# CORONAVIRUS

DALLA RICERCA SCIENTIFICA ALLE FAKE NEWS

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GRUPPO DI RICERCA

STESURA ARTICOLO

RIVISTA SCIENTIFICA

PAIR REVIEW

PUBBLICAZIONE

DB SCIENTIFICI
(ABSTRACT VS FULL TEXT)

Emergenza Coronavirus

Disponibilità immediata

# PERMANENZA DEL VIRUS SUI MATERIALI

The NEW ENGLAND JOURNAL of MEDICINE

CORRESPONDENCE

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

TO THE EDITOR: A novel human coronavirus that is now named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (formerly called HCoV-19) emerged in Wuhan, China, in late 2019 and is now causing a pandemic.[1] We analyzed the aerosol and surface stability of SARS-CoV-2 and compared it with SARS-CoV-1, the most closely related human coronavirus.[2]

We evaluated the stability of SARS-CoV-2 and SARS-CoV-1 in aerosols and on various surfaces and estimated their decay rates using a Bayesian regression model (see the Methods section in the Supplementary Appendix, available with the full text of this letter at NEJM.org). SARS-CoV-2 nCoV-WA1-2020 (MN985325.1) and SARS-CoV-1 Tor2 (AY274119.3) were the strains used. Aerosols (<5 μm) containing SARS-CoV-2 ($10^{5.25}$ 50% tissue-culture infectious dose [$TCID_{50}$] per milliliter) or SARS-CoV-1 ($10^{5.75-7.00}$ $TCID_{50}$ per milliliter) were generated with the use of a three-jet Collison nebulizer and fed into a Goldberg drum to create an aerosolized environment. The inoculum resulted in cycle-threshold values between 20 and 22, similar to those observed in samples obtained from the upper and lower respiratory tract in humans.

Our data consisted of 10 experimental conditions involving two viruses (SARS-CoV-2 and SARS-CoV-1) in five environmental conditions (aerosols, plastic, stainless steel, copper, and cardboard). All experimental measurements are reported as means across three replicates.

SARS-CoV-2 remained viable in aerosols throughout the duration of our experiment (3 hours), with a reduction in infectious titer from $10^{6.8}$ to $10^{5.7}$ $TCID_{50}$ per liter of air. This reduction was similar to that observed with SARS-CoV-1, from $10^{6.8}$ to $10^{6.8}$ $TCID_{50}$ per milliliter (Fig. 1A).

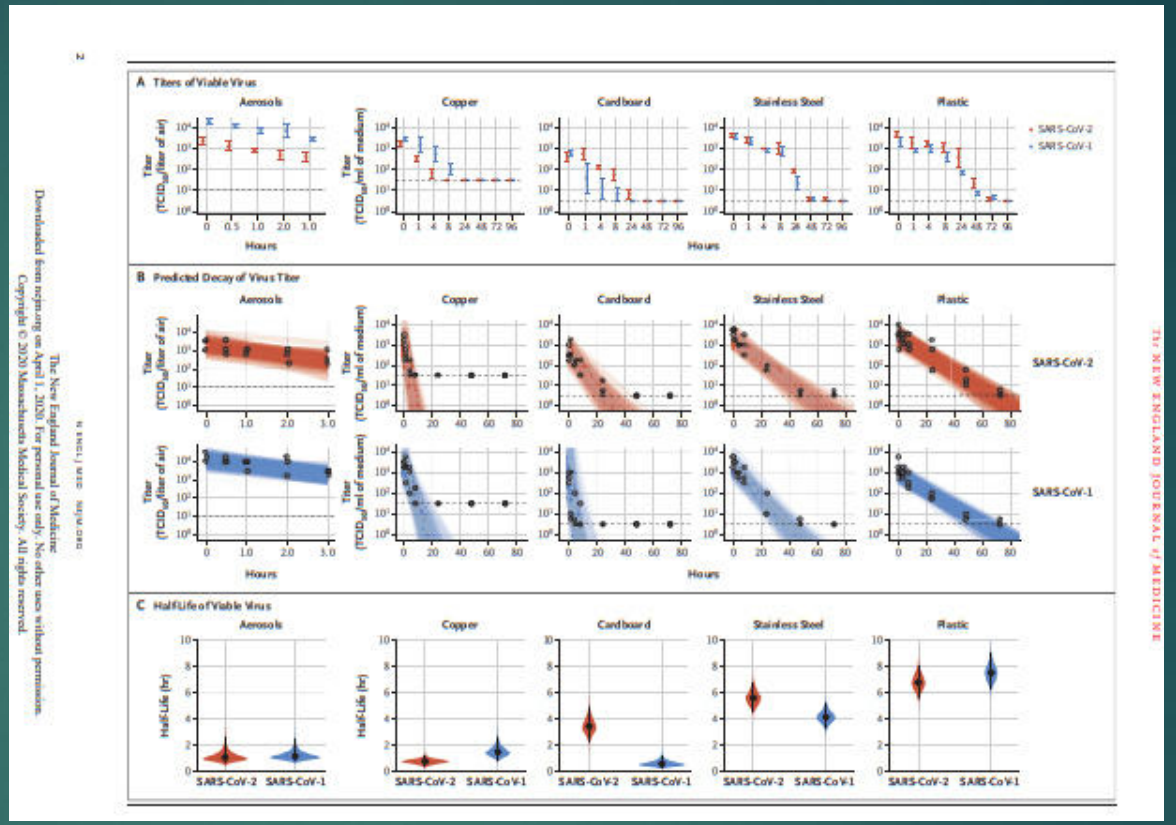
SARS-CoV-2 was more stable on plastic and stainless steel than on copper and cardboard, and viable virus was detected up to 72 hours after application to these surfaces (Fig. 1A), although the virus titer was greatly reduced (from $10^{3.7}$ to $10^{3.6}$ $TCID_{50}$ per milliliter of medium after 72 hours on plastic and from $10^{3.7}$ to $10^{3.6}$ $TCID_{50}$ per milliliter after 48 hours on stainless steel). The stability kinetics of SARS-CoV-1 were similar (from $10^{6.4}$ to $10^{4.7}$ $TCID_{50}$ per milliliter after 72 hours on plastic and from $10^{6.6}$ to $10^{4.6}$ $TCID_{50}$ per milliliter after 48 hours on stainless steel). On copper, no viable SARS-CoV-2 was measured after 4 hours and no viable SARS-CoV-1 was measured after 8 hours. On cardboard, no viable SARS-CoV-2 was measured after 24 hours and no viable SARS-CoV-1 was measured after 8 hours (Fig. 1A).

Both viruses had an exponential decay in virus titer across all experimental conditions, as indicated by a linear decrease in the $\log_{10}TCID_{50}$ per liter of air or milliliter of medium over time (Fig. 1B). The half-lives of SARS-CoV-2 and SARS-CoV-1 were similar in aerosols, with median estimates of approximately 1.1 to 1.2 hours and 95% credible intervals of 0.64 to 2.64 for SARS-CoV-2 and 0.78 to 2.43 for SARS-CoV-1 (Fig. 1C, and Table S1 in the Supplementary Appendix). The half-lives of the two viruses were also similar on copper. On cardboard, the half-life of SARS-CoV-2 was longer than that of SARS-CoV-1. The longest viability of both viruses was on stainless steel and plastic; the estimated median half-life of SARS-CoV-2 was approximately 5.6 hours on stainless steel and 6.8 hours on plastic (Fig. 1C). Estimated differences in the half-lives of the two viruses were small except for those on cardboard (Fig. 1C). Individual replicate data were noticeably "noisier" (i.e., there was more variation in the experiment, resulting in a larger standard error) for cardboard than for other surfaces (Fig. S1 through S5), so we advise caution in interpreting this result.

We found that the stability of SARS-CoV-2 was similar to that of SARS-CoV-1 under the experimental circumstances tested. This indicates that differences in the epidemiologic characteristics of these viruses probably arise from other factors, including high viral loads in the upper










Aerosol: 3 ore
Rame: 4 ore
Cartone: 8-24 ore
Acciaio: 48 ore
Plastica: 72 ore

Concetto di PROBABILITÀ

CORRESPONDENCE

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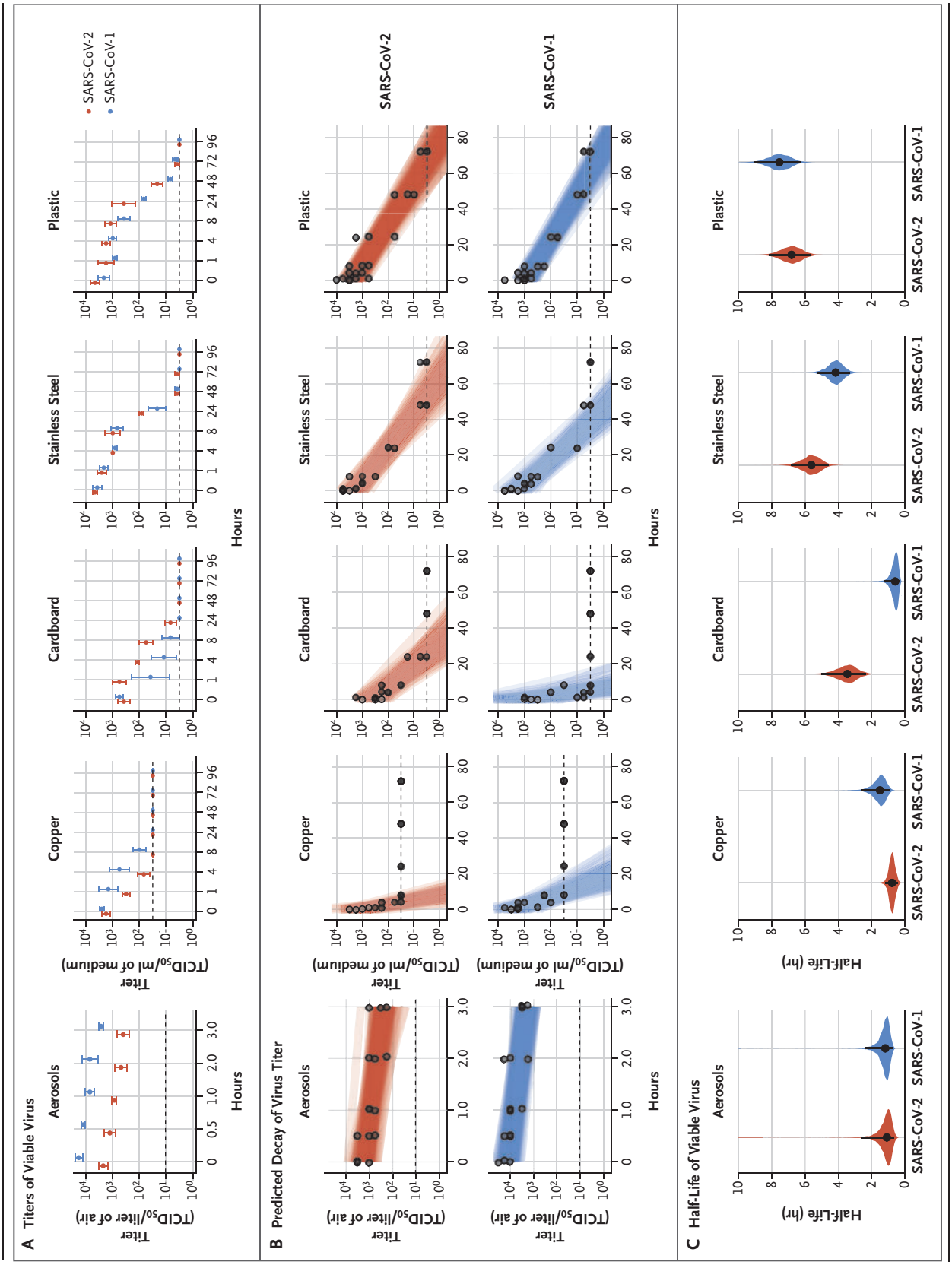

**Figure 1 (facing page). Viability of SARS-CoV-1 and SARS-CoV-2 in Aerosols and on Various Surfaces.**

As shown in Panel A, the titer of aerosolized viable virus is expressed in 50% tissue-culture infectious dose ($TCID_{50}$) per liter of air. Viruses were applied to copper, cardboard, stainless steel, and plastic maintained at 21 to 23°C and 40% relative humidity over 7 days. The titer of viable virus is expressed as $TCID_{50}$ per milliliter of collection medium. All samples were quantified by end-point titration on Vero E6 cells. Plots show the means and standard errors (I bars) across three replicates. As shown in Panel B, regression plots indicate the predicted decay of virus titer over time; the titer is plotted on a logarithmic scale. Points show measured titers and are slightly jittered (i.e., they show small rapid variations in the amplitude or timing of a waveform arising from fluctuations) along the time axis to avoid overplotting. Lines are random draws from the joint posterior distribution of the exponential decay rate (negative of the slope) and intercept (initial virus titer) to show the range of possible decay patterns for each experimental condition. There were 150 lines per panel, including 50 lines from each plotted replicate. As shown in Panel C, violin plots indicate posterior distribution for the half-life of viable virus based on the estimated exponential decay rates of the virus titer. The dots indicate the posterior median estimates, and the black lines indicate a 95% credible interval. Experimental conditions are ordered according to the posterior median half-life of SARS-CoV-2. The dashed lines indicate the limit of detection, which was $3.33\times10^{0.5}$ $TCID_{50}$ per liter of air for aerosols, $10^{0.5}$ $TCID_{50}$ per milliliter of medium for plastic, steel, and cardboard, and $10^{1.5}$ $TCID_{50}$ per milliliter of medium for copper.

respiratory tract and the potential for persons infected with SARS-CoV-2 to shed and transmit the virus while asymptomatic.[3,4] Our results indicate that aerosol and fomite transmission of SARS-CoV-2 is plausible, since the virus can remain viable and infectious in aerosols for hours and on surfaces up to days (depending on the inoculum shed). These findings echo those with SARS-CoV-1, in which these forms of transmission were associated with nosocomial spread and super-spreading events,[5] and they provide information for pandemic mitigation efforts.

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The findings and conclusions in this letter are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC). Names of specific vendors, manufacturers, or products are included for public health and informational purposes; inclusion does not imply endorsement of the vendors, manufacturers, or products by the CDC or the Department of Health and Human Services.

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Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

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3. Bai Y, Yao L, Wei T, et al. Presumed asymptomatic carrier transmission of COVID-19. JAMA 2020 February 21 (Epub ahead of print).
4. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 viral load in upper respiratory specimens of infected patients. N Engl J Med. DOI: 10.1056/NEJMc2001737.
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# VIRUS E ANIMALI DA COMPAGNIA


**DIFFERENZE FONDAMENTALI**

CONTAGIATO

INFETTO

INFETTIVO

CONTAMINATO

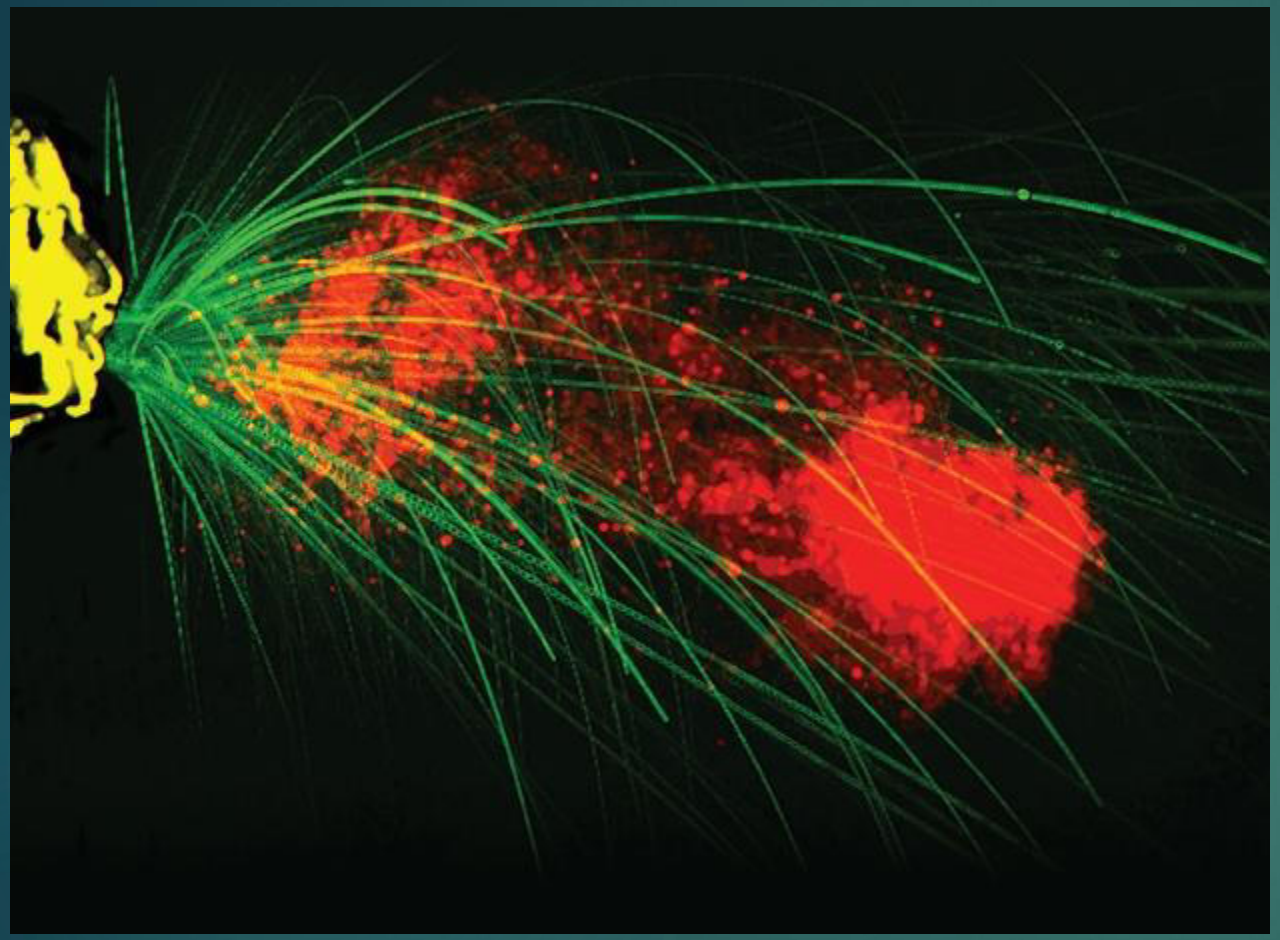
Tratto da: https://www.lastampa.it/la-zampa/cani/2020/04/02/news/cani-e-gatti-e-il-coronavirus-a-torino-lo-studio-per-capire-quale-ruolo-hanno-nella-trasmissione-del-virus-1.38669844

Intervista al Prof. Sergio Rosati - Professore Ordinario di Malattie infettive del Dipartimento di Scienze veterinarie - Università di Torino

**Il caso del cane di Hong Kong prima, il gatto di Liegi poi. Come se li spiega?**
«In questo momento ci stiamo basando su pochissimi dati: il primo caso è quello emerso a Hong Kong relativo a un cane che è stato trovato positivo a un tampone. Questo tampone è rimasto positivo per qualche giorno e, in realtà, un numero di giorni che tenderebbe a escludere una contaminazione passiva però al quale non è seguita la sieroconversione, ossia la risposta del sistema immunitario all'infezione. Quando un animale rimane sieronegativo, ossia non sieroconverte, cioè non produce anticorpi, vuol dire che il virus non è neanche riuscito a interessare il sistema immunitario. Vuol dire che si è replicato talmente poco che il sistema immunitario non se ne è neanche accorto. Il fatto che il cane sia rimasto sieronegativo fa pensare che se c'è stata una replicazione questa sia avvenuta su pochissime cellule della mucosa del naso, che il virus fa fatica a passare da un ospite all'altro e che la quantità di virus che viene prodotta da queste poche cellule che si sono infettate è trascurabile. Tutto fa pensare che negli animali vi sia una contaminazione con una lieve, forse, capacità replicativa ma non in grado di utilizzare il cane o il gatto come una specie alternativa alla trasmissione.

**Per fare chiarezza. Ci può spiegare i concetti di infetto, contagiato e infettivo?**
«Una persona diventa infetta nel momento in cui il virus comincia a replicare, quindi inizia l'infezione. L'infettività di una persona è quindi la capacità di questa persona di trasmettere l'infezione. Questo può avvenire prima dei sintomi clinici, la cosiddetta attività pre-sintomatica, oppure contemporaneamente ai sintomi oppure anche quando i sintomi stanno venendo meno, ossia nella cosiddetta fase di convalescenza. L'infettività quindi dura un po' più a lungo, sia prima che dopo la fase dove il paziente presenta i sintomi clinici. Contagiato invece è quando una persona viene a contatto con delle cariche infettanti, ossia quando una persona trasmette a un'altra persona una carica virale sufficiente a iniziare una nuova infezione. Nel caso del cane di Hong Kong è più corretto parlare di contaminazione. L'animale è stato contaminato, ma non infettato: è entrato a contatto con cariche infettanti, ma non è detto che si sia infettato».

# QUESTE FANTOMATICHE DROPLETS



SALIVA E MUCO (LARGE DROPLETS)

SALIVA E MUCO (MICRO DROPLETS)

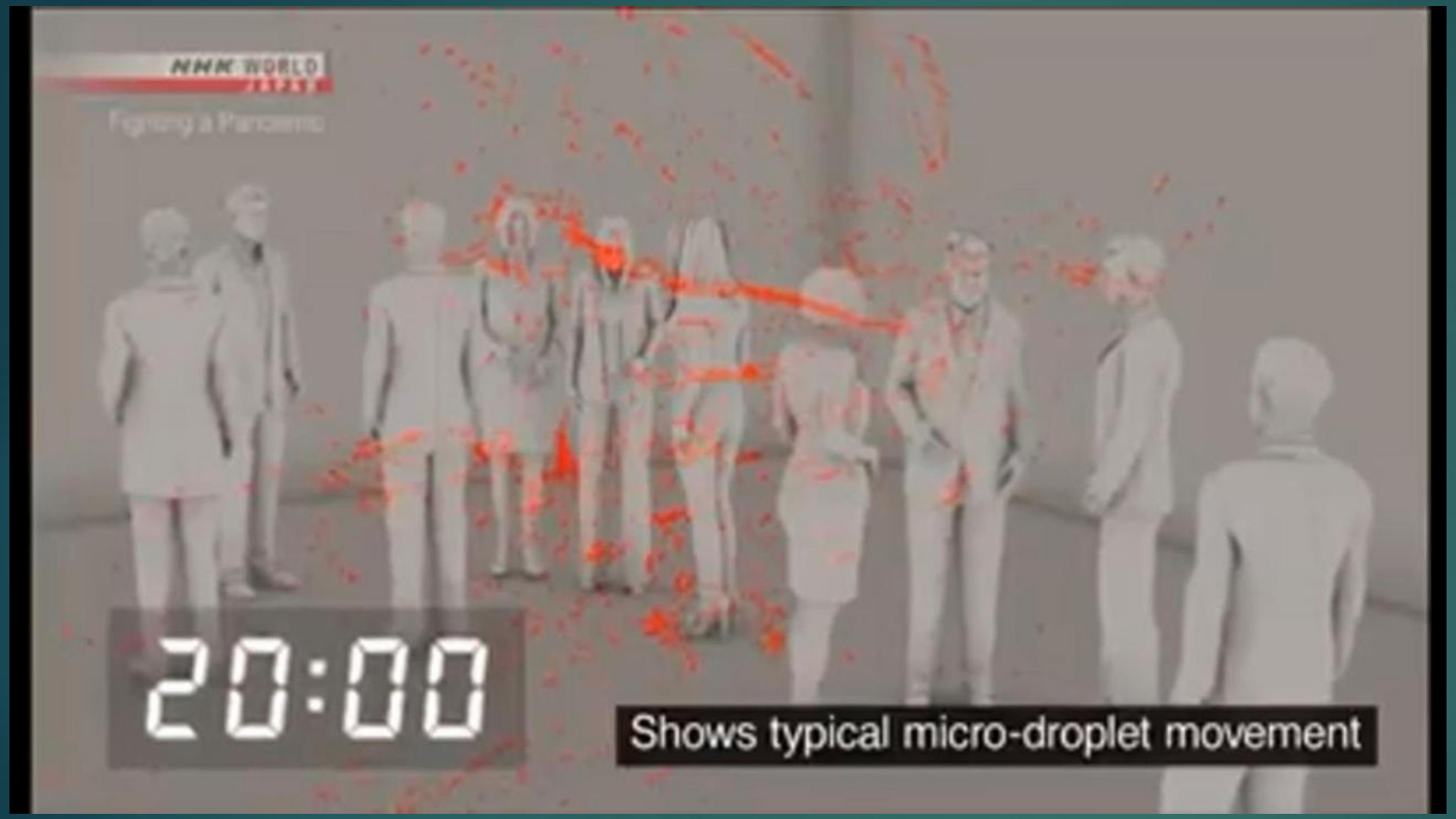
8 m starnuto
6 m tosse — 1-10 min

? — 20 min

*L. Bourouiba*
*The Fluid Dynamics of Disease Transmission*
*Laboratory/MIT*

*M. Yamakawa et al.*
*K. Tateda et al.*

# DROPLETS




Le LARGEdroplets, più larghe e pesanti, cadono e si depositano nei primissimi minuti.

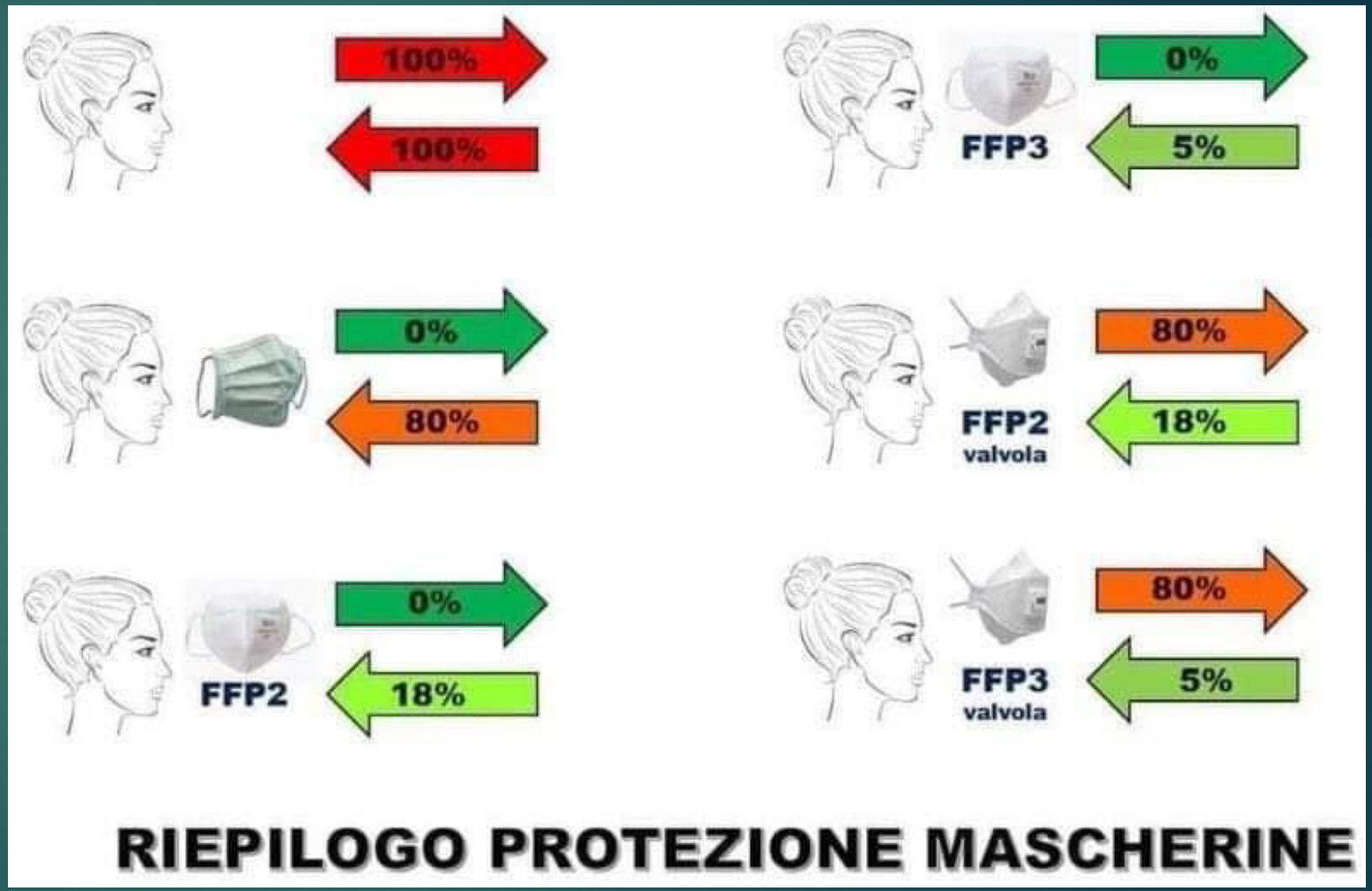
Le MICROdroplets, che si trasmettono anche solo col parlare e respirare, fluttuano ancora nell'aria dopo 20 minuti

*M. Yamakawa et al.*

*K. Tateda et al.*

# MASCHERINE


Quali mascherine possono proteggere dal coronavirus?
p100 SÌ 0.02 micron 20 nm
FFP3 SÌ 0.023 micron 23 nm
FFP2 NO 0.3 micron 300 nm
N95 NO 0.3 micron 300 nm
chirurgica NO 2 micron 2000 nm
coronavirus SARS-CoV-2 0.12 micron 120 nm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valvola
0%
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80%
5%
FFP3
valvola
RIEPILOGO PROTEZIONE MASCHERINE

# STATE A CASA

# USATE LA MASCHERINA

# GRAZIE