Comparison of Bioaerosol Collection Methods in the Detection of Airborne Influenza Virus

Laura L. Kienlen, Matthew W. Nonnenmann[1], Thomas M. Peters[1], Travis Henry[2]
[1]Department of Occupational and Environmental Health, The College of Public Health, and [2]State Hygienic Laboratory, The University of Iowa

Background

The World Health Organization estimates annual influenza epidemics generate up to 5 million cases of severe illness and 500,000 deaths worldwide.

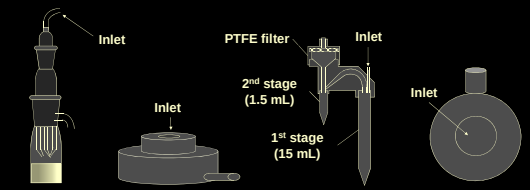
Methods for the detection of airborne influenza virus are needed to assess risk of exposure and evaluate control strategies.

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

New sampling strategies should be developed to increase the likelihood of detection.

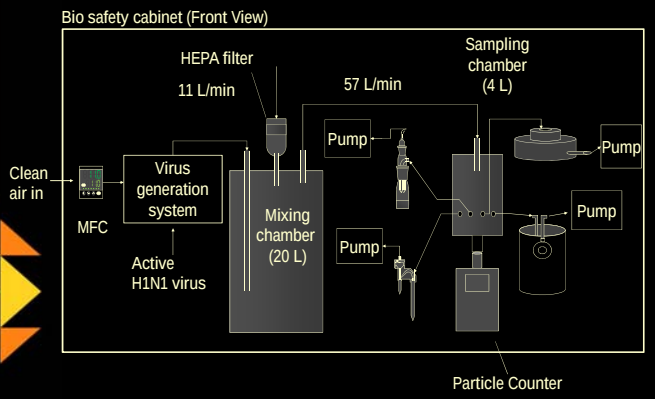
Objective

To compare four bioaerosol samplers in the collection of airborne influenza virus:



Experimental Setup

Aerosol generation, mixing, and sampling setup for 10 repeat experiments



Methods

Ten 30-minute laboratory trials were completed by aerosolizing active influenza virus (H1N1) in a bioaerosol chamber.

After each trial, aliquots from each liquid sampler were taken and stored at -80°C.

Aliquots were taken from dry samplers by washing the stages and filters in a predetermined volume of Hanks Balanced Salt Solution (HBSS). Aliquots were stored at -80°C.

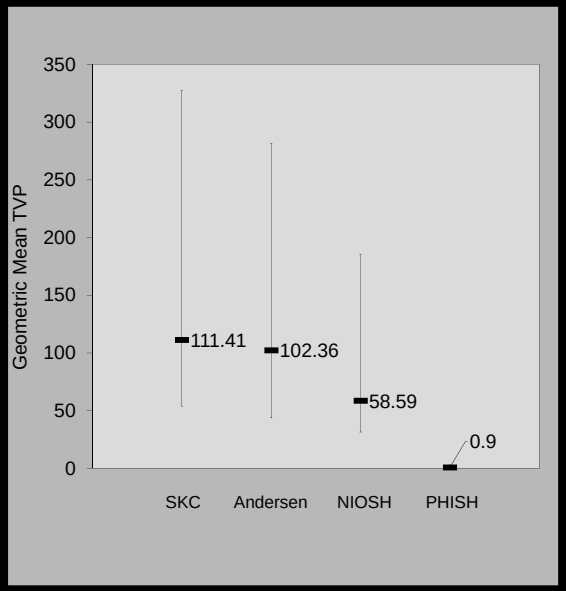
Aliquots from each sampler for each trial were analyzed in triplicate using RT-qPCR.

RT-qPCR data was converted to mean total virus particles per liter of sampled air (TVP) through the use of a standard curve.

Positive and negative controls were used with each RT-qPCR trial to confirm no contamination or inhibition occurred.

Results

Total virus particles (TVP) recovered per liter of sampled air



Results, continued

The total virus particles (TVP) recovered with the PHISH sampler was significantly lower than the TVP recovered by all other samplers ($p < 0.001$).

The TVP recovered with the SKC Biosampler and Andersen N6 sampler was substantially higher compared to the NIOSH Biosampler.

However, the difference in TVP recovered between these samplers was not statistically significant ($p > 0.05$).

Conclusions

Liquid based bioaerosol samplers (SKC and Andersen N6) recovered more TVP than dry collection samplers.

The SKC Biosampler recovered the most TVP.

The higher airflow of the Andersen N6 resulted in a lower limit of detection compared to other samplers.

Dry sampling methods may be collecting aerosolized virus particles, however current washing methods may not allow for optimal recovery from the sampling media.

Future Research

Viral plaque assays are being performed with these samples to determine which samplers are able to preserve viral infectivity.

Currently, there is no gold standard bioaerosol sampler for the measurement of virus particles in occupational settings.

A liquid based personal bioaerosol sampler is preferable to maximize the likelihood of influenza virus detection in environmental settings.

Acknowledgements

Renée Anthony, Ph.D., CIH, CSP for use of the PHISH sampler and funding provided by the University of Iowa College of Public Health – New Faculty Research Award. This research was funded, in part, by CDC/NIOSH Education and Research Center Training Grant (T42OH008491).

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