Highly Efficient Collection of Viable Aerosolized Pandemic H1N1 Particles

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BACKGROUND

- Influenza is one of the most contagious respiratory diseases and an important cause of morbidity, hospital admissions and mortality.
- In 2009, a pandemic caused by a new H1N1 strain resulted in 43 – 89 million people infected and up to 18,300 deaths.

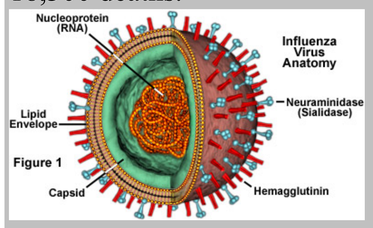


Figure 1

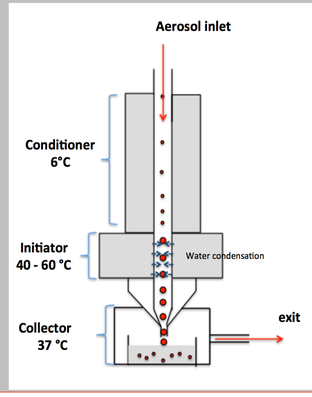
- Transmission of influenza virus between humans mainly occurs by three routes: direct or indirect contact, large droplet spray, aerosolized viruses.
- Existing samplers have low efficiency (5-10%) in collecting virus aerosols in the range of 20 - 100 nm[1].

OBJECTIVES

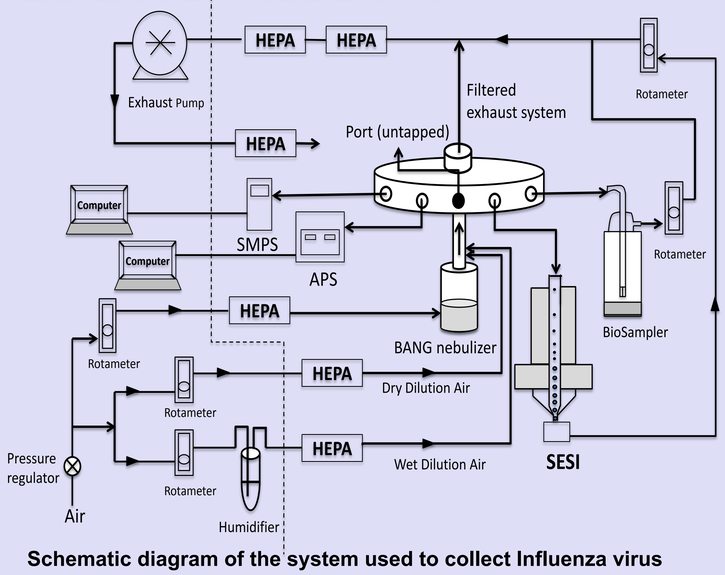
- Evaluate the performance of the Super Efficient Sampler for Influenza virus (SESI), based on ~~the~~ water condensation particle growth technology, in amplifying virus aerosols to larger size for improved physical and viable collection efficiency.

METHODS

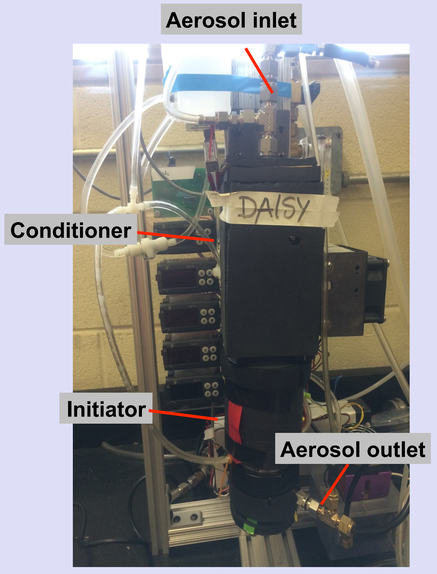
- Influenza virus strain A/Mexico/4108/2009 (pH1N1) (A/Mex) (80-120 nm) was obtained as a low-passage stock and propagated in MDCK cells in serum-free aDMEM with TPCK-trypsin with incubation at 5% CO2 and 33 °C [2].
- Condensation was used to enlarge influenza virus particles by introducing aerosols into a "growth tube" with a wetted wall held at higher temperature[3].



EXPERIMENTAL DESIGN



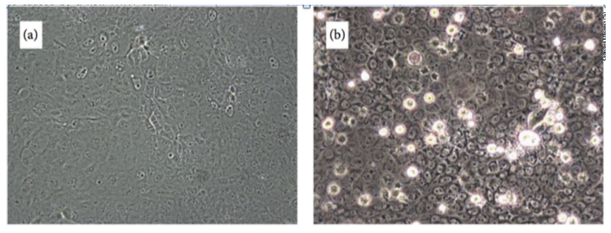
Schematic diagram of the system used to collect Influenza virus



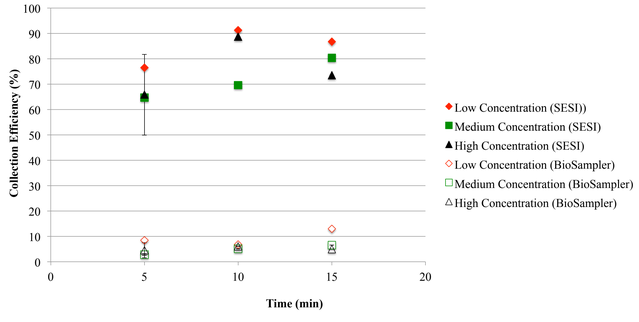
Picture of SESI

RESULTS

Early formation of influenza virus-specific CPE in cells



(a) Noninfected ATCC MDCK cells (negative control, 3 days postseed)
(b) ATCC MDCK cells inoculated with influenza virus



Viable influenza virus collection efficiency of SESI as a function of different collection time and concentration

Viability number

✓Viable collection efficiency of SESI (77.5 ± 9.4)% vs BioSampler (6.5 ± 2.8)%.

✓No significant collection efficiency difference for different starting concentrations and different collection times.

✓For collection times ranging from 5 min to 15 min, the viable H1N1 captured by the SESI was averaged 12 times higher than for the BioSampler, with inferred airborne concentrations of 4200±380 viruses/L of air as compared with 470±160 viruses/L for the BioSampler.

✓ Fabian P et al[5] compared the collection performance of an SKC Biosampler, a compact cascade impactor (CCI), Teflon filters, and gelatin filters, and found out that the SKC BioSampler recovered and preserved influenza virus infectivity much better than the other samplers. They also state that a new sampler is need for virus aerosol sampling.

✓ McDevitt J. et al[6] built a system and found that it had a performance "comparable" to the BioSampler.

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CONCLUSIONS

- The SESI efficiency for viable H1N1 capture is 12 times higher than that of the BioSampler.
- Water condensational particle growth technology significantly increases the collection efficiency of viable influenza H1N1. It achieves this by amplifying the diameter of aerosolized virus particles while minimizing damages/inactivation of the virus particles

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