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**Technical comment on: "Face masks effectively limit the probability of SARS-CoV-2 transmission"** Vol 372, Issue 6549, pp. 1439-1443, DOI: 10.1126/science.abg6296 https://www.science.org/doi/10.1126/science.abg6296



**KAI KISIELINSKI** Independent Researcher, Düsseldorf, Germany
**STEPHAN LUCKHAUS** Chairholder for Mathematics, Institute of Mathematics, University of Leipzig, Germany
**PAUL GIBONI** Independent Researcher, Hamburg, Germany
**ANDREAS PRESCHER** Chair of Anatomy, Institute of Molecular and Cellular Anatomy, Aachen, Germany
**STEFAN FUNKEN** Independent Researcher, Krefeld, Germany
**BERND KLOSTERHALFEN** Professor for Pathology, Institute of Pathology, Dueren, Germany
**OLIVER KEMPSKI** Professor for Neurosurgery, University of Mainz, Germany
**OLIVER HIRSCH** Professor of Business Psychology, University of Applied Sciences, Siegen, Germany

**Abstract:** We are presenting recent empirical findings and ask the authors to elaborate on their conclusions reached regarding the statistical significance (spatial/user). Additionally, an assessment by the authors with regard to objections of colleague Ioannidis is requested who, in view of massive erroneous predictions of modeling studies in COVID-19, concludes that these will generally not yield meaningful results in said area.

## Comment:

Aerosols are considered one of the major transmission routes of SARS-CoV2, although their quantitative contribution has not been conclusively determined. Since symptomatic people are almost absent from public spaces (testing, admission restrictions, etc.), the main argument for widespread mask use in the SARS-CoV2 pandemic is its protection against the virus spread with a postulated high probability of transmission by symptomless individuals. In a scientific study in Wuhan with nearly 10 million SARS-CoV2 PCR screenings there were 300 asymptomatic individuals who tested positive. However, screening of those 1174 closest contacts yielded zero PCR-positive tests. It follows that those who present clinically asymptomatic should be considered non-infectious (1). Thus, if asymptomatic people are not the focus of infection according to these findings, a mask for the asymptomatic can be questioned. Even if masks were to work, widespread use should be questioned because of the lack of literature clearly demonstrating the infectiousness of symptomless SARS-CoV2 infected individuals.
In addition, the infectivity and lethality risk of SARS-CoV-2 must be considered when recommending universal masking. Recent studies of SARS-CoV-2 show both significantly lower infectivity (2) and case fatality than previously thought. It has also been calculated that the median corrected infection fatality rate (IFR) was 0.10% (3, 4). In early October 2020, the WHO also publicly announced that projections indicate that COVID-19 is fatal for approximately 0.14% of infected.
No convincing data exists on the effectiveness of masks hindering the spread of the virus made by observations concerning the population, such as in the high-quality prospective randomized Danmask study; there was no mathematically significant difference between the 3030 mask wearers and the 2994 mask-less people in the rates of infection and disease with COVID-19 (5). In addition to this study, mention should also be made of the CDC study (6) in which the detection of SARS-CoV-2 infections were not directly related to popular mask use. A study by biologist Guerra from the U.S. also shows no effect of masks: comparing U.S. states with mandatory masking to mask-free states, there is no statistically significant difference for SARS-CoV2 infection and SARS-CoV2 death rates (7). These studies, considering realistic benchmarks, do not support a strong efficacy of masks in the context of SARS-CoV2 control. In total, empirical scientific evidence for masks as an effective means against SARS-CoV2 continues to be lacking with quite noteworthy non-

empirical data. Widespread mask advocacy continues to be maintainable only with predominantly theoretically based arguments and nonempirical data and is largely justified with single case reports, plausibility arguments based on model calculations and in vitro laboratory testing.
Indeed, if the potential adverse effects and long-term consequences of masks (8) are taken into account, even greater doubts arise regarding widespread use. At this point, we would like to emphasize the bacterial, fungal and especially the empirically proven viral contamination of masks among numerous other disadvantages of masks (8-10). The background of the political decisions on far-reaching mandatory mask use is difficult to understand scientifically (11). According to the medical principle of "primum nihil nocere" and in view of the presented findings, the mask would have to be scientifically re-evaluated in a SARS-CoV2 pandemic control (8).
A classification of the data obtained by Cheng et al in this regard would be interesting. For this reason, we would like to address the following questions:
1) The efficiency of the masks postulated by Cheng et al is non-linearly dependent on the viral load in the breathing air. Moreover, calculations are based on a postulate with a mean infection probability between 0.8% and 4.0%. Thus, a wide range of Pinf-values (1%-100%) is noted. The way that particle penetration is modelled, has serious shortcomings. As one sees from figure S10 the retention values are all over the place. And naked viroids of less than one micrometer diameter (e.g. 0.06-0,12μm for coronaviruses) are not comparable to other heavier particles of the same size. Water droplets are a different story altogether as the outer layers of masks are usually hydrophobic. What would be needed are retention values beta corona viruses before the masks and in the middle layer.
The single hit model is completely unrealistic. Infection probabilities as a function of virus exposition are usually S-shaped curves starting with a positive value depending on the susceptibility of the individual. Moreover the virus load determines also the probability of a severe illness. So avoiding asymptomatic infections resulting from a low virus exposition might be counter productive.
How do the empirical findings fit in with the interpretation of the published data/conclusions? What limitations (spatial/user-related) does this impose on the conclusions drawn for masks particularly in low-virus environments?
2) According to experimental studies, masks act like nebulizers and produce finer aerosols in percentage terms, which fly further and also float around the room longer than the larger aerosol particles released by people without masks (12). In addition, there is the empirically proven viral contamination of masks (9).
How have the authors taken this higher proportion of fine potentially virus-containing aerosols into account in their calculations? In the specific cases mentioned, how does this affect the assumptions of virus-rich and virus-poor indoor environments? How does the inhaled virus number (Nv) factor in formula 1 account for the nebulizer effect of the masks (increased virus presence indoors) and the data regarding asymptomatic carriers (decreased virus presence in aerosols)?
3) The calculations show statistical uncertainties (Cheng et al, Fig 2), which make the relevance of statements derived from them close to zero: due to standard deviations, they lie between 40% and 100% (Wuhan, Singapore, Gainesville and Omaha), in the worst case even between 10% and 100% (Hong Kong). According to colleague Ioannidis, a specification of threshold values or limit concentrations for the transmission of an infection by aerosols does not appear concretely possible since too many parameters play a role.
What is the authors position on the objection raised by colleague Ioannidis who, in view of the massive erroneous predictions in modeling studies of COVID-19, concludes that they will generally not yield meaningful results in this area (13)?

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**Competing interests:** Authors declare that they have no competing interests.