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Technical Advisory Group

SARS-CoV-2 infection risks at Ice Rinks

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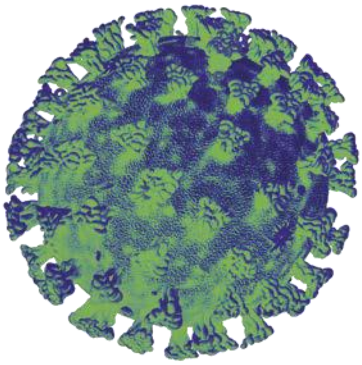

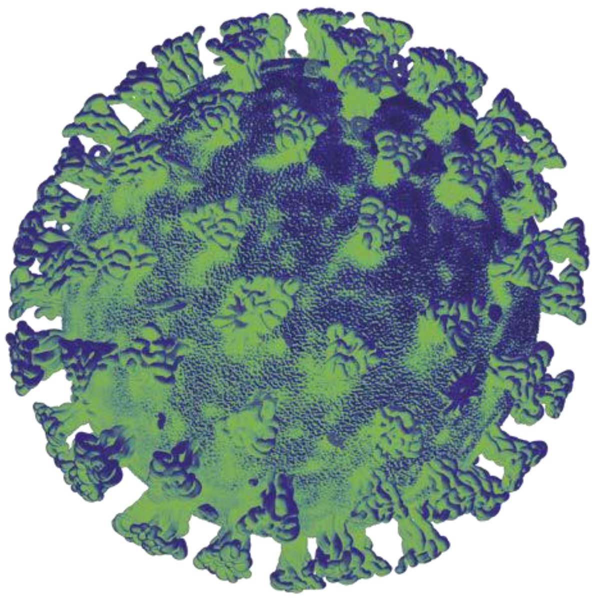

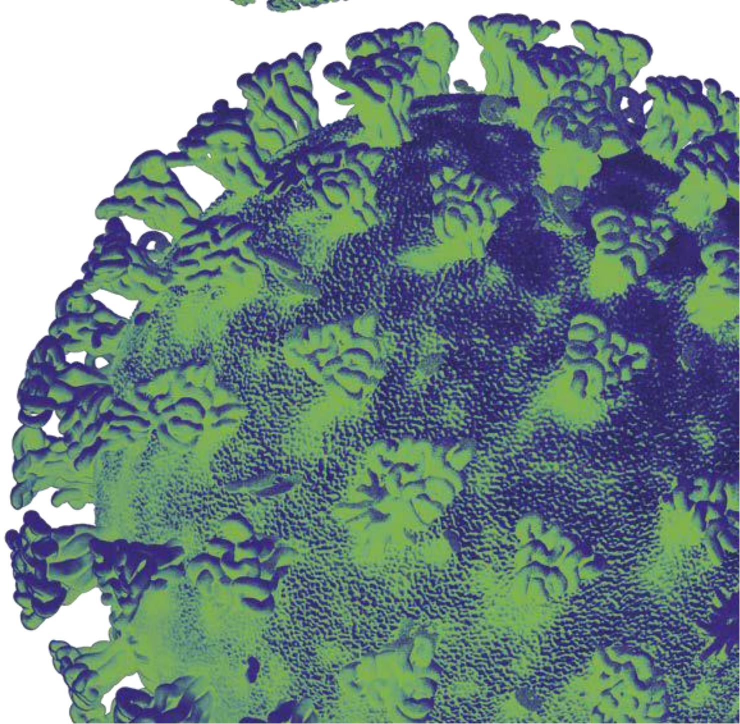

SARS-CoV-2 infection risks at ice rinks

This document identifies the key risks associated with the use of recreational ice venues within the context of COVID-19 before outlining mitigations. Considerations regarding professional ice sports are out of scope of this current guidance. This paper relates to ice rinks, ice walks and general ice venues where people may attend and be present on / near.

Recommendation: We identify compromised social distancing, pressure on healthcare, prolonged viability of SARS-CoV-2 in the cold, and the large number of surfaces and shared items as principal factors in elevating the risk posed by ice rink use beyond acceptable levels. We recommend recreational ice venues remain closed this winter.

1. **Potential for compromised social distancing**. (Direct risk)
   Risk: High. **Confidence:** High.

As skaters move around an ice surface, maintaining a 2m physical distance may prove challenging, particularly for less experienced skaters and during times of heavy use. The risk is further compounded by the potential for increased SARS-CoV-2 emissions during higher levels of aerobic activity (e.g. Buonanno et al 2020) and intermixing of households.

The use of pathways to direct skaters may reduce the potential for large-scale congregations but will also incur pinch-points and potential congestion. The need for intensive marshalling to support safety and social distancing places rink personnel at elevated risk, and requires use of a full range of personal protective equipment (PPE) to reduce the risk of infection. This is likely to significantly complicate marshalling, and relies upon the final step in the risk management hierarchy to adequately control the risk.

Ice sports attract spectators and bring players into close contact. Internationally, ice sports have been associated with multiple outbreaks (e.g. Florida; 14 of the 22 players and a rink staff member developed COVID-19; Atrubin et al 2020; 55% of participants at a curling tournament in Maryland; Luethy, 2020).

2. **Added pressure on Accident & Emergency presentations** (Indirect risk)
   Risk: Low. **Confidence:** Medium.

Moving on ice presents a risk of slips, trips, falls and collisions. These may lead to injuries requiring Accident & Emergency (A&E) treatment, for example for upper limb fractures (Barr et al. 2010). Within the UK context, more recent studies of hospital workload linked to temporary ice rinks estimate 1% of all admissions during the period of rink operation were due to injuries from skating (Kelsall & Bowyer, 2009; Barr et al 2010) whereas earlier studies report higher injury rates (e.g. Oakland, 1990). The importance of safe rink management education, wrist protectors and avoiding the sale of alcohol is stressed as a mitigating factor (Kelsall & Bowyer, 2009; Barr et al 2010; Oakland, 1990). At times of low COVID-19 related pressure on the NHS it is likely the additive impact of ice skating may be small enough to be absorbed, whereas at times of higher pressure enhanced control measures may prevent the use of ice rinks.

3. **Prolonged survival of infectious SARS-CoV-2 in cold environments** (Direct risk)
   Risk: High. **Confidence:** Medium.

Laboratory studies show SARS-CoV-2 survival is prolonged in colder conditions (TABLE 1) presenting potential risks from exposure to contaminated air or surfaces at ice rinks.

The skating ice surface is sustained at or below 0°C. The only study (Fisher et al 2020) identified which addressed the infectivity of SARS-CoV-2 after freezing in temperatures typical of rink ice performed the experiment in organic-rich substrates. The stability of SARS-CoV-2 in water ice is not known. While the lipid layer of enveloped viruses such as SARS-CoV-2 may increase its vulnerability to (repeated) freezing and thawing, other coronaviruses have proven resistant to freezing and thawing (murine hepatitis viruses: 15 cycles, Daniel & Talbot, 1987; Human Coronavirus 229E: 25 cycles, Lamarre & Talbot, 1989).

TABLE 1: Laboratory studies of SARS-CoV-2 infectivity in cold environments.

Study	T (°C)	Conditions	Outcome
Chin et al (2020)	4	Surface	No loss in infectivity for 14 days
Fisher et al (2020)	4	Meat	No loss in infectivity for 21 days
Fisher et al (2020)	-20	Meat	No loss in infectivity for 21 days
Fisher et al (2020)	-80	Meat	No loss in infectivity for 21 days
Riddell et al (2020)	20	Varied surfaces in the dark	Detectable after 28 days
Dabisch et al (2020)	10	Rotating drum aerosol, no UV, 20% RH	<1% (±0.5%) decay per minute
Dabisch et al (2020)	10	Rotating drum aerosol, no UV, 70% RH	1.7% (±1.2%) decay per minute
Dabisch et al (2020)	10	Rotating drum aerosol, 0.9W/m2 UV, 45% RH	11.1% (±4.7%) decay per minute
Dabisch et al (2020)	10	Rotating drum aerosol, 1.9W/m2 UV, 20% RH	18.9% (±4.8%) decay per minute
Dabisch et al (2020)	10	Rotating drum aerosol, 1.9W/m2 UV, 70% RH	22.4% (±10.4%) decay per minute

Artificial ice surfaces are formed by the accretion of ice or heated water onto a cooled surface which is then periodically groomed (e.g. by a Zamboni). Between grooming this presents a uniformly cold frozen surface which could become heavily contaminated by respiratory droplets from infectious skaters. Falls onto this surface or the handling of contaminated skates could present a likely mechanism for direct exposure to SARS-CoV-2. Physical grooming of the ice surface entails removal of the roughened surface and its replenishment by heated water (at >60°C https://www.exploratorium.edu/hockey/ice3.html) which could reduce the burden of infectious deposits between sessions. Ice removed in this manner is considered a biological hazard in Canada (Ontario Recreational Facilities Association: http://orfa.com/page-1863184) due to its contamination with respiratory secretions, vomit, urine and blood. Recreational Ice Venues need to ensure that the ice removed in this manner is disposed of appropriately and stored securely.

Temporary ice rinks operate during the darker and colder months of the year where outdoor air temperatures are lower (UK Met Office, Cardiff monthly high temperatures November-March <11.3°C) and both the duration and intensity of sunlight is at its weakest. These factors combine unfavourably to enhance the survival of aerosolised SARS-CoV-2 (Dabisch et al 2020). Permanent ice arena venues typically operate year-round under refrigerated indoor conditions. Moreover, the ventilation of indoor arenas has been investigated due to concerns regarding the accumulation of pollutants (e.g. Yang et al 2000). An investigation of a typical Scandinavian ice arena found very low air change rates (<0.03 changes per hour; Toomla et al 2020) while a study of bacterial loads within the air of a Polish ice arena found high levels of (likely skin and respiratory secretion-derived) bacteria which was inadequately managed by ventilation systems (Brągoszewska et al 2020). Notably, children at the arena were exposed to the highest doses compared to staff.

Uncertainties remain as to the resistance of SARS-CoV-2 to freeze-thaw damage and its persistence in water ice; however the combination of cold air and surface temperatures, diminished ultraviolet irradiance and limited ventilation is taken into account in our conclusion of a high risk.

4. **Infection by direct contact with contaminated equipment shared between users** (Direct risk)
   Risk: High. **Confidence:** High.

Sharing of skates and protective equipment between users presents a potential risk of fomite infection. This could be mitigated by sanitisation with appropriate disinfectants and rigorous handwashing. A further risk is presented by the extensive use of safety barriers, which in turn represent high-touch surfaces. This could be mitigated by regular disinfection, but this may not keep pace with the level of use in operations.

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