OMCeO Udine

Con il Patrocinio di

Corso di Formazione

Inquinamento atmosferico e danni alla salute:
cosa devono sapere e cosa devono fare il Medico e l'Odontoiatra

Sabato 14 maggio 2022 (dalle 9.00 alle 13.30)
Sala Riunioni Ordine dei Medici, Via Diaz 30 - UDINE

Monitoraggio della qualità dell'aria e aerosol veicolanti patogeni

Pierluigi Barbieri

UNIVERSITÀ DEGLI STUDI DI TRIESTE
Dipartimento di Scienze Chimiche e Farmaceutiche

Analytical Sciences for Human-Environment Interactions

Qualità dell'aria negli ambienti indoor: *studi sul campo* in tempi di pandemia COVID-19

Pierluigi Barbieri,

Università di Trieste

barbierp@units.it

Metti le scarpe da lavoro, incontra le persone in prima linea ed entra in campo!

Pierluigi Barbieri

PA ***Dipartimento di Scienze Chimiche e Farmaceutiche*** - Università degli Studi di Trieste

SC 03A1 – Chimica Analitica, SSD CHIM/12 Chimica dell'Ambiente e dei Beni Culturali

Unità di Ricerca DSCF, ***Analytical Sciences for Human/Environment Interactions***

Unità di Ricerca INSTM, ***interazioni tra materiali, dispositivi e microorganismi***

Presidente ***Ordine Regionale dei Chimici e dei Fisici FVG*** (2017-2021, 2021-2025)

Comitato Scientifico ***Società Italiana di Medicina Ambientale*** SIMA

UNIVERSITÀ DEGLI STUDI DI TRIESTE
Dipartimento di Scienze Chimiche e Farmaceutiche

UNIVERSITÀ DEGLI STUDI DI TRIESTE | Centro Interdipartimentale per l'Energia, l'Ambiente e i Trasporti Giacomo Ciamician

Consorzio Interuniversitario Nazionale per la Scienza e la Tecnologia dei Materiali INSTM

Già (2006- novembre 2015) **Consulente Tecnico della Procura della Repubblica** presso il **Tribunale di Trieste** su questioni di **inquinamento atmosferico** nel rione di Servola (Trieste) (P.M. dott. Federico Frezza, dott. Michele Dalla Costa, dott. Antonio Miggiani. dott. Giorgio Milillo).

Esperto a supporto del Sindaco di Trieste su tematiche di Inquinamento e Chimica Ambientale (ottobre 2016-dicembre 2018)

Nominato nel 2015 esperto nazionale presso il **Comitato Europeo di Normazione** nei gruppi di lavoro del comitato tecnico **CEN / TC 264 "Qualità dell'aria",** WG2 "Determinazione della concentrazione di odore mediante olfattometria dinamica " e WG 41 "Sensori elettronici per il monitoraggio di odoranti", WG28 "Aria ambiente e emissioni – Bioaerosols«, dal GL 4 "Qualità dell'aria" della Commissione Ambiente (CT 004) di UNI.

Dal 2014 supporta **l'Agenzia Regionale per la Protezione dell'Ambiente del Friuli Venezia Giulia** nella stesura di linee guida regionali per la caratterizzazione e gestione delle **molestie olfattive**, contratto ARPAFVG-DSCF "Sviluppo di un modello concettuale relativo agli impatti odorigeni dovuti ad impianti industriali ed attività produttive, finalizzato all'individuazione di indicatori utili per la quantificazione dell'impatto odorigeno all'interno di un approccio integrato di metodologie di analisi. Test applicativo all'area industriale di Trieste". Già rappresentante dell'Università degli Studi di Trieste presso il **Comitato scientifico dell'Agenzia Regionale per la Protezione dell'Ambiente del Friuli Venezia Giulia** a supporto della Direzione Generale, su designazione del Magnifico Rettore (prot.UniTS 7447 14/03/2016).

Dal settembre 2018 coordina il gruppo di lavoro che supporta la **Direzione centrale difesa dell'ambiente, energia e sviluppo sostenibile della Regione Friuli Venezia Giulia** su tematiche di inquinamento atmosferico («Aggiornamento del **Piano Regionale di Miglioramento della Qualità dell'Aria**»; «Legge regionale su gestione molestie olfattive»)

Febbraio 2020: Pandemia da patologia CoViD-19 generata da SARS CoV 2 (severe acute ***respiratory*** syndrome coronavirus 2): **focolai in casa d'amici**

Regione Emilia-Romagna

La Regione | Aree tematiche | Come fare per

/ Notizie / 2020 / Marzo

lunedì, 16 marzo 2020

Coronavirus, chiuso il comune di Medicina (Bo): contagio troppo elevato, non è possibile uscire e entrare

nytimes.com/interactive/2020/03/27/world/europe/coronavirus-italy-...

The New York Times

Bergamo, Italy

This is the bleak heart of the world's deadliest coronavirus outbreak.

Attiva pensieri…

Nostri primi studi su SARS CoV 2 negli aerosol ambientali

e azione

SIMA SOCIETÀ ITALIANA DI MEDICINA AMBIENTALE

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA CENTRO INTERDIPARTIMENTALE DI RICERCA INDUSTRIALE FONTI RINNOVABILI, AMBIENTE, MARE ED ENERGIA - FRAME

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

POSITION PAPER

Relazione circa l'effetto dell'inquinamento da particolato atmosferico e la diffusione di virus nella popolazione

https://www.simaitalia.org/wp-content/uploads/2022/03/COVID19_Position-Paper-SIMA_Relazione-circa-leffetto-dellinquinamento-da-particolato-atmosferico-e-la-diffusione-di-virus-nella-popolazione.pdf

Grandi polemiche

scienzainrete.it/articolo/inquinamento-e-covid-due-vaghi-indizi-non-fanno-prova/stefano-caserini-cinzia-perrino

SCIRE scienzainrete
il gruppo 2003 per la ricerca scientifica

Dona ora!

Inquinamento e Covid: due vaghi indizi non fanno una prova

di Stefano Caserini, Cinzia Perrino, Francesco Forastiere, Guido Poli, Elisa Vicenzi, Luca Carra

ELSEVIER

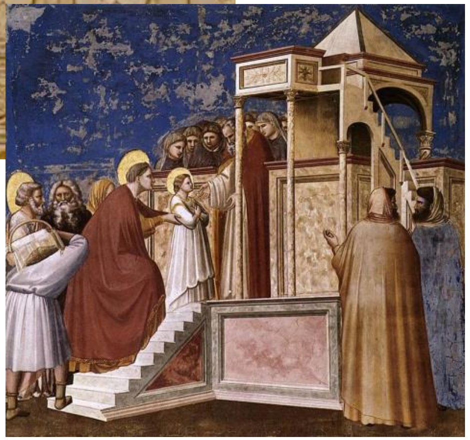
Environmental Research
Volume 204, Part B, March 2022, 112116

"SARS-CoV-2 is transmitted by particulate air pollution": Misinterpretations of statistical data, skewed citation practices, and misuse of specific terminology spreading the misconception ☆

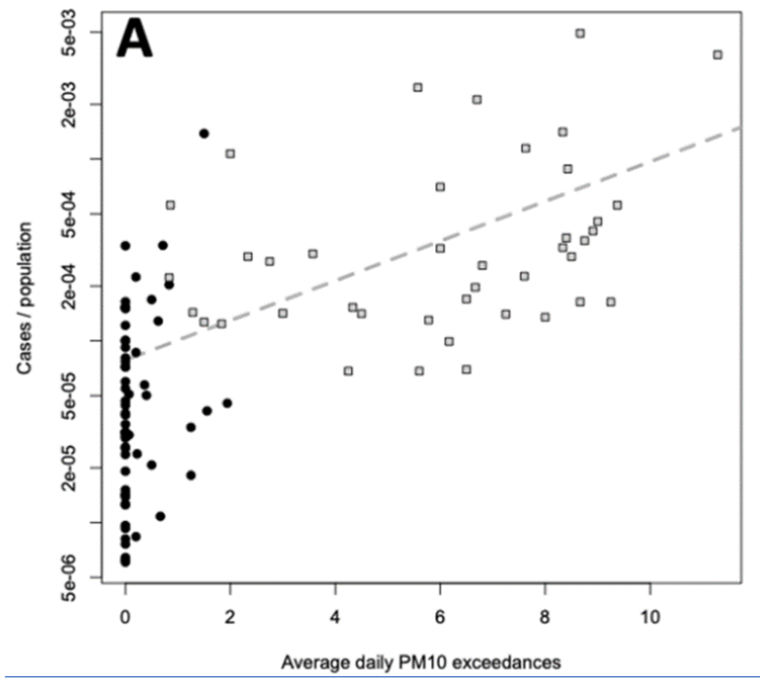
Alexander Ishmatov [a, b, c]

Necessità di **rafforzare COMPETENZA, ORGANIZZAZIONE ED OPERATIVITA'**
su una **componente «nuova» della qualità dell'aria**:

I MICROORGANISMI (PATOGENI) AERODISPERSI



Zona d'ombra:
NON ESISTONO METODI INTERNAZIONALMENTE RICONOSCIUTI PER MONITORARE VIRUS E BATTERI NELL'ARIA (anche influenza, TBC, Morbillo, Anti-Microbico-Resistenza)



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https://bmjopen.bmj.com/content/10/9/e039338

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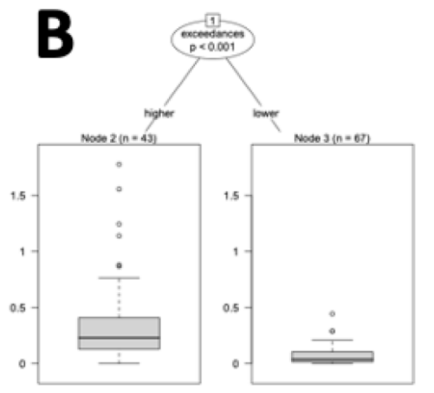
Public health
Original research

Potential role of particulate matter in the spreading of COVID-19 in Northern Italy: first observational study based on initial epidemic diffusion

PDF

Leonardo Setti[1], Fabrizio Passarini[1], Gianluigi De Gennaro[2], Pierluigi Barbieri[3], Sabina Licen[3], Maria Grazia Perrone[4], Andrea Piazzalunga[5], Massimo Borelli[3], Jolanda Palmisani[2], Alessia Di Gilio[2], Emanuele Rizzo[6], Annamaria Colao[7], Prisco Piscitelli[8], Alessandro Miani[9]



Relationship between the daily limit value of exceedances of PM_{10} and COVID-19 case ratios over the population in Italian provinces. (A) Scatter plot on a semilogarithmic scale relating the proportion of COVID-19 cases of the population of northern (grey squares) and southern (black bullets) Italian provinces vs the average daily limit value of exceedances of PM_{10}. The dashed binomial (logistic) regression is characterised by an increasing slope of 0.25 (p<0.001). (B) Box plots showing that—with a 1.29 cut-off value of exceedance of PM10—the proportion of COVID-19 cases is greater (p<0.001) in the most polluted provinces (39 out of 41 located in Northern Italy) than the less polluted provinces, mainly located in Southern Italy (62 out of 66).

Un ulteriore passo sperimentale: analisi RNA RT-PCR su filtri PM10

ELSEVIER

Environmental Research
Volume 188, September 2020, 109754

SARS-Cov-2RNA found on particulate matter of Bergamo in Northern Italy: First evidence

Leonardo Setti [a], Fabrizio Passarini [b], Gianluigi De Gennaro [c], Pierluigi Barbieri [d], Maria Grazia Perrone [e], Massimo Borelli [f], Jolanda Palmisani [g], Alessia Di Gilio [g], Valentina Torboli [f], Francesco Fontana [g], Libera Clemente [g], Alberto Pallavicini [f], Maurizio Ruscio [g], Prisco Piscitelli [h], Alessandro Miani [h, i]

34 PM10 samples in Bergamo area (the epicenter of the Italian COVID-19 epidemic) by using two air samplers over a continuous 3-weeks period. Filters were properly stored and underwent RNA extraction and amplification according to WHO protocols in two parallel blind analyses performed by two different authorized laboratories. Up to three highly specific molecular marker genes (E, N, and RdRP) were used to test the presence of SARS-CoV-2 RNA on particulate matter.

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Citations

https://doi.org/10.1016/j.envres.2020.109754

Editor's Note: This letter was published on March 17, 2020, at NEJM.org.

MANCANO CONOSCENZE CONSOLIDATE SU TEMI RILEVANTI (ANCORA!!!)

CORRESPONDENCE

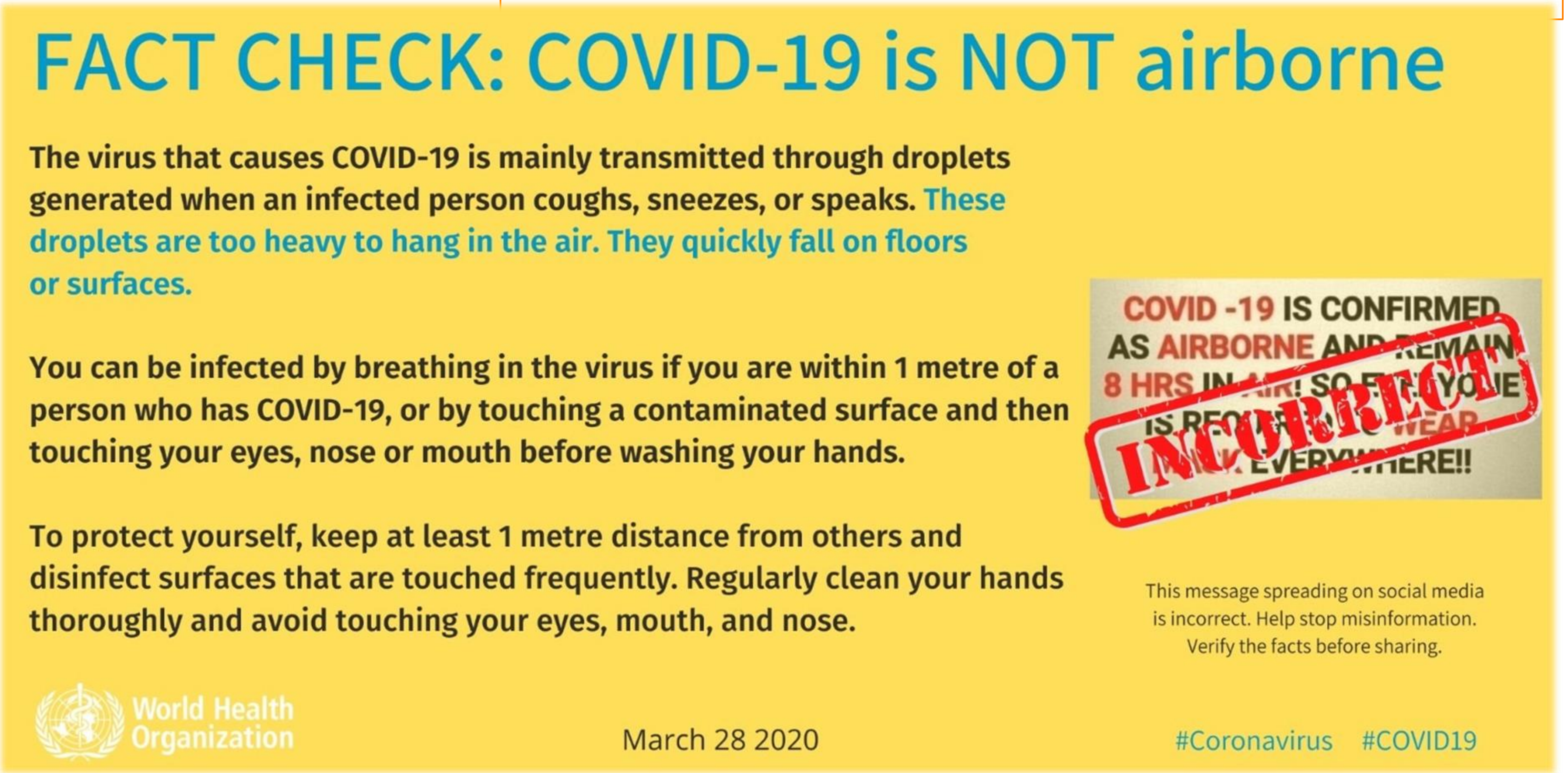
Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1

Airborne trasmission

N Engl J Med . 2020 Apr 16;382(16):1564-1567. doi: 10.1056/NEJMc2004973. Epub 2020 Mar 17.

Neeltje van Doremalen, Trenton Bushmaker, Dylan H Morris, Myndi G Holbrook, Amandine Gamble, Brandi N Williamson, Azaibi Tamin, Jennifer L Harcourt, Natalie J Thornburg, Susan I Gerber, James O Lloyd-Smith, Emmie de Wit, Vincent J Munster

… SARS-CoV-2 remained viable in aerosols throughout the duration of our experiment (3 hours) …



Role and characterization of Environmental Aerosols in the spread of SARS-CoV-2

International Journal of
Environmental Research and Public Health

Accepted: 16 April 2020

Open Access Editorial

Airborne Transmission Route of COVID-19: Why 2 Meters/6 Feet of Inter-Personal Distance Could Not Be Enough

by Leonardo Setti [1,*], Fabrizio Passarini [2], Gianluigi De Gennaro [3], Pierluigi Barbieri [4], Maria Grazia Perrone [5], Massimo Borelli [6], Jolanda Palmisani [3], Alessia Di Gilio [3], Prisco Piscitelli [7,8] and Alessandro Miani [8,9]

It Is Time to Address Airborne Transmission of Coronavirus Disease 2019 (COVID-19) FREE

Lidia Morawska, Donald K Milton

Clinical Infectious Diseases, Volume 71, Issue 9, 1 November 2020, Pages 2311–2313,
https://doi.org/10.1093/cid/ciaa939

Published: 06 July 2020 **Article history ▾**

Acknowledgment. Together with the authors, 239 scientists support this Commentary, and their affiliations and contact details are listed in the

We appeal to the medical community and to the relevant national and international bodies to recognize the potential for airborne spread of coronavirus disease 2019 (COVID-19). There is ***significant potential for inhalation exposure to viruses in microscopic respiratory droplets (microdroplets) at short to medium distances*** (up to ***several meters***, or room scale), and we are advocating for the use of preventive measures to mitigate this route of airborne transmission.

Transmission of SARS-CoV-2 in K-12 schools
Emerging SARS-CoV-2 Variants
Evidence for Conditions that Increase Risk of Severe Illness
Use of Masks to Control the Spread of SARS-CoV-2

SARS-CoV-2 is transmitted by exposure to infectious respiratory fluids

The principal mode by which people are infected with SARS-CoV-2 (the virus that causes COVID-19) is through exposure to respiratory fluids carrying infectious virus. Exposure occurs in three principal ways: (1) inhalation of very fine respiratory droplets and aerosol particles, (2) deposition of respiratory droplets and particles on exposed mucous membranes in the mouth, nose, or eye by direct splashes and sprays, and (3) touching mucous membranes with hands that have been soiled either directly by virus-containing respiratory fluids or indirectly by touching surfaces with virus on them.

Page First Published May 7, 2021

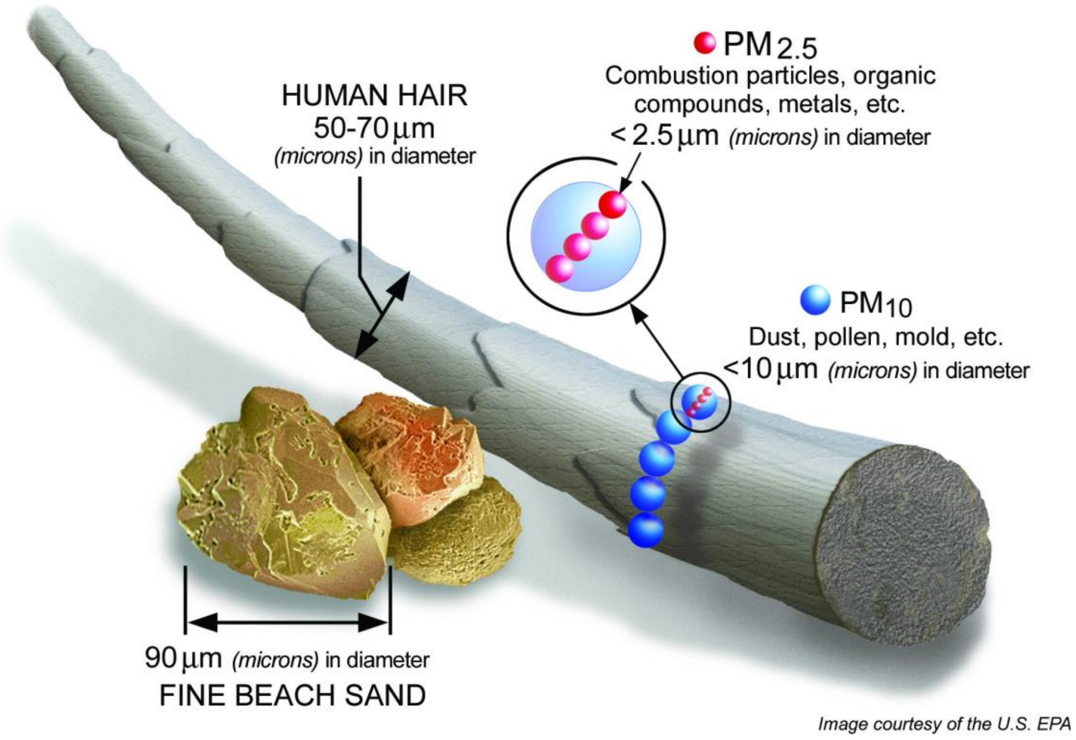
Transmission of Viruses in Droplets and Aerosols

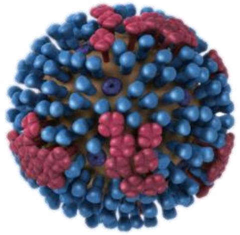
LINSEY C. MARR
CHARLES P. LUNSFORD PROFESSOR
CIVIL AND ENVIRONMENTAL ENGINEERING
VIRGINIA TECH

26 MARCH 2020

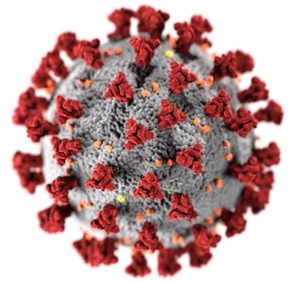
ENGINEERING
VIRGINIA TECH™

Virus Size

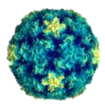




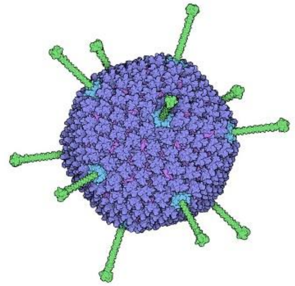
influenza
0.1 µm



SARS-CoV-2
0.12 µm



rhinovirus
0.03 µm



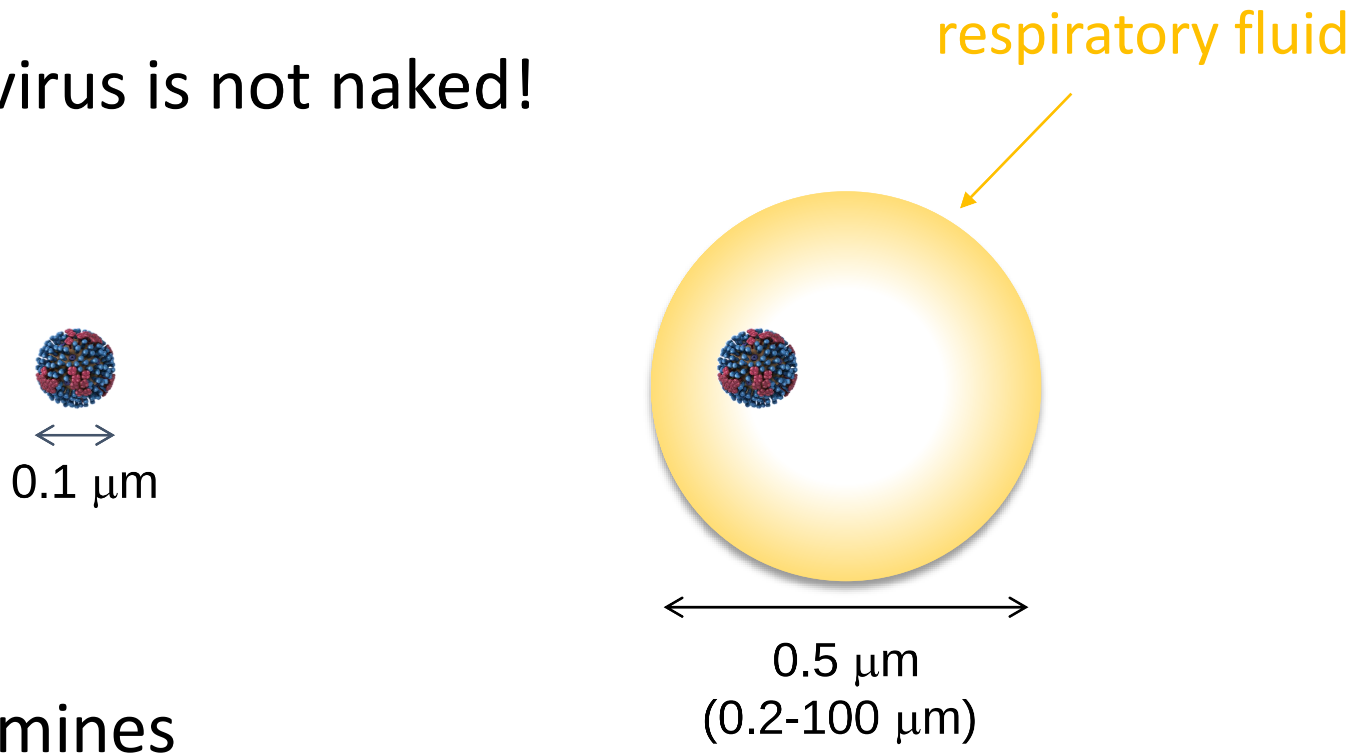
adenovirus
0.1 µm

https://www.cdc.gov/flu/resource-center/freeresources/graphics/images.htm, https://solutionsdesignedforhealthcare.com/rhinovirus, https://phil.cdc.gov/Details.aspx?pid=23312, https://pdb101.rcsb.org/motm/132

Lisa Marr, Virginia Tech, March 2020

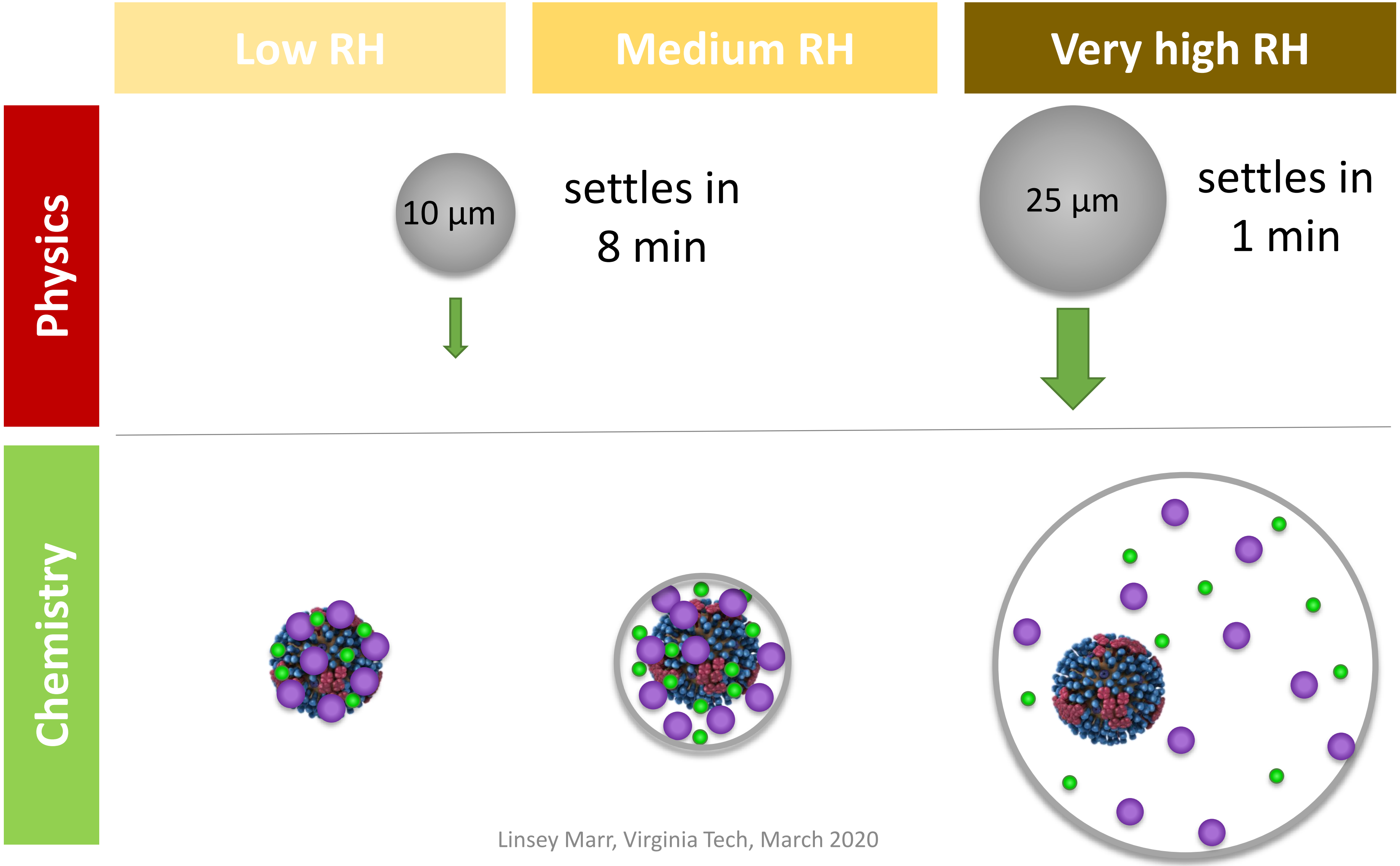
Size Matters

- Airborne virus is not naked!



- Size determines
  - Lifetime in the atmosphere
  - Where it deposits in the respiratory system

How Might RH Affect Transmission?



Le **particelle aerodisperse con diametri inferiori al micrometro** / tra cui le ultrafini (almeno una dimensione minore di 100 nanometri) **non sono normate e non sono definiti metodi standardizzati** per la loro determinazione

Contesto e obiettivi: ***la questione del rilevamento e del monitoraggio dell'infettività residua e della presenza di SARS-CoV-2 nei campioni di aria NON si basa ancora su metodi standardizzati*** e sono ***disponibili relativamente pochi dati sperimentali***, nonostante l'entità dell'impatto sociale del COVID-19.

Campionamento per il rilevamento dell'RNA di aerosol ambientale
Campionamento per la valutazione dell'infettività residua dell'aerosol
Conservazione e pretrattamento del campione, PM aerosol
Rilevamento di SARS CoV 2 (RT-PCR, CANARY)
Rilevazione dell'infettività (linee cellulari)

https://aerosol-soc.com/covid-19/

Lower level of certainty:

1. The dependence of airborne survival on relative humidity and aerosol particle composition remains uncertain. In one study, SARS-CoV-2 survived for longer at intermediate RH than high RH in tissue culture medium, with the reverse trend in artificial saliva.[10]
2. Although the airborne transmission of SARS-CoV-2 has been established between ferrets[20] and the airborne transmission in humans has been inferred (e.g. during a choral society rehearsal),[21] the relationship between RNA genome copy numbers and infectious virus remains uncertain.
3. The complex interactions of multiple pathogens, viral load and respiratory droplet composition and how this depends on the infection state of the individual remain to be addressed.

Low level of certainty:

1. **The dose of SARS-CoV-2 virus required to cause infection:** The minimum infectious dose (MID) for SARS-CoV-2 is not yet known, however the MID for SARS-CoV-1 was relatively low in the range 1-280 virions[11].

Epidemiology & Infection
https://doi.org/10.1017/S0950268821000790

Review of infective dose, routes of transmission and outcome of COVID-19 caused by the SARS-COV-2: comparison with other respiratory viruses‡

Sedighe Karimzadeh[1], Raj Bhopal[2] and Nguyen Tien Huy[3]

Sono stati proposti approcci tecnologici vecchi e nuovi per il campionamento e il rilevamento dei virus nell'ambiente;

richiedono verifiche sul campo per evidenziare scenari applicativi, punti di forza e limiti appropriati per la valutazione dell'esposizione virale ambientale correlata alla diffusione del COVID-19.

Anche per testare l'efficacia delle strategie e delle tecnologie di contenimento del COVID19!

Metti le scarpe da lavoro, incontra le persone in prima linea ed entra in campo!

https://biologue.plos.org/2017/05/03/***protocols-the-devil-is-in-the-details/***

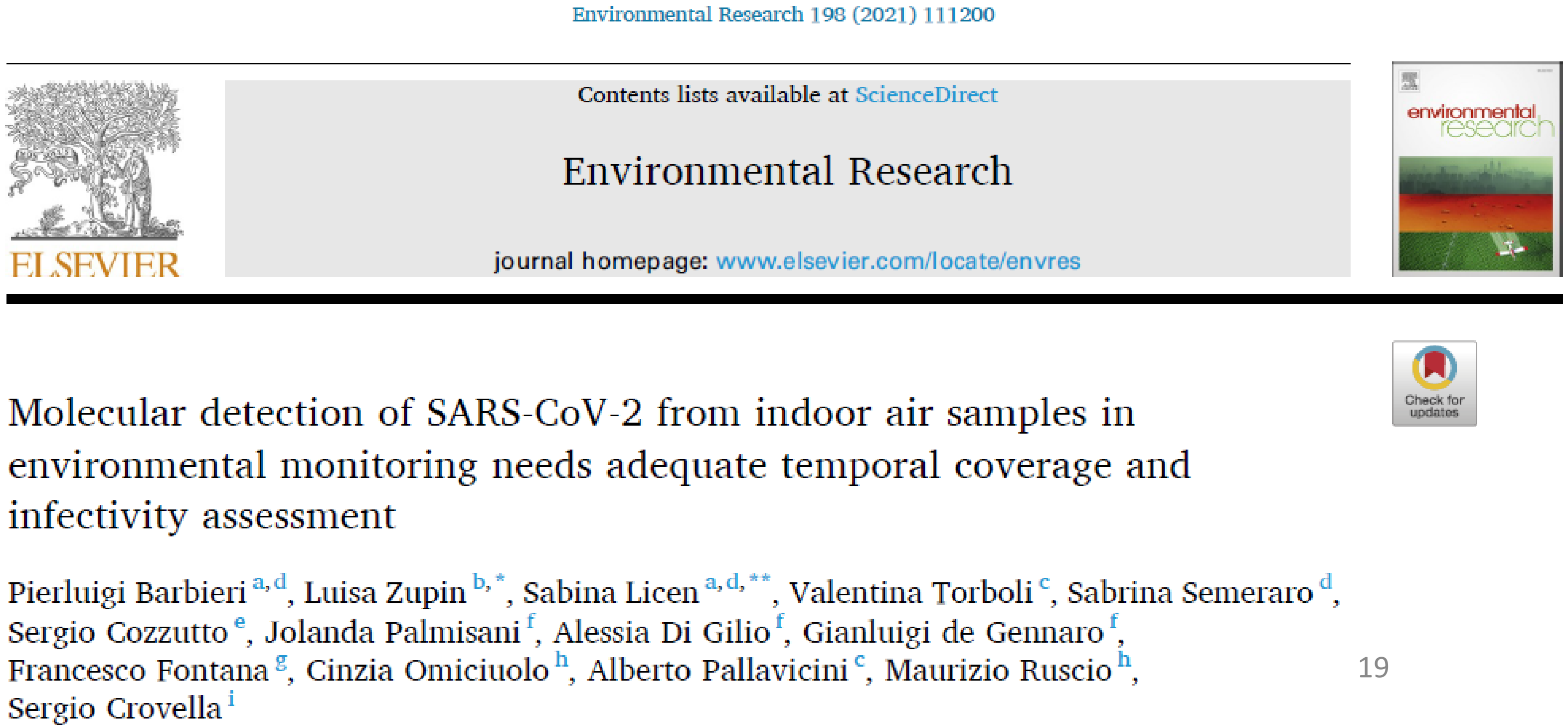
Dopo il successo nel rilevamento dell'RNA nel PM esterno → ***Proposta di controllo dell'aria indoor dell'RNA SARS-CoV-2 nei reparti ospedalieri → «Ti manca la valutazione dell'infettività!» Il rilevamento dell'RNA non è sufficiente***

Giugno 2020: ***campionamento in reparto Geriatrico dell'ospedale Maggiore (Trieste) con FAI Instruments Silent PM10 Sampler (G. de Gennaro UniBA)***

Settembre 2020: ***riattivazione del laboratorio BSL3 dell'ospedale San Polo di Monfalcone (ASUGI)*** *Sforzo congiunto (ASUGI-DSCF-TCR Tecora-QU),* ***- operativo!***

Infettività SARS-CoV-2 rilevata come *(i) replicazione del virus evidenziata da RT-PCR dopo incubazione (ad es. 7 giorni) e da* ***(ii) saggio effetto citopatico/placca sulla linea cellulare VERO E6***

Determinazione delle soglie Ct correlate a infettività residua per campioni ambientali


Environmental Research 198 (2021) 111200

Contents lists available at ScienceDirect

Environmental Research

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

ELSEVIER

Check for updates

Molecular detection of SARS-CoV-2 from indoor air samples in environmental monitoring needs adequate temporal coverage and infectivity assessment

Pierluigi Barbieri [a,d], Luisa Zupin [b,*], Sabina Licen [a,d,**], Valentina Torboli [c], Sabrina Semeraro [d], Sergio Cozzutto [e], Jolanda Palmisani [f], Alessia Di Gilio [f], Gianluigi de Gennaro [f], Francesco Fontana [g], Cinzia Omiciuolo [h], Alberto Pallavicini [c], Maurizio Ruscio [h], Sergio Crovella [i]

Ct values of RdRp gene amplification of the PM_{10} filter RNA extraction from hospital ward (four replicates) and from spiked control filters, both clean/new and used/environmental PM_{10}, sampled in 2018; N.D. = not detected.

PM_{10} Sample filter	Ct for RdRp replicate 1	Ct for RdRp replicate 2	Ct for RdRp replicate 3	Ct for RdRp replicate 4
June 19, 2020	37.4	36.7	37.7	37.1
June 20, 2020	38.5	N.D.	38.3	N.D.
June 21, 2020	40.3	N.D.	38.3	N.D.
June 22, 2020	40.5	N.D.	N.D.	N.D.
June 23, 2020	N.D.	39.1	N.D.	N.D.
Clean spiked E+6 copies	35.1			
Used spiked E+6 copies	39.1			
Used spiked E+8 copies	37.0	38.4		

PM10 samples

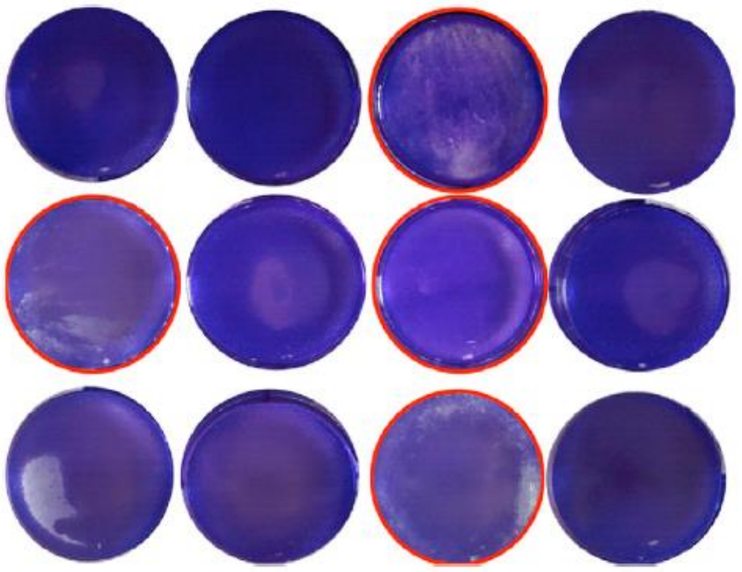


Fig. 2. Representation of the crystal violet staining of the 12 samples inoculated on Vero E6 cells. First row: patients 1,2,3,4; Second row: patients 5,6,7,8; Third row: patients 9,10,11,12. The darker violet corresponds to the viable cells still attached at the wells (see patients 1,2,4,6,8,9,10,12), instead, where the cells are less viable due to the infection they tend to detach and the staining corresponding to a low number of cells is weak (patients 3,5,7,11, red circled).

Ct e Effetto CitoPatico (infettività) su cellule Vero E6, dopo 7 giorni di inoculazione su campioni nasofaringei: nessun effettoCPE su cellule VERO E6 per campioni con Ct >24 o copie virali < 2E+10

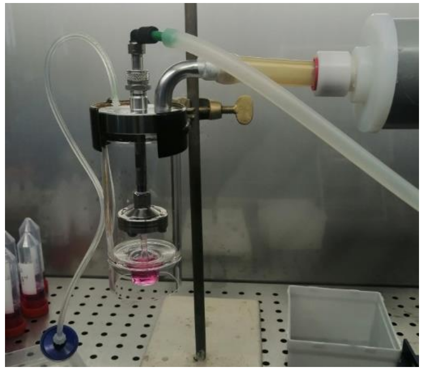
Table 4

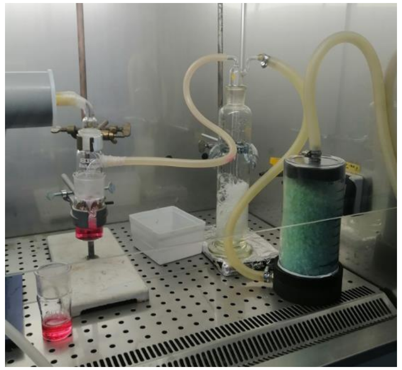
The cycle threshold (Ct) and the viral load (expressed as viral copies/ml) at day 0, 2, 5 and 7 post SARS-CoV-2 inoculation. The quantity of virus initially used to infect the cells at day 0, as well as the microscopically evaluation of the cytopathic effect at day 7 are reported.

Sample	Day 0		Day 2		Day 5		Day 7		Day 0	Day 7
	Ct	viral copy/ml	Ct	viral copy/ml	Ct	viral copy/ml	Ct	viral copy/ml	Viral copies for infection	cytopathic effect
1	24.4	4.16E+09	28.3	1.67E+08	29.6	3.00E+08	27.2	2.66E+08	2.08E+09	–
2	25.4	1.76E+09	26.0	1.13E+09	29.2	3.78E+08	27.9	1.46E+08	8.78E+08	–
3	*18.4*	*5.81E+11*	*15.6*	*5.49E+12*	*14.2*	*9.83E+12*	*13.8*	*3.21E+13*	*2.90E+11*	+
4	25.4	1.85E+09	28.7	1.21E+08	29.1	4.19E+08	28.0	1.28E+08	9.26E+08	–
5	*21.5*	*4.37E+10*	*18.4*	*5.48E+11*	*13.9*	*1.27E+13*	*13.9*	*2.97E+13*	*2.18E+10*	+
6	37.8	7.31E+04	33.0	3.65E+06	33.5	2.10E+07	28.6	7.75E+07	3.66E+04	–
7	*19.2*	*2.85E+11*	*16.2*	*3.32E+12*	*14.8*	*6.84E+12*	*14.4*	*1.87E+13*	*1.43E+11*	+
8	29.7	5.53E+07	31.8	9.30E+06	35.0	7.24E+06	28.4	9.17E+07	2.76E+07	–
9	34.2	1.31E+06	32.2	7.10E+06	38.2	8.40E+05	30.7	1.27E+07	6.53E+05	–
10	36.0	3.06E+05	36.9	1.48E+05	33.2	2.53E+07	30.3	1.74E+07	1,53E+05	–
11	*21.4*	*4.86E+10*	*22.1*	*2.72E+10*	*14.0*	*1.11E+13*	*13.9*	*3.04E+13*	*2.43E+10*	+
12	33.5	2.34E+06	31.8	9.98E+06	31.4	8.85E+07	28.2	1.13E+08	1,17E+06	–

June 2021: ***SARS-CoV-2 -aerosol generation & sampling tests in controlled environment***

CHTechnologies ***8 jets BLAM nebulizer***, for effective and gentle aerosolization (E10 viable viral copies aerosolized and more) Courtesy of SIMA!





SKC ***Biosampler***, Impinger with tangential flow on collection liquid surface

Test of SARS CoV 2 transmission

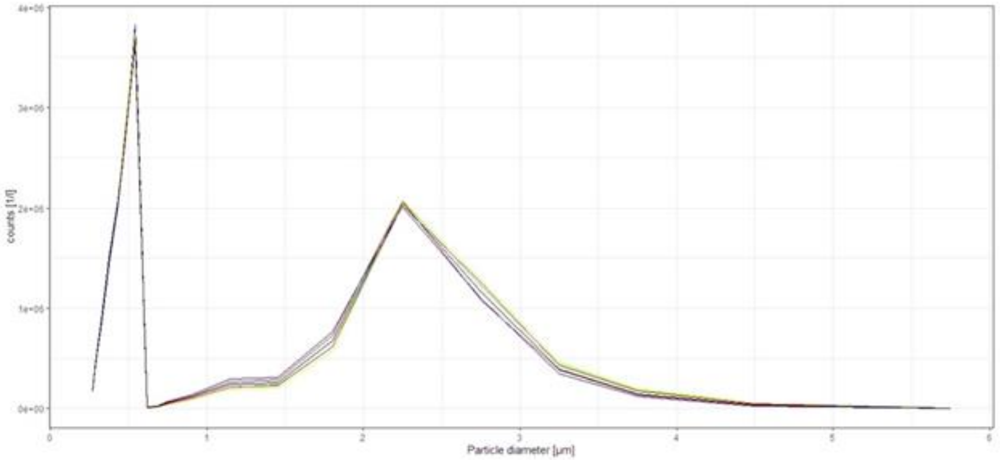
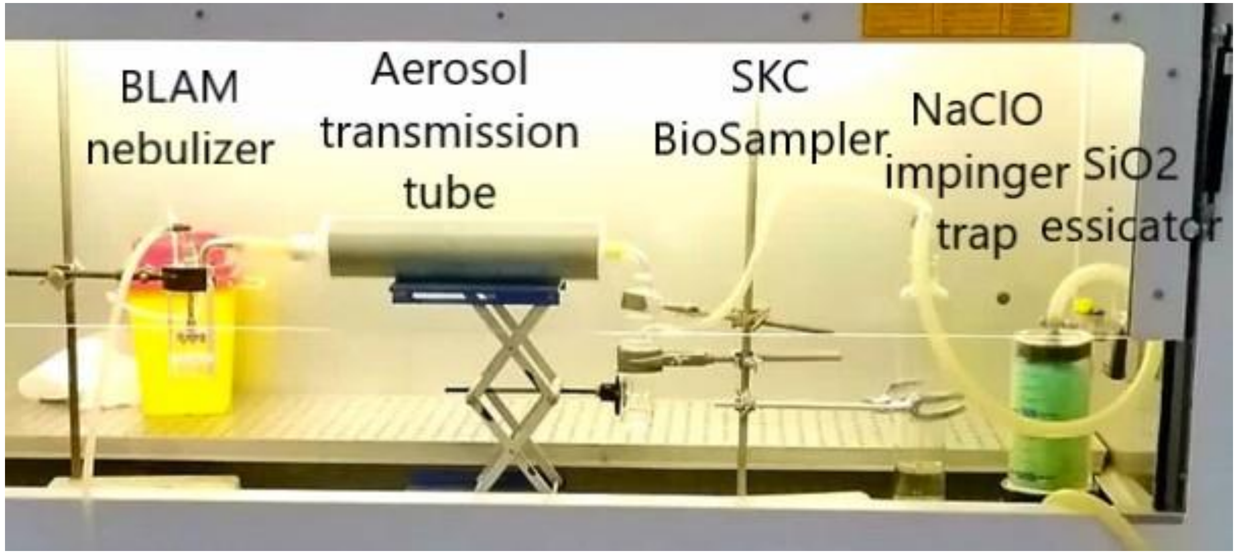


Figure 2: Average concentrations (particle counts/liter vs particle diameter in micrometers) of the aerosolization runs (15 measures each) measured at the inlet (3 runs) and idem at the outlet (3 runs) of the aerosol transmission tube.



Zupin, L.; Licen, S.; Milani, M.; Clemente, L.; Martello, L.; Semeraro, S.; Fontana, F.; Ruscio, M.; Miani, A.; Crovella, S.; Barbieri, P. Evaluation of Residual Infectivity after SARS-CoV-2 Aerosol Transmission in a Controlled Laboratory Setting. Int. J. Environ. Res. Public Health 2021, 18, 11172. https://doi.org/10.3390/ijerph182111172- Foundation for the setup of Viral Filtration Efficiency assay

Viral load (average viral copies for ml) at day 0 and at day 7. The data for 5 and 10 minutes of sampling, from the residual liquid in the nebulizer are reported. Cytopathic effects (CPE) and p-value from the results of Mann-Whitney test (MW) were also shown. ns= not significant statistical analysis

Table 1. Viral load (average viral copies for ml) at day 0 and at day 7. The data for 5 and 10 min of sampling, from the residual liquid in the nebulizer, and for the initial dilution prior to testing are reported. Cytopathic effects (CPE) and *p*-value from the results of Mann–Whitney test (MW) are also shown. ns = not significant statistical analysis.

	10^5 PFU/mL				10^4 PFU/mL				10^3 PFU/mL			
	Day 0	Day 7	CPE	MW	Day 0	Day 7	CPE	MW	Day 0	Day 7	CPE	MW
10′ sampling	9.1×10^7	6.2×10^9	+	0.0001	4.6×10^6	1.2×10^9	-	0.02	9.9×10^5	9.7×10^5	-	ns
5′ sampling	4.2×10^7	3.7×10^9	+	0.001	2.4×10^6	2.3×10^8	-	0.02	5.4×10^5	9.9×10^5	-	ns
nebulizer after aerosolization	2.1×10^9	1.6×10^{10}	+	0.03	4.1×10^8	1.4×10^{10}	+	0.03	3.4×10^7	8.2×10^9	+	0.03
Initial prior to testing	5.1×10^9	9.1×10^9	+	ns	4.2×10^8	1.3×10^{10}	+	ns	4.6×10^7	5.4×10^9	+	ns

Zupin, L.; Licen, S.; Milani, M.; Clemente, L.; Martello, L.; Semeraro, S.; Fontana, F.; Ruscio, M.; Miani, A.; Crovella, S.; Barbieri, P. Evaluation of Residual Infectivity after SARS-CoV-2 Aerosol Transmission in a Controlled Laboratory Setting. Int. J. Environ. Res. Public Health 2021, 18, 11172. https://doi.org/10.3390/ijerph182111172-
Foundation for the setup of Viral Filtration Efficiency assay

After 7 days gain of log3 viral copies also starting from 10^3PFU/ml and aerosol exposure of 5 mins

SECONDA ONDATA DI COVID19

In ulteriori studi svolti nel ***reparto di Malattie Infettive dell'Ospedale Maggiore di Trieste***, è stata applicata la tecnologia del campionamento di aerosol con la tecnologia del ***tubo di crescita per condensazione (CGT)*** di vapore acqueo in flusso laminare (Pan et al., 2016 DOI: 10.1111/jam.13051) con **Campionatore Biospot ViVAS**.

I campioni raccolti con questo approccio sembrano essere ideali per la valutazione dell'infettività mediante valutazione dell'Effetto CitoPatico Effect (CPE) su linee cellulari selezionate, poiché nessun impatto sulle superfici solide e forze di taglio trascurabili agiscono sui microrganismi campionati; inoltre, l'efficienza di campionamento si è dimostrata elevata anche per particelle di dimensioni inferiori a 300 nanometri .

La **tecnologia VIVAS è salutata come dirompente** dai maggiori scienziati degli aerosol al mondo (J.L. Jimenez (H=117): "*Difficult to sample infectious virus from room air: True, but never done for measles or tuberculosis.* Impressive technological advances (VIVAS) were needed, has been done by Lednicky et al. (2020)).
http://cires1.colorado.edu/jimenez/COVID/2020_11_13_COVID_Aerosols_Duke_Jimenez.pdf

Campionatore BioSpot ViVAS (Aerosol Devices inc)

Fondazione Kathleen Foreman Casali

http://www.fondazionicasali.it/fondazione-kathleen-foreman-casali/

Il ViableVirusAerosolSampler era stato impiegato con successo per il rilevamento di virus infettivi in stanze d'ospedale
https://doi.org/10.1016/j.ijid.2020.09.025

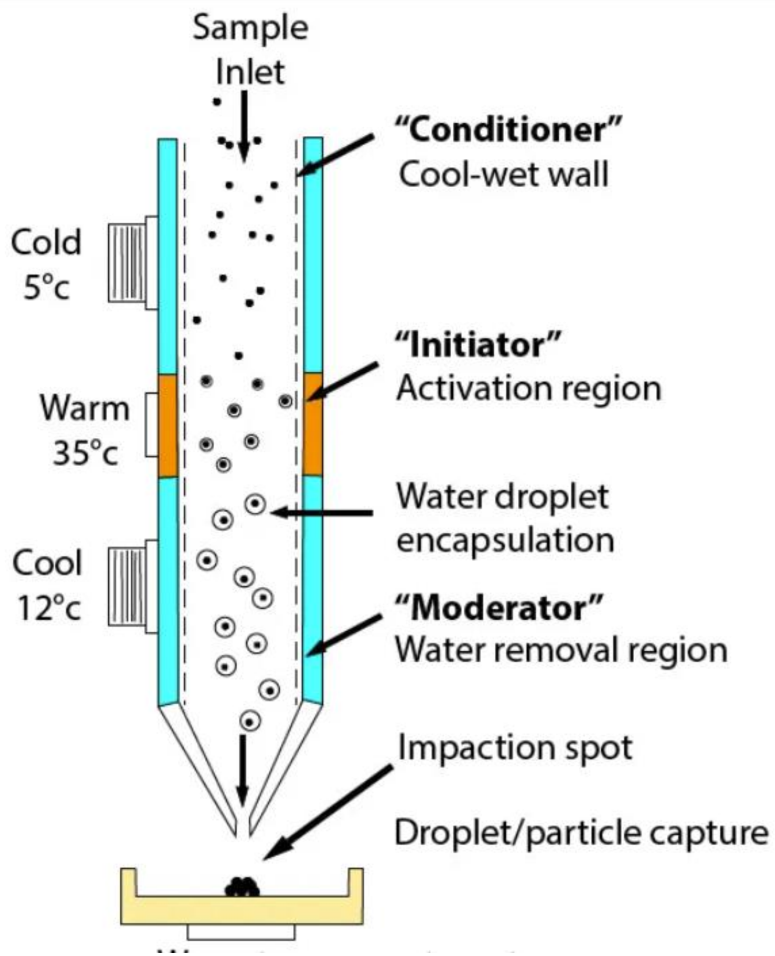
ELSEVIER

International Journal of Infectious Diseases
Volume 100, November 2020, Pages 476-482

IJID

Viable SARS-CoV-2 in the air of a hospital room with COVID-19 patients

John A. Lednicky [a, b], Michael Lauzardo [b, c], Z. Hugh Fan [d, e], Antarpreet Jutla [f], Trevor B. Tilly [f], Mayank Gangwar [f], Moiz Usmani [f], Sripriya Nannu Shankar [f], Karim Mohamed [e], Arantza Eiguren-Fernandez [g], Caroline J. Stephenson [a, b], Md. Mahbubul Alam [a, b], Maha A. Elbadry [a, b], Julia C. Loeb [a, b], Kuttichantran Subramaniam [b, h], Thomas B. Waltzek [b, h], Kartikeya Cherabuddi [c], J. Glenn Morris Jr. [b, c], Chang-Yu Wu [f]



Raccolta di particelle che trasportano agenti patogeni vitali nella capsula di Petri contenente ad es. VTM, per valutazione infettività (es. CPE su VERO E6)

Nuovo lavoro sul campo @SC Malattie Infettiva – Ospedale Maggiore (TS)

Prima applicazione di tecnologie CGT in Italia

(1)

BioSpot-VIVAS™ Bioaerosol Sampler

Aerosol Devices Inc

The BioSpot-VIVAS bioaerosol sampler, provides **high-efficiency, gentle** collection of bioaerosols into a liquid medium. It uses a patented laminar-flow water condensation growth tube (CGT) method.

- **High efficiency collection – viruses, bacteria, fungal spores, toxins, proteins, allergens**
- **<10nm to 10µm, >90% efficiency**
- **Concentrated samples into liquid for high sensitivity analysis**
- **Gentle collection maintains viability**
- **Can instantly preserve DNA/RNA**

Uses

- **Airborne disease transmission**
- **Environmental microbiome**
- **Infectious disease surveillance in public, transportation, medical and agricultural settings**

(2)

BioFlash Biological Identifier

Mobile, high sensitivity biothreat detector

Feature Highlights

- Rapid detection capability of airborne SARS-CoV-2
- Able to capture particles up to 10 microns in size
- Compact and lightweight design
- Easy to use and decontaminate
- PCR levels of sensitivity and specificity
- Extremely low false alarm rate
- Enables rapid response to new and emerging pathogens

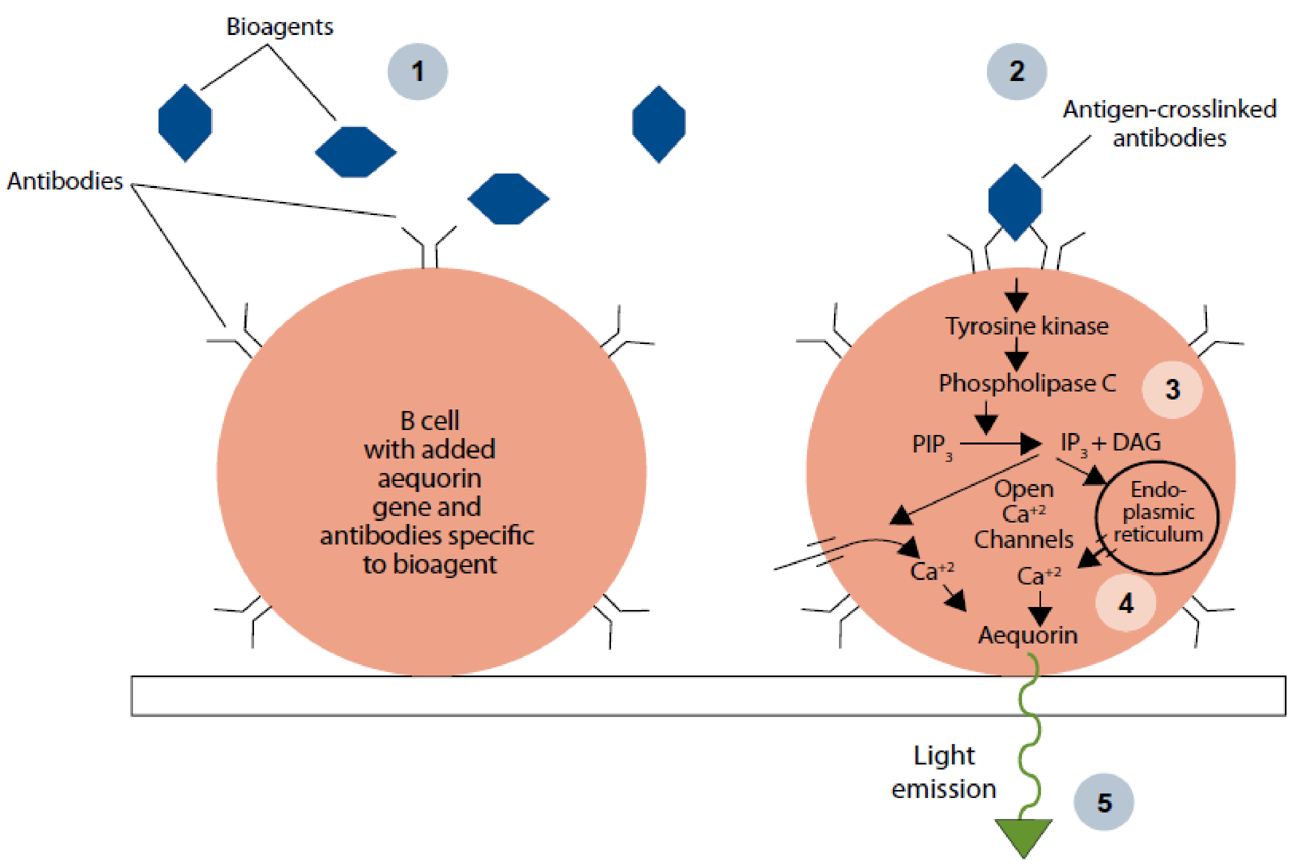
smiths detection

BioFlash detector PoC per agenti patogeni (es. SARS-CoV-2) nell'aria (2)

Utilizza cellule ingegnerizzate in grado di riconoscere la presenza del virus in 3 minuti nei campioni di aria raccolti.

Tecnologia CANARY- *Cellular Analysis and Notification of Antigen Risks and Yields* (Rider et al., A BCell-Based Sensor for Rapid Identification of Pathogen, Science, 2003 doi:10.1126/science.1084920)

I materiali di consumo sono prodotti negli USA (durata di conservazione 11 giorni) Parte dei campioni di aerosol raccolti (480 LPM) rimane disponibile per la conferma mediante RT-PCR. (https://www.smithsdetection.com/helping-detect-covid-19/)



The fundamental components of the CANARY biosensor include genetically engineered B cells that emit photons upon binding to specific bioagents and a photodetector that measures the luminescence. (1) B cells are exposed to bioagents in test sample, (2) bioagents bind to B-cell antibodies, (3) the biochemical signal transduction cascade is triggered, resulting in Ca^{2+} release, (4) Ca^{2+} makes aequorin emit photons, and (5) emitted photons are detected.

https://archive.ll.mit.edu/publications/technotes/TechNote_CANARY.pdf

#	*PATIENTS* Sampling date	Room	Ct swab of patient: date (E,RdRP2/S, N)	Age	Distance Patient-Sampler
1	31/08/2021	3	28/8 → 16 16 16	U25	2,5m
2	03/09/2021	11	2/9 → 36, 39, 37	23/10/1946	2,5m
3	IDEM	11	3/9 → 34.9 33.1	06/08/1928	IDEM
4	04/09/2021	2	10/9 → 18 18 17	30/04/1970	2,5m
5	07/09/2021	12	3/9 → 20 20 20	21/10/1964	2,5m
6	08/09/2021		7/9 → 17 17 16	26/06/1928	2,5m
7	10/09/2021	9	6/9 → 33 34 33	26/04/1964	2,5m
8	IDEM	9	4/9 → 25 27 30	23/09/1988	IDEM
9	14/09/2021	4	to be asked	24/07/1946	2,5m
10	12/10/2021	5	to be asked	to be asked	2,5m

AMBIENT AIR

		8LPM								480LPM							
#	VIVAS	Sampling duration (Hours)	Sampled volume (m3)	gene E copies/ sample	gene N2 copies/ sample	gene E copies /m3	gene N2 copies/ m3	CPE	BioFLash	Sampling duration (Hours)	Sampled volume (m3)	gene E copies/ sample	gene N2 copies/ sample	gene E copies /m3	gene N2 copies/ m3	CANARY detection	Note
1	Yes	3	1,44	nd	**2**	nd	**1**	NO	No								
2	Yes	3	1,44	**968**	**269**	**672**	**187**	NO	No								*
3	IDEM	IDEM	IDEM	IDEM	IDEM	IDEM	IDEM	IDEM	IDEM								
4	Yes	3	1,44	**269**	**21**	**187**	**15**	NO	No								
5	Yes	3	1,44			nd	nd		No								
6	Yes	1	0,6			nd	nd		Yes	0,5	14,4		**2**	nd	**0,4**	NO	
7	Yes	2,5	1,2			nd	nd		Yes	2,5	72			nd	nd	failure	**
8	IDEM	IDEM	IDEM			IDEM	IDEM	IDEM	IDEM	IDEM				IDEM	IDEM	IDEM	
9	No								Yes	0,5	14,4		**2**		**0,4**	failure	
10	No								Yes	1,75	50,4	**83**	**13**	**5,3**	**0,8**	NO	

* one patient intubated and moved from the room during sampling

** sampling interrupted by nurses at 2,5 hours (too much noise from instruments)

SARS-CoV-2 detection XPERT XPRESS SARS CoV 2 https://cepheid.widen.net/s/nb0a4ysmkf

CPE= Cytopathic effect on Vero E6 cells

PER I PAZIENTI CON Ct INFERIORE A 20, L'RNA VIRALE VIENE RILEVATO NELL'ARIA

BIOSPOT VIVAS nel reparto di Geriatria dell’Ospedale Maggiore di Trieste

Sample ID: 1
Test Type: Specimen
Sample Type:

Assay Information

Assay	Assay Version
Xpert Xpress SARS-CoV-2	2

Test Result: SARS-CoV-2 PRESUMPTIVE POS

Analyte Result

Analyte Name	Ct	EndPt	Analyte Result	Probe Check Result
E	39.0	125	POS	PASS
N2	0.0	-1	NEG	PASS

Sample ID: 2
Test Type: Specimen
Sample Type:

Assay Information

Assay	Assay Version
Xpert Xpress SARS-CoV-2	2

Test Result: SARS-CoV-2 PRESUMPTIVE POS

Analyte Result

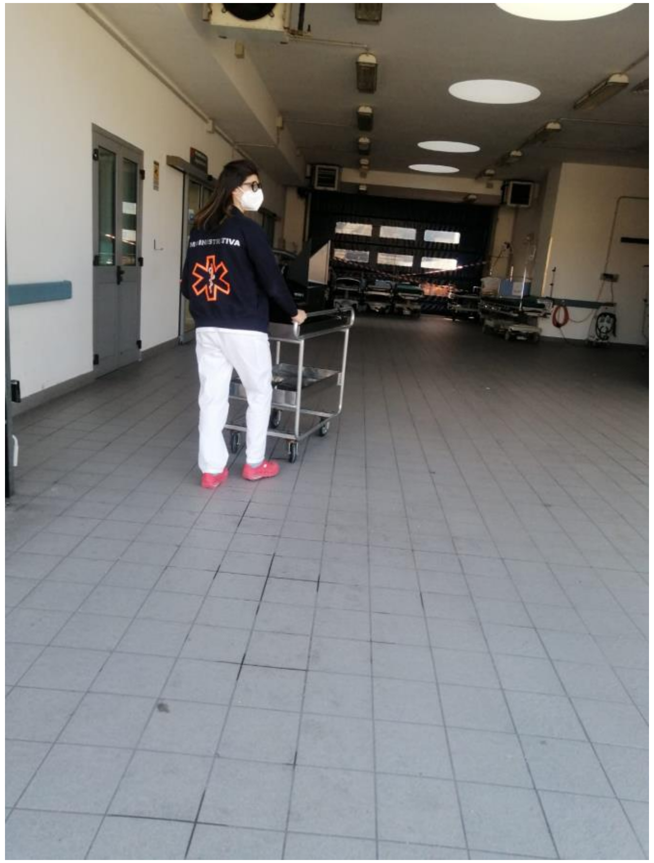
Analyte Name	Ct	EndPt	Analyte Result	Probe Check Result
E	38.0	208	POS	PASS
N2	0.0	-5	NEG	PASS

La nostra indagine nelle unità sanitarie ha mostrato la **presenza di RNA di SARS CoV 2 nell'aria** campionata, ma **non infettività** residua nei campioni

Cercando pazienti “freschi” in fase di diffusione virali:

indagini nei Dipartimenti di Pronto Soccorso negli ospedali a Trieste, Monfalcone, Gorizia si trovano raramente tracce:

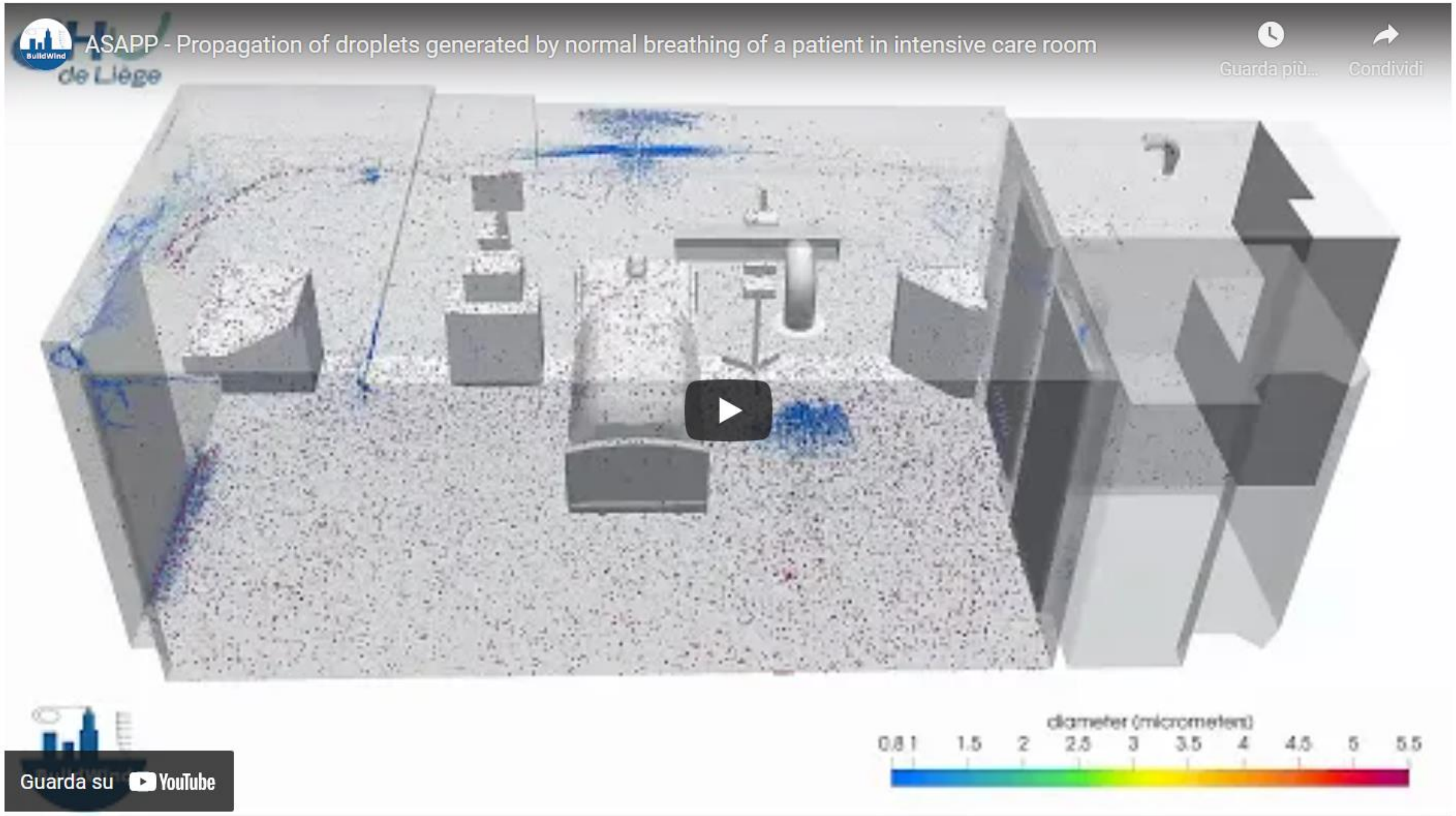
l’aerazione è importante; efficiente!



Sviluppi

Crescita del network, con SIMA, UniMIB, Buildwind, UniBA: proposte di progetto (presenza di aerosol patogeni nell'aria indoor non è eguale ovunque!!!)

https://www.buildwind.net/asapp/



12-13 maggio 2022

Campionamento con ViVAS
e Detector Bioflash

Analizzatore di CO2

#	strum	tipo		data
1	Vivas	campione	vtm	12/05/2022
2	Vivas	campione	vtm	12/05/2022
3	Vivas	trappola	vtm	12/05/2022
4	Bioflash	campione	vtm	12/05/2022
5	Bioflash	campione	vtm	12/05/2022
6	Vivas	campione	vtm	13/05/2022

Ct Values

Wedge	Sample Id	Sample Type	S gene (FAM)	ORF1ab (JOE)	RNA IC (Q670)	QC Statement/Notes
1	1	Unknown	33.1	34.5	30	
2	2	Unknown	35.7	0	30.6	
3	3	Unknown	0	0	0	RNA IC: Internal Control Failure
4	4	Unknown	33.2	34.8	30	
5	5	Unknown	0	34.9	29.8	
6	6	Unknown	35.4	33.8	30.3	

va ess

d'aria

Environmental Research
Volume 202, November 2021, 111560

CO_2 concentration monitoring inside educational buildings as a strategic tool to reduce the risk of Sars-CoV-2 airborne transmission

Alessia Di Gilio [a] [1], Jolanda Palmisani [a] [1], Manuela Pulimeno [b], Fabio Cerino [c], Mirko Cacace [c], Alessandro Miani [d], Gianluigi de Gennaro [a]

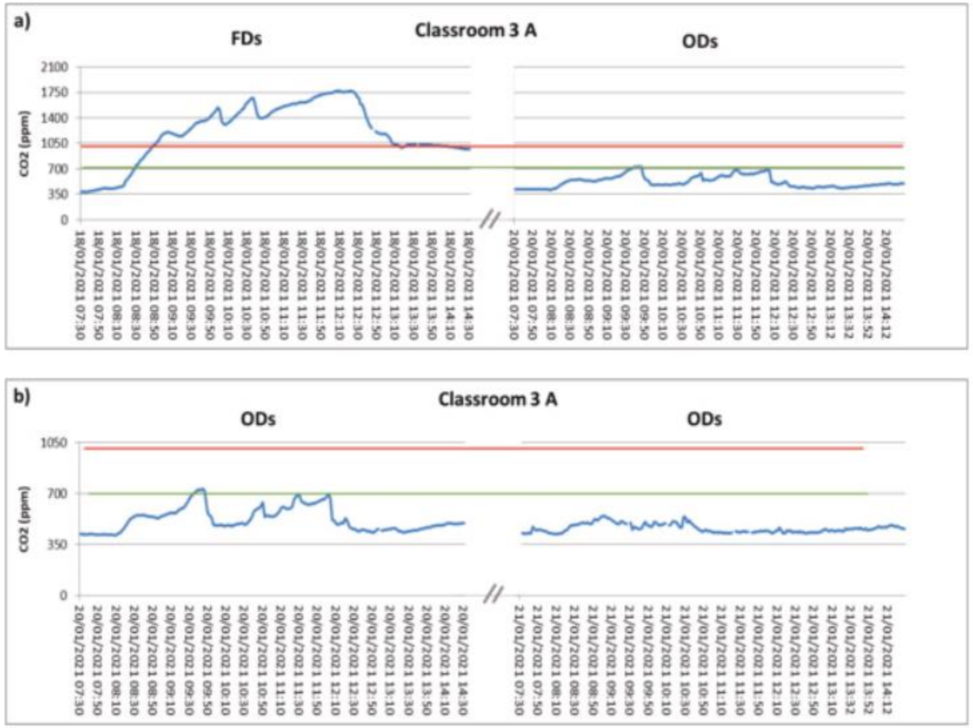


Fig. 4. Evolution of CO2 levels in the classroom 3A during one of first monitoring days (FDs) and during one of the following days (ODs) when a proper protocol of ventilation was implemented (a) and when the temporal variation of CO2 concentration has been frequently observed during the school hours thanks to real-time visualization of data (b).

Un elemento di attenzione: le sale d’aspetto

Monitor CO_2 , Umidità, Temperatura

Per una miglior gestione dei ricambi d’aria

Attualmente

Dottorato «PON innovazione» su *ricerca metagenomica di batteri e virus patogeni* (anche in **ambienti indoor peculiari, es. trasporti**: tecnologie portatili MD8 Airport; test di prototipi di tecnologie nazionali «portatili»)

Sorveglianza di comunità: patogeni convergenti tramite gli scarichi civili nei depuratori di reflui cittadini (es. metagenomica su campioni aerosol raccolto alle vasche di aereazione)

ELEMENTI DI NOVITA'

DECRETO-LEGGE 30 aprile 2022, n. 36

Ulteriori misure urgenti per l'attuazione del Piano nazionale di ripresa e resilienza (PNRR). (22G00049) (GU Serie Generale n.100 del 30-

note: Entrata in vigore del provvedimento: 01/05/2022

Capo III
Misure per l'attuazione del Piano nazionale di ripresa e resilienza in materia di ambiente, fonti rinnovabili, efficientamento energetico e salute

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Capo IV
Transizione digitale

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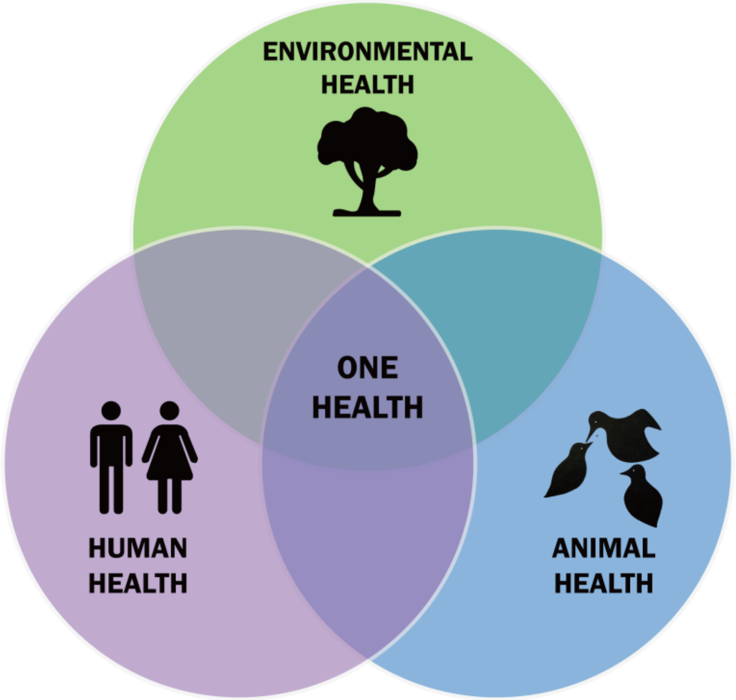
Art. 27

Istituzione del Sistema nazionale prevenzione salute
dai rischi ambientali e climatici

1. Allo scopo di migliorare e armonizzare le politiche e le strategie messe in atto dal Servizio sanitario nazionale per la prevenzione, il controllo e la cura delle malattie acute e croniche, trasmissibili e non trasmissibili, associate a rischi ambientali e climatici, e' istituito il Sistema nazionale prevenzione salute dai rischi ambientali e climatici, di seguito «SNPS».

2. Il SNPS, mediante l'applicazione dell'approccio integrato «one-health» nella sua evoluzione «planetary health» e tramite l'adeguata interazione con il Sistema nazionale a rete per la protezione ambientale, di cui alla legge 28 giugno 2016, n. 132, di



RINFORZARE LE SPECIFICITA' PROFESSIONALI
MA MASSIMIZZARE LE INTERAZIONI INTERPROFESSIONALI
ZEITGEIST: IMPARARE A LAVORARE ASSIEME
PNRR AIUTA MOLTO – MIGLIORARE L'ORGANIZZAZIONE!

GRAZIE PER LA VOSTRA ATTENZIONE

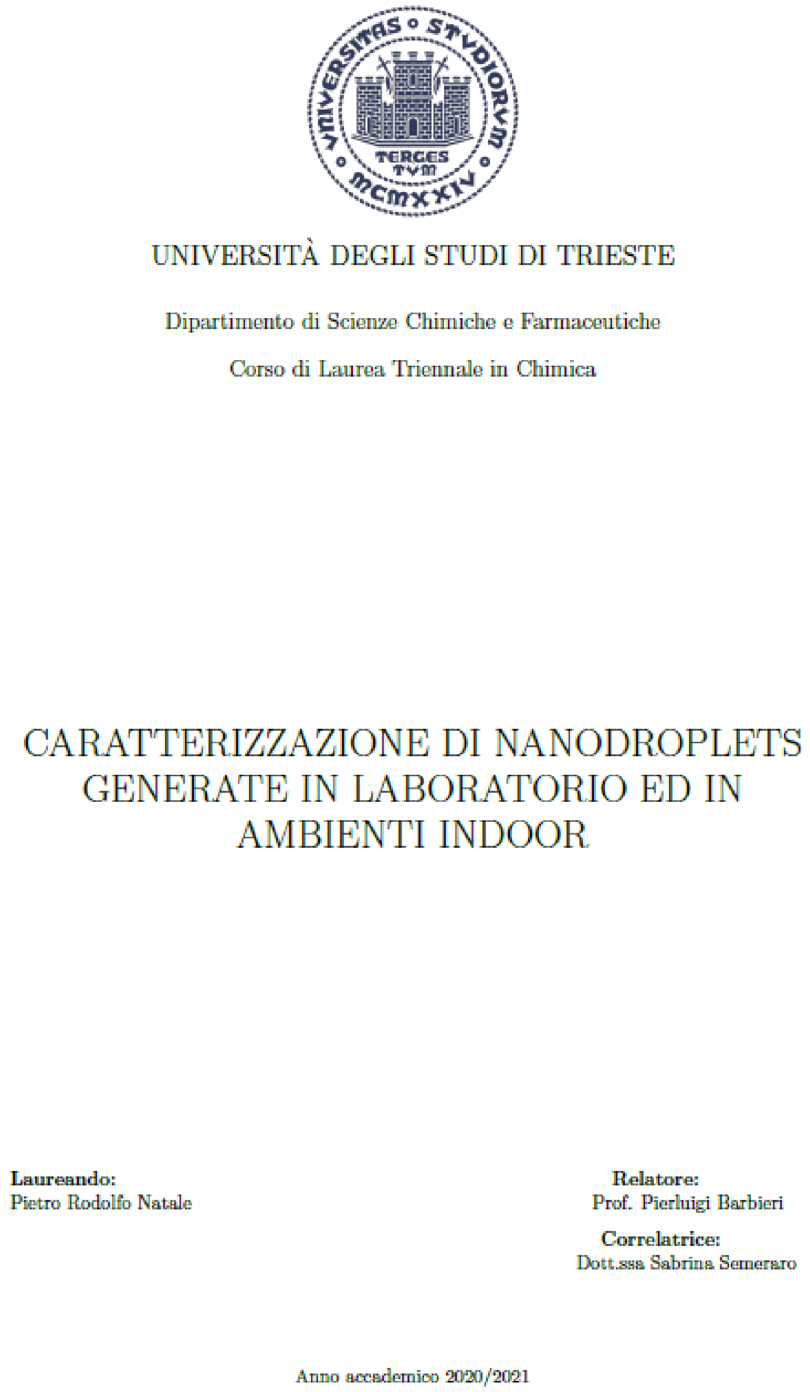
ALLA RETE ESTESA PROFESSIONALE E DI RICERCA

ED AI MIEI STRETTI COLLABORATORI,

MIEI BADANTI

S.Licen, S.Semeraro, E.Greco, A.S.Gaetano

Conoscenza e supporto alle decisioni sono «remo di fatica»


UNIVERSITÀ DEGLI STUDI DI TRIESTE

Dipartimento di Scienze Chimiche e Farmaceutiche

Corso di Laurea Triennale in Chimica

CARATTERIZZAZIONE DI NANODROPLETS GENERATE IN LABORATORIO ED IN AMBIENTI INDOOR

Laureando:
Pietro Rodolfo Natale

Relatore:
Prof. Pierluigi Barbieri

Correlatrice:
Dott.ssa Sabrina Semeraro

Anno accademico 2020/2021

Il Fast Mobility Particle Sizer (FMPS) è uno spettrometro capace di misurare la distribuzione dimensionale delle particelle da 5.6 a 560 nm, con una risoluzione totale di 32 canali.
La risoluzione è di 1s e ciò lo rende particolarmente adatto nel settore ambientale in quanto spesso si studiano fenomeni ad elevata variabilità temporale (ex: formazione ed accrescimento di aggregati).

Environment International
Volume 164, June 2022, 107266

Full length article

SARS-CoV-2 and other airborne respiratory viruses in outdoor aerosols in three Swiss cities before and during the first wave of the COVID-19 pandemic

Yile Tao [a, b], Xiaole Zhang [a, b], Guangyu Qiu [a, b], Martin Spillmann [a, b], Zheng Ji [c], Jing Wang [a, b]

https://doi.org/10.1016/j.envint.2022.107266

Real Time Laser Induced Fluorescence
Batteri: peaks of tryptophan and NADH emission,

AEROSOL SCIENCE AND TECHNOLOGY
2020, VOL. 54, NO. 5, 465–495
https://doi.org/10.1080/02786826.2019.1664724

Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE

OPEN ACCESS

Check for updates

Real-time sensing of bioaerosols: Review and current perspectives

J. Alex Huffman[a,b], Anne E. Perring[c], Nicole J. Savage[d], Bernard Clot[e], Benoît Crouzy[e], Fiona Tummon[e], Ofir Shoshanim[f], Brian Damit[g], Johannes Schneider[h], Vasanthi Sivaprakasam[i], Maria A. Zawadowicz[j], Ian Crawford[k], Martin Gallagher[k], David Topping[k], David C. Doughty[l], Steven C. Hill[l], and Yongle Pan[l]

ESC European Society of Cardiology

Cardiovascular Research doi:10.1093/cvr/cvaa288

Regional and global contributions of air pollution to risk of death from COVID-19

Andrea Pozzer[1,2], Francesca Dominici[3], Andy Haines[4], Christian Witt[5], Thomas Münzel[6,7*], and Jos Lelieveld[2,8*]

Debate 2:

is air pollution related to the COVID-19 spread?

Better

Is atmospheric Particulate Matter/environmental aerosol playing a role in stabilizing droplet nuclei (viral bioaerosol)?

Severe outbreaks of COVID-19 occurred in areas of the world with poor air quality (es. Wuhan, Po Valley).

Does pollutants (particulate matter) play a role in the spread of the COVID-19?

Several points of view

Direct effect of pollutants (PM) on health outcomes

(a) Previous exposure to fine dust has resulted in biological damage that makes the human body more susceptible / less resistant to the virus

(b) The fine powders inhaled together with the virus cause biological damage that makes the human body more susceptible / less resistant to the virus

Classification proposed by G.de Gennaro – University of Bari (Italy)

Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study

Xiao Wu, Rachel C Nethery, M Benjamin Sabath, Danielle Braun, Francesca Dominici

Xiao Wu, *doctoral student*; Rachel C Nethery, *assistant professor*; Benjamin Sabath, *data scientist*; Danielle Braun, *research scientist*; Francesca Dominici, *Clarence James Gamble professor of biostatistics, population, and data science*, Department of Biostatistics, Harvard T.H. Chan School of Public Health, Boston, MA, 02115, USA

Clinical research

COVID-19/SARS-CoV-2

Particulate matter pollution and the COVID-19 outbreak: results from Italian regions and provinces

Vanessa Bianconi[1], Paola Bronzo[1], Maciej Banach[2,3], Amirhossein Sahebkar[4,5], Massimo R. Mannarino[1], Matteo Pirro[1]

IZA DP No. 13231

Deregulation in a Time of Pandemic: Does Pollution Increase Coronavirus Cases or Deaths?

Claudia L. Persico
Kathryn R. Johnson

COVID-19 higher morbidity and mortality in Chinese regions with lower air quality

Riccardo Pansini[1,2,3] & Davide Fornacca[1,4]

[1] Institute of Eastern-Himalaya Biodiversity Research, Dali University, Yunnan, China
[2] Behavioral and Experimental Economics Research Center, Statistic and Mathematics College, Yunnan University of Finance and Economics, Kunming, China
[3] Department of Economics and Finance, Global Research Unit, City University of Hong Kong
[4] Institute for Environmental Sciences, University of Geneva, Switzerland

Understanding the heterogeneity of adverse COVID-19 outcomes:
the role of poor quality of air and lockdown decisions

Leonardo Becchetti*, *University of Rome Tor Vergata*
Gianluigi Conzo, *University of Rome Tor Vergata*
Pierluigi Conzo, *University of Turin & Collegio Carlo Alberto*
Francesco Salustri, *University of Oxford*

ELSEVIER | Contents lists available at ScienceDirect | Science of the Total Environment | journal homepage: www.elsevier.com/locate/scitotenv

Association between short-term exposure to air pollution and COVID-19 infection: Evidence from China

Yongjian Zhu[a], Jingui Xie[b,c,*], Fengming Huang[b], Liqing Cao[b]

[a] School of Management, University of Science and Technology of China, Hefei, China
[b] The First Affiliated Hospital of USTC, Division of Life Sciences and Medicine, University of Science and Technology of China, Hefei, China
[c] Brunel Business School, Brunel University London, Uxbridge, United Kingdom

Environmental Pollution 261 (2020) 114465

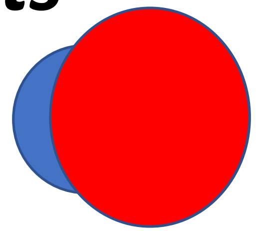
ELSEVIER | Contents lists available at ScienceDirect | Environmental Pollution | journal homepage: www.elsevier.com/locate/envpol

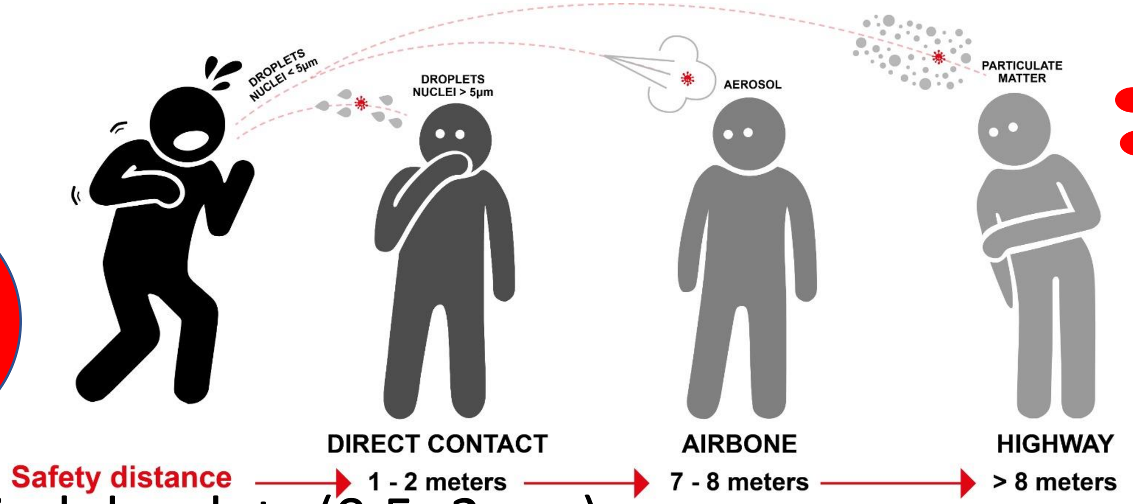
Can atmospheric pollution be considered a co-factor in extremely high level of SARS-CoV-2 lethality in Northern Italy?☆

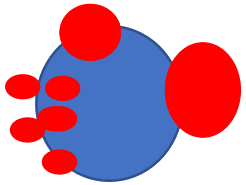
Edoardo Conticini[a], Bruno Frediani[a], Dario Caro[b,*]

[a] Rheumatology Unit, Department of Medicine, Surgery and Neurosciences, University of Siena, Policlinico Le Scotte, viale Mario Bracci 1, Siena, Italy
[b] Department of Environmental Science, Aarhus University, Frederiksborgvej 399, Roskilde, Denmark

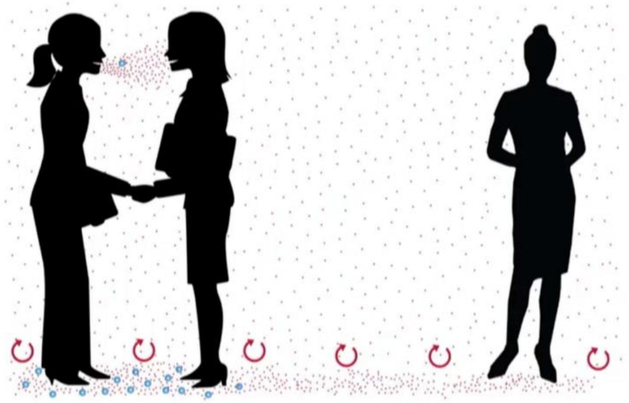
Air Particulate Matter may interact with viral droplets and nuclei: three effects



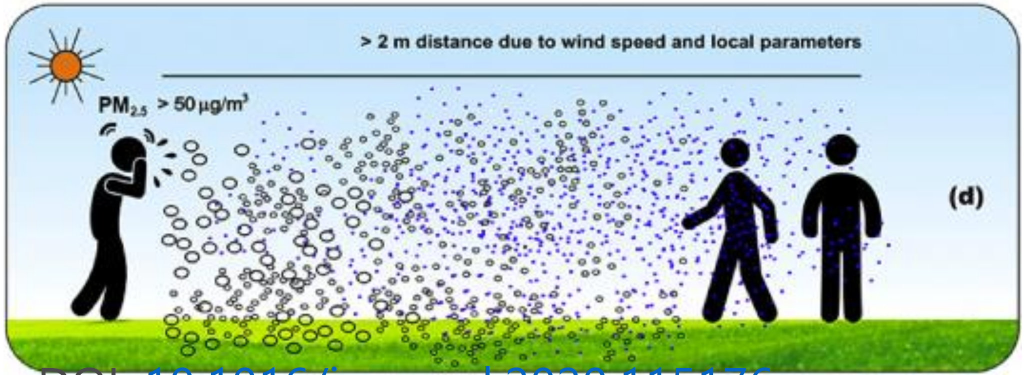




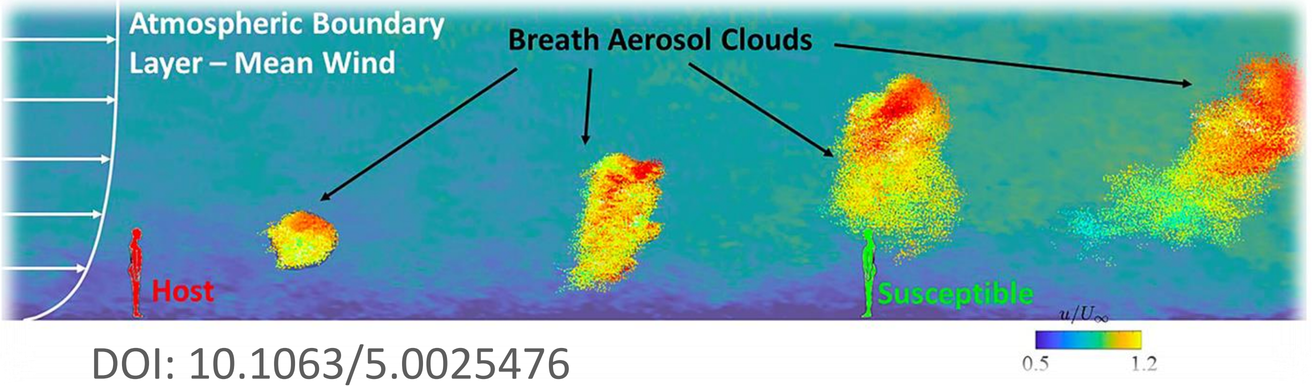
- **Primary carrier effect** - coalescence of viral droplets (0.5 -2 um) with finer particulate < 1 um, **stabilization and confinement** , bigger distances covered, contagion of persons and surfaces (fomites)
- **Precipitation effect** - coalescence of viral droplets (> 0,5 um) with finer particulate (Sum)> 10 um; precipitation on soils and surfaces contagion of surfaces (fomites)
- **Virus resuspension** – aerosolization of fomites



Graphic by Linsey Marr, August 26, 2020. Aerosols and Transmission of Respiratory Viruses 101.



DOI: 10.1016/j.envpol.2020.115176



DOI: 10.1063/5.0025476

But the role of air particulate matter /dust can be more complex in the COVID spread

Environmental Science & Technology

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An Imperative Need for Research on the Role of Environmental Factors in Transmission of Novel Coronavirus (COVID-19)

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Cite This: *Environ. Sci. Technol.* 2020, 54, 3730–3732 Read Online

February 2020

A further transmission route could be via airborne dust. It is considered that microorganisms in airborne particulate matters (PM) or dust is linked to infectious diseases.[5] Poor nation-wide air pollution is frequent in some developing countries, and the role of air PM and dust in the transmission of COVID-19 infection remains uninvestigated. Inhalation of virus-laden fine particles could transport the virus into deeper alveolar and tracheobronchial regions, which could increase the chance of infective transmission. Adsorption of the COVID-19 virus on airborne dust and PM could also contribute to long-range transport of the virus Therefore, investigations on adsorption, survival, and behavior of the COVID-19 virus with the surface of PM are needed to help to understand the role of air PM pollution in COVID-19 transmission.

Air Particulate Matter may interact with viral droplets and nuclei

PM – viral droplets interaction - leading to confinement and stabilization of the virus - is **probable in confined / indoor environment**, but if outdoor environment has low mixing layer and very high number of PM (e.g. Po Valley), a «boost effect» for infection can occur.

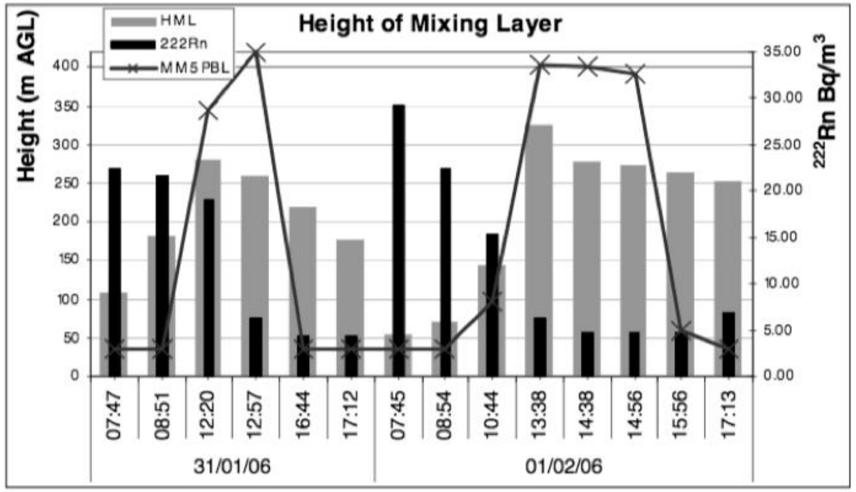
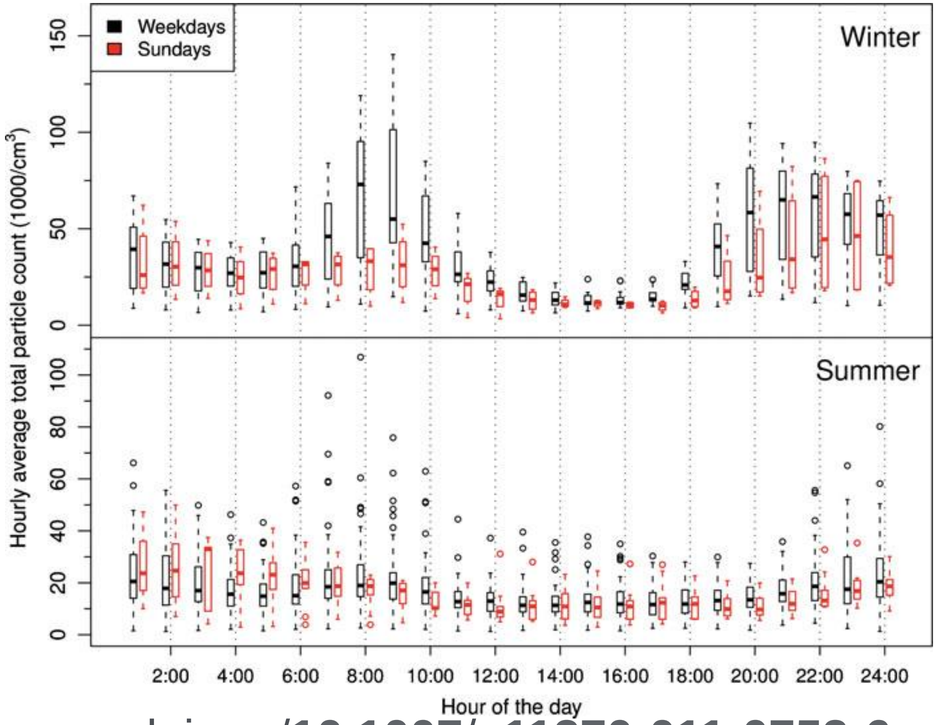
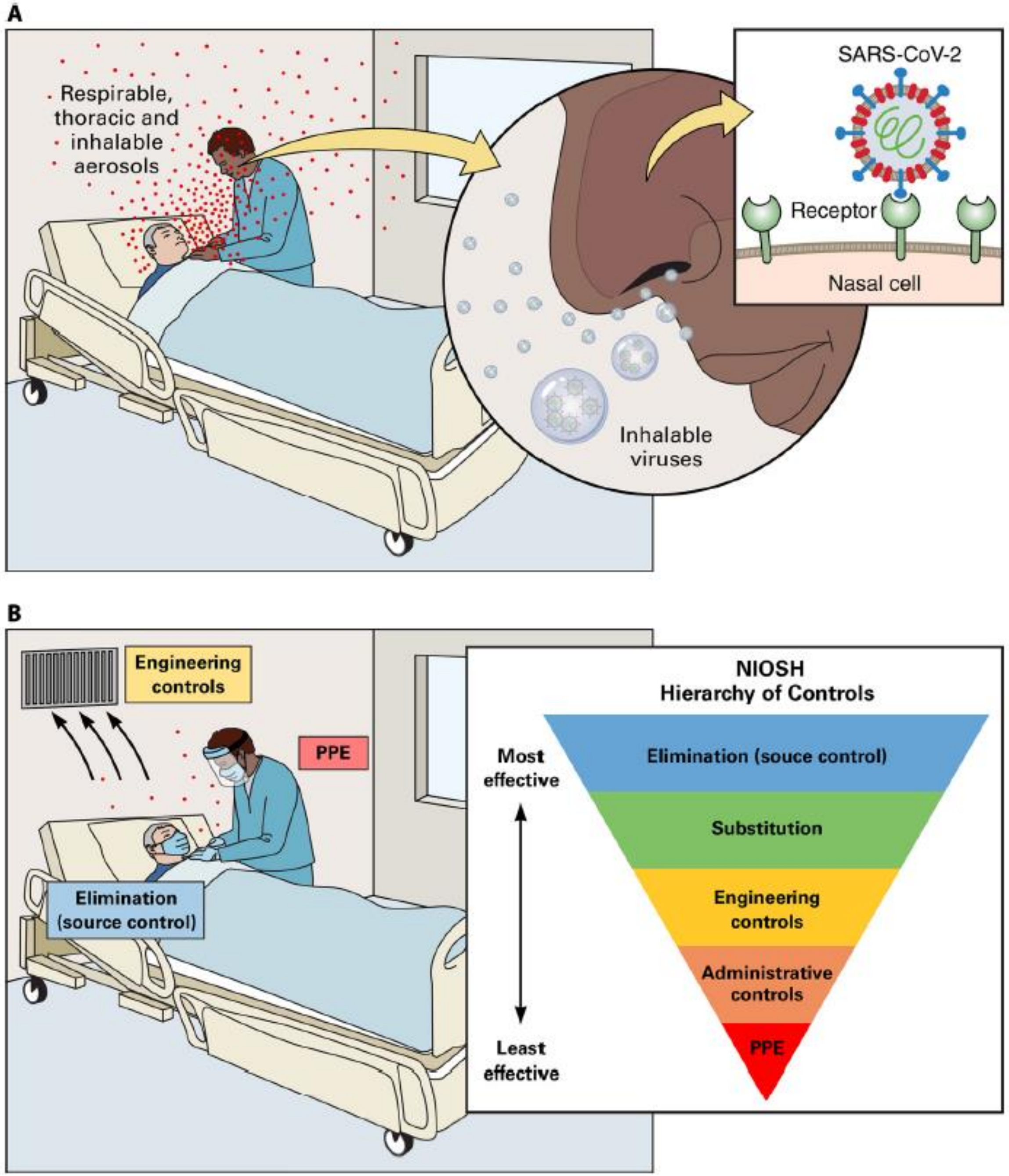


Fig. 1 Heights of ML measured by vertical profiles; MM5 PBL height predictions and ^{222}Rn measurments.



doi.org/10.1007/s11270-011-0752-6.



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REVIEW

SARS-CoV-2 and Health Care Worker Protection in Low-Risk Settings: a Review of Modes of Transmission and a Novel Airborne Model Involving Inhalable Particles

X. Sophie Zhang,[a,b,c,d] Caroline Duchaine[e,f]

FIG 1 A broader airborne model involving inhalable aerosols for SARS-CoV-2 transmission in low-risk health care settings. (A) Worst-case scenario: no protection on either the sick patient (source) or the health care worker (exposure), emission of particles of various sizes (droplets and aerosols) during natural respiratory activity (breathing, talking, and coughing), entry of infectious inhalable aerosols, and impaction in the nose where viral receptors are abundant and infectivity is greatest. (B) Best-case scenario and NIOSH hierarchy of controls: source control (mask-wearing by the sick patient), engineering control (optimal ventilation), and exposure control (droplet-contact PPE worn by the health care worker) to prevent short-range droplet and inhalable aerosol transmission.