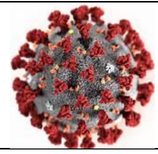
National COVID-19 Science Task Force (NCS-TF)



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In response to request from: Brigitte Meier, FOPH	**Date of request:** 03/06/2020
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Comment on planned updates :	

Responses to specific questions from FOPH, June 3, 2020

Summary of request/problem

FOPH sent the following request:

[...] haben wir den Auftrag erhalten ein weiteres Aussprachpapier [...] zu erarbeiten.

Im Aussprachepapier müssen folgende Aspekte diskutiert werden:

- Schutzkonzepte
- Distanz- und Hygienevorschriften
- Contact Tracing
- Veranstaltungen, Grossveranstaltungen

Dazu haben wir folgende Fragen an euch:

- Abgrenzung Tröpfchen vs. Aerosole und Relevanz von Aerosolen?
- Sinn und Unsinn von Lüften? – Relevanz für Veranstaltungen draussen vs. drinnen.
- Nutzen von Hygienemasken? Gibt es neu Erkenntnisse, die zu neuen Empfehlungen führen zu den bereits erarbeiteten und publizierten Maskenempfehlungen von euch im April?
- Relevanz von Superspreadern? Können diese vorgängig identifiziert werden? (Welche Faktoren determinieren Superspreader?)
- An was für Veranstaltungen, in welchen Situationen werden besonders viele Personen infiziert (Superspreading Events)?

Before addressing the specific questions below we would like to make a general point, based on our previously published policy briefs:

Fundamentally, the strategy to control SARS-CoV-2 rests on the combination of two approaches. **First, we have to prevent infection from occurring**, by social distancing, hygiene and masks. **Second**, in cases where infections did occur, **we need to stop further spread**; we have to trace contacts and test and quarantine them to stop onward transmission, and we have to identify and contain local and regional outbreaks.

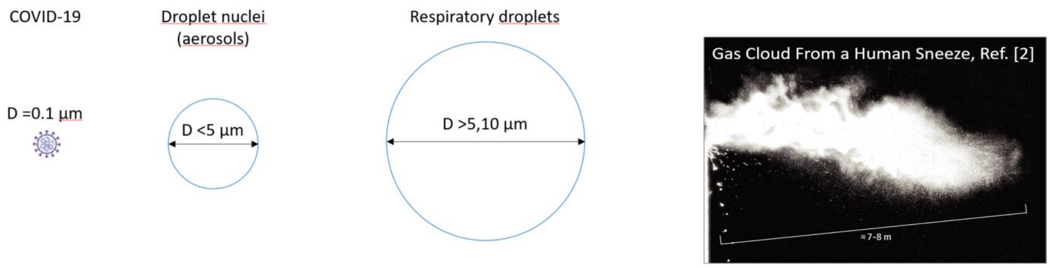
These two complementary approaches are essential to keep case number down and to safeguard health, the society and the economy. Situations where these complementary approaches are not effective jeopardize our ability to control the SARS-CoV-2 epidemic in Switzerland. This is for example the case for large events without social distancing and no defined seating order, so that tracing contacts is not possible. Such events would pose a large risk for the society and the economy, since even a temporal loss of control over the SARS-CoV-2 epidemic could result in very large costs.

When discussing the specific issues below, it is therefore essential that we always keep this goal in mind: Switzerland has made an enormous and successful effort to bring down the number of SARS-CoV-2 infections. It is extremely valuable to maintain low case numbers. **We thus have to make sure that Switzerland's strategy to control SARS-CoV-2 continues to be effective.** Any future release of measures in Switzerland should be done carefully and in a way that is fully in line with this strategy.

1. Transmission of SARS-CoV-2: distinction between droplets and aerosols; what is the relevance of aerosols?

The classification system of routes of respiratory disease transmission adopted e.g. by the WHO and CDC relies on the distinction between *respiratory droplets* and *droplet nuclei* or *aerosols* [1, 2]. We argue here that this distinction is based on a simplified and outdated model of disease transmission, and provide a perspective that is better grounded in physics. However, given the widespread use of these terms, we also discuss what is known about the transmission of SARS-CoV-2 in small droplets that are commonly referred to as "aerosols".

Respiratory droplets are defined as droplets larger than 5-10 µm in diameter, whereas aerosols correspond to smaller droplets. Respiratory droplets are assumed to fall fast, leading to contamination of surfaces, whereas aerosols remain suspended in air for much longer, where they can be directly inhaled.



This dichotomy of large vs. small droplets is based on a highly simplified model of disease transmission developed in the 1930s by W. F. Wells in the context of tuberculosis [2]. Wells assumed that *isolated* droplets are produced during exhalation. By comparing their settling times with evaporation times, he then proposed the 5-10 µm cut-off to distinguish between droplets that evaporate faster than they settle (aerosols) and droplets that settle faster than they evaporate (respiratory droplets).

Recent experiments on the gas clouds formed after a human sneeze [2] or on speech droplets [3] demonstrate that Wells' argument, based on individual droplets, is too simplistic. After a sneeze or cough, a cloud of droplets of various sizes is produced that can entrain the surrounding air and travel as far as 7-8 meters [2]. Droplets in the cloud can remain in the air for much longer than individual droplets, protected from evaporation by their moist surrounding. Even loud speech can emit thousands of droplets per second [3]. In particular, under a realistic viral load for COVID-19 and humidity conditions, at least 1000 virion-containing droplet nuclei that can remain airborne for more than 8 min were estimated to be produced during 1 min of loud speaking [3].

Despite these recent advances, the distinction between droplets and aerosols is still widely used in the literature about SARS-CoV-2. It is thus important to ask what we can learn about transmission from these studies. A recent important study analyzed viral transmission in two hospitals in Wuhan. This study analyzed viral RNA in what is commonly referred to as "aerosols", that is, small droplets suspended in air. The concentrations were found to be very low in aerosols detected in isolation wards, elevated in patients' toilet areas and undetectable in the majority of public areas, except for two areas prone to crowding. While infectivity of the virus was not established, these findings suggest that SARS-CoV-2 may have the potential for transmission by very small droplets that remain suspended in air [4]. An investigation of the stability of SARS-CoV-2 under such conditions estimated the virus's median half-life at about one hour, supporting the potential for transmission under these conditions [5]. Furthermore, efficient transmission of SARS-CoV-2 via in these small suspended droplets was demonstrated in an animal model [6].

Even though droplets and direct contact are the dominant way of transmission, these results show that SARS-CoV-2 can likely also be transmitted via aerosols, especially in poorly ventilated spaces [4]. (In addition, certain medical procedures can generate high concentrations of aerosols and present a major infection risk). This indicates that ventilation of closed indoor areas can be an important measure to prevent transmission, as will be discussed next.

2. Is it useful to ventilate closed rooms (e.g. opening windows)? If yes, how can this be implemented for events in closed spaces? What does it mean for events in open spaces?

It is useful to ventilate closed rooms. Large transmission events have typically occurred in indoor settings ([7]; see also the response to question 5). This viewpoint is also supported by a modelling study by a task force member for other viral pathogens. This study has shown that ventilation can have a substantial positive effect [8]. Ensuring adequate ventilation is also recommended by public health authorities such as the Center for Disease Control and Prevention (CDC). Ventilation can be achieved by opening windows and doors and prioritizing outdoor seating.

3. What is the effect of face masks? Are there new insights that would require updating our documents?

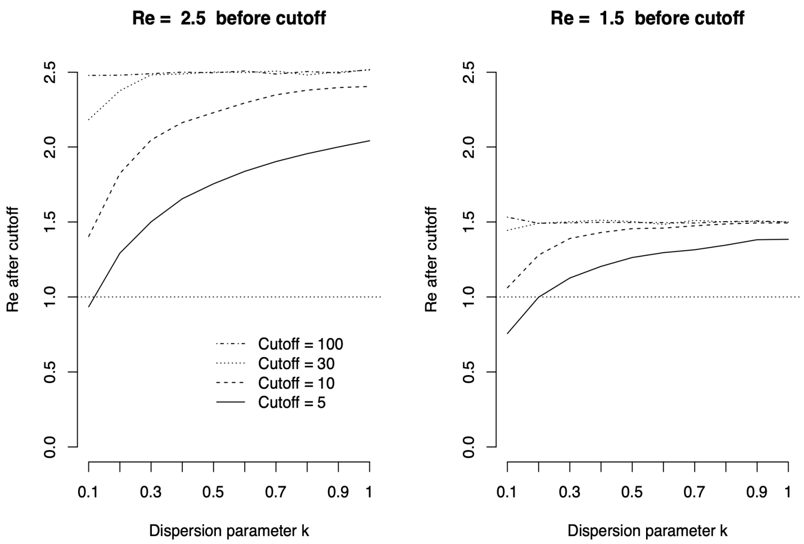
In our policy brief on the role of face masks from April 4th 2020 based on a rapid search of the literature on the effects of wearing masks by the general public or by healthcare professionals during epidemics and pandemics, we concluded that that the risk-benefit ratio is largely in favor of generalized mask-wearing in association with hand hygiene whenever social distancing cannot be maintained. We proposed that generalized wearing of masks should be implemented in combination with recommendations on hand hygiene and social distancing and communicated as part of a broader, coherent package of preventive measures for the entire community.

A new systematic review and meta-analysis commissioned by the WHO and published on June 1st addresses the effects of face masks on SARS-CoV-2, SARS-and MERS-transmission [9] . Face mask use was found to potentially result in a large reduction in the risk of infection: wearing a mask could reduce the risk of getting infected by up to 80% (it is important to keep in mind that confounding factors cannot be ruled out and could influence the estimate of the effect size). This finding supports the notion that a person wearing a mask does not only reduce the risk of infecting others but also reduces the risk of becoming infected. This supports and reinforces the earlier recommendations made by the Swiss National COVID-19 Science Task Force.

We would also like to point out that financial considerations could be relevant in terms of ensuring compliance with recommendations or regulations on mask wearing. If it turns out that the costs of face masks are a hurdle that prevent part of the population from using them, then subsidizing face masks could be considered.

4. What is the relevance of super spreaders? Can they be identified beforehand? Which factors determine whether someone is a superspreader?

The relevance of superspreading is currently actively debated. Multiple studies aimed to estimate the dispersion factor k, which describes how much a disease "clusters" has been estimated: k = 0.1[10], k = 0.54 [11], k = 0.58 [12], k = 0.45[13]. Lower values of the dispersion factor k imply a greater role of superspreading. For the lowest estimate of (i.e. k = 0.1) about 10% of cases would lead to 80% of the spread of SARS-CoV2 [10]. It is important to note that even under the most extreme estimate of k = 0.1 curtailing transmission by limiting only very large events may not have a very strong effect on reducing the reproduction number. The figure below shows the effective reproduction number Re as function of the dispersion parameter k after cutting off the maximum number of individuals to which an individual can transmit (cutoff = 5,10,30,100); this basically corresponds to an intervention where events with these numbers of participants are prevented. The two panels of the figure assume a different Re before cutoff. This graph shows that even at low values of k (i.e. large dispersion and high importance of super spreading) transmission needs to be curtailed at low numbers to reduce Re below one. The conclusion is that superspreading also occurs at events of moderate size and that precautionary measures to prevent transmission are also relevant at such events of moderate size.



The specific settings and behaviours that facilitate transmission (as detailed under question 5) are easier to identify beforehand then the patient-related characteristics which may facilitate the transmission of SARS-CoV-2. Some patients may shed virus at higher loads and for longer duration as compared to others, possibly related to differences in their immune system, treatments with immunocompromising drugs or individual distributions of virus receptors [14]. Furthermore, there may be individual differences in the number of particles released when talking [15] and more particles may be released when speaking loudly [15] or singing [14].

5. In which situations, at which events, is the risk of many people getting infected particularly high?

A systematic review of the available literature and media reports indicates that events with high levels of transmission are often linked to indoor settings (66.7%, 12 out of 18 events). Large clusters of infections have for example been observed in the context of religious venues and cruise ships and have been related to large numbers of attendees, confined spaces and physical contact. Further settings include hospitals, elderly care settings, worker dormitories, bars, schools, shops, offices, households, participation in sporting activities and eating together (restaurants, hotels, cafes etc.)[7].

Unresolved issues

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Appendices

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