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Viruses and other pathogens are often studied as stand-alone entities, despite that, in nature, they mostly live in multispecies associations called biofilms—both externally and within the host.

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Microorganisms in biofilms are enclosed by an extracellular matrix that confers protection and improves survival. Previous studies have shown that viruses can secondarily colonize preexisting biofilms, and viral biofilms have also been described.

...we raise the perspective that CoVs can persistently infect bats due to their association with biofilm structures. This phenomenon potentially provides an optimal environment for nonpathogenic & well-adapted viruses to interact with the host, as well as for viral recombination.

Biofilms can also enhance virion viability in extracellular environments, such as on fomites and in aquatic sediments, allowing viral persistence and dissemination.

Moreover, understanding the biofilm lifestyle of CoVs in reservoirs might contribute to explaining several burning questions as to persistence and transmissibility of highly pathogenic emerging CoVs.

It has been established that the majority of microorganisms on earth live in biofilms (45, 46). Viruses play an extensive ecological role and have been reported to exist in diverse microbial communities as biofilms.

They are involved in several dynamics, such as microbial diversity and biogeochemical cycles, due to their prevalence and variation across diverse ecosystems (47).

Therefore, it is essential to comprehend how the viruses effectively persist in different environments because this process can assist in the understanding of their transmissibility and cross-infectivity among different hosts.

Biofilm is an ecological cluster of microorganisms, surface-attached or floating, with the evolutionary purpose of protection, nutrition, or strengthening survival. In biofilms, the microorganisms are surrounded by a complex of assembled extracellular

matrix.

This results in heterogeneous biomolecular and biochemical arrangements that hinder the entry of exogenous components while facilitating the exchange of genetic elements among microbial cells (48, 49).

Viruses, as well as other microorganisms, may come into contact with preexisting biofilms and accidentally adhere and become a part of them, thus constituting secondary colonizers.

A study from 2002 supports that biofilms may encompass a set of nonenveloped enteric viruses, including caliciviruses, Rotavirus spp., Astrovirus spp., and hepatitis A virus, among other microorganisms such as Gram-negative bacteria and filamentous fungi

Some authors indicate that the human oral cavity may be an active site of infection and reservoir for SARS-CoV-2, assuming its interaction with the host oral microbiota (59), which is mostly in the form of biofilm.

virions & virus-infected eukaryotic cells embedded in biofilms have been reported to retain their infectivity. A study investigated the enveloped virus herpes simplex virus 1 (HSV-1) & the nonenveloped virus coxsackievirus type B5 (CVB5) within the fungal Candida albicans biofilm

viruses encompassed on biofilm kept their viability and infectivity, it indicates that biofilm lifestyle does not limit viral dissemination (60) and even can improve it. Therefore, viruses stored in biofilms may be regarded as temporary or long-term reservoirs in the environment

...the extracellular state represents a crucial step for viral dissemination, since intracellular formed virions have to spread to the surface of other target cells to restart viral replication. At this moment they are exposed to physicochemical & host immune system challenges.

Biofilms may contribute to viral recombination events, especially for supporting an environment in which distinct and infectious viruses are physically close and in the presence of extracellular enzymes and genetic fragments.

These viruses would be released from the biofilm and would coinfect the same host cell, leading to gene exchanges & recombination. Therefore, the facilitated cell coinfection by diverse viruses allows the evolution & emergence of new viral particles that can undergo spillover

Biofilm may act as viral storage, where virions remain infectious within the hosts (humans and wild, livestock, or domestic animals) and in the environment (food, water, excreta, plants, pastures, and fomites).

Biofilm may support virion persistence through matrix physicochemical protection against stresses, ... & against immune responses (immunological modulation) & also through resistance to chemical substances, keeping viral particles infective over time.