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Letter to the Editor

Respiratory mucus and persistence of virus on surfaces

Sir

When considering the persistence of viruses on surfaces and the activity of biocidal agents it is important to remember that respiratory viruses are transmitted in droplets of respiratory mucus, and that respiratory mucus has evolved to trap and neutralize viruses [1].

In their review article 'Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents' in this journal the authors claim that [2]:

'The analysis of 22 studies reveals that human coronaviruses such as Severe Acute Respiratory Syndrome (SARS) coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human coronaviruses (HCoV) can persist on inanimate surfaces like metal, glass or plastic for up to 9 days'.

However, there is a major criticism that can be made against this case for long term persistence of respiratory viruses such as coronaviruses on surfaces. The authors do not take into consideration that respiratory viruses are transmitted in respiratory mucus by coughs and sneezes and contamination with respiratory mucus of frequently touched surfaces. Respiratory mucus is a hostile environment for respiratory viruses for the following reasons:

Respiratory mucus from infected persons

1. Is likely to contain specific antibodies directed against the virus
2. Contains high numbers of leukocytes which give it a yellowish or green colour because of the high levels of peroxidase enzymes which inactivate viruses
3. Has intrinsic antiviral activity because of its polyanionic charge which binds viruses
4. Contains bacteria and fungi which may influence the environment around the viruses in the mucus

Studies on the persistence of viruses on surfaces do not use respiratory mucus as the vehicle to study the virus but usually culture the virus from a sputum sample and then apply the virus in culture medium to the surface to be studied.

For example, in one of the studies quoted by the authors to support the persistence of respiratory virus for 9 days on surfaces [3]. The investigators isolated virus from the sputum of

infected persons and then used the culture medium containing penicillin and streptomycin to contaminate surfaces. It is self-evident that a culture medium does not pose the same risk to virus infectivity as respiratory mucus containing leukocytes which have evolved over millennia to defend against viral infection.

My opinion, is that respiratory viruses will retain infectivity for a period of hours rather than days when transmitted in respiratory mucus.

One study which could be used to refute my opinion, is one on the survival of respiratory viruses on bank notes which demonstrated that the presence of respiratory mucus protected and prolonged the infectivity of influenza virus [4]. However, in this study the authors comment that the presence of mucus caused a rapid decline in the concentration of infectious virus, (a 10^2 reduction in only 2 hours). It is also important to note that the ability of a virus sample to infect a culture medium needs only a single virus whereas larger numbers of virus are needed to initiate an infection of the human airway due to the presence of mucus and mucociliary clearance defenses etc.

When considering the effectiveness of biocidal agents to inactivate respiratory viruses it is also important to consider that most assays use virus in culture medium rather than virus in respiratory mucus and that it is likely that viruses wrapped in respiratory mucus respond differently to exposure of biocidal agents when compared to viruses in culture medium.

References

- [1] Zanin M, Baviskar P, Webster R, Webby R. The Interaction between Respiratory Pathogens and Mucus. *Cell Host Microbe* 2016;19:159–68.
- [2] Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J Hosp Infect* 2020;104:246–51.
- [3] Rabenau HF, Cinatl J, Morgenstern B, Bauer G, Preiser W, Doerr HW. Stability and inactivation of SARS coronavirus. *Med Microbiol Immunol* 2005;194:1–6.
- [4] Thomas Y, Vogel G, Wunderli W, Suter P, Witschi M, Koch D, et al. Survival of influenza virus on banknotes. *Appl Environ Microbiol* 2008;74:3002–7.

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