Potential application of glycol-based sprays to manage transmission of SARS-CoV-2

Purpose

To support decisions on mitigation strategies, further assessment of the use of biocides as a means of limiting transmission of SARS-CoV-2 is required.

This note explores the requirements necessary to support the deployment of airborne glycol-based biocides, for the purpose of limiting transmission of SARS-CoV-2, specifically, on efficacy and safety, in relation to impact on human health, in indoor (shared) environments.

Background

The deployment of certain chemicals used in stage and theatre performances as artificial smoke and fog has been proposed as a possible method for reducing viral transmission in indoor (shared) environments. The proposals are based on evidence that these chemicals, such as triethylene glycol (TEG), have been shown to have antiviral properties when used on surfaces in a laboratory setting.

Chemical sprays have been proposed for use in environments in three ways:

- Space decontamination – spray delivery in an unoccupied space as a means of cleaning the environment.
- Human decontamination – spray delivery via a booth as a means of reducing the presence of virus on people.
- Continuous aerosolisation – some form of delivery via a device in the room or the ventilation system to provide ongoing pathogen reduction within an occupied space.

This paper focuses on the continuous aerosolisation approach for use in occupied spaces only.

Literature review

Recent paper produced by the SAGE (CV-19) Environmental and Modelling Group (EMG) titled "*Potential application of Air Cleaning devices and personal decontamination to manage transmission of COVID-19*" reviewed the available literature, and discussed the use of a broad range of biocidal sprays, including glycol-based agents in indoor spaces.

The paper was presented, discussed and approved at the SAGE meeting on 5th November 2020.

Evidence for effectiveness as an anti-viral treatment

The EMG paper reported that there is currently no strong evidence that using continuous spray chemicals in the air will be an effective control against SARS-CoV-2 transmission. While there is some evidence to suggest that such compounds may have anti-viral properties, and may be useful for surface disinfection and room decontamination, there is no precedent for such an approach to be used as a continuous spray in an occupied space for infection control.

Potential health impacts

In considering health effects of glycol-based biocidal agents, the EMG paper reported that under normal occupational situations, adverse health effects through exposure *via* skin contact are not likely to occur. There was also no evidence that levels found/used in theatres caused occupational asthma. There is some evidence that repeated exposures to a glycol-based aerosol may result in respiratory tract irritation, with cough, shortness of breath and tightness of the chest. However, it is not possible to extrapolate the findings to other workplaces/settings or to longer-term exposure impacts, without further research.

Regulatory Landscape

Biocidal products such as disinfectants are regulated under the EU Biocidal Products Regulation (BPR). The regulation requires that the active substances used in these products have to be supported through a formal evaluation and assessment process, to consider their potential risks to people, animals and the environment. To date, the industry has not supported triethylene glycol (TEG) as an active substance through this review process, therefore it cannot currently be used as an active substance in biocidal products.

Short term derogations from BPR are possible, in particular when the active substance may be needed on the grounds of public health or of public interest, when no alternatives are available. Although the current pandemic would enable application for a derogation based on public health grounds, lack of evidence on efficacy and safety of TEG, and the availability of other methods for limiting transmission, such as use of ventilation, filter and UV based air cleaners together with face coverings or social distancing, would not meet the necessary additional criteria. Therefore, to facilitate the process for regulatory approval for the use of glycol-based biocides in indoor settings to reduce the transmission of SARS-CoV-2, further evidence on efficacy and safety of these products is necessary - see further details below.

Further regulation to consider is Control of Substances Hazardous to Health Regulations 2002 (COSHH) which applies for use of substances which may be harmful to people's health related to their work activities. COSHH requires processes to be put in place to eliminate or control the risks.

Demonstration of effectiveness

Primary requirement would be to identify what concentration of glycol-based products in air is required to effectively reduce the likely transmission of SARS-CoV-2 in an indoor environment. The second requirement would be to demonstrate that a system could maintain a constant and uniform concentration of glycol-based agent at an appropriate level within a specific indoor environment given the different physical parameters that affect air flow, including size and layout of the room, number of occupants, surfaces and air circulation through natural and artificial ventilation.

To assess effectiveness of the products against transmission of airborne SARS-CoV-2, room-scale air chamber experiments would be needed, where the efficacy of a given steady state concentration of the chemical would need to be tested against continuous application of a given aerosolised viral load. A set of experiments considering range of concentrations of both chemical and viral load would provide the necessary data to develop a dose

response curve, identifying the concentration of chemical to effectively reduce the concentration of the virus in air. Ideally, tests would be carried out using SARS-CoV-2, however it is recognised that a surrogate would almost certainly have be used in the laboratory experiments for safety reasons. It would be essential to demonstrate that it would be an effective representative of SARS-CoV-2.

To deploy biocides as an effective means of reducing airborne transmission would require maintaining biocide concentration in the air at levels suitable to control SARS-CoV-2. Indoor environments are dynamic and concentrations of the biocide in the air (and of the virus) will be affected by a range of physical and biological factors. The impact of various parameters on dispersal and concentration of the biocide, and the resulting likelihood of virus exposure could be modelled using suitable models, providing information on the key factors that will need to be considered for effective delivery of the necessary concentration of biocide within a given indoor setting.

Demonstration of safety

At the concentration where the biocide found to be effective in deactivating SARS-COV-2, impacts on human health will need to be assessed – from inhalation, ingestion from 'contaminated' food/drink, contact through surfaces and other routes. Depending on concentrations being considered i.e. if concentrations needed to limit transmission are at or below levels routinely used in theatres or other venues, it may be possible to draw limited conclusions on short term impacts based on evidence available in the literature. Nevertheless, further studies would be required to cover fuller range of considerations, including to assess impact of continuous exposure, exposure through multiple routes (skin, eyes, ingestion, inhalation), and cumulative impacts. If the spray is sufficient to result in a notable rise in particle concentrations in the air, the safety should also be assessed against UK air quality standards for particulate matter in air.

Technology and its application

As continuous spray methodology for the control of airborne infection is not currently a widely used method in occupied buildings, if research studies were successful, there would need to be the development of appropriate and reliable technologies for deployment. This would need to consider the reliability and usability of a system and how it interfaced with other aspects of the building including its ventilation and fire systems. Systems would also need to consider safe storage and handling of the chemical agent used within it.

Communication and acceptability

Further work will be required to support effective communication with the public. This would be required at two levels:

1. To avoid unintended, negative behavioural responses that may result from the deployment of the glycol-based agent. For example, the use could reduce adherence to other measures if people believed that it provided all round protection.

2. Acceptability to being in an environment where there is continual exposure to a chemical agent. It is not clear whether concentrations would be high enough for the chemical to be detectable by those in the space, either through nasal/oral sense or visually as a “haze”.

Conclusion and Next Steps

In the absence a good understanding of health impacts of exposure, and lack of evidence of the effectiveness of spray chemicals in the air in controlling against SARS-CoV-2 transmission, it is not possible to effectively assess whether the risks associated with their use in this way would outweigh benefits gained from a potential/limited reduction in risk of transmission of SARS-CoV-2.

At this stage the gap to developing such an approach while feasible i.e. scientifically possible would require substantial and time-consuming work on safety, efficacy and delivery with a high chance of failure. The timescales for this (with money as no object) would be in the order of months.

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