nature SCIENTIFIC REPORTS

LIGHTAIR IonFlow unique ionizing technology effectively prevents airborne-transmitted influenza virus infection

A scientific report was published June 23, 2015, by Nature Scientific Reports, a primary research publication from the publishers of Nature, the world's most highly cited scientific journal. This document includes extracts from that report followed by additional conclusions by Lightair. The full report may be viewed at: http://www.nature.com/articles/srep11431

The ionizing device used in this study was developed on the basis of the IonFlow ionizing technology from Lightair AB, Solna, Sweden (www.lightair.com) by the Department of Microbiology, Karolinska Institutet, Stockholm, Sweden. This work was supported by the Swedish Research Council (LS) 320301.

Extracts from the report:

Ionizing air affects influenza virus infectivity and prevents airborne-transmission.

Marie Hagbom[1], Johan Nordgren[1*], Rolf Nybom[2], Kjell-Olof Hedlund[3], Hans Wigzell[2] & Lennart Svensson[1].*

ABSTRACT

By the use of a modified ionizer device based on the Lightair IonFlow technology, we describe effective prevention of airborne transmitted influenza A (strain Panama 99) virus infection between animals and inactivation of virus (>97%). Active ionizer prevented 100% (4/4) of guinea pigs from infection. Moreover, the device effectively captured airborne transmitted calicivirus, rotavirus and influenza virus. The ionizer generates negative ions, rendering airborne particles/aerosol droplets negatively charged and electrostatically attracts them to a positively charged collector plate. Trapped viruses are then identified by reverse transcription quantitative real-time PCR.
The device enables unique possibilities for rapid and simple removal of viruses from air and offers possibilities to simultaneously identify and prevent airborne transmission of viruses.

INTRODUCTION

- There is an urgent need for simple, portable and sensitive devices to collect, eliminate and identify viruses from air, to rapidly detect and prevent outbreaks and spread of infectious diseases.
- Each year, infectious diseases cause millions of deaths around the world and many of the most common infectious pathogens are spread by droplets or aerosols caused by cough, sneeze, vomiting etc.

[1] Div of Molecular Virology, Department of Clinical and Experimental Medicine, University of Linköping, 581 85, Linköping.
[2] Department of Microbiology and Tumor Biology (MTC), Karolinska Institutet, Stockholm, Sweden.
[3] Department of Diagnostics and Vaccine, Swedish Institute for Communicable Disease Control, Stockholm, Sweden.
* Contributed equally.

- The ionizing device used in this study operates at 12 V and generates negative ionizations in an electric field, which collide with and charge the aerosol particles. Those are then captured by a positively charged collector plate. Moreover, this device does not produce detectable levels of ozone and can thus be safely used in all environments.

RESULTS

- 3 of 4 animals were infected when the inactive ionizer was used. In contrast, none of the 4 animals in cage "B" developed an immune response to influenza virus when the ionizer was active
- Testing revealed that 40–60 min was required to eliminate >90% of free latex particles in the air. The particle counter can detect particles with size greater than 0.02 µm.
- The infectivity of aerosolized viruses was significantly reduced by >97%, indicating that ionization of the aerosol accounts for the vast majority of infectivity reduction, and not the exposure to the charged collector plate. This suggests that inactivation of viruses is associated with ionized air.

DISCUSSION

- Important advantages with this novel ionizing device is the simple handling, high robustness as well as the wide applicability to airborne pathogens.
- The observation that significantly higher numbers of rotavirus and CaCV particles were detected on the active ionizer compared to the inactive ionizer (~1500–3000 times), led to the conclusion that this technique can actively and efficiently collect viral particles from air.
- It is interesting to note that a broad range of particles sizes, from 35 nm to 10 µm was concentrated, suggesting a wide application range of the technology.
- Most interesting, and of great clinical significance of this study was the novel finding that the ionizing device could detect and prevent influenza virus infection in a controlled setting, mimicking "authentic" conditions.
- The easy handling, low cost, free of ozone production, robustness, high efficiency and low-voltage (12 volt) operation enables large-scale use. Locations critical for infectious spread, such as airplanes, hospitals, day-care centers, school environments and other public places could thus be monitored and controlled by the collection and analysis of airborne viruses and other pathogens on the collector plate.
- We conclude that this innovative technology hold great potential to collect and identify viruses in environmental air.

METHODS

- The experimental room has grounded metal walls, with a volume of 19 m^3 (B250*L330*H235cm). A particle counter (PortaCount Plus, TSI Incorporated, USA) was used before and during the experiment.
- The ionizing device used in this study was developed on the basis of the ion-flow ionizing technology from LightAir AB, Solna, Sweden (www.lightair.com). This device generates approximately 35 000 billion electrons per second (www.lightair.com) with a steady-state ozone

concentration below the detection limit (0,002 ppm) as tested by VTT Technical Research Center of Finland, Tampere, Finland. It has also been ozone tested and certified by ARB (Air Resources Board) in the US.

CONCLUSIONS BY LIGHTAIR

- Lightair IonFlow is highly efficient in inactivating viruses in the air, and capturing viruses even when there are only small amounts of viruses in the air.
- Lightair IonFlow's unique ionization technology offers a new solution to prevent aerosol-transmitted influenza infections by preventing the spread of airborne transmitted viruses without virtually generating ozone. The viruses used in the study are of great clinical and economic importance since they represent and was used as surrogates for viruses that cause among other diseases, different types of influenza, the "winter vomiting disease", diarrhea and gastroenteritis.
- The study shows that the Lightair IonFlow technology prevents the spread of infections caused by airborne viruses and other pathogens in the air with wide environmental and clinical applications suitable for distribution in airplanes, hospitals, day-care centers, school environments and other public places as well as homes.
- Lightair IonFlow technology is highly efficient in capturing small particles.

ABOUT SCIENTIFIC REPORTS BY NATURE PUBLISHING GROUP

Nature Publishing Group publishes *Nature* and *Scientific Reports*, which is widely considered to be two of the most authoritative and influential science primary research journals in the world. Nature.com claims an online readership with over 8 million visitors per month.

Nature Publishing Group employs rigorous selection criteria and many submissions are declined without being sent for review.

Each manuscript is handled by an Editorial Board Member, and most submissions are peer reviewed by one or more referees in addition to the Editorial Board Member. The Editorial Board — composed of practicing scientists from all fields within the journal's scope — manages the peer review process, and decides whether a paper should be accepted for publication.