

The Dynamics of Microbe Spread via Hands and Fomites Throughout an Outpatient Clinic

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Abstract:

Background: In our efforts to halt transmission of harmful microbes, it is important to understand the dynamics of their transfer via hands and fomites. Previous studies have explored these dynamics in acute care and, to a lesser extent, in long-term care. While treatment in outpatient clinics is of lower acuity, it can be an important source of transmission of respiratory, gastrointestinal, and other infections. The objective of this study was to understand how organisms move through an outpatient clinic on surfaces and hands. **Methods:** At the start of the clinic day, a tracer virus (bacteriophage MS2 at concentration 1×10^9 plaque forming units) was inoculated onto two fomites in the outpatient clinic: the door handle exiting the patient care area and the sign in pen at the front desk. Patient care, surface cleaning practices, and hand hygiene practices continued as typical. Fomites throughout the facility (n=19), hands of clinic staff (n=4), and hands of patients (n=3-4) were sampled at 2, 3.5, and 6 hours. **Results:** At 2, 3.5, and 6 hours post-contamination, MS2 was detected on all surfaces and hands sampled. The MS2 load detected on surfaces did not significantly differ at each of the sampling times (Figure 1). Levels of MS2 collected on hands decreased over the day, detecting significantly lower numbers at 6 hours than at 2 hours (Figure 2). **Conclusion:** Contamination spreads quickly in a high traffic outpatient clinic, reaching maximum contamination levels 2 hours after inoculation. Hands, as expected, yielded some of the highest levels of contamination. Surfaces were also serving as reservoirs of contamination, with those yielding the highest levels of contamination being door handles of exam rooms and chair arms in the nurse station. This emphasizes the importance of hand hygiene and frequent disinfection of frequently touched surfaces. Additional studies are underway evaluating the impact of targeted intervention protocols to reduce pathogen transmission.

Introduction:

Healthcare environments

- Allows for the growth and survival of nosocomial pathogens
- Cleaning and disinfection significantly disrupts ecological niches
- ~787 million visits to outpatient facilities each year (2013)
- HAI: \$28.4-45 billion dollars (2007)
- Infection control saved \$5.7-31.5 billion per year (2007)

Previous Transfer Studies

- Soft Surface Transfer: Tables 1 and 2

Outpatient Clinics

- Highly variable environment
 - Patient illnesses
 - Patient visits
 - Patient population
 - Building design
 - Staff training

Purpose:

- To understand how organisms move through an outpatient clinic on surfaces and hands

Methods:

- Viral Transfer Background
 - Fomite surfaces were cleaned with an ethanol based disinfectant prior to the opening of the clinic
 - Prior to opening of clinic bacteriophage MS2 was inoculated onto 2 surfaces at a concentration of 1×10^9 pfu/mL
 - Front desk sign in pen and door handle exiting patient care area
 - Normal practices were continued throughout the day
 - Fomite and hand samples (Table 3) were collected using a spongestick 2, 3.5 and 6 hours after the opening of the clinic
 - Samples were assayed using the top agar overlay technique
 - Incubated at 37°C for 24 hours
- Viral Transfer with Targeted Disinfection
 - Divided into three phases (Table 4)
 - The above methods were utilized prior to the opening of the clinic
 - 4 hours after opening all sample sites were disinfected with phase specific disinfectant (Table 4)
 - 2 hours after disinfection samples were collected using spongesticks and assayed as describe above

Results:

- Viral Transfer
 - MS2 was detected on all surfaces throughout the day
 - Viral concentrations remained stable on surfaces throughout all time points
 - Viral concentrations decreased on hands as the day progressed
 - Patient and staff surfaces had similar rates of contamination
 - Virus was detected more frequently on staff hands when compared to patients
 - Results are summarized in Table 5 and Figures 1-2.

Table 5: Comparison of Viral Transfer by Time

Outpatient Clinic	2 Hour	3.5 Hour	6 Hour	Total
Total Transfer	73% (19/26)	52% (14/27)	54% (14/26)	59% (47/79)
Dr/Nurse Surface Transfer	50% (3/6)	67% (4/6)	50% (3/6)	56% (10/18)
Dr/Nurse Hand Transfer	75% (3/4)	75% (3/4)	100% (4/4)	83% (10/12)
Patient Surface Transfer	77% (10/13)	31% (4/13)	46% (6/13)	51% (20/39)
Patient Hand Transfer	100% (3/3)	75% (3/4)	33% (1/3)	70% (7/10)
Range of pfu	0-1.8x10 ⁴ pfu/surface	0-7.3x10 ³ pfu/surface	0-3.4x10 ³ pfu/surface	0-7.3x10 ⁴ pfu/surface
Average Overall	1.0x10 ³ pfu/surface	370 pfu/surface	141 cfu/surface	496 pfu/surface
Average Contaminated	1.4x10 ³ pfu/surface	634 cfu/surface	261 cfu/surface	834 pfu/surface

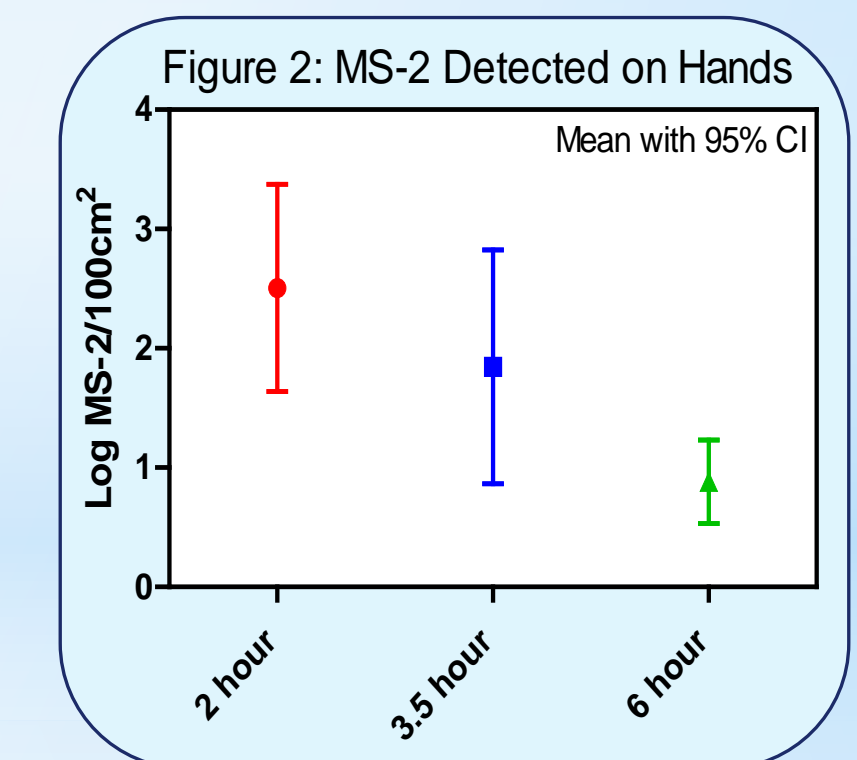
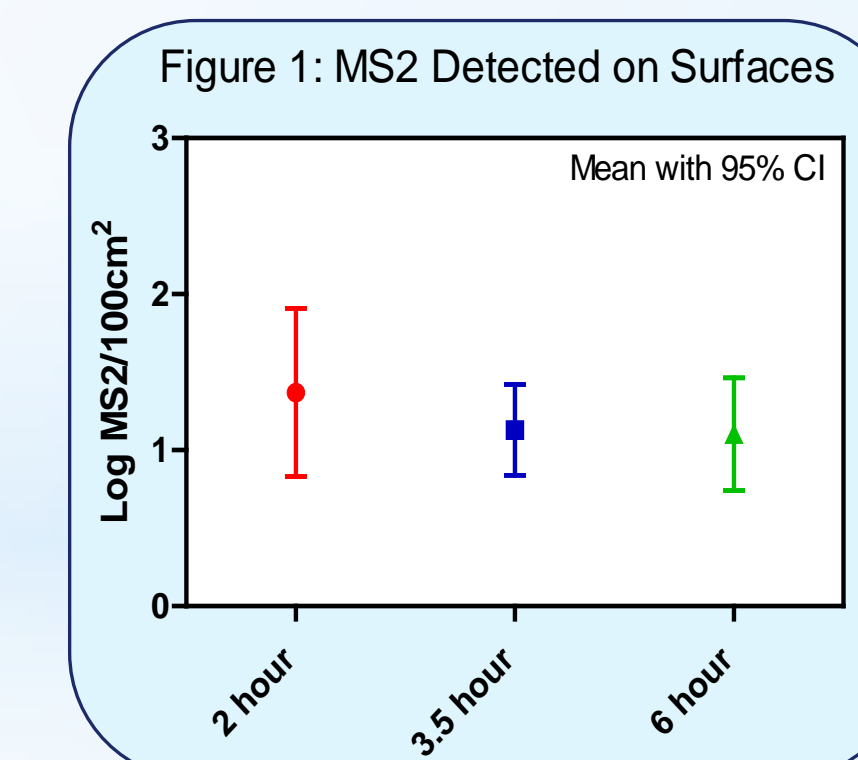


Table 3: Sample Sites and Surface Areas

Sample Sites	Area Sampled (cm ²)
Front Bathroom Handle's	100
Front Bathroom Faucet	100
Waiting Room Nurses Mouses	100
Waiting Room Counter	100
Waiting Room Survey Computer Mouse	100
Triage Seat Arms	30
Back Bathroom Handles	100
Back Bathroom Faucet	100
Nurses Station Mouses	100
Nurses Station Chair Arm	100
Patient Room Canisters (3)	100
Patient Room Bed (3)	100
Patient Room Inner Door Handle (3)	50
Staff Hands (4)	100
Patients Hands (4)	100

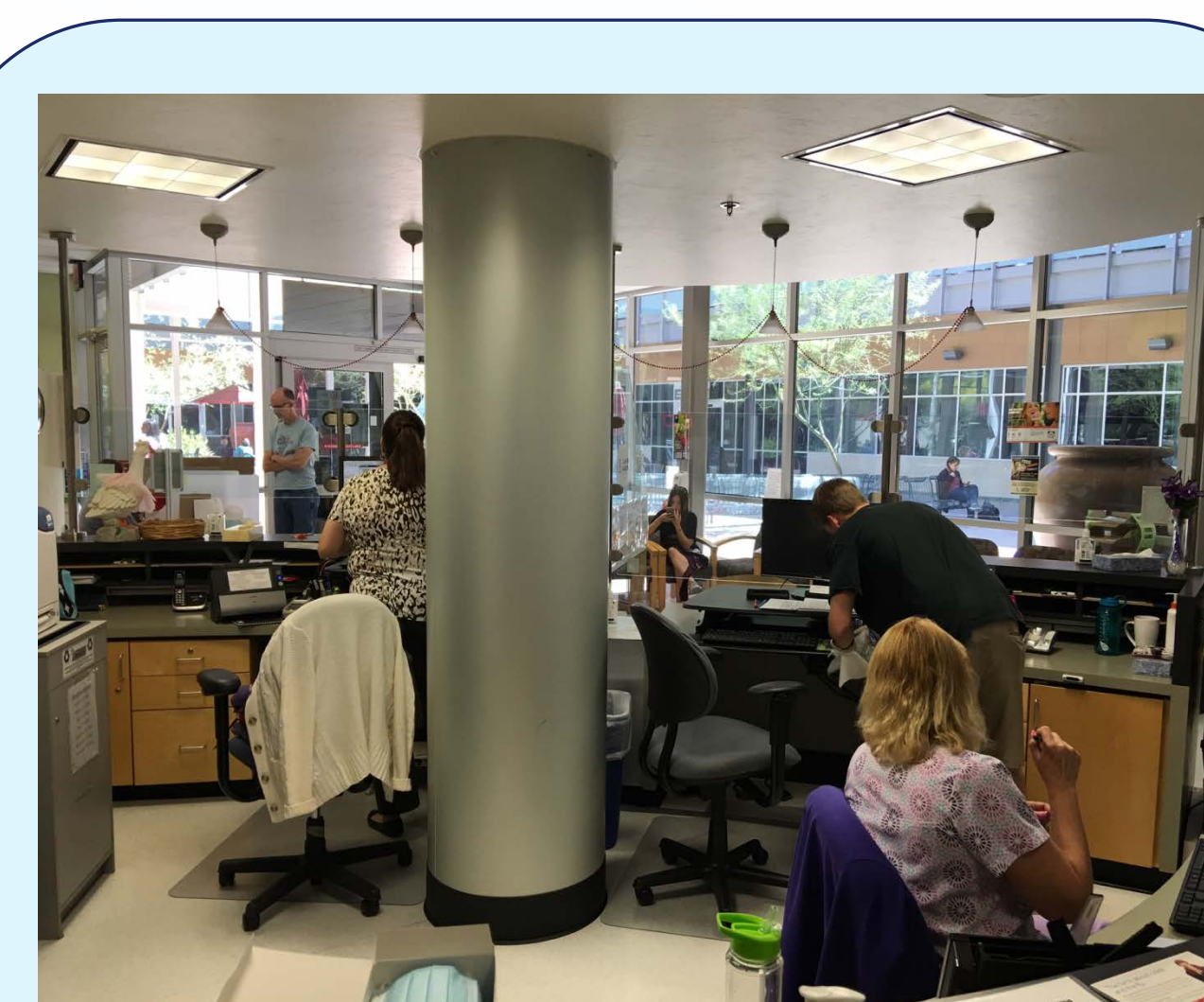
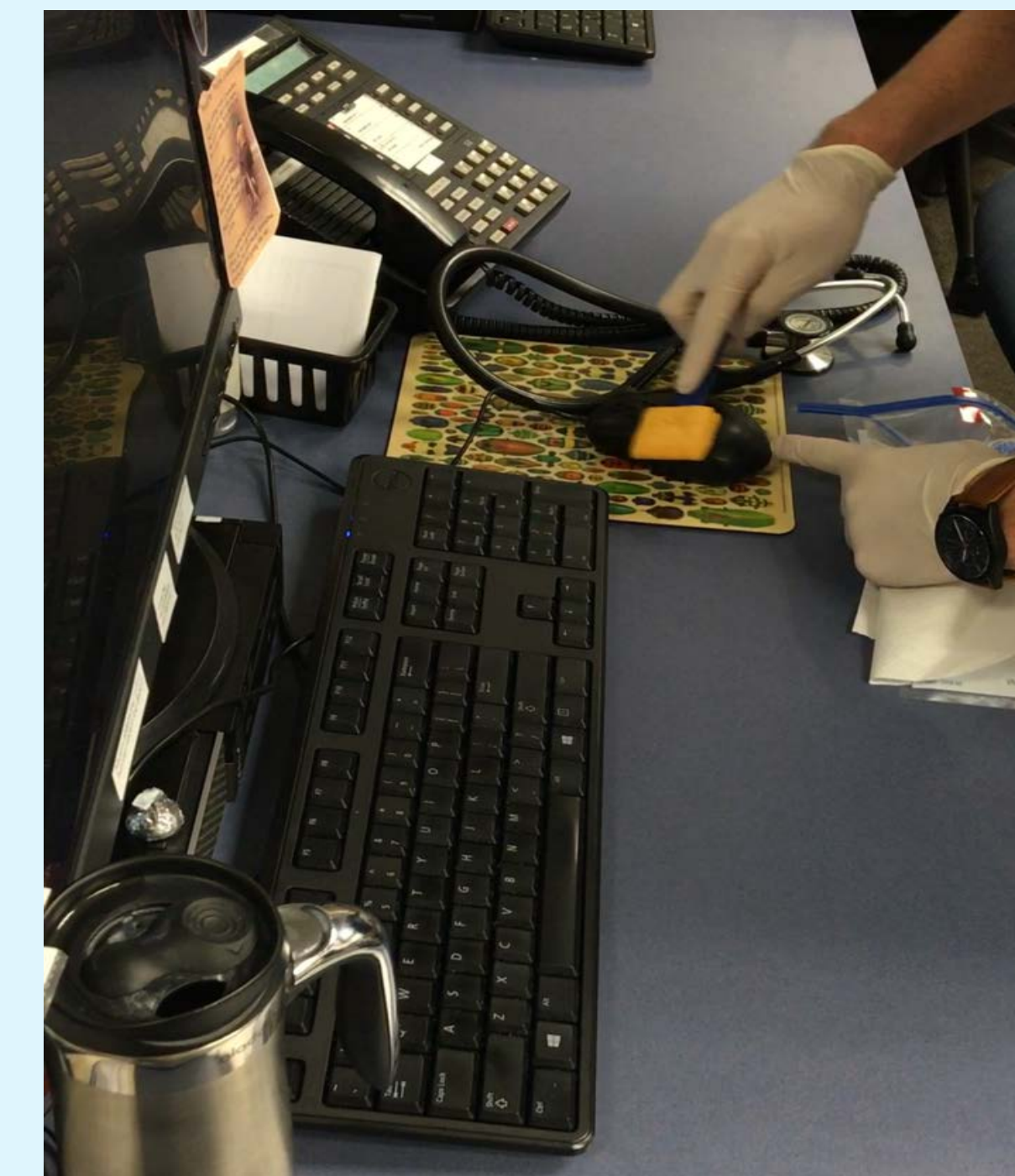


Table 4: Interventions based on Study Phase

Study Phase	Intervention
Background	N/A
Phase 1	Disinfection 4 hours after seeding with current product
Phase 2	Disinfection 4 hours after seeding with Purell Healthcare Surface Disinfectant
Phase 3	Disinfection 4 hours after seeding with Purell Healthcare Surface Disinfectant and hand hygiene signage and training

Viral Transfer with Targeted Disinfection

- Average concentrations decreased throughout each intervention phase (Table 6)
- Intervention 3 had the highest percent reduction (93%) compared to the background phase
- Target disinfection decreased concentrations on surfaces but not the number of contaminated surfaces
- Number of patients influences overall contamination patterns

Table 6: Average Concentrations and Percent Reductions

	Background	Phase 1	Phase 2	Phase 3
Average Concentration (pfu/cm ²)	753	378	171	51
Percent Reduction	N/A	50	77	93

Table 1: Doctor Office Transfer

Dr. Office	Transfer
Total Transfer	20% (10/50)
Dr/Nurse Surface Transfer	19% (6/32)
Patient Surface Transfer	22% (4/18)
Range of pfu	0 - 150 pfu/surface
Average Overall	8 pfu/surface
Average Contaminated Surface	40 pfu/surface

Table 2: Long Term Care Transfer

Long Term Care	Transfer
Total Transfer	20% (7/35)
Dr/Nurse Surface Transfer	0% (0/4)
Patient Surface Transfer	23% (7/31)
Range of pfu	0-46 pfu/surface
Average Overall	3 pfu/surface
Average Contaminated Surface	13 pfu/surface

Conclusions:

- Surfaces and hands can become contaminated in less than 2 hours in an outpatient clinic
- Frequently touched surfaces have the highest levels of contamination
- Disinfection of targeted surfaces can reduce the overall microbial load in the facility
- Increased awareness of hand hygiene reduces microbial load on surfaces