Developing a Sampling Strategy for Measuring Total Bacteria Aerosol Generated during Toilet Flushing in a Hospital Based Patient Care Setting

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Background

According to the Center for Disease Control and Prevention, there are approximately 17,000 deaths per year resulting from gastroenteritis diseases.

Flushing wastes generated from a person with gastroenteritis disease is hypothesized to generate bioaerosols that could contain infectious microorganisms such as *Clostridium difficile*.

Once microorganisms are aerosolized, they could be spread to other people where they could cause infection.

Few researchers have successfully detected airborne microorganisms in environmental settings using bioaerosol samplers.

Little data exists measuring the concentration of microorganisms aerosolized from flushing toilets.

Objectives

Develop a mobile sampling strategy to measure total bacteria aerosols generated during toilet flushing in a hospital based patient care setting.

Measure total viable bacteria associated with time and distance from flushing toilets.

Methods

A strategy was established to identify clean unoccupied hospital bathrooms to deploy a bioaerosol sampling cart.

Aerosol particle concentration was collected with the particle counter for 3 minutes before and 30 minutes after the flush.

The impactors sampled for intervals of 5, 10, and 15 minutes after the initial flush onto tryptic soy agar (TSA) plates.

The plates were incubated for 24 hours at 37˚C.

Positive and negative controls were used for each clean room flushing event to confirm culture conditions and ensure no plate contamination before sampling.

The plates were washed with phosphate buffer saline (PBS) to remove bacteria and stored at -20˚C for later molecular analysis.

Acknowledgements

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Experimental Setup

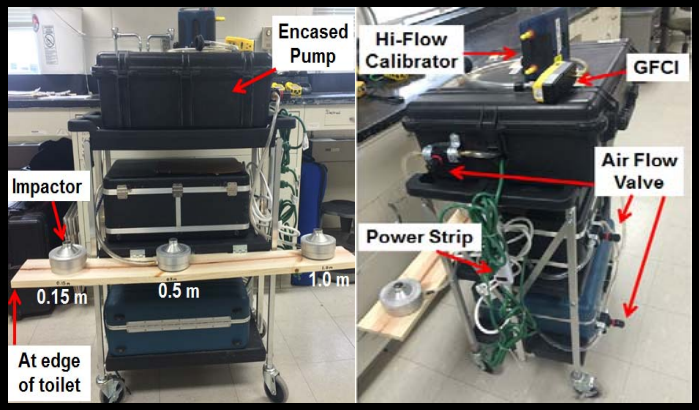

Figure 1. Mobile sampling cart front view (left) and side view (right). Not shown is the particle counter.

Results

The overall trend observed was increasing bacterial concentrations from time of flush and distance from the toilet (Figure 3) (n=4).

Particle concentrations were higher at the time of the toilet flush (Figure 4) (n=4).

The ventilation systems for all bathrooms were not operating at the time of sampling.

All bathrooms sampled were above 73% relative humidity.

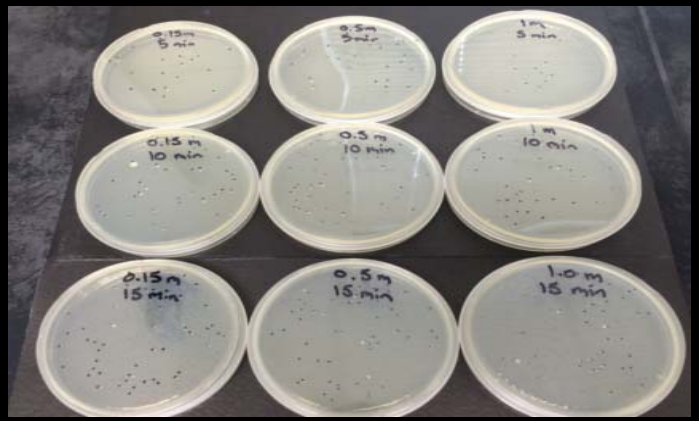

Figure 2. Tryptic soy agar plates representative of a single trial.

Results

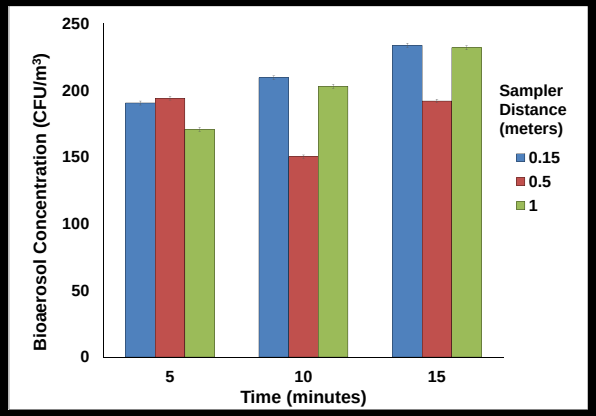

Figure 3. Geometric mean bioaerosol concentration for control rooms.

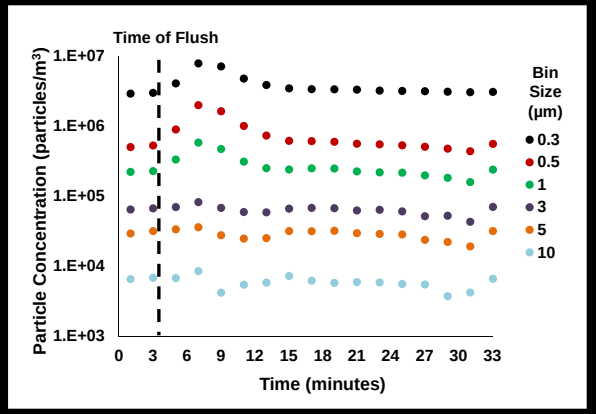

Figure 4. Geometric mean particle concentrations before and after toilet flush in control rooms.

Conclusion

The sampling strategy can be used to measure total viable bacteria aerosolized after a toilet flush in a hospital.

Future Research

Deploying this sampling cart in patient rooms with gastroenteritis may help determine environmental contamination resulting from flushing fecal waste.

Real-time polymerase chain reaction (qPCR) may provide a quantitative estimate for sampled bacteria.