1   **Aerosol and surface stability of HCoV-19 (SARS-CoV-2) compared to SARS-CoV-1**

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4   **Short author list**: Neeltje van Doremalen[1], James O. Lloyd-Smith[3.5], Vincent J. Munster[1]
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7   **Full author list:** Neeltje van Doremalen[1*], Trenton Bushmaker[1*], Dylan H. Morris[2*], Myndi G.
8   Holbrook[1], Amandine Gamble[3], Brandi N. Williamson[1], Azaibi Tamin[4], Jennifer L. Harcourt[4], Natalie J.
9   Thornburg[4], Susan I. Gerber[4], James O. Lloyd-Smith[3,5], Emmie de Wit[1], Vincent J. Munster[1]
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11   1. Laboratory of Virology, Division of Intramural Research, National Institute of Allergy and

12   Infectious Diseases, National Institutes of Health, Hamilton, MT, USA

13   2. Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ, USA

14   3. Department of Ecology and Evolutionary Biology, University of California, Los Angeles, Los

15   Angeles, CA, USA

16   4. Division of Viral Diseases, National Center for Immunization and Respiratory Diseases, Centers

17   for Disease Control and Prevention, Atlanta, GA, USA.

18   5. Fogarty International Center, National Institutes of Health, Bethesda, MD, USA

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20   [*] These authors contributed equally to this article

21   To the Editor,

22   A novel human coronavirus, now named severe acute respiratory syndrome coronavirus 2

23   (SARS-CoV-2, referred to as HCoV-19 here) that emerged in Wuhan, China in late 2019 is now causing a

24   pandemic[1]. Here, we analyze the aerosol and surface stability of HCoV-19 and compare it with SARS-

25   CoV-1, the most closely related human coronavirus.[2] We evaluated the stability of HCoV-19 and SARS-

26   CoV-1 in aerosols and on different surfaces and estimated their decay rates using a Bayesian regression

27   model (see Supplementary Appendix). All experimental measurements are reported as mean across 3

28   replicates.

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30   HCoV-19 remained viable in aerosols throughout the duration of our experiment (3 hours) with a

31   reduction in infectious titer from $10^{3.5}$ to $10^{2.7}$ $TCID_{50}/L$, similar to the reduction observed for SARS-CoV-

32   1, from $10^{4.3}$ to $10^{3.5}$ $TCID_{50}/mL$ (Figure 1A).

33   HCoV-19 was most stable on plastic and stainless steel and viable virus could be detected up to

34   72 hours post application (Figure 1A), though the virus titer was greatly reduced (plastic from $10^{3.7}$ to

35   $10^{0.6}$ $TCID_{50}/mL$ after 72 hours, stainless steel from $10^{3.7}$ to $10^{0.6}$ $TCID_{50}/mL$ after 48 hours). SARS-CoV-

36   1 had similar stability kinetics (polypropylene from $10^{3.4}$ to $10^{0.7}$ $TCID_{50}/mL$ after 72 hours, stainless steel

37   from $10^{3.6}$ to $10^{0.6}$ $TCID_{50}/mL$ after 48 hours). No viable virus could be measured after 4 hours on copper

38   for HCoV-19 and 8 hours for SARS-CoV-1, or after 24 hours on cardboard for HCoV-19 and 8 hours for

39   SARS-CoV-1 (Figure 1A).

40   Both viruses exhibited exponential decay in virus titer across all experimental conditions, as

41   indicated by linear decrease in the $\log_{10} TCID_{50}/mL$ over time (Figure 1B). HCoV-19 and SARS-CoV-1

42   exhibited similar half-lives in aerosols, with median estimates around 1.1-1.2 hours, and 95% credible

43   intervals of [0.64, 2.64] hours for HCoV-19 and [0.78 , 2.43] hours for SARS-CoV-1 (Figure 1C, Table

44   S1). Half-lives on copper were also similar between the two viruses. On cardboard, HCoV-19 showed a

45   considerably longer half-life than SARS-CoV-1. Both viruses showed longest viability on stainless steel

46   and plastic: the median half-life estimate for HCoV-19 was roughly 5.6 hours on steel and 6.8 hours on

47   plastic (Figure 1C, Table S1). Estimated differences in half-life between the two viruses were small

48   except for on cardboard (Figure 1C, Table S1). Individual replicate data were noticeably noisier for

49   cardboard than other surfaces (Figures S1–S5), so we advise caution in interpreting this result.

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51   Our findings show that the stability of HCoV-19 and SARS-CoV-1 under the experimental

52   circumstances tested is similar. This indicates that differences in the epidemiology of these viruses likely

53   arise from other factors, including high viral loads in the upper respiratory tract and the potential for

54   individuals infected with HCoV-19 to shed and transmit the virus while asymptomatic[3,4]. Our results

55   indicate that aerosol and fomite transmission of HCoV-19 are plausible, as the virus can remain viable

56   and infectious in aerosols for multiple hours and on surfaces up to days. This echoes the experience with

57   SARS-CoV-1, where these modes of transmission were associated with nosocomial spread and

58   superspreading events[5], and provides guidance for pandemic mitigation measures.

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72   Figure 1. Viability of SARS-CoV-1 and HCoV-19 in aerosols and on different surfaces. A) SARS-CoV

73   and HCoV-19 were aerosolized in a rotating drum maintained at 21-23°C and 65% RH over three hours.

74   Viable virus titer is shown in $TCID_{50}$/L air. For surfaces, viruses were applied on copper, cardboard, steel

75   and plastic maintained at 21-23°C and 40% RH over seven days. Viable virus titer is shown in

76     $TCID_{50}$/mL collection medium. All samples were quantified by end-point titration on Vero E6 cells. Plots

77   show the mean and standard error across three replicates. B) Regression plots showing predicted decay of

78   virus titer over time; titer plotted on a logarithmic scale. Points show measured titers and are slightly

79   jittered along the time axis to avoid overplotting. Lines are random draws from the joint posterior

80   distribution of the exponential decay rate (negative of the slope) and intercept (initial virus titer), thus

81   visualizing the range of possible decay patterns for each experimental condition. 150 lines per panel: 50

82   lines from each plotted replicate. C) Violin plots showing posterior distribution for half-life of viable

83   virus based on the estimated exponential decay rates of virus titer. Dot shows the posterior median

84   estimate and black line shows a 95% credible interval. Experimental conditions are ordered by posterior

85   median half-life for HCoV-19. Dotted line shows Limit of Detection (LOD), $3.33 \times 10^{0.5}$ TCID$_{50}$/L air for

86   aerosols, $10^{0.5}$ TCID$_{50}$/mL media for plastic, steel and cardboard and $10^{1.5}$ TCID$_{50}$/mL media for copper.

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