Is low indoor humidity a driver for healthcare-associated infections?

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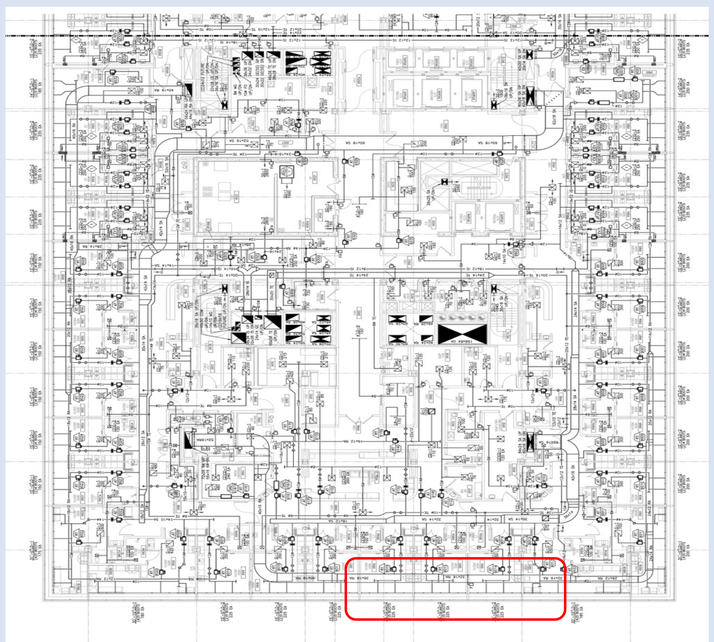
In the US and Europe, errors during in-patient medical care is a leading cause of death (6). A significant portion of this staggering statistic are deaths due to new infections, called nosocomial or healthcare-associated infections (HAIs), that patients acquire while in the hospital. At least 10% of all patients who enter an inpatient healthcare facility for treatment will develop a HAI (2). Tragically, in the US alone, the number of deaths from these infections is over 100,000 annually. What are the factors behind this situation and what more can we do to control the epidemic?

HAIs are the 6th leading cause of death in the US and in Europe

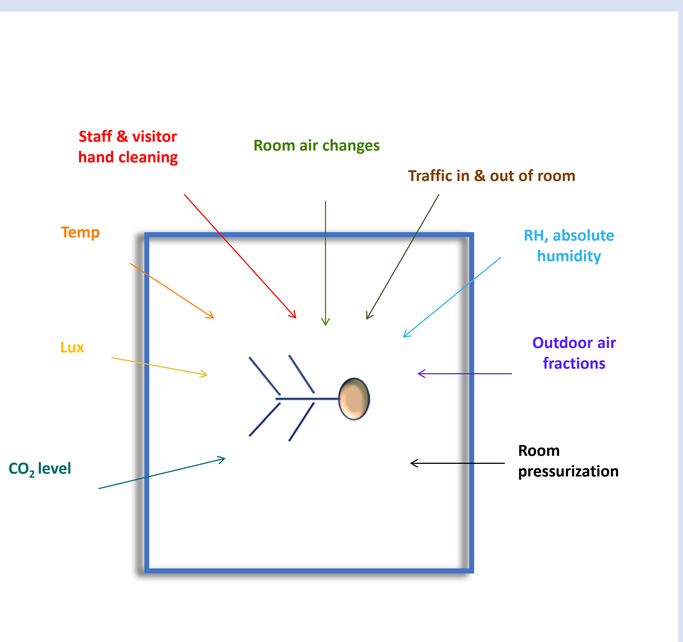
The building

Ten patient rooms across two floors were studied for 12 months. Five rooms on one floor were for patients with acute medical or surgical conditions while patients on the other floor were treated for cancer and were more likely to have immune system deficiencies.



Patient room monitoring

Environmental parameters were measured every 5 minutes in the ten patient rooms, yielding several million data points over the year-long project.



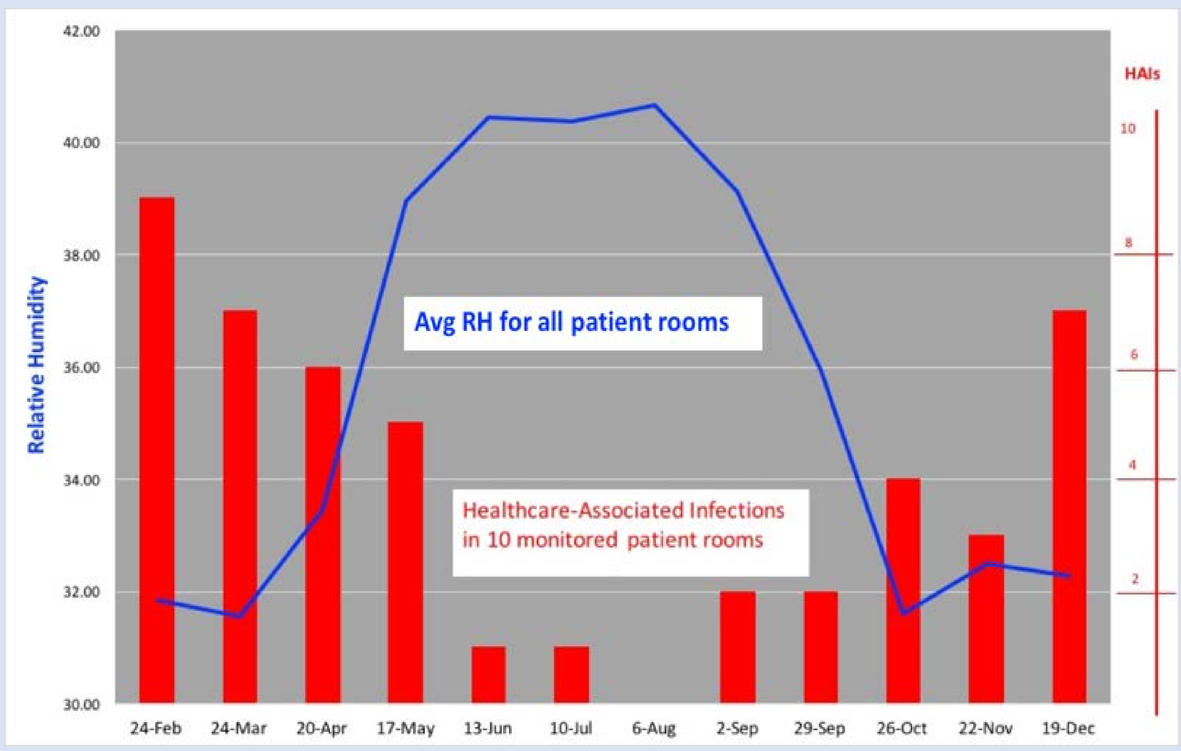
Patient HAIs

Patient outcomes determined from de-identified records were related to room measurements. Multivariate statistical analysis with linear regression was then run to see if any building parameter was significantly related to new patient infections (HAIs). HAIs as shown below were found.

# Patients	Clinical symptoms	HAI Organisms (if indicated)
1	site of infection not specified	Citrobacter infection
6	colitis and diarrhea	Clostridium difficile
6	post-surgical wound infection	
2	pneumonia	Cytomegalovirus, Pseudomonas, Epstein-Barr virus
5	urosepsis	organism unspecified, e Coli
3	infection with joint prosthesis	MRSA
6	central line with blood stream infection	bacteria unspecified
4	pneumonia	organism unspecified
1	gastritis, enteritis	Cytomegalovirus , salmonella,
4	bacteremia	organism unspecified
2	pneumonia	MRSA

Patient HAIs were **inversely** associated with relative humidity (RH) as an independent variable in the respective patient care rooms.

RESULTS: Relative humidity below 40% is associated with an increased prevalence of patient HAIs.



$t < 0.02$

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Conclusion: Humidification offers an effective, yet underutilized preventive measure against healthcare-associated infections caused by both bacterial and viral infections. RH from 40% - 60% may provide patients a safer indoor environment.

REFERENCES:

1. Anderson R.N. 2005. Deaths: leading causes for 2002. *National Vital Statistics Reports* 53(17), 67-70.
2. Classen D.C, Roger R, Griffin F, Federico F, Frankel T, Kimmel N, Whittington J.C, Frankel A, Seger A, James, B. 2011. 'Global Trigger Tool' Shows That Adverse Events In Hospitals May Be Ten Times Greater Than Previously Measured. *Health Affairs,* 30(4), 581–589.
3. Eames I, Tang J.W, Li Y, Wilson P. 2009. Airborne Transmission of Disease in Hospitals. *Soc. Interface*
4. Fernstrom A, Goldblatt M, 2013. Aerobiology and its Role in the Transmission of Infectious Diseases, *Journal of Pathogens*, Volume 2013, Article IS 493960, 13 pages.
5. Ramos T and Stephens B. 2014. Tools to improve built environment data collection for indoor microbial ecology investigations. *Building and Environment*, DOI: 10.1016 /j.buildenv. 2014. 07.004.
6. James J.T. 2013. A New, Evidence-based Estimate of Patient Harm Associated with Hospital Care. *J Patient Safety* 9(3), 122-128.
7. Reed D. and Kemmerly S. 2009. Infection Control and Prevention: A Review of Hospital-Acquired Infections and the Economic Implications. *Ochsner J*. Spring; 9(1), 27-31.