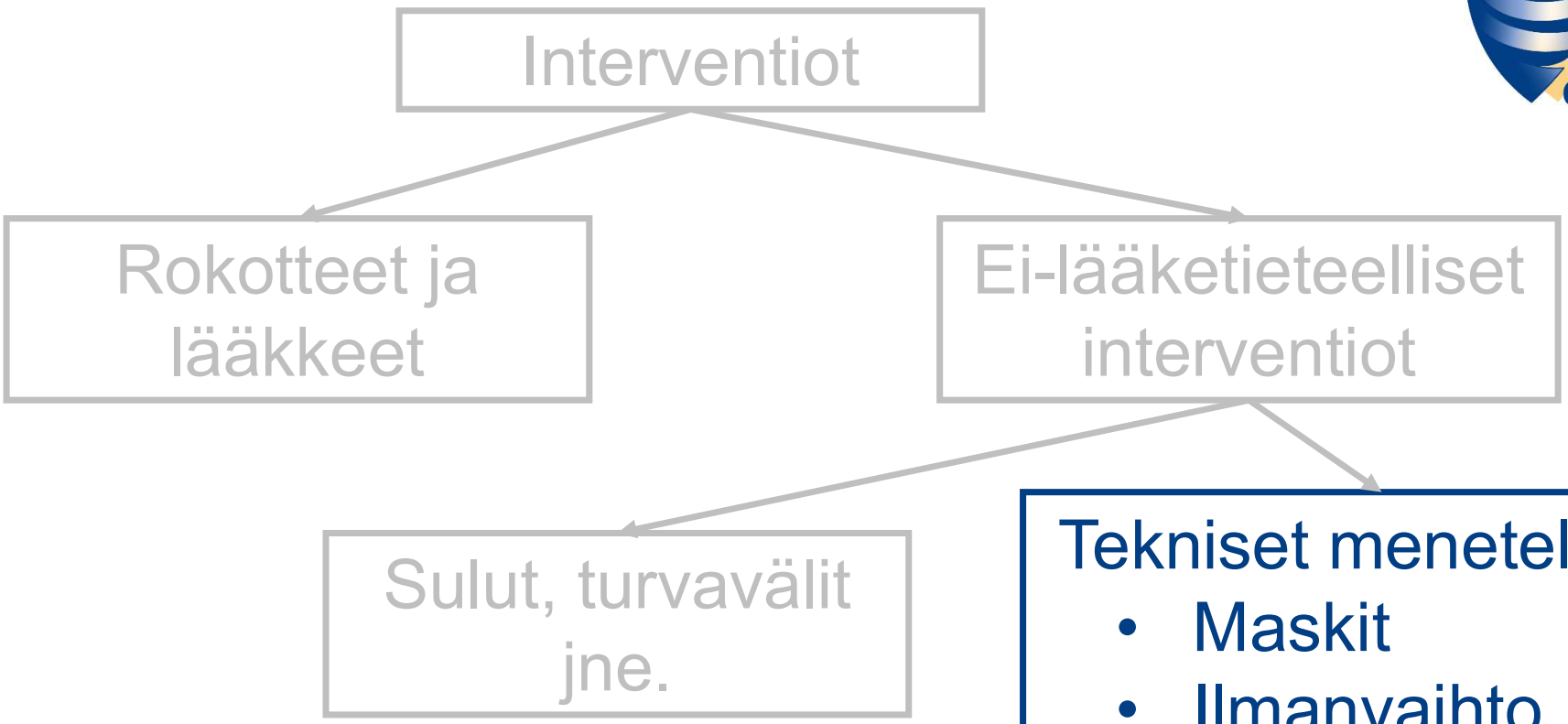
IRATORY VIRUS PANDEMIC DEFENCE

ERVENTION IS PERFECT AT PREVENTING SPREAD

.D




Interventiot
Rokotteet ja lääkkeet
Ei-lääketieteelliset interventiot
Sulut, turvavälit jne.
Tekniset menetelmät:
• Maskit
• Ilmanvaihto
• Ilmanpuhdistimet
• Uudet menetelmät


Interventiot
Rokotteet ja lääkkeet
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Sulut, turvavälit jne.
Tekniset menetelmät:
• Maskit
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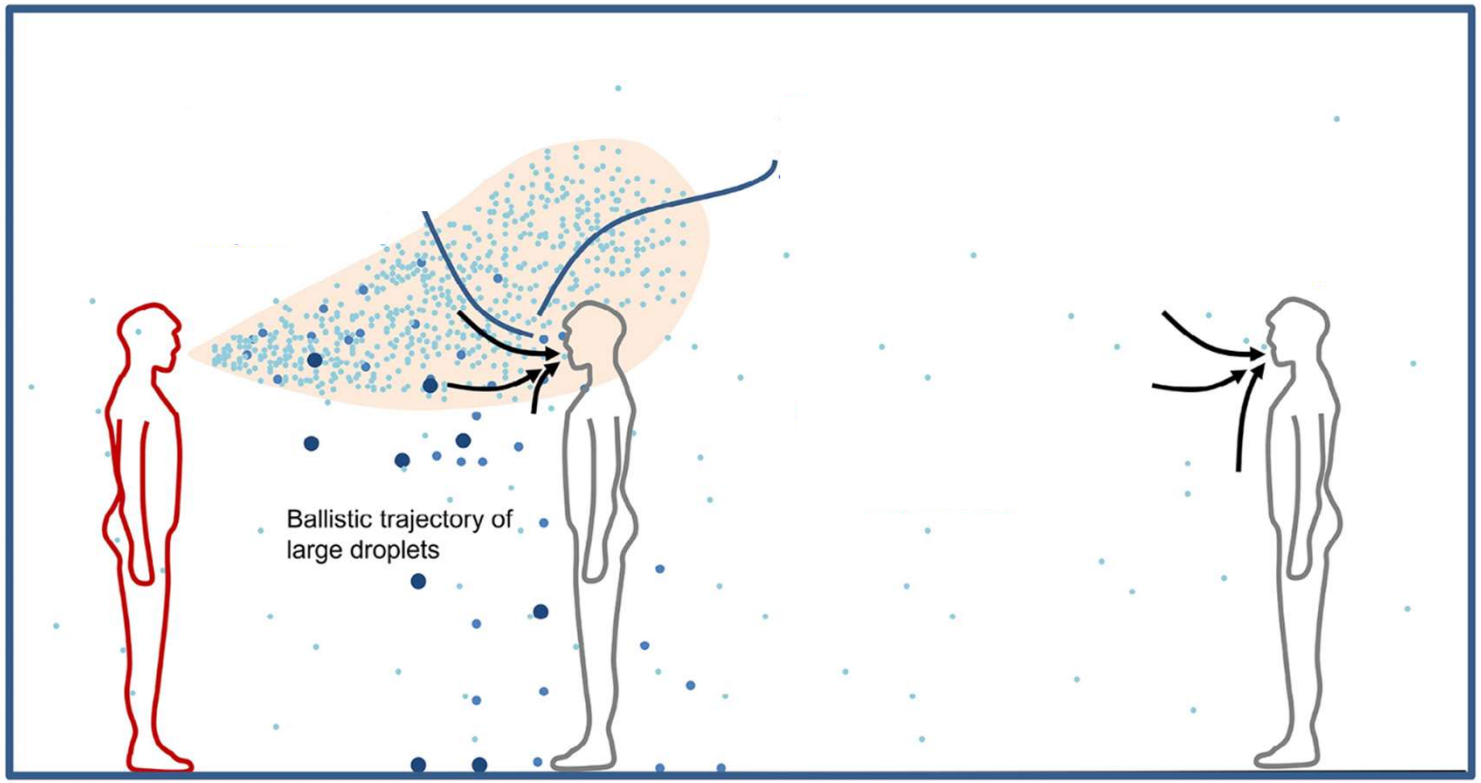
• Ilmanpuhdistimet
• Uudet menetelmät

CITIZENSHIELD

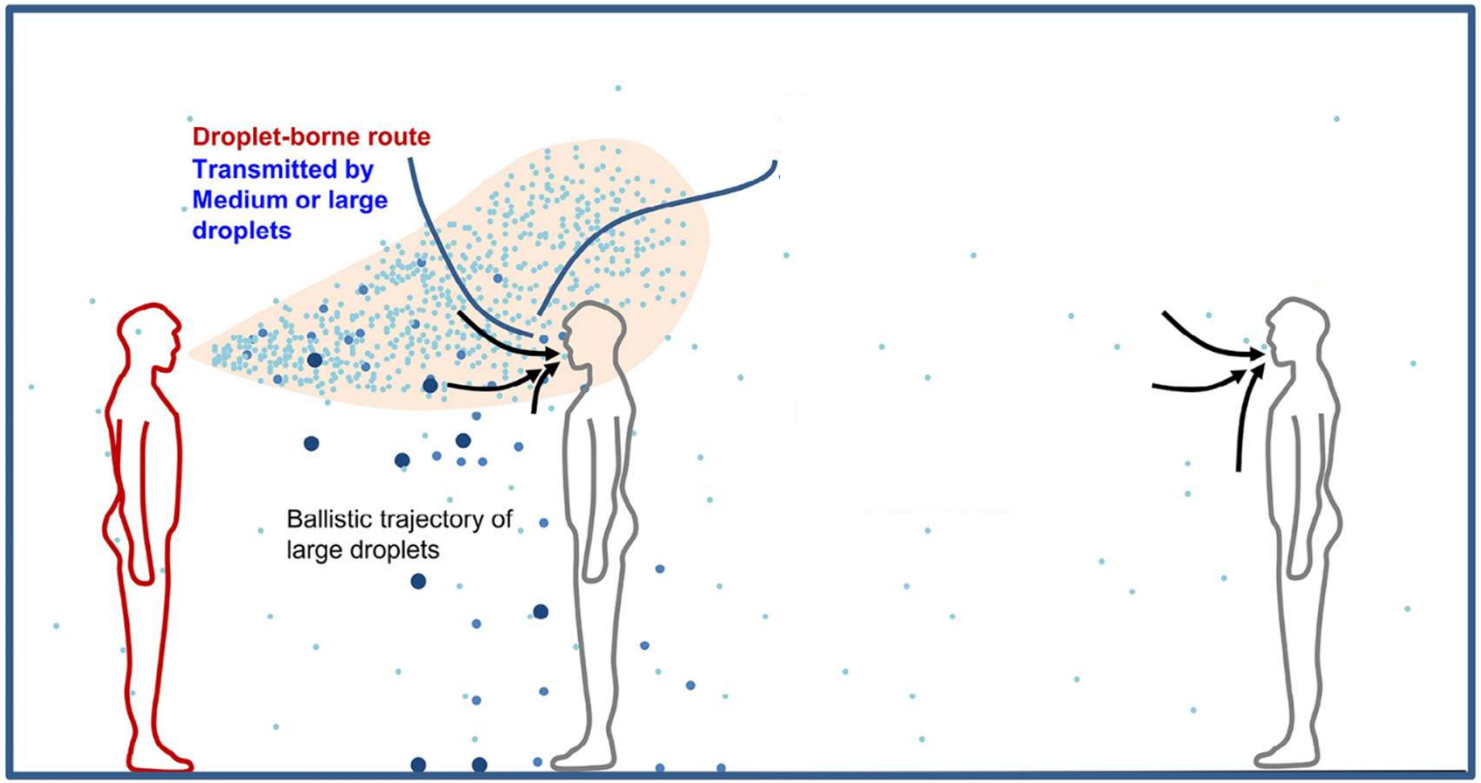
Tartuntareitit

Tartuntareitit



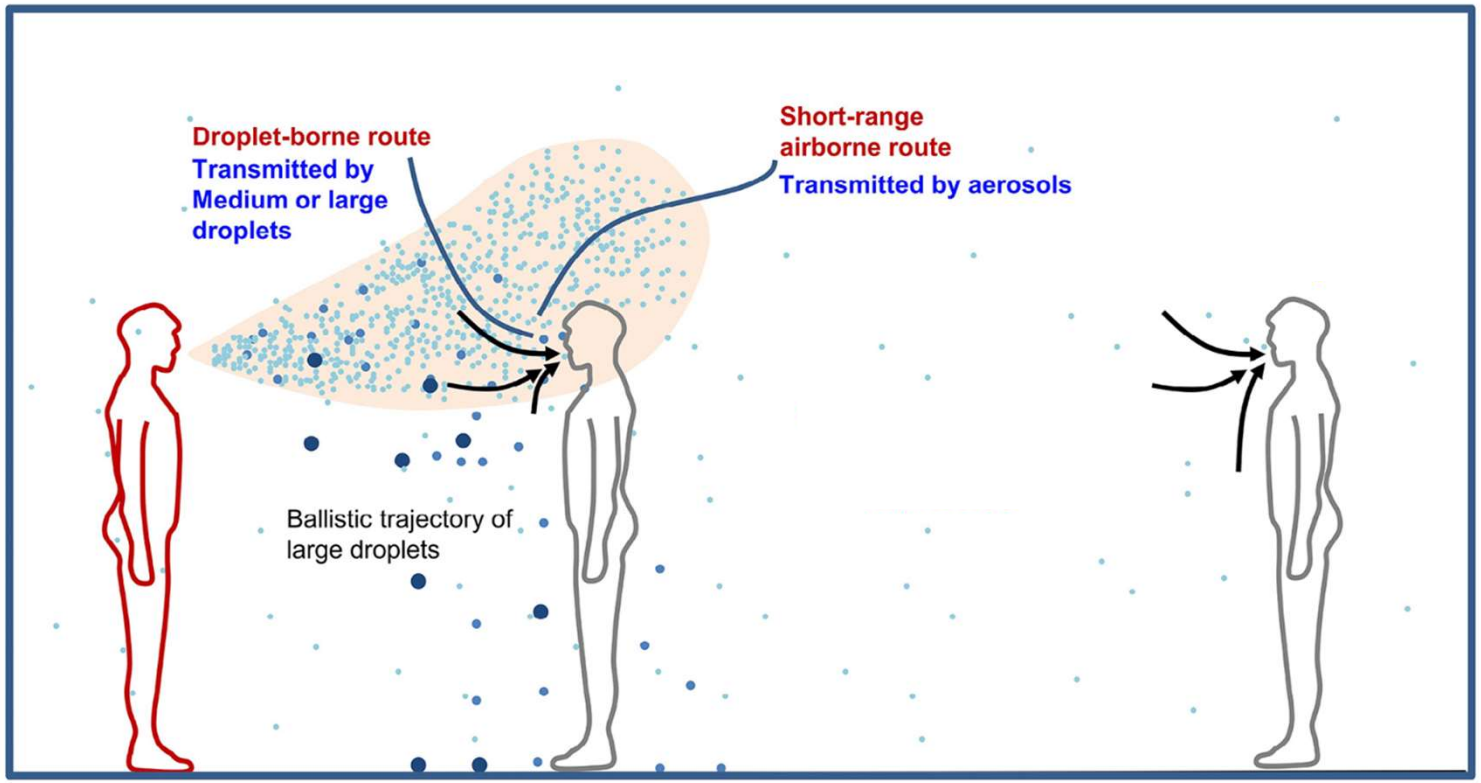
Wei, Jianjian, and Yuguo Li. 'Airborne Spread of Infectious Agents in the Indoor Environment'. *American Journal of Infection Control*, Indoor Air as a Vehicle for Human Pathogens, 44, no. 9, Supplement (2 September 2016): S102–8.

Tartuntareitit



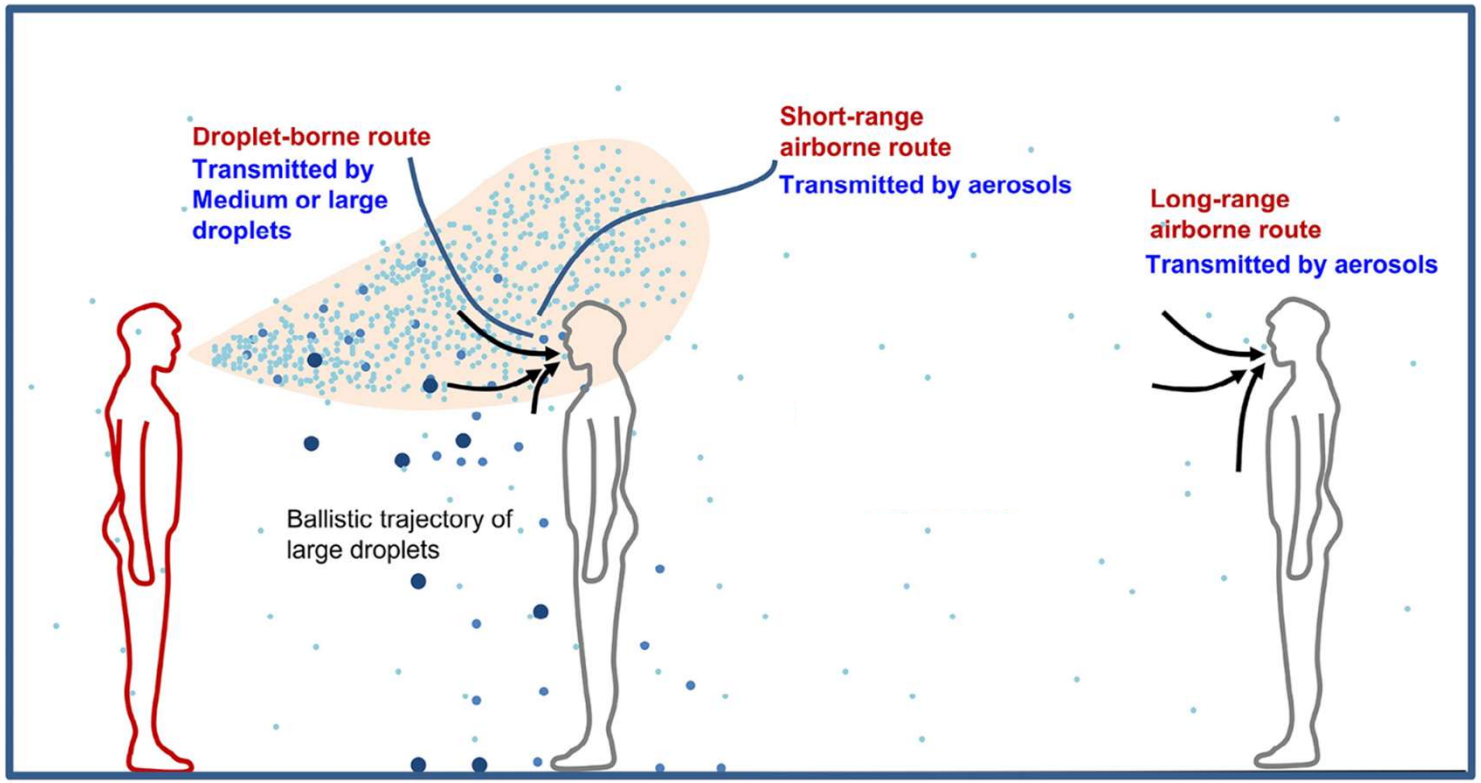
Wei, Jianjian, and Yuguo Li. 'Airborne Spread of Infectious Agents in the Indoor Environment'. *American Journal of Infection Control*, Indoor Air as a Vehicle for Human Pathogens, 44, no. 9, Supplement (2 September 2016): S102–8.

Tartuntareitit



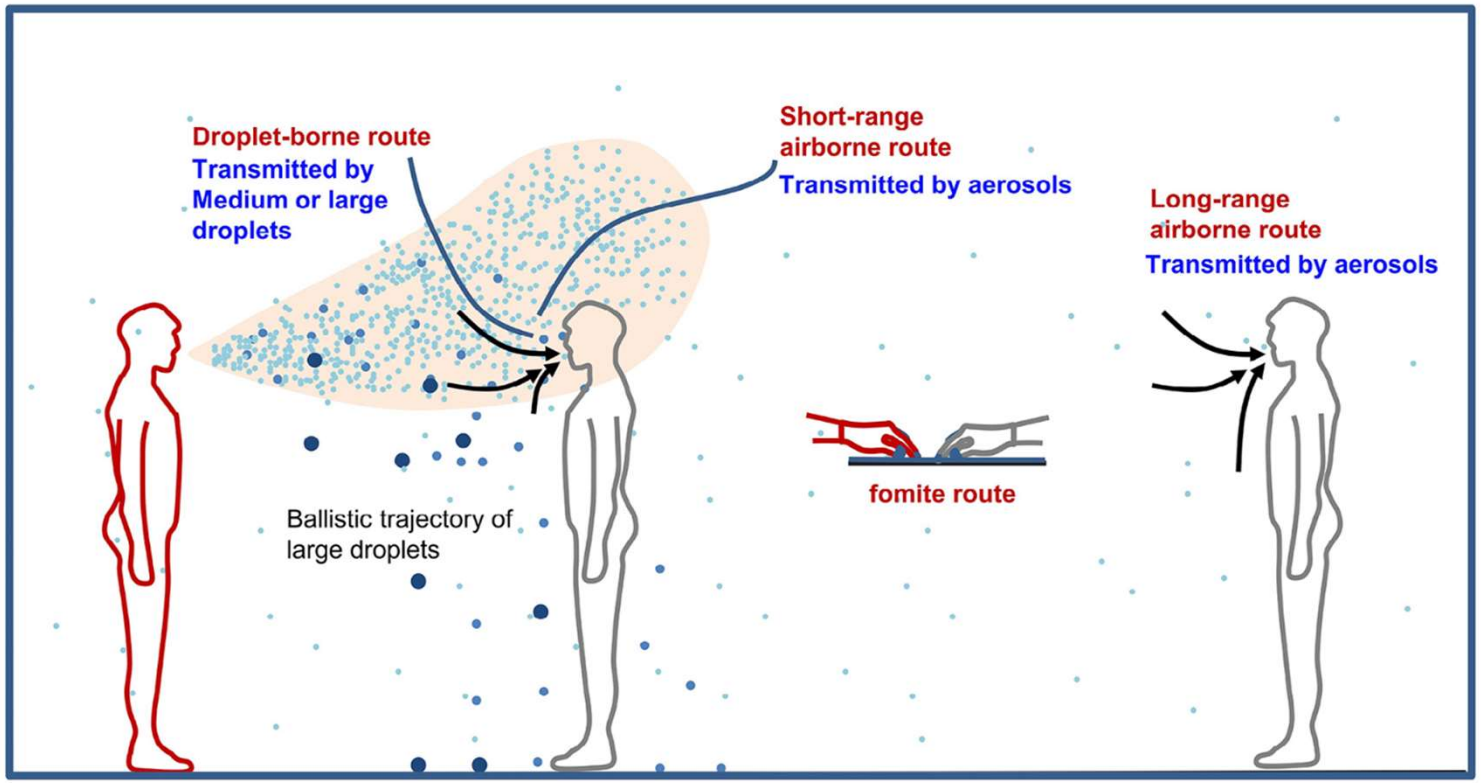
Wei, Jianjian, and Yuguo Li. 'Airborne Spread of Infectious Agents in the Indoor Environment'. *American Journal of Infection Control*, Indoor Air as a Vehicle for Human Pathogens, 44, no. 9, Supplement (2 September 2016): S102–8.

Tartuntareitit



Wei, Jianjian, and Yuguo Li. 'Airborne Spread of Infectious Agents in the Indoor Environment'. *American Journal of Infection Control*, Indoor Air as a Vehicle for Human Pathogens, 44, no. 9, Supplement (2 September 2016): S102–8.

Tartuntareitit



Wei, Jianjian, and Yuguo Li. 'Airborne Spread of Infectious Agents in the Indoor Environment'. *American Journal of Infection Control*, Indoor Air as a Vehicle for Human Pathogens, 44, no. 9, Supplement (2 September 2016): S102–8.

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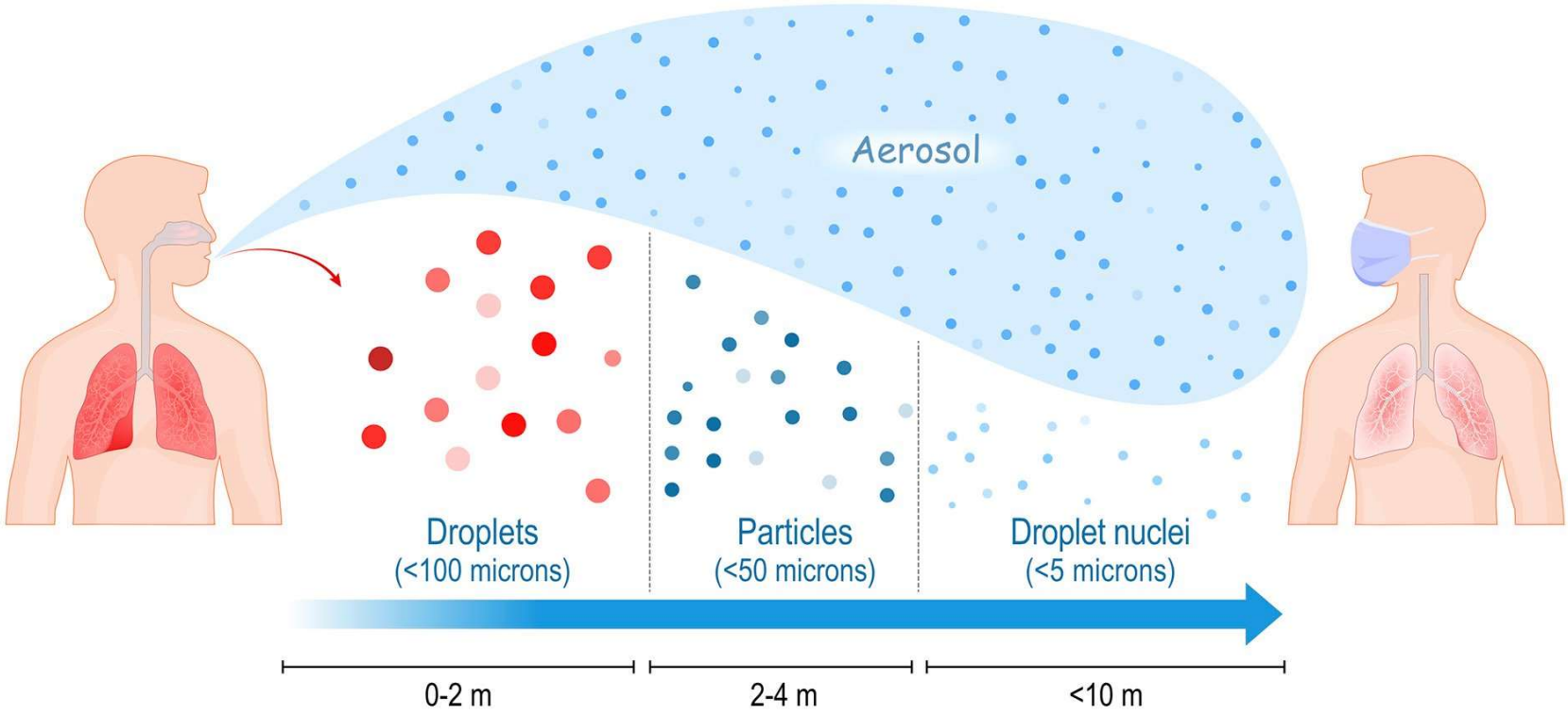
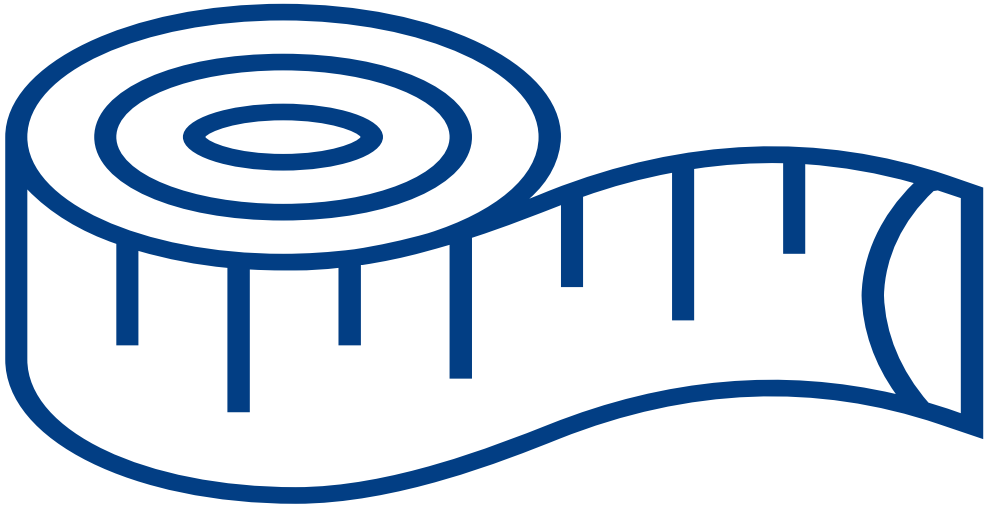


CITIZENSHIELD

Partikkelin koko



THE RELATIVE SIZE OF PARTICLES

From the COVID-19 pandemic to the U.S. West Coast wildfires, some of the biggest threats now are also the most microscopic.

A particle needs to be 10 microns (μm) or less before it can be inhaled into your respiratory tract. But just how small are these specks?

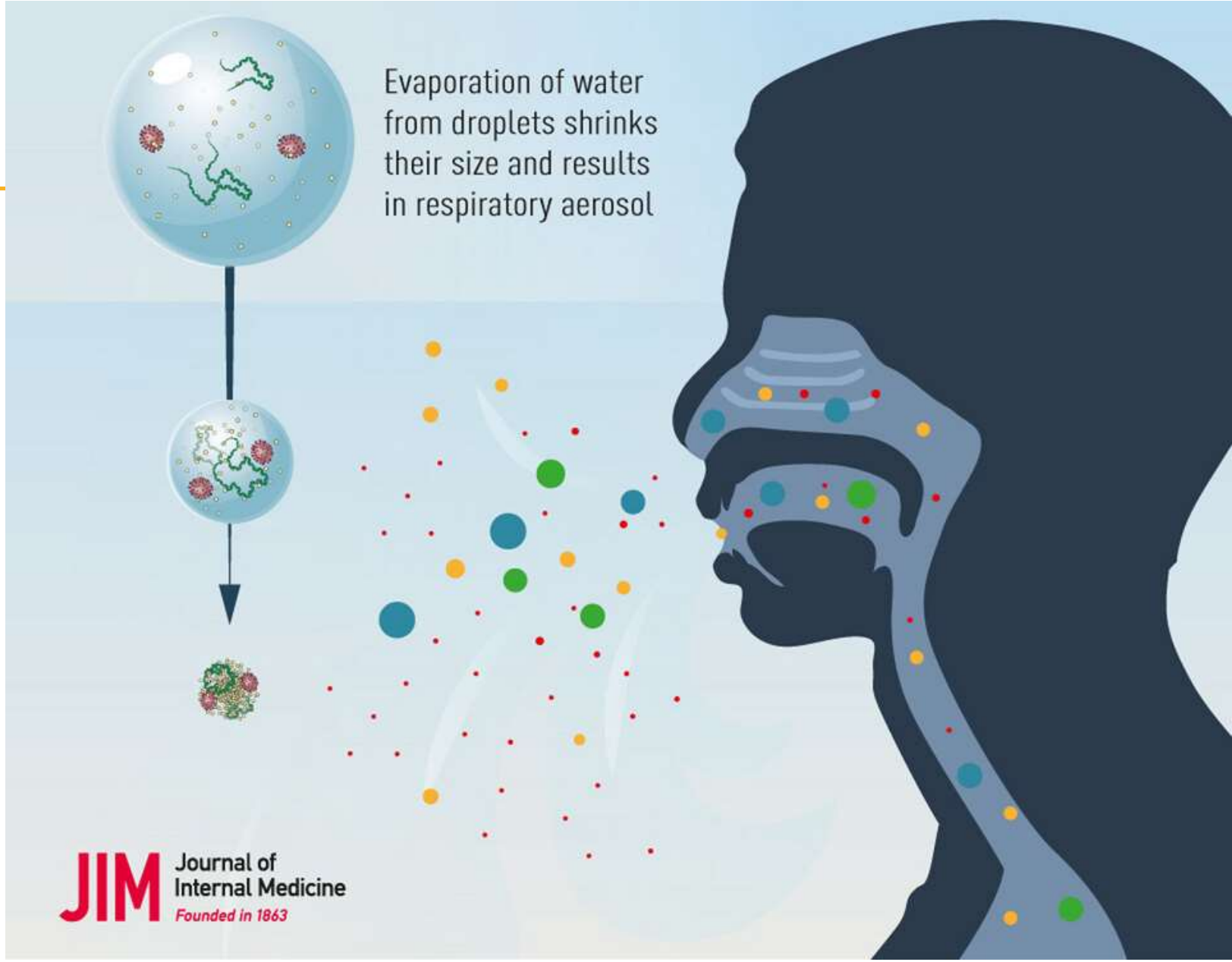
Here's a look at the relative sizes of some familiar particles ↘

https://www.visualcapitalist.com/visualizing-relative-size-of-particles/

SOURCES Clearstream, Daniel Loverbey, EPA, Financial Times, News Medical, Science Direct, SCMP, Susan Sokolowski, Petroclear, U.S. Dept. of Energy
COLLABORATORS **RESEARCH + WRITING** Carmen Ang, Iman Ghosh | **DESIGN + ART DIRECTION** Harrison Schell

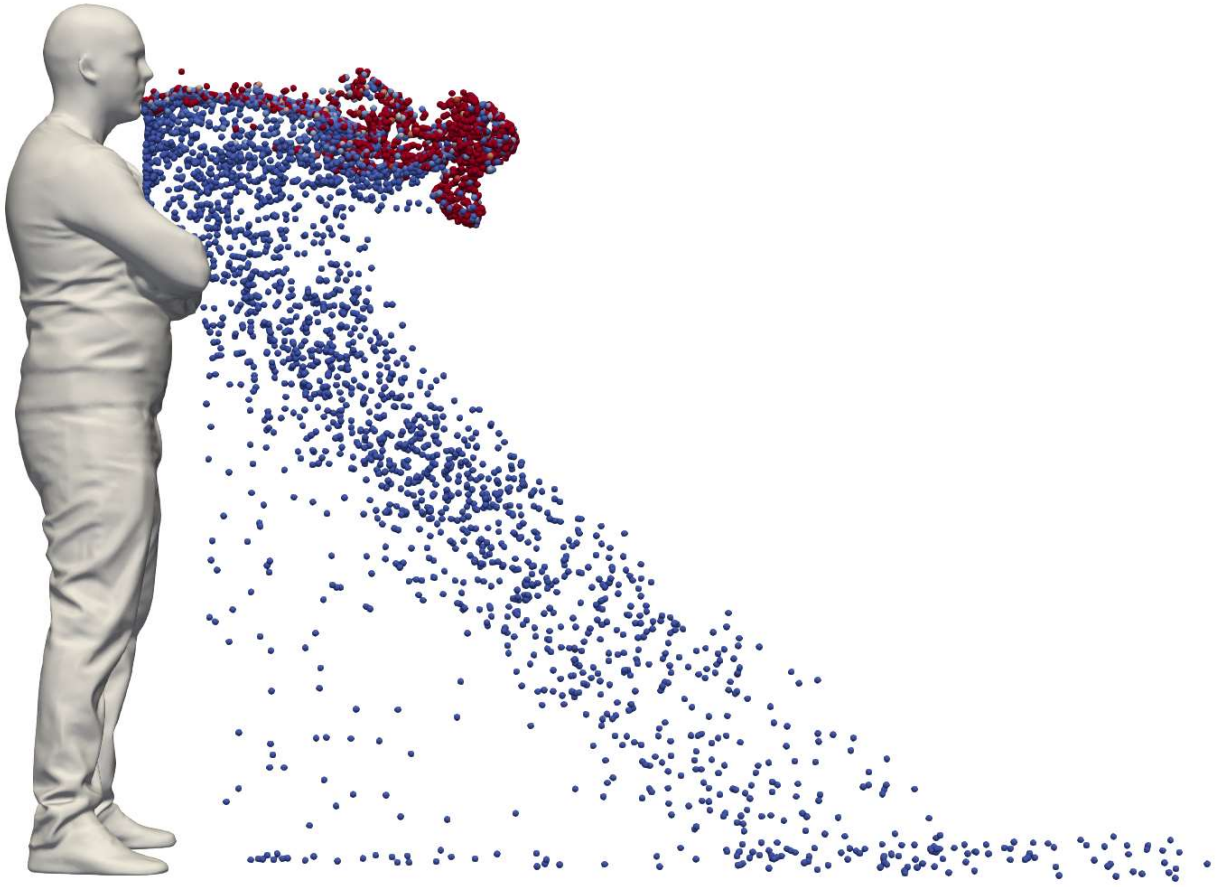
VISUAL CAPITALIST /visualcapitalist @visualcap visualcapitalist.com

Pisara vs. virus



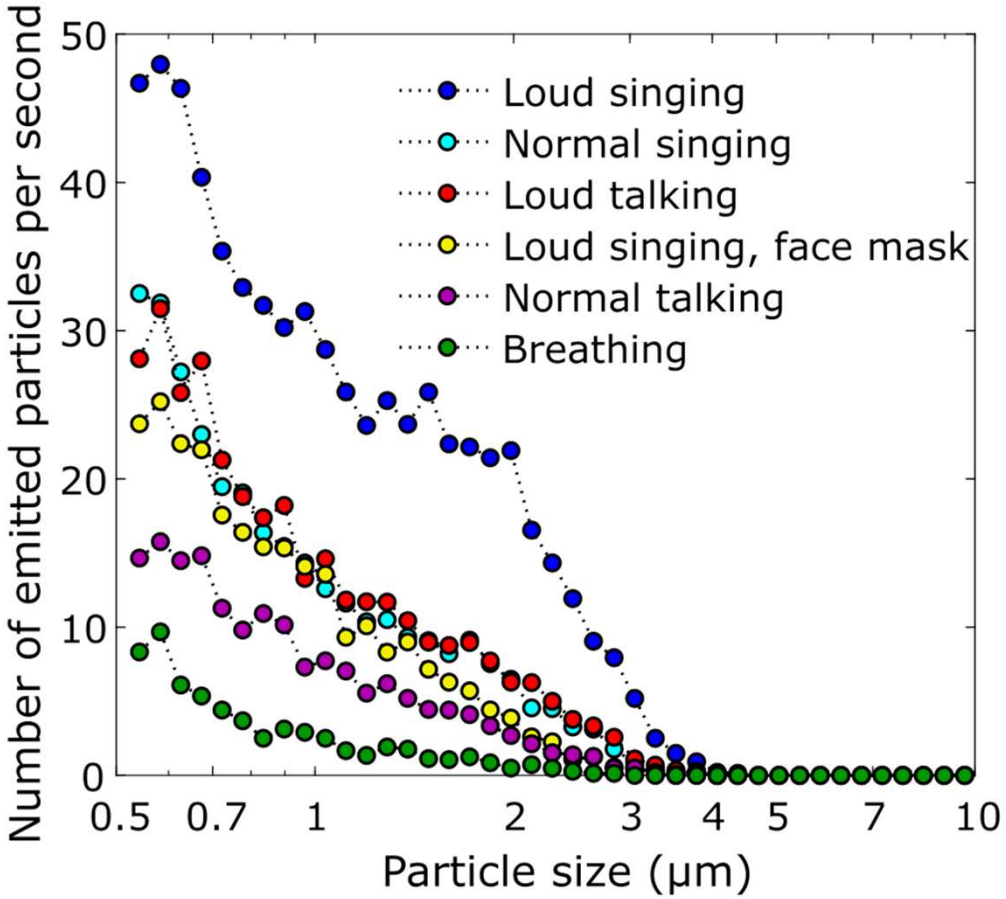
V. Stadnytskyi, P. Anfinrud, and A. Bax, 'Breathing, speaking, coughing or sneezing: What drives transmission of SARS-CoV-2?', *Journal of Internal Medicine*, vol. 290, no. 5, pp. 1010–1027, 2021, doi: 10.1111/joim.13326.

Yskäisy



- Punaiset kuivia
- Siniset kosteita

Minkä kokoisia partikkelit ovat?



M. Alsved *et al.*, 'Exhaled respiratory particles during singing and talking', *Aerosol Science and Technology*, vol. 54, no. 11, pp. 1245–1248, Nov. 2020, doi: 10.1080/02786826.2020.1812502.

Mitä tapahtuu vastaanottopäässä?

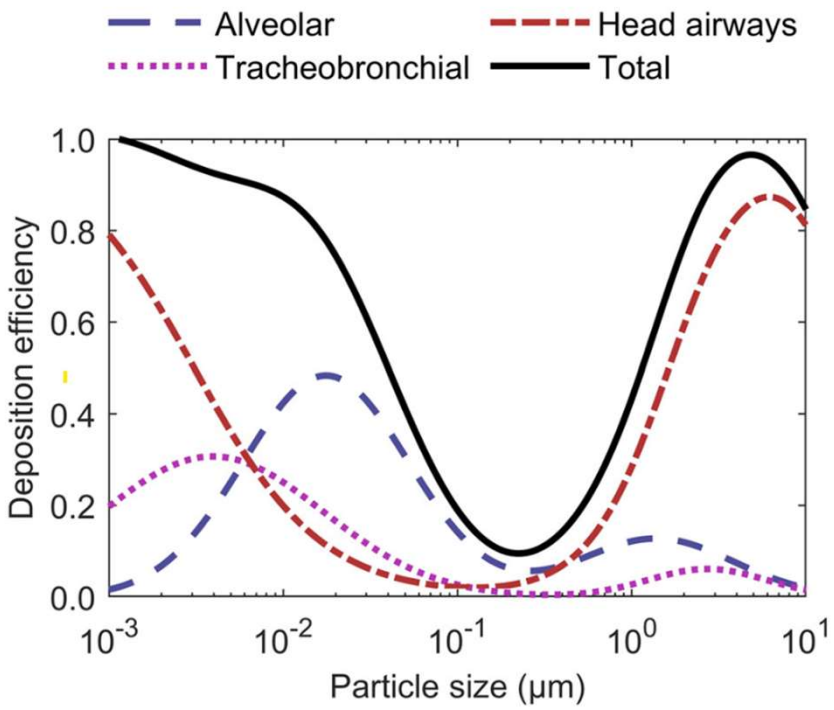


Figure 1. Particle deposition efficiency in the human respiratory tract as a function of particle size according to ICRP (1994) and Hinds (1999).

T. Lepistö, H. Kuuluvainen, P. Juuti, A. Järvinen, A. Arffman, and T. Rönkkö, 'Measurement of the human respiratory tract deposited surface area of particles with an electrical low pressure impactor', *Aerosol Science and Technology*, vol. 54, no. 8, pp. 958–971, Aug. 2020, doi: 10.1080/02786826.2020.1745141.

Paljonko partikkeleita syntyy?

- Yskäisy: noin 5000 partikkelia
- Aivastus: kymmeniä tuhansia partikkeleita
- Muut aktiviteetit:
  - Hengitys: 135 partikkelia/s
  - Puhe: 270 partikkelia/s
  - Äänekäs puhe: 570 partikkelia/s
  - Laulu: 690 partikkelia/s
  - Äänekäs laulu: 980 partikkelia/s
  - Äänekäs laulu maskin kanssa: 410 partikkelia/s

Muiden aktiviteettien lähde: M. Alsved *et al.*, 'Exhaled respiratory particles during singing and talking', *Aerosol Science and Technology*, vol. 54, no. 11, pp. 1245–1248, Nov. 2020.

Paljonko viruksia emittoituu?

CITIZENSHIELD

medRxiv
THE PREPRINT SERVER FOR HEALTH SCIENCES

CSH Cold Spring Harbor Laboratory BMJ Yale

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Quantity of SARS-CoV-2 RNA copies exhaled per minute during natural breathing over the course of COVID-19 infection

Gregory Lane, Guangyu Zhou, Judd F. Hultquist, Lacy M. Simons, Ramon Lorenzo- Redondo, Egon A. Ozer, Danielle M. McCarthy, Michael G. Ison, Chad J. Achenbach, Xinkun Wang, Ching Man Wai, Eugene Wyatt, Alan Aalsburg, Qiaohan Yang, Torben Noto, Arghavan Alisoltani, Daniel Ysselstein, Rajeshwar Awatramani, Robert Murphy, Grant Theron, Christina Zelano

doi: https://doi.org/10.1101/2023.09.06.23295138

Paljonko viruksia emittoituu?

CITIZENSHIELD

medRxiv THE PREPRINT SERVER FOR HEALTH SCIENCES

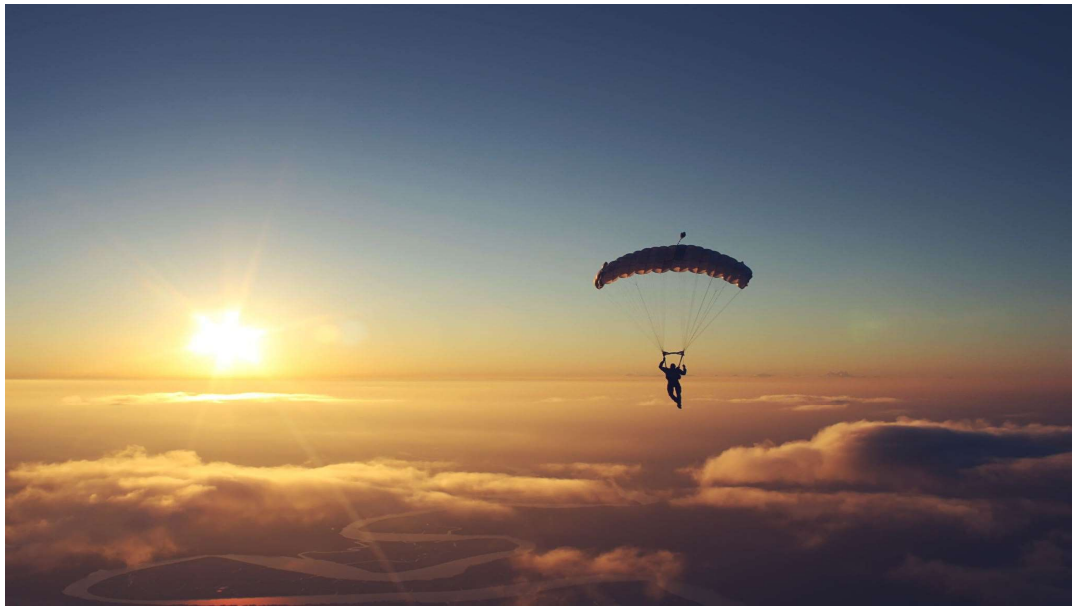
CSH Cold Spring Harbor Laboratory BMJ Yale

SARS-CoV-2 RNA copies during COVID-19 infection do not decrease significantly until day 8 from symptom-onset. COVID-19-positive participants exhaled an average of 80 SARS-CoV-2 viral RNA copies per minute during the first 8 days of infection, with significant variability both between and within individuals, including spikes over 800 copies a minute in some patients. After day 8, there was a steep drop to levels nearing the limit of detection, persisting for up to 20 days.

guide clinical practice.

CITIZENSHIELD

Ilmavälitteinen vai ei?



Ilmavälitteinen vai ei?

Safety Science 130 (2020) 104866

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/safety

Modelling aerosol transport and virus exposure with numerical simulations in relation to SARS-CoV-2 transmission by inhalation indoors

Ville Vuorinen[a,*], Mia Aarnio[b,1], Mikko Alava[h], Ville Alopaeus[c], Nina Atanasova[b,i], Mikko Auvinen[b], Nallannan Balasubramanian[e], Hadi Bordbar[g], Panu Erästö[f], Rafael Grande[d], Nick Hayward[e], Antti Hellsten[b], Simo Hostikka[g], Jyrki Hokkanen[m], Ossi Kaario[a], Aku Karvinen[l], Ilkka Kivistö[l], Marko Korhonen[h], Risto Kosonen[a], Janne Kuusela[n], Sami Lestinen[a], Erkki Laurila[a], Heikki J. Nieminen[e], Petteri Peltonen[a], Juho Pokki[c], Antti Puisto[h], Peter Råback[m], Henri Salmenjoki[h], Tarja Sironen[j,k], Monika Österberg[d]

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[b] Atmospheric Dispersion Modelling, Atmospheric Composition Research, Finnish Meteorological Institute, FI-00101 Helsinki, Finland
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[e] Department of Neuroscience and Biomedical Engineering, Aalto University, FI-00076 AALTO, Finland
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[k] Department of Veterinary Biosciences, Faculty of Veterinary Medicine, University of Helsinki, Helsinki, Finland
[l] VTT Technical Research Centre of Finland Ltd, Finland
[m] CSC-IT Center for Science Ltd, FI-02101, Finland
[n] Emergency Department, Mikkeli Central Hospital, The South Savo Social and Health Care Authority, FI-50100, Finland

Ilmavälitteinen vai ei?

Safety Science 130 (2020) 104866

Contents lists available at ScienceDirect

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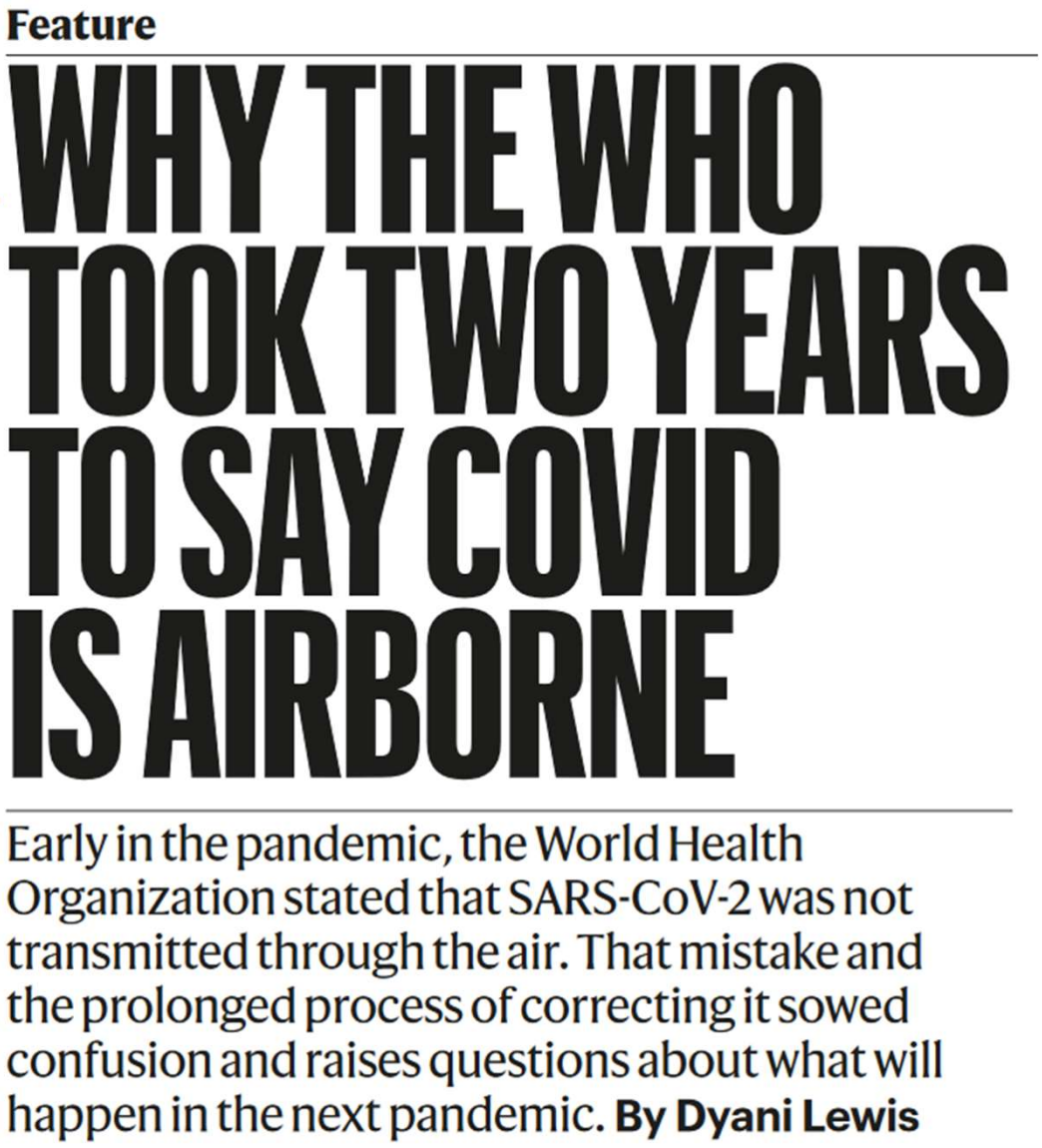
E-mail address: ville.vuorinen@aalto.fi (V. Vuorinen).
[1] Co-authors are listed in alphabetical order, not based

https://doi.org/10.1016/j.ssci.2020.104866
Received 25 May 2020; Accepted 31 May 2020
Available online 11 June 2020
0925-7535/

[m] CSC-IT Center for Science Ltd, FI-02101, Finland
[n] Emergency Department, Mikkeli Central Hospital, The South Savo Social and Health Care Authority, FI-50100, Finland

Ilmavälitteinen vai ei?



Feature

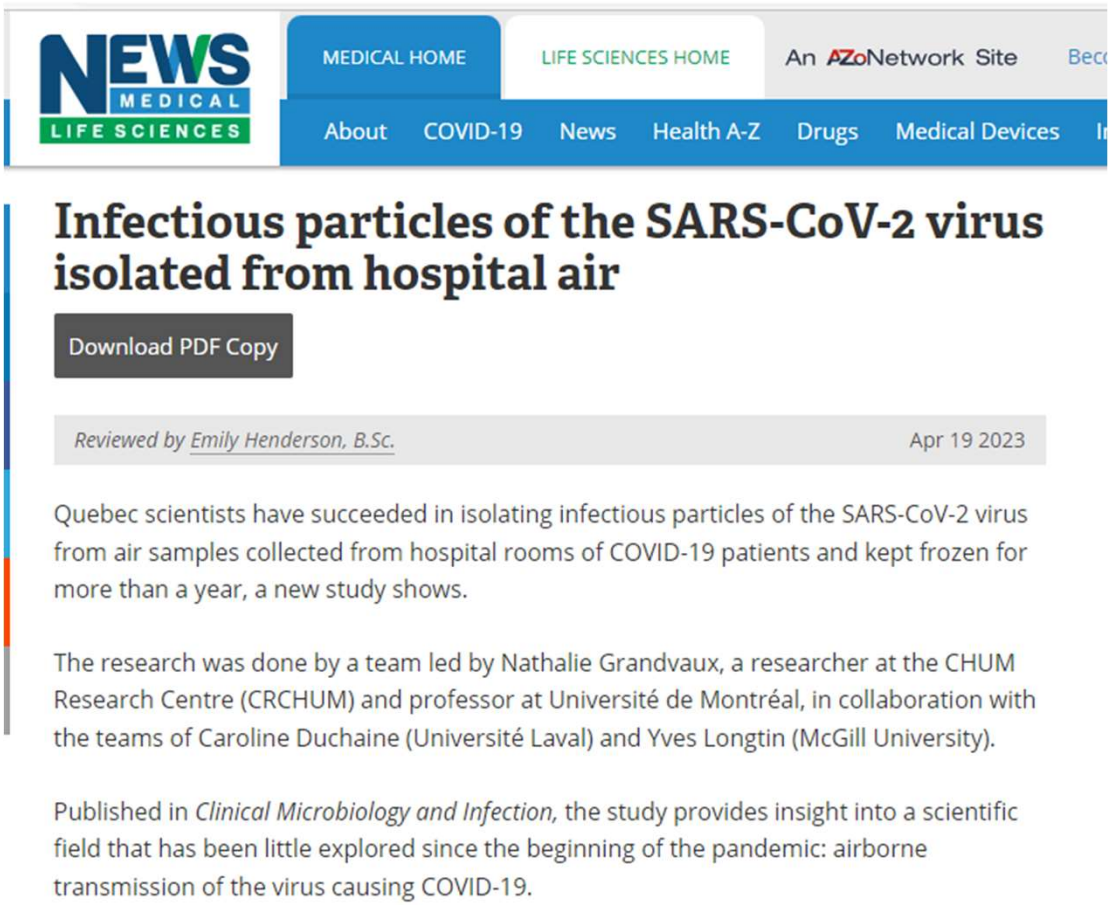
WHY THE WHO TOOK TWO YEARS TO SAY COVID IS AIRBORNE

Early in the pandemic, the World Health Organization stated that SARS-CoV-2 was not transmitted through the air. That mistake and the prolonged process of correcting it sowed confusion and raises questions about what will happen in the next pandemic. **By Dyani Lewis**

D. Lewis, 'Why the WHO took two years to say COVID is airborne', *Nature*, vol. 604, no. 7904, pp. 26–31, Apr. 2022.

Ilmavälitteinen vai ei?

CITIZENSHIELD



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Infectious particles of the SARS-CoV-2 virus isolated from hospital air

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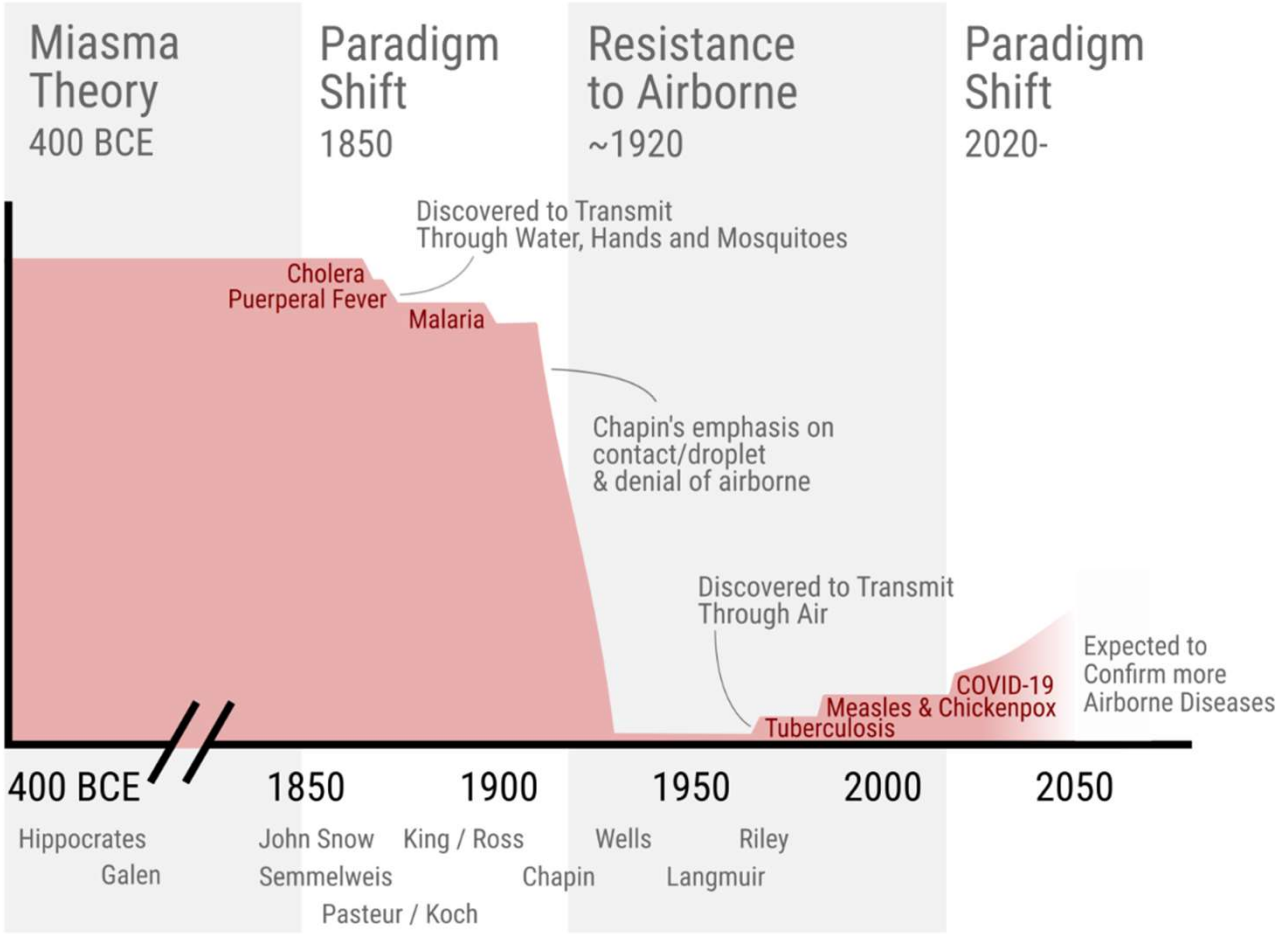
Reviewed by Emily Henderson, B.Sc. Apr 19 2023

Quebec scientists have succeeded in isolating infectious particles of the SARS-CoV-2 virus from air samples collected from hospital rooms of COVID-19 patients and kept frozen for more than a year, a new study shows.

The research was done by a team led by Nathalie Grandvaux, a researcher at the CHUM Research Centre (CRCHUM) and professor at Université de Montréal, in collaboration with the teams of Caroline Duchaine (Université Laval) and Yves Longtin (McGill University).

Published in *Clinical Microbiology and Infection*, the study provides insight into a scientific field that has been little explored since the beginning of the pandemic: airborne transmission of the virus causing COVID-19.

Ilmavälitteinen vai ei?

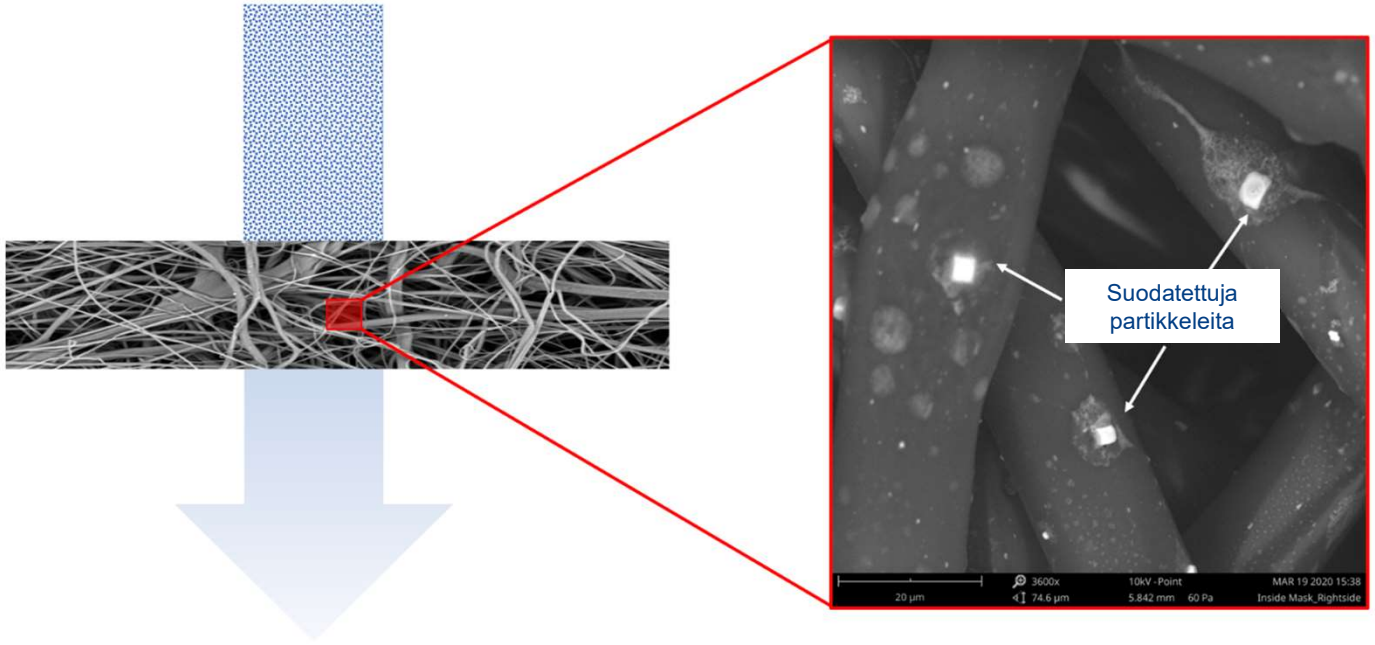


J. L. Jimenez *et al.*, 'What were the historical reasons for the resistance to recognizing airborne transmission during the COVID-19 pandemic?', *Indoor Air*, vol. 32, no. 8, p. e13070, 2022.

CITIZENSHIELD

Maskit suojautumisessa

Miten ilmansuodatin toimii



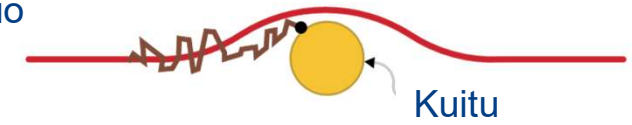
https://www.nanoscience.com/applications/materials-science/effectiveness-of-masks-fast-answers-with-automated-sem-analysis/

Miten ilmansuodatin toimii

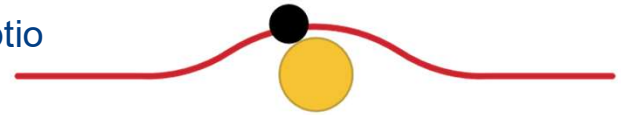
CITIZENSHIELD

Suodatusmekanismit

Diffuusio

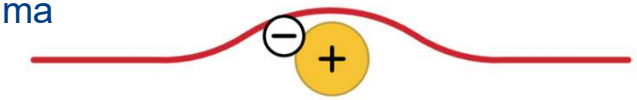


Interseptio



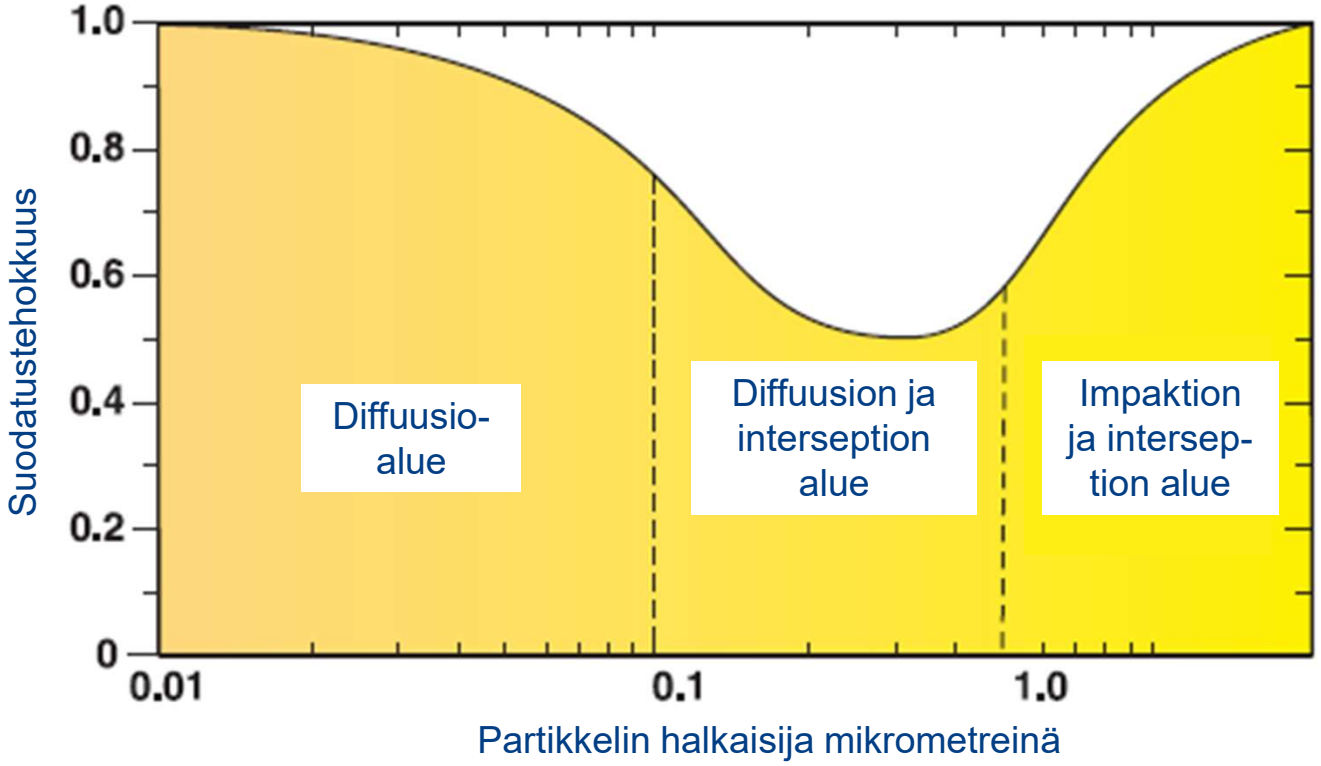
Impaktio

Elektrostaattinen vetovoima



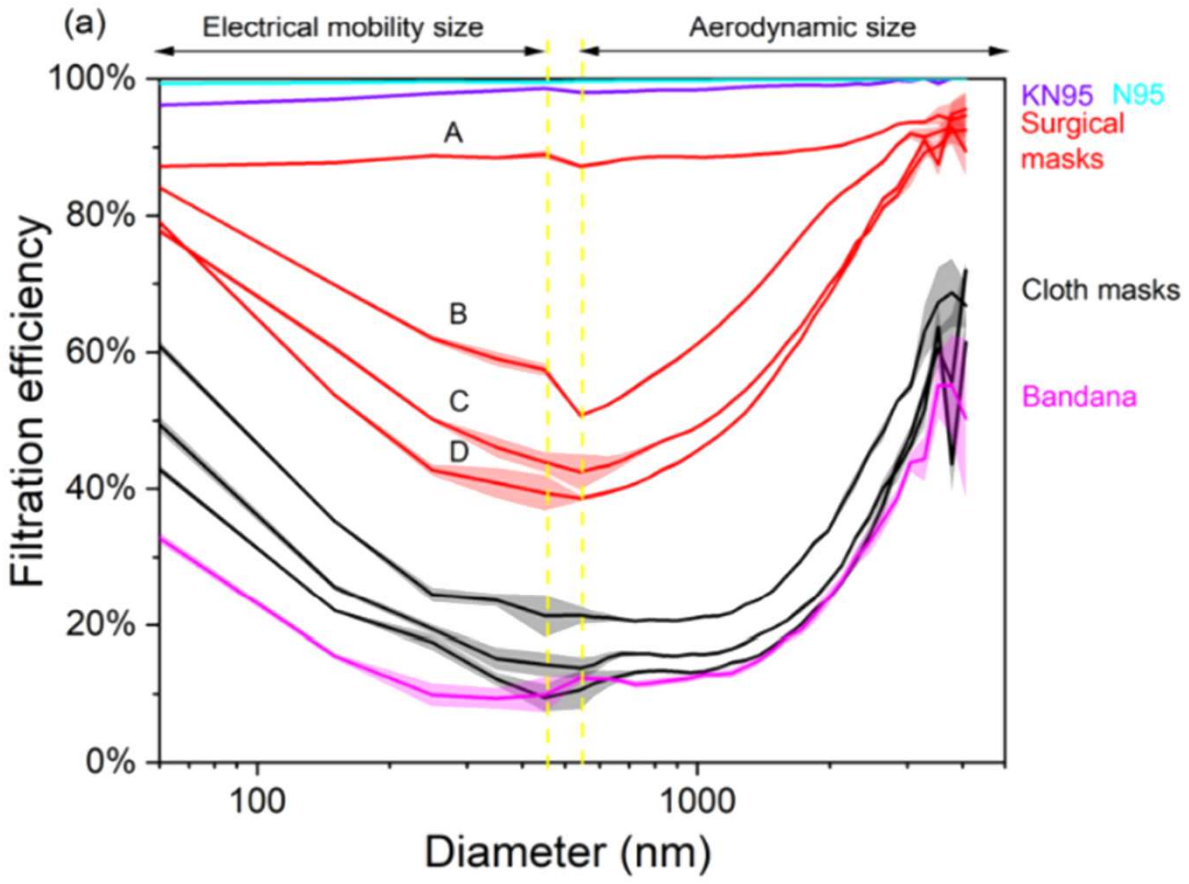
Wikipedia

Miten ilmansuodatin toimii

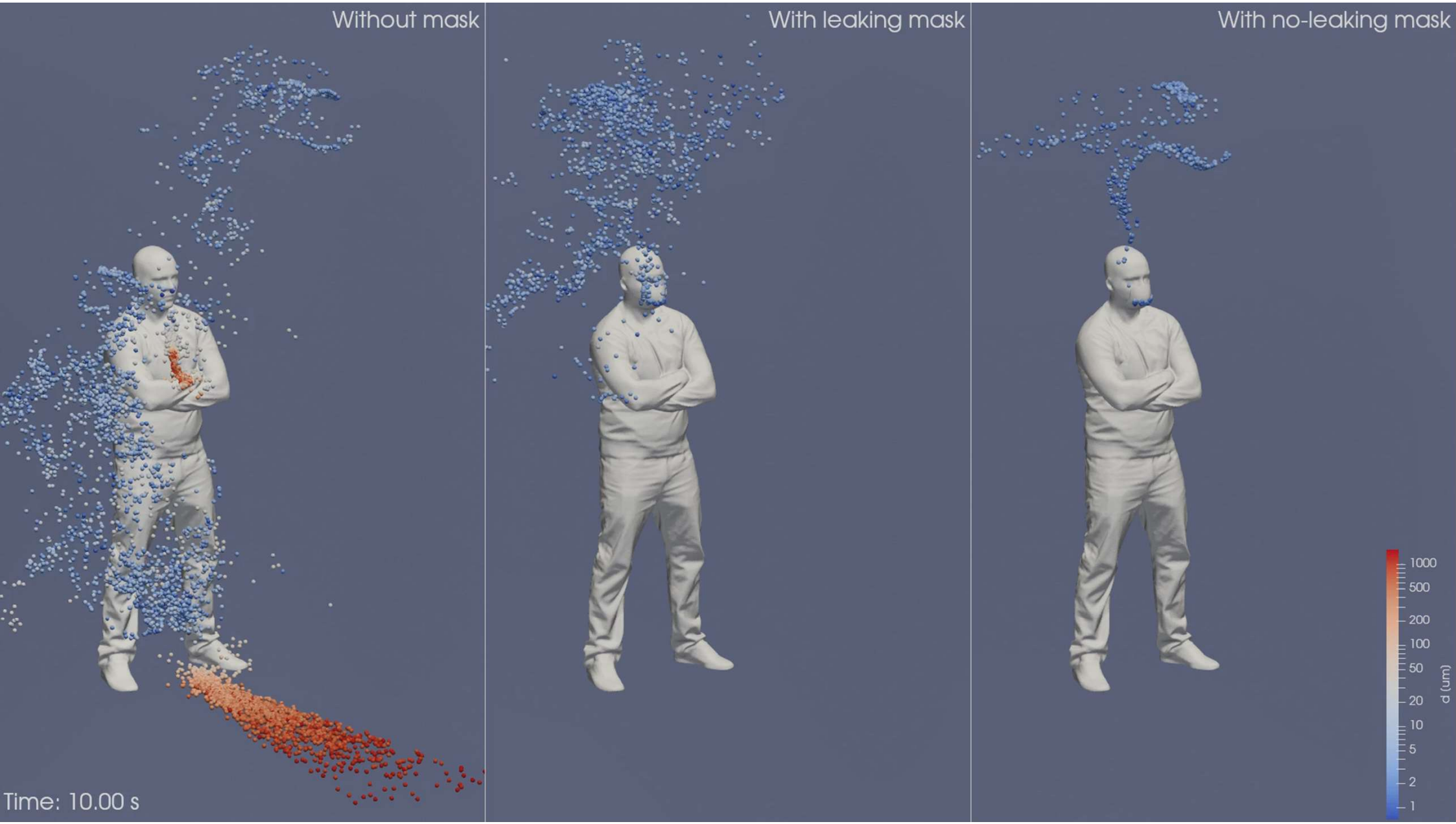


Wikipedia

Todellisten maskien suojaustehokkuus



S. Sankhyan *et al.*, 'Filtration Performance of Layering Masks and Face Coverings and the Reusability of Cotton Masks after Repeated Washing and Drying', *Aerosol Air Qual. Res.*, vol. 21, no. 11, p. 210117, 2021, doi: 10.4209/aaqr.210117.


Without mask
With leaking mask
With no-leaking mask
Time: 10.00 s
1000
500
200
100
50
20
10
5
2
1
d (um)

Auttaako maskit oikeasti?

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NEWS FEATURE | 06 October 2020

Face masks: what the data say

The science supports that face coverings are saving lives during the coronavirus pandemic, and yet the debate trundles on. How much evidence is enough?

Auttaako maskit oikeasti?

CITIZENSHIELD

PHILOSOPHICAL TRANSACTIONS A

royalsocietypublishing.org/journal/rsta

Review

Cite this article: Boulos L *et al*. 2023 Effectiveness of face masks for reducing transmission of SARS-CoV-2: a rapid systematic review. *Phil. Trans. R. Soc. A* **381**: 20230133. https://doi.org/10.1098/rsta.2023.0133

Received: 30 April 2023
Accepted: 23 May 2023

Effectiveness of face masks for reducing transmission of SARS-CoV-2: a rapid systematic review

Leah Boulos[1,2], Janet A. Curran[2,3], Allyson Gallant[2,4], Helen Wong[2,4], Catherine Johnson[2,6], Alannah Delahunty-Pike[2], Lynora Saxinger[7], Derek Chu[8,9,10], Jeannette Comeau[5], Trudy Flynn[11], Julie Clegg[11] and Christopher Dye[12]

[1]Maritime SPOR SUPPORT Unit, Nova Scotia Health, 5790 University Avenue, Halifax, Nova Scotia B3H 1V7, Canada

Auttaako maskit oikeasti?

PHILOSOPHICAL TRANSACTIONS A

Effectiveness of face masks for reducing transmission of

found no effect ($n = 8/65$; 12%) or favoured controls ($n = 1/65$; 2%). Seven observational studies found that respirators were more protective than surgical masks, while five found no statistically significant difference between the two mask types. Despite the ROB, and allowing for uncertain and variable efficacy, we conclude that wearing masks, wearing higher quality masks (respirators), and mask mandates generally reduced SARS-CoV-2 transmission in these study populations.

This article is part of the theme issue 'The effectiveness of non-pharmaceutical interventions

review. *Phil. Trans. R. Soc. A* **381**: 20230133.
https://doi.org/10.1098/rsta.2023.0133

Received: 30 April 2023
Accepted: 23 May 2023

Jeannette Comeau[5], Trudy Flynn[11], Julie Clegg[11] and Christopher Dye[12]

[1]Maritime SPOR SUPPORT Unit, Nova Scotia Health, 5790 University Avenue, Halifax, Nova Scotia B3H 1V7, Canada

Milloin maskia olisi hyvä käyttää?

- Tyhjässä tilassa?
  - Oletko varma, ettei tilassa ole ollut muita eikä sinne tule muita sinun jälkeesi?
- Ulkona?
  - Pystytkö pitämään turvavälin?

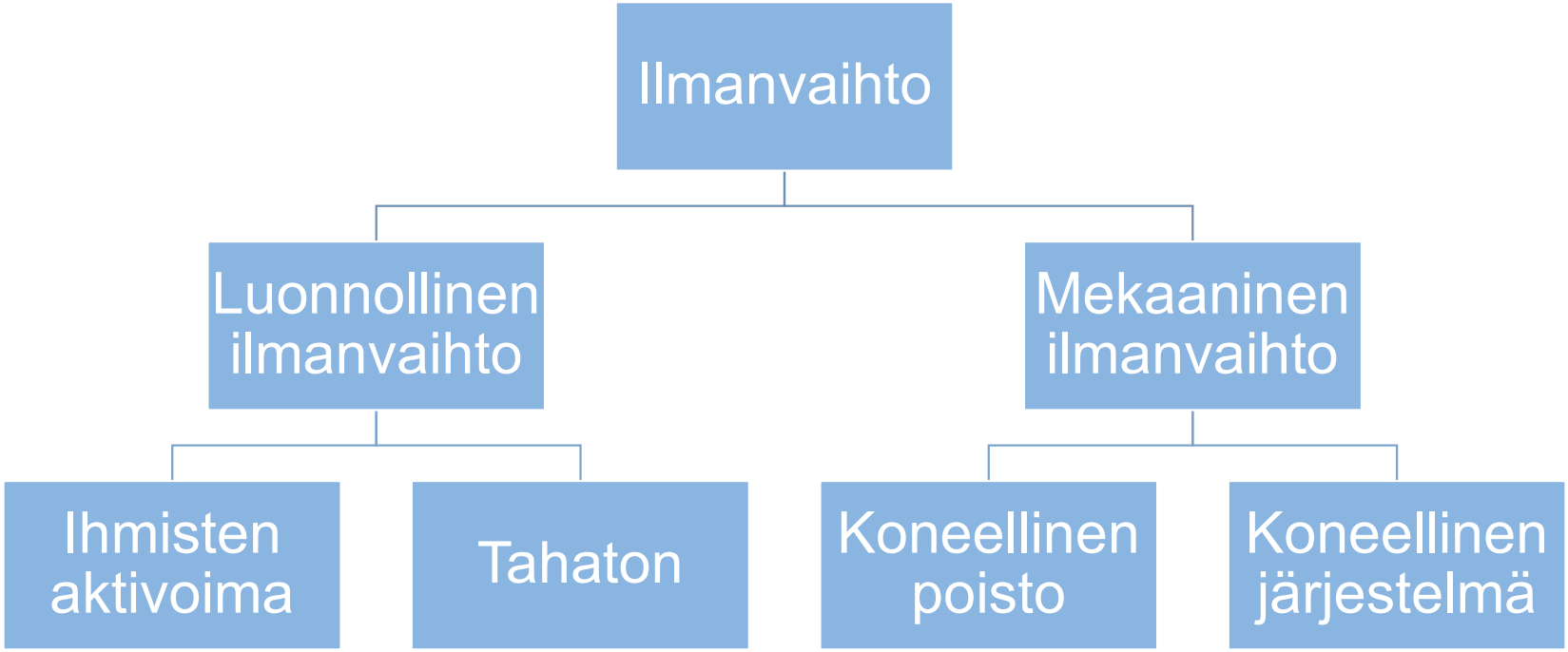
Maskityypit

- Kirurginen suu-nenäsuoja
  - Suojaa lähinnä muita
- FFP2
  - Suodattaa vähintään 94 % partikkeleista
  - Vuoto korkeintaan 8%
  - Käytännön suojauskerroin eli ilmoitettu suojauskerroin: 10
- FFP3
  - Suodattaa vähintään 99 % partikkeleista
  - Vuoto korkeintaan 2%
  - Käytännön suojauskerroin eli ilmoitettu suojauskerroin: 20

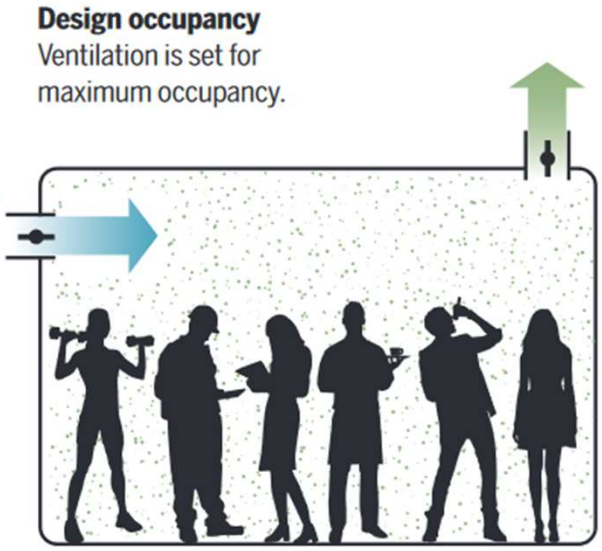
Ilmanvaihto suojautumisessa

https://www.hengitysliitto.fi/kodin-sisailma-ja-kunnossapito/ilmanvaihto/

Ilmanvaihto

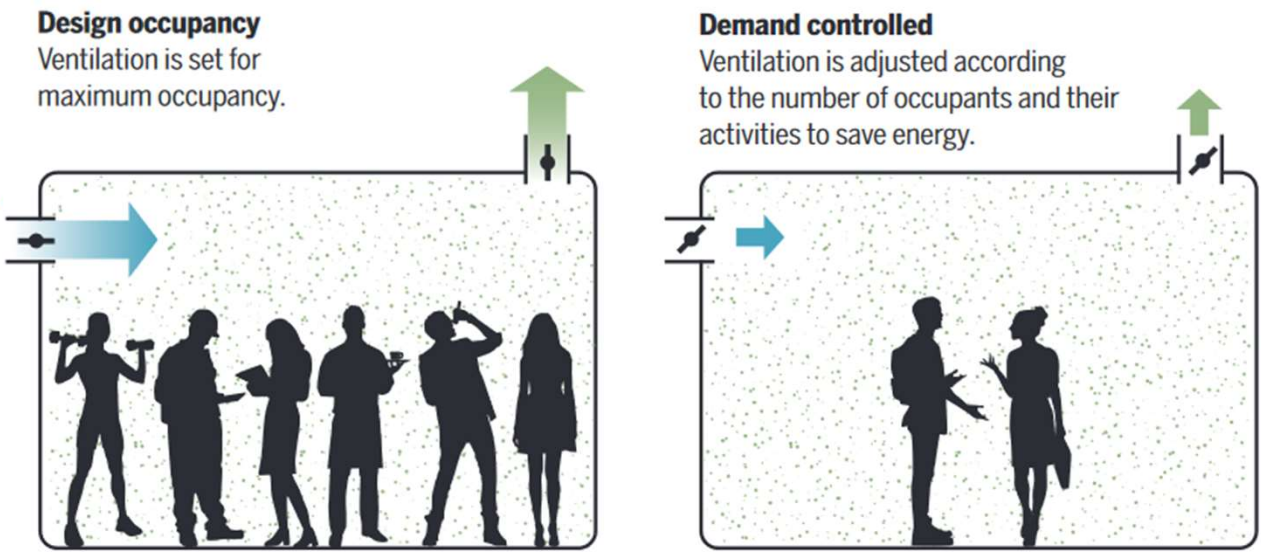


Ilmanvaihto



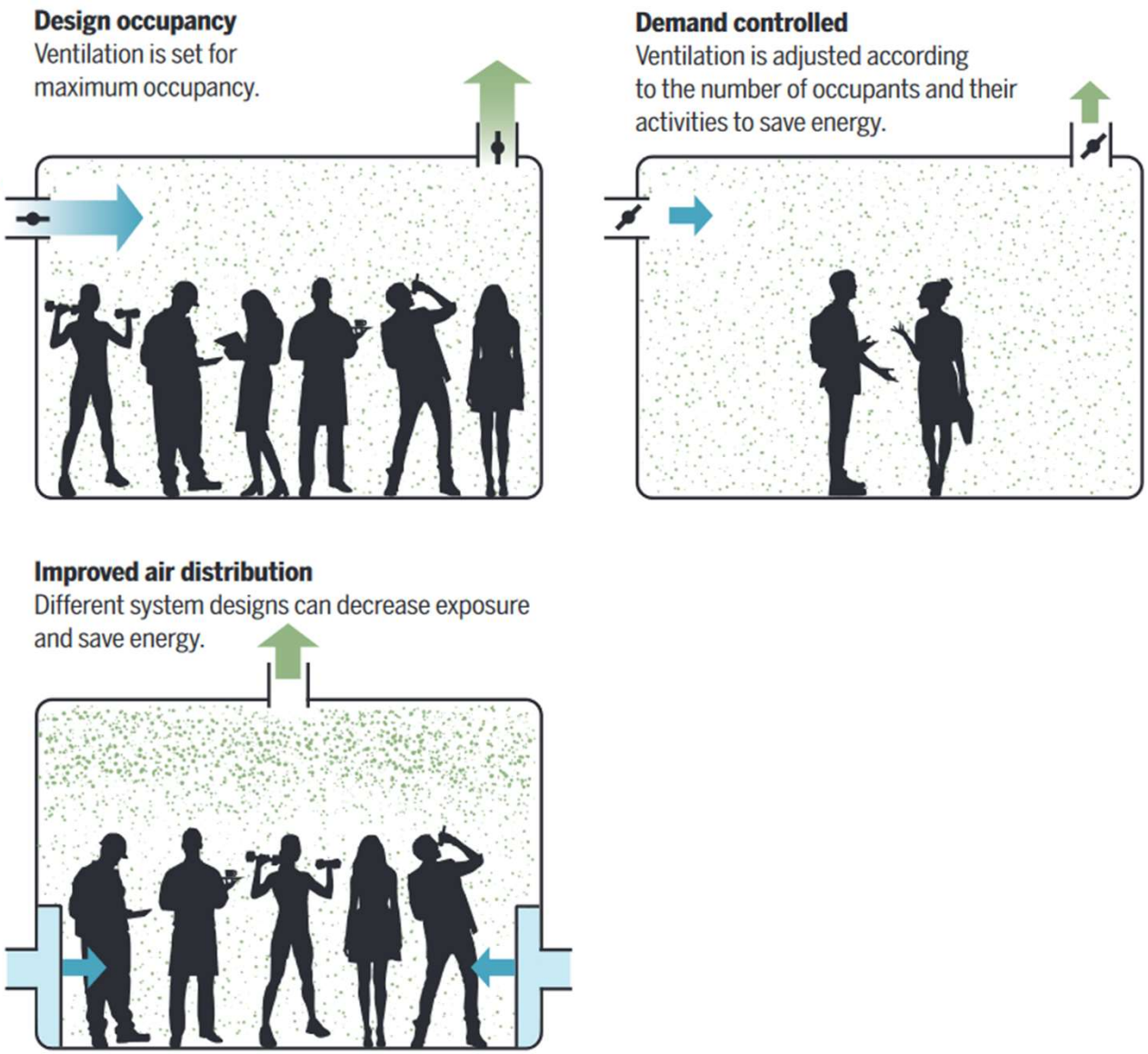
Morawska, Lidia, Joseph Allen, William Bahnfleth, Philomena M. Bluyssen, Atze Boerstra, Giorgio Buonanno, Junji Cao, et al. 'A Paradigm Shift to Combat Indoor Respiratory Infection'. *Science* 372, no. 6543 (14 May 2021): 689–91.

Ilmanvaihto



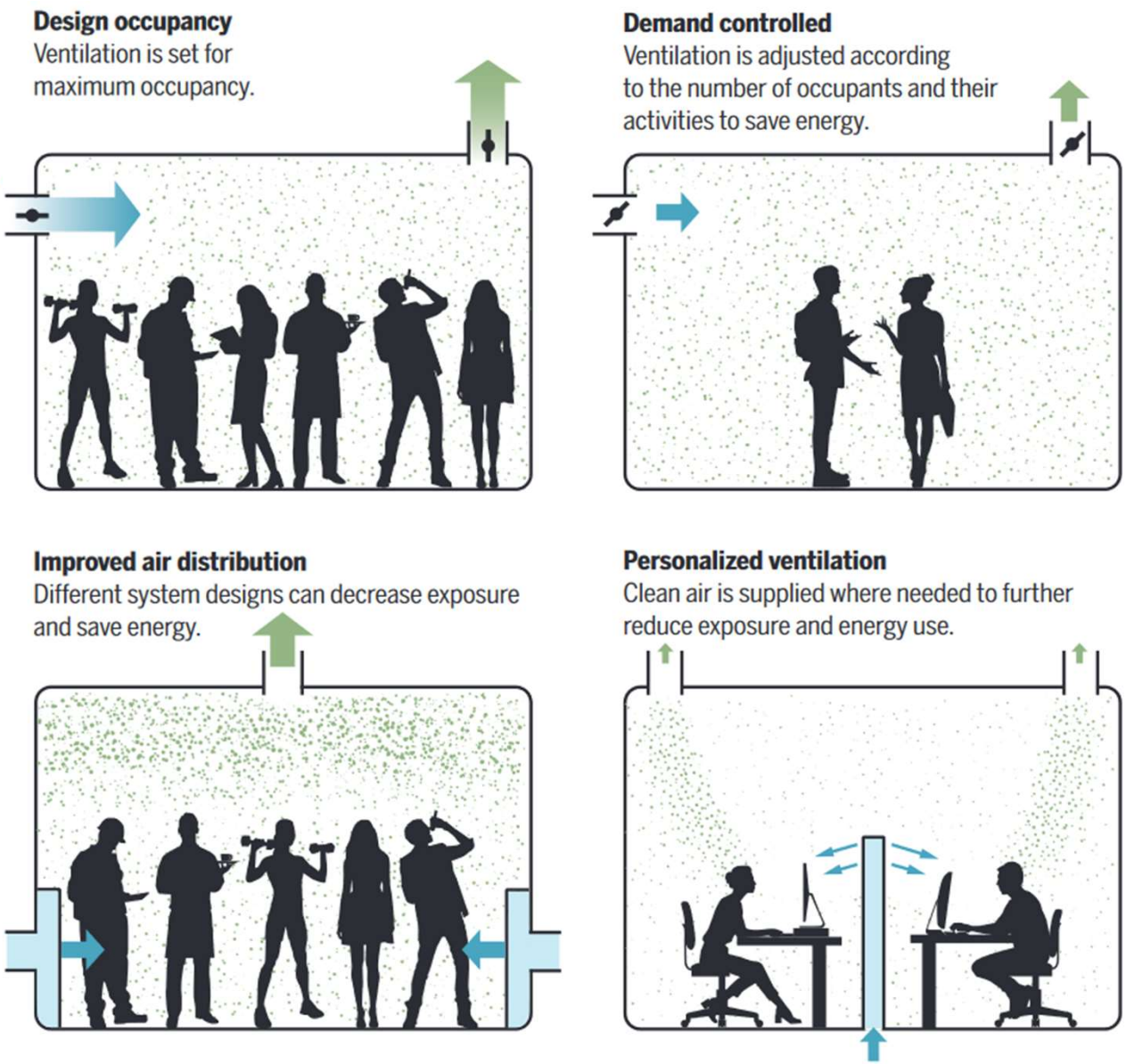
Morawska, Lidia, Joseph Allen, William Bahnfleth, Philomena M. Bluyssen, Atze Boerstra, Giorgio Buonanno, Junji Cao, et al. 'A Paradigm Shift to Combat Indoor Respiratory Infection'. *Science* 372, no. 6543 (14 May 2021): 689–91.

Ilmanvaihto



Morawska, Lidia, Joseph Allen, William Bahnfleth, Philomena M. Bluyssen, Atze Boerstra, Giorgio Buonanno, Junji Cao, et al. 'A Paradigm Shift to Combat Indoor Respiratory Infection'. *Science* 372, no. 6543 (14 May 2021): 689–91.

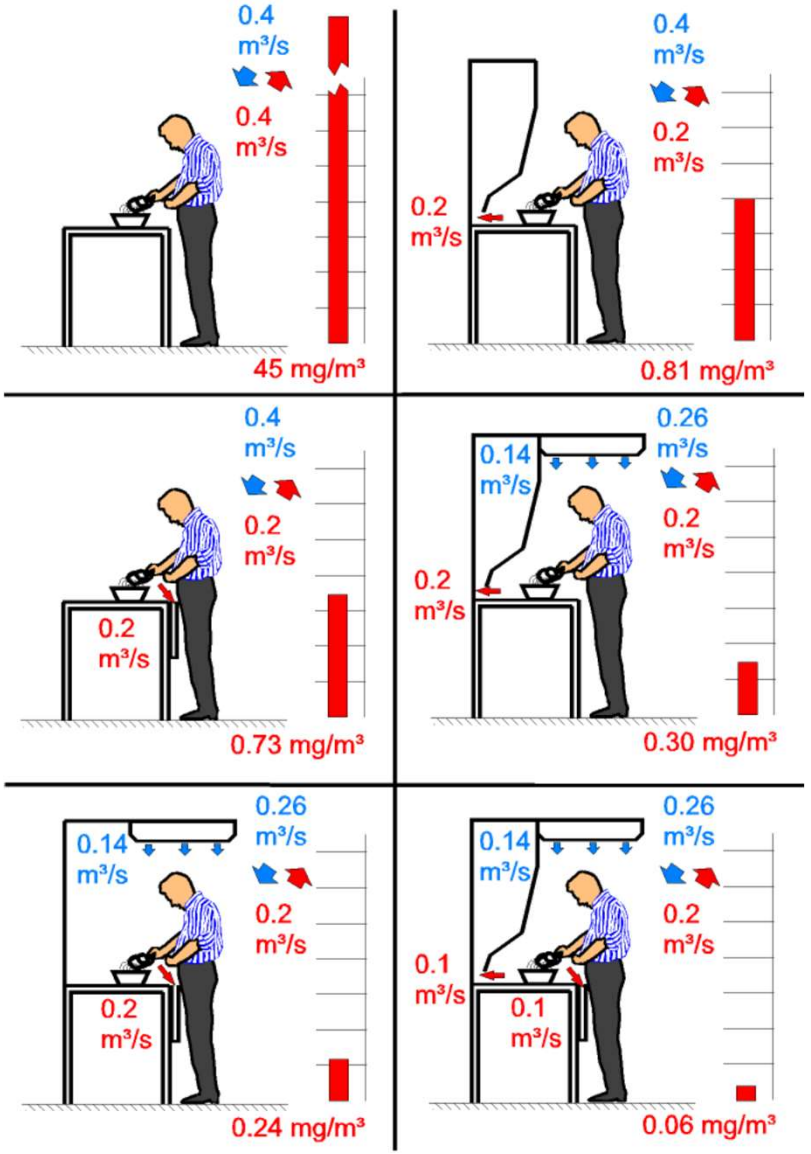
Ilmanvaihto



Morawska, Lidia, Joseph Allen, William Bahnfleth, Philomena M. Bluyssen, Atze Boerstra, Giorgio Buonanno, Junji Cao, et al. 'A Paradigm Shift to Combat Indoor Respiratory Infection'. *Science* 372, no. 6543 (14 May 2021): 689–91.

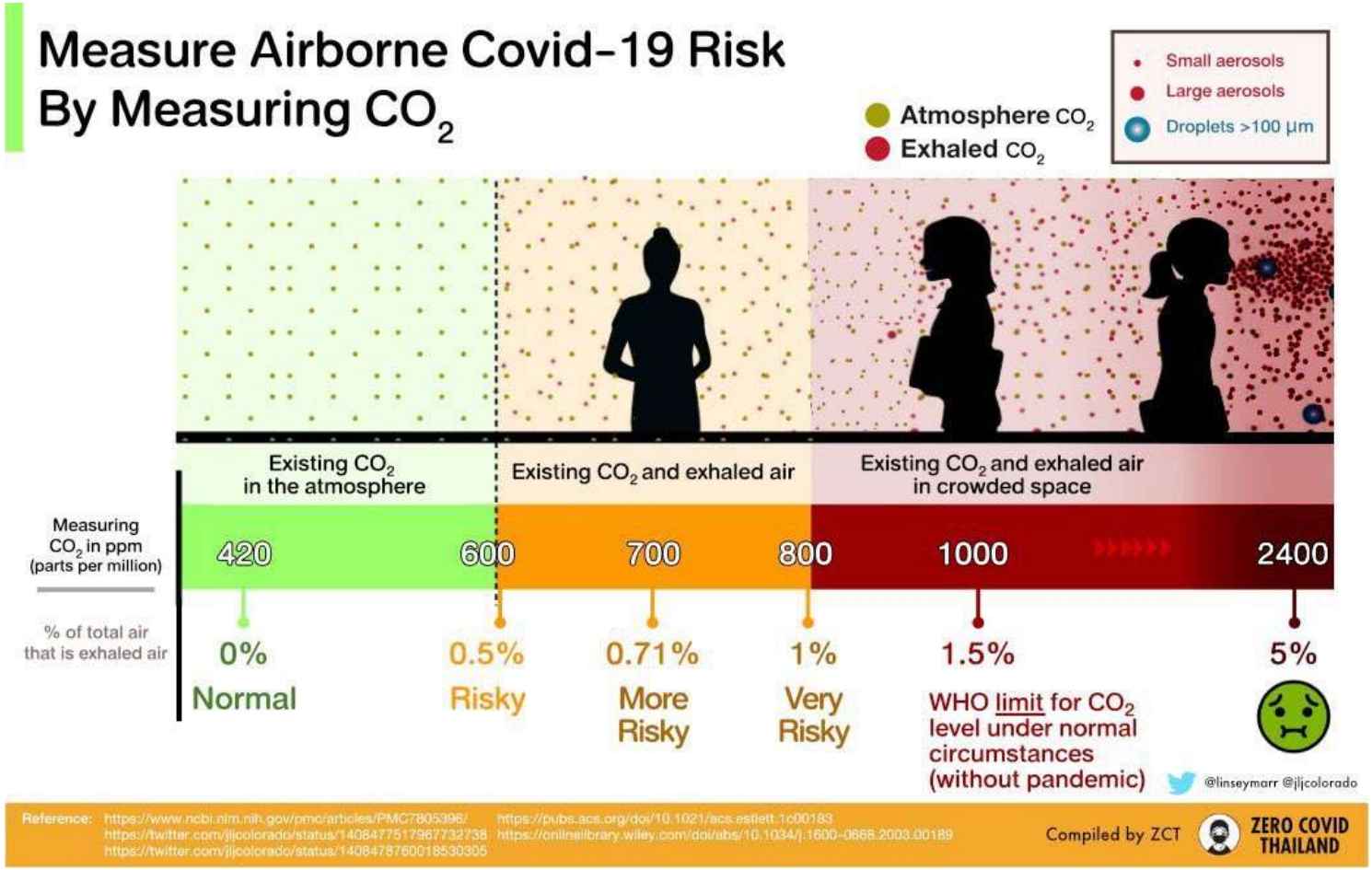
Paikallinen ilmanvaihto

- Altistuminen:
  45 → 0,06 mg/m³



I. Kulmala, Thesis.

CO2 ilmanvaihdon mittarina



- Luotettava vain, mikäli ei käytetä kiertoilmaa
- NDIR (nondispersive infrared) on luotettava mittausmenetelmä

Auttaako ilmanvaihto oikeasti?

CITIZENSHIELD

Longitudinal analysis of built environment and aerosol contamination associated with isolated COVID-19 positive individuals

Patrick F. Horve[1,2], Leslie G. Dietz[2], Garis Bowles[2], Georgia MacCrone[2], Andreas Olsen-Martinez[2], Dale Northcutt[2,3], Vincent Moore[2], Liliana Barnatan[2], Hooman Parhizkar[3,4] & Kevin G. Van Den Wymelenberg[2,3,4]✉

The indoor environment is the primary location for the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of coronavirus disease 2019 (COVID-19), largely driven by respiratory particle accumulation in the air and increased connectivity between the individuals occupying indoor spaces. In this study, we aimed to track a cohort of subjects as they occupied a COVID-19 isolation dormitory to better understand the impact of subject and environmental viral load over time, symptoms, and room ventilation on the detectable viral load within a single room. We find that subject samples demonstrate a decrease in overall viral load over time, symptoms significantly impact environmental viral load, and we provide the first real-world evidence for decreased aerosol SARS-CoV-2 load with increasing ventilation, both from mechanical and window sources. These results may guide environmental viral surveillance strategies and be used to better control the spread of SARS-CoV-2 within built environments and better protect those caring for individuals with COVID-19.

Horve, Patrick F., Leslie G. Dietz, Garis Bowles, Georgia MacCrone, Andreas Olsen-Martinez, Dale Northcutt, Vincent Moore, Liliana Barnatan, Hooman Parhizkar, and Kevin G. Van Den Wymelenberg. 2022. 'Longitudinal Analysis of Built Environment and Aerosol Contamination Associated with Isolated COVID-19 Positive Individuals'. *Scientific Reports* 12 (1): 7395. https://doi.org/10.1038/s41598-022-11303-8

Paljonko ilmanvaihdon pitäisi olla?

- Korona-aikaiset suositukset vaihtelevat ollen yleensä noin 6…12 vaihtoa tunnissa (ACH, Air Changes per Hour).
- Todelliset arvot yleensä selvästi pienempiä.
- Miten voitaisiin tehdä?

Mitä voitaisiin tehdä?

Siirtää patogeenit sisältä ulos

Kerätä patogeenit

Inaktivoida patogeenit

CITIZENSHIELD

Ilmanpuhdistus suojautumisessa

Ilmanpuhdistin

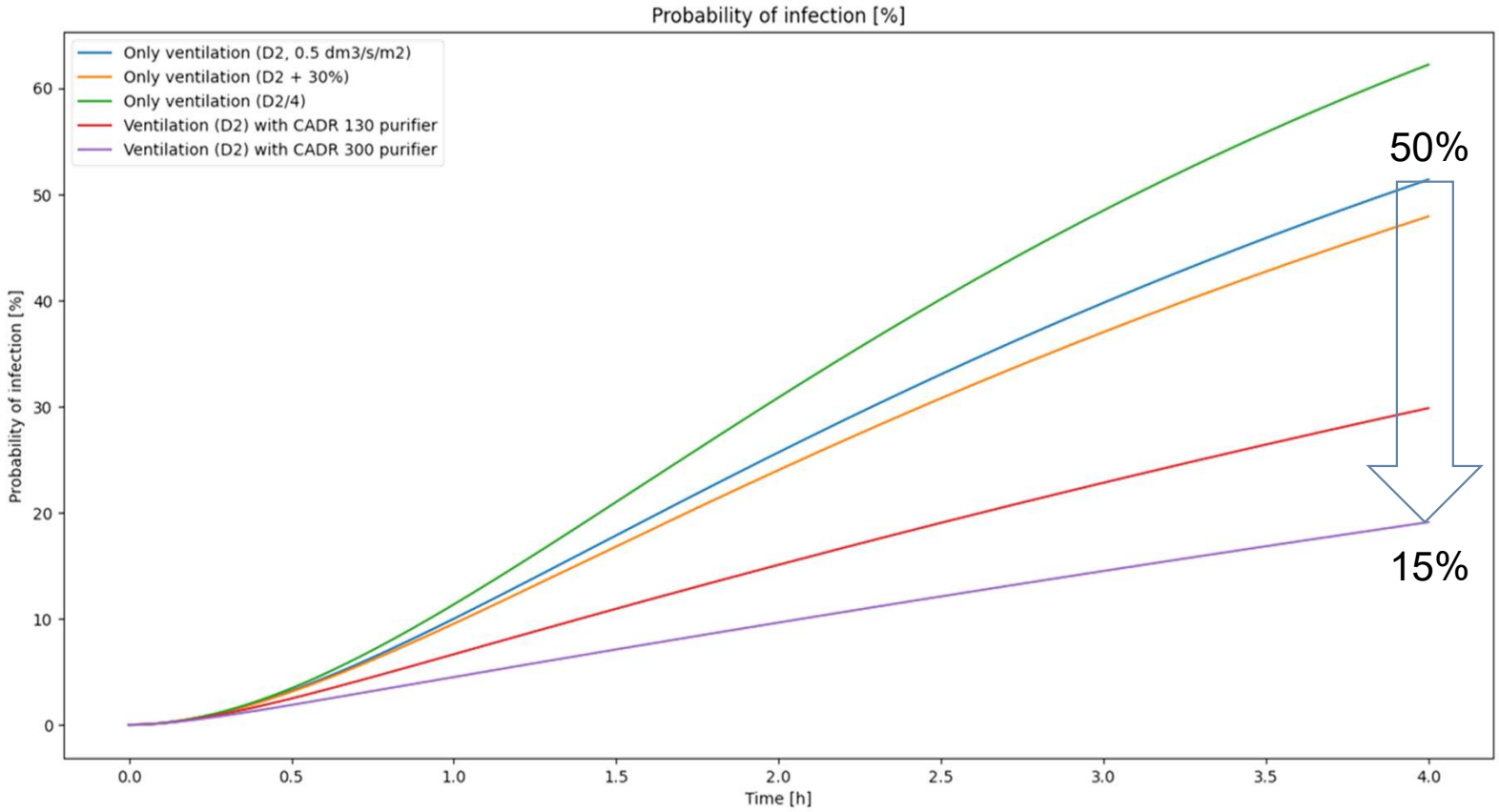
- Tärkein valintakriteeti on **puhtaan ilman tuotto** (CADR, Clean Air Delivery Rate)
  - Ilmavirran ja erotustehokkuuden tulo
- Ilmanpuhdistimen aiheuttama ilmanvaihtokerroin:

$$Ilmanvaihtoa\ tunnissa = \frac{puhtaan\ ilman\ tuotto}{huoneen\ tilavuus}$$

eli

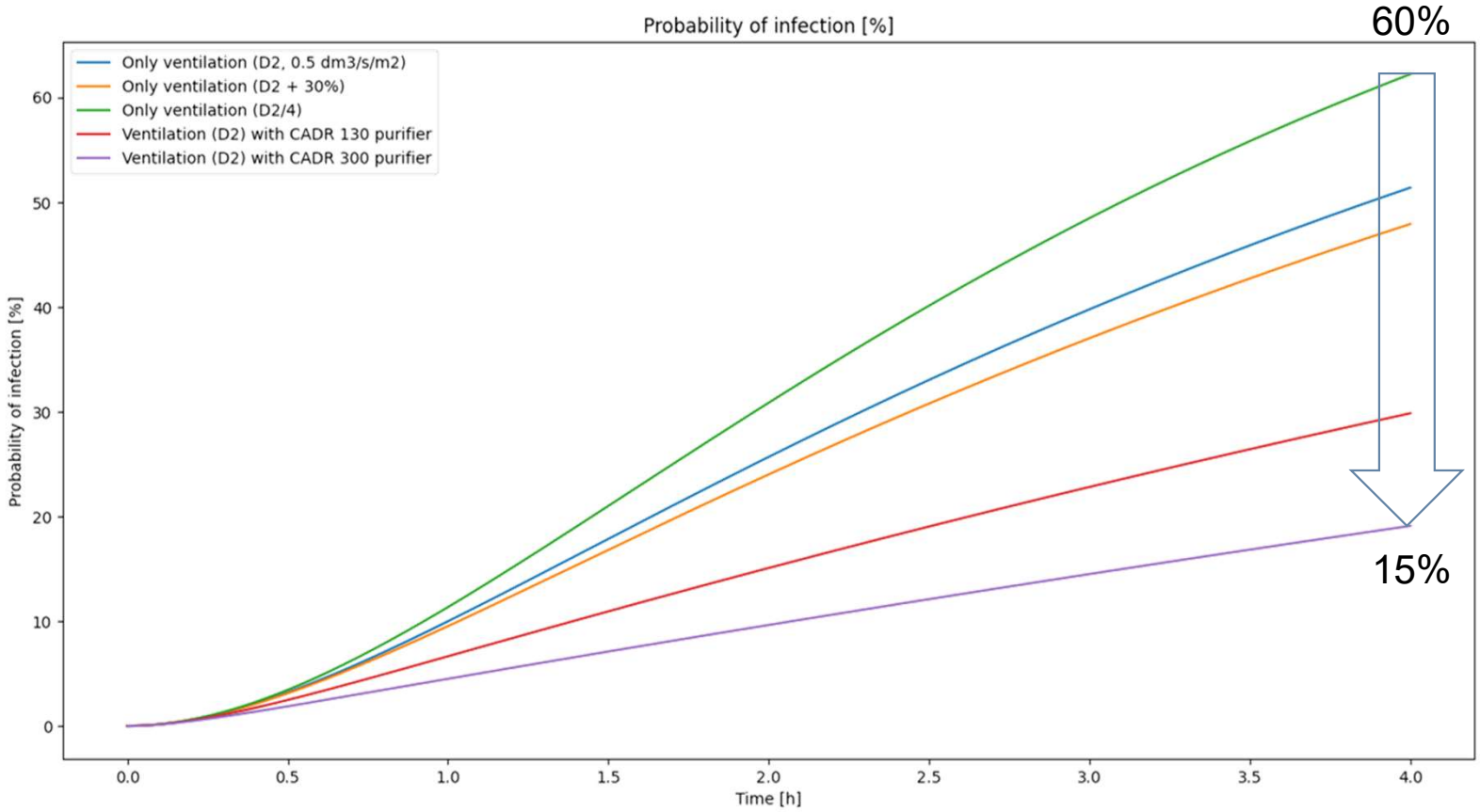
$$\mathrm{ACH} = \frac{\mathrm{CADR}}{huoneen\ tilavuus}$$

Laulaminen kotona



- Room area: 25 m2
- Room height: 2.7 m
- Emission rate: 62 quanta/h
- Deposition rate: 0.24 h-1
- Inactivation rate: 0.63 h-1
- Breathing rate 6.0 dm3/min

Laulaminen kotona



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Tapausesimerkki

Can the spread of flu be limited by purifying the indoor air?

– E3 is starting extensive study in Helsinki kindergartens

E3 project is starting an extensive research in Helsinki's four kindergartens. The two-year multidisciplinary study begins in November 2022, covering the entire early childhood education in the city of Helsinki. The core purpose of the study is to focus on four kindergartens in Helsinki to find out whether air purification can reduce the incidence of circulating upper respiratory tract infections and stomach diseases in children and adults. The arrangement offers a unique opportunity to follow the people who spend a significant

https://www.pandemicresponse.fi/post/can-the-spread-of-flu-be-limited-by-purifying-the-indoor-air

Tapausesimerkki

Can the spread of flu be limited by purifying the indoor air?

– E3 is starting extensive study in Helsinki kindergartens

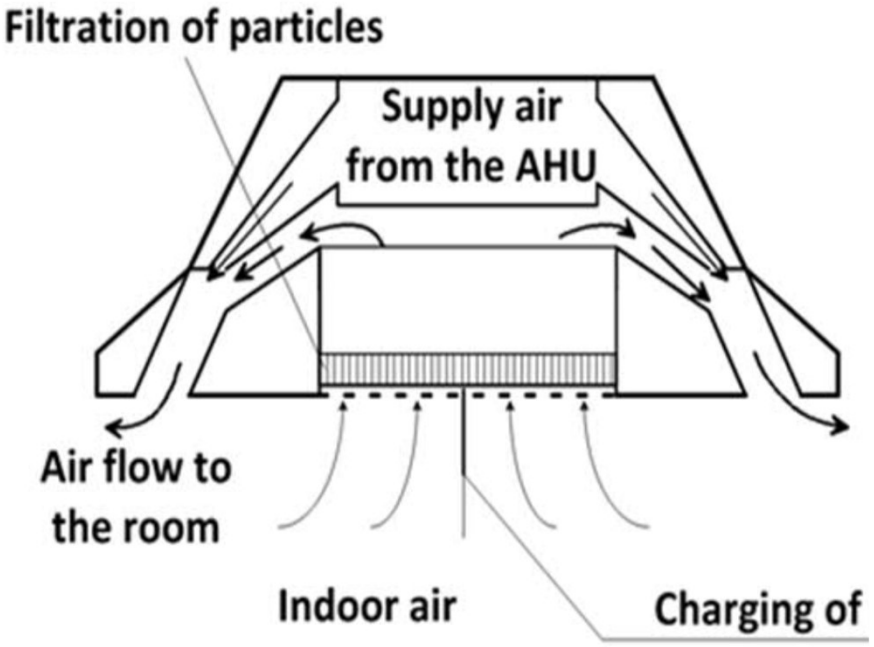
There was 30 % less morbidity of children in the kindergartens with air purifiers than in those without the purifiers!

E3 project is starting an extensive research in Helsinki's four kindergartens. The two-year multidisciplinary study begins in November 2022, covering the entire early childhood education in the city of Helsinki. The core purpose of the study is to focus on four kindergartens in Helsinki to find out whether air purification can reduce the incidence of circulating upper respiratory tract infections and stomach diseases in children and adults. The arrangement offers a unique opportunity to follow the people who spend a significant

https://www.pandemicresponse.fi/post/can-the-spread-of-flu-be-limited-by-purifying-the-indoor-air

Sisäilmaa puhdistava tuloilmalaite

- Tehokkaan tuloilman ja huoneilman suodatuksen kombinaatio.
- 90 % alenema partikkelikonsentraatiossa ilman merkittäviä muutoksia ilmanvaihtojärjestelmään.



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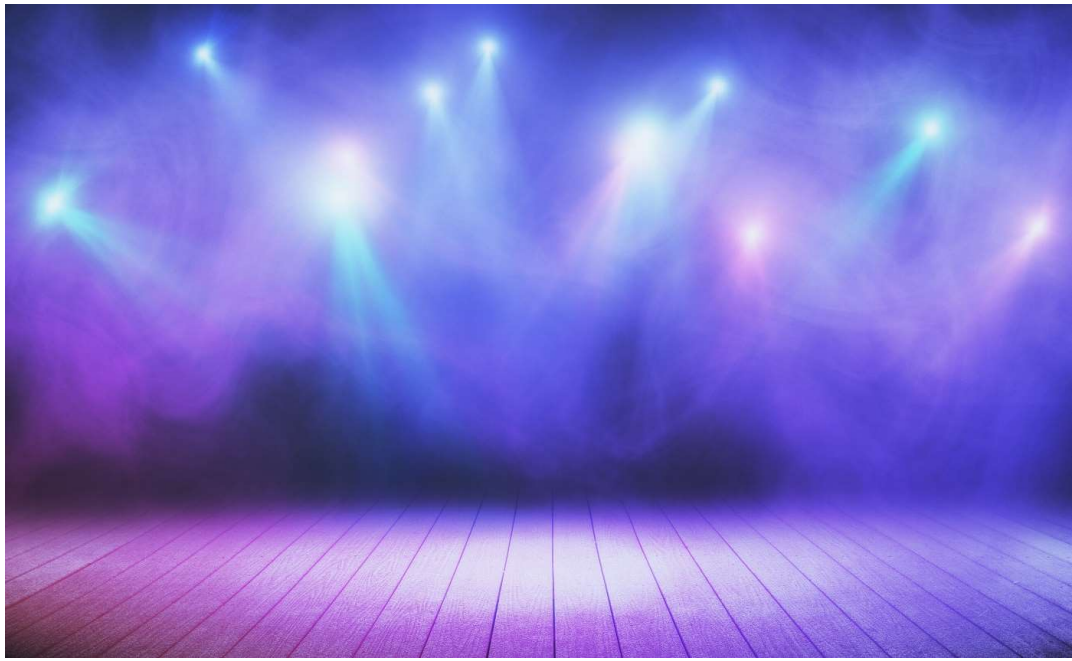
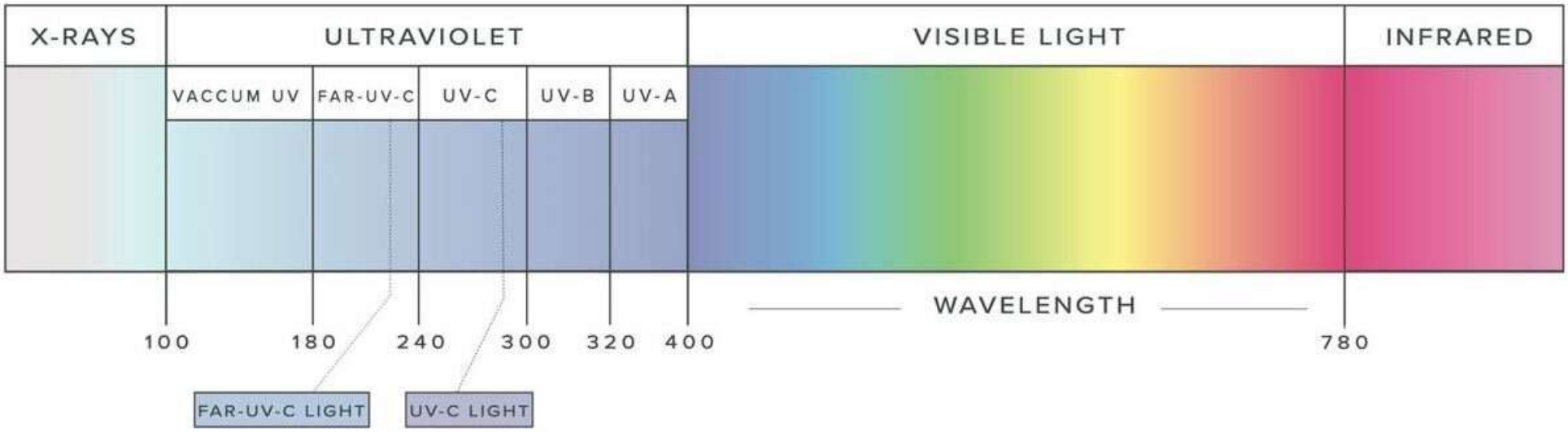
CITIZENSHIELD

Inaktivointi suojautumisessa



Far-UVC



https://www.wavelengthlighting.com/blog/2020/10/1/how-does-far-uvc-light-compare-to-uvc-coronavirus-disinfection

Far-UVC

CITIZENSHIELD

nature > scientific reports > articles > article

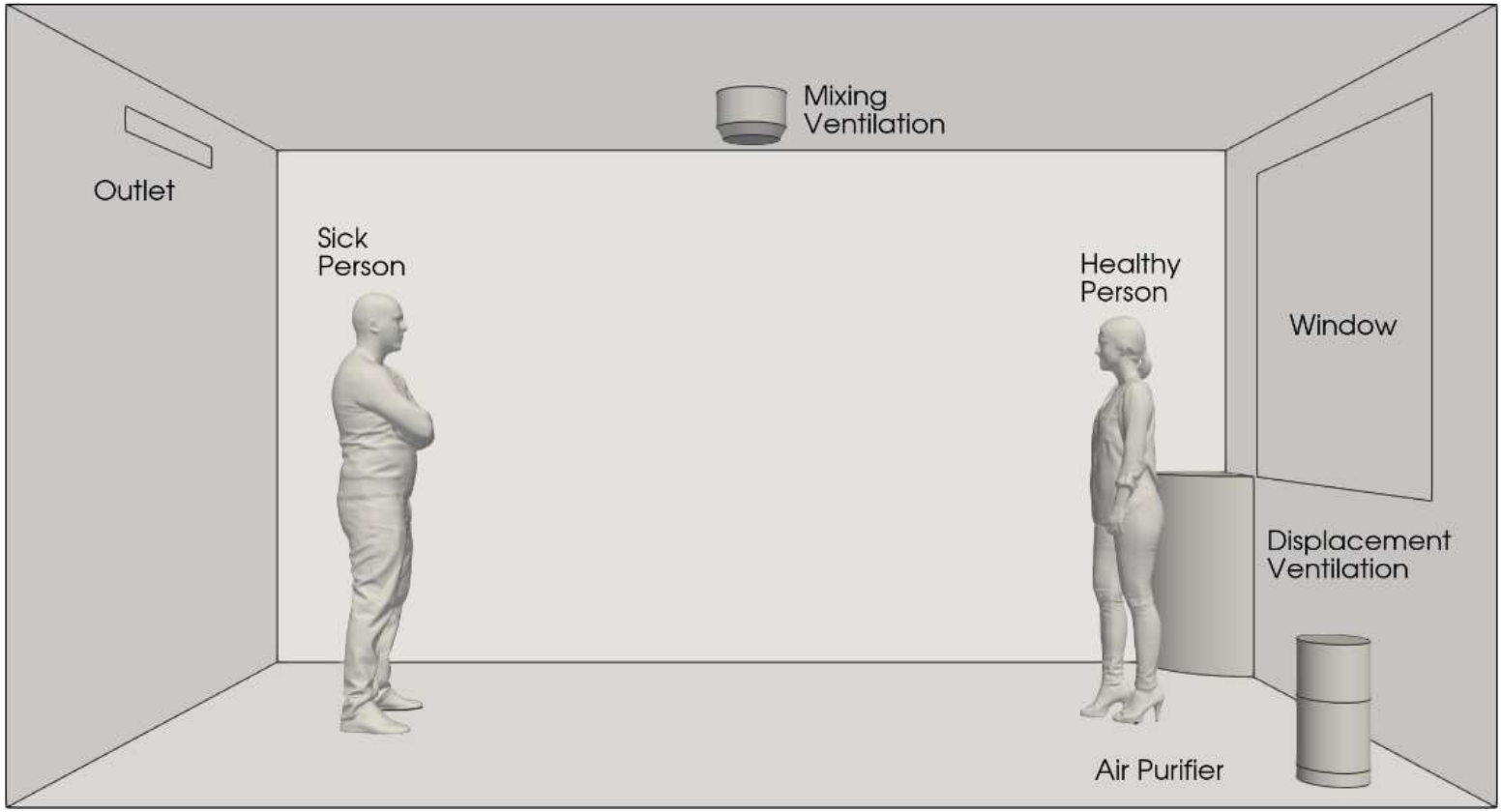
Article | Open Access | Published: 24 June 2020

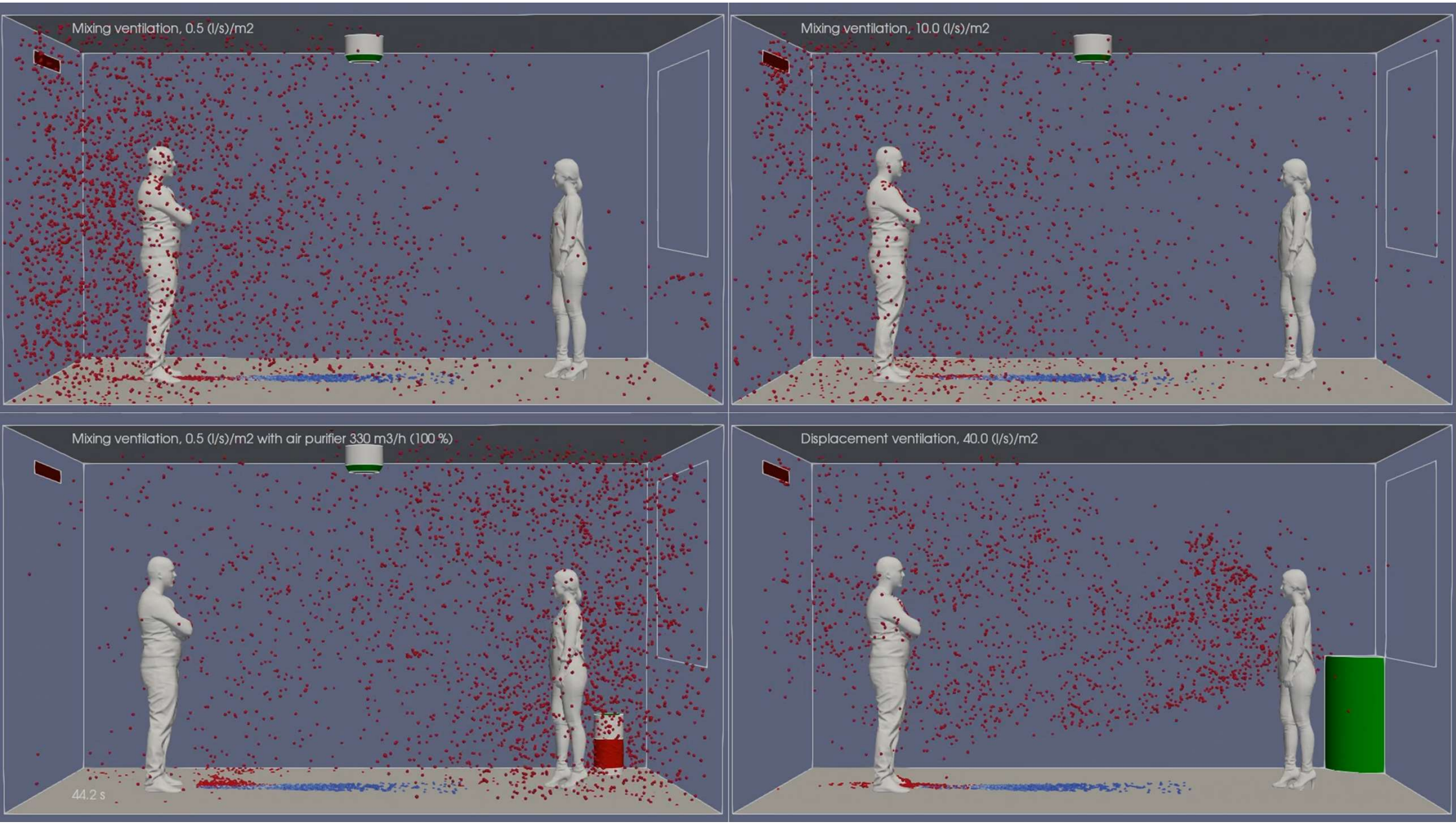
Far-UVC light (222 nm) efficiently and safely inactivates airborne human coronaviruses

Manuela Buonanno, David Welch, Igor Shuryak & David J. Brenner

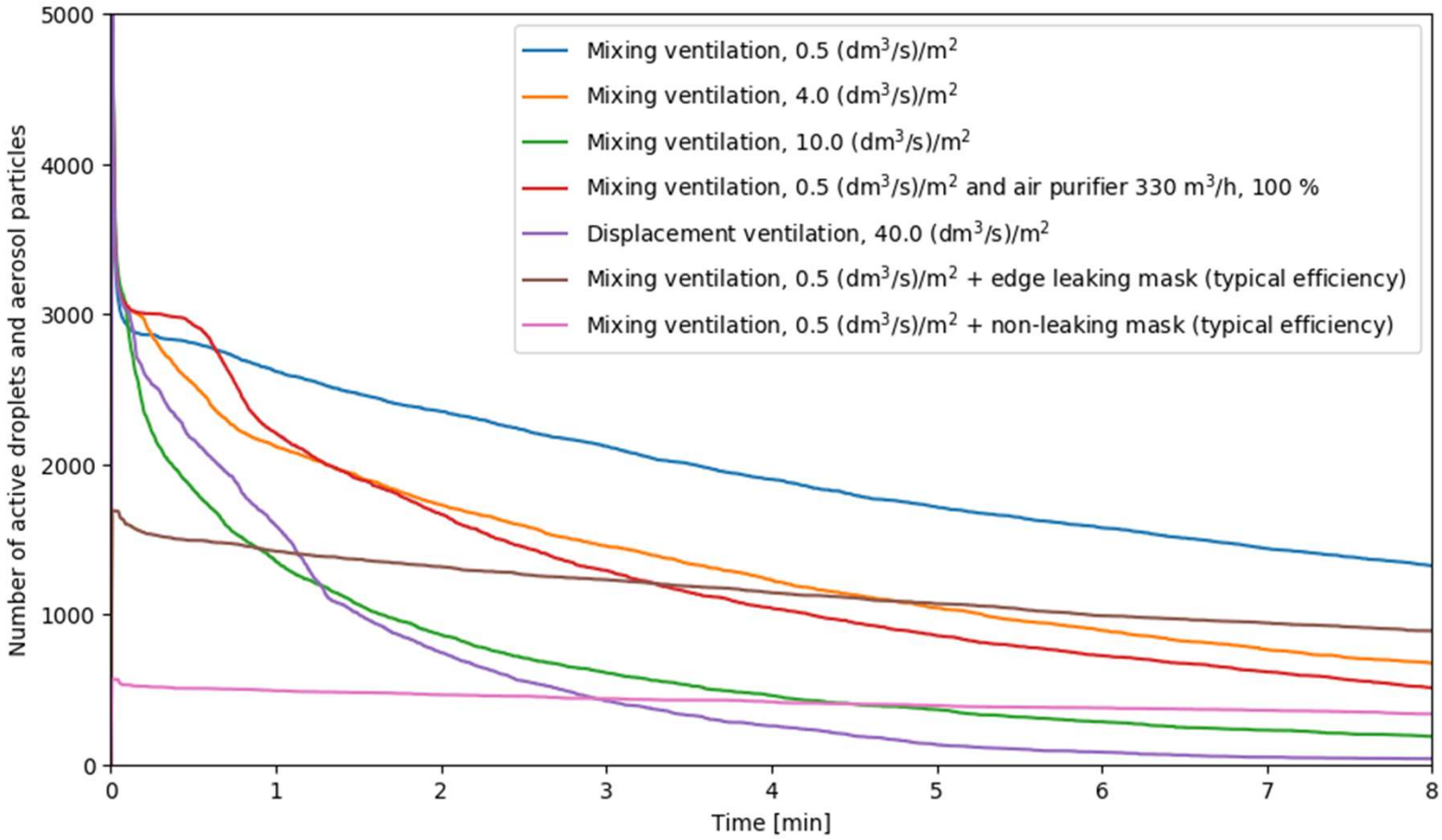
Scientific Reports **10**, Article number: 10285 (2020) | Cite this article

Esimerkki


Mixing
Ventilation
Outlet
Sick
Person
Healthy
Person
Window
Displacement
Ventilation
Air Purifier

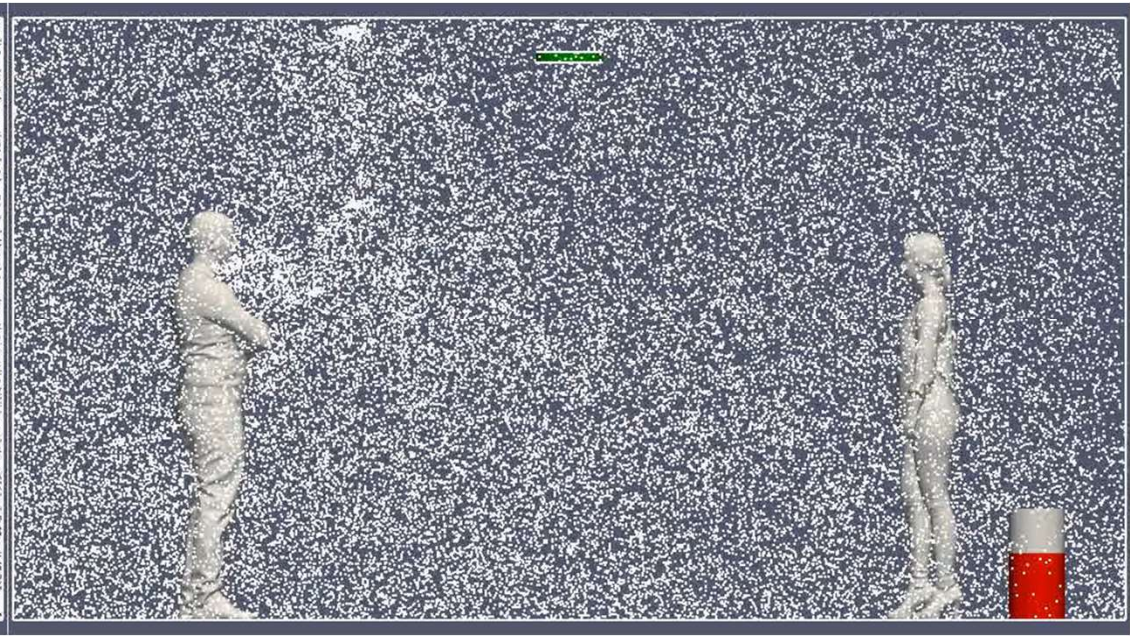

Mixing ventilation, 0.5 (l/s)/m2
Mixing ventilation, 10.0 (l/s)/m2
Mixing ventilation, 0.5 (l/s)/m2 with air purifier 330 m3/h (100 %)
44.2 s
Displacement ventilation, 40.0 (l/s)/m2

Yskäisyn jälkeen…

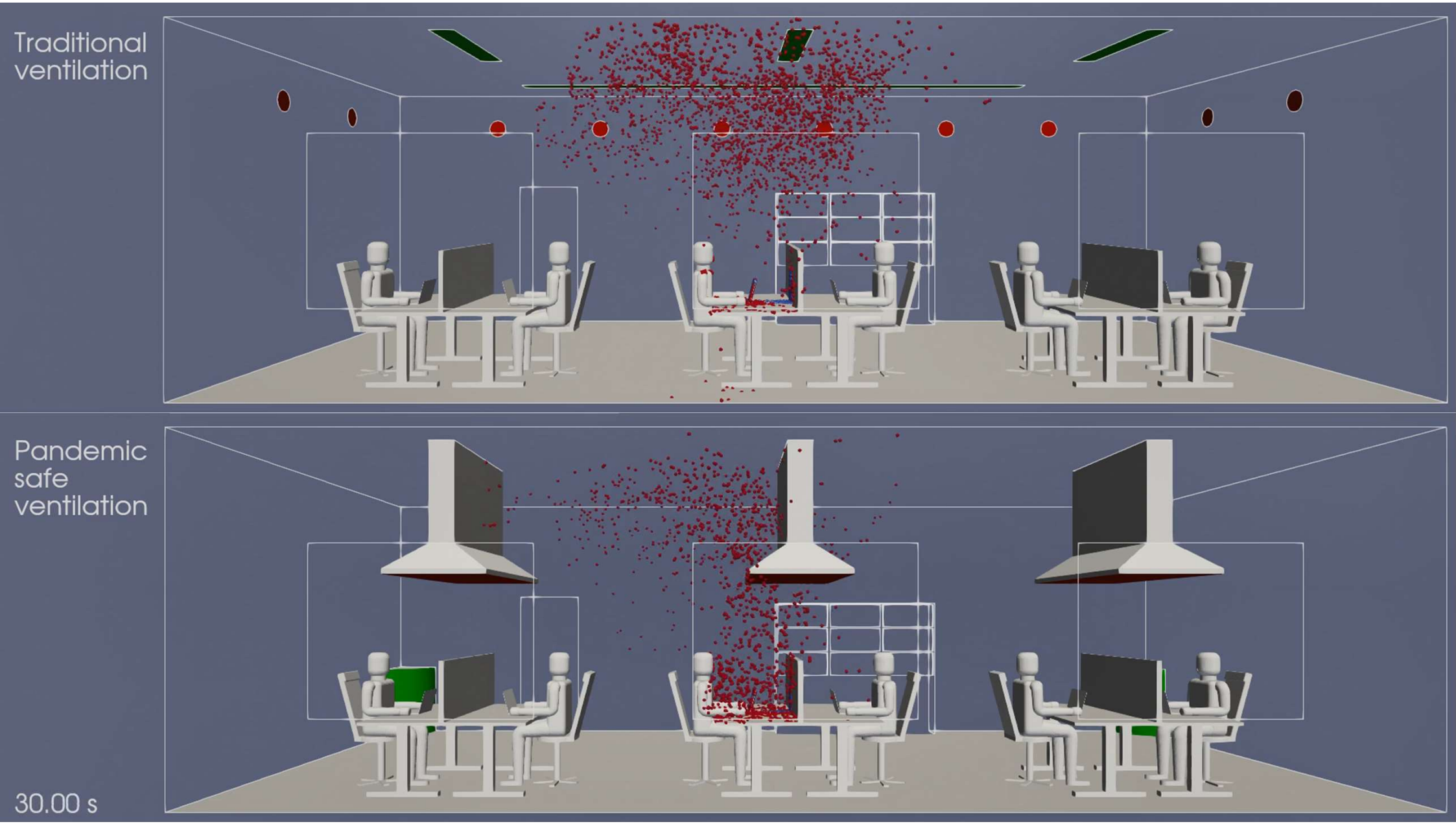


Hengitys

Ilman ilmanpuhdistinta

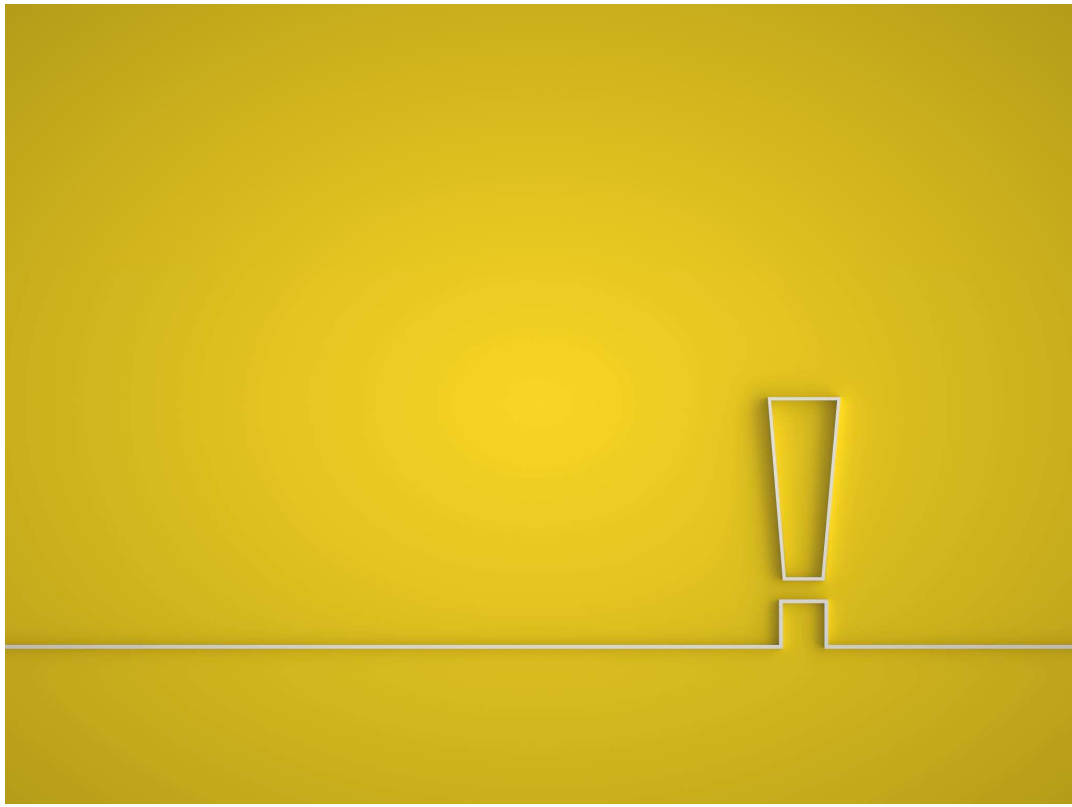


Ilmanpuhdistimen kanssa


Traditional ventilation
Pandemic safe ventilation
30.00 s

CITIZENSHIELD

Yhteenveto



Yhteenveto

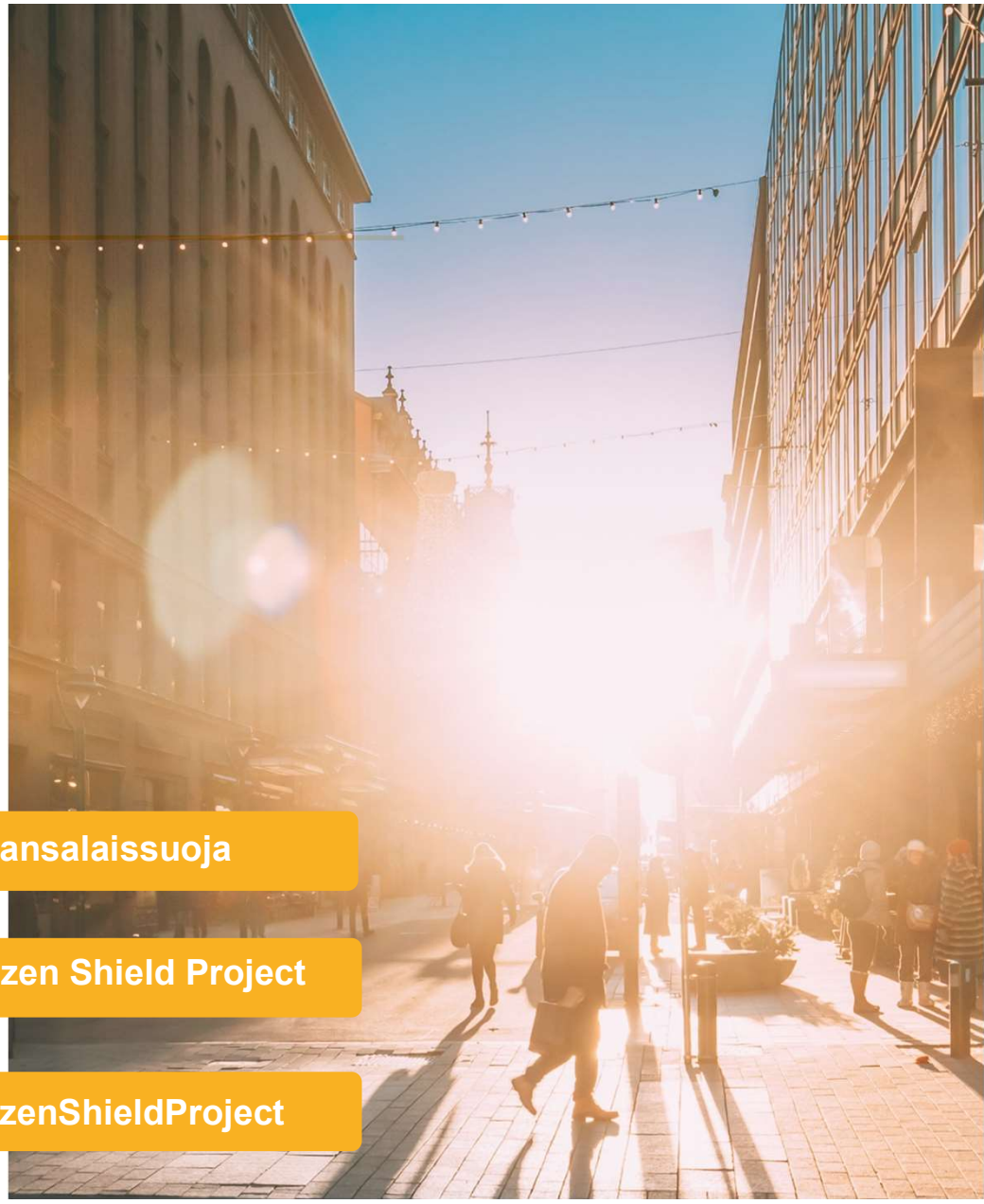
- Pandemian hinta on valtava
- Torjuntakeinojen joukko on laaja
  - Ei-lääketieteelliset käytettävissä heti alussa
- Maskit suojaavat
  - Erityisesti muita, mutta hengityssuojaimet myös käyttäjäänsä
- Ilmanvaihdolla voidaan poistaa tilasta patogeeneja
- Ilmanvaihdon lisäksi voidaan käyttää ilmanpuhdistusta
- Tämä kaikki on tehtävissä kestävästi

CITIZENSHIELD

Kiitos!

YHTEYSTIEDOT

Aku Karvinen
@AkuKarvinen
aku.karvinen@vtt.fi
www.citizenshield.fi



@Kansalaissuoja

Citizen Shield Project

CitizenShieldProject

Tämä hanke on Suomen Akatemian rahoittama