

Transmission of and Exposure to SARS-CoV-2

Transmission Pathways

16. Modes of transmission of SARS-CoV-2 are becoming better understood. In common with other respiratory infections, the transmission route involves transfer of the virus from an infected person to the recipient, predominantly through the respiratory tract. At the start of the pandemic the prevailing authoritative opinion stressed the potential risk from contact with contaminated surfaces (fomites), and inhalation of relatively large infective droplets. More recent evidence suggests that transmission from surfaces is less important and that droplet transmission is feasible only when individuals are in close proximity (SAGE-EMG, 2020a). The main route is airborne transmission through inhalation of aerosols (very fine particles suspended in air), which can be transmitted indoors over distances of several metres (Meyerowitz et al., 2021; Stadnytskyi et al., 2021). Breathing, talking and singing result in the emission of fine aerosol, with higher vocalisation volumes substantially increasing the amount of aerosol emitted; coughing emits similar amounts of fine aerosol to loud speaking or singing (Gregson et al., 2021). The interconnection of the different routes is illustrated in Figure 2.

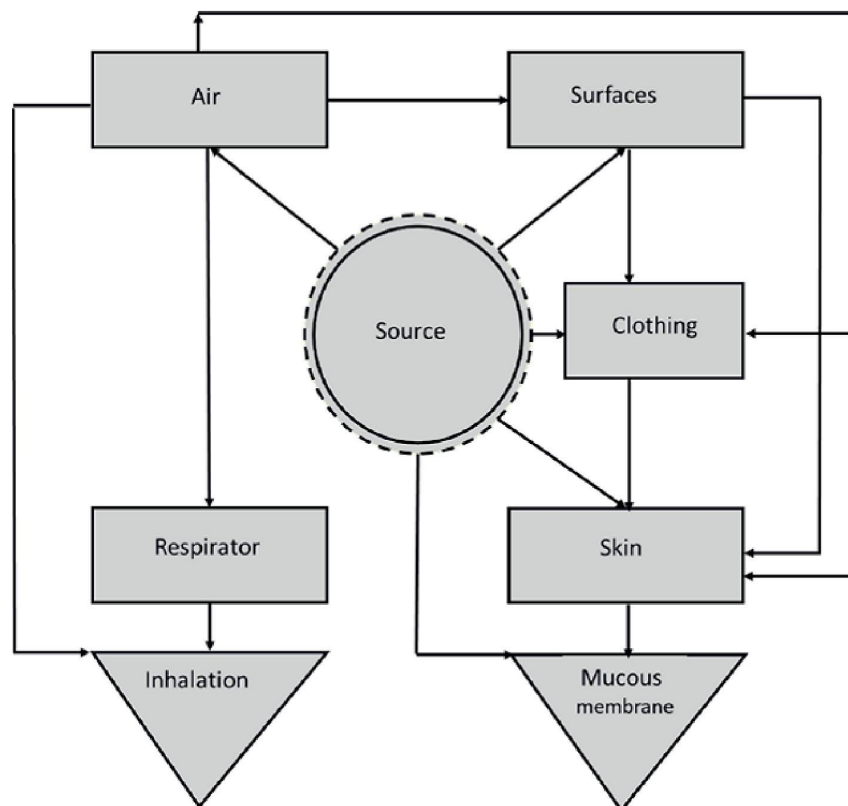


Figure 2: A source, pathway receptor model for transmission of SARS-CoV-2 (Williams et al, 2021)

17. It is difficult to determine the relative contribution of each of these transmission pathways and it is possible that the contribution of each may vary depending on the exposure setting or environment and the activities undertaken by people (SAGE, 2020). In general terms, the risk of viral infection depends on the level of exposure which, in turn, depends on the number, frequency, duration and proximity of infection sources (both social and occupational). In addition, environmental factors such as temperature, humidity and exposure to sunlight are relevant: e.g., the virus survives longer outside the body in cold dry environments (Dabisch et al., 2020, Chi et al., 2021).

18. The ONS has created an estimate of exposure to generic infectious disease, and physical proximity to others, for UK occupations based on US analysis of these factors. Occupations involving both regular exposure to infected individuals plus close contact with people will have higher risk of transmission, while those with close proximity yet lower exposure to disease will have lower risk. For example, health and social care workers who have a greater chance of being near to infected people will be at greater risk than someone working from home.

Exposure Environments

19. Several different environments or settings have been linked with SARS-CoV-2 transmission, including the home, transportation, social environments and 15 workplaces, with the home being the dominant source of infection (Anderson et al., 2020). High risks of infection have been associated with crowded poorly ventilated indoor spaces (HSE, 2021), particularly where activities promote increased emission of virus contaminated aerosol, e.g., singing, or situations where face masks are not worn (SAGE, 2020). Frequent and prolonged contact with an infected individual is also linked to increased transmission (SAGE, 2020) – by principle, the risk will be higher when the environment has greater numbers of infected people (e.g., in health and social care). These factors may be behind many of the reported workplace clusters of COVID-19 cases, although the role of shared transport or shared accommodation often confounds the interpretation (ECDC, 2020).

20. As described above, cold environments with dry air maintain the viability of the virus longer than in the environments typically found in homes or workplaces. This suggests that workers in cold workplaces, such as food processing plants, may be at greater risk of COVID-19 infection than workers in otherwise similar workplaces. Additionally, it is common in food processing plants that workers are closer together than in many other workplaces, and the HSE (2021) also noted that workers in meat processing plants use high pressure water hoses to clean surfaces and this may create a risk of inhaling fine water droplets containing the virus.

21. SAGE-EMG (2021) noted that outbreaks among staff in prisons occurred despite control measures that typically included restrictions on prisoner mixing, isolation of new arrivals and others who may be infected, confining prisoners to their cells for up to 23 hours a day and stopping visitors. The environment in prison may predispose the spread of infection because of the high population density,

high turnover of prisoners, sharing of facilities and accommodation, and poor ventilation.

22. Public transport and transportation of workers is a recognised transmission environment (SAGE-EMG 2020b). The risk is attributed to potential close contact with infected individuals, aerosol transmission because of poor ventilation, and possibly fomite transmission via handles and other hard surfaces. Gartland et al., (2021) reviewed the information on transmission and control of the virus on public transport. They showed there was evidence for SARS-CoV-2 viral RNA being present on transport and possibly resulting in infection, but the relative contribution of transmission routes could not be assessed. Similarly, while the use of face masks, improved ventilation and social distancing would reduce risk of transmission the effectiveness of each of these measures on public transport could not be determined.

23. Physical proximity to infected people goes beyond public- or patient-facing environments and can involve proximity to infected work colleagues (who may be asymptomatic). A risk of transmission is present in jobs where colleagues gathering in groups is an integral part of the job. As well as the example above of meat processors, some jobs entail the use of shared spaces within the workplace for rest and refreshments, such as train, taxi and bus drivers resting between journeys, or health professionals sharing changing facilities (Ochoa-Leite et al., 2021; Emecen et al., 2021). It follows, then, that solo jobs, such as HGV driving, will carry less risk in this respect. Similarly, working outdoors should, in principle, limit transmission of SARS-CoV-2 because of good ventilation and (probably) greater distance between people, yet that will depend on the relative amount of worktime outdoors and congregating indoors with colleagues.

24. Across the time course of the pandemic, there have been varying levels of hybrid working whereby people alternated between working at home and working in the workplace (where there will be a variable number of people with whom they have physical proximity with others under varying environmental conditions). Thus, the level of exposure and potential for transmission will likely have varied across time in any given workplace, job or sector.

Individual Behaviour and Transmission Risks

25. Transmission of the virus is dependent on the behaviour of individuals, whether that is complying with appropriate social distancing rules, wearing face coverings, or using other intervention measures. For instance, some work environments may entail or encourage behaviours that increase risk while others inherently control it. Some employers may provide better exposure controls than others both for their workers and for the public. Some people may choose to adopt risky behaviours dictated by personality, culture, or their inherent beliefs. In addition, typical human behaviours such as habitual face touching provides a possible route for transmission of the virus from fomites to the mucous membranes, while the tendency for kissing/hugging on greeting provides an even more direct route to infection.