

Impact of Quaternary Ammonium Disinfectants on Transfer of Viruses from Fomites to Fingers



ABSTRACT

BACKGROUND: Hard and soft surfaces (fomites) can play a role in the transmission of both enteric and respiratory viruses. Transmission can occur by touching of contaminated surfaces and bringing the hand to either the mouth or nose or by re-aerosolization of the virus from the surface. In adults face touching occurs every 3 to 4 minutes. The amount of virus transfer which occurs depends on the nature of the surface, the virus type and the degree and type of activity within a facility.

METHODS: We conducted studies on the finger transfers of both a non-enveloped (MS2 coliphage) and an enveloped virus (Coronavirus 229E).

RESULTS: The greatest degree of non-enveloped virus occurred with glass and laminate, while the greatest of the enveloped virus occurred from porcelain and glass. Transfer to the finger from surfaces of the coronavirus was reduced by treatment of surfaces with various commonly available quaternary ammonium disinfectants after 24 hours of application to the fomites by 37% to 99.9%.

CONCLUSION: The results indicate that spread of viruses in a faculty and exposure via hand contact can significantly be reduced by disinfection of fomites and activity of quaternary disinfectants may last for 24 hours.

METHODS

In the first set of experiments virus was inoculated onto different hard surfaces and let dry for 15 minutes. One transfer trial consisted of six transfer events using the index, middle, and ring fingers of both hands for each surface type. The transfer protocol was conducted according to Lopez et al. (2013) by placing the finger pad directly onto the contaminated carrier, achieving full contact with the 1-cm² inoculum zone for 10 seconds at 1.0 kg/cm² of average pressure (range, 900 g/cm² to 1,200 g/cm²). Virus was recovered from the fingers by washing with one mL of cell culture media and the virus recovered assayed on MRC-5 cells (coronavirus) or *Escherichia coli* (MS2). The amount of virus placed on the carriers was determined by inoculation of another set of carriers and virus recovery by scraping and washing the surface with culture media. In the second set of experiments the carriers were treated with various commercially available quaternary ammonium disinfectants and after 24 hours inoculated with coronavirus and after 15 minutes recovered from the fomites as stated previously.

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RESULTS

Figure 1. Transfer of Virus from Fomite to Finger

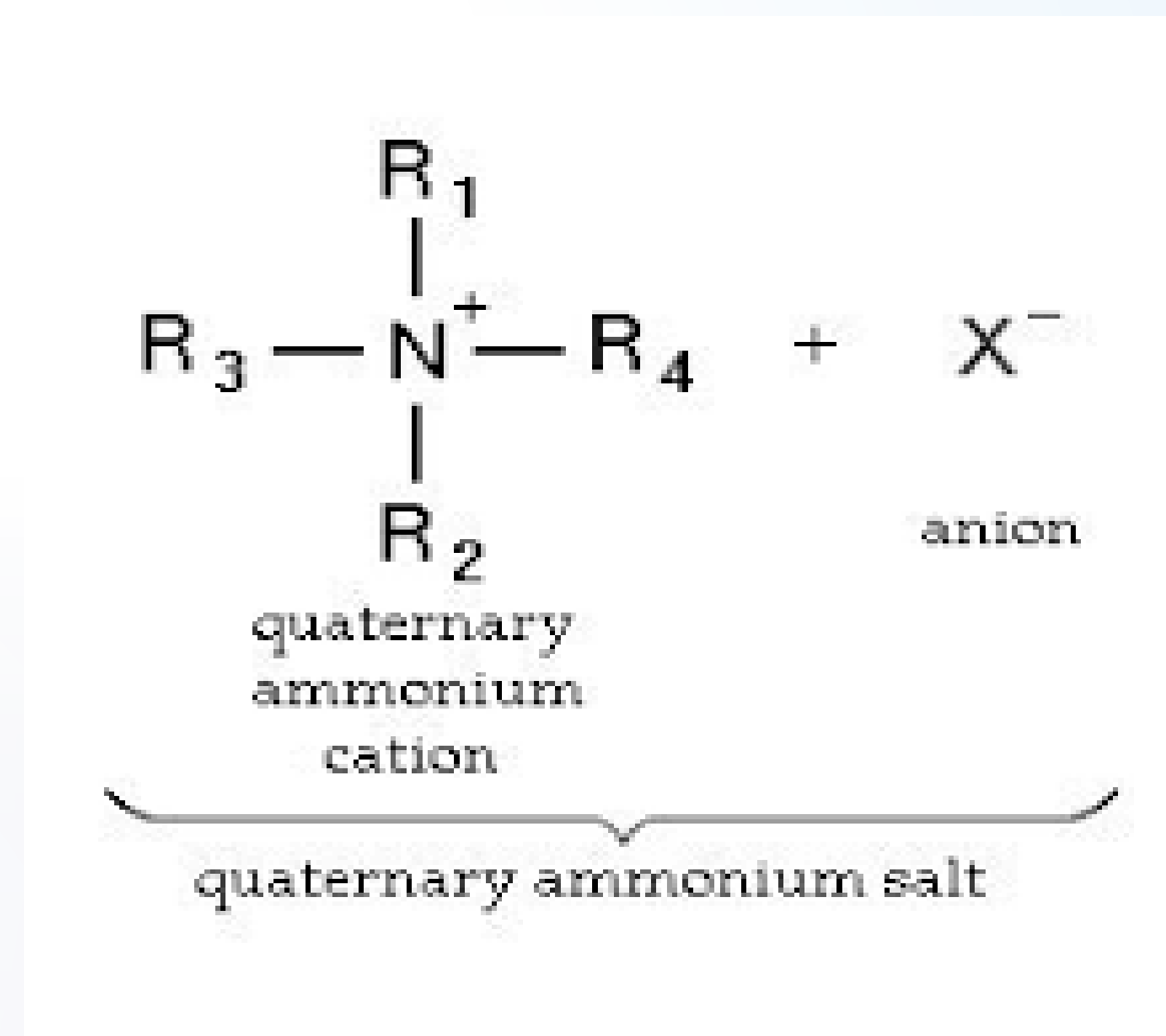
Fomite	Coronavirus 229E *	Coliphage MS-2**
Stainless Steel	0.46	37
Glass	37	63
Glazed Porcelain	49	41
Laminate	7	63
Formica	25	Not done

*enveloped virus ** non-enveloped virus

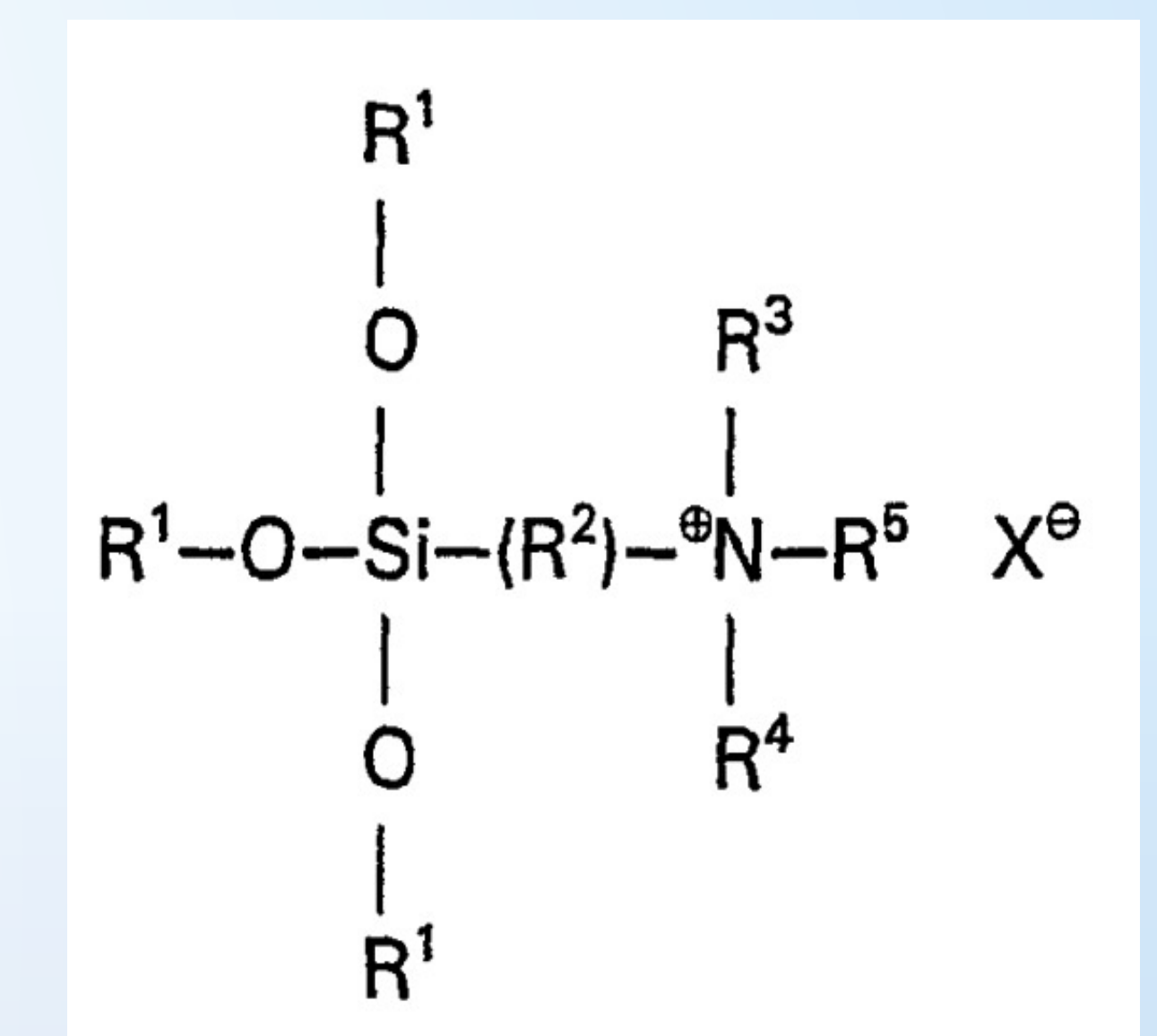
Figure 2. Finger Transfer of Human Coronavirus 229E from Quat Disinfected Fomites*

Product Type	Percent of Coronavirus Transfer to Finger
Control – no Quat	49.1
Quat - Disinfecting wipe	17.6
Polymeric organosilane Quat spray	4.1
Polymeric organosilane coating	0.08

*Disinfectant added to the surface then after 24 hours virus added to the surface followed 15 minutes later by finger transfer



Quaternary Ammonium Disinfectant Structure



Organosilane Quaternary Ammonium Disinfectant Structure

CONCLUSIONS:

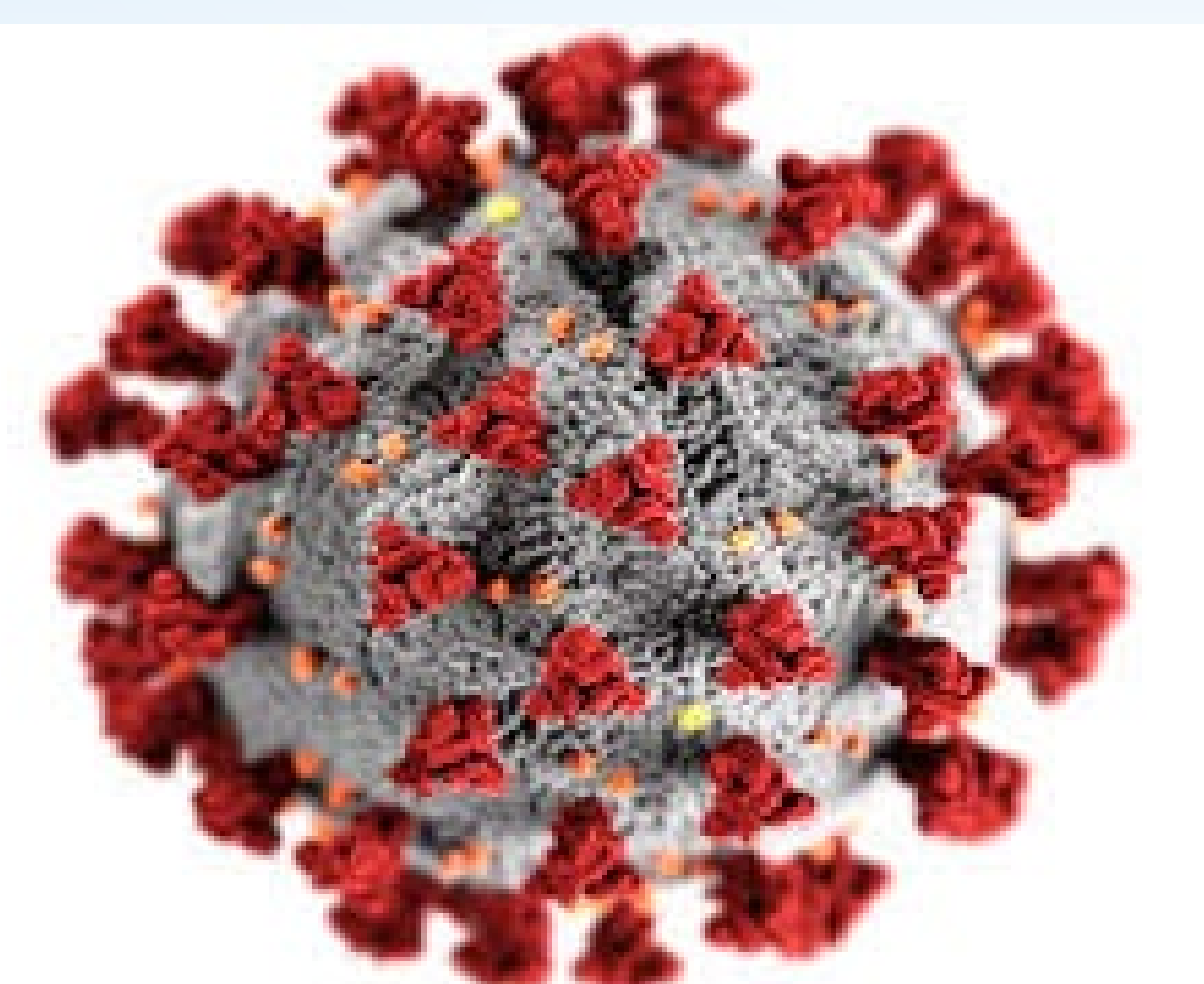
- An enveloped virus (human coronavirus 229E) and a non-enveloped virus (MS2) are transferred to the finger to different degrees depending upon the type of fomite.
- Coronavirus 229E transfer occurred the most from glazed porcelain
- Quaternary Ammonium disinfectants reduced the amount of transfer even after 24 hours of application
- Organosilane quaternary ammonium disinfectants are the most effective in preventing transfer 24 hours after contamination with the virus
- Both types of quaternary ammonium compounds reduce the risk of finger contamination even after 24 hours since application

Reference

Lopez GU. 2013. Transfer efficiency of bacteria and viruses from porous and nonporous fomites to fingers under different relative humidity. *Appl Environ Microbiol* 79:5728-5734

Approvals: This study was approved University of Arizona Office of Risk Management

Disclosure Statement: This study was supported in part from a grant to the University of Arizona from Allied Biosciences and Disinfection Gift Trust Fund at the University of North Carolina



Human Coronavirus



MS2 virus (coliphage)