Impact of continuously acting disinfectants on fomite-to-finger transfer on probability of coronavirus transmission

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**Abstract**

Inanimate surfaces, or fomites, can serve as routes of transmission of enteric and respiratory viruses. This study investigated the change in microbial transfer from contaminated fomites to fingers following treatment of surfaces with continuously acting disinfectants used to treat a fomite.

**Introduction**

Fomites are known to play a role in the transmission of both respiratory and enteric viruses (Boone and Gerba, 2007). Clearing and disinfecting surfaces on a regular basis reduces the risk of fomite transmission, but recontamination may occur between these practices. These is especially true of frequency touch areas such as sinks, handrails, counters, etc. The development of antivirus surfaces, coatings or spray disinfectants offers another barrier to transmission in between regular cleaning and disinfection. The goal of this study was to assess impact of transfer of the human coronavirus 229E to the finger wit ha surface that been treated with disinfectants that would leave an anti-viral residual.

**Material and Methods**

**Virus**. Human coronavirus 229E (HCoV) (ATCC-740), a respiratory virus, was propagated and assayed in the fetal human fibroblast, MRC-5 cell line (ATCC CCL-171). Infected cells were frozen and thawed three times at -20°C to release virus after cytopathogenic effects (CPE) were observed in the monolayer. This was followed by centrifugation at 1000 g for 20 minutes to remove cell debris, addition to the virus suspension of 12% polyethylene glycol (MW 8000) and 0.5 M sodium chloride, and stirring overnight at 4°C. After centrifugation at 10,000 g for 60 minutes, the pellet was resuspended in 0.01 M phosphate buffered saline (PBS; pH 7.4) (Sigma, St. Louis, MO) to 10% of the original virus suspension volume. The virus was then titered and stored at -80°C until needed. The virus was enumerated on cell cultures using either TCID50 technique (Payment and Trudel 1993). The virus was titered in 96-well plastic cell culture plates by culture infectious dose 50% technique (TCID50) using the Spearman and Kärber algorithm (Hierholzer and Killington, 1996). This technique determines the dilution at which 50% of the wells show CPE. Taking the inverse log of this dilution gives a titer of the virus per ml TCID50.

**Subject**. The subject was a healthy 75 year old male. Permission was obtained from University of Arizona Institutional Biosafety Office before the conduct of the study. Infected cells were frozen and thawed three times at-20°C to release virus after cytopathogenic effects (CPE) were observed in the monolayer. This was followed by centrifugation at 1000 g for 20 minutes to remove cell debris, addition to the virus suspension of 12% polyethylene glycol (MW 8000) and 0.5 M sodium chloride, and stirring overnight at 4°C. After centrifugation at 10,000 g for 60 minutes, the pellet was resuspended in 0.01 M phosphate buffered saline (PBS; pH 7.4) (Sigma, St. Louis, MO) to 10% of the original virus suspension volume. The virus was then titered and stored at -80°C until needed. The procedure was approved by the University of Arizona Risk Management and did not need a human subject review.

**Control wash**. Prior to all experiments, the subject’s hands were washed with warm water and Softsoap antibacterial liquid hand soap (Colgate-Palmolive, Morristown, NJ) for 45 seconds, rinsed with water, and dried with paper towels. Each hand was then sprayed twice with 70% ethanol, rubbing the alcohol thoroughly over the hands and wrists for 15 seconds, and subsequently air dried. After conducting fomite-to-finger transfer experiments with the prepared inoculum, fingers were disinfected twice with 70% ethanol, wrapped with a 70% ethanol-saturated paper towel for 30 s, washed and rinsed using warm water and Softsoap antibacterial liquid hand soap (Colgate-Palmolive, Morristown, NJ) for 45 seconds, and then dried with paper towels.

The study was conducted in a room with a humidifier to achieve a relative humidity of ~55% at room temperature 73 oF (22.2 oC).

**Finger sampling**. The method of Lopez et al (2013) which involved the use of recovery the virus from the fingers by rubbing into a solution of 1 ml of Medium Essential Media (MEM) was used to recover the virus from the finger. The MEM was placed in a sterile plastic petri dish and the finger rubbed in the liquid for 10 seconds.

**Transfer experimen**t. One transfer trial consisted of three separate fomite-to-finger transfer events using the index, middle, and ring fingers of the right and left hand for each surface type. Two transfer trials were conducted, resulting in six transfers in total for each fomite under a relative humidity of 50 to 60%. A protocol adapted from Ansari et al. (1988) was used to perform the fomite-to-finger transfer of test organisms from the previously mentioned nonporous fomites to hands after a 30-min drying time. The fomite transfer was performed by placing the fingers on the center, covering the inoculated area of the fomite, for 10 seconds with 1.0 kg/cm2(98.0665 kPa) of average pressure (range, 900 g/cm2 to 1,200 g/cm2) (Ansari et al 1988; Mbithi et al 1992). A porcelain surface was used since the greatest amount of finger to fomite occur with this material (Gerba et al 2021).

The gazed porcelain (tiles) surfaces were treated by spraying the disinfectant or using a wipe 24 hours before the virus was applied to the surfaces. After drying (30 minutes) the transfer experiment took place. The glazed porcelain where s 1 X 1 inch squares obtained from Home Depot (Atlanta, GA).

**Risk Assessment**.

**Results**

The products tested, methods of application to the porcelain tiles are shown in Table 1. The transfer percent of the virus from the tile to the finger after treatment of the surface and performing the finger transfer after 24 hrs of treating surface.

Table 1. Disinfect products evaluated

|  |  |  |  |
| --- | --- | --- | --- |
| **Product**  **Number** | **Active ingredients** | **Description** | **Manufacturer or Source** |
| 1  2 |  | Disinfecting wipe  Disinfecting wipe AF3 | Walmart, Bentonville, AK  PDI, Woodcliff Lake, NJ |
| 3 |  | Sani-24 spray, polymeric quat | PDI, Woodcliff Lake, NJ |
| 4 |  | Polymeric slinated quat | Allied Biosciences, Dallas, TX |
| 5 | No treatment | Not applicable | No disinfectant |
|  |  |  |  |

Table 2. Fomite-to-finger pad transfer efficiencies of human coronavirus 229E

|  |  |  |  |
| --- | --- | --- | --- |
| **Product** | **Mean Pre-Transfer Surface Viral Titer Log10 ± S.D. (n=3)** | **Transfer Replicates (n)** | **Mean Transfer Efficiency % ± S.D.** |
| 1 |  | 3 | ~51 |
| 2 |  | 3 | ~20 |
| 3 |  | 3 | 0 |
| 4 |  | 3 | 0.01 |
| 5 | 4.72 ± 0.10 | 6 | 49.07 ± 16.70 |
|  |  |  |  |

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