

Humidify to reduce respiratory virus transmission

Can altering indoor humidity reduce transmission of respiratory viruses? That question prompted Jennifer Reiman, PhD, the Mayo Clinic, and a collaborative partnership operating under the banner Integrated Science Education Outreach (InSciEd Out) to embark on a pilot study.

KNOWN

- Student absences increase during winter, and children are the main introducers of influenza into households.
- Missing ten percent of school days in a year for any reason predicts low student achievement.¹
- School budgets in many states are based on the average daily attendance at a school.
- Total economic burden of influenza in the USA is greater than \$87 billion per year.²

HYPOTHESIS

Increasing relative humidity (RH) to 40 to 60% in classrooms will reduce the capacity of influenza to survive on surfaces or spread between classmates as aerosols.

APPROACH

Conduct a study to answer whether increased humidity impacts the following:

- Presence and quantity of viruses and the transmission of viruses via airborne particles and surfaces
- Survivability of influenza (ability of samples to infect cells in culture)
- Influenza-like illnesses and student/staff absences

TWO-MONTH PILOT STUDY

This non-invasive study in four preschool classrooms at the Aldrich Memorial Nursery School in Rochester, MN, was conducted without collecting clinical data from students or staff. Instead, while staff and students went about their business teaching and learning, air and surface samples were collected from classrooms for analysis in the Mayo Clinic lab.

From January 25 to February 23, 2016, two classrooms were humidified with steam humidifiers donated by DriSteem, while two identical classrooms were not humidified. From the beginning of humidification through March 11, Dr. Reiman and her team collected attendance data and the following samples from all four classrooms:

- Air samples with a cyclone sampler, which collects and sorts airborne particles in separate chambers from smaller than one micron to more than four microns in diameter
- Surface samples from paper-wrapped markers, blocks, and Play-Doh utensils that had been handled by students during class times

A total of 650 samples were collected from the classrooms — 360 air samples and 290 surface samples. Half of the samples were from the humidified rooms and half from the unhumidified rooms.

Back in the lab, paper from the wrapped objects was dusted for fingerprints, which were cut out of the paper and put into media. Media containing samples from the cyclone sampler and from the fingerprint searches were prepared for analysis through a series of vortexing, incubating, and centrifugation steps that ended with each sample in a separately labeled solution. Solutions were then subject to a process that amplifies RNA sequences specific to influenza A.³



Aldrich Memorial Nursery School classroom

Humidified classrooms showed a significant reduction in influenza presence in sampled air.

“This is really exciting data, because we see that, in the humidified room, we’re reducing the amount of flu that we see in the air, which is the main way that flu is transmitted, and also on surfaces, the secondary route.”



Jennifer M. Reiman, PhD | Rochester, MN
Postdoctoral Research Fellow, Mayo Clinic



DriSteed XTR electrode steam humidifier in one of the two humidified classrooms at the Aldrich Memorial Nursery School

INFLUENZA-POSITIVE SAMPLES IN HUMIDIFIED VS. UNHUMIDIFIED ROOMS

Analysis of collected samples showed the following for humidified rooms:

- Significant decrease in the percentage of total air samples containing influenza
- Trend toward a lower percentage of surface samples containing influenza
- Significant reduction in influenza presence for total air and paper samples

Influenza-positive samples from air and surfaces

Sample type	Humidified rooms percent positive	Unhumidified rooms percent positive	Odds ratio*
Air	11.7	18.3	0.51
Surfaces (paper)	18.0	22.1	0.51

* Odds ratio less than 1 indicates a reduced likelihood of finding influenza-positive samples in humidified rooms compared to unhumidified rooms.

REFERENCES

1. Henderson T, Hill C, Norton K. 2014. The Connection Between Missing School and Health: A Review of Chronic Absenteeism.
2. Molinari NA, Ortega-Sanchez IR, Messonnier ML, Thompson WW, Wortley PM, Weintraub E, Bridges CB. 2007. The annual impact of seasonal influenza in the US: measuring disease burden and costs. *Vaccine* 25:5086-5096.
3. Influenza is an RNA virus, so Scientists in the Mayo Clinic lab amplified RNA sequences that were specific to influenza A using quantitative real-time polymerase chain reaction (qRT-PCR).
4. Shaman J, Pitzer VE, et al: Absolute humidity and the seasonal onset of influenza in the continental United States. *PLoS Biol* 2010, 8(2):e1000316.
5. Reiman JM et al. 2018. Humidity as a non-pharmaceutical intervention for influenza A. *bioRxiv*. doi: <https://doi.org/10.1101/273870>

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INFLUENZA INFECTIVITY IN HUMIDIFIED VS. UNHUMIDIFIED ROOMS

Research has established that flu outbreaks can be predicted 14 to 16 days after outdoor humidity bottoms out in the continental United States.⁴ Therefore, in order for the pilot study to be instructive, the humidifiers were turned off on February 23 in response to Rochester's seasonal increase in outdoor humidity.

A subset of 45 influenza-positive samples from the beginning of humidification through March 11 were tested in cultures to see if they were able to infect cells (in a plastic dish). Of these 45 samples, 27 were from unhumidified rooms, and 18 were from humidified rooms.

Testing cultures for infectivity is a secondary test for flu that is more stringent than testing for presence. The infectivity results were even more remarkable than the presence results. Of the 45 samples tested, 16 resulted in infectious cultures:

- 13 of the 27 cultures (48%) from unhumidified rooms tested infectious.
- 3 of the 18 cultures (17%) from humidified rooms tested infectious.

STUDENT ABSENCES

While the sample size is too small to be statistically significant, this is worth noting: During the period of elevated humidity in January through the end of the study in March, there were ten student absences due to influenza-like illnesses reported. Seven were from unhumidified rooms, and three were from humidified rooms.

CONCLUSION

Steam humidification resulted in a significant reduction in the total number of influenza-positive samples in the air and on surfaces, viral copies, and viral infectivity. "This is the first prospective study suggesting that exogenous humidification could serve as a scalable NPI [non-pharmaceutical intervention] for influenza or other viral outbreaks."⁵

RESOURCES

For more information on DriSteed's steam generating humidifiers, go to [Steam generation](http://www.dristeem.com/steam-generation) at dristeem.com.

For more information on finding your local DriSteed representative, go to [Find a rep](http://www.dristeem.com/find-a-rep) at dristeem.com.